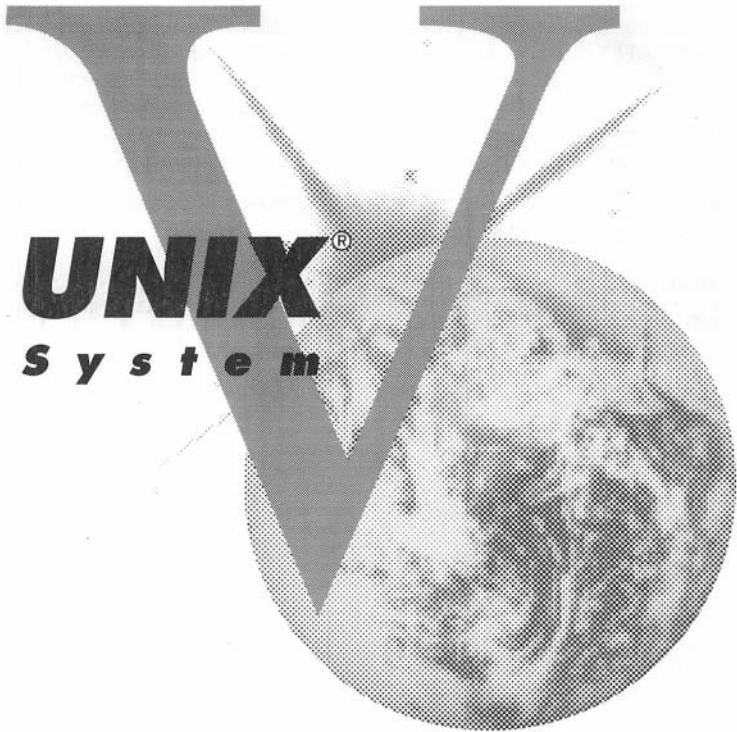




UNIX System Laboratories, Inc.
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**UNIX[®] SYSTEM V
RELEASE 4**

Programmer's Reference Manual



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INTRODUCTION

INTRODUCTION

Introduction

This manual describes the programming features of the UNIX system. It contains individual manual pages that describe commands, system calls, subroutines, file formats, and other useful topics, such as the ASCII table shown on `ascii(5)`. It provides neither a general overview of the UNIX system nor details of the implementation of the system.

Not all commands, features, and facilities described in this manual are available in every UNIX system. Some of the features require additional utilities that may not exist on your system.

The manual is divided into five sections:

1. Commands
2. System Calls
3. Subroutines:
 - 3C. C Programming Language Library Routines
 - 3S. Standard I/O Library Routines
 - 3E. Executable and Linking Format Library Routines
 - 3G. General Purpose Library Routines
 - 3M. Math Library Routines
 - 3X. Specialized Library Routines
4. File Formats
5. Miscellaneous Facilities

Section 1 (*Commands*) describes commands that support C and other programming languages.

Section 2 (*System Calls*) describes the access to the services provided by the UNIX system kernel, including the C language interface.

Section 3 (*Subroutines*) describes the available general subroutines. In many cases, several related subroutines are described on the same manual page. Their binary versions reside in various system libraries. See `intro(3)` for descriptions of these libraries and the files in which they are stored.

Section 4 (*File Formats*) documents the structure of particular kinds of files; for example, the format of the output of the link editor is given in `a.out(4)`. Excluded are files used by only one command (for example, the assembler's intermediate files, if any). In general, the C language structures corresponding to these formats can be found in the directories `/usr/include` and `/usr/include/sys`.

Section 5 (*Miscellaneous Facilities*) contains a variety of things. Included are descriptions of character sets, macro packages, etc.

References with numbers other than those above mean that the utility is contained in the appropriate section of another manual. References with (1) following the command mean that the utility is contained in this manual or the *User's Reference Manual*. In these cases, the SEE ALSO section of the entry in which the reference appears will point you to the correct book.

Each section consists of a number of independent entries of a page or so each. Entries within each section are alphabetized, with the exception of the introductory entry that begins each section. Some entries may describe several routines, commands, etc. In such cases, the entry appears only once, alphabetized under its "primary" name, the name that appears at the upper corners of each manual page. Subsections 3C and 3S are grouped together because their functions constitute the standard C library.

All entries are based on a common format, not all of whose parts always appear:

- The NAME part gives the name(s) of the entry and briefly states its purpose.
- The SYNOPSIS part summarizes the use of the program or function being described. A few conventions are used, particularly in Section 2 (*System Calls*):
 - Constant width typeface strings are literals and are to be typed just as they appear.
 - *Italic* strings usually represent substitutable argument prototypes and program names found elsewhere in the manual.
 - Square brackets [] around an argument prototype indicate that the argument is optional. When an argument prototype is given as *name* or *file*, it always refers to a file name.
 - Ellipses ... are used to show that the previous argument prototype may be repeated.
 - A final convention is used by the commands themselves. An argument beginning with a minus - or plus + sign is often taken to be some sort of flag argument, even if it appears in a position where a file name could appear. Therefore, it is unwise to have files whose names begin with - or +.

- The **DESCRIPTION** part describes the utility.
- The **EXAMPLE(S)** part gives example(s) of usage, where appropriate.
- The **FILES** part gives the file names that are built into the program.
- The **SEE ALSO** part gives pointers to related information.
- The **DIAGNOSTICS** part discusses the diagnostic indications that may be produced. Messages that are intended to be self-explanatory are not listed.
- The **NOTES** part gives generally helpful hints about the use of the utility.

A "Table of Contents" and a "Permuted Index" derived from that table precede Section 1. The "Permuted Index" is a list of keywords, given in the second of three columns, together with the context in which each keyword is found. Keywords are either topical keywords or the names of manual entries. Entries are identified with their section numbers shown in parentheses. This is important because there is considerable duplication of names among the sections, arising principally from commands and functions that exist only to exercise a particular system call. The right column lists the name of the manual page on which each keyword may be found. The left column contains useful information about the keyword.

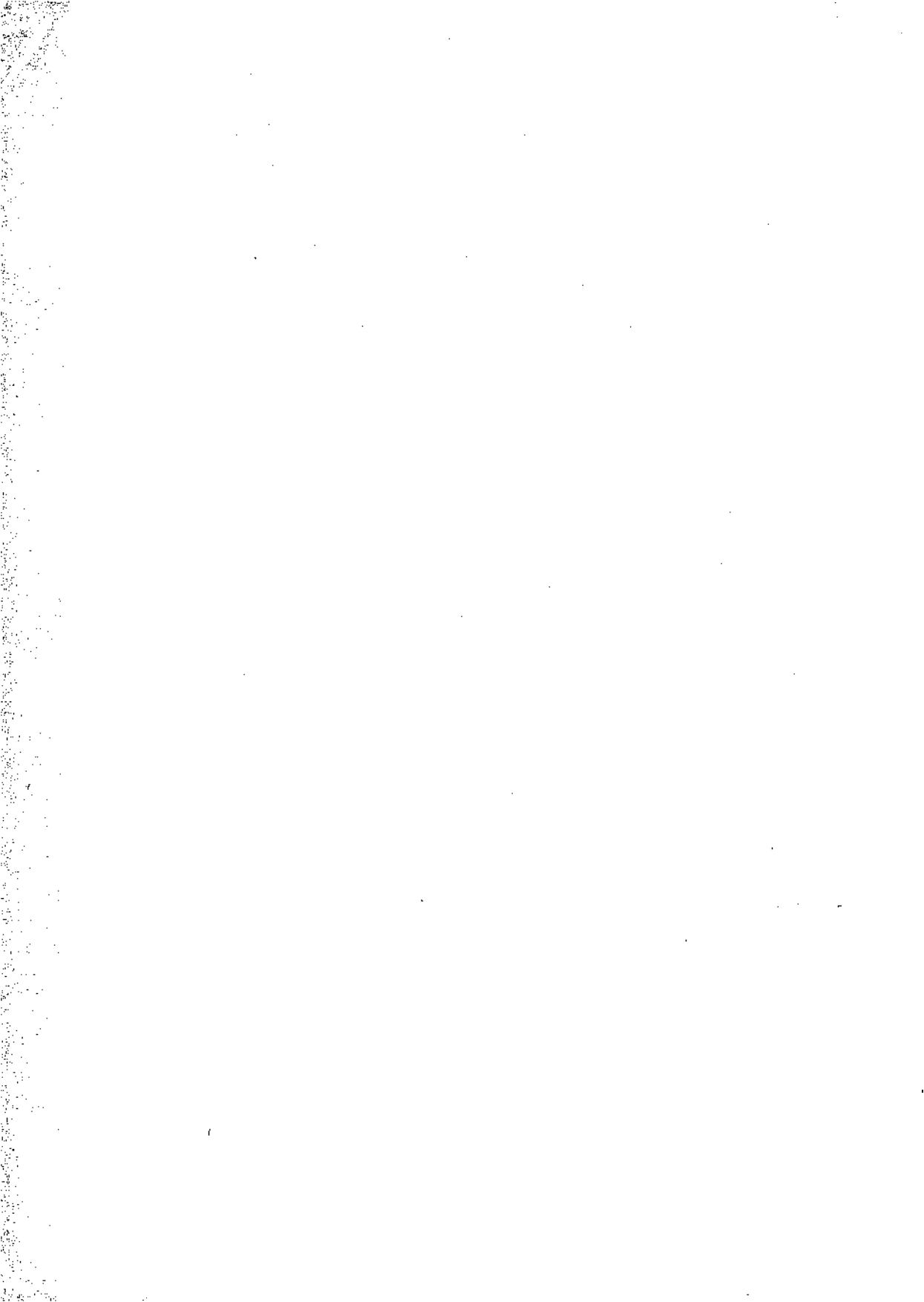


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1. Commands

intro(1)	introduction to programming commands
admin(1)	create and administer SCCS files
ar(1)	maintain portable archive or library
as(1)	assembler
cb(1)	C program beautifier
cc(1)	C compiler
cdc(1)	change the delta comment of an SCCS delta
cflow(1)	generate C flowgraph
cof2elf(1)	COFF to ELF object file translation
comb(1)	combine SCCS deltas
cscope(1)	interactively examine a C program
ctrace(1)	C program debugger
cxref(1)	generate C program cross-reference
delta(1)	make a delta (change) to an SCCS file
dis(1)	object code disassembler
dump(1)	dump selected parts of an object file
get(1)	get a version of an SCCS file
help(1)	ask for help with message numbers or SCCS commands
install(1M)	install commands
ld(1)	link editor for object files
ldd(1)	list dynamic dependencies
lex(1)	generate programs for simple lexical tasks
lint(1)	a C program checker
lorder(1)	find ordering relation for an object library
lprof(1)	display line-by-line execution count profile data
m4(1)	macro processor
make(1)	maintain, update, and regenerate groups of programs
mcs(1)	manipulate the comment section of an object file
nm(1)	print name list of an object file
prof(1)	display profile data
prs(1)	print an SCCS file
regcmp(1)	regular expression compile
rmdel(1)	remove a delta from an SCCS file
sact(1)	print current SCCS file editing activity
sccsdiff(1)	compare two versions of an SCCS file
sdb(1)	symbolic debugger
size(1)	print section sizes in bytes of object files
strip(1)	strip symbol table, debugging and line number information from an object file

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tsort(1)	topological sort
unset(1)	undo a previous get of an SCCS file
val(1)	validate an SCCS file
vc(1)	version control
what(1)	print identification strings
yacc(1)	yet another compiler-compiler

2. System Calls

intro(2)	introduction to system calls and error numbers
access(2)	determine accessibility of a file
acct(2)	enable or disable process accounting
adjtime(2)	correct the time to allow synchronization of the system clock
alarm(2)	set a process alarm clock
brk, sbrk(2)	change data segment space allocation
chdir, fchdir(2)	change working directory
chmod, fchmod(2)	change mode of file
chown, lchown, fchown(2)	change owner and group of a file
chroot(2)	change root directory
close(2)	close a file descriptor
creat(2)	create a new file or rewrite an existing one
dup(2)	duplicate an open file descriptor
exec: execl, execv, execlp, execvp(2)	execute a file
exit, _exit(2)	terminate process
fcntl(2)	file control
fork(2)	create a new process
fpathconf, pathconf(2)	get configurable pathname variables
fsync(2)	synchronize a file's in-memory state with that on the physical medium
getcontext, setcontext(2)	get and set current user context
getdents(2)	read directory entries and put in a file system independent format
getgroups, setgroups(2)	get or set supplementary group access list IDs
getmsg(2)	get next message off a stream
getpid, getpgrp, getppid, getpgid(2)	get process, process group, and parent process IDs
getrlimit, setrlimit(2)	control maximum system resource consumption
getsid(2)	get session ID
getuid, geteuid, getgid, getegid(2)	get real user, effective user, real group, and effective group IDs
ioctl(2)	control device
kill(2)	send a signal to a process or a group of processes
link(2)	link to a file

lseek(2)	move read/write file pointer
memcntl(2)	memory management control
mincore(2)	determine residency of memory pages
mkdir(2)	make a directory
mknod(2)	make a directory, or a special or ordinary file
mmap(2)	map pages of memory
mount(2)	mount a file system
mprotect(2)	set protection of memory mapping
msgctl(2)	message control operations
msgget(2)	get message queue
msgop: msgsnd, msgrcv(2)	message operations
munmap(2)	unmap pages of memory
nice(2)	change priority of a time-sharing process
open(2)	open for reading or writing
pause(2)	suspend process until signal
pipe(2)	create an interprocess channel
plock(2)	lock into memory or unlock process, text, or data
poll(2)	input/output multiplexing
prcntl(2)	process scheduler control
prcntlset(2)	generalized process scheduler control
profil(2)	execution time profile
ptrace(2)	process trace
putmsg(2)	send a message on a stream
read(2)	read from file
readlink(2)	read the value of a symbolic link
rename(2)	change the name of a file
rmdir(2)	remove a directory
semctl(2)	semaphore control operations
semget(2)	get set of semaphores
semop(2)	semaphore operations
setpgid(2)	set process group ID
setpgrp(2)	set process group ID
setsid(2)	set session ID
setuid, setgid(2)	set user and group IDs
shmctl(2)	shared memory control operations
shmget(2)	get shared memory segment identifier
shmop: shmat, shmdt(2)	shared memory operations
sigaction(2)	detailed signal management
sigaltstack(2)	set or get signal alternate stack context
signal, sigset, sighold, sigelse, sigignore, sigpause(2)	simplified signal management

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sigpending(2)	examine signals that are blocked and pending
sigprocmask(2)	change or examine signal mask
sigsend, sigsendset(2)	send a signal to a process or a group of processes
sigsuspend(2)	install a signal mask and suspend process until signal
stat, lstat, fstat(2)	get file status
statvfs, fstatvfs(2)	get file system information
stime(2)	set time
swapctl(2)	manage swap space
symlink(2)	make a symbolic link to a file
sync(2)	update super block
sys3b(2)	machine-specific functions
sysfs(2)	get file system type information
sysinfo(2)	get and set system information strings
termios: tcgetattr, tcsetattr, tcsendbreak, tcdrain, tcflush, tcflow, cfgetospeed, cfgetispeed, cfsetispeed, cfsetospeed, tcgetpgrp, tcsetpgrp, tcgetsid(2)	general terminal interface
time(2)	get time
times(2)	get process and child process times
uadmin(2)	administrative control
ulimit(2)	get and set user limits
umask(2)	set and get file creation mask
umount(2)	unmount a file system
uname(2)	get name of current UNIX system
unlink(2)	remove directory entry
ustat(2)	get file system statistics
utime(2)	set file access and modification times
vfork(2)	spawn new process in a virtual memory efficient way
wait(2)	wait for child process to stop or terminate
waitid(2)	wait for child process to change state
waitpid(2)	wait for child process to change state
write, writev(2)	write on a file

3. Functions

intro(3)	introduction to functions and libraries
a64l, l64a(3C)	convert between long integer and base-64 ASCII string
abort(3C)	generate an abnormal termination signal
abs, labs(3C)	return integer absolute value
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atexit(3C)	add program termination routine

bsearch(3C) binary search a sorted table

catgets(3C) read a program message

catopen, catclose(3C) open/close a message catalogue

clock(3C) report CPU time used

conv: toupper, tolower, _toupper, _tolower, toascii(3C) translate characters

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ctermid(3S) generate file name for terminal

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cctype: isdigit, isxdigit, islower, isupper, isalpha, isalnum, isspace, iscntrl, ispunct,
isprint, isgraph, isascii(3C) character handling

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div, ldiv(3C) compute the quotient and remainder

drand48, erand48, lrand48, nrand48, mrand48, jrand48, srand48, seed48,
lcong48(3C) generate uniformly distributed pseudo-random numbers

dup2(3C) duplicate an open file descriptor

ecvt, fcvt, gcvt(3C) convert floating-point number to string

end, etext, edata(3C) last locations in program

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error, feof, clearerr, fileno(3S) stream status inquiries

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..... IEEE floating point environment control

fread, fwrite(3S) binary input/output

frexp, ldexp, logb, modf, modff, nextafter, scalb(3C)
..... manipulate parts of floating-point numbers

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ftw, nftw(3C) walk a file tree

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gets, fgets(3S)	get a string from a stream
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strerror(3C)	get error message string
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strtol, strtoul, atol, atoi(3C)	convert string to integer
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 atan2f(3M) trigonometric functions

assert(3X) verify program assertion

crypt(3X) password and file encryption functions

dlclose(3X) close a shared object

dlderror(3X) get diagnostic information

dlopen(3X) open a shared object

dlsym(3X) get the address of a symbol in shared object

libwindows(3X) windowing terminal function library

maillock(3X) manage lockfile for user's mailbox

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 signal messages /system signal psignal(3C)
 signal pause(2)
 signal, sigset, sighold, sigrelse, signal(2)
 signal sigsuspend install a signal sigsuspend(2)
 signal state sigsetjmp, sigsetjmp(3C)
 signal to a process or a group of kill(2)
 signal to a process or a group of/ sigsend(2)

raise send	signal to program	raise(3C)
sigismember manipulate sets of	signals /sigaddset, sigdelset,	sigemptyset(3C)
signal base	signals	signal(5)
ssignal, gsignal software	signals	ssignal(3C)
pending sigpending examine	signals that are blocked and	sigpending(2)
sighold, sigrelse, sigignore,	sigpause simplified signal/ /sigset,	signal(2)
blocked and pending	sigpending examine signals that are	sigpending(2)
signal mask	sigprocmask change or examine	sigprocmask(2)
signal, sigset, sighold,	sigrelse, sigignore, sigpause/	signal(2)
to a process or a group of/	sigsend, sigsendset send a signal	sigsend(2)
process or a group of/ sigsend,	sigsendset send a signal to a	sigsend(2)
sigignore, sigpause/ signal,	sigset, sighold, sigrelse,	signal(2)
goto with signal state	sigsetjmp, siglongjmp a non-local	sigsetjmp(3C)
and suspend process until signal	sigsuspend install a signal mask	sigsuspend(2)
lex generate programs for	simple lexical tasks	lex(1)
rand, srand	simple random-number generator	rand(3C)
/sigrelse, sigignore, sigpause	simplified signal management	signal(2)
asin, asinf, acos, acosf,/ trig:	sin, sinf, cos, cosf, tan, tanf,	trig(3M)
asinf, acos, acosf,/ trig: sin,	sinf, cos, cosf, tan, tanf, asin,	trig(3M)
tanh, tanhf, asinh, acosh,/	sinh, sinhf, cosh, coshf,	sinh(3M)
tanhf, asinh, acosh,/ sinh,	sinhf, cosh, coshf, tanh,	sinh(3M)
elf_fsize: elf32_fsize return the	size of an object file type	elf_fsize(3E)
of object files	size print section sizes in bytes	size(1)
size print section	sizes in bytes of object files	size(1)
interval	sleep suspend execution for	sleep(3C)
current user ttyslot find the	slot in the utmp file of the	ttyslot(3C)
ssignal, gsignal	software signals	ssignal(3C)
qsort quicker	sort	qsort(3C)
tsort topological	sort	tsort(1)
bsearch binary search a	sorted table	bsearch(3C)
brk, sbrk change data segment	space allocation	brk(2)
munlockall lock or unlock address	space mlockall,	mlockall(3C)
swapctl manage swap	space	swapctl(2)
memory efficient way vfork	spawn new process in a virtual	vfork(2)
mknod make a directory, or a	special or ordinary file	mknod(2)
strftime language	specific strings	strftime(4)
truncate, ftruncate set a file to a	specified length	truncate(3C)
bufsplit	split buffer into fields	bufsplit(3G)
printf, fprintf,	sprintf print formatted output	printf(3S)
data in a machine-independent/	sputl, sgetl access long integer	sputl(3X)
/logf, log10, log10f, pow, powf,	sqrt, sqrtf exponential, logarithm,/	exp(3M)
/log10, log10f, pow, powf, sqrt,	sqrtf exponential, logarithm,/	exp(3M)
exponential, logarithm, power,	square root functions /sqrt, sqrtf	exp(3M)
generator rand,	rand simple random-number	rand(3C)
/rand48, nrand48, mrand48, jrand48,	rand48, seed48, lcong48 generate/	drand48(3C)
scanf, fscanf,	scanf convert formatted input	scanf(3S)
	ssignal, gsignal software signals	ssignal(3C)

set or get signal alternate package stdio
 package stdipc: ftok call
 stat data returned by ustat get file system
 feof, clearerr, fileno stream
 stat, lstat, fstat get file wstat wait
 information list
 fmtmsg display a message on input/output package
 communication package
 compile and match/ regexp: compile, compile and/ regexpr, compile,
 wait wait for child process to synchronize memory with physical
 string manipulations
 compressing or/ strccpy: streadd, strncmp, strcpy, strncpy,/ string:
 copy strings, compressing or/ /strncmp, strcpy, strncpy, strlen,
 string: strcat, strdup, strncat,
 /strdup, strncat, strcmp, strncmp,
 /strchr, strrchr, strpbrk, strspn, strcpy, strncpy,/ string: strcat,
 strings, compressing or/ strccpy: fclose, fflush close or flush a
 fopen, freopen, fdopen open a reposition a file pointer in a
 reposition a file pointer in a
 getw get character or word from a getmsg get next message off a
 gets, fgets get a string from a putw put character or word on a
 putmsg send a message on a puts, fputs put a string on a
 setvbuf assign buffering to a ferror, feof, clearerr, fileno
 push character back onto input bgets read
 or/ strccpy: streadd, strcadd, stack context sigaltstack sigaltstack(2)
 standard buffered input/output stdio(3S)
 standard interprocess communication stdipc(3C)
 stat data returned by stat system stat(5)
 stat, lstat, fstat get file status stat(2)
 stat system call stat(5)
 statistics ustat(2)
 status inquiries ferror, ferror(3S)
 status stat(2)
 status wstat(5)
 statvfs, fstatvfs get file system statvfs(2)
 stdarg handle variable argument stdarg(5)
 stderr or system console fmtmsg(3C)
 stdio standard buffered stdio(3S)
 stdipc: ftok standard interprocess stdipc(3C)
 step, advance regular expression regexp(5)
 step, advance regular expression regexpr(3G)
 stime set time stime(2)
 stop or terminate wait(2)
 storage msync msync(3C)
 str: strfind, strspn, strtrns str(3G)
 strcadd, strcpy copy strings, strccpy(3G)
 strcat, strdup, strncat, strcmp, string(3C)
 strccpy: streadd, strcadd, strcpy strccpy(3G)
 strchr, strrchr, strpbrk, strspn,/ string(3C)
 strcmp, strncmp, strcpy, strncpy,/ string(3C)
 strcoll string collation strcoll(3C)
 strcpy, strncpy, strlen, strchr,/ string(3C)
 strcspn, strtok, strstr string/ string(3C)
 strdup, strncat, strcmp, strncmp, string(3C)
 streadd, strcadd, strcpy copy strccpy(3G)
 stream fclose(3S)
 stream fopen(3S)
 stream fseek, rewind, ftell fseek(3S)
 stream fsetpos, fgetpos fsetpos(3C)
 stream getc, getchar, fgetc, getc(3S)
 stream getmsg(2)
 stream gets(3S)
 stream putc, putchar, fputc, putc(3S)
 stream putmsg(2)
 stream puts(3S)
 stream setbuf, setbuf(3S)
 stream status inquiries ferror(3S)
 stream ungetc ungetc(3S)
 stream up to next delimiter bgets(3G)
 strcpy copy strings, compressing strccpy(3G)
 strerror get error message string strerror(3C)

manipulations str:	strfind, strrspn, strtrns string	str(3G)
date and time to string	strftime, cftime, asctime, convert	strftime(3C)
long integer and base-64 ASCII	strftime language specific strings	strftime(4)
strcoll	string a64l, l64a convert between	a64l(3C)
tzset convert date and time to	string collation	strcoll(3C)
convert floating-point number to	string /localtime, gmtime, asctime,	ctime(3C)
gets, fgets get a	string ecvt, fcvt, gcvt	ecvt(3C)
mbstowcs, wcstombs multibyte	string from a stream	gets(3S)
getsubopt parse suboptions from a	string functions mbstring:	mbstring(3C)
gettxt retrieve a text	string	getsubopt(3C)
str: strfind, strrspn, strtrns	string	gettxt(3C)
puts, fputs put a	string manipulations	str(3G)
strspn, strcspn, strtok, strstr	string on a stream	puts(3S)
elf_strptr make a	string operations /strpbrk,	string(3C)
strcmp, strncmp, strcpy, strncpy,/	string pointer	elf_strptr(3E)
strerror get error message	string: strcat, strdup, strncat,	string(3C)
asctime, convert date and time to	string	strerror(3C)
strtod, atof, convert	string strftime, cftime,	strftime(3C)
strtol, strtoul, atoi convert	string to double-precision number	strtod(3C)
strxfrm	string to integer	strtol(3C)
/streadd, strcadd, strcpy copy	string transformation	strxfrm(3C)
strftime language specific	strings, compressing or expanding/	strcpy(3G)
get and set system information	strings	strftime(4)
what print identification	strings sysinfo	sysinfo(2)
and line number information from/	strings	what(1)
line number information from/ strip	strip strip symbol table, debugging	strip(1)
/strcmp, strncmp, strcpy, strncpy,	strip symbol table, debugging and	strip(1)
strncpy,/ string: strcat, strdup,	strlen, strchr, strrchr, strpbrk,/	string(3C)
/strcat, strdup, strncat, strcmp,	strncat, strcmp, strncmp, strcpy,	string(3C)
/strncat, strcmp, strncmp, strcpy,	strncmp, strcpy, strncpy, strlen,/	string(3C)
/strcpy, strlen, strchr, strrchr,	strncpy, strlen, strchr, strrchr,/	string(3C)
manipulations str: strfind,	strpbrk, strspn, strcspn, strtok,/	string(3C)
/strlen, strchr, strrchr, strpbrk,	strrchr, strpbrk, strspn, strcspn,/	string(3C)
strpbrk, strspn, strcspn, strtok,	strrspn, strtrns string	str(3G)
double-precision number	strspn, strcspn, strtok, strstr/	string(3C)
/strchr, strpbrk, strrspn, strcspn,	strstr string operations /strrchr,	string(3C)
string to integer	strtod, atof, convert string to	strtod(3C)
to integer strtol,	strtok, strstr string operations	string(3C)
str: strfind, strrspn,	strtol, strtoul, atoi, atoi convert	strtol(3C)
offsetof offset of	strtoul, atoi, atoi convert string	strtol(3C)
mktime converts a tm	strtrns string manipulations	str(3G)
getsubopt parse	structure member	offsetof(3C)
sync update	structure to a calendar time	mktime(3C)
getgroups, setgroups get or set	strxfrm string transformation	strxfrm(3C)
	suboptions from a string	getsubopt(3C)
	super block	sync(2)
	supplementary group access list IDs	getgroups(2)

initgroups initialize the	supplementary group access list	initgroups(3C)
sleep	suspend execution for interval	sleep(3C)
pause	suspend process until signal	pause(2)
/install a signal mask and	suspend process until signal	sigsuspend(2)
swab	swab swap bytes	swab(3C)
swapctl manage	swap bytes	swab(3C)
contexts makecontext,	swap space	swapctl(2)
dlsym get the address of a	swapcontext manipulate user	makecontext(3C)
number information/ strip strip	swapctl manage swap space	swapctl(2)
elf_getarsym retrieve archive	symbol in shared object	dlsym(3X)
sdb	symbol table, debugging and line	strip(1)
readlink read the value of a	symbol table	elf_getarsym(3E)
symlink make a	symbolic debugger	sdb(1)
file	symbolic link	readlink(2)
adptime correct the time to allow	symbolic link to a file	symlink(2)
state with that on the/ fsync	symlink make a symbolic link to a	symlink(2)
storage msync	sync update super block	sync(2)
variables	synchronization of the system clock	adjtime(2)
information	synchronize a file's in-memory	fsync(2)
information strings	synchronize memory with physical	msync(3C)
stat data returned by stat	sys3b machine-specific functions	sys3b(2)
intro introduction to	sysconf get configurable system	sysconf(3C)
to allow synchronization of the	sysfs get file system type	sysfs(2)
display a message on stderr or	sysinfo get and set system	sysinfo(2)
types primitive	system call	stat(5)
perror print	system calls and error numbers	intro(2)
directory entries and put in a file	system clock /correct the time	adjtime(2)
statvfs, fstatvfs get file	system console fmtmsg	fmtmsg(3C)
sysinfo get and set	system data types	types(5)
mount mount a file	system error messages	perror(3C)
/setrlimit control maximum	system independent format /read	getdents(2)
psiginfo,-/ psignal, psiginfo,-	system information	statvfs(2)
signal messages psignal, psiginfo,-	system information strings	sysinfo(2)
ustat get file	system issue a shell command	system(3S)
timezone set default	system	mount(2)
sysfs get file	system resource consumption	getrlimit(2)
umount unmount a file	system signal messages psignal,	psignal(3C)
uname get name of current UNIX	system signal messages /system	psignal(3C)
sysconf get configurable	system statistics	ustat(2)
bsearch binary search a sorted	system time zone	timezone(4)
information/ strip strip symbol	system type information	sysfs(2)
retrieve archive symbol	system	umount(2)
	system variables	uname(2)
	table	sysconf(3C)
	table, debugging and line number	bsearch(3C)
	table elf_getarsym	elf_getarsym(3E)

class-dependent program header	table /elf32_newphdr retrieve elf_getphdr(3E)
hdestroy manage hash search	tables hsearch, hcreate, hsearch(3C)
acosf,/ trig: sin, sinf, cos, cosf,	tan, tanf, asin, asinf, acos, trig(3M)
trig: sin, sinf, cos, cosf, tan,	tanf, asin, asinf, acos, acosf,/ trig(3M)
sinh, sinhf, cosh, coshf,	tanh, tanhf, asinh, acosh,/ sinh(3M)
/sinhf, cosh, coshf, tanh,	tanhf, asinh, acosh, atanh/ sinh(3M)
programs for simple lexical	tasks lex generate lex(1)
tcsetattr, tcsetattr, tcsetattr,	tcdrain, tcf flush, tcf flow,/ termios: termios(2)
/tcsetattr, tcsetattr, tcsetattr,	tcf low, cfgetospeed, cfgetispeed,/ termios(2)
/tcsetattr, tcsetattr, tcsetattr,	tcf lish, tcf low, cfgetospeed,/ termios(2)
tcdrain, tcf flush, tcf flow,/ termios:	tcsetattr, tcsetattr, tcsetattr, termios(2)
general/ /cfsetispeed, cfsetospeed,	tcgetpgrp, tcsetpgrp, tcgetsid termios(2)
/cfsetospeed, tcgetpgrp, tcsetpgrp,	tcgetsid general terminal interface termios(2)
termios: tcgetattr, tcsetattr,	tcsetattr, tcsetattr, tcsetattr, termios(2)
tcf flush,/ termios: tcgetattr,	tcsetattr, tcsetattr, tcsetattr, termios(2)
process group ID	tcsetpgrp set terminal foreground tcsetpgrp(3C)
terminal/ /cfsetospeed, tcgetpgrp,	tcsetpgrp, tcgetsid general termios(2)
trees tsearch, tfind,	tdelete, twalk manage binary search tsearch(3C)
directory: opendir, readdir,	telldir, seekdir, rewinddir,/ directory(3C)
temporary file tmpnam,	tmpnam create a name for a tmpnam(3S)
tmpfile create a	temporary file tmpfile(3S)
tmpnam, tmpnam create a name for a	temporary file tmpnam(3S)
ctermid generate file name for	terminal ctermid(3S)
ID tcsetpgrp set	terminal foreground process group tcsetpgrp(3C)
libwindows windowing	terminal function library libwindows(3X)
tcsetpgrp, tcgetsid general	terminal interface /tcgetpgrp, termios(2)
jagent host control of windowing	terminal jagent(5)
ttyname, isatty find name of a	terminal ttyname(3C)
used between host and windowing	terminal under layers(1) /protocol layers(5)
exit, _exit	terminate process exit(2)
wait for child process to stop or	terminate wait wait(2)
atexit add program	termination routine atexit(3C)
abort generate an abnormal	termination signal abort(3C)
tcsetattr, tcsetattr, tcf flush,/	termios: tcgetattr, tcsetattr, termios(2)
lock into memory or unlock process,	text, or data plock plock(2)
gettxt retrieve a	text string gettxt(3C)
search trees tsearch,	tfind, tdelete, twalk manage binary tsearch(3C)
setitimer get/set value of interval	timer getitimer, getitimer(3C)
the difference between two calendar	times difftime computes difftime(3C)
times	times get process and child process times(2)
times get process and child process	times times(2)
set file access and modification	times utime utime(2)
nice change priority of a	time-sharing process nice(2)
zone	timezone set default system time timezone(4)
mktime converts a	tm structure to a calendar time mktime(3C)
temporary file	tmpfile create a temporary file tmpfile(3S)
	tmpnam, tmpnam create a name for a tmpnam(3S)

/tolower, _toupper, _tolower, popen, pclose initiate pipe
 conv: toupper, tolower, _toupper, toascii translate/ conv: toupper, tsort
 translate/ conv: toupper, tolower, _tolower, toascii translate/ conv: ptrace process
 strxfrm string
 _toupper, _tolower, toascii
 cof2elf COFF to ELF object file
 elf32_xlatetom class-dependent data
 ftw, nftw walk a file
 tdelete, twalk manage binary search
 tanf, asin, asinf, acos, acosf, /acosf, atan, atanf, atan2, atan2f
 specified length
 manage binary search trees
 terminal
 file of the current user
 tsearch, tfind, tdelete, return the size of an object file
 elf_kind determine file
 sysfs get file system
 /fpclass, unordered determine
 nl_types native language data
 types primitive system data
 ctime, localtime, gmtime, asctime, getpw get name from
 file/ /endspent, fgetspent, lckpwdf, mask
 system
 unget
 SCCS file
 input stream
 /srand48, seed48, lcong48 generate
 elf_rawfile retrieve
 mktemp make a
 uname get name of current
 mlockall, munlockall lock or
 toascii translate characters conv(3C)
 to/from a process popen(3S)
 _tolower, toascii translate/ conv(3C)
 tolower, _toupper, _tolower, conv(3C)
 topological sort tsort(1)
 _toupper, _tolower, toascii conv(3C)
 toupper, tolower, _toupper, conv(3C)
 trace ptrace(2)
 transformation strxfrm(3C)
 translate characters /tolower, conv(3C)
 translation cof2elf(1)
 translation /elf32_xlatetof, elf_xlate(3E)
 tree ftw(3C)
 trees tsearch, tfind, tsearch(3C)
 trig: sin, sinf, cos, cosf, tan, trig(3M)
 trigonometric functions /acos, trig(3M)
 truncate, ftruncate set a file to a truncate(3C)
 tsearch, tfind, tdelete, twalk tsearch(3C)
 tsort topological sort tsort(1)
 ttyname, isatty find name of a ttyname(3C)
 ttyslot find the slot in the utmp ttyslot(3C)
 twalk manage binary search trees tsearch(3C)
 type elf_fsize: elf32_fsize elf_fsize(3E)
 type elf_kind(3E)
 type information sysfs(2)
 type of floating point number isnan(3C)
 types nl_types(5)
 types primitive system data types types(5)
 types types(5)
 tzset convert date and time to/ ctime(3C)
 uadmin administrative control uadmin(2)
 ucontext user context ucontext(5)
 UID getpw(3C)
 ulckpwdf manipulate shadow password getspent(3C)
 ulimit get and set user limits ulimit(2)
 umask set and get file creation umask(2)
 umount unmount a file system umount(2)
 uname get name of current UNIX uname(2)
 undo a previous get of an SCCS file unget(1)
 unget undo a previous get of an unget(1)
 ungetc push character back onto ungetc(3S)
 uniformly distributed pseudo-random/ drand48(3C)
 uninterpreted file contents elf_rawfile(3E)
 unique file name mktemp(3C)
 UNIX system uname(2)
 unlink remove directory entry unlink(2)
 unlock address space mlockall(3C)

mlock, munlock lock (or	unlock) pages in memory	mlock(3C)
plock lock into memory or	unlock process, text, or data	plock(2)
munmap	unmap pages of memory	munmap(2)
umount	unmount a file system	umount(2)
isnan, isnanf, finite, fpclass,	unordered determine type of/ isnan,	isnan(3C)
pause suspend process	until signal	pause(2)
a signal mask and suspend process	until signal sigsuspend install	sigsuspend(2)
elf_update	update an ELF descriptor	elf_update(3E)
programs make maintain,	update, and regenerate groups of	make(1)
lsearch, lfind linear search and	update	lsearch(3C)
sync	update super block	sync(2)
/utmpxname, getutmp, getutmpx,	updwtmp, updwtmpx access utmpx file/	getutx(3C)
/getutmp, getutmpx, updwtmp,	updwtmpx access utmpx file entry	getutx(3C)
levels for an application for	use with fmtmsg /a list of severity	addseverity(3C)
setuid, setgid set	user and group IDs	setuid(2)
setcontext get and set current	user context getcontext,	getcontext(2)
ucontext	user context	ucontext(5)
makecontext, swapcontext manipulate	user contexts	makecontext(3C)
get character login name of the	user cuserid	cuserid(3S)
/geteuid, getgid, getegid get real	user, effective user, real group,/	getuid(2)
environ	user environment	environ(5)
getdate convert	user format date and time	getdate(3C)
ulimit get and set	user limits	ulimit(2)
/getegid get real user, effective	user, real group, and effective/	getuid(2)
in the utmp file of the current	user ttyslot find the slot	ttyslot(3C)
maillock manage lockfile for	user's mailbox	maillock(3X)
elf_end finish	using an object file	elf_end(3E)
modification times	ustat get file system statistics	ustat(2)
utmp, wtmp	utime set file access and	utime(2)
setutent, endutent, utmpname access	utmp and wtmp entry formats	utmp(4)
ttyslot find the slot in the	utmp file entry /pututline,	getut(3C)
formats	utmp file of the current user	ttyslot(3C)
/pututline, setutent, endutent,	utmp, wtmp utmp and wtmp entry	utmp(4)
utmpx, wtmpx	utmpname access utmp file entry	getut(3C)
getutmpx, updwtmp, updwtmpx access	utmpx and wtmpx entry formats	utmpx(4)
formats	utmpx file entry /getutmp,	getutx(3C)
/pututxline, setutxent, endutxent,	utmpx, wtmpx utmpx and wtmpx entry	utmpx(4)
val	utmpxname, getutmp, getutmpx,/	getutx(3C)
free, realloc, calloc, memalign,	val validate an SCCS file	val(1)
abs, labs return integer absolute	validate an SCCS file	val(1)
elf_hash compute hash	valloc, memory allocator malloc,	malloc(3C)
getenv return	value	abs(3C)
floor, ceiling, remainder, absolute	value	elf_hash(3E)
readlink read the	value for environment name	getenv(3C)
getitimer, setitimer get/set	value functions /rint, remainder	floor(3M)
	value of a symbolic link	readlink(2)
	value of interval timer	getitimer(3C)

putenv change or add	value to environment	putenv(3C)
convert between binary and decimal	values /_d2dec,_dec2s,_dec2d	deconvn(3C)
	values machine-dependent values	values(5)
values machine-dependent	values	values(5)
list	varargs handle variable argument	varargs(5)
stdarg handle	variable argument list	stdarg(5)
varargs handle	variable argument list	varargs(5)
print formatted output of a	variable argument list /vsprintf	vprintf(3S)
pathconf get configurable pathname	variables fpathconf,	fpathconf(2)
sysconf get configurable system	variables	sysconf(3C)
	vc version control	vc(1)
get option letter from argument	vector getopt	getopt(3C)
assert	verify program assertion	assert(3X)
vc	version control	vc(1)
get get a	version of an SCCS file	get(1)
ELF library and application	versions elf_version coordinate	elf_version(3E)
scsdiff compare two	versions of an SCCS file	scsdiff(1)
virtual memory efficient way	vfork spawn new process in a	vfork(2)
output of a variable/ vprintf,	vfprintf, vsprintf print formatted	vprintf(3S)
getvfprintf, getvfprintf get	vfstab file entry /getvfprintf,	getvfprintf(3C)
vfork spawn new process in a	virtual memory efficient way	vfork(2)
formatted output of a variable/	vprintf, vfprintf, vsprintf print	vprintf(3S)
a variable/ vprintf, vfprintf,	vsprintf print formatted output of	vprintf(3S)
state waitid	wait for child process to change	waitid(2)
state waitpid	wait for child process to change	waitpid(2)
terminate wait	wait for child process to stop or	wait(2)
wstat	wait status	wstat(5)
or terminate	wait wait for child process to stop	wait(2)
change state	waitid wait for child process to	waitid(2)
change state	waitpid wait for child process to	waitpid(2)
ftw, nftw	walk a file tree	ftw(3C)
mbstring: mbstowcs,	wctombs multibyte string functions	mbstring(3C)
mbchar: mbtowc, mblen	wctomb multibyte character handling	mbchar(3C)
encrypted isencrypt determine	whether a character buffer is	isencrypt(3G)
libwindows	windowing terminal function library	libwindows(3X)
jagent host control of	windowing terminal	jagent(5)
/protocol used between host and	windowing terminal under layers(1)	layers(5)
prof profile	within a function	prof(5)
fgetc, getw get character or	word from a stream getc, getchar,	getc(3S)
putc, putw put character or	word on a stream putc, putchar,	putc(3S)
chdir, fchdir change	working directory	chdir(2)
getcwd get path-name of current	working directory	getcwd(3C)
write, writev	write on a file	write(2)
putpwent	write password file entry	putpwent(3C)
putspent	write shadow password file entry	putspent(3C)
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write,	writev write on a file	write(2)

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open open for reading or writing	open(2)
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timezone set default system time zone	timezone(4)

COMMANDS (1)

NAME

intro – introduction to programming commands

DESCRIPTION

This section describes the programming commands in alphabetical order. Unless otherwise noted, the commands accept options and other arguments according to the following syntax:

name [*option(s)*] [*cmdarg(s)*]

where:

name is the name of an executable file.

option is *-noargletter(s)* or *-argletter <> optarg*, where:

noargletter is a single letter representing an option without an option argument;

argletter is a single letter representing an option requiring an option argument;

<> is optional white space;

optarg is an option argument (character string) satisfying the preceding *argletter*.

cmdarg is *"-"* by itself, which indicates the standard input, or a path name (or other command argument) *not* beginning with *"-"*.

Throughout the manual pages there are references to *TMPDIR*, *BINDIR*, *INCDIR*, and *LIBDIR*. These represent directory names whose value is specified on each manual page as necessary. For example, *TMPDIR* might refer to */var/tmp*. These are not environment variables and cannot be set. [There is an environment variable called *TMPDIR* which can be set. See *tmpnam(3S)*.] There are also references to *LIBPATH*, the default search path of the link editor and other tools.

SEE ALSO

exit(2), *wait(2)*, *getopt(3C)*,
getopts(1) in the *User's Reference Manual*.

DIAGNOSTICS

Upon termination, each command returns two bytes of status, one supplied by the system and giving the cause for termination, and (in the case of "normal" termination) one supplied by the program [see *wait(2)* and *exit(2)*]. The former byte is 0 for normal termination; the latter is customarily 0 for successful execution and non-zero to indicate troubles such as erroneous parameters, or bad or inaccessible data. It is called variously "exit code," "exit status," or "return code," and is described only where special conventions are involved.

WARNINGS

Some commands produce unexpected results when processing files containing null characters. These commands often treat text input lines as strings and therefore become confused upon encountering a null character (the string terminator) within a line.

NAME

admin - create and administer SCCS files

SYNOPSIS

```
admin [-n] [-i{name}] [-rrel] [-t{name}] [-f flag{flag-val}] [-d flag{flag-val}] [-a login]
      [-e login] [-m{mrlist}] [-y{comment}] [-h] [-z] files
```

DESCRIPTION

admin is used to create new SCCS files and change parameters of existing ones. Arguments to admin, which may appear in any order, consist of keyletter arguments (that begin with -) and named files (note that SCCS file names must begin with the characters s.). If a named file does not exist, it is created and its parameters are initialized according to the specified keyletter arguments. Parameters not initialized by a keyletter argument are assigned a default value. If a named file does exist, parameters corresponding to specified keyletter arguments are changed, and other parameters are left unchanged.

If a directory is named, admin behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of - is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file to be processed. Again, non-SCCS files and unreadable files are silently ignored.

The keyletter arguments are listed below. Each argument is explained as if only one named file were to be processed because the effect of each argument applies independently to each named file.

- n This keyletter indicates that a new SCCS file is to be created.
- i{name} The *name* of a file from which the text for a new SCCS file is to be taken. The text constitutes the first delta of the file (see -r keyletter for delta numbering scheme). If the -i keyletter is used, but the file name is omitted, the text is obtained by reading the standard input until an end-of-file is encountered. If this keyletter is omitted, then the SCCS file is created empty. Only one SCCS file may be created by an admin command on which the i keyletter is supplied. Using a single admin to create two or more SCCS files requires that they be created empty (no -i keyletter). Note that the -i keyletter implies the -n keyletter.
- rrel The *release* into which the initial delta is inserted. This keyletter may be used only if the -i keyletter is also used. If the -r keyletter is not used, the initial delta is inserted into release 1. The level of the initial delta is always 1 (by default initial deltas are named 1.1).
- t{name} The *name* of a file from which descriptive text for the SCCS file is to be taken. If the -t keyletter is used and admin is creating a new SCCS file (the -n and/or -i keyletters also used), the descriptive text file name must also be supplied. In the case of existing SCCS files: (1) a -t keyletter without a file name causes removal of the descriptive text (if any) that is currently in the SCCS file, and (2) a -t keyletter with a file name causes text (if any) in the named file to replace the descriptive text (if any) that is currently in the SCCS file.

- f***flag* This keyletter specifies a *flag*, and, possibly, a value for the *flag*, to be placed in the SCCS file. Several **-f** keyletters may be supplied on a single *admin* command line. The allowable *flags* and their values are:
- b** Allows use of the **-b** keyletter on a *get* command to create branch deltas.
- c***ceil* The highest release (i.e., ceiling): a number greater than 0 but less than or equal to 9999 that may be retrieved by a *get* command for editing. The default value for an unspecified **c** flag is 9999.
- f***floor* The lowest release (i.e., floor): a number greater than 0 but less than 9999 that may be retrieved by a *get* command for editing. The default value for an unspecified **f** flag is 1.
- d***SID* The default delta number (SID) to be used by a *get* command.
- i**[*str*] Causes the No id keywords (ge6) message issued by *get* or *delta* to be treated as a fatal error. In the absence of this flag, the message is only a warning. The message is issued if no SCCS identification keywords [see *get*(1)] are found in the text retrieved or stored in the SCCS file. If a value is supplied, the keywords must exactly match the given string. The string must contain a keyword, and no embedded newlines.
- j** Allows concurrent *get* commands for editing on the same SID of an SCCS file. This flag allows multiple concurrent updates to the same version of the SCCS file.
- l***list* A *list* of releases to which deltas can no longer be made (*get -e* against one of these "locked" releases fails). The *list* has the following syntax:
- ```
<list> ::= <range> | <list> , <range>
<range> ::= RELEASE NUMBER | a
```
- The character *a* in the *list* is equivalent to specifying all releases for the named SCCS file.
- n** Causes *delta* to create a null delta in each of those releases (if any) being skipped when a delta is made in a new release (e.g., in making delta 5.1 after delta 2.7, releases 3 and 4 are skipped). These null deltas serve as anchor points so that branch deltas may later be created from them. The absence of this flag causes skipped releases to be non-existent in the SCCS file, preventing branch deltas from being created from them in the future.
- q***text* User-definable text substituted for all occurrences of the `%Q%` keyword in SCCS file text retrieved by *get*.

- mmod*     *module* name of the SCCS file substituted for all occurrences of the %M% keyword in SCCS file text retrieved by *get*. If the *m* flag is not specified, the value assigned is the name of the SCCS file with the leading *s.* removed.
- ttype*     *type* of module in the SCCS file substituted for all occurrences of %Y% keyword in SCCS file text retrieved by *get*.
- v[pgm]*     Causes *delta* to prompt for Modification Request (MR) numbers as the reason for creating a delta. The optional value specifies the name of an MR number validity checking program [see *delta*(1)]. This program will receive as arguments the module name, the value of the *type* flag (see *ttype* above), and the *mrlist*. (If this flag is set when creating an SCCS file, the *m* keyletter must also be used even if its value is null).
- dflag*     Causes removal (deletion) of the specified *flag* from an SCCS file. The *-d* keyletter may be specified only when processing existing SCCS files. Several *-d* keyletters may be supplied in a single *admin* command. See the *-f* keyletter for allowable *flag* names.
- (*list* used with *-d* indicates a *list* of releases to be unlocked. See the *-f* keyletter for a description of the *l* flag and the syntax of a *list*.)
- alogin*     A login name, or numerical UNIX System group ID, to be added to the list of users who may make deltas (changes) to the SCCS file. A group ID is equivalent to specifying all login names common to that group ID. Several *a* keyletters may be used on a single *admin* command line. As many logins or numerical group IDs as desired may be on the list simultaneously. If the list of users is empty, then anyone may add deltas. If login or group ID is preceded by a *!* they are to be denied permission to make deltas.
- elogin*     A login name, or numerical group ID, to be erased from the list of users allowed to make deltas (changes) to the SCCS file. Specifying a group ID is equivalent to specifying all login names common to that group ID. Several *-e* keyletters may be used on a single *admin* command line.
- m[mrlist]*     The list of Modification Requests (MR) numbers is inserted into the SCCS file as the reason for creating the initial delta in a manner identical to *delta*. The *v* flag must be set and the MR numbers are validated if the *v* flag has a value (the name of an MR number validation program). Diagnostics will occur if the *v* flag is not set or MR validation fails.
- y[comment]*     The *comment* text is inserted into the SCCS file as a comment for the initial delta in a manner identical to that of *delta*. Omission of the *-y* keyletter results in a default comment line being inserted.



The `-y` keyletter is valid only if the `-i` and/or `-n` keyletters are specified (i.e., a new SCCS file is being created).

- `-h` Causes `admin` to check the structure of the SCCS file [see `sccsfile(4)`], and to compare a newly computed check-sum (the sum of all the characters in the SCCS file except those in the first line) with the check-sum that is stored in the first line of the SCCS file. Appropriate error diagnostics are produced. This keyletter inhibits writing to the file, nullifying the effect of any other keyletters supplied; therefore, it is only meaningful when processing existing files.
- `-z` The SCCS file check-sum is recomputed and stored in the first line of the SCCS file (see `-h`, above). Note that use of this keyletter on a truly corrupted file may prevent future detection of the corruption.

The last component of all SCCS file names must be of the form `s.file`. New SCCS files are given mode 444 [see `chmod(1)`]. Write permission in the pertinent directory is, of course, required to create a file. All writing done by `admin` is to a temporary `x-file`, called `x.file`, [see `get(1)`], created with mode 444 if the `admin` command is creating a new SCCS file, or with the same mode as the SCCS file if it exists. After successful execution of `admin`, the SCCS file is removed (if it exists), and the `x-file` is renamed with the name of the SCCS file. This renaming process ensures that changes are made to the SCCS file only if no errors occurred.

It is recommended that directories containing SCCS files be mode 755 and that SCCS files themselves be mode 444. The mode of the directories allows only the owner to modify SCCS files contained in the directories. The mode of the SCCS files prevents any modification at all except by SCCS commands.

`admin` also makes use of a transient lock file (called `z.file`), which is used to prevent simultaneous updates to the SCCS file by different users. See `get(1)` for further information.

## FILES

- `x-file` [see `delta(1)`]
- `z-file` [see `delta(1)`]
- `bdiff` Program to compute differences between the "gotten" file and the `g-file` [see `get(1)`].

## SEE ALSO

`bdiff(1)`, `ed(1)`, `delta(1)`, `get(1)`, `help(1)`, `prs(1)`, `what(1)`, `sccsfile(4)`.

## DIAGNOSTICS

Use the `help` command for explanations.

## NOTES

If it is necessary to patch an SCCS file for any reason, the mode may be changed to 644 by the owner allowing use of a text editor. You must run `admin -h` on the edited file to check for corruption followed by an `admin -z` to generate a proper check-sum. Another `admin -h` is recommended to ensure the SCCS file is valid.

**NAME**

ar – maintain portable archive or library

**SYNOPSIS**

ar [ -v ] -key [ arg ] [ posname ] afile [ name... ]

**DESCRIPTION**

The ar command maintains groups of files combined into a single archive file. Its main use is to create and update library files. However, it can be used for any similar purpose. The magic string and the file headers used by ar consist of printable ASCII characters. If an archive is composed of printable files, the entire archive is printable.

When ar creates an archive, it creates headers in a format that is portable across all machines. The portable archive format and structure are described in detail in ar(4). The archive symbol table [described in ar(4)] is used by the link editor ld to effect multiple passes over libraries of object files in an efficient manner. An archive symbol table is only created and maintained by ar when there is at least one object file in the archive. The archive symbol table is in a specially named file that is always the first file in the archive. This file is never mentioned or accessible to the user. Whenever the ar command is used to create or update the contents of such an archive, the symbol table is rebuilt. The s option described below will force the symbol table to be rebuilt.

The -v option causes ar to print its version number on standard error.

Unlike command options, the key is a required part of the ar command line. The key is formed with one of the following letters: drqtpmx. Arguments to the key, alternatively, are made with one of more of the following set: vvaibcls. posname is an archive member name used as a reference point in positioning other files in the archive. afile is the archive file. The names are constituent files in the archive file. The meanings of the key characters are as follows:

- d Delete the named files from the archive file.
- r Replace the named files in the archive file. If the optional character u is used with r, then only those files with dates of modification later than the archive files are replaced. If an optional positioning character from the set abi is used, then the posname argument must be present and specifies that new files are to be placed after (a) or before (b or i) posname. Otherwise new files are placed at the end.
- q Quickly append the named files to the end of the archive file. Optional positioning characters are invalid. The command does not check whether the added members are already in the archive. This option is useful to avoid quadratic behavior when creating a large archive piece-by-piece.
- t Print a table of contents of the archive file. If no names are given, all files in the archive are listed. If names are given, only those files are listed.
- p Print the named files in the archive.
- m Move the named files to the end of the archive. If a positioning character is present, then the posname argument must be present and, as in r, specifies where the files are to be moved.

- x** Extract the named files. If no names are given, all files in the archive are extracted. In neither case does **x** alter the archive file.

The meanings of the other key arguments are as follows:

- v** Give a verbose file-by-file description of the making of a new archive file from the old archive and the constituent files. When used with **t**, give a long listing of all information about the files. When used with **x**, print the filename preceding each extraction.
- c** Suppress the message that is produced by default when *afile* is created.
- l** This option is obsolete. It is recognized, but ignored, and will be removed in the next release.
- s** Force the regeneration of the archive symbol table even if **ar(1)** is not invoked with a command which will modify the archive contents. This command is useful to restore the archive symbol table after the **strip(1)** command has been used on the archive.

#### SEE ALSO

**ld(1)**, **lorder(1)**, **strip(1)**, **a.out(4)**, **ar(4)**.

#### NOTES

If the same file is mentioned twice in an argument list, it may be put in the archive twice.

Since the archiver no longer uses temporary files, the **-l** option is obsolete and will be removed in the next release.

By convention, archives are suffixed with the characters **.a**.

**as(1)**

**as(1)**

**NAME**

**as** - assembler

**SYNOPSIS**

**as** [*options*] *file*

**DESCRIPTION**

The **as** command creates object files from assembly language source *files*. The following flags may be specified in any order:

- o *objfile* Put the output of the assembly in *objfile*. By default, the output file name is formed by removing the *.s* suffix, if there is one, from the input file name and appending a *.o* suffix.
- n Turn off long/short address optimization. By default, address optimization takes place.
- m Run the **m4** macro processor on the input to the assembler.
- R Remove (unlink) the input file after assembly is completed.
- dl Obsolete. Assembler issues a warning saying that it is ignoring the *-dl* option.
- T Accept obsolete assembler directives.
- v Write the version number of the assembler being run on the standard error output.
- Q{*y* | *n*} If *-Qy* is specified, place the version number of the assembler being run in the object file. The default is *-Qn*.
- Y [*md*],*dir* Find the **m4** preprocessor (*m*) and/or the file of predefined macros (*d*) in directory *dir* instead of in the customary place.

**FILES**

By default, **as** creates its temporary files in */var/tmp*. This location can be changed by setting the environment variable **TMPDIR** [see **tmpnam** in **tmpnam(3S)**].

**SEE ALSO**

**cc(1)**, **ld(1)**, **m4(1)**, **nm(1)**, **strip(1)**, **tmpnam(3S)**, **a.out(4)**.

**NOTES**

If the *-m* (**m4** macro processor invocation) option is used, keywords for **m4** [see **m4(1)**] cannot be used as symbols (variables, functions, labels) in the input file since **m4** cannot determine which keywords are assembler symbols and which keywords are real **m4** macros.

The *.align* assembler directive may not work in the *.text* section when long/short address optimization is performed.

Arithmetic expressions may only have one forward referenced symbol per expression.

Whenever possible, you should access the assembler through a compilation system interface program such as **cc**.

**cb(1)**

**cb(1)**

**NAME**

**cb** - C program beautifier

**SYNOPSIS**

**cb** [-s] [-j] [-l *leng*] [-V] [*file ...*]

**DESCRIPTION**

The **cb** comand reads syntactically correct C programs either from its arguments or from the standard input, and writes them on the standard output with spacing and indentation that display the structure of the C code. By default, **cb** preserves all user new-lines.

**cb** accepts the following options.

- s Write the code in the style of Kernighan and Ritchie found in *The C Programming Language*.
- j Put split lines back together.
- l *leng* Split lines that are longer than *leng*.
- V Print on standard error output the version of **cb** invoked.

**NOTES**

**cb** treats **asm** as a keyword.

The format of structure initializations is unchanged by **cb**.

Punctuation that is hidden in preprocessing directives causes indentation errors.

**SEE ALSO**

**cc(1)**.

Kernighan, B. W., and Ritchie, D. M., *The C Programming Language*, Second Edition, Prentice-Hall, 1988.

**NAME**

cc - C compiler

**SYNOPSIS**

cc [*options*] *file* ...

**DESCRIPTION**

cc is the interface to the C compilation system. The compilation tools conceptually consist of a preprocessor, compiler, optimizer, basic block analyzer, assembler, and link editor. cc processes the supplied options and then executes the various tools with the proper arguments. cc accepts several types of files as arguments.

Files whose names end with .c are taken to be C source files and may be preprocessed, compiled, optimized, instrumented for profiling, assembled, and link edited. The compilation process may be stopped after the completion of any pass if the appropriate options are supplied. If the compilation process runs through the assembler, then an object file is produced whose name is that of the source with .o substituted for .c. However, the .o file is normally deleted if a single C file is compiled and then immediately link edited. In the same way, files whose names end in .s are taken to be assembly source files; they may be assembled and link edited. Files whose names end in .i are taken to be preprocessed C source files, and they may be compiled, optimized, instrumented for profiling, assembled, and link edited. Files whose names do not end in .c, .s, or .i are handed to the link editor, which produces a dynamically linked executable whose name by default is a.out.

Since cc usually creates files in the current directory during the compilation process, it is necessary to run cc in a directory in which a file can be created.

The following options are interpreted by cc:

-A *name*[(tokens)]

Associates *name* as a predicate with the specified *tokens* as if by a #assert preprocessing directive.

Preassertions:           system(unix)  
                          cpu (M32)  
                          machine (u3b2)

- A - Causes all predefined macros (other than those that begin with \_\_) and predefined assertions to be forgotten.
- B *c* *c* can be either *dynamic* or *static*. -B *dynamic* causes the link editor to look for files named *libx.so* and then for files named *libx.a* when given the -lx option. -B *static* causes the link editor to look only for files named *libx.a*. This option may be specified multiple times on the command line as a toggle. This option and its argument are passed to ld.
- C Cause the preprocessing phase to pass along all comments other than those on preprocessing directive lines.
- c Suppress the link editing phase of the compilation and do not remove any produced object files.

**-D** *name*[=*tokens*]

Associates *name* with the specified *tokens* as if by a `#define` preprocessing directive. If no *tokens* is specified, the token 1 is supplied.

Predefinitions:      u3b2  
                          unix

**-d** *c*   *c* can be either *y* or *n*. **-dy** specifies dynamic linking, which is the default, in the link editor. **-dn** specifies static linking in the link editor. This option and its argument are passed to `ld`.

**-E**   Only preprocess the named C files and send the result to the standard output. The output will contain preprocessing directives for use by the next pass of the compilation system.

**-f**   This option is obsolete and will be ignored.

**-G**   Used to direct the link editor to produce a shared object rather than a dynamically linked executable. This option is passed to `ld`. It cannot be used with the **-dn** option.

**-g**   Cause the compiler to generate additional information needed for the use of `sdb`. Use of `sdb` on a program compiled with both the **-g** and **-O** options is not recommended unless the user understands the behavior of optimization.

**-H**   Print, one per line, the path name of each file included during the current compilation on the standard error output.

**-I** *dir*   Alter the search for included files whose names do not begin with `/` to look in *dir* prior to the usual directories. The directories for multiple **-I** options are searched in the order specified.

**-J** *sfm*

Specify the assembly language source math library, `libsfm.sa`. This library is searched when its name is encountered, so the placement of this option is significant. Note that this is a special-purpose library and should be used only when necessary [see `intro(3M)`]. This option and its argument are passed to the optimizer only when both **-O** and **-Ksd** are also specified.

**-K** [*mode*, *goal*, PIC, *minabi*]

**-K mode**

*mode* can be either *fpe* (software floating point emulation) or *mau* (hardware math accelerator unit). Compile with the indicated floating-point *mode*.

**-K goal**

*goal* can be either *sd* to optimize for speed, or *sz* to optimize for size; either have an effect only if the **-O** option is also specified.

**-K PIC**

Causes position-independent code (PIC) to be generated.

**-K minabi**

Directs the compilation system to use a version of the C library that minimizes dynamic linking, without changing the application's ABI conformance (or non-conformance, as the case may be). Applications that use the Network Services Library or the X library may not use **-K minabi**.

The **-K** option can accept multiple arguments. For example,

**-K fpe, sz** can be used instead of **-K fpe -K sz**.

- L dir** Add *dir* to the list of directories searched for libraries by **ld**. This option and its argument are passed to **ld**.
- l name**  
Search the library *libname.so* or *libname.a*. Its placement on the command line is significant as a library is searched at a point in time relative to the placement of other libraries and object files on the command line. This option and its argument are passed to **ld**.
- O** Arrange for compilation phase optimization. This option has no effect on *.s* files.
- o pathname**  
Produce an output object file *pathname*, instead of the default *a.out*. This option and its argument are passed to **ld**.
- P** Only preprocess the named C files and leave the result in corresponding files suffixed *.i*. The output will not contain any preprocessing directives, unlike **-E**.
- p** Arrange for the compiler to produce code that counts the number of times each routine is called; also, if link editing takes place, profiled versions of *libc.a* and *libm.a* (with the **-lm** option) are linked if the **-dn** option is used. A *mon.out* file will then be produced at normal termination of execution of the object program. An execution profile can then be generated by use of **prof**.
- Q c** *c* can be either *y* or *n*. If *c* is *y*, identification information about each invoked compilation tool will be added to the output files (the default behavior). This can be useful for software administration. Giving *n* for *c* suppresses this information.
- q c** *c* can be either *l* or *p*. **-ql** causes the invocation of the basic block analyzer and arranges for the production of code that counts the number of times each source line is executed. A listing of these counts can be generated by use of **lprof**. **-qp** is a synonym for **-p**.
- S** Compile, optimize (if **-O** is present), and do not assemble or link edit the named C files. The assembler-language output is left in corresponding files suffixed *.s*.
- U name**  
Causes any definition of *name* to be forgotten, as if by a **#undef** preprocessing directive. If the same *name* is specified for both **-D** and **-U**, *name* is not defined, regardless of the order of the options.



- V Cause each invoked tool to print its version information on the standard error output.
- v Cause the compiler to perform more and stricter semantic checks, and to enable certain lint-like checks on the named C files.
- W *tool, arg<sub>1</sub>[, arg<sub>2</sub> ...]*  
Hand off the argument(s) *arg<sub>i</sub>*; each as a separate argument to *tool*. Each argument must be separated from the preceding by only a comma. (A comma can be part of an argument by escaping it by an immediately preceding backslash (\) character; the backslash is removed from the resulting argument.) *tool* can be one of the following:
 

|   |                      |
|---|----------------------|
| p | A synonym for 0      |
| 0 | compiler             |
| 2 | optimizer            |
| b | basic block analyzer |
| a | assembler            |
| 1 | link editor          |

For example, `-Wa, -o, obfile` passes `-o` and `obfile` to the assembler, in that order; also `-Wl, -I, name` causes the linking phase to override the default name of the dynamic linker, `/usr/lib/libc.so.1`.

The order in which the argument(s) are passed to a tool with respect to the other specified command line options may change.

- X *c* Specify the degree of conformance to the ANSI C standard. *c* can be one of the following:
  - t (transition)  
The compiled language includes all new features compatible with older (pre-ANSI) C (the default behavior). The compiler warns about all language constructs that have differing behavior between the new and old versions and uses the pre-ANSI C interpretation. This includes, for example, warning about the use of trigraphs the new escape sequence `\a`, and the changes to the integral promotion rules.
  - a (ANSI)  
The compiled language includes all new features of ANSI C and uses the new interpretation of constructs with differing behavior. The compiler continues to warn about the integral promotion rule changes, but does not warn about trigraph replacements or new escape sequences.
  - c (conformance)  
The compiled language and associated header files are ANSI C conforming, but include all conforming extensions of `-Xa`. Warnings will be produced about some of these. Also, only ANSI defined identifiers are visible in the standard header files.

The predefined macro `__STDC__` has the value 0 for `-Xt` and `-Xa`, and 1 for `-Xc`. All warning messages about differing behavior can be eliminated in `-Xa` through appropriate coding; for example, use of casts can eliminate the integral promotion change warnings.

**-Y *item, dir***

Specify a new directory *dir* for the location of *item*. *item* can consist of any of the characters representing tools listed under the `-W` option or the following characters representing directories containing special files:

- F** obsolete. Use `-YP` instead. For this release, `-YF` will be simulated using `-YP`. `-YF` will be removed in the next release.
- I** directory searched last for include files: *INCDIR* (see `-I`)
- S** directory containing the start-up object files: *LIBDIR*
- L** obsolete. Use `-YP` instead. For this release, `-YL` will be simulated using `-YP`. `-YL` will be removed in the next release.
- U** obsolete. Use `-YP` instead. For this release, `-YU` will be simulated using `-YP`. `-YU` will be removed in the next release.
- P** Change the default directories used for finding libraries. *dir* is a colon-separated path list.

If the location of a tool is being specified, then the new path name for the tool will be *dir/tool*. If more than one `-Y` option is applied to any one item, then the last occurrence holds.

cc recognizes `-a`, `-B`, `-e`, `-h`, `-m`, `-o`, `-r`, `-s`, `-t`, `-u`, and `-z` and passes these options and their arguments to `ld`. cc also passes any unrecognized options to `ld` without any diagnostic.

When cc is put in a file *prefixcc*, the prefix will be recognized and used to prefix the names of each tool executed. For example, `OLDcc` will execute `OLDacomp`, `OLDnewoptim`, `OLDbasicblk`, `OLDas`, and `OLDld`, and will link the object file(s) with `OLDcrt1.o`. Therefore, be careful when moving cc around. The prefix applies to the compiler, optimizer, basic block analyzer, assembler, link editor, and the start-up routines.

**FILES**

|                        |                             |
|------------------------|-----------------------------|
| <i>file.c</i>          | C source file               |
| <i>file.i</i>          | preprocessed C source file  |
| <i>file.o</i>          | object file                 |
| <i>file.s</i>          | assembly language file      |
| <i>a.out</i>           | link-edited output          |
| <i>LIBDIR/*crti.o</i>  | startup initialization code |
| <i>LIBDIR/*crt1.o</i>  | startup routine             |
| <i>LIBDIR/*crtn.o</i>  | last startup routine        |
| <i>TMPDIR/*</i>        | temporary files             |
| <i>LIBDIR/acomp</i>    | preprocessor and compiler   |
| <i>LIBDIR/newoptim</i> | optimizer                   |
| <i>LIBDIR/basicblk</i> | basic block analyzer        |
| <i>BINDIR/as</i>       | assembler                   |

**cc(1)**

**cc(1)**

|                        |                                                                                                                                      |
|------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| <i>BINDIR</i> /ld      | link editor                                                                                                                          |
| <i>LIBDIR</i> /libc.so | shared standard C library                                                                                                            |
| <i>LIBDIR</i> /libc.a  | archive standard C library                                                                                                           |
| <i>INCDIR</i>          | usually /usr/include                                                                                                                 |
| <i>LIBDIR</i>          | usually /usr/ccs/lib                                                                                                                 |
| <i>BINDIR</i>          | usually /usr/ccs/bin                                                                                                                 |
| <i>TMPDIR</i>          | usually /var/tmp but can be redefined by setting the environment variable <i>TMPDIR</i> (see <i>tempnam</i> in <i>tempnam(3S)</i> ). |

**SEE ALSO**

*as(1)*, *ld(1)*, *lint(1)*, *lprofFP(1)*, *prof(1)*, *sdb(1)*, *monitor(3C)*, *tempnam(3S)*.

The ``C Compilation System'' chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

Kernighan, B. W., and Ritchie, D. M., *The C Programming Language*, Second Edition, Prentice-Hall, 1988.

American National Standard for Information Systems - Programming Language C, X3.159-1989.

**NOTES**

Obsolescent but still recognized *cc* options include *-f*, *-F*, *-YF*, *-YL*, and *-YU*. The *-q1* and *-O* options do not work together; *-O* will be ignored.

**NAME**

cdc - change the delta comment of an SCCS delta

**SYNOPSIS**

cdc -r *SID* [-m[*mrlist*] ] [ -y[*comment*] ] *file*...

**DESCRIPTION**

cdc changes the delta comment, for the *SID* (SCCS identification string) specified by the -r keyletter, of each named SCCS file.

The delta comment is the Modification Request (MR) and comment information normally specified via the -m and -y keyletters of the *delta* command.

If *file* is a directory, cdc behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of - is given, the standard input is read (see the NOTES section) and each line of the standard input is taken to be the name of an SCCS file to be processed.

Arguments to cdc, which may appear in any order, consist of keyletter arguments and file names.

All the described keyletter arguments apply independently to each named file:

-r*SID*           Used to specify the SCCS *ID*entification (*SID*) string of a delta for which the delta comment is to be changed.

-m*mrlist*       If the SCCS file has the v flag set [see *admin*(1)] then a list of MR numbers to be added and/or deleted in the delta comment of the *SID* specified by the -r keyletter may be supplied. A null MR list has no effect.

*mrlist* entries are added to the list of MRs in the same manner as that of *delta*. In order to delete an MR, precede the MR number with the character ! (see the EXAMPLES section). If the MR to be deleted is currently in the list of MRs, it is removed and changed into a comment line. A list of all deleted MRs is placed in the comment section of the delta comment and preceded by a comment line stating that they were deleted.

If -m is not used and the standard input is a terminal, the prompt *MRs?* is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. The *MRs?* prompt always precedes the *comments?* prompt (see -y keyletter).

*mrlist* entries in a list are separated by blanks and/or tab characters. An unescaped new-line character terminates the MR list.

Note that if the v flag has a value [see *admin*(1)], it is taken to be the name of a program (or shell procedure) that validates the correctness of the MR numbers. If a non-zero exit status is returned from the MR number validation program, cdc terminates and the delta comment remains unchanged.

**-y[comment]**

Arbitrary text used to replace the *comment(s)* already existing for the delta specified by the **-r** keyletter. The previous comments are kept and preceded by a comment line stating that they were changed. A null *comment* has no effect.

If **-y** is not specified and the standard input is a terminal, the prompt **comments?** is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. An unescaped new-line character terminates the *comment* text.

If you made the delta and have the appropriate file permissions, you can change its delta comment. If you own the file and directory you can modify the delta comment.

#### EXAMPLES

```
cdc -r1.6 -m"b188-12345 !b187-54321 b189-00001" -ytrouble s.file
```

adds b188-12345 and b189-00001 to the MR list, removes b187-54321 from the MR list, and adds the comment trouble to delta 1.6 of s.file.

Entering:

```
· cdc -r1.6 s.file
 MRs? !b187-54321 b188-12345 b189-00001
 comments? trouble
```

produces the same result.

#### FILES

x-file [see delta(1)]  
z-file [see delta(1)]

#### SEE ALSO

admin(1), delta(1), get(1), help(1), prs(1), sccsfile(4).

#### DIAGNOSTICS

Use help for explanations.

#### NOTES

If SCCS file names are supplied to the cdc command via the standard input (- on the command line), then the **-m** and **-y** keyletters must also be used.

**NAME**

cflow - generate C flowgraph

**SYNOPSIS**

cflow [-r] [-ix] [-i\_] [-dnum] files

**DESCRIPTION**

The `cflow` command analyzes a collection of C, `yacc`, `lex`, assembler, and object files and builds a graph charting the external function references. Files suffixed with `.y`, `.l`, and `.c` are processed by `yacc`, `lex`, and the C compiler as appropriate. The results of the preprocessed files, and files suffixed with `.i`, are then run through the first pass of `lint`. Files suffixed with `.s` are assembled. Assembled files, and files suffixed with `.o`, have information extracted from their symbol tables. The results are collected and turned into a graph of external references that is written on the standard output.

Each line of output begins with a reference number, followed by a suitable number of tabs indicating the level, then the name of the global symbol followed by a colon and its definition. Normally only function names that do not begin with an underscore are listed (see the `-i` options below). For information extracted from C source, the definition consists of an abstract type declaration (e.g., `char *`), and, delimited by angle brackets, the name of the source file and the line number where the definition was found. Definitions extracted from object files indicate the file name and location counter under which the symbol appeared (e.g., `text`). Leading underscores in C-style external names are deleted. Once a definition of a name has been printed, subsequent references to that name contain only the reference number of the line where the definition may be found. For undefined references, only `<>` is printed.

As an example, suppose the following code is in `file.c`:

```
int i;
main()
{
 f();
 g();
 f();
}
f()
{
 i = h();
}
```

The command

```
cflow -ix file.c
```

produces the output

```
1 main: int(), <file.c 4>
2 f: int(), <file.c 11>
3 h: <>
4 i: int, <file.c 1>
5 g: <>
```

When the nesting level becomes too deep, the output of `cflow` can be piped to the `pr` command, using the `-e` option, to compress the tab expansion to something less than every eight spaces.

In addition to the `-D`, `-I`, and `-U` options [which are interpreted just as they are by `cc`], the following options are interpreted by `cflow`:

- `-r` Reverse the "caller: callee" relationship producing an inverted listing showing the callers of each function. The listing is also sorted in lexicographical order by callee.
- `-ix` Include external and static data symbols. The default is to include only functions in the flowgraph.
- `-i_` Include names that begin with an underscore. The default is to exclude these functions (and data if `-ix` is used).
- `-dnum` The *num* decimal integer indicates the depth at which the flowgraph is cut off. By default this number is very large. Attempts to set the cutoff depth to a nonpositive integer will be ignored.

**SEE ALSO**

`as(1)`, `cc(1)`, `lex(1)`, `lint(1)`, `nm(1)`, `yacc(1)`.  
`pr(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

Complains about multiple definitions and only believes the first.

**NOTES**

Files produced by `lex` and `yacc` cause the reordering of line number declarations, which can confuse `cflow`. To get proper results, feed `cflow` the `yacc` or `lex` input.

**NAME**

cof2elf – COFF to ELF object file translation

**SYNOPSIS**

cof2elf [-iqV] [-Q{yn}] [-s *directory*] *files*

**DESCRIPTION**

cof2elf converts one or more COFF object *files* to ELF. This translation occurs in place, meaning the original file contents are modified. If an input file is an archive, each member will be translated as necessary, and the archive will be rebuilt with its members in the original order. cof2elf does not change input files that are not COFF.

Options have the following meanings.

- i Normally, the files are modified only when full translation occurs. Unrecognized data, such as unknown relocation types, are treated as errors and prevent translation. Giving the -i flag ignores these partial translation conditions and modifies the file anyway.
- q Normally, cof2elf prints a message for each file it examines, telling whether the file was translated, ignored, etc. The -q flag (for quiet) suppresses these messages.
- Q*arg* If *arg* is *y*, identification information about cof2elf will be added to the output files. This can be useful for software administration. Giving *n* for *arg* explicitly asks for no such information, which is the default behavior.
- s*directory* As mentioned above, cof2elf modifies the input files. This option saves a copy of the original files in the specified *directory*, which must exist. cof2elf does not save files it does not modify.
- V This flag tells cof2elf to print a version message on standard error.

**SEE ALSO**

ld(1), elf(3E), a.out(4), ar(4).

**NOTES**

Some debugging information is discarded. Although this does not affect the behavior of a running program, it may affect the information available for symbolic debugging.

cof2elf translates only COFF relocatable files. It does not translate executable or static shared library files for two main reasons. First, the operating system supports executable files and static shared libraries, making translation unnecessary. Second, those files have specific address and alignment constraints determined by the file format. Matching the constraints with a different object file format is problematic.

When possible, programmers should recompile their source code to build new object files. cof2elf is provided for those times when source code is unavailable.



**NAME**

comb - combine SCCS deltas

**SYNOPSIS**

comb [-o] [-s] [-pSID] [-clist] files

**DESCRIPTION**

comb generates a shell procedure [see sh(1)] that, when run, reconstructs the given SCCS files. The reconstructed files are typically smaller than the original files. The arguments may be specified in any order, but all keyletter arguments apply to all named SCCS files. If a directory is named, comb behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of - is given, the standard input is read; each line of the input is taken to be the name of an SCCS file to be processed; non-SCCS files and unreadable files are silently ignored. The generated shell procedure is written on the standard output.

The keyletter arguments are as follows. Each argument is explained as if only one named file is to be processed, but the effects of any keyletter argument apply independently to each named file.

- o For each get -e, this argument causes the reconstructed file to be accessed at the release of the delta to be created, otherwise the reconstructed file would be accessed at the most recent ancestor. Use of the -o keyletter may decrease the size of the reconstructed SCCS file. It may also alter the shape of the delta tree of the original file.
- s This argument causes comb to generate a shell procedure that, when run, produces a report that gives for each file: the file name, size (in blocks) after combining, original size (also in blocks), and percentage change computed by:

$$100 * (original - combined) / original$$

It is recommended that before any SCCS files are actually combined, one should use this option to determine exactly how much space is saved by the combining process.

- pSID The SCCS identification string (SID) of the oldest delta to be preserved. All older deltas are discarded in the reconstructed file.
- clist A list of deltas to be preserved. All other deltas are discarded. See get(1) for the syntax of a list.

If no keyletter arguments are specified, comb preserves only leaf deltas and the minimal number of ancestors needed to preserve the tree.

**FILES**

s.COMB the reconstructed SCCS file  
 comb????? temporary file

**SEE ALSO**

admin(1), delta(1), get(1), help(1), prs(1), sccsfile(4).  
 sh(1) in the *User's Reference Manual*.

**comb(1)**

**comb(1)**

**DIAGNOSTICS**

Use `help(1)` for explanations.

**NOTES**

`comb` may rearrange the shape of the tree of deltas.

`comb` may not save any space; in fact, it is possible for the reconstructed file to be larger than the original.

**NAME**

cscope – interactively examine a C program

**SYNOPSIS**

cscope [*options*] *files* . . .

**DESCRIPTION**

cscope is an interactive screen-oriented tool that allows the user to browse through C source files for specified elements of code.

By default, cscope examines the C (.c and .h), lex (.l); and yacc (.y) source files in the current directory. cscope may also be invoked for source files named on the command line. In either case, cscope searches the standard directories for #include files that it does not find in the current directory. cscope uses a symbol cross-reference, cscope.out by default, to locate functions, function calls, macros, variables, and preprocessor symbols in the files.

cscope builds the symbol cross-reference the first time it is used on the source files for the program being browsed. On a subsequent invocation, cscope rebuilds the cross-reference only if a source file has changed or the list of source files is different. When the cross-reference is rebuilt, the data for the unchanged files are copied from the old cross-reference, which makes rebuilding faster than the initial build.

The following options can appear in any combination:

- b Build the cross-reference only.
- c Ignore letter case when searching.
- c Use only ASCII characters in the cross-reference file, that is, do not compress the data.
- d Do not update the cross-reference.
- e Suppress the ^e command prompt between files.
- f *reffile* Use *reffile* as the cross-reference file name instead of the default cscope.out.
- I *incdir* Look in *incdir* (before looking in *INCDIR*, the standard place for header files, normally */usr/include*) for any #include files whose names do not begin with / and that are not specified on the command line or in *namefile* below. (The #include files may be specified with either double quotes or angle brackets.) The *incdir* directory is searched in addition to the current directory (which is searched first) and the standard list (which is searched last). If more than one occurrence of -I appears, the directories are searched in the order they appear on the command line.
- i *namefile* Browse through all source files whose names are listed in *namefile* (file names separated by spaces, tabs, or new-lines) instead of the default (cscope.files). If this option is specified, cscope ignores any files appearing on the command line.

- L Do a single search with line-oriented output when used with the *-num pattern* option.
- l Line-oriented interface (see "Line-Oriented Interface" below).
- num pattern* Go to input field *num* (counting from 0) and find *pattern*.
- P *path* Prepend *path* to relative file names in a pre-built cross-reference file so you do not have to change to the directory where the cross-reference file was built. This option is only valid with the *-d* option.
- P *n* Display the last *n* file path components instead of the default (1). Use 0 to not display the file name at all.
- s *dir* Look in *dir* for additional source files. This option is ignored if source files are given on the command line.
- T Use only the first eight characters to match against C symbols. A regular expression containing special characters other than a period (.) will not match any symbol if its minimum length is greater than eight characters.
- U Do not check file time stamps (assume that no files have changed).
- u Unconditionally build the cross-reference file (assume that all files have changed).
- v Print on the first line of screen the version number of *cscope*.

The *-I*, *-p*, and *-T* options can also be in the *cscope.files* file.

### Requesting the Initial Search

After the cross-reference is ready, *cscope* will display this menu:

```

Find this C symbol:
Find this function definition:
Find functions called by this function:
Find functions calling this function:
Find this text string:
Change this text string:
Find this egrep pattern:
Find this file:
Find files #including this file:

```

Press the TAB key repeatedly to move to the desired input field, type the text to search for, and then press the RETURN key.

### Issuing Subsequent Requests

If the search is successful, any of these single-character commands can be used:

- 1-9 Edit the file referenced by the given line number.
- SPACE Display next set of matching lines.
- + Display next set of matching lines.

- Display previous set of matching lines.
- ^e Edit displayed files in order.
- > Append the displayed list of lines to a file.
- | Pipe all lines to a shell command.

At any time these single-character commands can also be used:

- TAB Move to next input field.
- RETURN Move to next input field.
- ^n Move to next input field.
- ^p Move to previous input field.
- ^y Search with the last text typed.
- ^b Move to previous input field and search pattern.
- ^f Move to next input field and search pattern.
- ^c Toggle ignore/use letter case when searching. (When ignoring letter case, search for FILE will match File and file.)
- ^r Rebuild the cross-reference.
- ! Start an interactive shell (type ^d to return to cscope).
- ^l Redraw the screen.
- ? Give help information about cscope commands.
- ^d Exit cscope.

Note: If the first character of the text to be searched for matches one of the above commands, escape it by typing a \ (backslash) first.

### Substituting New Text for Old Text

After the text to be changed has been typed, cscope will prompt for the new text, and then it will display the lines containing the old text. Select the lines to be changed with these single-character commands:

- 1-9 Mark or unmark the line to be changed.
- \* Mark or unmark all displayed lines to be changed.
- SPACE Display next set of lines.
- + Display next set of lines.
- Display previous set of lines.
- a Mark all lines to be changed.
- ^d Change the marked lines and exit.
- ESCAPE Exit without changing the marked lines.
- ! Start an interactive shell (type ^d to return to cscope).
- ^l Redraw the screen.
- ? Give help information about cscope commands.

### Special Keys

If your terminal has arrow keys that work in vi(1), you can use them to move around the input fields. The up-arrow key is useful to move to the previous input field instead of using the TAB key repeatedly. If you have the CLEAR, NEXT, or PREV keys they will act as the ^l, +, and - commands, respectively.

### Line-Oriented Interface

The -l option lets you use cscope where a screen-oriented interface would not be useful, e.g., from another screen-oriented program.

cscope will prompt with >> when it is ready for an input line starting with the field number (counting from 0) immediately followed by the search pattern, e.g., `lmain` finds the definition of the `main` function.

If you just want a single search, instead of the `-l` option use the `-L` and `-num pattern` options, and you won't get the >> prompt.

For `-l`, cscope outputs the number of reference lines

`cscope: 2 lines`

For each reference found, cscope outputs a line consisting of the file name, function name, line number, and line text, separated by spaces, e.g.,

`main.c main 161 main(argc, argv)`

Note that the editor is not called to display a single reference, unlike the screen-oriented interface.

You can use the `r` command to rebuild the database.

cscope will quit when it detects end-of-file, or when the first character of an input line is `^d` or `q`.

**ENVIRONMENT VARIABLES**

- EDITOR** Preferred editor, which defaults to `vi(1)`.
- INCLUDEDIRS** Colon-separated list of directories to search for `#include` files.
- HOME** Home directory, which is automatically set at login.
- SHELL** Preferred shell, which defaults to `sh(1)`.
- SOURCEDIRS** Colon-separated list of directories to search for additional source files.
- TERM** Terminal type, which must be a screen terminal.
- TERMINFO** Terminal information directory full path name. If your terminal is not in the standard `terminfo` directory, see `curses(3X)` and `terminfo(4)` for how to make your own terminal description.
- TMPDIR** Temporary file directory, which defaults to `/var/tmp`.
- VIEWER** Preferred file display program [such as `pg`], which overrides `EDITOR` (see above).
- VPATH** A colon-separated list of directories, each of which has the same directory structure below it. If `VPATH` is set, cscope searches for source files in the directories specified; if it is not set, cscope searches only in the current directory.

**FILES**

- `cscope.files` Default files containing `-I`, `-p`, and `-T` options and the list of source files (overridden by the `-i` option).
- `cscope.out` Symbol cross-reference file, which is put in the home directory if it cannot be created in the current directory.
- `ncscope.out` Temporary file containing new cross-reference before it replaces the old cross-reference.
- `INCDIR` Standard directory for `#include` files (usually `/usr/include`).

## SEE ALSO

The "cscope" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

## NOTES

cscope recognizes function definitions of the form:

```
fname blank (args) white arg_decs white {
```

where:

*fname* is the function name

*blank* is zero or more spaces or tabs, not including newlines

*args* is any string that does not contain a " or a newline

*white* is zero or more spaces, tabs, or newlines

*arg\_decs* are zero or more argument declarations (*arg\_decs* may include comments and white space)

It is not necessary for a function declaration to start at the beginning of a line. The return type may precede the function name; cscope will still recognize the declaration. Function definitions that deviate from this form will not be recognized by cscope.

The Function column of the search output for the menu option Find functions called by this function: input field will only display the first function called in the line, that is, for this function

```
e()
{
 return (f() + g());
}
```

the display would be

```
Functions called by this function: e
```

```
File Function Line
a.c f 3 return(f() + g());
```

Occasionally, a function definition or call may not be recognized because of braces inside #if statements. Similarly, the use of a variable may be incorrectly recognized as a definition.

A typedef name preceding a preprocessor statement will be incorrectly recognized as a global definition, e.g.,

```
LDFILE *
#if AR16WR
```

Preprocessor statements can also prevent the recognition of a global definition, e.g.,

```
char flag
#ifdef ALLOCATE_STORAGE
 = -1
#endif
;
```

A function declaration inside a function is incorrectly recognized as a function call, e.g.,

```
f()
{
 void g();
}
```

is incorrectly recognized as a call to `g()`.

`cscope` recognizes C++ classes by looking for the `class` keyword, but doesn't recognize that a `struct` is also a class, so it doesn't recognize inline member function definitions in a structure. It also doesn't expect the `class` keyword in a `typedef`, so it incorrectly recognizes `X` as a definition in

```
typedef class X * Y;
```

It also doesn't recognize operator function definitions

```
Bool Feature::operator==(const Feature & other)
{
 ...
}
```



**NAME**

ctrace - C program debugger

**SYNOPSIS**

ctrace [*options*] [*file*]

**DESCRIPTION**

The **ctrace** command allows the user to monitor the sequential execution of a C program as each program statement executes. The effect is similar to executing a shell procedure with the **-x** option. **ctrace** reads the C program in *file* (or from standard input if the user does not specify *file*), inserts statements to print the text of each executable statement and the values of all variables referenced or modified, and writes the modified program to the standard output. The output of **ctrace** must be placed into a temporary file because the **cc(1)** command does not allow the use of a pipe. This file can then be compiled and executed.

As each statement in the program executes, it will be listed at the terminal, followed by the name and value of any variables referenced or modified in the statement; these variable names and values will be followed by any output from the statement. Loops in the trace output are detected and tracing is stopped until the loop is exited or a different sequence of statements within the loop is executed. A warning message is printed after each 1000 loop cycles to help the user detect infinite loops. The trace output goes to the standard output so the user can put it into a file for examination with an editor or the **bfs(1)** or **tail(1)** commands.

The options commonly used are:

- f functions** Trace only these *functions*.
- v functions** Trace all but these *functions*.

The user may want to add to the default formats for printing variables. Long and pointer variables are always printed as signed integers. Pointers to character arrays are also printed as strings if appropriate. **char**, **short**, and **int** variables are also printed as signed integers and, if appropriate, as characters. **double** variables are printed as floating point numbers in scientific notation. The user can request that variables be printed in additional formats, if appropriate, with these options:

- o** Octal
- x** Hexadecimal
- u** Unsigned
- e** Floating point

These options are used only in special circumstances:

- l n** Check *n* consecutively executed statements for looping trace output, instead of the default of 20. Use 0 to get all the trace output from loops.
- s** Suppress redundant trace output from simple assignment statements and string copy function calls. This option can hide a bug caused by use of the = operator in place of the == operator.
- t n** Trace *n* variables per statement instead of the default of 10 (the maximum number is 20). The diagnostics section explains when to use this option.

**ctrace(1)****ctrace(1)**

- P Preprocess the input before tracing it. The user can also use the -D, -I, and -U cc(1) options.
- p *string* Change the trace print function from the default of `printf`. For example, `fprintf(stderr, ...)` would send the trace to the standard error output.
- r *f* Use file *f* in place of the `runtime.c` trace function package. This replacement lets the user change the entire print function, instead of just the name and leading arguments (see the -p option).
- V Prints version information on the standard error.
- Q*arg* If *arg* is *y*, identification information about `ctrace` will be added to the output files. This can be useful for software administration. Giving *n* for *arg* explicitly asks for no such information, which is the default behavior.

**EXAMPLE**

If the file `lc.c` contains this C program:

```

1 #include <stdio.h>
2 main() /* count lines in input */
3 {
4 int c, nl;
5
6 nl = 0;
7 while ((c = getchar()) != EOF)
8 if (c == '\n')
9 ++nl;
10 printf("%d\n", nl);
11 }
```

these commands and test data are entered:

```

cc lc.c
a.out
1
(cnt1-d)
```

the program will be compiled and executed. The output of the program will be the number 2, which is incorrect because there is only one line in the test data. The error in this program is common, but subtle. If the user invokes `ctrace` with these commands:

```

ctrace lc.c >temp.c
cc temp.c
a.out
```

the output will be:

```

2 main()
6 nl = 0;
 /* nl == 0 */
7 while ((c = getchar()) != EOF)
```

The program is now waiting for input. If the user enters the same test data as before, the output will be:

```

 /* c == 49 or '1' */
8 if (c == '\n')
 /* c == 10 or '\n' */
9 ++nl;
 /* nl == 1 */
7 while ((c = getchar()) != EOF)
 /* c == 10 or '\n' */
8 if (c == '\n')
 /* c == 10 or '\n' */
9 ++nl;
 /* nl == 2 */
7 while ((c = getchar()) != EOF)

```

If an end-of-file character (ctrl-d) is entered, the final output will be:

```

 /* c == -1 */
10 printf("%d\n", nl);
 /* nl == 2 */
 return

```

Note the information printed out at the end of the trace line for the `nl` variable following line 10. Also note the `return` comment added by `ctrace` at the end of the trace output. This shows the implicit return at the terminating brace in the function.

The trace output shows that variable `c` is assigned the value `'1'` in line 7, but in line 8 it has the value `'\n'`. Once user attention is drawn to this `if` statement, he or she will probably realize that the assignment operator (`=`) was used in place of the equality operator (`==`). This error can easily be missed during code reading.

## EXECUTION-TIME TRACE CONTROL

The default operation for `ctrace` is to trace the entire program file, unless the `-f` or `-v` options are used to trace specific functions. The default operation does not give the user statement-by-statement control of the tracing, nor does it let the user turn the tracing off and on when executing the traced program.

The user can do both of these by adding `ctroff()` and `ctron()` function calls to the program to turn the tracing off and on, respectively, at execution time. Thus, complex criteria can be arbitrarily coded for trace control with `if` statements, and this code can even be conditionally included because `ctrace` defines the `CTRACE` preprocessor variable. For example:

```

#ifdef CTRACE
 if (c == '!' && i > 1000)
 ctron();
#endif

```

These functions can also be called from `sdb(1)` if they are compiled with the `-g` option. For example, to trace all but lines 7 to 10 in the main function, enter:

## ctrace(1)

## ctrace(1)

```
sdb a.out
main:7b ctroff()
main:11b ctron()
r
```

The trace can be turned off and on by setting static variable `tr_ct_` to 0 and 1, respectively. This on/off option is useful if a user is using a debugger that can not call these functions directly.

### FILES

`/usr/ccs/lib/ctrace/runtime.c`                      run-time trace package

### SEE ALSO

`sdb(1)`, `ctype(3C)`, `fclose(3S)`, `printf(3S)`, `string(3C)`.  
`bfs(1)`, `tail(1)` in the *User's Reference Manual*.

### DIAGNOSTICS

This section contains diagnostic messages from both `ctrace` and `cc(1)`, since the traced code often gets some `cc` warning messages. The user can get `cc` error messages in some rare cases, all of which can be avoided.

#### ctrace Diagnostics

**warning: some variables are not traced in this statement**

Only 10 variables are traced in a statement to prevent the C compiler "out of tree space; simplify expression" error. Use the `-t` option to increase this number.

**warning: statement too long to trace**

This statement is over 400 characters long. Make sure that tabs are used to indent the code, not spaces.

**cannot handle preprocessor code, use -P option**

This is usually caused by `#ifdef/#endif` preprocessor statements in the middle of a C statement, or by a semicolon at the end of a `#define` preprocessor statement.

**'if ... else if' sequence too long**

Split the sequence by removing an `else` from the middle.

**possible syntax error, try -P option**

Use the `-P` option to preprocess the `ctrace` input, along with any appropriate `-D`, `-I`, and `-U` preprocessor options.

### NOTES

Defining a function with the same name as a system function may cause a syntax error if the number of arguments is changed. Just use a different name.

`ctrace` assumes that `BADMAG` is a preprocessor macro, and that `EOF` and `NULL` are `#defined` constants. Declaring any of these to be variables, e.g., `"int EOF;"`, will cause a syntax error.

Pointer values are always treated as pointers to character strings.

**ctrace** does not know about the components of aggregates like structures, unions, and arrays. It cannot choose a format to print all the components of an aggregate when an assignment is made to the entire aggregate. **ctrace** may choose to print the address of an aggregate or use the wrong format (e.g., 3.149050e-311 for a structure with two integer members) when printing the value of an aggregate.

The loop trace output elimination is done separately for each file of a multi-file program. Separate output elimination can result in functions called from a loop still being traced, or the elimination of trace output from one function in a file until another in the same file is called.

**NAME**

**cxref** – generate C program cross-reference

**SYNOPSIS**

**cxref** [*options*] *files*

**DESCRIPTION**

The **cxref** command analyzes a collection of C files and builds a cross-reference table. **cxref** uses a special version of **cc** to include **#define**'d information in its symbol table. It generates a list of all symbols (auto, static, and global) in each individual file, or, with the **-c** option, in combination. The table includes four fields: NAME, FILE, FUNCTION, and LINE. The line numbers appearing in the LINE field also show reference marks as appropriate. The reference marks include:

```
assignment =
declaration -
definition *
```

If no reference marks appear, you can assume a general reference.

**OPTIONS**

**cxref** interprets the **-D**, **-I**, **-U** options in the same manner that **cc** does. In addition, **cxref** interprets the following options:

- c** Combine the source files into a single report. Without the **-c** option, **cxref** generates a separate report for each file on the command line.
- d** Disables printing declarations, making the report easier to read.
- l** Does not print local variables. Prints only global and file scope statistics.
- o file** Direct output to *file*.
- s** Operates silently; does not print input file names.
- t** Format listing for 80-column width.
- wnum** Width option that formats output no wider than *num* (decimal) columns. This option will default to 80 if *num* is not specified or is less than 51.
- C** Runs only the first pass of **cxref**, creating a **.cx** file that can later be passed to **cxref**. This is similar to the **-c** option of **cc** or **lint**.
- F** Prints the full path of the referenced file names.
- Lcols** Modifies the number of columns in the LINE field. If you do not specify a number, **cxref** defaults to five columns.
- V** Prints version information on the standard error.

*-wname, file, function, line*

Changes the default width of at least one field. The default widths are:

| Field    | Characters        |
|----------|-------------------|
| NAME     | 15                |
| FILE     | 13                |
| FUNCTION | 15                |
| LINE     | 20 (4 per column) |

## FILES

|                     |                                                                                                                                             |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------|
| <i>TMPDIR/tcx.*</i> | temporary files                                                                                                                             |
| <i>TMPDIR/cx.*</i>  | temporary files                                                                                                                             |
| <i>LIBDIR/xref</i>  | accessed by <i>cxref</i>                                                                                                                    |
| <i>LIBDIR</i>       | usually <i>/usr/ccs/lib</i>                                                                                                                 |
| <i>TMPDIR</i>       | usually <i>/var/tmp</i> but can be redefined by setting the environment variable <i>TMPDIR</i> [see <i>tempnam</i> in <i>tempnam(3S)</i> ]. |

## EXAMPLE

```
a.c
1 main()
2 {
3 int i;
4 extern char c;
5
6 i=65;
7 c=(char) i;
8 }
```

Resulting cross-reference table:

| NAME | FILE       | FUNCTION | LINE |    |   |
|------|------------|----------|------|----|---|
| c    | a.c        | ---      | 4-   | 7= |   |
| i    | a.c        | main     | 3*   | 6= | 7 |
| main | a.c        | ---      | 2*   |    |   |
| u3b2 | predefined | ---      | 0*   |    |   |
| unix | predefined | ---      | 0*   |    |   |

## SEE ALSO

*cc(1)*, *lint(1)*.

## DIAGNOSTICS

Error messages usually mean you cannot compile the files.

**NAME**

delta - make a delta (change) to an SCCS file

**SYNOPSIS**

delta [-rSID] [-s] [-n] [-glist] [-m[mrlist]] [-y[comment]] [-p] files

**DESCRIPTION**

delta is used to permanently introduce into the named SCCS file changes that were made to the file retrieved by `get -e` (called the g-file or generated file).

delta makes a delta to each named SCCS file. If a directory is named, delta behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with `s.`) and unreadable files are silently ignored. If a name of `-` is given, the standard input is read (see the NOTES section); each line of the standard input is taken to be the name of an SCCS file to be processed.

delta may issue prompts on the standard output depending on certain keyletters specified and flags [see `admin(1)`] that may be present in the SCCS file (see `-m` and `-y` keyletters below).

Keyletter arguments apply independently to each named file.

- `-rSID`      Uniquely identifies which delta is to be made to the SCCS file. The use of this keyletter is necessary only if two or more outstanding gets for editing (`get -e`) on the same SCCS file were done by the same person (login name). The SID value specified with the `-r` keyletter can be either the SID specified on the `get` command line or the SID to be made as reported by the `get` command [see `get(1)`]. A diagnostic results if the specified SID is ambiguous, or, if necessary and omitted on the command line.
- `-s`            Suppresses the issue, on the standard output, of the created delta's SID, as well as the number of lines inserted, deleted and unchanged in the SCCS file.
- `-n`            Specifies retention of the edited g-file (normally removed at completion of delta processing).
- `-glist`        Specify a *list* [see `get(1)` for the definition of *list*] of deltas that are to be ignored when the file is accessed at the change level (SID) created by this delta.
- `-m[mrlist]`    If the SCCS file has the `v` flag set [see `admin(1)`] then a Modification Request (MR) number must be supplied as the reason for creating the new delta. If `-m` is not used and the standard input is a terminal, the prompt `MRs?` is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. The `MRs?` prompt always precedes the `comments?` prompt (see `-y` keyletter). MRs in a list are separated by blanks and/or tab characters. An unescaped new-line character terminates the MR list. Note that if the `v` flag has a value [see `admin(1)`], it is taken to be the name of a program (or shell



procedure) that will validate the correctness of the MR numbers. If a non-zero exit status is returned from the MR number validation program, `delta` terminates. (It is assumed that the MR numbers were not all valid.)

- `-y[comment]` Arbitrary text used to describe the reason for making the delta. A null string is considered a valid *comment*. If `-y` is not specified and the standard input is a terminal, the prompt `comments?` is issued on the standard output before the standard input is read; if the standard input is not a terminal, no prompt is issued. An unescaped new-line character terminates the comment text.
- `-p` Causes `delta` to print (on the standard output) the SCCS file differences before and after the delta is applied in a `diff(1)` format.

## FILES

- `g-file` Existed before the execution of `delta`; removed after completion of `delta`.
- `p-file` Existed before the execution of `delta`; may exist after completion of `delta`.
- `q-file` Created during the execution of `delta`; removed after completion of `delta`.
- `x-file` Created during the execution of `delta`; renamed to SCCS file after completion of `delta`.
- `z-file` Created during the execution of `delta`; removed during the execution of `delta`.
- `d-file` Created during the execution of `delta`; removed after completion of `delta`.
- `bdiff` Program to compute differences between the "gotten" file and the `g-file`.

## SEE ALSO

`admin(1)`, `cdc(1)`, `get(1)`, `help(1)`, `prs(1)`, `rmdel(1)`, `sccsfile(4)`, `bdiff(1)` in the *User's Reference Manual*.

## DIAGNOSTICS

Use `help(1)` for explanations.

## NOTES

A `get` of many SCCS files, followed by a `delta` of those files, should be avoided when the `get` generates a large amount of data. Instead, multiple `get/delta` sequences should be used.

If the standard input (`-`) is specified on the `delta` command line, the `-m` (if necessary) and `-y` keyletters must also be present. Omission of these keyletters causes an error.

Comments are limited to text strings of at most 1024 characters. Line lengths greater than 1000 characters cause undefined results.

**NAME**

`dis` - object code disassembler

**SYNOPSIS**

`dis [-o] [-V] [-L] [-s] [-d sec] [-D sec] [-F function] [-t sec] [-l string] file ...`

**DESCRIPTION**

The `dis` command produces an assembly language listing of *file*, which may be an object file or an archive of object files. The listing includes assembly statements and an octal or hexadecimal representation of the binary that produced those statements.

The following *options* are interpreted by the disassembler and may be specified in any order.

- `-d sec` Disassemble the named section as data, printing the offset of the data from the beginning of the section.
- `-D sec` Disassemble the named section as data, printing the actual address of the data.
- `-F function` Disassemble only the named function in each object file specified on the command line. The `-F` option may be specified multiple times on the command line.
- `-L` Lookup source labels for subsequent printing. This option works only if the file was compiled with additional debugging information [e.g., the `-g` option of `cc`].
- `-l string` Disassemble the archive file specified by *string*. For example, one would issue the command `dis -l x -l z` to disassemble `libx.a` and `libz.a`, which are assumed to be in `LIBDIR`.
- `-o` Print numbers in octal. The default is hexadecimal.
- `-s` Perform symbolic disassembly where possible. Symbolic disassembly output will appear on the line following the instruction. Symbol names will be printed using C syntax.
- `-t sec` Disassemble the named section as text.
- `-V` Print, on standard error, the version number of the disassembler being executed.

If the `-d`, `-D` or `-t` options are specified, only those named sections from each user-supplied file name will be disassembled. Otherwise, all sections containing text will be disassembled.

On output, a number enclosed in brackets at the beginning of a line, such as [5], indicates that the break-pointable line number starts with the following instruction. These line numbers will be printed only if the file was compiled with additional debugging information [e.g., the `-g` option of `cc`]. An expression such as `<40>` in the operand field or in the symbolic disassembly, following a relative displacement for control transfer instructions, is the computed address within the section to which control will be transferred. A function name will appear in the first column, followed by `()` if the object file contains a symbol table.

**dis(1)**

**dis(1)**

**FILES**

*LIBDIR* usually */usr/ccs/lib*

**SEE ALSO**

*as(1)*, *cc(1)*, *ld(1)*, *a.out(4)*.

**DIAGNOSTICS**

The self-explanatory diagnostics indicate errors in the command line or problems encountered with the specified files.

**NOTES**

Since the *-da* option did not adhere to the command syntax rules, it has been replaced by *-D*.

At this time, symbolic disassembly does not take advantage of additional information available if the file is compiled with the *-g* option.

**NAME**

`dump` - dump selected parts of an object file

**SYNOPSIS**

`dump [ options ] files`

**DESCRIPTION**

The `dump` command dumps selected parts of each of its object *file* arguments.

This command will accept both object files and archives of object files. It processes each file argument according to one or more of the following options:

- a           Dump the archive header of each member of an archive.
- C           Dump decoded C++ symbol table names.
- c           Dump the string table(s).
- D           Dump debugging information.
- f           Dump each file header.
- g           Dump the global symbols in the symbol table of an archive.
- h           Dump the section headers.
- L           Dump dynamic linking information and static shared library information, if available.
- l           Dump line number information.
- o           Dump each program execution header.
- r           Dump relocation information.
- s           Dump section contents in hexadecimal.
- T *index* or -T *index1, index2*  
Dump only the indexed symbol table entry defined by *index* or a range of entries defined by *index1, index2*.
- t           Dump symbol table entries.
- u           When reading a COFF object file, `dump` translates the file to ELF internally (this translation does not affect the file contents). This option controls how much translation occurs from COFF values to ELF. Normally (without `-u`), the COFF values are preserved as much as possible, showing the actual bytes in the file. If `-u` is used, `dump` updates the values and completes the internal translation, giving a consistent ELF view of the contents. Although the bytes displayed under this option might not match the file itself, they show how the file would look if it were converted to ELF. (See `cof2elf(1)` for more information.)
- V           Print version information.

The following modifiers are used in conjunction with the options listed above to modify their capabilities.

## dump(1)

## dump(1)

**-d** *number* or **-d** *number1, number2*

Dump the section number indicated by *number* or the range of sections starting at *number1* and ending at *number2*. This modifier can be used with **-h**, **-s**, and **-r**. When **-d** is used with **-h** or **-s**, the argument is treated as the number of a section or range of sections. When **-d** is used with **-r**, the argument is treated as the number of the section or range of sections to which the relocation applies. For example, to print out all relocation entries associated with the `.text` section, specify the number of the section as the argument to **-d**. If `.text` is section number 2 in the file, `dump -r -d 2` will print all associated entries. To print out a specific relocation section use `dump -s -n name` for raw data output, or `dump -sv -n name` for interpreted output.

**-n** *name*

Dump information pertaining only to the named entity. This modifier can be used with **-h**, **-s**, **-r**, and **-t**. When **-n** is used with **-h** or **-s**, the argument will be treated as the name of a section. When **-n** is used with **-t** or **-r**, the argument will be treated as the name of a symbol. For example, `dump -t -n .text` will dump the symbol table entry associated with the symbol whose name is `.text`, where `dump -h -n .text` will dump the section header information for the `.text` section.

**-p**

Suppress printing of the headings.

**-v**

Dump information in symbolic representation rather than numeric. This modifier can be used with **-a** (date, user id, group id), **-f** (class, data, type, machine, version, flags), **-h** (type, flags), **-o** (type, flags), **-r** (name, type), **-s** (interpret section contents wherever possible), **-t** (type, bind), and **-L** (value). When **-v** is used with **-s**, all sections that can be interpreted, such as the string table or symbol table, will be interpreted. For example, `dump -sv -n .symtab files` will produce the same formatted output as `dump -tv files`, but `dump -s -n .symtab files` will print raw data in hexadecimal. Without additional modifiers, `dump -sv files` will dump all sections in the files interpreting all those that it can and dumping the rest (such as `.text` or `.data`) as raw data.

The `dump` command attempts to format the information it dumps in a meaningful way, printing certain information in character, hexadecimal, octal or decimal representation as appropriate.

### SEE ALSO

`a.out(4)`, `ar(4)`.

**NAME**

get - get a version of an SCCS file

**SYNOPSIS**

```
get [-aseq-no.] [-ccutoff] [-ilist] [-rSID] [-wstring] [-xlist] [-l[p]] [-b] [-e] [-g]
 [-k] [-m] [-n] [-p] [-s] [-t] file...
```

**DESCRIPTION**

get generates an ASCII text file from each named SCCS file according to the specifications given by its keyletter arguments, which begin with -. The arguments may be specified in any order, but all keyletter arguments apply to all named SCCS files. If a directory is named, get behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of - is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file to be processed.

The generated text is normally written into a file called the g-file whose name is derived from the SCCS file name by simply removing the leading "s." (see also the FILES section below).

Each of the keyletter arguments is explained below as though only one SCCS file is to be processed, but the effects of any keyletter argument apply independently to each named file.

**-rSID** The SCCS identification string (SID) of the version (delta) of an SCCS file to be retrieved. Table 1 below shows, for the most useful cases, what version of an SCCS file is retrieved (as well as the SID of the version to be eventually created by `delta(1)` if the `-e` keyletter is also used), as a function of the SID specified.

**-ccutoff** Cutoff date-time, in the form:

```
YY[MM[DD[HH[MM[SS]]]]]
```

No changes (deltas) to the SCCS file that were created after the specified *cutoff* date-time are included in the generated ASCII text file. Units omitted from the date-time default to their maximum possible values; that is, `-c7502` is equivalent to `-c750228235959`. Any number of non-numeric characters may separate the two-digit pieces of the *cutoff* date-time. This feature allows one to specify a *cutoff* date in the form:

```
-c"77/2/2 9:22:25".
```

**-ilist** A *list* of deltas to be included (forced to be applied) in the creation of the generated file. The *list* has the following syntax:

```
<list> ::= <range> | <list> , <range>
<range> ::= SID | SID - SID
```

SID, the SCCS Identification of a delta, may be in any form shown in the "SID Specified" column of Table 1.

- xlist** A *list* of deltas to be excluded in the creation of the generated file. See the **-i** keyletter for the *list* format.
- e** Indicates that the **get** is for the purpose of editing or making a change (delta) to the SCCS file via a subsequent use of **delta(1)**. The **-e** keyletter used in a **get** for a particular version (SID) of the SCCS file prevents further **gets** for editing on the same SID until **delta** is executed or the **j** (joint edit) flag is set in the SCCS file [see **admin(1)**]. Concurrent use of **get -e** for different SIDs is always allowed.  
  
If the **g**-file generated by **get** with an **-e** keyletter is accidentally ruined in the process of editing it, it may be regenerated by re-executing the **get** command with the **-k** keyletter in place of the **-e** keyletter.  
  
SCCS file protection specified via the ceiling, floor, and authorized user list stored in the SCCS file [see **admin(1)**] are enforced when the **-e** keyletter is used.
- b** Used with the **-e** keyletter to indicate that the new delta should have an SID in a new branch as shown in Table 1. This keyletter is ignored if the **b** flag is not present in the file [see **admin(1)**] or if the retrieved delta is not a leaf delta. (A leaf delta is one that has no successors on the SCCS file tree.) A branch delta may always be created from a non-leaf delta. Partial SIDs are interpreted as shown in the "SID Retrieved" column of Table 1.
- k** Suppresses replacement of identification keywords (see below) in the retrieved text by their value. The **-k** keyletter is implied by the **-e** keyletter.
- l[p]** Causes a delta summary to be written into an **l**-file. If **-lp** is used, then an **l**-file is not created; the delta summary is written on the standard output instead. See IDENTIFICATION KEYWORDS for detailed information on the **l**-file.
- p** Causes the text retrieved from the SCCS file to be written on the standard output. No **g**-file is created. All output that normally goes to the standard output goes to file descriptor 2 instead, unless the **-s** keyletter is used, in which case it disappears.
- s** Suppresses all output normally written on the standard output. However, fatal error messages (which always go to file descriptor 2) remain unaffected.
- m** Causes each text line retrieved from the SCCS file to be preceded by the SID of the delta that inserted the text line in the SCCS file. The format is: SID, followed by a horizontal tab, followed by the text line.
- n** Causes each generated text line to be preceded with the **%M%** identification keyword value (see below). The format is: **%M%** value, followed by a horizontal tab, followed by the text line. When both the **-m** and **-n** keyletters are used, the format is: **%M%**

- value, followed by a horizontal tab, followed by the `-m` keyletter generated format.
- `-g` Suppresses the actual retrieval of text from the SCCS file. It is primarily used to generate an l-file, or to verify the existence of a particular SID.
  - `-t` Used to access the most recently created delta in a given release (e.g., `-r1`), or release and level (e.g., `-r1.2`).
  - `-w string` Substitute *string* for all occurrences of `%W%` when getting the file. Substitution occurs prior to keyword expansion.
  - `-aseq-no.` The delta sequence number of the SCCS file delta (version) to be retrieved. This keyletter is used by the `comb` command; it is not a generally useful keyletter. If both the `-r` and `-a` keyletters are specified, only the `-a` keyletter is used. Care should be taken when using the `-a` keyletter in conjunction with the `-e` keyletter, as the SID of the delta to be created may not be what one expects. The `-r` keyletter can be used with the `-a` and `-e` keyletters to control the naming of the SID of the delta to be created.

For each file processed, `get` responds (on the standard output) with the SID being accessed and with the number of lines retrieved from the SCCS file.

If the `-e` keyletter is used, the SID of the delta to be made appears after the SID accessed and before the number of lines generated. If there is more than one named file or if a directory or standard input is named, each file name is printed (preceded by a new-line) before it is processed. If the `-i` keyletter is used, included deltas are listed following the notation "Included"; if the `-x` keyletter is used, excluded deltas are listed following the notation "Excluded".



TABLE 1. Determination of SCCS Identification String

| SID*<br>Specified | -b Keyletter<br>Used† | Other<br>Conditions                            | SID<br>Retrieved | SID of Delta<br>to be Created |
|-------------------|-----------------------|------------------------------------------------|------------------|-------------------------------|
| none‡             | no                    | R defaults to mR                               | mR.mL            | mR.(mL+1)                     |
| none‡             | yes                   | R defaults to mR                               | mR.mL            | mR.mL.(mB+1).1                |
| R                 | no                    | R > mR                                         | mR.mL            | R.1***                        |
| R                 | no                    | R = mR                                         | mR.mL            | mR.(mL+1)                     |
| R                 | yes                   | R > mR                                         | mR.mL            | mR.mL.(mB+1).1                |
| R                 | yes                   | R = mR                                         | mR.mL            | mR.mL.(mB+1).1                |
| R                 | -                     | R < mR and<br>R does <i>not</i> exist          | hR.mL**          | hR.mL.(mB+1).1                |
| R                 | -                     | Trunk succ.#<br>in release > R<br>and R exists | R.mL             | R.mL.(mB+1).1                 |
| R.L               | no                    | No trunk succ.                                 | R.L              | R.(L+1)                       |
| R.L               | yes                   | No trunk succ.                                 | R.L              | R.L.(mB+1).1                  |
| R.L               | -                     | Trunk succ.<br>in release ≥ R                  | R.L              | R.L.(mB+1).1                  |
| R.L.B             | no                    | No branch succ.                                | R.L.B.mS         | R.L.B.(mS+1)                  |
| R.L.B             | yes                   | No branch succ.                                | R.L.B.mS         | R.L.(mB+1).1                  |
| R.L.B.S           | no                    | No branch succ.                                | R.L.B.S          | R.L.B.(S+1)                   |
| R.L.B.S           | yes                   | No branch succ.                                | R.L.B.S          | R.L.(mB+1).1                  |
| R.L.B.S           | -                     | Branch succ.                                   | R.L.B.S          | R.L.(mB+1).1                  |

\* "R", "L", "B", and "S" are the "release", "level", "branch", and "sequence" components of the SID, respectively; "m" means "maximum". Thus, for example, "R.mL" means "the maximum level number within release R"; "R.L.(mB+1).1" means "the first sequence number on the new branch (i.e., maximum branch number plus one) of level L within release R". Note that if the SID specified is of the form "R.L", "R.L.B", or "R.L.B.S", each of the specified components must exist.

\*\* "hR" is the highest existing release that is lower than the specified, non-existent, release R.

\*\*\* This is used to force creation of the first delta in a new release.

# Successor.

† The -b keyletter is effective only if the b flag [see admin(1)] is present in the file. An entry of - means "irrelevant".

‡ This case applies if the d (default SID) flag is not present in the file. If the d flag is present in the file, then the SID obtained from the d flag is interpreted as if it had been specified on the command line. Thus, one of the other cases in this table applies.

#### IDENTIFICATION KEYWORDS

Identifying information is inserted into the text retrieved from the SCCS file by replacing identification keywords with their value wherever they occur. The following keywords may be used in the text stored in an SCCS file:

| Keyword          | Value                                                                                                                                                                                                                      |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>%M%</code> | Module name: either the value of the <code>m</code> flag in the file [see <code>admin(1)</code> ], or if absent, the name of the SCCS file with the leading <code>s.</code> removed.                                       |
| <code>%I%</code> | SCCS identification (SID) ( <code>%R%.%L%.%B%.%S%</code> ) of the retrieved text.                                                                                                                                          |
| <code>%R%</code> | Release.                                                                                                                                                                                                                   |
| <code>%L%</code> | Level.                                                                                                                                                                                                                     |
| <code>%B%</code> | Branch.                                                                                                                                                                                                                    |
| <code>%S%</code> | Sequence.                                                                                                                                                                                                                  |
| <code>%D%</code> | Current date ( <code>YY/MM/DD</code> ).                                                                                                                                                                                    |
| <code>%H%</code> | Current date ( <code>MM/DD/YY</code> ).                                                                                                                                                                                    |
| <code>%T%</code> | Current time ( <code>HH:MM:SS</code> ).                                                                                                                                                                                    |
| <code>%E%</code> | Date newest applied delta was created ( <code>YY/MM/DD</code> ).                                                                                                                                                           |
| <code>%G%</code> | Date newest applied delta was created ( <code>MM/DD/YY</code> ).                                                                                                                                                           |
| <code>%U%</code> | Time newest applied delta was created ( <code>HH:MM:SS</code> ).                                                                                                                                                           |
| <code>%Y%</code> | Module type: value of the <code>t</code> flag in the SCCS file [see <code>admin(1)</code> ].                                                                                                                               |
| <code>%F%</code> | SCCS file name.                                                                                                                                                                                                            |
| <code>%P%</code> | Fully qualified SCCS file name.                                                                                                                                                                                            |
| <code>%Q%</code> | The value of the <code>q</code> flag in the file [see <code>admin(1)</code> ].                                                                                                                                             |
| <code>%C%</code> | Current line number. This keyword is intended for identifying messages output by the program such as "this should not have happened" type errors. It is not intended to be used on every line to provide sequence numbers. |
| <code>%Z%</code> | The four-character string <code>@(#)</code> recognizable by the <code>what</code> command.                                                                                                                                 |
| <code>%W%</code> | A shorthand notation for constructing <code>what</code> strings for UNIX System program files. <code>%W% = %Z%M%&lt;tab&gt;%I%</code>                                                                                      |
| <code>%A%</code> | Another shorthand notation for constructing <code>what</code> strings for non-UNIX System program files: <code>%A% = %Z%Y% %M% %I%%Z%</code>                                                                               |

Several auxiliary files may be created by `get`. These files are known generically as the `g`-file, `l`-file, `p`-file, and `z`-file. The letter before the hyphen is called the tag. An auxiliary file name is formed from the SCCS file name: the last component of all SCCS file names must be of the form `s.module-name`, the auxiliary files are named by replacing the leading `s.` with the tag. The `g`-file is an exception to this scheme: the `g`-file is named by removing the `s.` prefix. For example, `s.xyz.c`, the auxiliary file names would be `xyz.c`, `l.xyz.c`, `p.xyz.c`, and `z.xyz.c`, respectively.

The `g`-file, which contains the generated text, is created in the current directory (unless the `-p` keyletter is used). A `g`-file is created in all cases, whether or not any lines of text were generated by the `get`. It is owned by the real user. If the `-k` keyletter is used or implied, its mode is 644; otherwise its mode is 444. Only the real user need have write permission in the current directory.

The `l`-file contains a table showing which deltas were applied in generating the retrieved text. The `l`-file is created in the current directory if the `-l` keyletter is used; its mode is 444 and it is owned by the real user. Only the real user need have write permission in the current directory.

Lines in the l-file have the following format:

- a. A blank character if the delta was applied; \* otherwise.
- b. A blank character if the delta was applied or was not applied and ignored; \* if the delta was not applied and was not ignored.
- c. A code indicating a "special" reason why the delta was or was not applied: "I" (included), "X" (excluded), or "C" (cut off by a -c keyletter).
- d. Blank.
- e. SCCS identification (SID).
- f. Tab character.
- g. Date and time (in the form YY/MM/DD HH:MM:SS) of creation.
- h. Blank.
- i. Login name of person who created delta.

The comments and MR data follow on subsequent lines, indented one horizontal tab character. A blank line terminates each entry.

The p-file is used to pass information resulting from a `get` with an `-e` keyletter along to `delta`. Its contents are also used to prevent a subsequent execution of `get` with an `-e` keyletter for the same SID until `delta` is executed or the joint edit flag, `j`, [see `admin(1)`] is set in the SCCS file. The p-file is created in the directory containing the SCCS file and the effective user must have write permission in that directory. Its mode is 644 and it is owned by the effective user. The format of the p-file is: the gotten SID, followed by a blank, followed by the SID that the new delta will have when it is made, followed by a blank, followed by the login name of the real user, followed by a blank, followed by the date-time the `get` was executed, followed by a blank and the `-i` keyletter argument if it was present, followed by a blank and the `-x` keyletter argument if it was present, followed by a new-line. There can be an arbitrary number of lines in the p-file at any time; no two lines can have the same new delta SID.

The z-file serves as a lock-out mechanism against simultaneous updates. Its contents are the binary (2 bytes) process ID of the command (i.e., `get`) that created it. The z-file is created in the directory containing the SCCS file for the duration of `get`. The same protection restrictions as those for the p-file apply for the z-file. The z-file is created with mode 444.

## FILES

|                    |                                                                          |
|--------------------|--------------------------------------------------------------------------|
| g-file             | Created by the execution of <code>get</code> .                           |
| p-file             | [see <code>delta(1)</code> ]                                             |
| q-file             | [see <code>delta(1)</code> ]                                             |
| z-file             | [see <code>delta(1)</code> ]                                             |
| <code>bdiff</code> | Program to compute differences between the "gotten" file and the g-file. |

## SEE ALSO

`admin(1)`, `delta(1)`, `help(1)`, `prs(1)`, `what(1)`.  
`bdiff(1)` in the *User's Reference Manual*.

**get(1)**

**get(1)**

**DIAGNOSTICS**

Use `help(1)` for explanations.

**NOTES**

If the effective user has write permission (either explicitly or implicitly) in the directory containing the SCCS files, but the real user does not, then only one file may be named when the `-e` keyletter is used.

**NAME**

**help** - ask for help with message numbers or SCCS commands

**SYNOPSIS**

**help** [*args*]

**DESCRIPTION**

**help** finds information to explain a message from a command or explain the use of a SCCS command. Zero or more arguments may be supplied. If no arguments are given, **help** will prompt for one.

The arguments may be either information within the parentheses following a message or SCCS command names.

The response of the program will be the explanatory information related to the argument, if there is any.

When all else fails, try "help stuck".

**FILES**

*LIBDIR/help* directory containing files of message text.

*LIBDIR/help/helploc* file containing locations of help files not in *LIBDIR/help*.

*LIBDIR* usually */usr/ccs/lib*

## NAME

install - install commands

## SYNOPSIS

```
/usr/sbin/install [-c dira] [-f dirb] [-i] [-n dirc] [-m mode] [-u user] [-g group]
[-o] [-s] file [dirx ...]
```

## DESCRIPTION

The `install` command is most commonly used in “makefiles” [see `make(1)`] to install a *file* (updated target file) in a specific place within a file system. Each *file* is installed by copying it into the appropriate directory, thereby retaining the mode and owner of the original command. The program prints messages telling the user exactly what files it is replacing or creating and where they are going.

If no options or directories (*dirx* ...) are given, `install` will search a set of default directories (`/usr/usr/bin`, `/usr/usr/usr/bin`, `/etc`, `/usr/usr/lib`, and `/usr/usr/usr/lib`, in that order) for a file with the same name as *file*. When the first occurrence is found, `install` issues a message saying that it is overwriting that file with *file*, and proceeds to do so. If the file is not found, the program states this and exits without further action.

If one or more directories (*dirx* ...) are specified after *file*, those directories will be searched before the directories specified in the default list.

The meanings of the options are:

- c *dira*      Installs a new command (*file*) in the directory specified by *dira*, only if it is not found. If it is found, `install` issues a message saying that the file already exists, and exits without overwriting it. May be used alone or with the `-s` option.
- f *dirb*      Forces *file* to be installed in given directory, whether or not one already exists. If the file being installed does not already exist, the mode and owner of the new file will be set to `755` and `bin`, respectively. If the file already exists, the mode and owner will be that of the already existing file. May be used alone or with the `-o` or `-s` options.
- i            Ignores default directory list, searching only through the given directories (*dirx* ...). May be used alone or with any other options except `-c` and `-f`.
- n *dirc*      If *file* is not found in any of the searched directories, it is put in the directory specified in *dirc*. The mode and owner of the new file will be set to `755` and `bin`, respectively. May be used alone or with any other options except `-c` and `-f`.
- m *mode*      The mode of the new file is set to *mode*.
- u *user*      The owner of the new file is set to *user*.

## install(1M)

## install(1M)

- g** *group*      The group id of the new file is set to *group*. Only available to the superuser.
- o**              If *file* is found, this option saves the “found” file by copying it to *OLDfile* in the directory in which it was found. This option is useful when installing a frequently used file such as */usr/bin/sh* or */usr/lib/saf/ttymon*, where the existing file cannot be removed. May be used alone or with any other options except **-c**.
- s**              Suppresses printing of messages other than error messages. May be used alone or with any other options.

### SEE ALSO

*make(1)*.

**NAME**

ld – link editor for object files

**SYNOPSIS**

ld [*options*] *files* ...

**DESCRIPTION**

The ld command combines relocatable object files, performs relocation, and resolves external symbols. ld operates in two modes, static or dynamic, as governed by the -d option. In static mode, -dn, relocatable object files given as arguments are combined to produce an executable object file; if the -r option is specified, relocatable object files are combined to produce one relocatable object file. In dynamic mode, -dy, the default, relocatable object files given as arguments are combined to produce an executable object file that will be linked at execution with any shared object files given as arguments; if the -G option is specified, relocatable object files are combined to produce a shared object. In all cases, the output of ld is left in a.out by default.

If any argument is a library, it is searched exactly once at the point it is encountered in the argument list. The library may be either a relocatable archive or a shared object. For an archive library, only those routines defining an unresolved external reference are loaded. The archive library symbol table [see ar(4)] is searched sequentially with as many passes as are necessary to resolve external references that can be satisfied by library members. Thus, the ordering of members in the library is functionally unimportant, unless there exist multiple library members defining the same external symbol. A shared object consists of a single entity all of whose references must be resolved within the executable being built or within other shared objects with which it is linked.

The following options are recognized by ld:

- a In static mode only, produce an executable object file; give errors for undefined references. This is the default behavior for static mode. -a may not be used with the -r option.
- b In dynamic mode only, when creating an executable, do not do special processing for relocations that reference symbols in shared objects. Without the -b option, the link editor will create special position-independent relocations for references to functions defined in shared objects and will arrange for data objects defined in shared objects to be copied into the memory image of the executable by the dynamic linker at run time. With the -b option, the output code may be more efficient, but it will be less sharable.
- d[y|n] When -dy, the default, is specified, ld uses dynamic linking; when -dn is specified, ld uses static linking.
- e *epsym* Set the entry point address for the output file to be that of the symbol *epsym*.



**-h *name***

In dynamic mode only, when building a shared object, record *name* in the object's dynamic section. *name* will be recorded in executables that are linked with this object rather than the object's UNIX System file name. Accordingly, *name* will be used by the dynamic linker as the name of the shared object to search for at run time.

**-lx** Search a library *libx.so* or *libx.a*, the conventional names for shared object and archive libraries, respectively. In dynamic mode, unless the **-Bstatic** option is in effect, *ld* searches each directory specified in the library search path for a file *libx.so* or *libx.a*. The directory search stops at the first directory containing either. *ld* chooses the file ending in *.so* if **-lx** expands to two files whose names are of the form *libx.so* and *libx.a*. If no *libx.so* is found, then *ld* accepts *libx.a*. In static mode, or when the **-Bstatic** option is in effect, *ld* selects only the file ending in *.a*. A library is searched when its name is encountered, so the placement of **-l** is significant.

**-m** Produce a memory map or listing of the input/output sections on the standard output.

**-o *outfile***

Produce an output object file named *outfile*. The name of the default object file is *a.out*.

**-r** Combine relocatable object files to produce one relocatable object file. *ld* will not complain about unresolved references. This option cannot be used in dynamic mode or with **-a**.

**-s** Strip symbolic information from the output file. The debug and line sections and their associated relocation entries will be removed. Except for relocatable files or shared objects, the symbol table and string table sections will also be removed from the output object file.

**-t** Turn off the warning about multiply defined symbols that are not the same size.

**-u *symname***

Enter *symname* as an undefined symbol in the symbol table. This is useful for loading entirely from an archive library, since initially the symbol table is empty and an unresolved reference is needed to force the loading of the first routine. The placement of this option on the command line is significant; it must be placed before the library that will define the symbol.

**-z *defs***

Force a fatal error if any undefined symbols remain at the end of the link. This is the default when building an executable. It is also useful when building a shared object to assure that the object is self-contained, that is, that all its symbolic references are resolved internally.

**-z *nodefs***

Allow undefined symbols. This is the default when building a shared object. It may be used when building an executable in dynamic mode and linking with a shared object that has unresolved references in routines not used by that executable. This option should be used with caution.

- z *text***  
In dynamic mode only, force a fatal error if any relocations against non-writable, allocatable sections remain.
- B [*dynamic|static*]**  
Options governing library inclusion. **-Bdynamic** is valid in dynamic mode only. These options may be specified any number of times on the command line as toggles: if the **-Bstatic** option is given, no shared objects will be accepted until **-Bdynamic** is seen. See also the **-l** option.
- Bsymbolic**  
In dynamic mode only, when building a shared object, bind references to global symbols to their definitions within the object, if definitions are available. Normally, references to global symbols within shared objects are not bound until run time, even if definitions are available, so that definitions of the same symbol in an executable or other shared objects can override the object's own definition. **ld** will issue warnings for undefined symbols unless **-z defs** overrides.
- G**  
In dynamic mode only, produce a shared object. Undefined symbols are allowed.
- I *name***  
When building an executable, use *name* as the path name of the interpreter to be written into the program header. The default in static mode is no interpreter; in dynamic mode, the default is the name of the dynamic linker, `/usr/lib/libc.so.1`. Either case may be overridden by **-I.exec** will load this interpreter when it loads the `a.out` and will pass control to the interpreter rather than to the `a.out` directly.
- L *path***  
Add *path* to the library search directories. **ld** searches for libraries first in any directories specified with **-L** options, then in the standard directories. This option is effective only if it precedes the **-l** option on the command line.
- M *mapfile***  
In *static* mode only, read *mapfile* as a text file of directives to **ld**. Because these directives change the shape of the output file created by **ld**, use of this option is strongly discouraged.
- Q[*y|n*]**  
Under **-Qy**, an ident string is added to the `.comment` section of the output file to identify the version of the link editor used to create the file. This will result in multiple **ld** `idents` when there have been multiple linking steps, such as when using **ld -r**. This is identical with the default action of the `cc` command. **-Qn** suppresses version.
- V**  
Output a message giving information about the version of **ld** being used.
- YP, *dirlist***  
Change the default directories used for finding libraries. *dirlist* is a colon-separated path list.

ld(1)

ld(1)

The environment variable `LD_LIBRARY_PATH` may be used to specify library search directories. In the most general case, it will contain two directory lists separated by a semicolon:

*dirlist1;dirlist2*

If `ld` is called with any number of occurrences of `-L`, as in

`ld ... -Lpath1 ...-Lpathn ...`

then the search path ordering is

*dirlist1 path1 ... pathn dirlist2 LIBPATH*

`LD_LIBRARY_PATH` is also used to specify library search directories to the dynamic linker at run time. That is, if `LD_LIBRARY_PATH` exists in the environment, the dynamic linker will search the directories named in it, before its default directory, for shared objects to be linked with the program at execution.

The environment variable `LD_RUN_PATH`, containing a directory list, may also be used to specify library search directories to the dynamic linker. If present and not null, it is passed to the dynamic linker by `ld` via data stored in the output object file.

#### FILES

|                      |                                            |
|----------------------|--------------------------------------------|
| <code>libx.so</code> | libraries                                  |
| <code>libx.a</code>  | libraries                                  |
| <code>a.out</code>   | output file                                |
| <code>LIBPATH</code> | usually <code>/usr/ccs/lib:/usr/lib</code> |

#### SEE ALSO

`as(1)`, `cc(1)`, `exec(2)`, `exit(2)`, `end(3C)`, `a.out(4)`, `ar(4)`.

The "C Compilation System" chapter and the "Mapfile Option" appendix in the *Programmer's Guide: ANSI C and Programming Support Tools*.

#### NOTES

Through its options, the link editor gives users great flexibility; however, those who use the `-M mapfile` option must assume some added responsibilities. Use of this feature is *strongly* discouraged.

**NAME**

ldd – list dynamic dependencies

**SYNOPSIS**

ldd [-d | -r] *file*

**DESCRIPTION**

The `ldd` command lists the path names of all shared objects that would be loaded as a result of executing *file*. If *file* is a valid executable but does not require any shared objects, `ldd` will succeed, producing no output.

`ldd` may also be used to check the compatibility of *file* with the shared objects it uses. It does this by optionally printing warnings for any unresolved symbol references that would occur if *file* were executed. Two options govern this mode of `ldd`:

`-d` Causes `ldd` to check all references to data objects.

`-r` Causes `ldd` to check references to both data objects and functions.

Only one of the above options may be given during any single invocation of `ldd`.

**SEE ALSO**

`cc(1)`, `ld(1)`.

The "C Compilation System" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

**DIAGNOSTICS**

`ldd` prints its record of shared object path names to `stdout`. The optional list of symbol resolution problems are printed to `stderr`. If *file* is not an executable file or cannot be opened for reading, a non-zero exit status is returned.

**NOTES**

`ldd` doesn't list shared objects explicitly attached via `dlopen(3X)`.

`ldd` uses the same algorithm as the dynamic linker to locate shared objects.

**NAME**

lex - generate programs for simple lexical tasks

**SYNOPSIS**

```
lex [-ctvn -V -Q[y|n]] [file]
```

**DESCRIPTION**

The `lex` command generates programs to be used in simple lexical analysis of text.

The input *files* (standard input default) contain strings and expressions to be searched for and C text to be executed when these strings are found.

`lex` generates a file named `lex.yy.c`. When `lex.yy.c` is compiled and linked with the `lex` library, it copies the input to the output except when a string specified in the file is found. When a specified string is found, then the corresponding program text is executed. The actual string matched is left in `yytext`, an external character array. Matching is done in order of the patterns in the *file*. The patterns may contain square brackets to indicate character classes, as in `[abx-z]` to indicate `a`, `b`, `x`, `y`, and `z`; and the operators `*`, `+`, and `?` mean, respectively, any non-negative number of, any positive number of, and either zero or one occurrence of, the previous character or character class. Thus, `[a-zA-Z]+` matches a string of letters. The character `.` is the class of all ASCII characters except new-line. Parentheses for grouping and vertical bar for alternation are also supported. The notation `r{d,e}` in a rule indicates between `d` and `e` instances of regular expression `r`. It has higher precedence than `|`, but lower than `*`, `?`, `+`, and concatenation. The character `^` at the beginning of an expression permits a successful match only immediately after a new-line, and the character `$` at the end of an expression requires a trailing new-line. The character `/` in an expression indicates trailing context; only the part of the expression up to the slash is returned in `yytext`, but the remainder of the expression must follow in the input stream. An operator character may be used as an ordinary symbol if it is within " symbols or preceded by `\`.

Three macros are expected: `input()` to read a character; `unput(c)` to replace a character read; and `output(c)` to place an output character. They are defined in terms of the standard streams, but you can override them. The program generated is named `yylex()`, and the `lex` library contains a `main()` that calls it. The action `REJECT` on the right side of the rule causes this match to be rejected and the next suitable match executed; the function `yyomore()` accumulates additional characters into the same `yytext`; and the function `yyless(n)` pushes back `yylen - n` characters into the input stream. (`yylen` is an external `int` variable giving the length of `yytext`.) The macros `input` and `output` use files `yyin` and `yyout` to read from and write to, defaulted to `stdin` and `stdout`, respectively.

Any line beginning with a blank is assumed to contain only C text and is copied; if it precedes `%%`, it is copied into the external definition area of the `lex.yy.c` file. All rules should follow a `%%`, as in `yacc`. Lines preceding `%%` that begin with a non-blank character define the string on the left to be the remainder of the line; it can be called out later by surrounding it with `{}`. In this section, C code (and preprocessor statements) can also be included between `{` and `}`. Note that curly brackets do not imply parentheses; only string substitution is done.

## EXAMPLE

```

D [0-9]
%{
void
skipcommnts(void)
{
 for(;;)
 {
 while(input()!='*')
 ;
 if(input()=='/')
 return;
 else

 unput(yytext[yytext[0]]);
 }
}
%%
if printf("IF statement\n");
[a-z]+ printf("tag, value %s\n",yytext);
0{D}+ printf("octal number %s\n",yytext);
{D}+ printf("decimal number %s\n",yytext);
"+" printf("unary op\n");
"+" printf("binary op\n");
"\n" /*no action */
"/*" skipcommnts();
%%

```

The external names generated by lex all begin with the prefix yy or YY.

The flags must appear before any files.

- c Indicates C actions and is the default.
- t Causes the lex.yy.c program to be written instead to standard output.
- v Provides a two-line summary of statistics.
- n Will not print out the -v summary.
- V Print out version information on standard error.
- Q[y|n] Print out version information to output file lex.yy.c by using -Qy. The -Qn option does not print out version information and is the default.

Multiple files are treated as a single file. If no files are specified, standard input is used.

Certain default table sizes are too small for some users. The table sizes for the resulting finite state machine can be set in the definitions section:

**lex(1)**

**lex(1)**

%p *n* number of positions is *n* (default 2500)  
%n *n* number of states is *n* (500)  
%e *n* number of parse tree nodes is *n* (1000)  
%a *n* number of transitions is *n* (2000)  
%k *n* number of packed character classes is *n* (2500)  
%o *n* size of output array is *n* (3000)

The use of one or more of the above automatically implies the `-v` option, unless the `-n` option is used.

**SEE ALSO**

yacc(1).

The "lex" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

**NAME**

lint - a C program checker

**SYNOPSIS**

lint [*options*] *files*

**DESCRIPTION**

lint detects features of C program files which are likely to be bugs, non-portable, or wasteful. It also checks type usage more strictly than the compiler. lint issues error and warning messages. Among the things it detects are unreachable statements, loops not entered at the top, automatic variables declared and not used, and logical expressions whose value is constant. lint checks for functions that return values in some places and not in others, functions called with varying numbers or types of arguments, and functions whose values are not used or whose values are used but none returned.

Arguments whose names end with .c are taken to be C source files. Arguments whose names end with .ln are taken to be the result of an earlier invocation of lint with either the -c or the -o option used. The .ln files are analogous to .o (object) files that are produced by the cc(1) command when given a .c file as input. Files with other suffixes are warned about and ignored.

lint takes all the .c, .ln, and llib-1x.ln (specified by -1x) files and processes them in their command line order. By default, lint appends the standard C lint library (llib-1c.ln) to the end of the list of files. When the -c option is used, the .ln and the llib-1x.ln files are ignored. When the -c option is not used, the second pass of lint checks the .ln and the llib-1x.ln list of files for mutual compatibility.

Any number of lint options may be used, in any order, intermixed with file-name arguments. The following options are used to suppress certain kinds of complaints:

- a Suppress complaints about assignments of long values to variables that are not long.
- b Suppress complaints about break statements that cannot be reached.
- h Do not apply heuristic tests that attempt to intuit bugs, improve style, and reduce waste.
- m Suppress complaints about external symbols that could be declared static.
- u Suppress complaints about functions and external variables used and not defined, or defined and not used. (This option is suitable for running lint on a subset of files of a larger program).
- v Suppress complaints about unused arguments in functions.
- x Do not report variables referred to by external declarations but never used.



The following arguments alter lint's behavior:

- I*dir* Search for included header files in the directory *dir* before searching the current directory and/or the standard place.
  - l*x* Include the lint library *llib-lx.ln*. For example, you can include a lint version of the math library *llib-lm.ln* by inserting *-lm* on the command line. This argument does not suppress the default use of *llib-lc.ln*. These lint libraries must be in the assumed directory. This option can be used to reference local lint libraries and is useful in the development of multi-file projects.
  - L*dir* Search for lint libraries in *dir* before searching the standard place.
  - n Do not check compatibility against the standard C lint library.
  - p Attempt to check portability to other dialects of C. Along with stricter checking, this option causes all non-external names to be truncated to eight characters and all external names to be truncated to six characters and one case.
  - s Produce one-line diagnostics only. lint occasionally buffers messages to produce a compound report.
  - k Alter the behavior of /\*LINTED [*message*]\*/ directives. Normally, lint will suppress warning messages for the code following these directives. Instead of suppressing the messages, lint prints an additional message containing the comment inside the directive.
  - y Specify that the file being linted will be treated as if the /\*LINTLIBRARY\*/ directive had been used. A lint library is normally created by using the /\*LINTLIBRARY\*/ directive.
  - F Print pathnames of files. lint normally prints the filename without the path.
  - c Cause lint to produce a .ln file for every .c file on the command line. These .ln files are the product of lint's first pass only, and are not checked for inter-function compatibility.
  - ox Cause lint to create a lint library with the name *llib-lx.ln*. The -c option nullifies any use of the -o option. The lint library produced is the input that is given to lint's second pass. The -o option simply causes this file to be saved in the named lint library. To produce a *llib-lx.ln* without extraneous messages, use of the -x option is suggested. The -v option is useful if the source file(s) for the lint library are just external interfaces.
- Some of the above settings are also available through the use of "lint comments" (see below).
- V Write to standard error the product name and release.
  - w*file* Write a .ln file to *file*, for use by `cf1ow(1)`.

**-Rfile** Write a `.ln` file to *file*, for use by `cxref(1)`.

`lint` recognizes many `cc(1)` command line options, including `-D`, `-U`, `-g`, `-O`, `-Xt`, `-Xa`, and `-Xc`, although `-g` and `-O` are ignored. Unrecognized options are warned about and ignored. The predefined macro `lint` is defined to allow certain questionable code to be altered or removed for `lint`. Thus, the symbol `lint` should be thought of as a reserved word for all code that is planned to be checked by `lint`.

Certain conventional comments in the C source will change the behavior of `lint`:

- `/*ARGSUSEDn*/`  
makes `lint` check only the first *n* arguments for usage; a missing *n* is taken to be 0 (this option acts like the `-v` option for the next function).
- `/*CONSTCOND*/` or `/*CONSTANTCOND*/` or `/*CONSTANTCONDITION*/`  
suppresses complaints about constant operands for the next expression.
- `/*EMPTY*/`  
suppresses complaints about a null statement consequent on an `if` statement. This directive should be placed after the test expression, and before the semicolon. This directive is supplied to support empty `if` statements when a valid `else` statement follows. It suppresses messages on an empty `else` consequent.
- `/*FALLTHRU*/` or `/*FALLTHROUGH*/`  
suppresses complaints about fall through to a `case` or `default` labelled statement. This directive should be placed immediately preceding the label.
- `/*LINTLIBRARY*/`  
at the beginning of a file shuts off complaints about unused functions and function arguments in this file. This is equivalent to using the `-v` and `-x` options.
- `/*LINTED [message]*/`  
suppresses any intra-file warning except those dealing with unused variables or functions. This directive should be placed on the line immediately preceding where the lint warning occurred. The `-k` option alters the way in which `lint` handles this directive. Instead of suppressing messages, `lint` will print an additional message, if any, contained in the comment. This directive is useful in conjunction with the `-s` option for post-lint filtering.
- `/*NOTREACHED*/`  
at appropriate points stops comments about unreachable code. [This comment is typically placed just after calls to functions like `exit(2)`].
- `/*PRINTFLIKEn*/`  
makes `lint` check the first (*n-1*) arguments as usual. The *nth* argument is interpreted as a `printf` format string that is used to check the remaining arguments.

*/\*PROTOLIB*n*\*/*  
 causes `lint` to treat function declaration prototypes as function definitions if *n* is non-zero. This directive can only be used in conjunction with the */\* LINTLIBRARY \*/* directive. If *n* is zero, function prototypes will be treated normally.

*/\*SCANFLIKE*n*\*/*  
 makes `lint` check the first (*n*-1) arguments as usual. The *n*th argument is interpreted as a `scanf` format string that is used to check the remaining arguments.

*/\*VARARGS*n*\*/*  
 suppresses the usual checking for variable numbers of arguments in the following function declaration. The data types of the first *n* arguments are checked; a missing *n* is taken to be 0. The use of the ellipsis terminator (...) in the definition is suggested in new or updated code.

`lint` produces its first output on a per-source-file basis. Complaints regarding included files are collected and printed after all source files have been processed, if `-s` is not specified. Finally, if the `-c` option is not used, information gathered from all input files is collected and checked for consistency. At this point, if it is not clear whether a complaint stems from a given source file or from one of its included files, the source filename will be printed followed by a question mark.

The behavior of the `-c` and the `-o` options allows for incremental use of `lint` on a set of C source files. Generally, one invokes `lint` once for each source file with the `-c` option. Each of these invocations produces a `.ln` file that corresponds to the `.c` file, and prints all messages that are about just that source file. After all the source files have been separately run through `lint`, it is invoked once more (without the `-c` option), listing all the `.ln` files with the needed `-lx` options. This will print all the inter-file inconsistencies. This scheme works well with `make`; it allows `make` to be used to `lint` only the source files that have been modified since the last time the set of source files were `linted`.

## FILES

|                                 |                                                                                                                                                                     |
|---------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>LIBDIR</code>             | the directory where the <code>lint</code> libraries specified by the <code>-lx</code> option must exist                                                             |
| <code>LIBDIR/lint[12]</code>    | first and second passes                                                                                                                                             |
| <code>LIBDIR/llib-1c.ln</code>  | declarations for C Library functions (binary format; source is in <code>LIBDIR/llib-1c</code> )                                                                     |
| <code>LIBPATH/llib-1m.ln</code> | declarations for Math Library functions (binary format; source is in <code>LIBDIR/llib-1m</code> )                                                                  |
| <code>TMPDIR/*lint*</code>      | temporaries                                                                                                                                                         |
| <code>TMPDIR</code>             | usually <code>/var/tmp</code> but can be redefined by setting the environment variable <code>TMPDIR</code> [see <code>tempnam</code> in <code>tempnam(3S)</code> ]. |

**lint(1)**

**lint(1)**

*LIBDIR* usually `/ccs/lib`

*LIBPATH* usually `/usr/ccs/lib:/usr/lib`

**SEE ALSO**

`cc(1)`, `make(1)`.

See the "lint" chapter in the *C Programmer's Guide: ANSI C and Programming Support Tools*.

**NAME**

**lorder** – find ordering relation for an object library

**SYNOPSIS**

**lorder** *file* ...

**DESCRIPTION**

The input is one or more object or library archive *files* [see **ar(1)**]. The standard output is a list of pairs of object file or archive member names; the first file of the pair refers to external identifiers defined in the second. The output may be processed by **tsort(1)** to find an ordering of a library suitable for one-pass access by **ld**. Note that the link editor **ld** is capable of multiple passes over an archive in the portable archive format [see **ar(4)**] and does not require that **lorder** be used when building an archive. The usage of the **lorder** command may, however, allow for a more efficient access of the archive during the link edit process.

The following example builds a new library from existing `.o` files.

```
ar -cr library 'lorder *.o | tsort'
```

**FILES**

`TMPDIR/*symref` temporary files

`TMPDIR/*symdef` temporary files

`TMPDIR` usually `/var/tmp` but can be redefined by setting the environment variable `TMPDIR` [see **tempnam()** in **tempnam(3S)**].

**SEE ALSO**

**ar(1)**, **ld(1)**, **tsort(1)**, **tempnam(3S)**, **tmpname(3S)**, **ar(4)**.

**NOTES**

**lorder** will accept as input any object or archive file, regardless of its suffix, provided there is more than one input file. If there is but a single input file, its suffix must be `.o`.

**NAME**

**lprof** - display line-by-line execution count profile data

**SYNOPSIS**

**lprof** [-p] [-s] [-x] [-I *inmdir*] [-r *srcfile*] [-c *cntfile*] [-o *prog*] [-V]

**lprof** -m *file1.cnt file2.cnt filen.cnt* [-T] -d *destfile.cnt*

**DESCRIPTION**

**lprof** reports the execution characteristics of a program on a (source) line by line basis. This is useful as a means to determine which and how often portions of the code were executed.

**lprof** interprets a profile file (*prog.cnt* by default) produced by the profiled program *prog* (a.out by default). *prog* creates a profile file if it has been loaded with the **-ql** option of **cc**. The profile information is computed for functions in a source file if the **-ql** option was used when the source file was compiled.

A shared object may also be profiled by specifying **-ql** when the shared object is created. When a dynamically linked executable is run, one profile file is produced for each profiled shared object linked to the executable. This feature is useful in building a single report covering multiple and disparate executions of a common library. For example, if programs *prog1* and *prog2* both use library *libx.a*, running these profiled programs will produce two profile files, *prog1.cnt* and *prog2.cnt*, which cannot be combined. However, if *libx* is built as a profiled shared object, *libx.so*, and *prog1* and *prog2* are built as profiled dynamically linked executables, then running these programs with the merge option will produce three profile files; one of them, *libx.so.cnt*, will contain the *libx* profile information from both runs.

By default, **lprof** prints a listing of source files (the names of which are stored in the symbol table of the executable file), with each line preceded by its line number (in the source file) and the number of times the line was executed.

The following options may appear singly or be combined in any order:

- p** Print listing, each line preceded by the line number and the number of times it was executed (default). This option can be used together with the **-s** option to print both the source listing and summary information.
- s** Print summary information of percentage of lines of code executed per function.
- x** Instead of printing the execution count numbers for each line, print each line preceded by its line number and a [U] if the line was not executed. If the line was executed, print only the line number.
- I *inmdir*** Look for source or header files in the directory *inmdir* in addition to the current directory and the standard place for `#include` files (usually `/usr/include`). The user can specify more than one directory by using multiple **-I** options.
- r *srcfile*** Instead of printing all source files, print only those files named in **-r** options (to be used with the **-p** option only). The user can specify multiple files with a single **-r** option.

- c *cntfile* Use the file *cntfile* instead of *prog.cnt* as the input profile file.
- o *prog* Use the name of the program *prog* instead of the name used when creating the profile file. Because the program name stored in the profile file contains the relative path, this option is necessary if the executable file or profile file has been moved.
- v Print, on standard error, the version number of *lprof*.

### Merging Data Files

*lprof* can also be used to merge profile files. The *-m* option must be accompanied by the *-d* option:

- m *file1.cnt file2.cnt fileN.cnt -d destfile.cnt*  
Merge the data files *file1.cnt* through *fileN.cnt* by summing the execution counts per line, so that data from several runs can be accumulated. The result is written to *destfile.cnt*. The data files must contain profiling data for the same *prog* (see the *-T* option below).
- T Time stamp override. Normally, the time stamps of the executable files being profiled are checked, and data files will not be merged if the time stamps do not match. If *-T* is specified, this check is skipped.

### CONTROLLING THE RUN-TIME PROFILING ENVIRONMENT

The environment variable *PROFOPTS* provides run-time control over profiling. When a profiled program (or shared object) is about to terminate, it examines the value of *PROFOPTS* to determine how the profiling data are to be handled. A terminating shared object will honor every *PROFOPTS* option except *file=filename*.

The environment variable *PROFOPTS* is a comma-separated list of options interpreted by the program being profiled. If *PROFOPTS* is not defined in the environment, then the default action is taken: The profiling data are saved in a file (with the default name, *prog.cnt*) in the current directory. If *PROFOPTS* is set to the null string, no profiling data are saved. The following are the available options:

- msg={y|n}* If *msg=y* is specified, a message stating that profile data are being saved is printed to *stderr*. If *msg=n* is specified, only the profiling error messages are printed. The default is *msg=y*.
- merge={y|n}*  
If *merge=y* is specified, the data files will be merged after successive runs. If *merge=n* is specified, the data files are not merged after successive runs, and the data file is overwritten after each execution. The merge will fail if the program has been recompiled, and the data file will be left in *TMPDIR*. The default is *merge=n*.
- pid={y|n}* If *pid=y* is specified, the name of the data file will include the process ID of the profiled program. Inclusion of the process ID allows for the creation of different data files for programs calling *fork*. If *pid=n* is specified, the default name is used. The default is *pid=n*. For *lprof* to generate its profiling report, the *-c* option must be specified with *lprof* otherwise the default will fail.

*dir=dirname*

The data file is placed in the directory *dirname* if this option is specified. Otherwise, the data file is created in the directory that is current at the end of execution.

*file=filename*

*filename* is used as the name of the data file in *dir* created by the profiled program if this option is specified. Otherwise, the default name is used. For `lprof` to generate its profiling report, the `-c` option must be specified with `lprof` if the file option has been used at execution time; otherwise the default will fail.

## FILES

*prog.cnt* profile data  
*TMPDIR* usually `/var/tmp` but can be redefined by setting the environment variable `TMPDIR` [see `tempnam` in `tempnam(3S)`].

## SEE ALSO

`cc(1)`, `prof(1)`, `fork(2)`, `tempnam(3S)`.

The "lprof" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

## NOTES

For the `-m` option, if *destfile.cnt* exists, its previous contents are destroyed.

Optimized code cannot be profiled; if both optimization and line profiling are requested, profiling has precedence.

Different parts of one line of a source file may be executed different numbers of times (e.g., the `for` loop below); the count corresponds to the first part of the line.

For example, in the following `for` loop

```

 main()
1 [2] {
 int j;
1 [5] for (j = 0; j < 5; j++)
5 [6] sub(j);
1 [8] }

 sub(a)
 int a;
5 [12] {
5 [13] printf("a is %d\n", a);
5 [14] }
```

line 5 consists of three parts. The line count listed, however, is for the initialization part, that is, `j = 0`.



**NAME**

m4 – macro processor

**SYNOPSIS**

m4 [*options*] [*files*]

**DESCRIPTION**

The m4 command is a macro processor intended as a front end for C, assembler, and other languages. Each of the argument files is processed in order; if there are no files, or if a file name is -, the standard input is read. The processed text is written on the standard output.

The options and their effects are as follows:

- e Operate interactively. Interrupts are ignored and the output is unbuffered.
- s Enable line sync output for the C preprocessor (#line ...)
- B*int* Change the size of the push-back and argument collection buffers from the default of 4,096.
- H*int* Change the size of the symbol table hash array from the default of 199. The size should be prime.
- S*int* Change the size of the call stack from the default of 100 slots. Macros take three slots, and non-macro arguments take one.
- T*int* Change the size of the token buffer from the default of 512 bytes.

To be effective, the above flags must appear before any file names and before any -D or -U flags:

-D*name*[=*val*]

Defines *name* to *val* or to null in *val*'s absence.

-U*name*

undefines *name*.

Macro calls have the form:

*name*(*arg1*,*arg2*, ..., *argn*)

The ( must immediately follow the name of the macro. If the name of a defined macro is not followed by a (, it is deemed to be a call of that macro with no arguments. Potential macro names consist of alphanumeric characters and underscore (\_), where the first character is not a digit.

Leading unquoted blanks, tabs, and new-lines are ignored while collecting arguments. Left and right single quotes are used to quote strings. The value of a quoted string is the string stripped of the quotes.

When a macro name is recognized, its arguments are collected by searching for a matching right parenthesis. If fewer arguments are supplied than are in the macro definition, the trailing arguments are taken to be null. Macro evaluation proceeds normally during the collection of the arguments, and any commas or right parentheses that happen to turn up within the value of a nested call are as effective as those in the original input text. After argument collection, the value of the macro is pushed back onto the input stream and rescanned.

m4 makes available the following built-in macros. These macros may be redefined, but once this is done the original meaning is lost. Their values are null unless otherwise stated.

|                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|--------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>define</b>      | the second argument is installed as the value of the macro whose name is the first argument. Each occurrence of $\$n$ in the replacement text, where $n$ is a digit, is replaced by the $n$ -th argument. Argument 0 is the name of the macro; missing arguments are replaced by the null string; $\#\$ is replaced by the number of arguments; $\$*$ is replaced by a list of all the arguments separated by commas; $\$@$ is like $\$*$ , but each argument is quoted (with the current quotes). |
| <b>undefine</b>    | removes the definition of the macro named in its argument.                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>defn</b>        | returns the quoted definition of its argument(s). It is useful for renaming macros, especially built-ins.                                                                                                                                                                                                                                                                                                                                                                                          |
| <b>pushdef</b>     | like <b>define</b> , but saves any previous definition.                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>popdef</b>      | removes current definition of its argument(s), exposing the previous one, if any.                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>ifdef</b>       | if the first argument is defined, the value is the second argument, otherwise the third. If there is no third argument, the value is null. The word <code>unix</code> is predefined.                                                                                                                                                                                                                                                                                                               |
| <b>shift</b>       | returns all but its first argument. The other arguments are quoted and pushed back with commas in between. The quoting nullifies the effect of the extra scan that will subsequently be performed.                                                                                                                                                                                                                                                                                                 |
| <b>changequote</b> | change quote symbols to the first and second arguments. The symbols may be up to five characters long. <b>changequote</b> without arguments restores the original values (i.e., <code>`</code> and <code>'</code> ).                                                                                                                                                                                                                                                                               |
| <b>changecom</b>   | change left and right comment markers from the default <code>#</code> and new-line. With no arguments, the comment mechanism is effectively disabled. With one argument, the left marker becomes the argument and the right marker becomes new-line. With two arguments, both markers are affected. Comment markers may be up to five characters long.                                                                                                                                             |
| <b>divert</b>      | m4 maintains 10 output streams, numbered 0-9. The final output is the concatenation of the streams in numerical order; initially stream 0 is the current stream. The <b>divert</b> macro changes the current output stream to its (digit-string) argument. Output diverted to a stream other than 0 through 9 is discarded.                                                                                                                                                                        |
| <b>undivert</b>    | causes immediate output of text from diversions named as arguments, or all diversions if no argument. Text may be undiverted into another diversion. Undiverting discards the diverted text.                                                                                                                                                                                                                                                                                                       |

|                       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>divnum</code>   | returns the value of the current output stream.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <code>dnl</code>      | reads and discards characters up to and including the next new-line.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <code>ifelse</code>   | has three or more arguments. If the first argument is the same string as the second, then the value is the third argument. If not, and if there are more than four arguments, the process is repeated with arguments 4, 5, 6 and 7. Otherwise, the value is either the fourth string, or, if it is not present, null.                                                                                                                                                                                                                                |
| <code>incr</code>     | returns the value of its argument incremented by 1. The value of the argument is calculated by interpreting an initial digit-string as a decimal number.                                                                                                                                                                                                                                                                                                                                                                                             |
| <code>decr</code>     | returns the value of its argument decremented by 1.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <code>eval</code>     | evaluates its argument as an arithmetic expression, using 32-bit arithmetic. Operators include <code>+</code> , <code>-</code> , <code>*</code> , <code>/</code> , <code>%</code> , <code>**</code> (exponentiation), bitwise <code>&amp;</code> , <code> </code> , <code>^</code> , and <code>~</code> ; relationals; parentheses. Octal and hex numbers may be specified as in C. The second argument specifies the radix for the result; the default is 10. The third argument may be used to specify the minimum number of digits in the result. |
| <code>len</code>      | returns the number of characters in its argument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <code>index</code>    | returns the position in its first argument where the second argument begins (zero origin), or <code>-1</code> if the second argument does not occur.                                                                                                                                                                                                                                                                                                                                                                                                 |
| <code>substr</code>   | returns a substring of its first argument. The second argument is a zero origin number selecting the first character; the third argument indicates the length of the substring. A missing third argument is taken to be large enough to extend to the end of the first string.                                                                                                                                                                                                                                                                       |
| <code>translit</code> | transliterates the characters in its first argument from the set given by the second argument to the set given by the third. No abbreviations are permitted.                                                                                                                                                                                                                                                                                                                                                                                         |
| <code>include</code>  | returns the contents of the file named in the argument.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <code>sinclude</code> | is identical to <code>include</code> , except that it says nothing if the file is inaccessible.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <code>syscmd</code>   | executes the UNIX System command given in the first argument. No value is returned.                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <code>sysval</code>   | is the return code from the last call to <code>syscmd</code> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| <code>maketemp</code> | fills in a string of <code>XXXXX</code> in its argument with the current process ID.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| <code>m4exit</code>   | causes immediate exit from <code>m4</code> . Argument 1, if given, is the exit code; the default is 0.                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| <code>m4wrap</code>   | argument 1 will be pushed back at final EOF; example:<br><code>m4wrap(`cleanup`)</code>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

- errprint**      prints its argument on the diagnostic output file.
- dumpdef**      prints current names and definitions, for the named items, or for all if no arguments are given.
- traceon**      with no arguments, turns on tracing for all macros (including built-ins). Otherwise, turns on tracing for named macros.
- traceoff**     turns off trace globally and for any macros specified. Macros specifically traced by **traceon** can be untraced only by specific calls to **traceoff**.

**SEE ALSO**

**as(1), cc(1).**

**NAME**

**make** – maintain, update, and regenerate groups of programs

**SYNOPSIS**

**make** [-f *makefile*] [-eiknpqrst] [*names*]

**DESCRIPTION**

**make** allows the programmer to maintain, update, and regenerate groups of computer programs. **make** executes commands in *makefile* to update one or more target *names* (*names* are typically programs). If the -f option is not present, then *makefile*, *Makefile*, and the Source Code Control System (SCCS) files *s.makefile*, and *s.Makefile* are tried in order. If *makefile* is -, the standard input is taken. More than one -f *makefile* argument pair may appear.

**make** updates a target only if its dependents are newer than the target. All prerequisite files of a target are added recursively to the list of targets. Missing files are deemed to be outdated.

The following list of four directives can be included in *makefile* to extend the options provided by **make**. They are used in *makefile* as if they were targets:

- .DEFAULT:** If a file must be made but there are no explicit commands or relevant built-in rules, the commands associated with the name **.DEFAULT** are used if it exists.
- .IGNORE:** Same effect as the -i option.
- .PRECIOUS:** Dependents of the **.PRECIOUS** entry will not be removed when quit or interrupt are hit.
- .SILENT:** Same effect as the -s option.

The options for **make** are listed below:

- e Environment variables override assignments within makefiles.
- f *makefile* Description filename (*makefile* is assumed to be the name of a description file).
- i Ignore error codes returned by invoked commands.
- k Abandon work on the current entry if it fails, but continue on other branches that do not depend on that entry.
- n No execute mode. Print commands, but do not execute them. Even command lines beginning with an @ are printed.
- p Print out the complete set of macro definitions and target descriptions.
- q Question. **make** returns a zero or non-zero status code depending on whether or not the target file has been updated.
- r Do not use the built-in rules.
- s Silent mode. Do not print command lines before executing.
- t Touch the target files (causing them to be updated) rather than issue the usual commands.

### Creating the makefile

The makefile invoked with the `-f` option is a carefully structured file of explicit instructions for updating and regenerating programs, and contains a sequence of entries that specify dependencies. The first line of an entry is a blank-separated, non-null list of targets, then a `:`, then a (possibly null) list of prerequisite files or dependencies. Text following a `;` and all following lines that begin with a tab are shell commands to be executed to update the target. The first non-empty line that does not begin with a tab or `#` begins a new dependency or macro definition. Shell commands may be continued across lines with a backslash-new-line (`\ new-line`) sequence. Everything printed by make (except the initial tab) is passed directly to the shell as is. Thus,

```
 echo a\
 b
```

will produce

```
 ab
```

exactly the same as the shell would.

Sharp (`#`) and new-line surround comments including contained `\ new-line` sequences.

The following makefile says that `pgm` depends on two files `a.o` and `b.o`, and that they in turn depend on their corresponding source files (`a.c` and `b.c`) and a common file `incl.h`:

```
pgm: a.o b.o
 cc a.o b.o -o pgm
a.o: incl.h a.c
 cc -c a.c
b.o: incl.h b.c
 cc -c b.c
```

Command lines are executed one at a time, each by its own shell. The `SHELL` environment variable can be used to specify which shell `make` should use to execute commands. The default is `/usr/bin/sh`. The first one or two characters in a command can be the following: `@`, `-`, `@-`, or `-@`. If `@` is present, printing of the command is suppressed. If `-` is present, `make` ignores an error. A line is printed when it is executed unless the `-s` option is present, or the entry `.SILENT:` is included in *makefile*, or unless the initial character sequence contains a `@`. The `-n` option specifies printing without execution; however, if the command line has the string `$(MAKE)` in it, the line is always executed (see the discussion of the `MAKEFLAGS` macro in the "Environment" section below). The `-t` (touch) option updates the modified date of a file without executing any commands.

Commands returning non-zero status normally terminate `make`. If the `-i` option is present, if the entry `.IGNORE:` is included in *makefile*, or if the initial character sequence of the command contains `-`, the error is ignored. If the `-k` option is present, work is abandoned on the current entry, but continues on other branches that do not depend on that entry.

Interrupt and quit cause the target to be deleted unless the target is a dependent of the directive `.PRECIOUS`.

### Environment

The environment is read by `make`. All variables are assumed to be macro definitions and are processed as such. The environment variables are processed before any makefile and after the internal rules; thus, macro assignments in a makefile override environment variables. The `-e` option causes the environment to override the macro assignments in a makefile. Suffixes and their associated rules in the makefile will override any identical suffixes in the built-in rules.

The `MAKEFLAGS` environment variable is processed by `make` as containing any legal input option (except `-f` and `-p`) defined for the command line. Further, upon invocation, `make` "invents" the variable if it is not in the environment, puts the current options into it, and passes it on to invocations of commands. Thus, `MAKEFLAGS` always contains the current input options. This feature proves very useful for "super-makes". In fact, as noted above, when the `-n` option is used, the command `$(MAKE)` is executed anyway; hence, one can perform a `make -n` recursively on a whole software system to see what would have been executed. This result is possible because the `-n` is put in `MAKEFLAGS` and passed to further invocations of `$(MAKE)`. This usage is one way of debugging all of the makefiles for a software project without actually doing anything.

### Include Files

If the string `include` appears as the first seven letters of a line in a *makefile*, and is followed by a blank or a tab, the rest of the line is assumed to be a filename and will be read by the current invocation, after substituting for any macros.

### Macros

Entries of the form `string1 = string2` are macro definitions. `string2` is defined as all characters up to a comment character or an unescaped new-line. Subsequent appearances of `$(string1[:subst1=[subst2]])` are replaced by `string2`. The parentheses are optional if a single-character macro name is used and there is no substitute sequence. The optional `:subst1=subst2` is a substitute sequence. If it is specified, all non-overlapping occurrences of `subst1` in the named macro are replaced by `subst2`. Strings (for the purposes of this type of substitution) are delimited by blanks, tabs, new-line characters, and beginnings of lines. An example of the use of the substitute sequence is shown in the "Libraries" section below.

### Internal Macros

There are five internally maintained macros that are useful for writing rules for building targets.

- `$$` The macro `$$` stands for the filename part of the current dependent with the suffix deleted. It is evaluated only for inference rules.
- `$$@` The `$$@` macro stands for the full target name of the current target. It is evaluated only for explicitly named dependencies.
- `$$<` The `$$<` macro is only evaluated for inference rules or the `.DEFAULT` rule. It is the module that is outdated with respect to the target (the "manufactured" dependent file name). Thus, in the `.c.o` rule, the `$$<` macro would evaluate to the `.c` file. An example for making optimized `.o` files from `.c` files is:

```

.c.o:
 cc -c -O $*.c
or:
.c.o:
 cc -c -O $<

```

- \$? The \$? macro is evaluated when explicit rules from the makefile are evaluated. It is the list of prerequisites that are outdated with respect to the target, and essentially those modules that must be rebuilt.
- \$\$ The \$\$ macro is only evaluated when the target is an archive library member of the form lib(file.o). In this case, \$@ evaluates to lib and \$\$ evaluates to the library member, file.o.

Four of the five macros can have alternative forms. When an upper case D or F is appended to any of the four macros, the meaning is changed to "directory part" for D and "file part" for F. Thus, \$(@D) refers to the directory part of the string \$@. If there is no directory part, ./ is generated. The only macro excluded from this alternative form is \$?.

### Suffixes

Certain names (for instance, those ending with .o) have inferable prerequisites such as .c, .s, etc. If no update commands for such a file appear in *makefile*, and if an inferable prerequisite exists, that prerequisite is compiled to make the target. In this case, make has inference rules that allow building files from other files by examining the suffixes and determining an appropriate inference rule to use. The current default inference rules are:

```

.c .c~ .f .f~ .s .s~ .sh .sh~ .C .C~
.c.a .c.o .c~.a .c~.c .c~.o .f.a .f.o .f~.a .f~.f .f~.o
.h~.h .l.c .l.o .l~.c .l~.l .l~.o .s.a .s.o .s~.a .s~.o
.s~.s .sh~.sh .y.c .y.o .y~.c .y~.o .y~.y .C.a .C.o .C~.a
.C~.C .C~.o .L.C .L.o .L~.C .L~.L .L~.o .Y.C .Y.o .Y~.C
.Y~.o .Y~.Y

```

The internal rules for make are contained in the source file *rules.c* for the make program. These rules can be locally modified. To print out the rules compiled into the make on any machine in a form suitable for recompilation, the following command is used:

```
make -pf - 2>/dev/null </dev/null
```

A tilde in the above rules refers to an SCCS file [see *sccsfile(4)*]. Thus, the rule *.c~.o* would transform an SCCS C source file into an object file (.o). Because the *s.* of the SCCS files is a prefix, it is incompatible with the make suffix point of view. Hence, the tilde is a way of changing any file reference into an SCCS file reference.

A rule with only one suffix (for example, *.c:*) is the definition of how to build *x* from *x.c*. In effect, the other suffix is null. This feature is useful for building targets from only one source file, for example, shell procedures and simple C programs.



Additional suffixes are given as the dependency list for `.SUFFIXES`. Order is significant: the first possible name for which both a file and a rule exist is inferred as a prerequisite. The default list is:

```
.SUFFIXES: .o .c .c~ .y .y~ .l .l~ .s .s~ .sh .sh~ .h .h~ .f .f~ .C
.C~ .Y .Y~ .L .L~
```

Here again, the above command for printing the internal rules will display the list of suffixes implemented on the current machine. Multiple suffix lists accumulate; `.SUFFIXES:` with no dependencies clears the list of suffixes.

### Inference Rules

The first example can be done more briefly.

```
pgm: a.o b.o
 cc a.o b.o -o pgm
a.o b.o: incl.h
```

This abbreviation is possible because `make` has a set of internal rules for building files. The user may add rules to this list by simply putting them in the *makefile*.

Certain macros are used by the default inference rules to permit the inclusion of optional matter in any resulting commands. For example, `CFLAGS`, `LFLAGS`, and `YFLAGS` are used for compiler options to `cc(1)`, `lex(1)`, and `yacc(1)`, respectively. Again, the previous method for examining the current rules is recommended.

The inference of prerequisites can be controlled. The rule to create a file with suffix `.o` from a file with suffix `.c` is specified as an entry with `.c.o`: as the target and no dependents. Shell commands associated with the target define the rule for making a `.o` file from a `.c` file. Any target that has no slashes in it and starts with a dot is identified as a rule and not a true target.

### Libraries

If a target or dependency name contains parentheses, it is assumed to be an archive library, the string within parentheses referring to a member within the library. Thus, `lib(file.o)` and `$(LIB)(file.o)` both refer to an archive library that contains `file.o`. (This example assumes the `LIB` macro has been previously defined.) The expression `$(LIB)(file1.o file2.o)` is not legal. Rules pertaining to archive libraries have the form `.XX.a` where the `XX` is the suffix from which the archive member is to be made. An unfortunate by-product of the current implementation requires the `XX` to be different from the suffix of the archive member. Thus, one cannot have `lib(file.o)` depend upon `file.o` explicitly. The most common use of the archive interface follows. Here, we assume the source files are all C type source:

```
lib: lib(file1.o) lib(file2.o) lib(file3.o)
 @echo lib is now up-to-date
.c.a:
 $(CC) -c $(CFLAGS) $<
 $(AR) $(ARFLAGS) $@ $*.o
 rm -f $*.o
```

In fact, the .c.a rule listed above is built into make and is unnecessary in this example. A more interesting, but more limited example of an archive library maintenance construction follows:

```
lib: lib(file1.o) lib(file2.o) lib(file3.o)
 $(CC) -c $(CFLAGS) $(?:.o=.c)
 $(AR) $(ARFLAGS) lib $?
 rm $?
 @echo lib is now up-to-date
.c.a:;
```

Here the substitution mode of the macro expansions is used. The \$? list is defined to be the set of object filenames (inside lib) whose C source files are outdated. The substitution mode translates the .o to .c. (Unfortunately, one cannot as yet transform to .c~; however, this transformation may become possible in the future.) Also note the disabling of the .c.a: rule, which would have created each object file, one by one. This particular construct speeds up archive library maintenance considerably. This type of construct becomes very cumbersome if the archive library contains a mix of assembly programs and C programs.

**FILES**

[Mm]akefile and s.[Mm]akefile  
/usr/bin/sh

**SEE ALSO**

cc(1), lex(1), yacc(1), printf(3S), sccsfile(4).  
cd(1), sh(1) in the *User's Reference Manual*.

See the "make" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

**NOTES**

Some commands return non-zero status inappropriately; use -i or the - command line prefix to overcome the difficulty.

Filenames with the characters = : @ will not work. Commands that are directly executed by the shell, notably cd(1), are ineffectual across new-lines in make. The syntax lib(file1.o file2.o file3.o) is illegal. You cannot build lib(file.o) from file.o.

**NAME**

**mcs** – manipulate the comment section of an object file.

**SYNOPSIS**

**mcs** [-a *string*] [-c] [-d] [-n *name*] [-p] [-V] *file* ...

**DESCRIPTION**

The **mcs** command is used to manipulate a section, by default the `.comment` section, in an ELF object file. It is used to add to, delete, print, and compress the contents of a section in an ELF object file, and only print the contents of a section in a COFF object file. **mcs** must be given one or more of the options described below. It applies each of the options in order to each file.

The following options are available.

- a *string*  
Append *string* to the comment section of the ELF object files. If *string* contains embedded blanks, it must be enclosed in quotation marks.
- c  
Compress the contents of the comment section of the ELF object files. All duplicate entries are removed. The ordering of the remaining entries is not disturbed.
- d  
Delete the contents of the comment section from the ELF object files. The section header for the comment section is also removed.
- n *name*  
Specify the name of the comment section to access if other than `.comment`. By default, **mcs** deals with the section named `.comment`. This option can be used to specify another section.
- p  
Print the contents of the comment section on the standard output. Each section printed is tagged by the name of the file from which it was extracted, using the format *filename*[*member\_name*]: for archive files; and *filename*: for other files.
- V  
Print, on standard error, the version number of **mcs**.

If the input file is an archive [see `ar(4)`], the archive is treated as a set of individual files. For example, if the `-a` option is specified, the string is appended to the comment section of each ELF object file in the archive; if the archive member is not an ELF object file, then it is left unchanged.

If **mcs** is executed on an archive file the archive symbol table will be removed, unless only the `-p` option has been specified. The archive symbol table must be restored by executing the `ar` command with the `-s` option before the archive can be linked by the `ld` command. **mcs** will produce appropriate warning messages when this situation arises.

**EXAMPLES**

```
mcs -p file # Print file's comment section
mcs -a string file # Append string to file's comment section
```

**mcs(1)**

**mcs(1)**

**FILES**

*TMPDIR/mcs\** temporary files  
*TMPDIR* usually */var/tmp* but can be redefined by setting the environment variable *TMPDIR* [see *tmpnam()* in *tmpnam(3S)*].

**SEE ALSO**

*ar(1)*, *as(1)*, *cc(1)*, *ld(1)*, *tmpnam(3S)*, *a.out(4)*, *ar(4)*.  
See the "Object Files" chapter in *Programmer's Guide: ANSI C and Programming Support Tools*.

**NOTES**

*mcs* cannot add to, delete or compress the contents of a section that is contained within a segment.

**NAME**

nm - print name list of an object file

**SYNOPSIS**

nm [ -oxhvnfurplVT ] files

**DESCRIPTION**

The nm command displays the symbol table of each ELF or COFF object file, specified by *file(s)*. The file may be a relocatable or absolute ELF or COFF object file; or it may be an archive of relocatable or absolute ELF or COFF object files. For each symbol, the following information will be printed:

|              |                                                                                                                                                                                                                                                                                                                                                                                                  |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Index</b> | The index of the symbol. (The index appears in brackets.)                                                                                                                                                                                                                                                                                                                                        |
| <b>Value</b> | The value of the symbol is one of the following: a section offset for defined symbols in a relocatable file; alignment constraints for symbols whose section index is <code>SHN_COMMON</code> ; a virtual address in executable and dynamic library files.                                                                                                                                       |
| <b>Size</b>  | The size in bytes of the associated object.                                                                                                                                                                                                                                                                                                                                                      |
| <b>Type</b>  | A symbol is of one of the following types: <code>NOTYPE</code> (no type was specified), <code>OBJECT</code> (a data object such as an array or variable), <code>FUNC</code> (a function or other executable code), <code>SECTION</code> (a section symbol), or <code>FILE</code> (name of the source file).                                                                                      |
| <b>Bind</b>  | The symbol's binding attributes. <code>LOCAL</code> symbols have a scope limited to the object file containing their definition; <code>GLOBAL</code> symbols are visible to all object files being combined; and <code>WEAK</code> symbols are essentially global symbols with a lower precedence than <code>GLOBAL</code> .                                                                     |
| <b>Other</b> | A field reserved for future use, currently containing 0.                                                                                                                                                                                                                                                                                                                                         |
| <b>Shndx</b> | Except for three special values, this is the section header table index in relation to which the symbol is defined. The following special values exist: <code>ABS</code> indicates the symbol's value will not change through relocation; <code>COMMON</code> indicates an unallocated block and the value provides alignment constraints; and <code>UNDEF</code> indicates an undefined symbol. |
| <b>Name</b>  | The name of the symbol.                                                                                                                                                                                                                                                                                                                                                                          |

The output of nm may be controlled using the following options:

- o Print the value and size of a symbol in octal instead of decimal.
- x Print the value and size of a symbol in hexadecimal instead of decimal.
- h Do not display the output heading data.
- v Sort external symbols by value before they are printed.
- n Sort external symbols by name before they are printed.
- e See NOTES below.
- f See NOTES below.
- u Print undefined symbols only.

- r       Prepend the name of the object file or archive to each output line.
- p       Produce easily parsable, terse output. Each symbol name is preceded by its value (blanks if undefined) and one of the letters U (undefined), N (symbol has no type), D (data object symbol), T (text symbol), S (section symbol), or F (file symbol). If the symbol's binding attribute is LOCAL, the key letter is lower case; if the symbol's binding attribute is WEAK, the key letter is upper case; if the -1 modifier is specified, the upper case key letter is followed by a \*; if the symbol's binding attribute is GLOBAL, the key letter is upper case.
- 1       Distinguish between WEAK and GLOBAL symbols by appending a \* to the key letter for WEAK symbols.
- v       Print the version of the nm command executing on the standard error output.
- T       See NOTES below.

Options may be used in any order, either singly or in combination, and may appear anywhere in the command line. When conflicting options are specified (such as nm -v -n) the first is taken and the second ignored with a warning message to the user.

#### SEE ALSO

as(1), cc(1), dump(1), ld(1), a.out(4), ar(4).

#### NOTES

The following options are obsolete because of changes to the object file format and will be deleted in a future release.

- e       Print only external and static symbols. The symbol table now contains only static and external symbols. Automatic symbols no longer appear in the symbol table. They do appear in the debugging information produced by cc -g, which may be examined using dump(1).
- f       Produce full output. Redundant symbols (such as .text, .data, etc.) which existed previously do not exist and producing full output will be identical to the default output.
- T       By default, nm prints the entire name of the symbols listed. Since symbol names have been moved to the last column, the problem of overflow is removed and it is no longer necessary to truncate the symbol name.

**NAME**

prof - display profile data

**SYNOPSIS**

prof [-t | c | a | n] [-o | x] [-g | l] [-z] [-h] [-s] [-m *mdata*] -V [*prog*]

**DESCRIPTION**

The `prof` command interprets a profile file produced by the `monitor` function. The symbol table in the object file *prog* (`a.out` by default) is read and correlated with a profile file (`mon.out` by default). For each external text symbol the percentage of time spent executing between the address of that symbol and the address of the next is printed, together with the number of times that function was called and the average number of milliseconds per call.

The mutually exclusive options `-t`, `-c`, `-a`, and `-n` determine the type of sorting of the output lines:

- `-t` Sort by decreasing percentage of total time (default).
- `-c` Sort by decreasing number of calls.
- `-a` Sort by increasing symbol address.
- `-n` Sort lexically by symbol name.

The mutually exclusive options `-o` and `-x` specify the printing of the address of each symbol monitored:

- `-o` Print each symbol address (in octal) along with the symbol name.
- `-x` Print each symbol address (in hexadecimal) along with the symbol name.

The mutually exclusive options `-g` and `-l` control the type of symbols to be reported. The `-l` option must be used with care; it applies the time spent in a static function to the preceding (in memory) global function, instead of giving the static function a separate entry in the report. If all static functions are properly located (see example below), this feature can be very useful. If not, the resulting report may be misleading.

Assume that `A` and `B` are global functions and only `A` calls static function `S`. If `S` is located immediately after `A` in the source code (that is, if `S` is properly located), then, with the `-l` option, the amount of time spent in `A` can easily be determined, including the time spent in `S`. If, however, both `A` and `B` call `S`, then, if the `-l` option is used, the report will be misleading; the time spent during `B`'s call to `S` will be attributed to `A`, making it appear as if more time had been spent in `A` than really had. In this case, function `S` cannot be properly located.

- `-g` Include static (non-global) functions.
- `-l` Do not include static (non-global) functions (default).

The following options may be used in any combination:

- `-z` Include all symbols in the profile range, even if associated with zero number of calls and zero time.

## prof(1)

## prof(1)

- h Suppress the heading normally printed on the report. (This is useful if the report is to be processed further.)
- s Print a summary of several of the monitoring parameters and statistics on the standard error output.
- m *mdata*  
Use file *mdata* instead of *mon.out* as the input profile file.
- v Print *prof* version information on the standard error output.

A program creates a profile file if it has been link edited with the `-p` option of `cc`. This option to the `cc` command arranges for calls to `monitor` at the beginning and end of execution. It is the call to `monitor` at the end of execution that causes the system to write a profile file. The number of calls to a function is tallied if the `-p` option was used when the file containing the function was compiled.

The name of the file created by a profiled program is controlled by the environmental variable `PROFDIR`. If `PROFDIR` is not set, *mon.out* is produced in the directory current when the program terminates. If `PROFDIR=string`, *string/pid.progname* is produced, where *progname* consists of `argv[0]` with any path prefix removed, and *pid* is the process ID of the program. If `PROFDIR` is set, but null, no profiling output are produced.

A single function may be split into subfunctions for profiling by means of the `MARK` macro [see `prof(5)`].

### FILES

*mon.out* default profile file  
*a.out* default namelist (object) file

### SEE ALSO

`cc(1)`, `lprof(1)`, `exit(2)`, `profil(2)`, `monitor(3C)`, `prof(5)`.  
The "lprof" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

### NOTES

The times reported in successive identical runs may show variances because of varying cache-hit ratios that result from sharing the cache with other processes. Even if a program seems to be the only one using the machine, hidden background or asynchronous processes may blur the data. In rare cases, the clock ticks initiating recording of the program counter may "beat" with loops in a program, grossly distorting measurements. Call counts are always recorded precisely, however.

Only programs that call `exit` or return from `main` are guaranteed to produce a profile file, unless a final call to `monitor` is explicitly coded.

The times for static functions are attributed to the preceding external text symbol if the `-g` option is not used. However, the call counts for the preceding function are still correct; that is, the static function call counts are not added to the call counts of the external function.



If more than one of the options `-t`, `-c`, `-a`, and `-n` is specified, the last option specified is used and the user is warned.

Profiling may be used with dynamically linked executables, but care must be applied. Currently, shared objects cannot be profiled with `prof`. Thus, when a profiled, dynamically linked program is executed, only the "main" portion of the image is sampled. This means that all time spent outside of the "main" object, that is, time spent in a shared object, will not be included in the profile summary; the total time reported for the program may be less than the total time used by the program.

Because the time spent in a shared object cannot be accounted for, the use of shared objects should be minimized whenever a program is profiled with `prof`. If possible, the program should be linked statically before being profiled.

Consider an extreme case. A profiled program dynamically linked with the shared C library spends 100 units of time in some `libc` routine, say, `malloc`. Suppose `malloc` is called only from routine B and B consumes only 1 unit of time. Suppose further that routine A consumes 10 units of time, more than any other routine in the "main" (profiled) portion of the image. In this case, `prof` will conclude that most of the time is being spent in A and almost no time is being spent in B. From this it will be almost impossible to tell that the greatest improvement can be made by looking at routine B and not routine A. The value of the profiler in this case is severely degraded; the solution is to use archives as much as possible for profiling.

**NAME**

`prs` - print an SCCS file

**SYNOPSIS**

`prs [-d[dataspec]] [-r[SID]] [-e] [-l] [-c[date-time]] [-a] files`

**DESCRIPTION**

`prs` prints, on the standard output, parts or all of an SCCS file [see `sccsfile(4)`] in a user-supplied format. If a directory is named, `prs` prints the files in that directory, except the non-SCCS files (last component of the path name does not begin with `s.`) and unreadable files. If a name of `-` is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file or directory to be processed. `prs` silently ignores non-SCCS files and unreadable files.

Arguments to `prs`, which may appear in any order, consist of keyletter arguments and file names.

The keyletter arguments apply independently to each named file:

- `-d[dataspec]` Specifies the output data specification. The *dataspec* is a string consisting of SCCS file data keywords (see the DATA KEYWORDS section) interspersed with optional user-supplied text.
- `-r[SID]` Specifies the SCCS identification (SID) string of a delta for which information is desired. The default is the top delta.
- `-e` Requests information for all deltas created earlier than and including the delta designated via the `-r` keyletter or the date given by the `-c` option.
- `-l` Requests information for all deltas created later than and including the delta designated via the `-r` keyletter or the date given by the `-c` option.
- `-c[date-time]` The cutoff date-time in the form:  
 YY[MM[DD[HH[MM[SS]]]]]  
 Units omitted from the date-time default to their maximum possible values; for example, `-c7502` is equivalent to `-c750228235959`. Any number of non-numeric characters may separate the fields of the cutoff date; for example, `"-c77/2/2 9:22:25"`.
- `-a` Requests printing of information for both removed, i.e., delta type = R, [see `rmdel(1)`] and existing, i.e., delta type = D, deltas. If the `-a` keyletter is not specified, information for existing deltas only is provided.

**DATA KEYWORDS**

Data keywords specify those parts of an SCCS file that are to be retrieved and output. All parts of an SCCS file [see `sccsfile(4)`] have an associated data keyword. There is no limit on the number of times a data keyword may appear in a *dataspec*.

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The information printed by prs consists of: (1) the user-supplied text; and (2) appropriate values (extracted from the SCCS file) substituted for the recognized data keywords in the order of appearance in the *dataspec*. The format of a data keyword value is either "Simple" (S), in which keyword substitution is direct, or "Multi-line" (M), in which keyword substitution is followed by a carriage return.

User-supplied text is any text other than recognized data keywords. A tab is specified by \t and carriage return/new-line is specified by \n. The default data keywords are:

" :Dt : \t :DL : \nMRs : \n :MR : COMMENTS : \n :C : "

| Keyword | Data Item                               | File Section | Value                     | Format |
|---------|-----------------------------------------|--------------|---------------------------|--------|
| :Dt:    | Delta information                       | Delta Table  | See below*                | S      |
| :DL:    | Delta line statistics                   | "            | :Li : / :Ld : / :Lu :     | S      |
| :Li:    | Lines inserted by Delta                 | "            | nnnnn                     | S      |
| :Ld:    | Lines deleted by Delta                  | "            | nnnnn                     | S      |
| :Lu:    | Lines unchanged by Delta                | "            | nnnnn                     | S      |
| :DT:    | Delta type                              | "            | D or R                    | S      |
| :I:     | SCCS ID string (SID)                    | "            | :R : . :L : . :B : . :S : | S      |
| :R:     | Release number                          | "            | nnnn                      | S      |
| :L:     | Level number                            | "            | nnnn                      | S      |
| :B:     | Branch number                           | "            | nnnn                      | S      |
| :S:     | Sequence number                         | "            | nnnn                      | S      |
| :D:     | Date Delta created                      | "            | :Dy : / :Dm : / :Dd :     | S      |
| :Dy:    | Year Delta created                      | "            | nn                        | S      |
| :Dm:    | Month Delta created                     | "            | nn                        | S      |
| :Dd:    | Day Delta created                       | "            | nn                        | S      |
| :T:     | Time Delta created                      | "            | :Th : . :Tm : . :Ts :     | S      |
| :Th:    | Hour Delta created                      | "            | nn                        | S      |
| :Tm:    | Minutes Delta created                   | "            | nn                        | S      |
| :Ts:    | Seconds Delta created                   | "            | nn                        | S      |
| :P:     | Programmer who created Delta            | "            | logname                   | S      |
| :DS:    | Delta sequence number                   | "            | nnnn                      | S      |
| :DP:    | Predecessor Delta seq-no.               | "            | nnnn                      | S      |
| :DI:    | Seq-no. of deltas incl., excl., ignored | "            | :Dn : / :Dx : / :Dg :     | S      |
| :Dn:    | Deltas included (seq #)                 | "            | :DS : :DS : ...           | S      |
| :Dx:    | Deltas excluded (seq #)                 | "            | :DS : :DS : ...           | S      |
| :Dg:    | Deltas ignored (seq #)                  | "            | :DS : :DS : ...           | S      |
| :MR:    | MR numbers for delta                    | "            | text                      | M      |
| :C:     | Comments for delta                      | "            | text                      | M      |
| :UN:    | User names                              | User Names   | text                      | M      |
| :FL:    | Flag list                               | Flags        | text                      | M      |

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| Keyword Data Item               | File Section | Value             | Format |
|---------------------------------|--------------|-------------------|--------|
| :Y: Module type flag            | "            | text              | S      |
| :MF: MR validation flag         | "            | yes or no         | S      |
| :MP: MR validation pgm name     | "            | text              | S      |
| :KF: Keyword error/warning flag | "            | yes or no         | S      |
| :KV: Keyword validation string  | "            | text              | S      |
| :BF: Branch flag                | "            | yes or no         | S      |
| :J: Joint edit flag             | "            | yes or no         | S      |
| :LK: Locked releases            | "            | :R: ...           | S      |
| :Q: User-defined keyword        | "            | text              | S      |
| :M: Module name                 | "            | text              | S      |
| :FB: Floor boundary             | "            | :R:               | S      |
| :CB: Ceiling boundary           | "            | :R:               | S      |
| :Ds: Default SID                | "            | :I:               | S      |
| :ND: Null delta flag            | "            | yes or no         | S      |
| :FD: File descriptive text      | Comments     | text              | M      |
| :BD: Body                       | Body         | text              | M      |
| :GB: Gotten body                | "            | text              | M      |
| :W: A form of what(1) string    | N/A          | :Z::M:\t:I:       | S      |
| :A: A form of what(1) string    | N/A          | :Z::Y: :M: :I::Z: | S      |
| :Z: what(1) string delimiter    | N/A          | @ (#)             | S      |
| :F: SCCS file name              | N/A          | text              | S      |
| :PN: SCCS file path name        | N/A          | text              | S      |

\* :Dt: = :DT: :I: :D: :T: :P: :DS: :DP:

**EXAMPLES**

The command

```
prs -d"Users and/or user IDs for :F: are:\n:UN:" s.file
```

may produce on the standard output:

```
Users and/or user IDs for s.file are:
xyz
131
abc
```

The command

```
prs -d"Newest delta for pgm :M:: :I: Created :D: By :P:" -r
s.file
```

may produce on the standard output:

```
Newest delta for pgm main.c: 3.7 Created 77/12/1 By cas
```

The default case:

```
prs s.file
```

**prs(1)**

**prs(1)**

produces on the standard output:

```
D 1.1 77/12/1 00:00:00 cas 1 000000/00000/00000
```

```
MRs:
```

```
b178-12345
```

```
b179-54321
```

```
COMMENTS:
```

```
this is the comment line for s.file initial delta
```

for each delta table entry of the "D" type. The only keyletter argument allowed to be used with the "special case" is the -a keyletter.

**FILES**

```
/var/tmp/pr????
```

**SEE ALSO**

admin(1), delta(1), get(1), help(1), sccsfile(4).

**DIAGNOSTICS**

Use help(1) for explanations.

**NAME**

regcmp - regular expression compile

**SYNOPSIS**

regcmp [-] *file*...

**DESCRIPTION**

The **regcmp** command performs a function similar to **regcomp** and, in most cases, precludes the need for calling **regcomp** from C programs. Bypassing **regcmp** saves on both execution time and program size. The command **regcmp** compiles the regular expressions in *file* and places the output in *file.i*. If the **-** option is used, the output is placed in *file.c*. The format of entries in *file* is a name (C variable) followed by one or more blanks followed by one or more regular expressions enclosed in double quotes. The output of **regcmp** is C source code. Compiled regular expressions are represented as `extern char` vectors. *file.i* files may thus be `#included` in C programs, or *file.c* files may be compiled and later loaded. In the C program that uses the **regcmp** output, `regex(abc, line)` applies the regular expression named `abc` to `line`. Diagnostics are self-explanatory.

**EXAMPLES**

```
name "([A-Za-z][A-Za-z0-9_])* $0"
telno "\({0,1}([2-9][01][1-9])$0\) {0,1} *"
 "([2-9][0-9]{2})$1[-]{0,1}"
 "([0-9]{4})$2"
```

The three arguments to `telno` shown above must all be entered on one line.

In the C program that uses the **regcmp** output,

```
 regex(telno, line, area, exch, rest)
```

applies the regular expression named `telno` to `line`.

**SEE ALSO**

**regcmp(3G)**.

**NAME**

rmdel - remove a delta from an SCCS file

**SYNOPSIS**

rmdel -rSID files

**DESCRIPTION**

rmdel removes the delta specified by the *SID* (SCCS identification string) from each named SCCS file. The delta to be removed must be the newest (most recent) delta in its branch in the delta chain of each named SCCS file. In addition, the delta specified must not be that of a version being edited for the purpose of making a delta; that is, if a p-file exists for the named SCCS file [see *get(1)*], the delta specified must not appear in any entry of the p-file.

The -r option specifies the *SID* level of the delta to be removed.

If a directory is named, rmdel behaves as though each file in the directory were specified as a named file, except that non-SCCS files (last component of the path name does not begin with s.) and unreadable files are silently ignored. If a name of - is given, the standard input is read; each line of the standard input is taken to be the name of an SCCS file to be processed; non-SCCS files and unreadable files are silently ignored.

The rules governing the removal of a delta are as follows: if you make a delta and have appropriate file permissions, you can remove it; if you own the file and directory in which a new delta file resides, you can remove the delta.

**FILES**

x.file [See *delta(1)*]  
z.file [See *delta(1)*]

**SEE ALSO**

*delta(1)*, *get(1)*, *help(1)*, *prs(1)*, *sccsfile(4)*.

**DIAGNOSTICS**

Use *help(1)* for explanations.

**NAME**

**sact** - print current SCCS file editing activity

**SYNOPSIS**

**sact** *files*

**DESCRIPTION**

**sact** informs the user of any impending deltas to a named SCCS file. This situation occurs when **get** with the **-e** option has been previously executed without a subsequent execution of **delta**. If a directory is named on the command line, **sact** behaves as though each file in the directory were specified as a named file, except that non-SCCS files and unreadable files are silently ignored. If a name of **-** is given, the standard input is read with each line being taken as the name of an SCCS file to be processed.

The output for each named file consists of five fields separated by spaces.

- |         |                                                                                                                          |
|---------|--------------------------------------------------------------------------------------------------------------------------|
| Field 1 | specifies the SID of a delta that currently exists in the SCCS file to which changes will be made to make the new delta. |
| Field 2 | specifies the SID for the new delta to be created.                                                                       |
| Field 3 | contains the logname of the user who will make the delta (i.e., executed a <b>get</b> for editing).                      |
| Field 4 | contains the date that <b>get -e</b> was executed.                                                                       |
| Field 5 | contains the time that <b>get -e</b> was executed.                                                                       |

**SEE ALSO**

**delta(1)**, **diff(1)**, **get(1)**, **help(1)**, **unget(1)**.

**DIAGNOSTICS**

Use **help(1)** for explanations.



**NAME**

**sccsdiff** - compare two versions of an SCCS file

**SYNOPSIS**

**sccsdiff** *-rSID1 -rSID2 [-p] [-sn] files*

**DESCRIPTION**

**sccsdiff** compares two versions of an SCCS file and generates the differences between the two versions. Any number of SCCS files may be specified, but arguments apply to all files.

- rSID1 -rSID2** *SID1* and *SID2* specify the deltas of an SCCS file that are to be compared. Versions are passed to **bdiff** in the order given.
- p** pipe output for each file through **pr**.
- sn** *n* is the file segment size that **bdiff** will pass to **diff**. This option is useful when **diff** fails due to a high system load.

**FILES**

*/var/tmp/get?????* temporary files

**SEE ALSO**

**get(1)**, **help(1)**.

**diff(1)**, **bdiff(1)**, **pr(1)** in the *User's Reference Manual*.

**NAME**

sdb – symbolic debugger

**SYNOPSIS**

sdb [-e] [-s *signo*] [-V] [-W] [-w] [*objfile* [*corfile* [*directory-list*]]]

**DESCRIPTION**

sdb is the symbolic debugger for C and assembly programs. sdb may be used to examine executable program files and core files. It may also be used to examine live processes in a controlled execution environment.

The *objfile* argument is the name of an executable program file. To take full advantage of the symbolic capabilities of sdb, this file should be compiled with the -g (debug) option. If it has not been compiled with the -g option, the symbolic capabilities of sdb will be limited, but the file can still be examined and the program debugged. *objfile* may also be a path name in the /proc directory, in which case the currently executing process denoted by that path name is controlled by sdb.

The *corfile* argument is the name of a core image file. A core image file is produced by the abnormal termination of *objfile* or by the use of gcore. A core image file contains a copy of the segments of a program. The default for *corfile* is core. A core image file need not be present to use sdb. Using a hyphen (-) instead of *corfile* forces sdb to ignore an existing core image file.

The *directory-list* argument is a colon-separated list of directories that is used by sdb to locate source files used to build *objfile*. If no directory list is specified, sdb will look in the current directory.

The following options are recognized by sdb:

- e Ignore symbolic information and treat nonsymbolic addresses as file offsets.
- s *signo*  
Where *signo* is a decimal number that corresponds to a signal number [see `signal(2)`], do not stop live processes under control of sdb that receive the signal. This option may be used more than once on the sdb command line.
- V Print version information. If no *objfile* argument is specified on the command line, sdb will exit after printing the version information.
- W Suppress warnings about *corfile* being older than *objfile* or about source files that are older than *objfile*.
- w Allow user to write to *objfile* or *corfile*.

sdb recognizes a current line and a current file. When sdb is examining an executable program file without a core file, the current line and current file are initially set to the line and file containing the first line of main. If *corfile* exists, then current line and current file are initially set to the line and file containing the source statement where the process terminated. The current line and current file change automatically as a live process executes. They may also be changed with the source file examination commands.

Names of variables are written as in C. Variables local to a procedure may be accessed using the form *procedure:variable*. If no procedure name is given, the procedure containing the current line is used by default.

Structure members may be referred to as *variable.member*, pointers to structure members as *variable->member*, and array elements as *variable[number]*. Pointers may also be dereferenced by using the form *pointer[number]*. Combinations of these forms may also be used. The form *number->member* may be used where *number* is the address of a pointer, and *number.member* where *number* is interpreted as the address of a structure instance. The template of the structure type used in this case will be the last structure type referenced. When *sdb* displays the value of a structure, it does so by displaying the value of all elements of the structure. The address of a structure is displayed by displaying the address of the structure instance rather than the addresses of individual elements.

Elements of a multidimensional array may be referred to as *variable [number] [number]...*, or as *variable [number, number, ...]*. In place of *number*, the form *number; number* may be used to indicate a range of values, \* may be used to indicate all legitimate values for that subscript, or subscripts may be omitted entirely if they are the last subscripts and the full range of values is desired. If no subscripts are specified, *sdb* will display the value of all elements of the array.

A particular instance of a variable on the stack is referred to as *procedure:variable, number*. The *number* is the occurrence of the specified procedure on the stack, with the topmost occurrence being 1. The default procedure is the one containing the current line.

Addresses may be used in *sdb* commands as well. Addresses are specified by decimal, octal, or hexadecimal numbers.

Line numbers in the source program are specified by the form *filename:number* or *procedure:number*. In either case, the *number* is relative to the beginning of the file and corresponds to the line number used by text editors or the output of *pr*. A number used by itself implies a line in the current file.

While a live process is running under *sdb*, all addresses and identifiers refer to the live process. When *sdb* is not examining a live process, the addresses and identifiers refer to *objfile* or *corfile*.

## Commands

The commands for examining data in the program are:

- t Prints a stack trace of the terminated or halted program. The function invoked most recently is at the top of the stack. For C programs, the stack ends with *\_start*, which is the startup routine that invokes *main*.
- T Prints the top line of the stack trace.

*variable/clm*

Print the value of *variable* according to length *l* and format *m*. The numeric count *c* indicates that a region of memory, beginning at the address implied by *variable*, is to be displayed. The length specifiers are:

- b one byte
- h two bytes (half word)
- l four bytes (long word)

Legal values for *m* are:

- c character
- d signed decimal
- u unsigned decimal
- o octal
- x hexadecimal
- f 32-bit single precision floating point
- g 64-bit double precision floating point
- s Assumes that *variable* is a string pointer and prints characters starting at the address pointed to by the variable.
- a Prints characters starting at the variable's address. Do not use this with register variables.
- p pointer to procedure
- i Disassembles machine-language instruction with addresses printed numerically and symbolically.
- I Disassembles machine-language instruction with addresses printed numerically only.

Length specifiers are effective with formats *c*, *d*, *u*, *o*, *x*. The length specifier determines the output length of the value to be displayed. This value may be truncated. The count specifier *c* displays that many units of memory, starting at the address of the *variable*. The number of bytes in the unit of memory is determined by *l* or by the size associated with the variable. If the specifiers *c*, *l*, and *m* are omitted, *sdb* uses defaults. If a count specifier is used with the *s* or *a* command, then that many characters are printed. Otherwise, successive characters are printed until either a null byte is reached or 128 characters are printed. The last variable may be redisplayed with the *./* command.

For a limited form of pattern matching, use the *sh* metacharacters *\** and *?* within procedure and variable names. (*sdb* does not accept these metacharacters in file names, as the function name in a line number when setting a breakpoint, in the function call command, or as the argument to the *e* command.) If no procedure name is supplied, *sdb* matches both local and global variables. If the procedure name is specified, then *sdb* matches only local variables. To match global variables only, use *:pattern*. To print all variables, use *\*:\**.

*linenumber?lm*

*variable?lm*

Prints the value at the address from the executable or text space given by *linenumber* or *variable* (procedure name), according to the format *lm*. The default format is *i*.

*variable=lm*

*linenumber=lm*

*number=lm*

Prints the address of *variable* or *linenumber*, or the value of *number*. *l* specifies length and *m* specifies the format. If no format is specified, then sdb uses *lx* (four-byte hex). *m* allows you to convert between decimal, octal, and hexadecimal.

*variable!value*

Sets *variable* to the given *value*. The value may be a number, a character constant, or a variable. The value must be well-defined; structures are allowed only if assigning to another structure variable of the same type. Character constants are denoted *'character'*. Numbers are viewed as integers unless a decimal point or exponent is used. In this case, they are treated as having the type *double*. Registers, except the floating point registers, are viewed as integers. Register names are identical to those used by the assembler (for example, *%regname* where *regname* is the name of a register). If the address of a variable is given, it is regarded as the address of a variable of type *int*. C conventions are used in any type conversions necessary to perform the indicated assignment.

**x** Prints the machine registers and the current machine-language instruction.

**X** Prints the current machine-language instruction.

The commands for examining source files are:

**e**

**e** *procedure*

**e** *filename*

**e** *directory/*

**e**, without arguments, prints the name of the current file. The second form sets the current file to the file containing the procedure. The third form sets the current file to *filename*. The current line is set to the first line in the named procedure or file. Source files are assumed to be in the directories in the directory list. The fourth form adds *directory* to the end of the directory list.

**/regular expression/**

Searches forward from the current line for a line containing a string matching *regular expression*, as in **ed**. The trailing **/** may be omitted, except when associated with a breakpoint.

**?regular expression?**

Searches backward from the current line for a line containing a string matching *regular expression*, as in **ed**. The trailing **?** may be omitted, except when associated with a breakpoint.

- p** Prints the current line.
- z** Prints the current line and the following nine lines. Sets the current line to the last line printed.
- w** Prints the 10 lines (the window) around the current line.
- number*  
Specifies the current line. Prints the new current line.
- count+*  
Advances the current line by *count* lines. Prints the new current line.
- count-*  
Resets the current line by *count* lines back. Prints the new current line.

The commands for controlling the execution of the source program are:

*count* **r** *args*

*count* **R**

Runs the program with the given arguments. The **r** command with no arguments reuses the previous arguments to the program. The **R** command runs the program with no arguments. An argument beginning with **<** or **>** redirects the standard input or output, respectively. Full **sh** syntax is accepted. If *count* is given, it specifies the number of breakpoints to be ignored.

*linenumber* **c** *count*

*linenumber* **C** *count*

Continues execution. **sdb** stops when it encounters *count* breakpoints. The signal that stopped the program is reactivated with the **C** command and ignored with the **c** command. If a line number is specified, then a temporary breakpoint is placed at the line and execution continues. The breakpoint is deleted when the command finishes.

*linenumber* **g** *count*

Continues with execution resumed at the given line. If *count* is given, it specifies the number of breakpoints to be ignored.

**s** *count*

**S** *count*

**s** single steps the program through *count* lines or if no *count* is given, then the program runs for one line. **s** will step from one function into a called function. **S** also steps a program, but it will not step into a called function. It steps over the function called.

**i** *count*

**I** *count*

Single steps by *count* machine-language instructions. The signal that caused the program to stop is reactivated with the **I** command and ignored with the **i** command.

*variable* \$m *count*

*address* :m *count*

Single steps (as with *s*) until the specified location is modified with a new value. If *count* is omitted, it is, in effect, infinity. *Variable* must be accessible from the current procedure. This command can be very slow.

*level* v

Toggles verbose mode. This is for use when single stepping with *S*, *s*, or *m*. If *level* is omitted, then just the current source file and/or function name is printed when either changes. If *level* is 1 or greater, each C source line is printed before it executes. If *level* is 2 or greater, each assembler statement is also printed. A *v* turns verbose mode off.

*k* Kills the program being debugged.

*procedure* (*arg1,arg2,...*)

*procedure* (*arg1,arg2,...*) /*m*

Executes the named procedure with the given arguments. Arguments can be register names, integer, character, or string constants, or names of variables accessible from the current procedure. The second form causes the value returned by the procedure to be printed according to format *m*. If no format is given, it defaults to *d*.

*linenumber* b *commands*

Sets a breakpoint at the given line. If a procedure name without a line number is given (e.g., *proc:*), a breakpoint is placed at the first line in the procedure even if it was not compiled with the *-g* option. If no *linenumber* is given, a breakpoint is placed at the current line. If no *commands* are given, execution stops at the breakpoint and control is returned to *sdb*. Otherwise the *commands* are executed when the breakpoint is encountered. Multiple commands are specified by separating them with semicolons. Nested associated commands are not permitted; setting breakpoints within the associated environments is permitted.

*B* Prints a list of the currently active breakpoints.

*linenumber* d

Deletes a breakpoint at the given line. If no *linenumber* is given, then the breakpoints are deleted interactively. Each breakpoint location is printed and a line is read from the standard input. If the line begins with a *y* or *d*, then the breakpoint is deleted.

*D* Deletes all breakpoints.

*l* Prints the last executed line.

*linenumber* a

Announces a line number. If *linenumber* is of the form *proc:number*, the command effectively does a *linenumber:b l;c*. If *linenumber* is of the form *proc:*, the command effectively does a *proc:b T;c*.

Miscellaneous commands:

**#rest-of-line**

The *rest-of-line* represents comments that are ignored by sdb.

**!command**

The *command* is interpreted by sh.

**new-line**

If the previous command printed a source line, then advance the current line by one line and print the new current line. If the previous command displayed a memory location, then display the next memory location. If the previous command disassembled an instruction, then disassemble the next instruction.

**end-of-file character**

Scrolls the next 10 lines of instructions, source, or data depending on which was printed last. The end-of-file character is usually control-d.

**< filename**

Read commands from *filename* until the end of file is reached, and then continue to accept commands from standard input. Commands are echoed, preceded by two asterisks, just before being executed. This command may not be nested; < may not appear as a command in a file.

**M** Prints the address maps.

**" string "**

Prints the given string. The C escape sequences of the form *\character*, *\octaldigits*, or *\xhexdigits* are recognized, where *character* is a nonnumeric character. The trailing quote may be omitted.

**q** Exits the debugger.

**v** Prints version stamping information.

#### SEE ALSO

cc(1), signal(2), a.out(4), core(4), syms(4).

ed(1), gcore(1), sh(1) in the *User's Reference Manual*.

The "sdb" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

#### NOTES

If *objfile* is a dynamically linked executable, variables, function names, and so on that are defined in shared objects may not be referenced until the shared object in which the variable, etc., is defined is attached to the process. For shared objects attached at startup (e.g., *libc.so.1*, the default C library), this implies that such variables may not be accessed until *main* is called.

The *objfile* argument is accessed directly for debugging information while the process is created via the *PATH* variable.



**NAME**

**size** - print section sizes in bytes of object files

**SYNOPSIS**

**size** [ **-F -f -n -o -V -x**] *files*

**DESCRIPTION**

The **size** command produces segment or section size information in bytes for each loaded section in ELF or COFF object files. **size** prints out the size of the text, data, and bss (uninitialized data) segments (or sections) and their total.

**size** processes ELF and COFF object files entered on the command line. If an archive file is input to the **size** command, the information for each object file in the archive is displayed.

When calculating segment information, the **size** command prints out the total file size of the non-writable segments, the total file size of the writable segments, and the total memory size of the writable segments minus the total file size of the writable segments.

If it cannot calculate segment information, **size** calculates section information. When calculating section information, it prints out the total size of sections that are allocatable, non-writable, and not NOBITS, the total size of the sections that are allocatable, writable, and not NOBITS, and the total size of the writable sections of type NOBITS. (NOBITS sections do not actually take up space in the *file*.)

If **size** cannot calculate either segment or section information, it prints an error message and stops processing the file.

- F** Prints out the size of each loadable segment, the permission flags of the segment, then the total of the loadable segment sizes. If there is no segment data, **size** prints an error message and stops processing the file.
- f** Prints out the size of each allocatable section, the name of the section, and the total of the section sizes. If there is no section data, **size** prints out an error message and stops processing the file.
- n** Prints out non-loadable segment or non-allocatable section sizes. If segment data exists, **size** prints out the memory size of each loadable segment or file size of each non-loadable segment, the permission flags, and the total size of the segments. If there is no segment data, **size** prints out, for each allocatable and non-allocatable section, the memory size, the section name, and the total size of the sections. If there is no segment or section data, **size** prints an error message and stops processing.
- o** Prints numbers in octal, not decimal.
- V** Prints the version information for the **size** command on the standard error output.
- x** Prints numbers in hexadecimal; not decimal.

**size (1)**

**size(1)**

**EXAMPLES**

The examples below are typical `size` output.

`size file`             $2724 + 88 + 0 = 2812$

`size -f file`         $26 (.text) + 5 (.init) + 5 (.fini) = 36$

`size -F file`         $2724 (r-x) + 88 (rwx) + 0 (rwx) = 2812$

**SEE ALSO**

`as(1)`, `cc(1)`, `ld(1)`, `a.out(4)`, `ar(4)`.

**NOTES**

Since the size of bss sections is not known until link-edit time, the `size` command will not give the true total size of pre-linked objects.

**NAME**

**strip** - strip symbol table, debugging and line number information from an object file.

**SYNOPSIS**

**strip** [-blrVx] file ...

**DESCRIPTION**

The **strip** command strips the symbol table, debugging information, and line number information from **ELF** object files; **COFF** object files can no longer be stripped. Once this stripping process has been done, no symbolic debugging access will be available for that file; therefore, this command is normally run only on production modules that have been debugged and tested.

If **strip** is executed on a common archive file [see **ar(4)**] in addition to processing the members, **strip** will remove the archive symbol table. The archive symbol table must be restored by executing the **ar(1)** command with the **-s** option before the archive can be linked by the **ld(1)** command. **strip** will produce appropriate warning messages when this situation arises.

The amount of information stripped from the **ELF** object file can be controlled by using any of the following options:

- b** Same effect as the default behavior. This option is obsolete and will be removed in the next release.
- l** Strip line number information only; do not strip the symbol table or debugging information.
- r** Same effect as the default behavior. This option is obsolete and will be removed in the next release.
- V** Print, on standard error, the version number of **strip**.
- x** Do not strip the symbol table; debugging and line number information may be stripped.

**strip** is used to reduce the file storage overhead taken by the object file.

**FILES**

|                     |                                                                                                                                              |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TMPDIR/strp*</b> | temporary files                                                                                                                              |
| <b>TMPDIR</b>       | usually <b>/var/tmp</b> but can be redefined by setting the environment variable <b>TMPDIR</b> [see <b>tmpnam(0)</b> in <b>tmpnam(3S)</b> ]. |

**SEE ALSO**

**ar(1)**, **as(1)**, **cc(1)**, **ld(1)**, **tmpnam(3S)**, **a.out(4)**, **ar(4)**.

**NOTES**

The symbol table section will not be removed if it is contained within a segment, or the file is either a relocatable or dynamic shared object.

The line number and debugging sections will not be removed if they are contained within a segment, or their associated relocation section is contained within a segment.

**tsort(1)**

**tsort(1)**

**NAME**

tsort - topological sort

**SYNOPSIS**

tsort [*file*]

**DESCRIPTION**

The `tsort` command produces on the standard output a totally ordered list of items consistent with a partial ordering of items mentioned in the input *file*. If no *file* is specified, the standard input is understood.

The input consists of pairs of items (nonempty strings) separated by blanks. Pairs of different items indicate ordering. Pairs of identical items indicate presence, but not ordering.

**SEE ALSO**

lorder(1).

**DIAGNOSTICS**

Odd data: there is an odd number of fields in the input file.

**NAME**

unget - undo a previous get of an SCCS file

**SYNOPSIS**

unget [-rSID] [-s] [-n] files

**DESCRIPTION**

unget undoes the effect of a get -e done prior to creating the intended new delta. If a directory is named, unget behaves as though each file in the directory were specified as a named file, except that non-SCCS files and unreadable files are silently ignored. If a name of - is given, the standard input is read with each line being taken as the name of an SCCS file to be processed.

Keyletter arguments apply independently to each named file.

- rSID      Uniquely identifies which delta is no longer intended. (This would have been specified by get as the "new delta"). The use of this keyletter is necessary only if two or more outstanding gets for editing on the same SCCS file were done by the same person (login name). A diagnostic results if the specified SID is ambiguous, or if it is necessary and omitted on the command line.
- s          Suppresses the printout, on the standard output, of the intended delta's SID.
- n          Causes the retention of the gotten file, which would normally be removed from the current directory.

unget must be performed by the same user who performed the original get -e.

**FILES**

- p-file      [see delta(1)]
- q-file      [see delta(1)]
- z-file      [see delta(1)]

**SEE ALSO**

delta(1), get(1), help(1), sact(1).

**DIAGNOSTICS**

Use help(1) for explanations.

val(1)

val(1)

## NAME

val - validate an SCCS file

## SYNOPSIS

val -

val [-s] [-rSID] [-mname] [-ytype] files

## DESCRIPTION

val determines if the specified *file* is an SCCS file meeting the characteristics specified by the optional argument list. Arguments to val may appear in any order. The arguments consist of keyletter arguments, which begin with a -, and named files.

val has a special argument, -, which causes reading of the standard input until an end-of-file condition is detected. Each line read is independently processed as if it were a command line argument list.

val generates diagnostic messages on the standard output for each command line and file processed, and also returns a single 8-bit code on exit as described below.

The keyletter arguments are defined as follows. The effects of any keyletter argument apply independently to each named file on the command line.

- s           The presence of this argument silences the diagnostic message normally generated on the standard output for any error that is detected while processing each named file on a given command line.
- rSID       The argument value *SID* (SCCS identification string) is an SCCS delta number. A check is made to determine if the *SID* is ambiguous (e. g., -r1 is ambiguous because it physically does not exist but implies 1.1, 1.2, etc., which may exist) or invalid (e. g., r1.0 or r1.1.0 are invalid because neither can exist as a valid delta number). If the *SID* is valid and not ambiguous, a check is made to determine if it actually exists.
- mname      The argument value *name* is compared with the SCCS %M% keyword in *file*.
- ytype      The argument value *type* is compared with the SCCS %Y% keyword in *file*.

The 8-bit code returned by val is a disjunction of the possible errors; it can be interpreted as a bit string where (moving from left to right) set bits are interpreted as follows:

- bit 0 = missing file argument
- bit 1 = unknown or duplicate keyletter argument
- bit 2 = corrupted SCCS file
- bit 3 = cannot open file or file not SCCS
- bit 4 = *SID* is invalid or ambiguous
- bit 5 = *SID* does not exist
- bit 6 = %Y%, -y mismatch
- bit 7 = %M%, -m mismatch

**val(1)**

**val(1)**

`val` can process two or more files on a given command line and in turn can process multiple command lines (when reading the standard input). In these cases an aggregate code is returned: a logical OR of the codes generated for each command line and file processed.

**SEE ALSO**

`admin(1)`, `delta(1)`, `get(1)`, `help(1)`, `prs(1)`.

**DIAGNOSTICS**

Use `help(1)` for explanations.

**NOTES**

`val` can process up to 50 files on a single command line.

**NAME**

vc – version control

**SYNOPSIS**

vc [-a] [-t] [-cchar] [-s] [keyword=value ... keyword=value]

**DESCRIPTION**

This command is obsolete and will be removed in the next release.

The `vc` command copies lines from the standard input to the standard output under control of its arguments and of “control statements” encountered in the standard input. In the process of performing the copy operation, user-declared *keywords* may be replaced by their string *value* when they appear in plain text and/or control statements.

The copying of lines from the standard input to the standard output is conditional, based on tests (in control statements) of keyword values specified in control statements or as `vc` command arguments.

A control statement is a single line beginning with a control character, except as modified by the `-t` keyletter (see below). The default control character is colon (:), except as modified by the `-c` keyletter (see below). Input lines beginning with a backslash (\) followed by a control character are not control lines and are copied to the standard output with the backslash removed. Lines beginning with a backslash followed by a non-control character are copied in their entirety.

A keyword is composed of 9 or less alphanumeric; the first must be alphabetic. A value is any ASCII string that can be created with `ed`; a numeric value is an unsigned string of digits. Keyword values may not contain blanks or tabs.

Replacement of keywords by values is done whenever a keyword surrounded by control characters is encountered on a version control statement. The `-a` keyletter (see below) forces replacement of keywords in all lines of text. An uninterpreted control character may be included in a value by preceding it with \. If a literal \ is desired, then it too must be preceded by \.

The following options are valid:

- `-a` Forces replacement of keywords surrounded by control characters with their assigned value in all text lines and not just in `vc` statements.
- `-t` All characters from the beginning of a line up to and including the first tab character are ignored for the purpose of detecting a control statement. If a control statement is found, all characters up to and including the tab are discarded.
- `-cchar` Specifies a control character to be used in place of the “:” default.
- `-s` Silences warning messages (not error) that are normally printed on the diagnostic output.

`vc` recognizes the following version control statements:

```
:dcl keyword[, ..., keyword]
```

Declare keywords. All keywords must be declared.



:asg *keyword=value*

Assign values to keywords. An `asg` statement overrides the assignment for the corresponding keyword on the `vc` command line and all previous `asg` statements for that keyword. Keywords that are declared but are not assigned values have null values.

:if *condition*

...

:end

Skip lines of the standard input. If the condition is true, all lines between the `if` statement and the matching `end` statement are copied to the standard output. If the condition is false, all intervening lines are discarded, including control statements. Note that intervening `if` statements and matching `end` statements are recognized solely for the purpose of maintaining the proper `if-end` matching.

The syntax of a condition is:

```

<cond> ::= ["not"] <or>
<or> ::= <and> | <and> "|" <or>
<and> ::= <exp> | <exp> "&" <and>
<exp> ::= "(" <or> ")" | <value> <op> <value>
<op> ::= "=" | "!=" | "<" | ">"
<value> ::= <arbitrary ASCII string> | <numeric string>

```

The available operators and their meanings are:

```

= equal
!= not equal
& and
| or
> greater than
< less than
() used for logical groupings
not may only occur immediately after the if, and when
 present, inverts the value of the entire condition

```

The `>` and `<` operate only on unsigned integer values (e.g., `: 012 > 12` is false). All other operators take strings as arguments (e.g., `: 012 != 12` is true).

The precedence of the operators (from highest to lowest) is:

```

= != > < all of equal precedence
&
|

```

Parentheses may be used to alter the order of precedence.

Values must be separated from operators or parentheses by at least one blank or tab.

**::text** Replace keywords on lines that are copied to the standard output. The two leading control characters are removed, and keywords surrounded by control characters in text are replaced by their value before the line is copied to the output file. This action is independent of the **-a** keyletter.

**:on**

**:off** Turn on or off keyword replacement on all lines.

**:ctl *char***  
Change the control character to *char*.

**:msg *message***  
Print *message* on the diagnostic output.

**:err *message***  
Print *message* followed by:  
    **ERROR: err statement on line ... (915)**  
on the diagnostic output. **vc** halts execution, and returns an exit code of 1.

**SEE ALSO**

**help(1)**.  
**ed(1)** in the *User's Reference Manual*.

## what(1)

## what(1)

### NAME

what - print identification strings

### SYNOPSIS

what [-s] files

### DESCRIPTION

what searches the given files for all occurrences of the pattern that the get command substitutes for %Z% (this is @(#) at this printing) and prints out what follows until the first ", >, new-line, \, or null character. For example, if the C program in file f.c contains

```
#ident "@(#)identification information "
```

and f.c is compiled to yield f.o and a.out, then the command

```
what f.c f.o a.out
```

prints

```
f.c: identification information
```

```
f.o: identification information
```

```
a.out: identification information
```

what is intended to be used in conjunction with the get command, which automatically inserts identifying information, but it can also be used where the information is inserted manually. Only one option exists:

```
-s Quit after finding the first occurrence of pattern in each file.
```

### SEE ALSO

get(1), help(1), mcs(1).

### DIAGNOSTICS

Exit status is 0 if any matches are found, otherwise 1. See help(1) for explanations.

## NAME

yacc - yet another compiler-compiler

## SYNOPSIS

yacc [-vVdlt] [-Q[y|n]] *file*

## DESCRIPTION

The yacc command converts a context-free grammar into a set of tables for a simple automaton that executes an LALR(1) parsing algorithm. The grammar may be ambiguous; specified precedence rules are used to break ambiguities.

The output file, *y.tab.c*, must be compiled by the C compiler to produce a program *yyparse*. This program must be loaded with the lexical analyzer program, *yylex*, as well as *main* and *yyerror*, an error handling routine. These routines must be supplied by the user; the *lex(1)* command is useful for creating lexical analyzers usable by yacc.

- v Prepares the file *y.output*, which contains a description of the parsing tables and a report on conflicts generated by ambiguities in the grammar.
- d Generates the file *y.tab.h* with the `#define` statements that associate the yacc-assigned "token codes" with the user-declared "token names." This association allows source files other than *y.tab.c* to access the token codes.
- l Specifies that the code produced in *y.tab.c* will not contain any `#line` constructs. This option should only be used after the grammar and the associated actions are fully debugged.
- Q[y|n] The `-Qy` option puts the version stamping information in *y.tab.c*. This allows you to know what version of yacc built the file. The `-Qn` option (the default) writes no version information.
- t Compiles runtime debugging code by default. Runtime debugging code is always generated in *y.tab.c* under conditional compilation control. By default, this code is not included when *y.tab.c* is compiled. Whether or not the `-t` option is used, the runtime debugging code is under the control of `YYDEBUG`, a preprocessor symbol. If `YYDEBUG` has a non-zero value, then the debugging code is included. If its value is zero, then the code will not be included. The size and execution time of a program produced without the runtime debugging code will be smaller and slightly faster.
- v Prints on the standard error output the version information for yacc.

## FILES

|                                      |                         |
|--------------------------------------|-------------------------|
| <i>y.output</i>                      |                         |
| <i>y.tab.c</i>                       |                         |
| <i>y.tab.h</i>                       | defines for token names |
| <i>yacc.tmp</i> ,                    |                         |
| <i>yacc.debug</i> , <i>yacc.acts</i> | temporary files         |

## yacc(1)

## yacc(1)

*LIBDIR*/yaccpar

parser prototype for C programs

*LIBDIR*

usually */usr/ccs/lib*

### SEE ALSO

*lex(1)*.

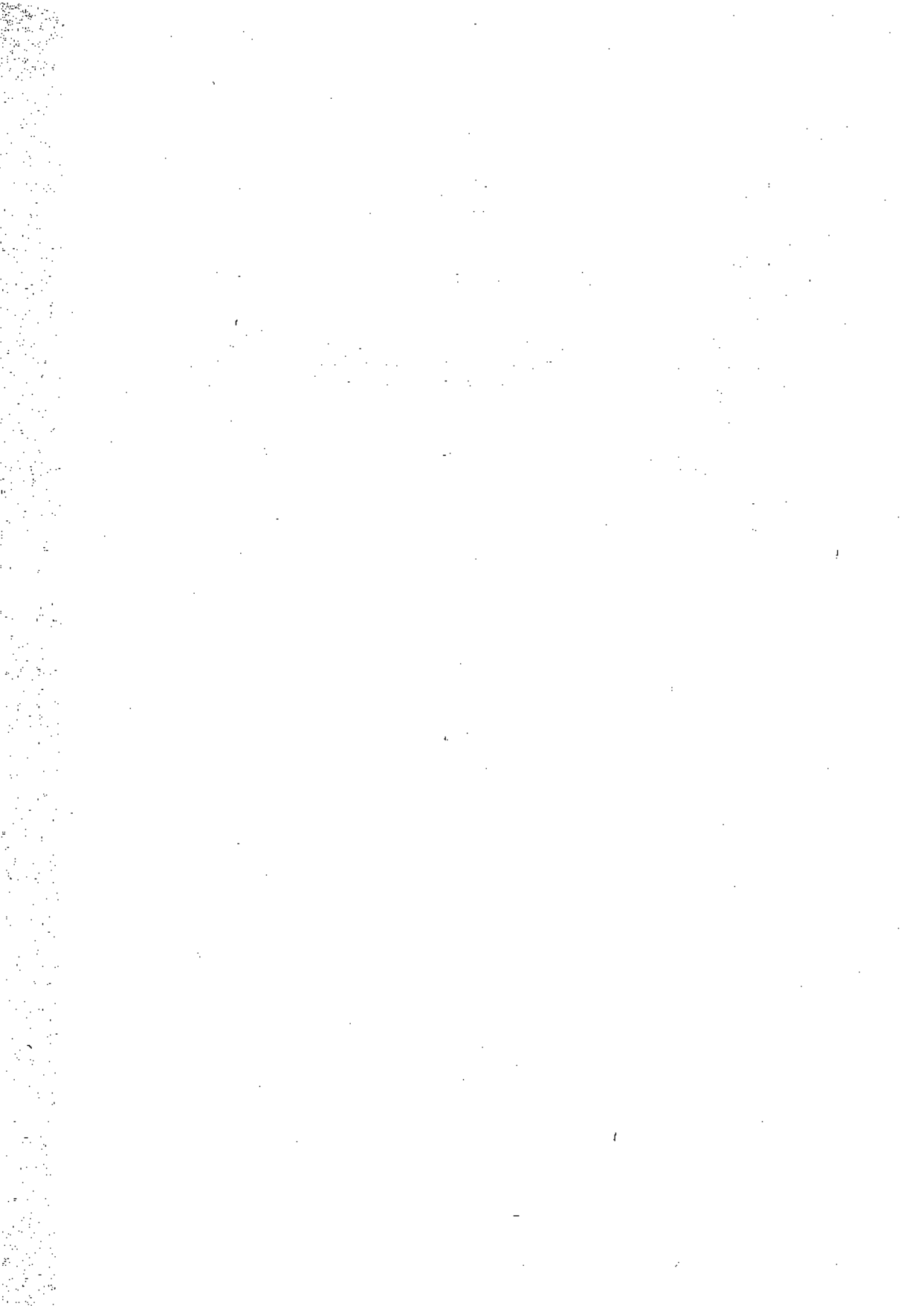
The “yacc” chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

### DIAGNOSTICS

The number of reduce-reduce and shift-reduce conflicts is reported on the standard error output; a more detailed report is found in the *y.output* file. Similarly, if some rules are not reachable from the start symbol, this instance is also reported.

### NOTES

Because file names are fixed, at most one yacc process can be active in a given directory at a given time.



SYSTEM CALLS(2)

**SYSTEM CALLS (2)**



**NAME**

intro – introduction to system calls and error numbers

**SYNOPSIS**

```
#include <errno.h>
```

**DESCRIPTION**

This section describes all of the system calls. Most of these calls have one or more error returns. An error condition is indicated by an otherwise impossible returned value. This is almost always `-1` or the `NULL` pointer; the individual descriptions specify the details. An error number is also made available in the external variable `errno`. `errno` is not cleared on successful calls, so it should be tested only after an error has been indicated.

Each system call description attempts to list all possible error numbers. The following is a complete list of the error numbers and their names as defined in `<errno.h>`.

1 **EPERM** Not super-user

Typically this error indicates an attempt to modify a file in some way forbidden except to its owner or the super-user. It is also returned for attempts by ordinary users to do things allowed only to the super-user.

2 **ENOENT** No such file or directory

A file name is specified and the file should exist but doesn't, or one of the directories in a path name does not exist.

3 **ESRCH** No such process

No process can be found corresponding to that specified by PID in the `kill` or `ptrace` routine.

4 **EINTR** Interrupted system call

An asynchronous signal (such as `interrupt` or `quit`), which the user has elected to catch, occurred during a system service routine. If execution is resumed after processing the signal, it will appear as if the interrupted routine call returned this error condition.

5 **EIO** I/O error

Some physical I/O error has occurred. This error may in some cases occur on a call following the one to which it actually applies.

6 **ENXIO** No such device or address

I/O on a special file refers to a subdevice which does not exist, or exists beyond the limit of the device. It may also occur when, for example, a tape drive is not on-line or no disk pack is loaded on a drive.

7 **E2BIG** Arg list too long

An argument list longer than `ARG_MAX` bytes is presented to a member of the `exec` family of routines. The argument list limit is the sum of the size of the argument list plus the size of the environment's exported shell variables.

- 8 **ENOEXEC** Exec format error  
A request is made to execute a file which, although it has the appropriate permissions, does not start with a valid format [see a.out(4)].
- 9 **EBADF** Bad file number  
Either a file descriptor refers to no open file, or a read [respectively, write] request is made to a file that is open only for writing (respectively, reading).
- 10 **ECHILD** No child processes  
A wait routine was executed by a process that had no existing or unwaited-for child processes.
- 11 **EAGAIN** No more processes  
For example, the fork routine failed because the system's process table is full or the user is not allowed to create any more processes, or a system call failed because of insufficient memory or swap space.
- 12 **ENOMEM** Not enough space  
During execution of an exec, brk, or sbrk routine, a program asks for more space than the system is able to supply. This is not a temporary condition; the maximum size is a system parameter. The error may also occur if the arrangement of text, data, and stack segments requires too many segmentation registers, or if there is not enough swap space during the fork routine. If this error occurs on a resource associated with Remote File Sharing (RFS), it indicates a memory depletion which may be temporary, dependent on system activity at the time the call was invoked.
- 13 **EACCES** Permission denied  
An attempt was made to access a file in a way forbidden by the protection system.
- 14 **EFAULT** Bad address  
The system encountered a hardware fault in attempting to use an argument of a routine. For example, errno potentially may be set to EFAULT any time a routine that takes a pointer argument is passed an invalid address, if the system can detect the condition. Because systems will differ in their ability to reliably detect a bad address, on some implementations passing a bad address to a routine will result in undefined behavior.
- 15 **ENOTBLK** Block device required  
A non-block file was mentioned where a block device was required (e.g., in a call to the mount routine).
- 16 **EBUSY** Device busy  
An attempt was made to mount a device that was already mounted or an attempt was made to unmount a device on which there is an active file (open file, current directory, mounted-on file, active text segment). It will also occur if an attempt is made to enable accounting when it is already enabled. The device or resource is currently unavailable.

- 17 **EEXIST** File exists  
An existing file was mentioned in an inappropriate context (e.g., call to the `link` routine).
- 18 **EXDEV** Cross-device link  
A link to a file on another device was attempted.
- 19 **ENODEV** No such device  
An attempt was made to apply an inappropriate operation to a device (e.g., read a write-only device).
- 20 **ENOTDIR** Not a directory  
A non-directory was specified where a directory is required (e.g., in a path prefix or as an argument to the `chdir` routine).
- 21 **EISDIR** Is a directory  
An attempt was made to write on a directory.
- 22 **EINVAL** Invalid argument  
An invalid argument was specified (e.g., unmounting a non-mounted device), mentioning an undefined signal in a call to the `signal` or `kill` routine.
- 23 **ENFILE** File table overflow  
The system file table is full (i.e., `SYS_OPEN` files are open, and temporarily no more files can be opened).
- 24 **EMFILE** Too many open files  
No process may have more than `OPEN_MAX` file descriptors open at a time.
- 25 **ENOTTY** Not a typewriter  
A call was made to the `ioctl` routine specifying a file that is not a special character device.
- 26 **ETXTBSY** Text file busy  
An attempt was made to execute a pure-procedure program that is currently open for writing. Also an attempt to open for writing or to remove a pure-procedure program that is being executed.
- 27 **EFBIG** File too large  
The size of a file exceeded the maximum file size, `FCHR_MAX` [see `getrlimit`].
- 28 **ENOSPC** No space left on device  
While writing an ordinary file or creating a directory entry, there is no free space left on the device. In the `fcntl` routine, the setting or removing of record locks on a file cannot be accomplished because there are no more record entries left on the system.
- 29 **ESPIPE** Illegal seek  
A call to the `lseek` routine was issued to a pipe.

- 30 **EROFS** Read-only file system  
An attempt to modify a file or directory was made on a device mounted read-only.
- 31 **EMLINK** Too many links  
An attempt to make more than the maximum number of links, `LINK_MAX`, to a file.
- 32 **EPIPE** Broken pipe  
A write on a pipe for which there is no process to read the data. This condition normally generates a signal; the error is returned if the signal is ignored.
- 33 **EDOM** Math argument out of domain of func  
The argument of a function in the math package (3M) is out of the domain of the function.
- 34 **ERANGE** Math result not representable  
The value of a function in the math package (3M) is not representable within machine precision.
- 35 **ENMSG** No message of desired type  
An attempt was made to receive a message of a type that does not exist on the specified message queue [see `msgop(2)`].
- 36 **EIDRM** Identifier removed  
This error is returned to processes that resume execution due to the removal of an identifier from the file system's name space [see `msgctl(2)`, `semctl(2)`, and `shmctl(2)`].
- 37 **ECHRNG** Channel number out of range
- 38 **EL2NSYNC** Level 2 not synchronized
- 39 **EL3HLT** Level 3 halted
- 40 **EL3RST** Level 3 reset
- 41 **ELNRNG** Link number out of range
- 42 **EUNATCH** Protocol driver not attached
- 43 **ENOCSS** No CSI structure available
- 44 **EL2HLT** Level 2 halted
- 45 **EDEADLK** Deadlock condition  
A deadlock situation was detected and avoided. This error pertains to file and record locking.
- 46 **ENOLCK** No record locks available  
There are no more locks available. The system lock table is full [see `fcntl(2)`].
- 47-49 Reserved

- 58-59 Reserved
- 60 **ENOSTR** Device not a stream  
A `putmsg` or `getmsg` system call was attempted on a file descriptor that is not a STREAMS device.
- 61 **ENODATA** No data available
- 62 **ETIME** Timer expired  
The timer set for a STREAMS `ioctl` call has expired. The cause of this error is device specific and could indicate either a hardware or software failure, or perhaps a timeout value that is too short for the specific operation. The status of the `ioctl` operation is indeterminate.
- 63 **ENOSR** Out of stream resources  
During a STREAMS `open`, either no STREAMS queues or no STREAMS head data structures were available. This is a temporary condition; one may recover from it if other processes release resources.
- 64 **ENONET** Machine is not on the network  
This error is Remote File Sharing (RFS) specific. It occurs when users try to advertise, unadvertise, mount, or unmount remote resources while the machine has not done the proper startup to connect to the network.
- 65 **ENOPKG** Package not installed  
This error occurs when users attempt to use a system call from a package which has not been installed.
- 66 **EREMOTE** Object is remote  
This error is RFS specific. It occurs when users try to advertise a resource which is not on the local machine, or try to mount/unmount a device (or pathname) that is on a remote machine.
- 67 **ENOLINK** Link has been severed  
This error is RFS specific. It occurs when the link (virtual circuit) connecting to a remote machine is gone.
- 68 **EADV** Advertise error  
This error is RFS specific. It occurs when users try to advertise a resource which has been advertised already, or try to stop RFS while there are resources still advertised, or try to force unmount a resource when it is still advertised.
- 69 **ESRMNT** Srmount error  
This error is RFS specific. It occurs when an attempt is made to stop RFS while resources are still mounted by remote machines, or when a resource is readadvertised with a client list that does not include a remote machine that currently has the resource mounted.
- 70 **ECOMM** Communication error on send  
This error is RFS specific. It occurs when the current process is waiting for a message from a remote machine, and the virtual circuit fails.

- 71 **EPROTO** Protocol error  
Some protocol error occurred. This error is device specific, but is generally not related to a hardware failure.
- 74 **EMULTIHOP** Multihop attempted  
This error is RFS specific. It occurs when users try to access remote resources which are not directly accessible.
- 76 **EDOTDOT** Error 76  
This error is RFS specific. A way for the server to tell the client that a process has transferred back from mount point.
- 77 **EBADMSG** Not a data message  
During a `read`, `getmsg`, or `ioctl` `I_RECVFD` system call to a `STREAMS` device, something has come to the head of the queue that can't be processed. That something depends on the system call:
  - `read`: control information or a passed file descriptor.
  - `getmsg`: passed file descriptor.
  - `ioctl`: control or data information.
- 78 **ENAMETOOLONG** File name too long  
The length of the path argument exceeds `PATH_MAX`, or the length of a path component exceeds `NAME_MAX` while `_POSIX_NO_TRUNC` is in effect; see `limits(4)`.
- 79 **EOVERFLOW**  
Value too large for defined data type.
- 80 **ENOTUNIQ** Name not unique on network  
Given log name not unique.
- 81 **EBADFD** File descriptor in bad state  
Either a file descriptor refers to no open file or a read request was made to a file that is open only for writing.
- 82 **EREMCHG** Remote address changed
- 83 **ELIBACC** Cannot access a needed shared library  
Trying to `exec` an `a.out` that requires a static shared library and the static shared library doesn't exist or the user doesn't have permission to use it.
- 84 **ELIBBAD** Accessing a corrupted shared library  
Trying to `exec` an `a.out` that requires a static shared library (to be linked in) and `exec` could not load the static shared library. The static shared library is probably corrupted.
- 85 **ELIBSCN** `.lib` section in `a.out` corrupted  
Trying to `exec` an `a.out` that requires a static shared library (to be linked in) and there was erroneous data in the `.lib` section of the `a.out`. The `.lib` section tells `exec` what static shared libraries are needed. The `a.out` is probably corrupted.

- 86 **ELIBMAX** Attempting to link in more shared libraries than system limit  
Trying to **exec** an **a.out** that requires more static shared libraries than is allowed on the current configuration of the system. See the *System Administrator's Guide*.
- 87 **ELIBEXEC** Cannot **exec** a shared library directly  
Attempting to **exec** a shared library directly.
- 88 **EILSEQ** Error 88  
Illegal byte sequence. Handle multiple characters as a single character.
- 89 **ENOSYS** Operation not applicable
- 90 **ELOOP** Number of symbolic links encountered during path name traversal exceeds **MAXSYMLINKS**
- 91 **ESTART** Error 91  
Interrupted system call should be restarted.
- 92 **ESTRPIPE** Error 92  
Streams pipe error (not externally visible).
- 93 **ENOTEMPTY** Directory not empty
- 94 **EUSERS** Too many users  
Too many users.
- 95 **ENOTSOCK** Socket operation on non-socket  
Self-explanatory.
- 96 **EDESTADDRREQ** Destination address required  
A required address was omitted from an operation on a transport endpoint. Destination address required.
- 97 **EMSGSIZE** Message too long  
A message sent on a transport provider was larger than the internal message buffer or some other network limit.
- 98 **EPROTOTYPE** Protocol wrong type for socket  
A protocol was specified that does not support the semantics of the socket type requested.
- 99 **ENOPROTOOPT** Protocol not available  
A bad option or level was specified when getting or setting options for a protocol.
- 120 **EPROTONOSUPPORT** Protocol not supported  
The protocol has not been configured into the system or no implementation for it exists.
- 121 **ESOCKTNOSUPPORT** Socket type not supported  
The support for the socket type has not been configured into the system or no implementation for it exists.
- 122 **EOPNOTSUPP** Operation not supported on transport endpoint  
For example, trying to accept a connection on a datagram transport endpoint.

- 123 **EPFNOSUPPORT** Protocol family not supported  
The protocol family has not been configured into the system or no implementation for it exists. Used for the Internet protocols.
- 124 **EAFNOSUPPORT** Address family not supported by protocol family  
An address incompatible with the requested protocol was used.
- 125 **EADDRINUSE** Address already in use  
User attempted to use an address already in use, and the protocol does not allow this.
- 126 **EADDRNOTAVAIL** Cannot assign requested address  
Results from an attempt to create a transport endpoint with an address not on the current machine.
- 127 **ENETDOWN** Network is down  
Operation encountered a dead network.
- 128 **ENETUNREACH** Network is unreachable  
Operation was attempted to an unreachable network.
- 129 **ENETRESET** Network dropped connection because of reset  
The host you were connected to crashed and rebooted.
- 130 **ECONNABORTED** Software caused connection abort  
A connection abort was caused internal to your host machine.
- 131 **ECONNRESET** Connection reset by peer  
A connection was forcibly closed by a peer. This normally results from a loss of the connection on the remote host due to a timeout or a reboot.
- 132 **ENOBUFS** No buffer space available  
An operation on a transport endpoint or pipe was not performed because the system lacked sufficient buffer space or because a queue was full.
- 133 **EISCONN** Transport endpoint is already connected  
A connect request was made on an already connected transport endpoint; or, a `sendto` or `sendmsg` request on a connected transport endpoint specified a destination when already connected.
- 134 **ENOTCONN** Transport endpoint is not connected  
A request to send or receive data was disallowed because the transport endpoint is not connected and (when sending a datagram) no address was supplied.
- 143 **ESHUTDOWN** Cannot send after transport endpoint shutdown  
A request to send data was disallowed because the transport endpoint has already been shut down.
- 144 **ETOOMANYREFS** Too many references: cannot splice
- 145 **ETIMEDOUT** Connection timed out  
A connect or send request failed because the connected party did not properly respond after a period of time. (The timeout period is dependent on the communication protocol.)



- 146 **ECONNREFUSED** Connection refused  
No connection could be made because the target machine actively refused it. This usually results from trying to connect to a service that is inactive on the remote host.
- 147 **EHOSTDOWN** Host is down  
A transport provider operation failed because the destination host was down.
- 148 **EHOSTUNREACH** No route to host  
A transport provider operation was attempted to an unreachable host.
- 149 **EALREADY** Operation already in progress  
An operation was attempted on a non-blocking object that already had an operation in progress.
- 150 **EINPROGRESS** Operation now in progress  
An operation that takes a long time to complete (such as a connect) was attempted on a non-blocking object.
- 151 **ESTALE** Stale NFS file handle

## DEFINITIONS

### Background Process Group

Any process group that is not the foreground process group of a session that has established a connection with a controlling terminal.

### Controlling Process

A session leader that established a connection to a controlling terminal.

### Controlling Terminal

A terminal that is associated with a session. Each session may have, at most, one controlling terminal associated with it and a controlling terminal may be associated with only one session. Certain input sequences from the controlling terminal cause signals to be sent to process groups in the session associated with the controlling terminal; see `termio(7)`.

### Directory

Directories organize files into a hierarchical system where directories are the nodes in the hierarchy. A directory is a file that catalogues the list of files, including directories (sub-directories), that are directly beneath it in the hierarchy. Entries in a directory file are called links. A link associates a file identifier with a filename. By convention, a directory contains at least two links, `.` (dot) and `..` (dot-dot). The link called dot refers to the directory itself while dot-dot refers to its parent directory. The root directory, which is the top-most node of the hierarchy, has itself as its parent directory. The pathname of the root directory is `/` and the parent directory of the root directory is `/`.

### Downstream

In a stream, the direction from stream head to driver.

### Driver

In a stream, the driver provides the interface between peripheral hardware and the stream. A driver can also be a pseudo-driver, such as a multiplexor or log driver [see `log(7)`], which is not associated with a hardware device.

**Effective User ID and Effective Group ID**

An active process has an effective user ID and an effective group ID that are used to determine file access permissions (see below). The effective user ID and effective group ID are equal to the process's real user ID and real group ID respectively, unless the process or one of its ancestors evolved from a file that had the set-user-ID bit or set-group ID bit set [see `exec(2)`].

**File Access Permissions**

Read, write, and execute/search permissions on a file are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches the user ID of the owner of the file and the appropriate access bit of the "owner" portion (0700) of the file mode is set.

The effective user ID of the process does not match the user ID of the owner of the file, but either the effective group ID or one of the supplementary group IDs of the process match the group ID of the file and the appropriate access bit of the "group" portion (0070) of the file mode is set.

The effective user ID of the process does not match the user ID of the owner of the file, and neither the effective group ID nor any of the supplementary group IDs of the process match the group ID of the file, but the appropriate access bit of the "other" portion (0007) of the file mode is set.

Otherwise, the corresponding permissions are denied.

**File Descriptor**

A file descriptor is a small integer used to do I/O on a file. The value of a file descriptor is from 0 to (`NOFILES-1`). A process may have no more than `NOFILES` file descriptors open simultaneously. A file descriptor is returned by system calls such as `open`, or `pipe`. The file descriptor is used as an argument by calls such as `read`, `write`, `ioctl`, and `close`.

**File Name**

Names consisting of 1 to `NAME_MAX` characters may be used to name an ordinary file, special file or directory.

These characters may be selected from the set of all character values excluding `\0` (null) and the ASCII code for `/` (slash).

Note that it is generally unwise to use `*`, `?`, `[`, or `]` as part of file names because of the special meaning attached to these characters by the shell [see `sh(1)`]. Although permitted, the use of unprintable characters in file names should be avoided.

A file name is sometimes referred to as a pathname component. The interpretation of a pathname component is dependent on the values of `NAME_MAX` and `_POSIX_NO_TRUNC` associated with the path prefix of that component. If any pathname component is longer than `NAME_MAX` and `_POSIX_NO_TRUNC` is in effect for the path prefix of that component [see `fpathconf(2)` and `limits(4)`], it shall be considered an error condition in that implementation. Otherwise, the implementation shall use the first `NAME_MAX` bytes of the pathname component.

**Foreground Process Group**

Each session that has established a connection with a controlling terminal will distinguish one process group of the session as the foreground process group of the controlling terminal. This group has certain privileges when accessing its controlling terminal that are denied to background process groups.

**Message**

In a stream, one or more blocks of data or information, with associated STREAMS control structures. Messages can be of several defined types, which identify the message contents. Messages are the only means of transferring data and communicating within a stream.

**Message Queue**

In a stream, a linked list of messages awaiting processing by a module or driver.

**Message Queue Identifier**

A message queue identifier (`msqid`) is a unique positive integer created by a `msgget` system call. Each `msqid` has a message queue and a data structure associated with it. The data structure is referred to as `msqid_ds` and contains the following members:

```

struct ipc_perm msg_perm;
struct msg *msg_first;
struct msg *msg_last;
ushort msg_cbytes;
ushort msg_qnum;
ushort msg_qbytes;
pid_t msg_lspid;
pid_t msg_lrpid;
time_t msg_stime;
time_t msg_rtime;
time_t msg_ctime;

```

Here are descriptions of the fields of the `msqid_ds` structure:

`msg_perm` is an `ipc_perm` structure that specifies the message operation permission (see below). This structure includes the following members:

```

uid_t cuid; /* creator user id */
gid_t cgid; /* creator group id */
uid_t uid; /* user id */
gid_t gid; /* group id */
mode_t mode; /* r/w permission */
ushort seq; /* slot usage sequence # */
key_t key; /* key */

```

`*msg_first` is a pointer to the first message on the queue.

`*msg_last` is a pointer to the last message on the queue.

`msg_cbytes` is the current number of bytes on the queue.

`msg_qnum` is the number of messages currently on the queue.

`msg_qbytes` is the maximum number of bytes allowed on the queue.

`msg_lpid` is the process ID of the last process that performed a `msgsnd` operation.

`msg_lrpid` is the process id of the last process that performed a `msgrcv` operation.

`msg_stime` is the time of the last `msgsnd` operation.

`msg_rtime` is the time of the last `msgrcv` operation

`msg_ctime` is the time of the last `msgctl` operation that changed a member of the above structure.

### Message Operation Permissions

In the `msgop` and `msgctl` system call descriptions, the permission required for an operation is given as `{token}`, where `token` is the type of permission needed, interpreted as follows:

|       |                 |
|-------|-----------------|
| 00400 | READ by user    |
| 00200 | WRITE by user   |
| 00040 | READ by group   |
| 00020 | WRITE by group  |
| 00004 | READ by others  |
| 00002 | WRITE by others |

Read and write permissions on a `msgid` are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches `msg_perm.cuid` or `msg_perm.uid` in the data structure associated with `msgid` and the appropriate bit of the "user" portion (0600) of `msg_perm.mode` is set.

The effective group ID of the process matches `msg_perm.cgid` or `msg_perm.gid` and the appropriate bit of the "group" portion (060) of `msg_perm.mode` is set.

The appropriate bit of the "other" portion (006) of `msg_perm.mode` is set.

Otherwise, the corresponding permissions are denied.

### Module

A module is an entity containing processing routines for input and output data. It always exists in the middle of a stream, between the stream's head and a driver. A module is the STREAMS counterpart to the commands in a shell pipeline except that a module contains a pair of functions which allow independent bidirectional (downstream and upstream) data flow and processing.

### Multiplexor

A multiplexor is a driver that allows streams associated with several user processes to be connected to a single driver, or several drivers to be connected to a single user process. STREAMS does not provide a general multiplexing driver, but does provide the facilities for constructing them and for connecting

multiplexed configurations of streams.

**Orphaned Process Group**

A process group in which the parent of every member in the group is either itself a member of the group, or is not a member of the process group's session.

**Path Name**

A path name is a null-terminated character string starting with an optional slash (/), followed by zero or more directory names separated by slashes, optionally followed by a file name.

If a path name begins with a slash, the path search begins at the root directory. Otherwise, the search begins from the current working directory.

A slash by itself names the root directory.

Unless specifically stated otherwise, the null path name is treated as if it named a non-existent file.

**Process ID**

Each process in the system is uniquely identified during its lifetime by a positive integer called a process ID. A process ID may not be reused by the system until the process lifetime, process group lifetime and session lifetime ends for any process ID, process group ID and session ID equal to that process ID.

**Parent Process ID**

A new process is created by a currently active process [see `fork(2)`]. The parent process ID of a process is the process ID of its creator.

**Privilege**

Having appropriate privilege means having the capability to override system restrictions.

**Process Group**

Each process in the system is a member of a process group that is identified by a process group ID. Any process that is not a process group leader may create a new process group and become its leader. Any process that is not a process group leader may join an existing process group that shares the same session as the process. A newly created process joins the process group of its parent.

**Process Group Leader**

A process group leader is a process whose process ID is the same as its process group ID.

**Process Group ID**

Each active process is a member of a process group and is identified by a positive integer called the process group ID. This ID is the process ID of the group leader. This grouping permits the signaling of related processes [see `kill(2)`].

**Process Lifetime**

A process lifetime begins when the process is forked and ends after it exits, when its termination has been acknowledged by its parent process. See `wait(2)`.

**Process Group Lifetime**

A process group lifetime begins when the process group is created by its process group leader, and ends when the lifetime of the last process in the group ends or when the last process in the group leaves the group.

**Read Queue**

In a stream, the message queue in a module or driver containing messages moving upstream.

**Real User ID and Real Group ID**

Each user allowed on the system is identified by a positive integer (0 to MAX-UID) called a real user ID.

Each user is also a member of a group. The group is identified by a positive integer called the real group ID.

An active process has a real user ID and real group ID that are set to the real user ID and real group ID, respectively, of the user responsible for the creation of the process.

**Root Directory and Current Working Directory**

Each process has associated with it a concept of a root directory and a current working directory for the purpose of resolving path name searches. The root directory of a process need not be the root directory of the root file system.

**Saved User ID and Saved Group ID**

The saved user ID and saved group ID are the values of the effective user ID and effective group ID prior to an exec of a file whose set user or set group file mode bit has been set [see exec(2)].

**Semaphore Identifier**

A semaphore identifier (`semid`) is a unique positive integer created by a `semget` system call. Each `semid` has a set of semaphores and a data structure associated with it. The data structure is referred to as `semid_ds` and contains the following members:

```

struct ipc_perm sem_perm; /* operation permission struct */
struct sem *sem_base; /* ptr to first semaphore in set */
ushort sem_nsems; /* number of sems in set */
time_t sem_otime; /* last operation time */
time_t sem_ctime; /* last change time */
 /* Times measured in secs since */
 /* 00:00:00 GMT, Jan. 1, 1970 */

```

Here are descriptions of the fields of the `semid_ds` structure:

`sem_perm` is an `ipc_perm` structure that specifies the semaphore operation permission (see below). This structure includes the following members:

```

uid_t uid; /* user id */
gid_t gid; /* group id */
uid_t cuid; /* creator user id */
gid_t cgid; /* creator group id */
mode_t mode; /* r/a permission */
ushort seq; /* slot usage sequence number */
key_t key; /* key */

```

`sem_nsems` is equal to the number of semaphores in the set. Each semaphore in the set is referenced by a nonnegative integer referred to as a `sem_num`. `sem_num` values run sequentially from 0 to the value of `sem_nsems` minus 1.

`semotime` is the time of the last `semop` operation.

`sem_ctime` is the time of the last `semctl` operation that changed a member of the above structure.

A semaphore is a data structure called `sem` that contains the following members:

```
ushort semval; /* semaphore value */
pid_t sempid; /* pid of last operation */
ushort semncnt; /* # awaiting semval > cval */
ushort semzcnt; /* # awaiting semval = 0 */
```

`semval` is a non-negative integer that is the actual value of the semaphore.

`sempid` is equal to the process ID of the last process that performed a semaphore operation on this semaphore.

`semncnt` is a count of the number of processes that are currently suspended awaiting this semaphore's `semval` to become greater than its current value.

`semzcnt` is a count of the number of processes that are currently suspended awaiting this semaphore's `semval` to become 0.

### Semaphore Operation Permissions

In the `semop` and `semctl` system call descriptions, the permission required for an operation is given as `{token}`, where `token` is the type of permission needed interpreted as follows:

```
00400 READ by user
00200 ALTER by user
00040 READ by group
00020 ALTER by group
00004 READ by others
00002 ALTER by others
```

Read and alter permissions on a `semid` are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches `sem_perm.cuid` or `sem_perm.uid` in the data structure associated with `semid` and the appropriate bit of the "user" portion (0600) of `sem_perm.mode` is set.

The effective group ID of the process matches `sem_perm.cgid` or `sem_perm.gid` and the appropriate bit of the "group" portion (060) of `sem_perm.mode` is set.

The appropriate bit of the "other" portion (06) of `sem_perm.mode` is set. Otherwise, the corresponding permissions are denied.

### Session

A session is a group of processes identified by a common ID called a session ID, capable of establishing a connection with a controlling terminal. Any process that is not a process group leader may create a new session and process group, becoming the session leader of the session and process group leader of the process group. A newly created process joins the session of its creator.

### Session ID

Each session in the system is uniquely identified during its lifetime by a positive integer called a session ID, the process ID of its session leader.

### Session Leader

A session leader is a process whose session ID is the same as its process and process group ID.

### Session Lifetime

A session lifetime begins when the session is created by its session leader, and ends when the lifetime of the last process that is a member of the session ends, or when the last process that is a member in the session leaves the session.

### Shared Memory Identifier

A shared memory identifier (`shmid`) is a unique positive integer created by a `shmget` system call. Each `shmid` has a segment of memory (referred to as a shared memory segment) and a data structure associated with it. (Note that these shared memory segments must be explicitly removed by the user after the last reference to them is removed.) The data structure is referred to as `shmid_ds` and contains the following members:

```

struct ipc_perm shm_perm; /* operation permission struct */
int shm_segsz; /* size of segment */
struct region *shm_reg; /* ptr to region structure */
char pad[4]; /* for swap compatibility */
pid_t shm_lpid; /* pid of last operation */
pid_t shm_cpid; /* creator pid */
ushort shm_nattch; /* number of current attaches */
ushort shm_cnattch; /* used only for shminfo */
time_t shm_atime; /* last attach time */
time_t shm_dtime; /* last detach time */
time_t shm_ctime; /* last change time */
/* Times measured in secs since */
/* 00:00:00 GMT, Jan. 1, 1970 */

```

Here are descriptions of the fields of the `shmid_ds` structure:

`shm_perm` is an `ipc_perm` structure that specifies the shared memory operation permission (see below). This structure includes the following members:



```

uid_t cuid; /* creator user id */
gid_t cgid; /* creator group id */
uid_t uid; /* user id */
gid_t gid; /* group id */
mode_t mode; /* r/w permission */
ushort seq; /* slot usage sequence # */
key_t key; /* key */

```

`shm_segsz` specifies the size of the shared memory segment in bytes.

`shm_cpuid` is the process ID of the process that created the shared memory identifier.

`shm_lpid` is the process ID of the last process that performed a `shmop` operation.

`shm_nattch` is the number of processes that currently have this segment attached.

`shm_atime` is the time of the last `shmat` operation [see `shmop(2)`].

`shm_dtime` is the time of the last `shmdt` operation [see `shmop(2)`].

`shm_ctime` is the time of the last `shmctl` operation that changed one of the members of the above structure.

### Shared Memory Operation Permissions

In the `shmop` and `shmctl` system call descriptions, the permission required for an operation is given as `{token}`, where `token` is the type of permission needed interpreted as follows:

```

00400 READ by user
00200 WRITE by user
00040 READ by group
00020 WRITE by group
00004 READ by others
00002 WRITE by others

```

Read and write permissions on a `shmid` are granted to a process if one or more of the following are true:

The effective user ID of the process is super-user.

The effective user ID of the process matches `shm_perm.cuid` or `shm_perm.uid` in the data structure associated with `shmid` and the appropriate bit of the "user" portion (0600) of `shm_perm.mode` is set.

The effective group ID of the process matches `shm_perm.cgid` or `shm_perm.gid` and the appropriate bit of the "group" portion (060) of `shm_perm.mode` is set.

The appropriate bit of the "other" portion (06) of `shm_perm.mode` is set.

Otherwise, the corresponding permissions are denied.

**Special Processes**

The process with ID 0 and the process with ID 1 are special processes referred to as `proc0` and `proc1`; see `kill(2)`. `proc0` is the process scheduler. `proc1` is the initialization process (`init`); `proc1` is the ancestor of every other process in the system and is used to control the process structure.

**STREAMS**

A set of kernel mechanisms that support the development of network services and data communication drivers. It defines interface standards for character input/output within the kernel and between the kernel and user level processes. The STREAMS mechanism is composed of utility routines, kernel facilities and a set of data structures.

**Stream**

A stream is a full-duplex data path within the kernel between a user process and driver routines. The primary components are a stream head, a driver and zero or more modules between the stream head and driver. A stream is analogous to a shell pipeline except that data flow and processing are bidirectional.

**Stream Head**

In a stream, the stream head is the end of the stream that provides the interface between the stream and a user process. The principle functions of the stream head are processing STREAMS-related system calls, and passing data and information between a user process and the stream.

**Super-user**

A process is recognized as a super-user process and is granted special privileges, such as immunity from file permissions, if its effective user ID is 0.

**Upstream**

In a stream, the direction from driver to stream head.

**Write Queue**

In a stream, the message queue in a module or driver containing messages moving downstream.

**NAME**

`access` – determine accessibility of a file

**SYNOPSIS**

```
#include <unistd.h>
```

```
int access(const char *path, int amode);
```

**DESCRIPTION**

*path* points to a path name naming a file. `access` checks the named file for accessibility according to the bit pattern contained in *amode*, using the real user ID in place of the effective user ID and the real group ID in place of the effective group ID. The bit pattern contained in *amode* is constructed by an OR of the following constants (defined in `<unistd.h>`):

```

R_OK read
W_OK write
X_OK execute (search)
F_OK check existence of file

```

Access to the file is denied if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied on a component of the path prefix.                                                                                                                                     |
| <b>EACCES</b>       | Permission bits of the file mode do not permit the requested access.                                                                                                                               |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space for the process.                                                                                                                            |
| <b>EINTR</b>        | A signal was caught during the <code>access</code> system call.                                                                                                                                    |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines.                                                                                                                             |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOTDIR</b>      | A component of the path prefix is not a directory.                                                                                                                                                 |
| <b>ENOENT</b>       | Read, write, or execute (search) permission is requested for a null path name.                                                                                                                     |
| <b>ENOENT</b>       | The named file does not exist.                                                                                                                                                                     |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                                           |
| <b>EROFS</b>        | Write access is requested for a file on a read-only file system.                                                                                                                                   |

**SEE ALSO**

`chmod(2)`, `stat(2)`  
 "File Access Permission" in `intro(2)`

**access(2)**

**access(2)**

**DIAGNOSTICS**

If the requested access is permitted, a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

**NAME**

acct – enable or disable process accounting

**SYNOPSIS**

```
#include <unistd.h>

int acct(const char *path);
```

**DESCRIPTION**

acct enables or disables the system process accounting routine. If the routine is enabled, an accounting record will be written in an accounting file for each process that terminates. The termination of a process can be caused by one of two things: an `exit` call or a signal [see `exit(2)` and `signal(2)`]. The effective user ID of the process calling `acct` must be superuser.

`path` points to a pathname naming the accounting file. The accounting file format is given in `acct(4)`.

The accounting routine is enabled if `path` is non-zero and no errors occur during the system call. It is disabled if `path` is `(char *)NULL` and no errors occur during the system call.

acct will fail if one or more of the following are true:

|                     |                                                                                                                                                                                                                |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | The file named by <code>path</code> is not an ordinary file.                                                                                                                                                   |
| <b>EBUSY</b>        | An attempt is being made to enable accounting using the same file that is currently being used.                                                                                                                |
| <b>EFAULT</b>       | <code>path</code> points to an illegal address.                                                                                                                                                                |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <code>path</code> .                                                                                                                                    |
| <b>ENAMETOOLONG</b> | The length of the <code>path</code> argument exceeds <code>{PATH_MAX}</code> , or the length of a <code>path</code> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOTDIR</b>      | A component of the path prefix is not a directory.                                                                                                                                                             |
| <b>ENOENT</b>       | One or more components of the accounting file pathname do not exist.                                                                                                                                           |
| <b>EPERM</b>        | The effective user of the calling process is not superuser.                                                                                                                                                    |
| <b>EROFS</b>        | The named file resides on a read-only file system.                                                                                                                                                             |

**SEE ALSO**

`exit(2)`, `signal(2)`.  
`acct(4)` in the *System Administrator's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

adjtime – correct the time to allow synchronization of the system clock

**SYNOPSIS**

```
#include <sys/time.h>

int adjtime(struct timeval *delta, struct timeval *olddelta);
```

**DESCRIPTION**

adjtime adjusts the system's notion of the current time, as returned by gettimeofday(3C), advancing or retarding it by the amount of time specified in the struct timeval pointed to by *delta*.

The adjustment is effected by speeding up (if that amount of time is positive) or slowing down (if that amount of time is negative) the system's clock by some small percentage, generally a fraction of one percent. Thus, the time is always a monotonically increasing function. A time correction from an earlier call to adjtime may not be finished when adjtime is called again. If *delta* is 0, then *olddelta* returns the status of the effects of the previous adjtime call and there is no effect on the time correction as a result of this call. If *olddelta* is not a NULL pointer, then the structure it points to will contain, upon return, the number of seconds and/or microseconds still to be corrected from the earlier call. If *olddelta* is a NULL pointer, the corresponding information will not be returned.

This call may be used in time servers that synchronize the clocks of computers in a local area network. Such time servers would slow down the clocks of some machines and speed up the clocks of others to bring them to the average network time.

Only the super-user may adjust the time of day.

The adjustment value will be silently rounded to the resolution of the system clock.

**RETURN**

A 0 return value indicates that the call succeeded. A -1 return value indicates an error occurred, and in this case an error code is stored into the global variable *errno*.

**ERRORS**

The following error codes may be set in *errno*:

|        |                                                                                                                                                                                           |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EFAULT | <i>delta</i> or <i>olddelta</i> points outside the process's allocated address space, or <i>olddelta</i> points to a region of the process' allocated address space that is not writable. |
| EPERM  | The process's effective user ID is not that of the super-user.                                                                                                                            |

**SEE ALSO**

gettimeofday(3C)  
date(1) in the *User's Reference Manual*.

**NAME**

**alarm** - set a process alarm clock

**SYNOPSIS**

```
#include <unistd.h>

unsigned alarm(unsigned sec);
```

**DESCRIPTION**

**alarm** instructs the alarm clock of the calling process to send the signal **SIGALRM** to the calling process after the number of real time seconds specified by *sec* have elapsed [see **signal(2)**].

Alarm requests are not stacked; successive calls reset the alarm clock of the calling process.

If *sec* is 0, any previously made alarm request is canceled.

**fork** sets the alarm clock of a new process to 0 [see **fork(2)**]. A process created by the **exec** family of routines inherits the time left on the old process's alarm clock.

**SEE ALSO**

**fork(2)**, **exec(2)**, **pause(2)**, **signal(2)**, **sigset(2)**.

**DIAGNOSTICS**

**alarm** returns the amount of time previously remaining in the alarm clock of the calling process.

**NAME**

**brk, sbrk** – change data segment space allocation

**SYNOPSIS**

```
#include <unistd.h>
int brk(void *endds);
void *sbrk(int incr);
```

**DESCRIPTION**

**brk** and **sbrk** are used to change dynamically the amount of space allocated for the calling process's data segment [see **exec(2)**]. The change is made by resetting the process's break value and allocating the appropriate amount of space. The break value is the address of the first location beyond the end of the data segment. The amount of allocated space increases as the break value increases. Newly allocated space is set to zero. If, however, the same memory space is reallocated to the same process its contents are undefined.

**brk** sets the break value to *endds* and changes the allocated space accordingly.

**sbrk** adds *incr* bytes to the break value and changes the allocated space accordingly. *incr* can be negative, in which case the amount of allocated space is decreased.

**brk** and **sbrk** will fail without making any change in the allocated space if one or more of the following are true:

- |               |                                                                                                                                                                                                                                                         |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENOMEM</b> | Such a change would result in more space being allocated than is allowed by the system-imposed maximum process size [see <b>ulimit(2)</b> ].                                                                                                            |
| <b>EAGAIN</b> | Total amount of system memory available for a read during physical IO is temporarily insufficient [see <b>shmop(2)</b> ]. This may occur even though the space requested was less than the system-imposed maximum process size [see <b>ulimit(2)</b> ]. |

**SEE ALSO**

**exec(2)**, **shmop(2)**, **ulimit(2)**, **end(3C)**.

**DIAGNOSTICS**

Upon successful completion, **brk** returns a value of 0 and **sbrk** returns the old break value. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.



**NAME**

chdir, fchdir - change working directory

**SYNOPSIS**

```
#include <unistd.h>

int chdir(const char *path);
int fchdir(int fildes);
```

**DESCRIPTION**

chdir and fchdir cause a directory pointed to by *path* or *fildes* to become the current working directory, the starting point for path searches for path names not beginning with /. *path* points to the path name of a directory. The *fildes* argument to fchdir is an open file descriptor of a directory.

In order for a directory to become the current directory, a process must have execute (search) access to the directory.

chdir will fail and the current working directory will be unchanged if one or more of the following are true:

|                     |                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied for any component of the path name.                                                                                                                     |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space of the process.                                                                                                              |
| <b>EINTR</b>        | A signal was caught during the execution of the chdir system call.                                                                                                                  |
| <b>EIO</b>          | An I/O error occurred while reading from or writing to the file system.                                                                                                             |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                               |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds { <b>PATH_MAX</b> }, or the length of a <i>path</i> component exceeds { <b>NAME_MAX</b> } while <b>_POSIX_NO_TRUNC</b> is in effect. |
| <b>ENOTDIR</b>      | A component of the path name is not a directory.                                                                                                                                    |
| <b>ENOENT</b>       | Either a component of the path prefix or the directory named by <i>path</i> does not exist or is a null pathname.                                                                   |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                            |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it.                                                                       |

fchdir will fail and the current working directory will be unchanged if one or more of the following are true:

|               |                                                 |
|---------------|-------------------------------------------------|
| <b>EACCES</b> | Search permission is denied for <i>fildes</i> . |
| <b>EBADF</b>  | <i>fildes</i> is not an open file descriptor.   |

## chdir(2)

## chdir(2)

|         |                                                                                           |
|---------|-------------------------------------------------------------------------------------------|
| EINTR   | A signal was caught during the execution of the <code>fchdir</code> system call.          |
| EIO     | An I/O error occurred while reading from or writing to the file system.                   |
| ENOLINK | <i>files</i> points to a remote machine and the link to that machine is no longer active. |
| ENOTDIR | The open file descriptor <i>files</i> does not refer to a directory.                      |

### SEE ALSO

`chroot(2)`.

### DIAGNOSTICS

Upon successful completion, a value of zero is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

## NAME

chmod, fchmod – change mode of file

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>

int chmod(const char *path, mode_t mode);
int fchmod(int fildes, mode_t mode);
```

## DESCRIPTION

chmod and fchmod set the access permission portion of the mode of the file whose name is given by *path* or referenced by the descriptor *fildes* to the bit pattern contained in *mode*. Access permission bits are interpreted as follows:

|         |       |                                                                                                               |
|---------|-------|---------------------------------------------------------------------------------------------------------------|
| S_ISUID | 04000 | Set user ID on execution.                                                                                     |
| S_ISGID | 020#0 | Set group ID on execution if # is 7, 5, 3, or 1<br>Enable mandatory file/record locking if # is 6, 4, 2, or 0 |
| S_ISVTX | 01000 | Save text image after execution.                                                                              |
| S_IRWXU | 00700 | Read, write, execute by owner.                                                                                |
| S_IRUSR | 00400 | Read by owner.                                                                                                |
| S_IWUSR | 00200 | Write by owner.                                                                                               |
| S_IXUSR | 00100 | Execute (search if a directory) by owner.                                                                     |
| S_IRWXG | 00070 | Read, write, execute by group.                                                                                |
| S_IRGRP | 00040 | Read by group.                                                                                                |
| S_IWGRP | 00020 | Write by group.                                                                                               |
| S_IXGRP | 00010 | Execute by group.                                                                                             |
| S_IRWXO | 00007 | Read, write, execute (search) by others.                                                                      |
| S_IROTH | 00004 | Read by others.                                                                                               |
| S_IWOTH | 00002 | Write by others                                                                                               |
| S_IXOTH | 00001 | Execute by others.                                                                                            |

Modes are constructed by OR'ing the access permission bits.

The effective user ID of the process must match the owner of the file or the process must have the appropriate privilege to change the mode of a file.

If the process is not a privileged process and the file is not a directory, mode bit 01000 (save text image on execution) is cleared.

If neither the process nor a member of the supplementary group list is privileged, and the effective group ID of the process does not match the group ID of the file, mode bit 02000 (set group ID on execution) is cleared.

If a 0410 executable file has the sticky bit (mode bit 01000) set, the operating system will not delete the program text from the swap area when the last user process terminates. If a 0413 or ELF executable file has the sticky bit set, the operating system will not delete the program text from memory when the last user process terminates. In either case, if the sticky bit is set the text will already be available (either in a swap area or in memory) when the next user of the file executes it, thus making execution faster.

If a directory is writable and has the sticky bit set, files within that directory can be removed or renamed only if one or more of the following is true [see `unlink(2)` and `rename(2)`]:

- the user owns the file
- the user owns the directory
- the file is writable by the user
- the user is a privileged user

If the mode bit 02000 (set group ID on execution) is set and the mode bit 00010 (execute or search by group) is not set, mandatory file/record locking will exist on a regular file. This may affect future calls to `open(2)`, `creat(2)`, `read(2)`, and `write(2)` on this file.

Upon successful completion, `chmod` and `fchmod` mark for update the `st_ctime` field of the file.

`chmod` will fail and the file mode will be unchanged if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied on a component of the path prefix of <i>path</i> .                                                                                                                     |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space of the process.                                                                                                                             |
| <b>EINTR</b>        | A signal was caught during execution of the system call.                                                                                                                                           |
| <b>EIO</b>          | An I/O error occurred while reading from or writing to the file system.                                                                                                                            |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it.                                                                                      |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOTDIR</b>      | A component of the prefix of <i>path</i> is not a directory.                                                                                                                                       |
| <b>ENOENT</b>       | Either a component of the path prefix, or the file referred to by <i>path</i> does not exist or is a null pathname.                                                                                |
| <b>ENOLINK</b>      | <i>fildev</i> points to a remote machine and the link to that machine is no longer active.                                                                                                         |
| <b>EPERM</b>        | The effective user ID does not match the owner of the file and the process does not have appropriate privilege.                                                                                    |
| <b>EROFS</b>        | The file referred to by <i>path</i> resides on a read-only file system.                                                                                                                            |

`fchmod` will fail and the file mode will be unchanged if:

|                |                                                                                                                 |
|----------------|-----------------------------------------------------------------------------------------------------------------|
| <b>EBADF</b>   | <i>fildev</i> is not an open file descriptor                                                                    |
| <b>EIO</b>     | An I/O error occurred while reading from or writing to the file system.                                         |
| <b>EINTR</b>   | A signal was caught during execution of the <code>fchmod</code> system call.                                    |
| <b>ENOLINK</b> | <i>path</i> points to a remote machine and the link to that machine is no longer active.                        |
| <b>EPERM</b>   | The effective user ID does not match the owner of the file and the process does not have appropriate privilege. |
| <b>EROFS</b>   | The file referred to by <i>fildev</i> resides on a read-only file system.                                       |

**SEE ALSO**

`chown(2)`, `creat(2)`, `fcntl(2)`, `mknod(2)`, `open(2)`, `read(2)`, `stat(2)`, `write(2)`, `mkfifo(3C)`, `stat(5)`.

`chmod(1)` in the *User's Reference Manual*.

The "File and Record Locking" chapter in the *Application Programmer's Guide*.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

NAME

chown, lchown, fchown – change owner and group of a file

SYNOPSIS

```
#include <unistd.h>
#include <sys/stat.h>

int chown(const char *path, uid_t owner, gid_t group);
int lchown(const char *path, uid_t owner, gid_t group);
int fchown(int fildes, uid_t owner, gid_t group);
```

DESCRIPTION

The owner *id* and group ID of the file specified by *path* or referenced by the descriptor *fildes*, are set to *owner* and *group* respectively. If *owner* or *group* is specified as -1, the corresponding ID of the file is not changed.

The function *lchown* sets the owner ID and group ID of the named file just as *chown* does, except in the case where the named file is a symbolic link. In this case *lchown* changes the ownership of the symbolic link file itself, while *chown* changes the ownership of the file or directory to which the symbolic link refers.

If *chown*, *lchown*, or *fchown* is invoked by a process other than super-user, the set-user-ID and set-group-ID bits of the file mode, *S\_ISUID* and *S\_ISGID* respectively, are cleared [see *chmod(2)*].

The operating system has a configuration option, *{\_POSIX\_CHOWN\_RESTRICTED}*, to restrict ownership changes for the *chown*, *lchown*, and *fchown* system calls. When *{\_POSIX\_CHOWN\_RESTRICTED}* is not in effect, the effective user ID of the process must match the owner of the file or the process must be the super-user to change the ownership of a file. When *{\_POSIX\_CHOWN\_RESTRICTED}* is in effect, the *chown*, *lchown*, and *fchown* system calls, for users other than super-user, prevent the owner of the file from changing the owner ID of the file and restrict the change of the group of the file to the list of supplementary group IDs.

Upon successful completion, *chown*, *fchown* and *lchown* mark for update the *st\_ctime* field of the file.

*chown* and *lchown* fail and the owner and group of the named file remain unchanged if one or more of the following are true:

- EACCES** Search permission is denied on a component of the path prefix of *path*.
- EFAULT** *path* points outside the allocated address space of the process.
- EINTR** A signal was caught during the *chown* or *lchown* system calls.
- EINVAL** *group* or *owner* is out of range.
- EIO** An I/O error occurred while reading from or writing to the file system.

|                                                                                                                   |                                                                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ELOOP                                                                                                             | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                                 |
| EMULTIHOP                                                                                                         | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it. Too many symbolic links were encountered in translating <i>path</i> .                   |
| ENAMETOOLONG                                                                                                      | The length of the <i>path</i> argument exceeds { <code>PATH_MAX</code> }, or the length of a <i>path</i> component exceeds { <code>NAME_MAX</code> } while <code>_POSIX_NO_TRUNC</code> is in effect. |
| ENOLINK                                                                                                           | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                                              |
| ENOTDIR                                                                                                           | A component of the path prefix of <i>path</i> is not a directory.                                                                                                                                     |
| ENOENT                                                                                                            | Either a component of the path prefix or the file referred to by <i>path</i> does not exist or is a null pathname.                                                                                    |
| EPERM                                                                                                             | The effective user ID does not match the owner of the file or the process is not the super-user and { <code>_POSIX_CHOWN_RESTRICTED</code> } indicates that such privilege is required.               |
| EROFS                                                                                                             | The named file resides on a read-only file system.                                                                                                                                                    |
| fchown fails and the owner and group of the named file remain unchanged if one or more of the following are true: |                                                                                                                                                                                                       |
| EBADF                                                                                                             | <i>fdes</i> is not an open file descriptor.                                                                                                                                                           |
| EINVAL                                                                                                            | <i>group</i> or <i>owner</i> is out of range.                                                                                                                                                         |
| EPERM                                                                                                             | The effective user ID does not match the owner of the file or the process is not the super-user and { <code>_POSIX_CHOWN_RESTRICTED</code> } indicates that such privilege is required.               |
| EROFS                                                                                                             | The named file referred to by <i>fdes</i> resides on a read-only file system.                                                                                                                         |
| EINTR                                                                                                             | A signal was caught during execution of the system call.                                                                                                                                              |
| EIO                                                                                                               | An I/O error occurred while reading from or writing to the file system.                                                                                                                               |
| ENOLINK                                                                                                           | <i>fdes</i> points to a remote machine and the link to that machine is no longer active.                                                                                                              |

**SEE ALSO**

chmod(2).  
chown(1), chgrp(1) in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

chroot - change root directory

**SYNOPSIS**

```
#include <unistd.h>

int chroot(const char *path);
```

**DESCRIPTION**

*path* points to a path name naming a directory. **chroot** causes the named directory to become the root directory, the starting point for path searches for path names beginning with /. The user's working directory is unaffected by the **chroot** system call.

The effective user ID of the process must be super-user to change the root directory.

The .. entry in the root directory is interpreted to mean the root directory itself. Thus, .. cannot be used to access files outside the subtree rooted at the root directory.

**chroot** will fail and the root directory will remain unchanged if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space of the process.                                                                                                                             |
| <b>EINTR</b>        | A signal was caught during the <b>chroot</b> system call.                                                                                                                                          |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it.                                                                                      |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                                           |
| <b>ENOTDIR</b>      | Any component of the path name is not a directory.                                                                                                                                                 |
| <b>ENOENT</b>       | The named directory does not exist or is a null pathname.                                                                                                                                          |
| <b>EPERM</b>        | The effective user ID is not super-user.                                                                                                                                                           |

**SEE ALSO**

**chdir(2)**.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.



**NAME**

close – close a file descriptor

**SYNOPSIS**

```
#include <unistd.h>
int close(int fildes);
```

**DESCRIPTION**

*fildes* is a file descriptor obtained from a `creat`, `open`, `dup`, `fcntl`, or `pipe` system call. `close` closes the file descriptor indicated by *fildes*. All outstanding record locks owned by the process (on the file indicated by *fildes*) are removed.

When all file descriptors associated with the open file description have been closed, the open file description is freed.

If the link count of the file is zero, when all file descriptors associated with the file have been closed, the space occupied by the file is freed and the file is no longer accessible.

If a STREAMS-based [see `intro(2)`] *fildes* is closed, and the calling process had previously registered to receive a SIGPOLL signal [see `signal(2)`] for events associated with that stream [see `I_SETSIG` in `streamio(7)`], the calling process will be unregistered for events associated with the stream. The last `close` for a stream causes the stream associated with *fildes* to be dismantled. If `O_NDELAY` and `O_NONBLOCK` are clear and there have been no signals posted for the stream, and if there are data on the module's write queue, `close` waits up to 15 seconds (for each module and driver) for any output to drain before dismantling the stream. The time delay can be changed via an `I_SETCLTIME` `ioctl` request [see `streamio(7)`]. If `O_NDELAY` or `O_NONBLOCK` is set, or if there are any pending signals, `close` does not wait for output to drain, and dismantles the stream immediately.

If *fildes* is associated with one end of a pipe, the last `close` causes a hangup to occur on the other end of the pipe. In addition, if the other end of the pipe has been named [see `fattach(3C)`], the last `close` forces the named end to be detached [see `fdetach(3C)`]. If the named end has no open processes associated with it and becomes detached, the stream associated with that end is also dismantled.

The named file is closed unless one or more of the following are true:

|                      |                                                                                        |
|----------------------|----------------------------------------------------------------------------------------|
| <code>EBADF</code>   | <i>fildes</i> is not a valid open file descriptor.                                     |
| <code>EINTR</code>   | A signal was caught during the <code>close</code> system call.                         |
| <code>ENOLINK</code> | <i>fildes</i> is on a remote machine and the link to that machine is no longer active. |

**SEE ALSO**

`creat(2)`, `dup(2)`, `exec(2)`, `fcntl(2)`, `intro(2)`, `open(2)`, `pipe(2)`, `signal(2)`, `signal(5)`, `streamio(7)`,  
`fattach(3C)`, `fdetach(3C)` in the *Programmer's Guide: Networking Interfaces*.

**close(2)**

**close(2)**

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

creat – create a new file or rewrite an existing one

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
```

```
int creat(const char *path, mode_t mode);
```

**DESCRIPTION**

creat creates a new ordinary file or prepares to rewrite an existing file named by the path name pointed to by *path*.

If the file exists, the length is truncated to 0 and the mode and owner are unchanged.

If the file does not exist the file's owner ID is set to the effective user ID of the process. The group ID of the file is set to the effective group ID of the process, or if the `S_ISGID` bit is set in the parent directory then the group ID of the file is inherited from the parent directory. The access permission bits of the file mode are set to the value of *mode* modified as follows:

If the group ID of the new file does not match the effective group ID or one of the supplementary group IDs, the `S_ISGID` bit is cleared.

All bits set in the process's file mode creation mask are cleared [see `umask(2)`].

The "save text image after execution bit" of the mode is cleared [see `chmod(2)` for the values of *mode*].

Upon successful completion, a write-only file descriptor is returned and the file is open for writing, even if the mode does not permit writing. The file pointer is set to the beginning of the file. The file descriptor is set to remain open across `exec` system calls [see `fcntl(2)`]. A new file may be created with a mode that forbids writing.

The call `creat(path, mode)` is equivalent to:

```
open(path, O_WRONLY | O_CREAT | O_TRUNC, mode)
```

creat fails if one or more of the following are true:

|               |                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b> | Search permission is denied on a component of the path prefix.                                                                          |
| <b>EACCES</b> | The file does not exist and the directory in which the file is to be created does not permit writing.                                   |
| <b>EACCES</b> | The file exists and write permission is denied.                                                                                         |
| <b>EAGAIN</b> | The file exists, mandatory file/record locking is set, and there are outstanding record locks on the file [see <code>chmod(2)</code> ]. |
| <b>EFAULT</b> | <i>path</i> points outside the allocated address space of the process.                                                                  |

**creat(2)****creat(2)**

|                     |                                                                                                                                                                                  |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EISDIR</b>       | The named file is an existing directory.                                                                                                                                         |
| <b>EINTR</b>        | A signal was caught during the <b>creat</b> system call.                                                                                                                         |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                            |
| <b>EMFILE</b>       | The process has too many open files [see <b>getrlimit(2)</b> ].                                                                                                                  |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <b>{PATH_MAX}</b> , or the length of a <i>path</i> component exceeds <b>{NAME_MAX}</b> while <b>_POSIX_NO_TRUNC</b> is in effect. |
| <b>ENOTDIR</b>      | A component of the path prefix is not a directory.                                                                                                                               |
| <b>ENOENT</b>       | A component of the path prefix does not exist.                                                                                                                                   |
| <b>ENOENT</b>       | The path name is null.                                                                                                                                                           |
| <b>EROFS</b>        | The named file resides or would reside on a read-only file system.                                                                                                               |
| <b>ETXTBSY</b>      | The file is a pure procedure (shared text) file that is being executed.                                                                                                          |
| <b>ENFILE</b>       | The system file table is full.                                                                                                                                                   |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                         |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines.                                                                                                           |
| <b>ENOSPC</b>       | The file system is out of inodes.                                                                                                                                                |

**SEE ALSO .**

**chmod(2)**, **close(2)**, **dup(2)**, **fcntl(2)**, **getrlimit(2)**, **lseek(2)**, **open(2)**, **read(2)**, **umask(2)**, **write(2)**, **stat(5)**.

**DIAGNOSTICS**

Upon successful completion a non-negative integer, namely the lowest numbered unused file descriptor, is returned. Otherwise, a value of -1 is returned, no files are created or modified, and **errno** is set to indicate the error.

**NAME**

dup – duplicate an open file descriptor

**SYNOPSIS**

```
#include <unistd.h>

int dup(int fildes);
```

**DESCRIPTION**

*fildes* is a file descriptor obtained from a `creat`, `open`, `dup`, `fcntl`, or `pipe` system call. `dup` returns a new file descriptor having the following in common with the original:

Same open file (or pipe).

Same file pointer (i.e., both file descriptors share one file pointer).

Same access mode (read, write or read/write).

The new file descriptor is set to remain open across `exec` system calls [see `fcntl(2)`].

The file descriptor returned is the lowest one available.

`dup` will fail if one or more of the following are true:

**EBADF**            *fildes* is not a valid open file descriptor.

**EINTR**           A signal was caught during the `dup` system call.

**EMFILE**          The process has too many open files [see `getrlimit(2)`].

**ENOLINK**         *fildes* is on a remote machine and the link to that machine is no longer active.

**SEE ALSO**

`close(2)`, `creat(2)`, `exec(2)`, `fcntl(2)`, `getrlimit(2)`, `open(2)`, `pipe(2)`, `dup2(3C)`, `lockf(3C)`.

**DIAGNOSTICS**

Upon successful completion a non-negative integer, namely the file descriptor, is returned. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.

**NAME**

exec: execl, execlv, execlx, execve, execlp, execlpv – execute a file

**SYNOPSIS**

```
#include <unistd.h>

int execl (const char *path, const char *arg0, ..., const char
 *argn, (char *)0);

int execlv (const char *path, char *const *argv);

int execlx (const char *path, const char *arg0, ..., const char
 *argn, (char *)0, const char *envp[]);

int execve (const char *path, char *const *argv, char *const
 *cnup);

int execlp (const char *file, const char *arg0, ..., const char
 *argn, (char *)0);

int execlpv (const char *file, char *const *argv);
```

**DESCRIPTION**

exec in all its forms overlays a new process image on an old process. The new process image is constructed from an ordinary, executable file. This file is either an executable object file, or a file of data for an interpreter. There can be no return from a successful exec because the calling process image is overlaid by the new process image.

An interpreter file begins with a line of the form

```
#! pathname [arg]
```

where *pathname* is the path of the interpreter, and *arg* is an optional argument. When an interpreter file is exec'd, the system execs the specified interpreter. The *pathname* specified in the interpreter file is passed as *arg0* to the interpreter. If *arg* was specified in the interpreter file, it is passed as *arg1* to the interpreter. The remaining arguments to the interpreter are *arg0* through *argn* of the originally exec'd file.

When a C program is executed, it is called as follows:

```
int main (int argc, char *argv[], char *envp[]);
```

where *argc* is the argument count, *argv* is an array of character pointers to the arguments themselves, and *envp* is an array of character pointers to the environment strings. As indicated, *argc* is at least one, and the first member of the array points to a string containing the name of the file.

*path* points to a path name that identifies the new process file.

*file* points to the new process file. If *file* does not contain a slash character, the path prefix for this file is obtained by a search of the directories passed in the PATH environment variable [see environ(5)]. The environment is supplied typically by the shell [see sh(1)].

If the new process file is not an executable object file, `execlp` and `execvp` use the contents of that file as standard input to `sh(1)`.

The arguments `arg0`, ..., `argn` point to null-terminated character strings. These strings constitute the argument list available to the new process image. Minimally, `arg0` must be present. It will become the name of the process, as displayed by the `ps` command. Conventionally, `arg0` points to a string that is the same as `path` (or the last component of `path`). The list of argument strings is terminated by a `(char *)0` argument.

`argv` is an array of character pointers to null-terminated strings. These strings constitute the argument list available to the new process image. By convention, `argv` must have at least one member, and it should point to a string that is the same as `path` (or its last component). `argv` is terminated by a null pointer.

`envp` is an array of character pointers to null-terminated strings. These strings constitute the environment for the new process image. `envp` is terminated by a null pointer. For `execl`, `execv`, `execvp`, and `execlp`, the C run-time start-off routine places a pointer to the environment of the calling process in the global object `extern char **environ`, and it is used to pass the environment of the calling process to the new process.

File descriptors open in the calling process remain open in the new process, except for those whose close-on-exec flag is set; [see `fcntl(2)`]. For those file descriptors that remain open, the file pointer is unchanged.

Signals that are being caught by the calling process are set to the default disposition in the new process image [see `signal(2)`]. Otherwise, the new process image inherits the signal dispositions of the calling process.

If the set-user-ID mode bit of the new process file is set [see `chmod(2)`], `exec` sets the effective user ID of the new process to the owner ID of the new process file. Similarly, if the set-group-ID mode bit of the new process file is set, the effective group ID of the new process is set to the group ID of the new process file. The real user ID and real group ID of the new process remain the same as those of the calling process.

If the effective user-ID is `root` or super-user, the set-user-ID and set-group-ID bits will be honored when the process is being controlled by `ptrace`.

The shared memory segments attached to the calling process will not be attached to the new process [see `shmop(2)`].

Profiling is disabled for the new process; see `profil(2)`.

The new process also inherits the following attributes from the calling process:

- nice value [see `nice(2)`]
- scheduler class and priority [see `prctl(2)`]
- process ID
- parent process ID
- process group ID
- supplementary group IDs

- semadj values [see `semop(2)`]
- session ID [see `exit(2)` and `signal(2)`]
- trace flag [see `ptrace(2)` request 0]
- time left until an alarm clock signal [see `alarm(2)`]
- current working directory
- root directory
- file mode creation mask [see `umask(2)`]
- resource limits [see `getrlimit(2)`]
- utime, stime, cutime, and cstime [see `times(2)`]
- file-locks [see `fcntl(2)` and `lockf(3C)`]
- controlling terminal
- process signal mask [see `sigprocmask(2)`]
- pending signals [see `sigpending(2)`]

Upon successful completion, `exec` marks for update the `st_atime` field of the file. Should the `exec` succeed, the process image file is considered to have been `open ()-ed`. The corresponding `close ()` is considered to occur at a time after this open, but before process termination or successful completion of a subsequent call to `exec`.

`exec` will fail and return to the calling process if one or more of the following are true:

- EACCES** Search permission is denied for a directory listed in the new process file's path prefix.
- E2BIG** The number of bytes in the new process's argument list is greater than the system-imposed limit of 5120 bytes. The argument list limit is sum of the size of the argument list plus the size of the environment's exported shell variables.
- EACCES** The new process file is not an ordinary file.
- EACCES** The new process file mode denies execution permission.
- EAGAIN** Total amount of system memory available when reading via raw I/O is temporarily insufficient.
- EFAULT** Required hardware is not present.
- EFAULT** An *a.out* that was compiled with the MAU or 32B flag is running on a machine without a MAU or 32B.
- EFAULT** An argument points to an illegal address.
- EINTR** A signal was caught during the `exec` system call.
- ELIBACC** Required shared library does not have execute permission.
- ELIBEXEC** Trying to `exec(2)` a shared library directly.
- ELOOP** Too many symbolic links were encountered in translating *path* or *file*.
- EMULTIHOP** Components of *path* require hopping to multiple remote machines and the file system type does not allow it.



|                     |                                                                                                                                                                                                                   |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>ENAMETOOLONG</b> | The length of the <i>file</i> or <i>path</i> argument exceeds { <b>PATH_MAX</b> }, or the length of a <i>file</i> or <i>path</i> component exceeds { <b>NAME_MAX</b> } while <b>_POSIX_NO_TRUNC</b> is in effect. |
| <b>ENOENT</b>       | One or more components of the new process path name of the file do not exist or is a null pathname.                                                                                                               |
| <b>ENOTDIR</b>      | A component of the new process path of the file prefix is not a directory.                                                                                                                                        |
| <b>ENOEXEC</b>      | The <b>exec</b> is not an <b>execlp</b> or <b>execvp</b> , and the new process file has the appropriate access permission but an invalid magic number in its header.                                              |
| <b>ETXTBSY</b>      | The new process file is a pure procedure (shared text) file that is currently open for writing by some process.                                                                                                   |
| <b>ENOMEM</b>       | The new process requires more memory than is allowed by the system-imposed maximum <b>MAXMEM</b> .                                                                                                                |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                                                          |

**SEE ALSO**

**alarm(2)**, **exit(2)**, **fcntl(2)**, **fork(2)**, **getrlimit(2)**, **nice(2)**, **prctl(2)**, **ptrace(2)**, **semop(2)**, **signal(2)**, **sigpending(2)**, **sigprocmask(2)**, **times(2)**, **umask(2)**, **lockf(3C)**, **system(3S)**, **a.out(4)**, **environ(5)**, **sh(1)**, **ps(1)** in the *User's Reference Manual*.

**DIAGNOSTICS**

If **exec** returns to the calling process, an error has occurred; the return value is -1 and **errno** is set to indicate the error.

**NAME**

exit, \_exit - terminate process

**SYNOPSIS**

```
#include <stdlib.h>
void exit(int status);
#include <unistd.h>
void _exit(int status);
```

**DESCRIPTION**

**\_exit** terminates the calling process with the following consequences:

All of the file descriptors, directory streams and message catalogue descriptors open in the calling process are closed.

A **SIGCHLD** signal is sent to the calling process's parent process.

If the parent process of the calling process has not specified the **SA\_NOCLDWAIT** flag [see **sigaction(2)**], the calling process is transformed into a "zombie process." A zombie process is a process that only occupies a slot in the process table. It has no other space allocated either in user or kernel space. The process table slot that it occupies is partially overlaid with time accounting information [see **<sys/proc.h>**] to be used by the **times** system call.

The parent process ID of all of the calling process's existing child processes and zombie processes is set to 1. This means the initialization process [see **intro(2)**] inherits each of these processes.

Each attached shared memory segment is detached and the value of **shm\_nattach** in the data structure associated with its shared memory identifier is decremented by 1.

For each semaphore for which the calling process has set a **semadj** value [see **semop(2)**], that **semadj** value is added to the **semval** of the specified semaphore.

If the process has a process, text, or data lock, an **unlock** is performed [see **plock(2)**].

An accounting record is written on the accounting file if the system's accounting routine is enabled [see **acct(2)**].

If the process is a controlling process, **SIGHUP** is sent to the foreground process group of its controlling terminal and its controlling terminal is deallocated.

If the calling process has any stopped children whose process group will be orphaned when the calling process exits, or if the calling process is a member of a process group that will be orphaned when the calling process exits, that process group will be sent **SIGHUP** and **SIGCONT** signals.

The C function **exit(3C)** calls any functions registered through the **atexit** function in the reverse order of their registration. The function **\_exit** circumvents all such functions and cleanup.

**exit(2)****exit(2)**

The symbols **EXIT\_SUCCESS** and **EXIT\_FAILURE** are defined in `stdlib.h` and may be used as the value of *status* to indicate successful or unsuccessful termination, respectively.

**SEE ALSO**

`acct(2)`, `intro(2)`, `plock(2)`, `semop(2)`, `sigaction(2)`, `signal(2)`, `times(2)`, `wait(2)`, `atexit(3C)`.

**NOTES**

See `signal(2)` NOTES.

## NAME

fcntl - file control

## SYNOPSIS

```
#include <sys/types.h>
#include <fcntl.h>
#include <unistd.h>

int fcntl (int fildes, int cmd, ... /* arg */);
```

## DESCRIPTION

fcntl provides for control over open files. *fildes* is an open file descriptor [see intro(2)].

fcntl may take a third argument, *arg*, whose data type, value and use depend upon the value of *cmd*. *cmd* specifies the operation to be performed by fcntl and may be one of the following:

- F\_DUPFD** Return a new file descriptor with the following characteristics:
- Lowest numbered available file descriptor greater than or equal to the integer value given as the third argument.
  - Same open file (or pipe) as the original file.
  - Same file pointer as the original file (i.e., both file descriptors share one file pointer).
  - Same access mode (read, write, or read/write) as the original file.
  - Shares any locks associated with the original file descriptor.
  - Same file status flags (i.e., both file descriptors share the same file status flags) as the original file.
  - The close-on-exec flag [see F\_GETFD] associated with the new file descriptor is set to remain open across exec(2) system calls.
- F\_GETFD** Get the close-on-exec flag associated with *fildes*. If the low-order bit is 0, the file will remain open across exec. Otherwise, the file will be closed upon execution of exec.
- F\_SETFD** Set the close-on-exec flag associated with *fildes* to the low-order bit of the integer value given as the third argument (0 or 1 as above).
- F\_GETFL** Get *fildes* status flags.
- F\_SETFL** Set *fildes* status flags to the integer value given as the third argument. Only certain flags can be set [see fcntl(5)].
- F\_FREESP** Free storage space associated with a section of the ordinary file *fildes*. The section is specified by a variable of data type `struct flock` pointed to by the third argument *arg*. The data type `struct flock` is defined in the `<fcntl.h>` header file [see fcntl(5)] and contains the following members: `l_whence` is 0, 1, or 2 to indicate that the relative offset `l_start` will be measured

from the start of the file, the current position, or the end of the file, respectively. `l_start` is the offset from the position specified in `l_whence`. `l_len` is the size of the section. An `l_len` of 0 frees up to the end of the file; in this case, the end of file (i.e., file size) is set to the beginning of the section freed. Any data previously written into this section is no longer accessible.

The following commands are used for record-locking. Locks may be placed on an entire file or on segments of a file.

**F\_SETLK** Set or clear a file segment lock according to the `flock` structure that `arg` points to [see `fcntl(5)`]. The `cmd` `F_SETLK` is used to establish read (`F_RDLCK`) and write (`F_WRLCK`) locks, as well as remove either type of lock (`F_UNLCK`). If a read or write lock cannot be set, `fcntl` will return immediately with an error value of `-1`.

**F\_SETLKW** This `cmd` is the same as `F_SETLK` except that if a read or write lock is blocked by other locks, `fcntl` will block until the segment is free to be locked.

**F\_GETLK** If the lock request described by the `flock` structure that `arg` points to could be created, then the structure is passed back unchanged except that the lock type is set to `F_UNLCK` and the `l_whence` field will be set to `SEEK_SET`.

If a lock is found that would prevent this lock from being created, then the structure is overwritten with a description of the first lock that is preventing such a lock from being created. The structure also contains the process ID and the system ID of the process holding the lock.

This command never creates a lock; it tests whether a particular lock could be created.

**F\_RSETLK** Used by the network lock daemon, `lockd(3N)`, to communicate with the NFS server kernel to handle locks on NFS files.

**F\_RSETLKW** Used by the network lock daemon, `lockd(3N)`, to communicate with the NFS server kernel to handle locks on NFS files.

**F\_RGETLK** Used by the network lock daemon, `lockd(3N)`, to communicate with the NFS server kernel to handle locks on NFS files.

A read lock prevents any process from write locking the protected area. More than one read lock may exist for a given segment of a file at a given time. The file descriptor on which a read lock is being placed must have been opened with read access.

A write lock prevents any process from read locking or write locking the protected area. Only one write lock and no read locks may exist for a given segment of a file at a given time. The file descriptor on which a write lock is being placed must have been opened with write access.

The `flock` structure describes the type (`l_type`), starting offset (`l_whence`), relative offset (`l_start`), size (`l_len`), process ID (`l_pid`), and system ID (`l_sysid`) of the segment of the file to be affected. The process ID and system ID fields are used only with the `F_GETLK` *cmd* to return the values for a blocking lock. Locks may start and extend beyond the current end of a file, but may not be negative relative to the beginning of the file. A lock may be set to always extend to the end of file by setting `l_len` to 0. If such a lock also has `l_whence` and `l_start` set to 0, the whole file will be locked. Changing or unlocking a segment from the middle of a larger locked segment leaves two smaller segments at either end. Locking a segment that is already locked by the calling process causes the old lock type to be removed and the new lock type to take effect. All locks associated with a file for a given process are removed when a file descriptor for that file is closed by that process or the process holding that file descriptor terminates. Locks are not inherited by a child process in a `fork(2)` system call.

When mandatory file and record locking is active on a file [see `chmod(2)`], `creat(2)`, `open(2)`, `read(2)` and `write(2)` system calls issued on the file will be affected by the record locks in effect.

`fcntl` will fail if one or more of the following are true:

|                |                                                                                                                                                                                                                                                                                                                                                          |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>  | <i>cmd</i> is <code>F_SETLK</code> , the type of lock ( <code>l_type</code> ) is a read lock ( <code>F_RDLCK</code> ) and the segment of a file to be locked is already write locked by another process, or the type is a write lock ( <code>F_WRLCK</code> ) and the segment of a file to be locked is already read or write locked by another process. |
| <b>EAGAIN</b>  | <i>cmd</i> is <code>F_FREESP</code> , the file exists, mandatory file/record locking is set, and there are outstanding record locks on the file.                                                                                                                                                                                                         |
| <b>EAGAIN</b>  | <i>cmd</i> is <code>F_SETLK</code> or <code>F_SETLKW</code> and the file is currently being mapped to virtual memory via <code>mmap</code> [see <code>mmap(2)</code> ].                                                                                                                                                                                  |
| <b>EBADF</b>   | <i>fildev</i> is not a valid open file descriptor.                                                                                                                                                                                                                                                                                                       |
| <b>EBADF</b>   | <i>cmd</i> is <code>F_SETLK</code> or <code>F_SETLKW</code> , the type of lock ( <code>l_type</code> ) is a read lock ( <code>F_RDLCK</code> ), and <i>fildev</i> is not a valid file descriptor open for reading.                                                                                                                                       |
| <b>EBADF</b>   | <i>cmd</i> is <code>F_SETLK</code> or <code>F_SETLKW</code> , the type of lock ( <code>l_type</code> ) is a write lock ( <code>F_WRLCK</code> ), and <i>fildev</i> is not a valid file descriptor open for writing.                                                                                                                                      |
| <b>EBADF</b>   | <i>cmd</i> is <code>F_FREESP</code> , and <i>fildev</i> is not a valid file descriptor open for writing.                                                                                                                                                                                                                                                 |
| <b>EDEADLK</b> | <i>cmd</i> is <code>F_SETLKW</code> , the lock is blocked by some lock from another process, and if <code>fcntl</code> blocked the calling process waiting for that lock to become free, a deadlock would occur.                                                                                                                                         |
| <b>EDEADLK</b> | <i>cmd</i> is <code>F_FREESP</code> , mandatory record locking is enabled, <code>O_NDELAY</code> and <code>O_NONBLOCK</code> are clear and a deadlock condition was detected.                                                                                                                                                                            |

|                  |                                                                                                                                                                                                                        |
|------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EFAULT</b>    | <i>cmd</i> is <b>F_FREESP</b> and the value pointed to by the third argument <i>arg</i> resulted in an address outside the process's allocated address space.                                                          |
| <b>EFAULT</b>    | <i>cmd</i> is <b>F_GETLK</b> , <b>F_SETLK</b> or <b>F_SETLKW</b> and the value pointed to by the third argument resulted in an address outside the program address space.                                              |
| <b>EINTR</b>     | A signal was caught during execution of the <code>fcntl</code> system call.                                                                                                                                            |
| <b>EIO</b>       | An I/O error occurred while reading from or writing to the file system.                                                                                                                                                |
| <b>EMFILE</b>    | <i>cmd</i> is <b>F_DUPFD</b> and the number of file descriptors currently open in the calling process is the configured value for the maximum number of open file descriptors allowed each user.                       |
| <b>EINVAL</b>    | <i>cmd</i> is <b>F_DUPFD</b> and the third argument is either negative, or greater than or equal to the configured value for the maximum number of open file descriptors allowed each user.                            |
| <b>EINVAL</b>    | <i>cmd</i> is not a valid value.                                                                                                                                                                                       |
| <b>EINVAL</b>    | <i>cmd</i> is <b>F_GETLK</b> , <b>F_SETLK</b> , or <b>F_SETLKW</b> and the third argument or the data it points to is not valid, or <i>fildev</i> refers to a file that does not support locking.                      |
| <b>ENOLCK</b>    | <i>cmd</i> is <b>F_SETLK</b> or <b>F_SETLKW</b> , the type of lock is a read or write lock, and there are no more record locks available (too many file segments locked) because the system maximum has been exceeded. |
| <b>ENOLINK</b>   | <i>fildev</i> is on a remote machine and the link to that machine is no longer active.                                                                                                                                 |
| <b>ENOLINK</b>   | <i>cmd</i> is <b>F_FREESP</b> , the file is on a remote machine, and the link to that machine is no longer active.                                                                                                     |
| <b>EOVERFLOW</b> | <i>cmd</i> is <b>F_GETLK</b> and the process ID of the process holding the requested lock is too large to be stored in the <i>l_pid</i> field.                                                                         |

**SEE ALSO**

`close(2)`, `creat(2)`, `dup(2)`, `exec(2)`, `fork(2)`, `open(2)`, `pipe(2)`, `fcntl(5)`.

The "File and Record Locking" chapter in the *Application Programmer's Guide*.

**DIAGNOSTICS**

On success, `fcntl` returns a value that depends on *cmd*:

|                 |                                                                                           |
|-----------------|-------------------------------------------------------------------------------------------|
| <b>F_DUPFD</b>  | A new file descriptor.                                                                    |
| <b>F_GETFD</b>  | Value of flag (only the low-order bit is defined). The return value will not be negative. |
| <b>F_SETFD</b>  | Value other than -1.                                                                      |
| <b>F_FREESP</b> | Value of 0.                                                                               |

|                 |                                                                    |
|-----------------|--------------------------------------------------------------------|
| <b>F_GETFL</b>  | Value of file status flags. The return value will not be negative. |
| <b>F_SETFL</b>  | Value other than -1.                                               |
| <b>F_GETLK</b>  | Value other than -1.                                               |
| <b>F_SETLK</b>  | Value other than -1.                                               |
| <b>F_SETLKW</b> | Value other than -1.                                               |

On failure, `fcntl` returns -1 and sets `errno` to indicate the error.

#### NOTES

In the future, the variable `errno` will be set to `EAGAIN` rather than `EACCES` when a section of a file is already locked by another process. Therefore, portable application programs should expect and test for either value.



**NAME**

fork – create a new process

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

pid_t fork(void);
```

**DESCRIPTION**

fork causes creation of a new process. The new process (child process) is an exact copy of the calling process (parent process). This means the child process inherits the following attributes from the parent process:

- real user ID, real group ID, effective user ID, effective group ID
- environment
- close-on-exec flag [see [exec\(2\)](#)]
- signal handling settings (i.e., SIG\_DFL, SIG\_IGN, SIG\_HOLD, function address)
- supplementary group IDs
- set-user-ID mode bit
- set-group-ID mode bit
- profiling on/off status
- nice value [see [nice\(2\)](#)]
- scheduler class [see [pricnt1\(2\)](#)]
- all attached shared memory segments [see [shmop\(2\)](#)]
- process group ID
- session ID [see [exit\(2\)](#)]
- current working directory
- root directory
- file mode creation mask [see [umask\(2\)](#)]
- resource limits [see [getrlimit\(2\)](#)]
- controlling terminal

Scheduling priority and any per-process scheduling parameters that are specific to a given scheduling class may or may not be inherited according to the policy of that particular class [see [pricnt1\(2\)](#)].

The child process differs from the parent process in the following ways:

- The child process has a unique process ID which does not match any active process group ID.

- The child process has a different parent process ID (i.e., the process ID of the parent process).

- The child process has its own copy of the parent's file descriptors and directory streams. Each of the child's file descriptors shares a common file pointer with the corresponding file descriptor of the parent.

- All `semadj` values are cleared [see [semop\(2\)](#)].

- Process locks, text locks and data locks are not inherited by the child [see [plock\(2\)](#)].

## fork(2)

## fork(2)

The child process's `tms` structure is cleared: `tms_utime`, `stime`, `cutime`, and `cstime` are set to 0 [see `times(2)`].

The time left until an alarm clock signal is reset to 0.

The set of signals pending for the child process is initialized to the empty set.

Record locks set by the parent process are not inherited by the child process [see `fcntl(2)`].

`fork` will fail and no child process will be created if one or more of the following are true:

**EAGAIN** The system-imposed limit on the total number of processes under execution by a single user would be exceeded.

**EAGAIN** Total amount of system memory available when reading via raw I/O is temporarily insufficient.

**ENOMEM** There is not enough swap space.

### SEE ALSO

`alarm(2)`, `exec(2)`, `fcntl(2)`, `getrlimit(2)`, `nice(2)`, `plock(2)`, `priocntl(2)`, `ptrace(2)`, `semop(2)`, `shmop(2)`, `signal(2)`, `times(2)`, `umask(2)`, `wait(2)`, `system(3S)`.

### DIAGNOSTICS

Upon successful completion, `fork` returns a value of 0 to the child process and returns the process ID of the child process to the parent process. Otherwise, a value of `(pid_t)-1` is returned to the parent process, no child process is created, and `errno` is set to indicate the error.

**NAME**

fpathconf, pathconf – get configurable pathname variables

**SYNOPSIS**

```
#include <unistd.h>

long fpathconf (int fildes, int name);
long pathconf (char *path, int name);
```

**DESCRIPTION**

The functions `fpathconf` and `pathconf` return the current value of a configurable limit or option associated with a file or directory. The *path* argument points to the pathname of a file or directory; *fildes* is an open file descriptor; and *name* is the symbolic constant (defined in `<unistd.h>`) representing the configurable system limit or option to be returned.

The values returned by `pathconf` and `fpathconf` depend on the type of file specified by *path* or *fildes*. The following table contains the symbolic constants supported by `pathconf` and `fpathconf` along with the POSIX defined return value. The return value is based on the type of file specified by *path* or *fildes*.

| Value of <i>name</i>              | See Note |
|-----------------------------------|----------|
| <code>_PC_LINK_MAX</code>         | 1        |
| <code>_PC_MAX_CANNON</code>       | 2        |
| <code>_PC_MAX_INPUT</code>        | 2        |
| <code>_PC_NAME_MAX</code>         | 3,4      |
| <code>_PC_PATH_MAX</code>         | 4,5      |
| <code>_PC_PIPE_BUF</code>         | 6        |
| <code>_PC_CHOWN_RESTRICTED</code> | 7        |
| <code>_PC_NO_TRUNC</code>         | 3,4      |
| <code>_PC_VDISABLE</code>         | 2        |

**Notes:**

- 1 If *path* or *fildes* refers to a directory, the value returned applies to the directory itself.
- 2 The behavior is undefined if *path* or *fildes* does not refer to a terminal file.
- 3 If *path* or *fildes* refers to a directory, the value returned applies to the filenames within the directory.
- 4 The behavior is undefined if *path* or *fildes* does not refer to a directory.
- 5 If *path* or *fildes* refers to a directory, the value returned is the maximum length of a relative pathname when the specified directory is the working directory.

- 6 If *path* or *fildev* refers to a pipe or FIFO, the value returned applies to the FIFO itself. If *path* or *fildev* refers to a directory, the value returned applies to any FIFOs that exist or can be created within the directory. If *path* or *fildev* refer to any other type of file, the behavior is undefined.
- 7 If *path* or *fildev* refers to a directory, the value returned applies to any files, other than directories, that exist or can be created within the directory.

The value of the configurable system limit or option specified by *name* does not change during the lifetime of the calling process.

fpathconf fails if the following is true:

**EBADF** *fildev* is not a valid file descriptor.

pathconf fails if one or more of the following are true:

**EACCES** search permission is denied for a component of the path prefix.

**ELOOP** too many symbolic links are encountered while translating *path*.

**EMULTIHOP** components of *path* require hopping to multiple remote machines and file system type does not allow it.

**ENAMETOOLONG**

the length of a pathname exceeds {**PATH\_MAX**}, or pathname component is longer than {**NAME\_MAX**} while (**\_POSIX\_NO\_TRUNC**) is in effect.

**ENOENT** *path* is needed for the command specified and the named file does not exist or if the *path* argument points to an empty string.

**ENOLINK** *path* points to a remote machine and the link to that machine is no longer active.

**ENOTDIR** a component of the path prefix is not a directory.

Both fpathconf and pathconf fail if the following is true:

**EINVAL** if *name* is an invalid value.

#### SEE ALSO

sysconf(3C), limits(4)

#### DIAGNOSTICS

If fpathconf or pathconf are invoked with an invalid symbolic constant or the symbolic constant corresponds to a configurable system limit or option not supported on the system, a value of -1 is returned to the invoking process. If the function fails because the configurable system limit or option corresponding to *name* is not supported on the system the value of **errno** is not changed.

**NAME**

**fsync** – synchronize a file's in-memory state with that on the physical medium

**SYNOPSIS**

```
#include <unistd.h>
```

```
int fsync(int fildes);
```

**DESCRIPTION**

**fsync** moves all modified data and attributes of *fildes* to a storage device. When **fsync** returns, all in-memory modified copies of buffers associated with *fildes* have been written to the physical medium. **fsync** is different from **sync**, which schedules disk I/O for all files but returns before the I/O completes.

**fsync** should be used by programs that require that a file be in a known state. For example, a program that contains a simple transaction facility might use **fsync** to ensure that all changes to a file or files caused by a given transaction were recorded on a storage medium.

**fsync** fails if one or more of the following are true:

- |                |                                                                                        |
|----------------|----------------------------------------------------------------------------------------|
| <b>EBADF</b>   | <i>fildes</i> is not a valid file descriptor open for writing.                         |
| <b>ENOLINK</b> | <i>fildes</i> is on a remote machine and the link on that machine is no longer active. |
| <b>EINTR</b>   | A signal was caught during execution of the <b>fsync</b> system call.                  |
| <b>EIO</b>     | An I/O error occurred while reading from or writing to the file system.                |

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

**NOTES**

The way the data reach the physical medium depends on both implementation and hardware. **fsync** returns when the device driver tells it that the write has taken place.

**SEE ALSO**

**sync(2)**

**NAME**

getcontext, setcontext – get and set current user context

**SYNOPSIS**

```
#include <ucontext.h>

int getcontext(ucontext_t *ucp);

int setcontext(ucontext_t *ucp);
```

**DESCRIPTION**

These functions, along with those defined in `makecontext(3C)`, are useful for implementing user level context switching between multiple threads of control within a process.

`getcontext` initializes the structure pointed to by `ucp` to the current user context of the calling process. The user context is defined by `ucontext(5)` and includes the contents of the calling process's machine registers, signal mask and execution stack.

`setcontext` restores the user context pointed to by `ucp`. The call to `setcontext` does not return; program execution resumes at the point specified by the context structure passed to `setcontext`. The context structure should have been one created either by a prior call to `getcontext` or `makecontext` or passed as the third argument to a signal handler [see `sigaction(2)`]. If the context structure was one created with `getcontext`, program execution continues as if the corresponding call of `getcontext` had just returned. If the context structure was one created with `makecontext`, program execution continues with the function specified to `makecontext`.

**NOTES**

When a signal handler is executed, the current user context is saved and a new context is created by the kernel. If the process leaves the signal handler via `longjmp(3C)` the original context will not be restored, and future calls to `getcontext` will not be reliable. Signal handlers should use `siglongjmp(3C)` or `setcontext` instead.

`getcontext` and `setcontext` will fail if the following is true:

**EFAULT** `ucp` points to an invalid address.

**DIAGNOSTICS**

On successful completion, `setcontext` does not return and `getcontext` returns 0. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**SEE ALSO**

`sigaction(2)`, `sigaltstack(2)`, `sigprocmask(2)`, `makecontext(3C)`, `ucontext(5)`.

**NAME**

getdents – read directory entries and put in a file system independent format

**SYNOPSIS**

```
#include <sys/dirent.h>

int getdents (int fildes, struct dirent *buf, size_t nbyte);
```

**DESCRIPTION**

*fildes* is a file descriptor obtained from an `open(2)` or `dup(2)` system call.

getdents attempts to read *nbyte* bytes from the directory associated with *fildes* and to format them as file system independent directory entries in the buffer pointed to by *buf*. Since the file system independent directory entries are of variable length, in most cases the actual number of bytes returned will be strictly less than *nbyte*. See `dirent(4)` to calculate the number of bytes.

The file system independent directory entry is specified by the `dirent` structure. For a description of this see `dirent(4)`.

On devices capable of seeking, getdents starts at a position in the file given by the file pointer associated with *fildes*. Upon return from *getdents*, the file pointer is incremented to point to the next directory entry.

This system call was developed in order to implement the `readdir` routine [for a description, see `directory(3C)`], and should not be used for other purposes.

getdents will fail if one or more of the following are true:

|                |                                                                                            |
|----------------|--------------------------------------------------------------------------------------------|
| <b>EBADF</b>   | <i>fildes</i> is not a valid file descriptor open for reading.                             |
| <b>EFAULT</b>  | <i>buf</i> points outside the allocated address space.                                     |
| <b>EINVAL</b>  | <i>nbyte</i> is not large enough for one directory entry.                                  |
| <b>ENOENT</b>  | The current file pointer for the directory is not located at a valid entry.                |
| <b>ENOLINK</b> | <i>fildes</i> points to a remote machine and the link to that machine is no longer active. |
| <b>ENOTDIR</b> | <i>fildes</i> is not a directory.                                                          |
| <b>EIO</b>     | An I/O error occurred while accessing the file system.                                     |

**SEE ALSO**

`directory(3C)`.  
`dirent(4)` in the *System Administrator's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion a non-negative integer is returned indicating the number of bytes actually read. A value of 0 indicates the end of the directory has been reached. If the system call failed, a -1 is returned and `errno` is set to indicate the error.

**NAME**

getgroups, setgroups – get or set supplementary group access list IDs

**SYNOPSIS**

```
#include <unistd.h>

int getgroups(int gidsetsize, gid_t *grouplist)
int setgroups(int ngroups, const gid_t *grouplist)
```

**DESCRIPTION**

**getgroups** gets the current supplemental group access list of the calling process and stores the result in the array of group IDs specified by *grouplist*. This array has *gidsetsize* entries and must be large enough to contain the entire list. This list cannot be greater than {NGROUPS\_MAX}. If *gidsetsize* equals 0, **getgroups** will return the number of groups to which the calling process belongs without modifying the array pointed to by *grouplist*.

**setgroups** sets the supplementary group access list of the calling process from the array of group IDs specified by *grouplist*. The number of entries is specified by *ngroups* and can not be greater than {NGROUPS\_MAX}. This function may be invoked only by the super-user.

**getgroups** will fail if:

**EINVAL** The value of *gidsetsize* is non-zero and less than the number of supplementary group IDs set for the calling process.

**setgroups** will fail if:

**EINVAL** The value of *ngroups* is greater than {NGROUPS\_MAX}.

**EPERM** The effective user ID is not super-user.

Either call will fail if:

**EFAULT** A referenced part of the array pointed to by *grouplist* is outside of the allocated address space of the process.

**SEE ALSO**

**chown(2)**, **getuid(2)**, **setuid(2)**, **initgroups(3C)**,  
**groups(1)** in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, **getgroups** returns the number of supplementary group IDs set for the calling process and **setgroups** returns the value 0. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.



**NAME**

getmsg – get next message off a stream

**SYNOPSIS**

```
#include <stropts.h>

int getmsg(int fd, struct strbuf *ctlptr,
 struct strbuf *dataptr, int *flagsp);

int getpmsg(int fd, struct strbuf *ctlptr,
 struct strbuf *dataptr, int *bandp, int *flagsp);
```

**DESCRIPTION**

getmsg retrieves the contents of a message [see intro(2)] located at the stream head read queue from a STREAMS file, and places the contents into user specified buffer(s). The message must contain either a data part, a control part, or both. The data and control parts of the message are placed into separate buffers, as described below. The semantics of each part is defined by the STREAMS module that generated the message.

The function getpmsg does the same thing as getmsg, but provides finer control over the priority of the messages received. Except where noted, all information pertaining to getmsg also pertains to getpmsg.

*fd* specifies a file descriptor referencing an open stream. *ctlptr* and *dataptr* each point to a *strbuf* structure, which contains the following members:

```
int maxlen; /* maximum buffer length */
int len; /* length of data */
char *buf; /* ptr to buffer */
```

*buf* points to a buffer in which the data or control information is to be placed, and *maxlen* indicates the maximum number of bytes this buffer can hold. On return, *len* contains the number of bytes of data or control information actually received, or 0 if there is a zero-length control or data part, or -1 if no data or control information is present in the message. *flagsp* should point to an integer that indicates the type of message the user is able to receive. This is described later.

*ctlptr* is used to hold the control part from the message and *dataptr* is used to hold the data part from the message. If *ctlptr* (or *dataptr*) is NULL or the *maxlen* field is -1, the control (or data) part of the message is not processed and is left on the stream head read queue. If *ctlptr* (or *dataptr*) is not NULL and there is no corresponding control (or data) part of the messages on the stream head read queue, *len* is set to -1. If the *maxlen* field is set to 0 and there is a zero-length control (or data) part, that zero-length part is removed from the read queue and *len* is set to 0. If the *maxlen* field is set to 0 and there are more than zero bytes of control (or data) information, that information is left on the read queue and *len* is set to 0. If the *maxlen* field in *ctlptr* or *dataptr* is less than, respectively, the control or data part of the message, *maxlen* bytes are retrieved. In this case, the remainder of the message is left on the stream head read queue and a non-zero return value is provided, as described below under DIAGNOSTICS.

By default, `getmsg` processes the first available message on the stream head read queue. However, a user may choose to retrieve only high priority messages by setting the integer pointed by `flagsp` to `RS_HIPRI`. In this case, `getmsg` processes the next message only if it is a high priority message. If the integer pointed by `flagsp` is 0, `getmsg` retrieves any message available on the stream head read queue. In this case, on return, the integer pointed to by `flagsp` will be set to `RS_HIPRI` if a high priority message was retrieved, or 0 otherwise.

For `getpmsg`, the flags are different. `flagsp` points to a bitmask with the following mutually-exclusive flags defined: `MSG_HIPRI`, `MSG_BAND`, and `MSG_ANY`. Like `getmsg`, `getpmsg` processes the first available message on the stream head read queue. A user may choose to retrieve only high-priority messages by setting the integer pointed to by `flagsp` to `MSG_HIPRI` and the integer pointed to by `bandp` to 0. In this case, `getpmsg` will only process the next message if it is a high-priority message. In a similar manner, a user may choose to retrieve a message from a particular priority band by setting the integer pointed to by `flagsp` to `MSG_BAND` and the integer pointed to by `bandp` to the priority band of interest. In this case, `getpmsg` will only process the next message if it is in a priority band equal to, or greater than, the integer pointed to by `bandp`, or if it is a high-priority message. If a user just wants to get the first message off the queue, the integer pointed to by `flagsp` should be set to `MSG_ANY` and the integer pointed to by `bandp` should be set to 0. On return, if the message retrieved was a high-priority message, the integer pointed to by `flagsp` will be set to `MSG_HIPRI` and the integer pointed to by `bandp` will be set to 0. Otherwise, the integer pointed to by `flagsp` will be set to `MSG_BAND` and the integer pointed to by `bandp` will be set to the priority band of the message.

If `O_NDELAY` and `O_NONBLOCK` are clear, `getmsg` blocks until a message of the type specified by `flagsp` is available on the stream head read queue. If `O_NDELAY` or `O_NONBLOCK` has been set and a message of the specified type is not present on the read queue, `getmsg` fails and sets `errno` to `EAGAIN`.

If a hangup occurs on the stream from which messages are to be retrieved, `getmsg` continues to operate normally, as described above, until the stream head read queue is empty. Thereafter, it returns 0 in the `len` fields of `ctlptr` and `dataptr`.

`getmsg` or `getpmsg` will fail if one or more of the following are true:

|                |                                                                                                                                                    |
|----------------|----------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EAGAIN</b>  | The <code>O_NDELAY</code> or <code>O_NONBLOCK</code> flag is set, and no messages are available.                                                   |
| <b>EBADF</b>   | <code>fd</code> is not a valid file descriptor open for reading.                                                                                   |
| <b>EBADMSG</b> | Queued message to be read is not valid for <code>getmsg</code> .                                                                                   |
| <b>EFAULT</b>  | <code>ctlptr</code> , <code>dataptr</code> , <code>bandp</code> , or <code>flagsp</code> points to a location outside the allocated address space. |
| <b>EINTR</b>   | A signal was caught during the <code>getmsg</code> system call.                                                                                    |
| <b>EINVAL</b>  | An illegal value was specified in <code>flagsp</code> , or the stream referenced by <code>fd</code> is linked under a multiplexor.                 |

**ENOSTR** A stream is not associated with *fd*.

**getmsg** can also fail if a STREAMS error message had been received at the stream head before the call to **getmsg**. The error returned is the value contained in the STREAMS error message.

**SEE ALSO**

**intro(2)**, **poll(2)**, **putmsg(2)**, **read(2)**, **write(2)**.  
*Programmer's Guide: STREAMS.*

**DIAGNOSTICS**

Upon successful completion, a non-negative value is returned. A value of 0 indicates that a full message was read successfully. A return value of **MORECTL** indicates that more control information is waiting for retrieval. A return value of **MOREDATA** indicates that more data are waiting for retrieval. A return value of **MORECTL | MOREDATA** indicates that both types of information remain. Subsequent **getmsg** calls retrieve the remainder of the message. However, if a message of higher priority has come in on the stream head read queue, the next call to **getmsg** will retrieve that higher priority message before retrieving the remainder of the previously received partial message.

**NAME**

getpid, getpgrp, getppid, getpgid – get process, process group, and parent process IDs

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

pid_t getpid(void);
pid_t getpgrp(void);
pid_t getppid(void);
pid_t getpgid(pid_t pid);
```

**DESCRIPTION**

getpid returns the process ID of the calling process.

getpgrp returns the process group ID of the calling process.

getppid returns the parent process ID of the calling process.

getpgid returns the process group ID of the process whose process ID is equal to *pid*, or the process group ID of the calling process, if *pid* is equal to zero.

getpgid will fail if one or more of the following is true:

- |              |                                                                                                                                                                                                                       |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EPERM</b> | The process whose process ID is equal to <i>pid</i> is not in the same session as the calling process, and the implementation does not allow access to the process group ID of that process from the calling process. |
| <b>ESRCH</b> | There is no process with a process ID equal to <i>pid</i> .                                                                                                                                                           |

**SEE ALSO**

exec(2), fork(2), getpid(2), getsid(2), intro(2), setpgid(2), setsid(2), setpgrp(2), signal(2).

**DIAGNOSTICS**

Upon successful completion, getpgid returns a process group ID. Otherwise, a value of (pid\_t) -1 is returned and *errno* is set to indicate the error.

**NAME**

getrlimit, setrlimit – control maximum system resource consumption

**SYNOPSIS**

```
#include <sys/time.h>
#include <sys/resource.h>

int getrlimit(int resource, struct rlimit *rlp);
int setrlimit(int resource, const struct rlimit *rlp);
```

**DESCRIPTION**

Limits on the consumption of a variety of system resources by a process and each process it creates may be obtained with `getrlimit` and set with `setrlimit`.

Each call to either `getrlimit` or `setrlimit` identifies a specific resource to be operated upon as well as a resource limit. A resource limit is a pair of values: one specifying the current (soft) limit, the other a maximum (hard) limit. Soft limits may be changed by a process to any value that is less than or equal to the hard limit. A process may (irreversibly) lower its hard limit to any value that is greater than or equal to the soft limit. Only a process with an effective user ID or superuser can raise a hard limit. Both hard and soft limits can be changed in a single call to `setrlimit` subject to the constraints described above. Limits may have an infinite value of `RLIM_INFINITY`. `rlp` is a pointer to `struct rlimit` that includes the following members:

```
 rlim_t rlim_cur; /* current (soft) limit */
 rlim_t rlim_max; /* hard limit */
```

`rlim_t` is an arithmetic data type to which objects of type `int`, `size_t`, and `off_t` can be cast without loss of information.

The possible resources, their descriptions, and the actions taken when current limit is exceeded, are summarized in the table below:

| Resources                | Description                                                                                                                       | Action                                                                                                                                              |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>RLIMIT_CORE</code> | The maximum size of a core file in bytes that may be created by a process. A limit of 0 will prevent the creation of a core file. | The writing of a core file will terminate at this size.                                                                                             |
| <code>RLIMIT_CPU</code>  | The maximum amount of CPU time in seconds used by a process.                                                                      | <code>SIGXCPU</code> is sent to the process. If the process is holding or ignoring <code>SIGXCPU</code> , the behavior is scheduling class defined. |
| <code>RLIMIT_DATA</code> | The maximum size of a process's heap in bytes.                                                                                    | <code>brk(2)</code> will fail with <code>errno</code> set to <code>ENOMEM</code> .                                                                  |

| Resources                  | Description                                                                                                             | Action                                                                                                                                                                                                                                                                                                                                   |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>RLIMIT_FSIZE</code>  | The maximum size of a file in bytes that may be created by a process. A limit of 0 will prevent the creation of a file. | <code>SIGXFSZ</code> is sent to the process. If the process is holding or ignoring <code>SIGXFSZ</code> , continued attempts to increase the size of a file beyond the limit will fail with <code>errno</code> set to <code>EFBIG</code> .                                                                                               |
| <code>RLIMIT_NOFILE</code> | The maximum number of open file descriptors that the process can have.                                                  | Functions that create new file descriptors will fail with <code>errno</code> set to <code>EMFILE</code> .                                                                                                                                                                                                                                |
| <code>RLIMIT_STACK</code>  | The maximum size of a process's stack in bytes. The system will not automatically grow the stack beyond this limit.     | <code>SIGSEGV</code> is sent to the process. If the process is holding or ignoring <code>SIGSEGV</code> , or is catching <code>SIGSEGV</code> and has not made arrangements to use an alternate stack [see <code>sigaltstack(2)</code> ], the disposition of <code>SIGSEGV</code> will be set to <code>SIG_DFL</code> before it is sent. |
| <code>RLIMIT_VMEM</code>   | The maximum size of a process's mapped address space in bytes.                                                          | <code>brk(2)</code> and <code>mmap(2)</code> functions will fail with <code>errno</code> set to <code>ENOMEM</code> . In addition, the automatic stack growth will fail with the effects outlined above.                                                                                                                                 |

Because limit information is stored in the per-process information, the shell builtin `ulimit` must directly execute this system call if it is to affect all future processes created by the shell.

The value of the current limit of the following resources affect these implementations defined constants:

| Limit                      | Implementation Defined Constant |
|----------------------------|---------------------------------|
| <code>RLIMIT_FSIZE</code>  | <code>FCHR_MAX</code>           |
| <code>RLIMIT_NOFILE</code> | <code>OPEN_MAX</code>           |

## RETURN VALUE

Upon successful completion, the function `getrlimit` returns a value of 0; otherwise, it returns a value of -1 and sets `errno` to indicate an error.

## ERRORS

Under the following conditions, the functions `getrlimit` and `setrlimit` fail and set `errno` to:

## getrlimit(2)

## getrlimit(2)

**EINVAL** if an invalid *resource* was specified; or in a `setrlimit` call, the new `rlim_cur` exceeds the new `rlim_max`.

**EPERM** if the limit specified to `setrlimit` would have raised the maximum limit value, and the caller is the superuser

### SEE ALSO

`malloc(3C)`, `open(2)`, `sigaltstack(2)`, `signal(5)`.

**NAME**

getsid – get session ID

**SYNOPSIS**

```
#include <sys/types.h>
pid_t getsid(pid_t pid);
```

**DESCRIPTION**

The function `getsid` returns the session ID of the process whose process ID is equal to *pid*. If *pid* is equal to `(pid_t)0`, `getsid` returns the session ID of the calling process.

**RETURN VALUE**

Upon successful completion, the function `getsid` returns the session ID of the specified process; otherwise, it returns a value of `(pid_t)-1` and sets `errno` to indicate an error.

**ERRORS**

Under the following conditions, the function `getsid` fails and sets `errno` to:

- EPERM** if the process whose process ID is equal to *pid* is not in the same session as the calling process, and the implementation does not allow access to the session ID of that process from the calling process.
- ESRCH** if there is no process with a process ID equal to *pid*.

**SEE ALSO**

`exec(2)`, `fork(2)`, `getpid(2)`, `setpgid(2)`, `setsid(2)`.



**NAME**

`getuid`, `geteuid`, `getgid`, `getegid` – get real user, effective user, real group, and effective group IDs

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

uid_t getuid (void);
uid_t geteuid (void);
gid_t getgid (void);
gid_t getegid (void);
```

**DESCRIPTION**

`getuid` returns the real user ID of the calling process.  
`geteuid` returns the effective user ID of the calling process.  
`getgid` returns the real group ID of the calling process.  
`getegid` returns the effective group ID of the calling process.

**SEE ALSO**

`intro(2)`, `setuid(2)`.

**NAME**

ioctl – control device

**SYNOPSIS**

```
#include <unistd.h>
int ioctl (int fildes, int request, ... /* arg */);
```

**DESCRIPTION**

ioctl performs a variety of control functions on devices and STREAMS. For non-STREAMS files, the functions performed by this call are device-specific control functions. *request* and an optional third argument with varying type are passed to the file designated by *fildes* and are interpreted by the device driver. This control is not frequently used on non-STREAMS devices, where the basic input/output functions are usually performed through the `read(2)` and `write(2)` system calls.

For STREAMS files, specific functions are performed by the `ioctl` call as described in `streamio(7)`.

*fildes* is an open file descriptor that refers to a device. *request* selects the control function to be performed and depends on the device being addressed. *arg* represents a third argument that has additional information that is needed by this specific device to perform the requested function. The data type of *arg* depends upon the particular control request, but it is either an `int` or a pointer to a device-specific data structure.

In addition to device-specific and STREAMS functions, generic functions are provided by more than one device driver, for example, the general terminal interface [see `termio(7)`].

ioctl fails for any type of file if one or more of the following are true:

- EBADF** *fildes* is not a valid open file descriptor.
- ENOTTY** *fildes* is not associated with a device driver that accepts control functions.
- EINTR** A signal was caught during the `ioctl` system call.

ioctl also fails if the device driver detects an error. In this case, the error is passed through `ioctl` without change to the caller. A particular driver might not have all of the following error cases. Under the following conditions, requests to device drivers may fail and set `errno` to:

- EFAULT** *request* requires a data transfer to or from a buffer pointed to by *arg*, but some part of the buffer is outside the process's allocated space.
- EINVAL** *request* or *arg* is not valid for this device.
- EIO** Some physical I/O error has occurred.
- ENXIO** The *request* and *arg* are valid for this device driver, but the service requested can not be performed on this particular subdevice.

**ioctl(2)**

**ioctl(2)**

**ENOLINK** *files* is on a remote machine and the link to that machine is no longer active.

STREAMS errors are described in **streamio(7)**.

**SEE ALSO**

**streamio(7)** in the *Programmer's Guide: STREAMS*.

**termio(7)** in the *System Administrator's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, the value returned depends upon the device control function, but must be a non-negative integer. Otherwise, a value of  $-1$  is returned and **errno** is set to indicate the error.

**NAME**

kill – send a signal to a process or a group of processes.

**SYNOPSIS**

```
#include <sys/types.h>
#include <signal.h>

int kill (pid_t pid, int sig);
```

**DESCRIPTION**

kill sends a signal to a process or a group of processes. The process or group of processes to which the signal is to be sent is specified by *pid*. The signal that is to be sent is specified by *sig* and is either one from the list given in **signal** [see **signal(5)**], or 0. If *sig* is 0 (the null signal), error checking is performed but no signal is actually sent. This can be used to check the validity of *pid*.

The real or effective user ID of the sending process must match the real or saved [from **exec(2)**] user ID of the receiving process unless the effective user ID of the sending process is superuser, [see **intro(2)**], or *sig* is SIGCONT and the sending process has the same session ID as the receiving process.

The process with ID 0 and the process with ID 1 are special processes [see **intro(2)**] and will be referred to below as *proc0* and *proc1*, respectively.

If *pid* is greater than 0, *sig* will be sent to the process whose process ID is equal to *pid*. *pid* may equal 1.

If *pid* is negative but not (pid\_t)-1, *sig* will be sent to all processes whose process group ID is equal to the absolute value of *pid* and for which the process has permission to send a signal.

If *pid* is 0, *sig* will be sent to all processes excluding *proc0* and *proc1* whose process group ID is equal to the process group ID of the sender. Permission is needed to send a signal to process groups.

If *pid* is (pid\_t)-1 and the effective user ID of the sender is not superuser, *sig* will be sent to all processes excluding *proc0* and *proc1* whose real user ID is equal to the effective user ID of the sender.

If *pid* is (pid\_t)-1 and the effective user ID of the sender is superuser, *sig* will be sent to all processes excluding *proc0* and *proc1*.

kill will fail and no signal will be sent if one or more of the following are true:

- |               |                                                                                                                                                                                                                                                         |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | <i>sig</i> is not a valid signal number.                                                                                                                                                                                                                |
| <b>EINVAL</b> | <i>sig</i> is SIGKILL and <i>pid</i> is (pid_t)1 (i.e., <i>pid</i> specifies <i>proc1</i> ).                                                                                                                                                            |
| <b>ESRCH</b>  | No process or process group can be found corresponding to that specified by <i>pid</i> .                                                                                                                                                                |
| <b>EPERM</b>  | The user ID of the sending process is not privileged, and its real or effective user ID does not match the real or saved user ID of the receiving process, and the calling process is not sending SIGCONT to a process that shares the same session ID. |

**kill(2)**

**kill(2)**

**SEE ALSO**

`getpid(2)`, `intro(2)`, `setpgrp(2)`, `signal(2)`, `getsid(2)`, `sigsend(2)`, `sigaction(2)`.

`kill(1)` in the *User's Reference Manual*.

**NOTES**

`sigsend` is a more versatile way to send signals to processes. The user is encouraged to use `sigsend` instead of `kill`.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

link - link to a file

**SYNOPSIS**

```
#include <unistd.h>
```

```
int link(const char *path1, const char *path2);
```

**DESCRIPTION**

*path1* points to a path name naming an existing file. *path2* points to a path name naming the new directory entry to be created. **link** creates a new link (directory entry) for the existing file and increments its link count by one.

Upon successful completion, **link** marks for update the `st_ctime` field of the file. Also, the `st_ctime` and `st_mtime` fields of the directory that contains the new entry are marked for update.

**link** will fail and no link will be created if one or more of the following are true:

|                     |                                                                                                                                                                                                                                      |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | A component of either path prefix denies search permission.                                                                                                                                                                          |
| <b>EACCES</b>       | The requested link requires writing in a directory with a mode that denies write permission.                                                                                                                                         |
| <b>EEXIST</b>       | The link named by <i>path2</i> exists.                                                                                                                                                                                               |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space of the process.                                                                                                                                                               |
| <b>EINTR</b>        | A signal was caught during the <b>link</b> system call.                                                                                                                                                                              |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                                                                |
| <b>EMLINK</b>       | The maximum number of links to a file would be exceeded.                                                                                                                                                                             |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it.                                                                                                                        |
| <b>ENAMETOOLONG</b> | The length of the <i>path1</i> or <i>path2</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path1</i> or <i>path2</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOTDIR</b>      | A component of either path prefix is not a directory.                                                                                                                                                                                |
| <b>ENOENT</b>       | <i>path1</i> or <i>path2</i> is a null path name.                                                                                                                                                                                    |
| <b>ENOENT</b>       | A component of either path prefix does not exist.                                                                                                                                                                                    |
| <b>ENOENT</b>       | The file named by <i>path1</i> does not exist.                                                                                                                                                                                       |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                                                                             |
| <b>ENOSPC</b>       | the directory that would contain the link cannot be extended.                                                                                                                                                                        |
| <b>EPERM</b>        | The file named by <i>path1</i> is a directory and the effective user ID is not super-user.                                                                                                                                           |

## link(2)

## llink(2)

**EROFS** The requested link requires writing in a directory on a read-only file system.

**EXDEV** The link named by *path2* and the file named by *path1* are on different logical devices (file systems).

### SEE ALSO

`unlink(2)`.

### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

`lseek` – move read/write file pointer

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

off_t lseek (int fd, off_t offset, int whence);
```

**DESCRIPTION**

*fd* is a file descriptor returned from a `creat`, `open`, `dup`, or `fcntl` system call. `lseek` sets the file pointer associated with *fd* as follows:

If *whence* is `SEEK_SET`, the pointer is set to *offset* bytes.

If *whence* is `SEEK_CUR`, the pointer is set to its current location plus *offset*.

If *whence* is `SEEK_END`, the pointer is set to the size of the file plus *offset*.

On success, `lseek` returns the resulting pointer location, as measured in bytes from the beginning of the file. Note that if *fd* is a remote file descriptor and *offset* is negative, `lseek` returns the file pointer even if it is negative.

`lseek` allows the file pointer to be set beyond the existing data in the file. If data are later written at this point, subsequent reads in the gap between the previous end of data and the newly written data will return bytes of value 0 until data are written into the gap.

`lseek` fails and the file pointer remains unchanged if one or more of the following are true:

- EBADF** *fd* is not an open file descriptor.
- ESPIPE** *fd* is associated with a pipe or fifo.
- EINVAL** *whence* is not `SEEK_SET`, `SEEK_CUR`, or `SEEK_END`. The process also gets a `SIGSYS` signal.
- EINVAL** *fd* is not a remote file descriptor, and the resulting file pointer would be negative.

Some devices are incapable of seeking. The value of the file pointer associated with such a device is undefined.

**SEE ALSO**

`creat(2)`, `dup(2)`, `fcntl(2)`, `open(2)`.

**DIAGNOSTICS**

Upon successful completion, a non-negative integer indicating the file pointer value is returned. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.



**NAME**

`memcntl` - memory management control

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/mman.h>

int memcntl(caddr_t addr, size_t len, int cmd, caddr_t arg,
 int attr, int mask);
```

**DESCRIPTION**

The function `memcntl` allows the calling process to apply a variety of control operations over the address space identified by the mappings established for the address range [*addr*, *addr + len*).

*addr* must be a multiple of the pagesize as returned by `sysconf(3C)`. The scope of the control operations can be further defined with additional selection criteria (in the form of attributes) according to the bit pattern contained in *attr*.

The following attributes specify page mapping selection criteria:

|                      |                         |
|----------------------|-------------------------|
| <code>SHARED</code>  | Page is mapped shared.  |
| <code>PRIVATE</code> | Page is mapped private. |

The following attributes specify page protection selection criteria:

|                         |                       |
|-------------------------|-----------------------|
| <code>PROT_READ</code>  | Page can be read.     |
| <code>PROT_WRITE</code> | Page can be written.  |
| <code>PROT_EXEC</code>  | Page can be executed. |

The selection criteria are constructed by an OR of the attribute bits and must match exactly.

In addition, the following criteria may be specified:

|                        |              |
|------------------------|--------------|
| <code>PROC_TEXT</code> | process text |
| <code>PROC_DATA</code> | process data |

where `PROC_TEXT` specifies all privately mapped segments with read and execute permission, and `PROC_DATA` specifies all privately mapped segments with write permission.

Selection criteria can be used to describe various abstract memory objects within the address space on which to operate. If an operation shall not be constrained by the selection criteria, *attr* must have the value 0.

The operation to be performed is identified by the argument *cmd*. The symbolic names for the operations are defined in `<sys/mman.h>` as follows:

|                      |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>MC_LOCK</code> | Lock in memory all pages in the range with attributes <i>attr</i> . A given page may be locked multiple times through different mappings; however, within a given mapping, page locks do not nest. Multiple lock operations on the same address in the same process will all be removed with a single unlock operation. A page locked in one process and mapped in another (or visible through a different mapping in the locking process) is locked in memory as long as the locking process does neither an implicit |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

nor explicit unlock operation. If a locked mapping is removed, or a page is deleted through file removal or truncation, an unlock operation is implicitly performed. If a writable `MAP_PRIVATE` page in the address range is changed, the lock will be transferred to the private page.

At present *arg* is unused, but must be 0 to ensure compatibility with potential future enhancements.

**MC\_LOCKAS**

Lock in memory all pages mapped by the address space with attributes *attr*. At present *addr* and *len* are unused, but must be `NULL` and 0 respectively, to ensure compatibility with potential future enhancements. *arg* is a bit pattern built from the flags:

|                          |                       |
|--------------------------|-----------------------|
| <code>MCL_CURRENT</code> | Lock current mappings |
| <code>MCL_FUTURE</code>  | Lock future mappings  |

The value of *arg* determines whether the pages to be locked are those currently mapped by the address space, those that will be mapped in the future, or both. If `MCL_FUTURE` is specified, then all mappings subsequently added to the address space will be locked, provided sufficient memory is available.

**MC\_SYNC**

Write to their backing storage locations all modified pages in the range with attributes *attr*. Optionally, invalidate cache copies. The backing storage for a modified `MAP_SHARED` mapping is the file the page is mapped to; the backing storage for a modified `MAP_PRIVATE` mapping is its swap area. *arg* is a bit pattern built from the flags used to control the behavior of the operation:

|                            |                             |
|----------------------------|-----------------------------|
| <code>MS_ASYNC</code>      | perform asynchronous writes |
| <code>MS_SYNC</code>       | perform synchronous writes  |
| <code>MS_INVALIDATE</code> | invalidate mappings         |

`MS_ASYNC` returns immediately once all write operations are scheduled; with `MS_SYNC` the system call will not return until all write operations are completed.

`MS_INVALIDATE` invalidates all cached copies of data in memory, so that further references to the pages will be obtained by the system from their backing storage locations. This operation should be used by applications that require a memory object to be in a known state.

**MC\_UNLOCK**

Unlock all pages in the range with attributes *attr*. At present *arg* is unused, but must be 0 to ensure compatibility with potential future enhancements.

**MC\_UNLOCKAS**

Remove address space memory locks, and locks on all pages in the address space with attributes *attr*. At present *addr*, *len*, and *arg* are unused, but must be `NULL`, 0 and 0 respectively, to ensure compatibility with potential future enhancements.

The *mask* argument must be zero; it is reserved for future use.

Locks established with the lock operations are not inherited by a child process after `fork`. `memcntl` fails if it attempts to lock more memory than a system-specific limit.

Due to the potential impact on system resources, all operations, with the exception of `MC_SYNC`, are restricted to processes with superuser effective user ID. The `memcntl` function subsumes the operations of `plock` and `mctl`.

#### RETURN VALUE

Upon successful completion, the function `memcntl` returns a value of 0; otherwise, it returns a value of -1 and sets `errno` to indicate an error.

#### ERRORS

Under the following conditions, the function `memcntl` fails and sets `errno` to:

- EAGAIN** if some or all of the memory identified by the operation could not be locked when `MC_LOCK` or `MC_LOCKAS` is specified.
- EBUSY** if some or all the addresses in the range `[addr, addr + len)` are locked and `MC_SYNC` with `MS_INVALIDATE` option is specified.
- EINVAL** if `addr` is not a multiple of the page size as returned by `sysconf`.
- EINVAL** if `addr` and/or `len` do not have the value 0 when `MC_LOCKAS` or `MC_UNLOCKAS` is specified.
- EINVAL** if `arg` is not valid for the function specified.
- EINVAL** if invalid selection criteria are specified in `attr`.
- ENOMEM** if some or all the addresses in the range `[addr, addr + len)` are invalid for the address space of the process or pages not mapped are specified.
- EPERM** if the process's effective user ID is not superuser and one of `MC_LOCK`, `MC_LOCKAS`, `MC_UNLOCK`, `MC_UNLOCKAS` was specified.

#### SEE ALSO

`mmap(2)`, `mprotect(2)`, `plock(2)`, `sysconf(2)`, `mlock(3C)`, `mlockall(3C)`, `msync(3C)`.

**NAME**

mincore – determine residency of memory pages

**SYNOPSIS**

```
#include <unistd.h>
int mincore(caddr_t addr, size_t len, char *vec);
```

**DESCRIPTION**

mincore returns the primary memory residency status of pages in the address space covered by mappings in the range [*addr*, *addr* + *len*). The status is returned as a character-per-page in the character array referenced by *\*vec* (which the system assumes to be large enough to encompass all the pages in the address range). The least significant bit of each character is set to 1 to indicate that the referenced page is in primary memory, 0 if it is not. The settings of other bits in each character are undefined and may contain other information in future implementations.

mincore returns residency information that is accurate at an instant in time. Because the system may frequently adjust the set of pages in memory, this information may quickly be outdated. Only locked pages are guaranteed to remain in memory; see `mementl(2)`.

**RETURN VALUE**

mincore returns 0 on success, -1 on failure.

**ERRORS**

mincore fails if:

- |               |                                                                                                                                                                      |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EFAULT</b> | <i>*vec</i> includes an out-of-range or otherwise inaccessible address.                                                                                              |
| <b>EINVAL</b> | <i>addr</i> is not a multiple of the page size as returned by <code>sysconf(3C)</code> .                                                                             |
| <b>EINVAL</b> | The argument <i>len</i> has a value less than or equal to 0.                                                                                                         |
| <b>ENOMEM</b> | Addresses in the range [ <i>addr</i> , <i>addr</i> + <i>len</i> ) are invalid for the address space of a process, or specify one or more pages which are not mapped. |

**SEE ALSO**

`mlock(3C)`, `mmap(2)`, `sysconf(3C)`.

**NAME**

`mknod` - make a directory

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>

int mknod(const char *path, mode_t mode);
```

**DESCRIPTION**

`mknod` creates a new directory named by the path name pointed to by *path*. The mode of the new directory is initialized from *mode* [see `chmod(2)` for values of mode]. The protection part of the *mode* argument is modified by the process's file creation mask [see `umask(2)`].

The directory's owner ID is set to the process's effective user ID. The directory's group ID is set to the process's effective group ID, or if the `S_ISGID` bit is set in the parent directory, then the group ID of the directory is inherited from the parent. The `S_ISGID` bit of the new directory is inherited from the parent directory.

If *path* is a symbolic link, it is not followed.

The newly created directory is empty with the exception of entries for itself (..) and its parent directory (..).

Upon successful completion, `mknod` marks for update the `st_atime`, `st_ctime` and `st_mtime` fields of the directory. Also, the `st_ctime` and `st_mtime` fields of the directory that contains the new entry are marked for update.

`mknod` fails and creates no directory if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Either a component of the path prefix denies search permission or write permission is denied on the parent directory of the directory to be created.                                               |
| <b>EEXIST</b>       | The named file already exists.                                                                                                                                                                     |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space of the process.                                                                                                                             |
| <b>EIO</b>          | An I/O error has occurred while accessing the file system.                                                                                                                                         |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMLINK</b>       | The maximum number of links to the parent directory would be exceeded.                                                                                                                             |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and the file system type does not allow it.                                                                                  |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |

## mkdIr(2)

## mkdIr(2)

|                |                                                                                          |
|----------------|------------------------------------------------------------------------------------------|
| <b>ENOENT</b>  | A component of the path prefix does not exist or is a null pathname.                     |
| <b>ENOLINK</b> | <i>path</i> points to a remote machine and the link to that machine is no longer active. |
| <b>ENOSPC</b>  | No free space is available on the device containing the directory.                       |
| <b>ENO'DIR</b> | A component of the path prefix is not a directory.                                       |
| <b>EROFS</b>   | The path prefix resides on a read-only file system.                                      |

### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned, and `errno` is set to indicate the error.

### SEE ALSO

`chmod(2)`, `mknod(2)`, `umask(2)`, `stat(5)`.

**NAME**

**mknod** – make a directory, or a special or ordinary file

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>

int mknod(const char *path, mode_t mode, dev_t dev);
```

**DESCRIPTION**

**mknod** creates a new file named by the path name pointed to by *path*. The file type and permissions of the new file are initialized from *mode*.

The file type is specified in *mode* by the **S\_IFMT** bits, which must be set to one of the following values:

|                |                   |
|----------------|-------------------|
| <b>S_IFIFO</b> | fifo special      |
| <b>S_IFCHR</b> | character special |
| <b>S_IFDIR</b> | directory         |
| <b>S_IFBLK</b> | block special     |
| <b>S_IFREG</b> | ordinary file     |

The file access permissions are specified in *mode* by the 0007777 bits, and may be constructed by an OR of the following values:

|                |       |                                                                                                               |
|----------------|-------|---------------------------------------------------------------------------------------------------------------|
| <b>S_ISUID</b> | 04000 | Set user ID on execution.                                                                                     |
| <b>S_ISGID</b> | 020#0 | Set group ID on execution if # is 7, 5, 3, or 1<br>Enable mandatory file/record locking if # is 6, 4, 2, or 0 |
| <b>S_ISVTX</b> | 01000 | Save text image after execution.                                                                              |
| <b>S_IRWXU</b> | 00700 | Read, write, execute by owner.                                                                                |
| <b>S_IRUSR</b> | 00400 | Read by owner.                                                                                                |
| <b>S_IWUSR</b> | 00200 | Write by owner.                                                                                               |
| <b>S_IXUSR</b> | 00100 | Execute (search if a directory) by owner.                                                                     |
| <b>S_IRWXG</b> | 00070 | Read, write, execute by group.                                                                                |
| <b>S_IRGRP</b> | 00040 | Read by group.                                                                                                |
| <b>S_IWGRP</b> | 00020 | Write by group.                                                                                               |
| <b>S_IXGRP</b> | 00010 | Execute by group.                                                                                             |
| <b>S_IRWXO</b> | 00007 | Read, write, execute (search) by others.                                                                      |
| <b>S_IROTH</b> | 00004 | Read by others.                                                                                               |
| <b>S_IWOTH</b> | 00002 | Write by others                                                                                               |
| <b>S_IXOTH</b> | 00001 | Execute by others.                                                                                            |

The owner ID of the file is set to the effective user ID of the process. The group ID of the file is set to the effective group ID of the process. However, if the **S\_ISGID** bit is set in the parent directory, then the group ID of the file is inherited from the parent. If the group ID of the new file does not match the effective group ID or one of the supplementary group IDs, the **S\_ISGID** bit is cleared.

The access permission bits of *mode* are modified by the process's file mode creation mask: all bits set in the process's file mode creation mask are cleared [see **umask(2)**]. If *mode* indicates a block or character special file, *dev* is a configuration-dependent specification of a character or block I/O device. If *mode* does not indicate a block special or character special device, *dev* is ignored. See **mkdev(3C)**.

`mknod` may be invoked only by a privileged user for file types other than FIFO special.

If *path* is a symbolic link, it is not followed.

`mknod` fails and creates no new file if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EEXIST</b>       | The named file exists.                                                                                                                                                                             |
| <b>EINVAL</b>       | <i>dev</i> is invalid.                                                                                                                                                                             |
| <b>EFAULT</b>       | <i>path</i> points outside the allocated address space of the process.                                                                                                                             |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and the file system type does not allow it.                                                                                  |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOTDIR</b>      | A component of the path prefix is not a directory.                                                                                                                                                 |
| <b>ENOENT</b>       | A component of the path prefix does not exist or is a null pathname.                                                                                                                               |
| <b>EPERM</b>        | The effective user ID of the process is not super-user.                                                                                                                                            |
| <b>EROFS</b>        | The directory in which the file is to be created is located on a read-only file system.                                                                                                            |
| <b>ENOSPC</b>       | No space is available.                                                                                                                                                                             |
| <b>EINTR</b>        | A signal was caught during the <code>mknod</code> system call.                                                                                                                                     |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                                           |

#### SEE ALSO

`chmod(2)`, `exec(2)`, `umask(2)`, `mkdev(3C)`, `mkfifo(3C)`, `fs(4)`, `stat(5)`, `mkdir(1)` in the *User's Reference Manual*.

#### DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

#### NOTES

If `mknod` creates a device in a remote directory using Remote File Sharing, the major and minor device numbers are interpreted by the server.



## NAME

`mmap` - map pages of memory

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/mman.h>

caddr_t mmap(caddr_t addr, size_t len, int prot, int flags, int fd,
 off_t off);
```

## DESCRIPTION

The function `mmap` establishes a mapping between a process's address space and a virtual memory object. The format of the call is as follows:

```
pa = mmap(addr, len, prot, flags, fd, off);
```

`mmap` establishes a mapping between the process's address space at an address *pa* for *len* bytes to the memory object represented by the file descriptor *fd* at offset *off* for *len* bytes. The value of *pa* is an implementation-dependent function of the parameter *addr* and values of *flags*, further described below. A successful `mmap` call returns *pa* as its result. The address ranges covered by [*pa*, *pa* + *len*) and [*off*, *off* + *len*) must be legitimate for the possible (not necessarily current) address space of a process and the object in question, respectively. `mmap` cannot grow a file.

The mapping established by `mmap` replaces any previous mappings for the process's pages in the range [*pa*, *pa* + *len*).

The parameter *prot* determines whether read, write, execute, or some combination of accesses are permitted to the pages being mapped. The protection options are defined in `<sys/mman.h>` as:

|                         |                           |
|-------------------------|---------------------------|
| <code>PROT_READ</code>  | Page can be read.         |
| <code>PROT_WRITE</code> | Page can be written.      |
| <code>PROT_EXEC</code>  | Page can be executed.     |
| <code>PROT_NONE</code>  | Page can not be accessed. |

Not all implementations literally provide all possible combinations. `PROT_WRITE` is often implemented as `PROT_READ|PROT_WRITE` and `PROT_EXEC` as `PROT_READ|PROT_EXEC`. However, no implementation will permit a write to succeed where `PROT_WRITE` has not been set. The behavior of `PROT_WRITE` can be influenced by setting `MAP_PRIVATE` in the *flags* parameter, described below.

The parameter *flags* provides other information about the handling of the mapped pages. The options are defined in `<sys/mman.h>` as:

|                          |                                |
|--------------------------|--------------------------------|
| <code>MAP_SHARED</code>  | Share changes.                 |
| <code>MAP_PRIVATE</code> | Changes are private.           |
| <code>MAP_FIXED</code>   | Interpret <i>addr</i> exactly. |

`MAP_SHARED` and `MAP_PRIVATE` describe the disposition of write references to the memory object. If `MAP_SHARED` is specified, write references will change the memory object. If `MAP_PRIVATE` is specified, the initial write reference will create a private copy of the memory object page and redirect the mapping to the copy. Either `MAP_SHARED` or `MAP_PRIVATE` must be specified, but not both. The mapping type is retained across a `fork(2)`.

Note that the private copy is not created until the first write; until then, other users who have the object mapped `MAP_SHARED` can change the object.

`MAP_FIXED` informs the system that the value of *pa* must be *addr*, exactly. The use of `MAP_FIXED` is discouraged, as it may prevent an implementation from making the most effective use of system resources.

When `MAP_FIXED` is not set, the system uses *addr* in an implementation-defined manner to arrive at *pa*. The *pa* so chosen will be an area of the address space which the system deems suitable for a mapping of *len* bytes to the specified object. All implementations interpret an *addr* value of zero as granting the system complete freedom in selecting *pa*, subject to constraints described below. A non-zero value of *addr* is taken to be a suggestion of a process address near which the mapping should be placed. When the system selects a value for *pa*, it will never place a mapping at address 0, nor will it replace any extant mapping, nor map into areas considered part of the potential data or stack segments.

The parameter *off* is constrained to be aligned and sized according to the value returned by `sysconf`. When `MAP_FIXED` is specified, the parameter *addr* must also meet these constraints. The system performs mapping operations over whole pages. Thus, while the parameter *len* need not meet a size or alignment constraint, the system will include, in any mapping operation, any partial page specified by the range [*pa*, *pa* + *len*).

The system will always zero-fill any partial page at the end of an object. Further, the system will never write out any modified portions of the last page of an object which are beyond its end. References to whole pages following the end of an object will result in the delivery of a SIGBUS signal. SIGBUS signals may also be delivered on various file system conditions, including quota exceeded errors.

#### RETURN VALUE

On success, `mmap` returns the address at which the mapping was placed (*pa*). On failure it returns (`caddr_t`)-1 and sets `errno` to indicate an error.

#### ERRORS

Under the following conditions, `mmap` fails and sets `errno` to:

|                     |                                                                                                                                                                                                  |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>EAGAIN</code> | The mapping could not be locked in memory.                                                                                                                                                       |
| <code>EBADF</code>  | <i>fd</i> is not open.                                                                                                                                                                           |
| <code>EACCES</code> | <i>fd</i> is not open for read, regardless of the protection specified, or <i>fd</i> is not open for write and <code>PROT_WRITE</code> was specified for a <code>MAP_SHARED</code> type mapping. |
| <code>ENXIO</code>  | Addresses in the range [ <i>off</i> , <i>off</i> + <i>len</i> ) are invalid for <i>fd</i> .                                                                                                      |
| <code>EINVAL</code> | The arguments <i>addr</i> (if <code>MAP_FIXED</code> was specified) or <i>off</i> are not multiples of the page size as returned by <code>sysconf</code> .                                       |
| <code>EINVAL</code> | The field in <i>flags</i> is invalid (neither <code>MAP_PRIVATE</code> or <code>MAP_SHARED</code> ).                                                                                             |
| <code>EINVAL</code> | The argument <i>len</i> has a value less than or equal to 0.                                                                                                                                     |
| <code>ENODEV</code> | <i>fd</i> refers to an object for which <code>mmap</code> is meaningless, such as a terminal.                                                                                                    |

**ENOMEM** `MAP_FIXED` was specified and the range `[addr, addr + len)` exceeds that allowed for the address space of a process, or `MAP_FIXED` was not specified and there is insufficient room in the address space to effect the mapping.

## NOTES

`mmap` allows access to resources via address space manipulations instead of the read/write interface. Once a file is mapped, all a process has to do to access it is use the data at the address to which the object was mapped. Consider the following pseudo-code:

```
fd = open(...)
lseek(fd, offset)
read(fd, buf, len)
/* use data in buf */
```

Here is a rewrite using `mmap`:

```
fd = open(...)
address = mmap((caddr_t) 0, len, (PROT_READ | PROT_WRITE),
 MAP_PRIVATE, fd, offset)
/* use data at address */
```

## SEE ALSO

`fcntl(2)`, `fork(2)`, `lockf(3C)`, `mlockall(3C)`, `mprotect(2)`, `munmap(2)`, `plock(2)`, `sysconf(2)`.

**NAME**

mount – mount a file system

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/mount.h>

int mount (const char *spec, const char *dir, int mflag,
 .../* int fstyp, const char *dataptr, size_t datalen*/);
```

**DESCRIPTION**

mount requests that a removable file system contained on the block special file identified by *spec* be mounted on the directory identified by *dir*. *spec* and *dir* are pointers to path names. *fstyp* is the file system type number. The `sysfs(2)` system call can be used to determine the file system type number. If both the `MS_DATA` and `MS_FSS` flag bits of *mflag* are off, the file system type defaults to the root file system type. Only if either flag is on is *fstyp* used to indicate the file system type.

If the `MS_DATA` flag is set in *mflag* the system expects the *dataptr* and *datalen* arguments to be present. Together they describe a block of file-system specific data at address *dataptr* of length *datalen*. This is interpreted by file-system specific code within the operating system and its format depends on the file system type. If a particular file system type does not require this data, *dataptr* and *datalen* should both be zero. Note that `MS_FSS` is obsolete and is ignored if `MS_DATA` is also set, but if `MS_FSS` is set and `MS_DATA` is not, *dataptr* and *datalen* are both assumed to be zero.

After a successful call to mount, all references to the file *dir* refer to the root directory on the mounted file system.

The low-order bit of *mflag* is used to control write permission on the mounted file system: if 1, writing is forbidden; otherwise writing is permitted according to individual file accessibility.

mount may be invoked only by the super-user. It is intended for use only by the mount utility.

mount fails if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EBUSY</b>        | <i>dir</i> is currently mounted on, is someone's current working directory, or is otherwise busy.                                                                                                  |
| <b>EBUSY</b>        | The device associated with <i>spec</i> is currently mounted.                                                                                                                                       |
| <b>EBUSY</b>        | There are no more mount table entries.                                                                                                                                                             |
| <b>EFAULT</b>       | <i>spec</i> , <i>dir</i> , or <i>datalen</i> points outside the allocated address space of the process.                                                                                            |
| <b>EINVAL</b>       | The super block has an invalid magic number or the <i>fstyp</i> is invalid.                                                                                                                        |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>spec</i> or <i>dir</i> .                                                                                                                |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |

## mount(2)

## mount(2)

|              |                                                                                                                                                                   |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENAMETOOLONG | The length of the <i>path</i> argument exceeds {PATH_MAX}, or the length of a <i>path</i> component exceeds {NAME_MAX} while <u>_POSIX_NO_TRUNC</u> is in effect. |
| ENOENT       | None of the named files exists or is a null pathname.                                                                                                             |
| ENOTDIR      | A component of a path prefix is not a directory.                                                                                                                  |
| EPERM        | The effective user ID is not super-user.                                                                                                                          |
| EREMOTE      | <i>spec</i> is remote and cannot be mounted.                                                                                                                      |
| ENOLINK      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                          |
| EMULTIHOP    | Components of <i>path</i> require hopping to multiple remote machines and the file system type does not allow it.                                                 |
| ENOTBLK      | <i>spec</i> is not a block special device.                                                                                                                        |
| ENXIO        | The device associated with <i>spec</i> does not exist.                                                                                                            |
| ENOTDIR      | <i>dir</i> is not a directory.                                                                                                                                    |
| EROFS        | <i>spec</i> is write protected and <i>mflag</i> requests write permission.                                                                                        |
| ENOSPC       | The file system state in the super-block is not F <sub>s</sub> OKAY and <i>mflag</i> requests write permission.                                                   |

### SEE ALSO

*sysfs(2)*, *umount(2)*.

*mount(1M)*, *fs(4)* in the *System Administrator's Reference Manual*.

### DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

`mprotect` – set protection of memory mapping

**SYNOPSIS**

```
#include <sys/types.h>
```

```
#include <sys/mman.h>
```

```
int mprotect(caddr_t addr, size_t len, int prot);
```

**DESCRIPTION**

The function `mprotect` changes the access protections on the mappings specified by the range `[addr, addr + len)` to be that specified by `prot`. Legitimate values for `prot` are the same as those permitted for `mmap` and are defined in `<sys/mman.h>` as:

```
PROT_READ /* page can be read */
PROT_WRITE /* page can be written */
PROT_EXEC /* page can be executed */
PROT_NONE /* page can not be accessed */
```

**RETURN VALUE**

Upon successful completion, the function `mprotect` returns a value of 0; otherwise, it returns a value of -1 and sets `errno` to indicate an error.

**ERRORS**

Under the following conditions, the function `mprotect` fails and sets `errno` to:

- EACCESS** if `prot` specifies a protection that violates the access permission the process has to the underlying memory object.
- EAGAIN** if `prot` specifies `PROT_WRITE` over a `MAP_PRIVATE` mapping and there are insufficient memory resources to reserve for locking the private page.
- EINVAL** if `addr` is not a multiple of the page size as returned by `sysconf`.
- EINVAL** The argument `len` has a value less than or equal to 0.
- ENOMEM** if addresses in the range `[addr, addr + len)` are invalid for the address space of a process, or specify one or more pages which are not mapped.

When `mprotect` fails for reasons other than `EINVAL`, the protections on some of the pages in the range `[addr, addr + len)` may have been changed. If the error occurs on some page at `addr2`, then the protections of all whole pages in the range `[addr, addr2)` will have been modified.

**SEE ALSO**

`mementl(2)`, `mmap(2)`, `plock(2)`, `mlock(3C)`, `mlockall(3C)`, `sysconf(3C)`.

**NAME**

msgctl - message control operations

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

int msgctl(int msqid, int cmd, .../* struct msqid_ds *buf */);
```

**DESCRIPTION**

msgctl provides a variety of message control operations as specified by *cmd*. The following *cmds* are available:

**IPC\_STAT** Place the current value of each member of the data structure associated with *msqid* into the structure pointed to by *buf*. The contents of this structure are defined in `intro(2)`.

**IPC\_SET** Set the value of the following members of the data structure associated with *msqid* to the corresponding value found in the structure pointed to by *buf*:

```
msg_perm.uid
msg_perm.gid
msg_perm.mode /* only access permission bits */
msg_qbytes
```

This *cmd* can only be executed by a process that has an effective user ID equal to either that of super user, or to the value of `msg_perm.cuid` or `msg_perm.uid` in the data structure associated with *msqid*. Only super user can raise the value of `msg_qbytes`.

**IPC\_RMID** Remove the message queue identifier specified by *msqid* from the system and destroy the message queue and data structure associated with it. This *cmd* can only be executed by a process that has an effective user ID equal to either that of super user, or to the value of `msg_perm.cuid` or `msg_perm.uid` in the data structure associated with *msqid*.

msgctl fails if one or more of the following are true:

**EACCES** *cmd* is `IPC_STAT` and operation permission is denied to the calling process [see `intro(2)`].

**EFAULT** *buf* points to an illegal address.

**EINVAL** *msqid* is not a valid message queue identifier.

**EINVAL** *cmd* is not a valid command.

**EINVAL** *cmd* is `IPC_SET` and `msg_perm.uid` or `msg_perm.gid` is not valid.

**EOVERFLOW** *cmd* is `IPC_STAT` and *uid* or *gid* is too large to be stored in the structure pointed to by *buf*.

**EPERM** *cmd* is `IPC_RMID` or `IPC_SET`. The effective user ID of the calling process is not that of super user, or the value of `msg_perm.cuid` or `msg_perm.uid` in the data structure associated with *msqid*.

**EPERM** *cmd* is `IPC_SET`, an attempt is being made to increase to the value of `msg_qbytes`, and the effective user ID of the calling process is not that of super user.

**SEE ALSO**

`intro(2)`, `msgget(2)`, `msgop(2)`.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.



**NAME**

msgget – get message queue

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

int msgget(key_t key, int msgflg);
```

**DESCRIPTION**

msgget returns the message queue identifier associated with *key*.

A message queue identifier and associated message queue and data structure [see [intro\(2\)](#)] are created for *key* if one of the following are true:

*key* is `IPC_PRIVATE`.

*key* does not already have a message queue identifier associated with it, and  $(msgflg \& IPC\_CREAT)$  is true.

On creation, the data structure associated with the new message queue identifier is initialized as follows:

`msg_perm.cuid`, `msg_perm.uid`, `msg_perm.cgid`, and `msg_perm.gid` are set to the effective user ID and effective group ID, respectively, of the calling process.

The low-order 9 bits of `msg_perm.mode` are set to the low-order 9 bits of *msgflg*.

`msg_qnum`, `msg_lspid`, `msg_lrpid`, `msg_stime`, and `msg_rtime` are set to 0.

`msg_ctime` is set to the current time.

`msg_qbytes` is set to the system limit.

msgget fails if one or more of the following are true:

- |               |                                                                                                                                                                                         |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b> | A message queue identifier exists for <i>key</i> , but operation permission [see <a href="#">intro(2)</a> ] as specified by the low-order 9 bits of <i>msgflg</i> would not be granted. |
| <b>ENOENT</b> | A message queue identifier does not exist for <i>key</i> and $(msgflg \& IPC\_CREAT)$ is false.                                                                                         |
| <b>ENOSPC</b> | A message queue identifier is to be created but the system-imposed limit on the maximum number of allowed message queue identifiers system wide would be exceeded.                      |
| <b>EEXIST</b> | A message queue identifier exists for <i>key</i> but $(msgflg \& IPC\_CREAT)$ and $(msgflg \& IPC\_EXCL)$ are both true.                                                                |

**SEE ALSO**

[intro\(2\)](#), [msgctl\(2\)](#), [msgop\(2\)](#), [stdipc\(3C\)](#).

**DIAGNOSTICS**

Upon successful completion, a non-negative integer, namely a message queue identifier, is returned. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.

## NAME

msgop: msgsnd, msgrcv - message operations

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/msg.h>

int msgsnd(int msqid, const void *msgp,
 size_t msgsz, int msgflg);

int msgrcv(int msqid, void *msgp,
 size_t msgsz, long msgtyp, int msgflg);
```

## DESCRIPTION

`msgsnd` sends a message to the queue associated with the message queue identifier specified by `msqid`. `msgp` points to a user defined buffer that must contain first a field of type long integer that will specify the type of the message, and then a data portion that will hold the text of the message. The following is an example of members that might be in a user defined buffer.

```
long mtype; /* message type */
char mtext[]; /* message text */
```

`mtype` is a positive integer that can be used by the receiving process for message selection. `mtext` is any text of length `msgsz` bytes. `msgsz` can range from 0 to a system imposed maximum.

`msgflg` specifies the action to be taken if one or more of the following are true:

The number of bytes already on the queue is equal to `msg_qbytes` [see `intro(2)`].

The total number of messages on all queues system-wide is equal to the system-imposed limit.

These actions are as follows:

If (`msgflg&IPC_NOWAIT`) is true, the message is not sent and the calling process returns immediately.

If (`msgflg&IPC_NOWAIT`) is false, the calling process suspends execution until one of the following occurs:

The condition responsible for the suspension no longer exists, in which case the message is sent.

`msqid` is removed from the system [see `msgctl(2)`]. When this occurs, `errno` is set to `EIDRM`, and a value of `-1` is returned.

The calling process receives a signal that is to be caught. In this case the message is not sent and the calling process resumes execution in the manner prescribed in `signal(2)`.

`msgsnd` fails and sends no message if one or more of the following are true:

|               |                                                                                                                  |
|---------------|------------------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | <i>msqid</i> is not a valid message queue identifier.                                                            |
| <b>EACCES</b> | Operation permission is denied to the calling process [see <i>intro(2)</i> ].                                    |
| <b>EINVAL</b> | <i>mtype</i> is less than 1.                                                                                     |
| <b>EAGAIN</b> | The message cannot be sent for one of the reasons cited above and ( <i>msgflg</i> & <i>IPC_NOWAIT</i> ) is true. |
| <b>EINVAL</b> | <i>msgsz</i> is less than zero or greater than the system-imposed limit.                                         |
| <b>EFAULT</b> | <i>msgp</i> points to an illegal address.                                                                        |

Upon successful completion, the following actions are taken with respect to the data structure associated with *msqid* [see *intro(2)*].

*msg\_qnum* is incremented by 1.

*msg\_lspid* is set to the process ID of the calling process.

*msg\_stime* is set to the current time.

*msgrcv* reads a message from the queue associated with the message queue identifier specified by *msqid* and places it in the user defined structure pointed to by *msgp*. The structure must contain a message type field followed by the area for the message text (see the structure *mymsg* above). *mtype* is the received message's type as specified by the sending process. *mtext* is the text of the message. *msgsz* specifies the size in bytes of *mtext*. The received message is truncated to *msgsz* bytes if it is larger than *msgsz* and (*msgflg*&*MSG\_NOERROR*) is true. The truncated part of the message is lost and no indication of the truncation is given to the calling process.

*msgtyp* specifies the type of message requested as follows:

If *msgtyp* is 0, the first message on the queue is received.

If *msgtyp* is greater than 0, the first message of type *msgtyp* is received.

If *msgtyp* is less than 0, the first message of the lowest type that is less than or equal to the absolute value of *msgtyp* is received.

*msgflg* specifies the action to be taken if a message of the desired type is not on the queue. These are as follows:

If (*msgflg*&*IPC\_NOWAIT*) is true, the calling process returns immediately with a return value of -1 and sets *errno* to *ENOMSG*.

If (*msgflg*&*IPC\_NOWAIT*) is false, the calling process suspends execution until one of the following occurs:

A message of the desired type is placed on the queue.

*msqid* is removed from the system. When this occurs, *errno* is set to *EIDRM*, and a value of -1 is returned.

The calling process receives a signal that is to be caught. In this case a message is not received and the calling process resumes execution in the manner prescribed in *signal(2)*.

`msgrcv` fails and receives no message if one or more of the following are true:

- EINVAL**        *msqid* is not a valid message queue identifier.
- EACCES**        Operation permission is denied to the calling process.
- EINVAL**        *msgsz* is less than 0.
- E2BIG**         The length of *mtext* is greater than *msgsz* and (*msgflg*&`MSG_NOERROR`) is false.
- ENOMSG**        The queue does not contain a message of the desired type and (*msgtyp*&`IPC_NOWAIT`) is true.
- EFAULT**        *msgp* points to an illegal address.

Upon successful completion, the following actions are taken with respect to the data structure associated with *msqid* [see `intro(2)`].

*msg\_qnum* is decremented by 1.

*msg\_lpid* is set to the process ID of the calling process.

*msg\_rtime* is set to the current time.

#### SEE ALSO

`intro(2)`, `msgctl(2)`, `msgget(2)`, `signal(2)`.

#### DIAGNOSTICS

If `msgsnd` or `msgrcv` return due to the receipt of a signal, a value of `-1` is returned to the calling process and `errno` is set to `EINTR`. If they return due to removal of *msqid* from the system, a value of `-1` is returned and `errno` is set to `EIDRM`.

Upon successful completion, the return value is as follows:

`msgsnd` returns a value of 0.

`msgrcv` returns the number of bytes actually placed into *mtext*.

Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.

**NAME**

`munmap` – unmap pages of memory.

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/mman.h>

int munmap(caddr_t addr, size_t len);
```

**DESCRIPTION**

The function `munmap` removes the mappings for pages in the range [*addr*, *addr* + *len*). Further references to these pages will result in the delivery of a `SIGSEGV` signal to the process.

The function `mmap` often performs an implicit `munmap`.

**RETURN VALUE**

Upon successful completion, the function `munmap` returns a value of 0; otherwise, it returns a value of -1 and sets `errno` to indicate an error.

**ERRORS**

Under the following conditions, the function `munmap` fails and sets `errno` to:

- EINVAL** if *addr* is not a multiple of the page size as returned by `sysconf`.
- EINVAL** if addresses in the range [*addr*, *addr* + *len*) are outside the valid range for the address space of a process.
- EINVAL** The argument *len* has a value less than or equal to 0.

**SEE ALSO**

`mmap(2)`, `sysconf(3C)`.

**NAME**

nice – change priority of a time-sharing process

**SYNOPSIS**

```
#include <unistd.h>

int nice(int incr);
```

**DESCRIPTION**

nice allows a process in the time-sharing scheduling class to change its priority. The `prctl` system call is a more general interface to scheduler functions.

nice adds the value of *incr* to the nice value of the calling process. A process's nice value is a non-negative number for which a more positive value results in lower CPU priority.

A maximum nice value of 39 and a minimum nice value of 0 are imposed by the system. (The default nice value is 20.) Requests for values above or below these limits result in the nice value being set to the corresponding limit.

**EPERM** nice fails and does not change the nice value if *incr* is negative or greater than 39 and the effective user ID of the calling process is not super-user.

**EINVAL** nice fails if called by a process in a scheduling class other than time-sharing.

**SEE ALSO**

`exec(2)`, `prctl(2)`.  
nice(1) in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, nice returns the new nice value minus 20. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

open – open for reading or writing

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>

int open (const char *path, int oflag, ... /* mode_t mode */);
```

**DESCRIPTION**

*path* points to a path name naming a file. `open` opens a file descriptor for the named file and sets the file status flags according to the value of *oflag*. *oflag* values are constructed by OR-ing Flags from the following list (only one of the first three flags below may be used):

`O_RDONLY`     Open for reading only.  
`O_WRONLY`     Open for writing only.  
`O_RDWR`       Open for reading and writing.  
`O_NDELAY` or `O_NONBLOCK`

These flags may affect subsequent reads and writes [see `read(2)` and `write(2)`]. If both `O_NDELAY` and `O_NONBLOCK` are set, `O_NONBLOCK` will take precedence.

When opening a FIFO with `O_RDONLY` or `O_WRONLY` set:

If `O_NDELAY` or `O_NONBLOCK` is set: An `open` for reading-only will return without delay; an `open` for writing-only will return an error if no process currently has the file open for reading.

If `O_NDELAY` and `O_NONBLOCK` are clear: An `open` for reading-only will block until a process opens the file for writing; an `open` for writing-only will block until a process opens the file for reading.

When opening a file associated with a terminal line:

If `O_NDELAY` or `O_NONBLOCK` is set: The `open` will return without waiting for the device to be ready or available; subsequent behavior of the device is device specific.

If `O_NDELAY` and `O_NONBLOCK` are clear: The `open` will block until the device is ready or available.

`O_APPEND`     If set, the file pointer will be set to the end of the file prior to each write.  
`O_SYNC`       When opening a regular file, this flag affects subsequent writes. If set, each `write(2)` will wait for both the file data and file status to be physically updated.  
`O_NOCTTY`     If set and the file is a terminal, the terminal will not be allocated as the calling process's controlling terminal.

## open(2)

## open(2)

- O\_CREAT** If the file exists, this flag has no effect, except as noted under **O\_EXCL** below. Otherwise, the file is created and the owner ID of the file is set to the effective user ID of the process, the group ID of the file is set to the effective group ID of the process, or if the **S\_ISGID** bit is set in the directory in which the file is being created, the file's group ID is set to the group ID of its parent directory. If the group ID of the new file does not match the effective group ID or one of the supplementary groups IDs, the **S\_ISGID** bit is cleared. The access permission bits of the file mode are set to the value of *mode*, modified as follows [see **creat(2)**]:
- All bits set in the file mode creation mask of the process are cleared [see **umask(2)**].
  - The "save text image after execution bit" of the mode is cleared [see **chmod(2)**].
- O\_TRUNC** If the file exists, its length is truncated to 0 and the mode and owner are unchanged. **O\_TRUNC** has no effect on FIFO special files or directories.
- O\_EXCL** If **O\_EXCL** and **O\_CREAT** are set, **open** will fail if the file exists. The check for the existence of the file and the creation of the file if it does not exist is atomic with respect to other processes executing **open** naming the same filename in the same directory with **O\_EXCL** and **O\_CREAT** set.

When opening a STREAMS file, *oflag* may be constructed from **O\_NDELAY** or **O\_NONBLOCK** OR-ed with either **O\_RDONLY**, **O\_WRONLY**, or **O\_RDWR**. Other flag values are not applicable to STREAMS devices and have no effect on them. The values of **O\_NDELAY** and **O\_NONBLOCK** affect the operation of STREAMS drivers and certain system calls [see **read(2)**, **getmsg(2)**, **putmsg(2)**, and **write(2)**]. For drivers, the implementation of **O\_NDELAY** and **O\_NONBLOCK** is device specific. Each STREAMS device driver may treat these options differently.

When **open** is invoked to open a named stream, and the **connld** module [see **connld(7)**] has been pushed on the pipe, **open** blocks until the server process has issued an **I\_RECVFD ioctl** [see **streamio(7)**] to receive the file descriptor.

If *path* is a symbolic link and **O\_CREAT** and **O\_EXCL** are set, the link is not followed.

The file pointer used to mark the current position within the file is set to the beginning of the file.

The new file descriptor is the lowest numbered file descriptor available and is set to remain open across **exec** system calls [see **fcntl(2)**].

Certain flag values can be set following **open** as described in **fcntl(2)**.

If **O\_CREAT** is set and the file did not previously exist, upon successful completion **open** marks for update the **st\_atime**, **st\_ctime** and **st\_mtime** fields of the file and the **st\_ctime** and **st\_mtime** fields of the parent directory.



If `O_TRUNC` is set and the file did previously exist, upon successful completion `open` marks for update the `st_ctime` and `st_mtime` fields of the file.

The named file is opened unless one or more of the following are true:

|                           |                                                                                                                                                                                                                  |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>EACCES</code>       | The file does not exist and write permission is denied by the parent directory of the file to be created.                                                                                                        |
| <code>EACCES</code>       | <code>O_TRUNC</code> is specified and write permission is denied                                                                                                                                                 |
| <code>EACCES</code>       | A component of the path prefix denies search permission.                                                                                                                                                         |
| <code>EACCES</code>       | <code>oflag</code> permission is denied for an existing file.                                                                                                                                                    |
| <code>EAGAIN</code>       | The file exists, mandatory file/record locking is set, and there are outstanding record locks on the file [see <code>chmod(2)</code> ].                                                                          |
| <code>EEXIST</code>       | <code>O_CREAT</code> and <code>O_EXCL</code> are set, and the named file exists.                                                                                                                                 |
| <code>EFAULT</code>       | <code>path</code> points outside the allocated address space of the process.                                                                                                                                     |
| <code>EINTR</code>        | A signal was caught during the <code>open</code> system call.                                                                                                                                                    |
| <code>EIO</code>          | A hangup or error occurred during the open of the STREAMS-based device.                                                                                                                                          |
| <code>EISDIR</code>       | The named file is a directory and <code>oflag</code> is write or read/write.                                                                                                                                     |
| <code>ELOOP</code>        | Too many symbolic links were encountered in translating <code>path</code> .                                                                                                                                      |
| <code>EMFILE</code>       | The process has too many open files [see <code>getrlimit(2)</code> ].                                                                                                                                            |
| <code>EMULTIHOP</code>    | Components of <code>path</code> require hopping to multiple remote machines and the file system does not allow it.                                                                                               |
| <code>ENAMETOOLONG</code> | The length of the <code>path</code> argument exceeds <code>{PATH_MAX}</code> , or the length of a <code>path</code> component exceeds <code>{NAME_MAX}</code> while <code>{_POSIX_NO_TRUNC}</code> is in effect. |
| <code>ENFILE</code>       | The system file table is full.                                                                                                                                                                                   |
| <code>ENOENT</code>       | <code>O_CREAT</code> is not set and the named file does not exist.                                                                                                                                               |
| <code>ENOENT</code>       | <code>O_CREAT</code> is set and a component of the path prefix does not exist or is the null pathname.                                                                                                           |
| <code>ENOLINK</code>      | <code>path</code> points to a remote machine, and the link to that machine is no longer active.                                                                                                                  |
| <code>ENOMEM</code>       | The system is unable to allocate a send descriptor.                                                                                                                                                              |
| <code>ENOSPC</code>       | <code>O_CREAT</code> and <code>O_EXCL</code> are set, and the file system is out of inodes.                                                                                                                      |
| <code>ENOSPC</code>       | <code>O_CREAT</code> is set and the directory that would contain the file cannot be extended.                                                                                                                    |

## open(2)

## open(2)

|         |                                                                                                                                                         |
|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------|
| ENOSR   | Unable to allocate a stream.                                                                                                                            |
| ENOTDIR | A component of the path prefix is not a directory.                                                                                                      |
| ENXIO   | The named file is a character special or block special file, and the device associated with this special file does not exist.                           |
| ENXIO   | O_NDELAY or O_NONBLOCK is set, the named file is a FIFO, O_WRONLY is set, and no process has the file open for reading.                                 |
| ENXIO   | A STREAMS module or driver open routine failed.                                                                                                         |
| EROFS   | The named file resides on a read-only file system and either O_WRONLY, O_RDWR, O_CREAT, or O_TRUNC is set in <i>oflag</i> (if the file does not exist). |
| ETXTBSY | The file is a pure procedure (shared text) file that is being executed and <i>oflag</i> is write or read/write.                                         |

### SEE ALSO

intro(2), chmod(2), close(2), creat(2), dup(2), exec(2), fcntl(2), getrlimit(2), lseek(2), read(2), getmsg(2), putmsg(2), stat(2), umask(2), write(2), stat(5).

### DIAGNOSTICS

Upon successful completion, the file descriptor is returned. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.

**pause (2)**

**pause (2)**

**NAME**

**pause** - suspend process until signal

**SYNOPSIS**

```
#include <unistd.h>

int pause(void);
```

**DESCRIPTION**

**pause** suspends the calling process until it receives a signal. The signal must be one that is not currently set to be ignored by the calling process.

If the signal causes termination of the calling process, **pause** does not return.

If the signal is caught by the calling process and control is returned from the signal-catching function [see **signal(2)**], the calling process resumes execution from the point of suspension; with a return value of -1 from **pause** and **errno** set to **EINTR**.

**SEE ALSO**

**alarm(2)**, **kill(2)**, **signal(2)**, **sigpause(2)**, **wait(2)**.

**NAME**

pipe – create an interprocess channel

**SYNOPSIS**

```
#include <unistd.h>

int pipe(int fildes[2]);
```

**DESCRIPTION**

pipe creates an I/O mechanism called a pipe and returns two file descriptors, *fildes*[0] and *fildes*[1]. The files associated with *fildes*[0] and *fildes*[1] are streams and are both opened for reading and writing. The `O_NDELAY` and `O_NONBLOCK` flags are cleared.

A read from *fildes*[0] accesses the data written to *fildes*[1] on a first-in-first-out (FIFO) basis and a read from *fildes*[1] accesses the data written to *fildes*[0] also on a FIFO basis.

The `FD_CLOEXEC` flag will be clear on both file descriptors.

Upon successful completion pipe marks for update the *st\_atime*, *st\_ctime*, and *st\_mtime* fields of the pipe.

pipe fails if:

- |               |                                                                                            |
|---------------|--------------------------------------------------------------------------------------------|
| <b>EMFILE</b> | If <code>{OPEN_MAX}-1</code> or more file descriptors are currently open for this process. |
| <b>ENFILE</b> | A file table entry could not be allocated.                                                 |

**SEE ALSO**

`fcntl(2)`, `getmsg(2)`, `poll(2)`, `putmsg(2)`, `read(2)`, `write(2)`, `streamio(7)`, `sh(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NOTES**

Since a pipe is bi-directional, there are two separate flows of data. Therefore, the size (*st\_size*) returned by a call to `fstat(2)` with argument *fildes*[0] or *fildes*[1] is the number of bytes available for reading from *fildes*[0] or *fildes*[1] respectively. Previously, the size (*st\_size*) returned by a call to `fstat()` with argument *fildes*[1] (the write-end) was the number of bytes available for reading from *fildes*[0] (the read-end).

**NAME**

**plock** – lock into memory or unlock process, text, or data

**SYNOPSIS**

```
#include <sys/lock.h>

int plock(int op);
```

**DESCRIPTION**

**plock** allows the calling process to lock into memory or unlock its text segment (text lock), its data segment (data lock), or both its text and data segments (process lock). Locked segments are immune to all routine swapping. The effective user ID of the calling process must be super-user to use this call. **plock** performs the function specified by *op*:

|                 |                                                         |
|-----------------|---------------------------------------------------------|
| <b>PROCLOCK</b> | Lock text and data segments into memory (process lock). |
| <b>TXLOCK</b>   | Lock text segment into memory (text lock).              |
| <b>DATLOCK</b>  | Lock data segment into memory (data lock).              |
| <b>UNLOCK</b>   | Remove locks.                                           |

**plock** fails and does not perform the requested operation if one or more of the following are true:

|               |                                                                                                                              |
|---------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>EPERM</b>  | The effective user ID of the calling process is not super-user.                                                              |
| <b>EINVAL</b> | <i>op</i> is equal to <b>PROCLOCK</b> and a process lock, a text lock, or a data lock already exists on the calling process. |
| <b>EINVAL</b> | <i>op</i> is equal to <b>TXLOCK</b> and a text lock, or a process lock already exists on the calling process.                |
| <b>EINVAL</b> | <i>op</i> is equal to <b>DATLOCK</b> and a data lock, or a process lock already exists on the calling process.               |
| <b>EINVAL</b> | <i>op</i> is equal to <b>UNLOCK</b> and no lock exists on the calling process.                                               |
| <b>EAGAIN</b> | Not enough memory.                                                                                                           |

**SEE ALSO**

**exec(2)**, **exit(2)**, **fork(2)**, **mementl(2)**.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned to the calling process. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

**NOTES**

**mementl** is the preferred interface to process locking.

## NAME

poll - input/output multiplexing

## SYNOPSIS

```
#include <stropts.h>
#include <poll.h>
```

```
int poll(struct poll *fds, size_t nfd, int timeout);
```

## DESCRIPTION

poll provides users with a mechanism for multiplexing input/output over a set of file descriptors that reference open files. poll identifies those files on which a user can send or receive messages, or on which certain events have occurred.

*fds* specifies the file descriptors to be examined and the events of interest for each file descriptor. It is a pointer to an array with one element for each open file descriptor of interest. The array's elements are pollfd structures, which contain the following members:

```
int fd; /* file descriptor */
short events; /* requested events */
short revents; /* returned events */
```

*fd* specifies an open file descriptor and *events* and *revents* are bitmasks constructed by an OR of any combination of the following event flags:

|            |                                                                                                                                                                                                                                  |
|------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| POLLIN     | Data other than high priority data may be read without blocking. For STREAMS, this flag is set even if the message is of zero length.                                                                                            |
| POLLRDNORM | Normal data (priority band = 0) may be read without blocking. For STREAMS, this flag is set even if the message is of zero length.                                                                                               |
| POLLRDBAND | Data from a non-zero priority band may be read without blocking. For STREAMS, this flag is set even if the message is of zero length.                                                                                            |
| POLLPRI    | High priority data may be received without blocking. For STREAMS, this flag is set even if the message is of zero length.                                                                                                        |
| POLLOUT    | Normal data may be written without blocking.                                                                                                                                                                                     |
| POLLWRNORM | The same as POLLOUT.                                                                                                                                                                                                             |
| POLLWRBAND | Priority data (priority band > 0) may be written. This event only examines bands that have been written to at least once.                                                                                                        |
| POLLMSG    | An M_SIG or M_PCSIG message containing the SIGPOLL signal has reached the front of the stream head read queue.                                                                                                                   |
| POLLERR    | An error has occurred on the device or stream. This flag is only valid in the revents bitmask; it is not used in the events field.                                                                                               |
| POLLHUP    | A hangup has occurred on the stream. This event and POLLOUT are mutually exclusive; a stream can never be writable if a hangup has occurred. However, this event and POLLIN, POLLRDNORM, POLLRDBAND, or POLLPRI are not mutually |

exclusive. This flag is only valid in the `revents` bitmask; it is not used in the `events` field.

**POLLNVAL** The specified `fd` value does not belong to an open file. This flag is only valid in the `revents` field; it is not used in the `events` field.

For each element of the array pointed to by `fds`, `poll` examines the given file descriptor for the event(s) specified in `events`. The number of file descriptors to be examined is specified by `nfds`.

If the value `fd` is less than zero, `events` is ignored and `revents` is set to 0 in that entry on return from `poll`.

The results of the `poll` query are stored in the `revents` field in the `pollfd` structure. Bits are set in the `revents` bitmask to indicate which of the requested events are true. If none are true, none of the specified bits are set in `revents` when the `poll` call returns. The event flags `POLLHUP`, `POLLERR`, and `POLLNVAL` are always set in `revents` if the conditions they indicate are true; this occurs even though these flags were not present in `events`.

If none of the defined events have occurred on any selected file descriptor, `poll` waits at least `timeout` milliseconds for an event to occur on any of the selected file descriptors. On a computer where millisecond timing accuracy is not available, `timeout` is rounded up to the nearest legal value available on that system. If the value `timeout` is 0, `poll` returns immediately. If the value of `timeout` is `INFTIM` (or `-1`), `poll` blocks until a requested event occurs or until the call is interrupted. `poll` is not affected by the `O_NDELAY` and `O_NONBLOCK` flags.

`poll` fails if one or more of the following are true:

|               |                                                                                        |
|---------------|----------------------------------------------------------------------------------------|
| <b>EAGAIN</b> | Allocation of internal data structures failed, but the request may be attempted again. |
| <b>EFAULT</b> | Some argument points outside the allocated address space.                              |
| <b>EINTR</b>  | A signal was caught during the <code>poll</code> system call.                          |
| <b>EINVAL</b> | The argument <code>nfds</code> is greater than <code>{OPEN_MAX}</code> .               |

#### SEE ALSO

`intro(2)`, `getmsg(2)`, `getrlimit(2)`, `putmsg(2)`, `read(2)`, `write(2)`  
*Programmer's Guide: STREAMS*

#### DIAGNOSTICS

Upon successful completion, a non-negative value is returned. A positive value indicates the total number of file descriptors that has been selected (i.e., file descriptors for which the `revents` field is non-zero). A value of 0 indicates that the call timed out and no file descriptors have been selected. Upon failure, a value of `-1` is returned and `errno` is set to indicate the error.

**NAME**

prionctl - process scheduler control

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/prionctl.h>
#include <sys/rtpriocntl.h>
#include <sys/tspriocntl.h>
```

```
long prionctl(idtype_t idtype, id_t id, int cmd, ... /* arg */);
```

**DESCRIPTION**

prionctl provides for control over the scheduling of active processes.

Processes fall into distinct classes with a separate scheduling policy applied to each class. The two classes currently supported are the real-time class and the time-sharing class. The characteristics of these classes are described under the corresponding headings below. The class attribute of a process is inherited across the fork and exec(2) system calls. prionctl can be used to dynamically change the class and other scheduling parameters associated with a running process or set of processes given the appropriate permissions as explained below.

In the default configuration, a runnable real-time process runs before any other process. Therefore, inappropriate use of real-time processes can have a dramatic negative impact on system performance.

prionctl provides a interface for specifying a process or set of processes to which the system call is to apply. The prionctlset system call provides the same functions as prionctl, but allows a more general interface for specifying the set of processes to which the system call is to apply.

For prionctl, the *idtype* and *id* arguments are used together to specify the set of processes. The interpretation of *id* depends on the value of *idtype*. The possible values for *idtype* and corresponding interpretations of *id* are as follows:

- P\_PID**        *id* is a process ID specifying a single process to which the prionctl system call is to apply.
- P\_PPID**      *id* is a parent process ID. The prionctl system call applies to all processes with the specified parent process ID.
- P\_PGID**      *id* is a process group ID. The prionctl system call applies to all processes in the specified process group.
- P\_SID**        *id* is a session ID. The prionctl system call applies to all processes in the specified session.
- P\_CID**        *id* is a class ID (returned by prionctl PC\_GETCID as explained below). The prionctl system call applies to all processes in the specified class.
- P\_UID**        *id* is a user ID. The prionctl system call applies to all processes with this effective user ID.



- P\_GID** *id* is a group ID. The `prionctl` system call applies to all processes with this effective group ID.
- P\_ALL** The `prionctl` system call applies to all existing processes. The value of *id* is ignored. The permission restrictions described below still apply.

An *id* value of `P_MYID` can be used in conjunction with the *idtype* value to specify the calling process's process ID, parent process ID, process group ID, session ID, class ID, user ID, or group ID.

In order to change the scheduling parameters of a process (using the `PC_SETPARMS` command as explained below) the real or effective user ID of the process calling `prionctl` must match the real or effective user ID of the receiving process or the effective user ID of the calling process must be super-user. These are the minimum permission requirements enforced for all classes. An individual class may impose additional permissions requirements when setting processes to that class and/or when setting class-specific scheduling parameters.

A special `sys` scheduling class exists for the purpose of scheduling the execution of certain special system processes (such as the swapper process). It is not possible to change the class of any process to `sys`. In addition, any processes in the `sys` class that are included in a specified set of processes are disregarded by `prionctl`. For example, an *idtype* of `P_UID` and an *id* value of zero would specify all processes with a user ID of zero except processes in the `sys` class and (if changing the parameters using `PC_SETPARMS`) the `init` process.

The `init` process is a special case. In order for a `prionctl` call to change the class or other scheduling parameters of the `init` process (process ID 1), it must be the only process specified by *idtype* and *id*. The `init` process may be assigned to any class configured on the system, but the time-sharing class is almost always the appropriate choice. (Other choices may be highly undesirable; see the *System Administrator's Guide* for more information.)

The data type and value of *arg* are specific to the type of command specified by *cmd*.

The following structure is used by the `PC_GETCID` and `PC_GETCLINFO` commands.

```
typedef struct {
 id_t pc_cid; /* Class id */
 char pc_clname[PC_CLNMSZ]; /* Class name */
 long pc_clinfo[PC_CLINFOSZ]; /* Class information */
} pcinfo_t;
```

`pc_cid` is a class ID returned by `prionctl PC_GETCID`. `pc_clname` is a buffer of size `PC_CLNMSZ` (defined in `<sys/prionctl.h>`) used to hold the class name (RT for real-time or TS for time-sharing).

`pc_clinfo` is a buffer of size `PC_CLINFOSZ` (defined in `<sys/prionctl.h>`) used to return data describing the attributes of a specific class. The format of this data is class-specific and is described under the appropriate heading (REAL-TIME CLASS or TIME-SHARING CLASS) below.

The following structure is used by the `PC_SETPARMS` and `PC_GETPARMS` commands.

```
typedef struct {
 id_t pc_cid; /* Process class */
 long pc_clparms[PC_CLPARMSZ]; /* Class-specific params */
} pcparms_t;
```

`pc_cid` is a class ID (returned by `prioctl PC_GETCID`). The special class ID `PC_CLNULL` can also be assigned to `pc_cid` when using the `PC_GETPARMS` command as explained below.

The `pc_clparms` buffer holds class-specific scheduling parameters. The format of this parameter data for a particular class is described under the appropriate heading below. `PC_CLPARMSZ` is the length of the `pc_clparms` buffer and is defined in `<sys/prioctl.h>`.

### Commands

Available `prioctl` commands are:

#### `PC_GETCID`

Get class ID and class attributes for a specific class given class name. The *idtype* and *id* arguments are ignored. If *arg* is non-null, it points to a structure of type `pcinfo_t`. The `pc_clname` buffer contains the name of the class whose attributes you are getting.

On success, the class ID is returned in `pc_cid`, the class attributes are returned in the `pc_clinfo` buffer, and the `prioctl` call returns the total number of classes configured in the system (including the `sys` class). If the class specified by `pc_clname` is invalid or is not currently configured the `prioctl` call returns `-1` with `errno` set to `EINVAL`. The format of the attribute data returned for a given class is defined in the `<sys/rtprioctl.h>` or `<sys/tpsrioctl.h>` header file and described under the appropriate heading below.

If *arg* is a `NULL` pointer, no attribute data is returned but the `prioctl` call still returns the number of configured classes.

#### `PC_GETCLINFO`

Get class name and class attributes for a specific class given class ID. The *idtype* and *id* arguments are ignored. If *arg* is non-null, it points to a structure of type `pcinfo_t`. `pc_cid` is the class ID of the class whose attributes you are getting.

On success, the class name is returned in the `pc_clname` buffer, the class attributes are returned in the `pc_clinfo` buffer, and the `prioctl` call returns the total number of classes configured in the system (including the `sys` class). The format of the attribute data returned for a given class is defined in the `<sys/rtprioctl.h>` or `<sys/tpsrioctl.h>` header file and described under the appropriate heading below.

If *arg* is a NULL pointer, no attribute data is returned but the `prionctl` call still returns the number of configured classes.

#### PC\_SETPARMS

Set the class and class-specific scheduling parameters of the specified process(es). *arg* points to a structure of type `pcparms_t`. `pc_cid` specifies the class you are setting and the `pc_clparms` buffer contains the class-specific parameters you are setting. The format of the class-specific parameter data is defined in the `<sys/rtpriocntl.h>` or `<sys/tpriocntl.h>` header file and described under the appropriate class heading below.

When setting parameters for a set of processes, `prionctl` acts on the processes in the set in an implementation-specific order. If `prionctl` encounters an error for one or more of the target processes, it may or may not continue through the set of processes, depending on the nature of the error. If the error is related to permissions (`EPERM`), `prionctl` continues through the process set, resetting the parameters for all target processes for which the calling process has appropriate permissions. `prionctl` then returns `-1` with `errno` set to `EPERM` to indicate that the operation failed for one or more of the target processes. If `prionctl` encounters an error other than permissions, it does not continue through the set of target processes but returns the error immediately.

#### PC\_GETPARMS

Get the class and/or class-specific scheduling parameters of a process. *arg* points to a structure of type `pcparms_t`.

If `pc_cid` specifies a configured class and a single process belonging to that class is specified by the *idtype* and *id* values or the `procset` structure, then the scheduling parameters of that process are returned in the `pc_clparms` buffer. If the process specified does not exist or does not belong to the specified class, the `prionctl` call returns `-1` with `errno` set to `ESRCH`.

If `pc_cid` specifies a configured class and a set of processes is specified, the scheduling parameters of one of the specified processes belonging to the specified class are returned in the `pc_clparms` buffer and the `prionctl` call returns the process ID of the selected process. The criteria for selecting a process to return in this case is class dependent. If none of the specified processes exist or none of them belong to the specified class the `prionctl` call returns `-1` with `errno` set to `ESRCH`.

If `pc_cid` is `PC_CLNULL` and a single process is specified the class of the specified process is returned in `pc_cid` and its scheduling parameters are returned in the `pc_clparms` buffer.

#### PC\_ADMIN

This command provides functionality needed for the implementation of the `dispadm(1M)` command. It is not intended for general use by other applications.

### REAL-TIME CLASS

The real-time class provides a fixed priority preemptive scheduling policy for those processes requiring fast and deterministic response and absolute user/application control of scheduling priorities. If the real-time class is

configured in the system it should have exclusive control of the highest range of scheduling priorities on the system. This ensures that a runnable real-time process is given CPU service before any process belonging to any other class.

The real-time class has a range of real-time priority (`rt_pri`) values that may be assigned to processes within the class. Real-time priorities range from 0 to  $x$ , where the value of  $x$  is configurable and can be determined for a specific installation by using the `prioctl PC_GETCID` or `PC_GETCLINFO` command.

The real-time scheduling policy is a fixed priority policy. The scheduling priority of a real-time process is never changed except as the result of an explicit request by the user/application to change the `rt_pri` value of the process.

For processes in the real-time class, the `rt_pri` value is, for all practical purposes, equivalent to the scheduling priority of the process. The `rt_pri` value completely determines the scheduling priority of a real-time process relative to other processes within its class. Numerically higher `rt_pri` values represent higher priorities. Since the real-time class controls the highest range of scheduling priorities in the system it is guaranteed that the runnable real-time process with the highest `rt_pri` value is always selected to run before any other process in the system.

In addition to providing control over priority, `prioctl` provides for control over the length of the time quantum allotted to processes in the real-time class. The time quantum value specifies the maximum amount of time a process may run assuming that it does not complete or enter a resource or event wait state (`sleep`). Note that if another process becomes runnable at a higher priority the currently running process may be preempted before receiving its full time quantum.

The system's process scheduler keeps the runnable real-time processes on a set of scheduling queues. There is a separate queue for each configured real-time priority and all real-time processes with a given `rt_pri` value are kept together on the appropriate queue. The processes on a given queue are ordered in FIFO order (that is, the process at the front of the queue has been waiting longest for service and receives the CPU first). Real-time processes that wake up after sleeping, processes which change to the real-time class from some other class, processes which have used their full time quantum, and runnable processes whose priority is reset by `prioctl` are all placed at the back of the appropriate queue for their priority. A process that is preempted by a higher priority process remains at the front of the queue (with whatever time is remaining in its time quantum) and runs before any other process at this priority. Following a `fork(2)` system call by a real-time process, the parent process continues to run while the child process (which inherits its parent's `rt_pri` value) is placed at the back of the queue.

The following structure (defined in `<sys/rtprioctl.h>`) defines the format used for the attribute data for the real-time class.

```
typedef struct {
 short rt_maxpri; /* Maximum real-time priority */
} rtinfo_t;
```

The `prlocntl PC_GETCID` and `PC_GETCLINFO` commands return real-time class attributes in the `pc_clinfo` buffer in this format.

`rt_maxpri` specifies the configured maximum `rt_pri` value for the real-time class (if `rt_maxpri` is `x`, the valid real-time priorities range from 0 to `x`).

The following structure (defined in `<sys/rtpriocntl.h>`) defines the format used to specify the real-time class-specific scheduling parameters of a process.

```
typedef struct {
 short rt_pri; /* Real-Time priority */
 ulong rt_tqsecs; /* Seconds in time quantum */
 long rt_tqnsecs; /* Additional nanoseconds in quantum */
} rtparms_t;
```

When using the `prlocntl PC_SETPARMS` or `PC_GETPARMS` commands, if `pc_cid` specifies the real-time class, the data in the `pc_clparms` buffer is in this format.

The above commands can be used to set the real-time priority to the specified value or get the current `rt_pri` value. Setting the `rt_pri` value of a process that is currently running or runnable (not sleeping) causes the process to be placed at the back of the scheduling queue for the specified priority. The process is placed at the back of the appropriate queue regardless of whether the priority being set is different from the previous `rt_pri` value of the process. Note that a running process can voluntarily release the CPU and go to the back of the scheduling queue at the same priority by resetting its `rt_pri` value to its current real-time priority value. In order to change the time quantum of a process without setting the priority or affecting the process's position on the queue, the `rt_pri` field should be set to the special value `RT_NOCHANGE` (defined in `<sys/rtpriocntl.h>`). Specifying `RT_NOCHANGE` when changing the class of a process to real-time from some other class results in the real-time priority being set to zero.

For the `prlocntl PC_GETPARMS` command, if `pc_cid` specifies the real-time class and more than one real-time process is specified, the scheduling parameters of the real-time process with the highest `rt_pri` value among the specified processes are returned and the process ID of this process is returned by the `prlocntl` call. If there is more than one process sharing the highest priority, the one returned is implementation-dependent.

The `rt_tqsecs` and `rt_tqnsecs` fields are used for getting or setting the time quantum associated with a process or group of processes. `rt_tqsecs` is the number of seconds in the time quantum and `rt_tqnsecs` is the number of additional nanoseconds in the quantum. For example setting `rt_tqsecs` to 2 and `rt_tqnsecs` to 500,000,000 (decimal) would result in a time quantum of two and one-half seconds. Specifying a value of 1,000,000,000 or greater in the `rt_tqnsecs` field results in an error return with `errno` set to `EINVAL`. Although the resolution of the `tq_nsecs` field is very fine, the specified time quantum

length is rounded up by the system to the next integral multiple of the system clock's resolution. For example, the finest resolution currently available on the 3B2 is 10 milliseconds (1 "tick"). Setting `rt_tqsecs` to 0 and `rt_tqnsecs` to 34,000,000 would specify a time quantum of 34 milliseconds, which would be rounded up to 4 ticks (40 milliseconds) on the 3B2. The maximum time quantum that can be specified is implementation-specific and equal to `LONG_MAX` ticks (defined in `<limits.h>`). Requesting a quantum greater than this maximum results in an error return with `errno` set to `ERANGE` (although infinite quanta may be requested using a special value as explained below). Requesting a time quantum of zero (setting both `rt_tqsecs` and `rt_tqnsecs` to 0) results in an error return with `errno` set to `EINVAL`.

The `rt_tqnsecs` field can also be set to one of the following special values (defined in `<sys/rtpriocntl.h>`), in which case the value of `rt_tqsecs` is ignored.

- `RT_TQINF`                    Set an infinite time quantum.
- `RT_TQDEF`                    Set the time quantum to the default for this priority [see `rt_dptbl(4)`].
- `RT_NOCHANGE`                Don't set the time quantum. This value is useful when you wish to change the real-time priority of a process without affecting the time quantum. Specifying this value when changing the class of a process to real-time from some other class is equivalent to specifying `RT_TQDEF`.

In order to change the class of a process to real-time (from any other class) the process invoking `priocntl` must have super-user privileges. In order to change the priority or time quantum setting of a real-time process the process invoking `priocntl` must have super-user privileges or must itself be a real-time process whose real or effective user ID matches the real or effective user ID of the target process.

The real-time priority and time quantum are inherited across the `fork(2)` and `exec(2)` system calls.

**TIME-SHARING CLASS**

The time-sharing scheduling policy provides for a fair and effective allocation of the CPU resource among processes with varying CPU consumption characteristics. The objectives of the time-sharing policy are to provide good response time to interactive processes and good throughput to CPU-bound jobs while providing a degree of user/application control over scheduling.

The time-sharing class has a range of time-sharing user priority (see `ts_upri` below) values that may be assigned to processes within the class. A `ts_upri` value of zero is defined as the default base priority for the time-sharing class. User priorities range from `-x` to `+x` where the value of `x` is configurable and can be determined for a specific installation by using the `priocntl PC_GETCID` or `PC_GETCLINFO` command.

The purpose of the user priority is to provide some degree of user/application control over the scheduling of processes in the time-sharing class. Raising or lowering the `ts_upri` value of a process in the time-sharing class raises or lowers the scheduling priority of the process. It is not guaranteed, however, that a process with a higher `ts_upri` value will run before one with a lower `ts_upri` value. This is because the `ts_upri` value is just one factor used to determine the scheduling priority of a time-sharing process. The system may dynamically adjust the internal scheduling priority of a time-sharing process based on other factors such as recent CPU usage.

In addition to the system-wide limits on user priority (returned by the `PC_GETCID` and `PC_GETCLINFO` commands) there is a per process user priority limit (see `ts_uprilim` below), which specifies the maximum `ts_upri` value that may be set for a given process; by default, `ts_uprilim` is zero.

The following structure (defined in `<sys/tspriocntl.h>`) defines the format used for the attribute data for the time-sharing class.

```
typedef struct {
 short ts_maxupri; /* Limits of user priority range */
} tsinfo_t;
```

The `prctl` `PC_GETCID` and `PC_GETCLINFO` commands return time-sharing class attributes in the `pc_clinfo` buffer in this format.

`ts_maxupri` specifies the configured maximum user priority value for the time-sharing class. If `ts_maxupri` is `x`, the valid range for both user priorities and user priority limits is from `-x` to `+x`.

The following structure (defined in `<sys/tspriocntl.h>`) defines the format used to specify the time-sharing class-specific scheduling parameters of a process.

```
typedef struct {
 short ts_uprilim; /* Time-Sharing user priority limit */
 short ts_upri; /* Time-Sharing user priority */
} tsparms_t;
```

When using the `prctl` `PC_SETPARMS` or `PC_GETPARMS` commands, if `pc_cid` specifies the time-sharing class, the data in the `pc_clparms` buffer is in this format.

For the `prctl` `PC_GETPARMS` command, if `pc_cid` specifies the time-sharing class and more than one time-sharing process is specified, the scheduling parameters of the time-sharing process with the highest `ts_upri` value among the specified processes is returned and the process ID of this process is returned by the `prctl` call. If there is more than one process sharing the highest user priority, the one returned is implementation-dependent.

Any time-sharing process may lower its own `ts_uprilim` (or that of another process with the same user ID). Only a time-sharing process with super-user privileges may raise a `ts_uprilim`. When changing the class of a process to time-sharing from some other class, super-user privileges are required in order to set the initial `ts_uprilim` to a value greater than zero. Attempts by a non-

super-user process to raise a `ts_uprlim` or set an initial `ts_uprlim` greater than zero fail with a return value of `-1` and `errno` set to `EPERM`.

Any time-sharing process may set its own `ts_upri` (or that of another process with the same user ID) to any value less than or equal to the process's `ts_uprlim`. Attempts to set the `ts_upri` above the `ts_uprlim` (and/or set the `ts_uprlim` below the `ts_upri`) result in the `ts_upri` being set equal to the `ts_uprlim`.

Either of the `ts_uprlim` or `ts_upri` fields may be set to the special value `TS_NOCHANGE` (defined in `<sys/tsprctl.h>`) in order to set one of the values without affecting the other. Specifying `TS_NOCHANGE` for the `ts_upri` when the `ts_uprlim` is being set to a value below the current `ts_upri` causes the `ts_upri` to be set equal to the `ts_uprlim` being set. Specifying `TS_NOCHANGE` for a parameter when changing the class of a process to time-sharing (from some other class) causes the parameter to be set to a default value. The default value for the `ts_uprlim` is `0` and the default for the `ts_upri` is to set it equal to the `ts_uprlim` which is being set.

The time-sharing user priority and user priority limit are inherited across the `fork` and `exec` system calls.

**RETURN VALUE**

Unless otherwise noted above, `prctl` returns a value of `0` on success. `prctl` returns `-1` on failure and sets `errno` to indicate the error.

**ERRORS**

`prctl` fails if one or more of the following are true :

- EPERM**            The calling process does not have the required permissions as explained above.
- EINVAL**         The argument *cmd* was invalid, an invalid or unconfigured class was specified, or one of the parameters specified was invalid.
- ERANGE**         The requested time quantum is out of range.
- ESRCH**           None of the specified processes exist.
- EFAULT**         All or part of the area pointed to by one of the data pointers is outside the process's address space.
- ENOMEM**         An attempt to change the class of a process failed because of insufficient memory.
- EAGAIN**          An attempt to change the class of a process failed because of insufficient resources other than memory (for example, class-specific kernel data structures).

**SEE ALSO**

- `fork(2)`, `exec(2)`, `nice(2)`, `prctlset(2)`
- `prctl(1)` in the *User's Reference Manual*
- `dispadm(1M)`, `rt_dptbl(4)`, `ts_dptbl(4)` in the *System Administrator's Reference Manual*



**NAME**

prIOCtlset - generalized process scheduler control

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/procset.h>
#include <sys/prIOCtl.h>
#include <sys/rtpriocntl.h>
#include <sys/tspriocntl.h>

long prIOCtlset(procset_t *psp, int cmd, ... /* arg */);
```

**DESCRIPTION**

prIOCtlset changes the scheduling properties of running processes. prIOCtlset has the same functions as the prIOCtl system call, but a more general way of specifying the set of processes whose scheduling properties are to be changed.

cmd specifies the function to be performed. arg is a pointer to a structure whose type depends on cmd. See prIOCtl(2) for the valid values of cmd and the corresponding arg structures.

psp is a pointer to a procset structure, which prIOCtlset uses to specify the set of processes whose scheduling properties are to be changed.

```
typedef struct procset {
 idop_t p_op; /* operator connecting left/right sets */
 idtype_t p_lidtype; /* left set ID type */
 id_t p_lid; /* left set ID */
 idtype_t p_ridtype; /* right set ID type */
 id_t p_rid; /* right set ID */
} procset_t;
```

p\_lidtype and p\_lid specify the ID type and ID of one ("left") set of processes; p\_ridtype and p\_rid specify the ID type and ID of a second ("right") set of processes. ID types and IDs are specified just as for the prIOCtl system call. p\_op specifies the operation to be performed on the two sets of processes to get the set of processes the system call is to apply to. The valid values for p\_op and the processes they specify are:

- POP\_DIFF set difference: processes in left set and not in right set
- POP\_AND set intersection: processes in both left and right sets
- POP\_OR set union: processes in either left or right sets or both
- POP\_XOR set exclusive-or: processes in left or right set but not in both

The following macro, which is defined in procset.h, offers a convenient way to initialize a procset structure:

```
#define setprocset(psp, op, ltype, lid, rtype, rid) \
 (psp)->p_op = (op), \
 (psp)->p_lidtype = (ltype), \
 (psp)->p_lid = (lid), \
 (psp)->p_ridtype = (rtype), \
 (psp)->p_rid = (rid),
```

**priocntlset(2)**

**priocntlset(2)**

**DIAGNOSTICS**

`priocntlset` has the same return values and errors as `priocntl`.

**SEE ALSO**

`priocntl(2)`

`priocntl(1)` in the *User's Reference Manual*

**NAME**

profil - execution time profile

**SYNOPSIS**

```
#include <unistd.h>

void profil(unsigned short *buff, size_t bufsiz, int offset,
 unsigned scale);
```

**DESCRIPTION**

profil provides CPU-use statistics by profiling the amount of CPU time expended by a program. profil generates the statistics by creating an execution histogram for a current process. The histogram is defined for a specific region of program code to be profiled, and the identified region is logically broken up into a set of equal size subdivisions, each of which corresponds to a count in the histogram. With each clock tick, the current subdivision is identified and its corresponding histogram count is incremented. These counts establish a relative measure of how much time is being spent in each code subdivision. The resulting histogram counts for a profiled region can be used to identify those functions that consume a disproportionately high percentage of CPU time.

*buff* is a buffer of *bufsiz* bytes in which the histogram counts are stored in an array of unsigned short int.

*offset*, *scale*, and *bufsiz* specify the region to be profiled.

*offset* is effectively the start address of the region to be profiled.

*scale*, broadly speaking, is a contraction factor that indicates how much smaller the histogram buffer is than the region to be profiled. More precisely, *scale* is interpreted as an unsigned 16-bit fixed-point fraction with the decimal point implied on the left. Its value is the reciprocal of the number of bytes in a subdivision, per byte of histogram buffer. Since there are two bytes per histogram counter, the effective ratio of subdivision bytes per counter is one half the scale.

Several observations can be made:

- the maximal value of *scale*, 0xffff (approximately 1), maps subdivisions 2 bytes long to each counter.
- the minimum value of *scale* (for which profiling is performed), 0x0002 (1/32,768), maps subdivision 65,536 bytes long to each counter.
- the default value of *scale* (currently used by cc -qp), 0x4000, maps subdivisions 8 bytes long to each counter.

The values are used within the kernel as follows: when the process is interrupted for a clock tick, the value of *offset* is subtracted from the current value of the program counter (pc), and the remainder is multiplied by *scale* to derive a result. That result is used as an index into the histogram array to locate the cell to be incremented. Therefore, the cell count represents the number of times that the process was executing code in the subdivision associated with that cell when the process was interrupted.

## profil(2)

## profil(2)

*scale* can be computed as  $(RATIO * 0200000L)$ , where *RATIO* is the desired ratio of *bufsiz* to profiled region size, and has a value between 0 and 1. Qualitatively speaking, the closer *RATIO* is to 1, the higher the resolution of the profile information.

*bufsiz* can be computed as  $(size\_of\_region\_to\_be\_profiled * RATIO)$ .

### SEE ALSO

`prof(1)`, `times(2)`, `monitor(3C)`.

### NOTES

Profiling is turned off by giving a *scale* of 0 or 1, and is rendered ineffective by giving a *bufsiz* of 0. Profiling is turned off when an `exec(2)` is executed, but remains on in both child and parent processes after a `fork(2)`. Profiling is turned off if a *buff* update would cause a memory fault.

## NAME

ptrace - process trace

## SYNOPSIS

```
#include <unistd.h>
#include <sys/types.h>

int ptrace(int request, pid_t pid, int addr, int data);
```

## DESCRIPTION

ptrace allows a parent process to control the execution of a child process. Its primary use is for the implementation of breakpoint debugging [see `sdb(1)`]. The child process behaves normally until it encounters a signal [see `signal(5)`], at which time it enters a stopped state and its parent is notified via the `wait(2)` system call. When the child is in the stopped state, its parent can examine and modify its "core image" using `ptrace`. Also, the parent can cause the child either to terminate or continue, with the possibility of ignoring the signal that caused it to stop.

The *request* argument determines the action to be taken by `ptrace` and is one of the following:

- 0 This request must be issued by the child process if it is to be traced by its parent. It turns on the child's trace flag that stipulates that the child should be left in a stopped state on receipt of a signal rather than the state specified by *func* [see `signal(2)`]. The *pid*, *addr*, and *data* arguments are ignored, and a return value is not defined for this request. Peculiar results ensue if the parent does not expect to trace the child.

The remainder of the requests can only be used by the parent process. For each, *pid* is the process ID of the child. The child must be in a stopped state before these requests are made.

- 1, 2 With these requests, the word at location *addr* in the address space of the child is returned to the parent process. If instruction and data space are separated, request 1 returns a word from instruction space, and request 2 returns a word from data space. If instruction and data space are not separated, either request 1 or request 2 may be used with equal results. The *data* argument is ignored. These two requests fail if *addr* is not the start address of a word, in which case a value of -1 is returned to the parent process and the parent's `errno` is set to `EIO`.
- 3 With this request, the word at location *addr* in the child's user area in the system's address space [see `<sys/user.h>`] is returned to the parent process. The *data* argument is ignored. This request fails if *addr* is not the start address of a word or is outside the user area, in which case a value of -1 is returned to the parent process and the parent's `errno` is set to `EIO`.
- 4, 5 With these requests, the value given by the *data* argument is written into the address space of the child at location *addr*. If instruction and data space are separated, request 4 writes a word into instruction space, and request 5 writes a word into data space. If instruction and data space are not separated, either request 4 or request 5 may be used with equal results. On success, the value written into the address space of

the child is returned to the parent. These two requests fail if *addr* is not the start address of a word. On failure a value of -1 is returned to the parent process and the parent's *errno* is set to EIO.

- 6 With this request, a few entries in the child's user area can be written. *data* gives the value that is to be written and *addr* is the location of the entry. The few entries that can be written are the general registers and the condition codes of the Processor Status Word.
- 7 This request causes the child to resume execution. If the *data* argument is 0, all pending signals including the one that caused the child to stop are canceled before it resumes execution. If the *data* argument is a valid signal number, the child resumes execution as if it had incurred that signal, and any other pending signals are canceled. The *addr* argument must be equal to 1 for this request. On success, the value of *data* is returned to the parent. This request fails if *data* is not 0 or a valid signal number, in which case a value of -1 is returned to the parent process and the parent's *errno* is set to EIO.
- 8 This request causes the child to terminate with the same consequences as `exit(2)`.
- 9 This request sets the trace bit in the Processor Status Word of the child and then executes the same steps as listed above for request 7. The trace bit causes an interrupt on completion of one machine instruction. This effectively allows single stepping of the child.

To forestall possible fraud, `ptrace` inhibits the set-user-ID facility on subsequent `exec(2)` calls. If a traced process calls `exec(2)`, it stops before executing the first instruction of the new image showing signal SIGTRAP. `ptrace` in general fails if one or more of the following are true:

- EIO *request* is an illegal number.
- ESRCH *pid* identifies a child that does not exist or has not executed a `ptrace` with request 0.
- EPERM the invoking subject does not have the appropriate MAC privileges.

**SEE ALSO**

`sdb(1)`, `exec(2)`, `signal(2)`, `wait(2)`.

## NAME

putmsg – send a message on a stream

## SYNOPSIS

```
#include <stropts.h>

int putmsg(int fd, const struct strbuf *ctlptr,
 const struct strbuf *dataptr, int flags);

int putpmsg(int fd, const struct strbuf *ctlptr,
 const struct strbuf *dataptr, int band, int flags);
```

## DESCRIPTION

putmsg creates a message from user-specified buffer(s) and sends the message to a STREAMS file. The message may contain either a data part, a control part, or both. The data and control parts to be sent are distinguished by placement in separate buffers, as described below. The semantics of each part is defined by the STREAMS module that receives the message.

The function putpmsg does the same thing as putmsg, but provides the user the ability to send messages in different priority bands. Except where noted, all information pertaining to putmsg also pertains to putpmsg.

*fd* specifies a file descriptor referencing an open stream. *ctlptr* and *dataptr* each point to a strbuf structure, which contains the following members:

```
int maxlen; /* not used */
int len; /* length of data */
void *buf; /* ptr to buffer */
```

*ctlptr* points to the structure describing the control part, if any, to be included in the message. The *buf* field in the strbuf structure points to the buffer where the control information resides, and the *len* field indicates the number of bytes to be sent. The *maxlen* field is not used in putmsg [see getmsg(2)]. In a similar manner, *dataptr* specifies the data, if any, to be included in the message. *flags* indicates what type of message should be sent and is described later.

To send the data part of a message, *dataptr* must not be NULL and the *len* field of *dataptr* must have a value of 0 or greater. To send the control part of a message, the corresponding values must be set for *ctlptr*. No data (control) part is sent if either *dataptr* (*ctlptr*) is NULL or the *len* field of *dataptr* (*ctlptr*) is set to -1.

For putmsg(0), if a control part is specified, and *flags* is set to RS\_HIPRI, a high priority message is sent. If no control part is specified, and *flags* is set to RS\_HIPRI, putmsg fails and sets *errno* to EINVAL. If *flags* is set to 0, a normal (non-priority) message is sent. If no control part and no data part are specified, and *flags* is set to 0, no message is sent, and 0 is returned.

The stream head guarantees that the control part of a message generated by putmsg is at least 64 bytes in length.

For putpmsg, the flags are different. *flags* is a bitmask with the following mutually-exclusive flags defined: MSG\_HIPRI and MSG\_BAND. If *flags* is set to 0, putpmsg fails and sets *errno* to EINVAL. If a control part is specified and *flags* is set to MSG\_HIPRI and *band* is set to 0, a high-priority message is sent. If *flags* is

set to `MSG_HIPRI` and either no control part is specified or `band` is set to a non-zero value, `putpmsg()` fails and sets `errno` to `EINVAL`. If `flags` is set to `MSG_BAND`, then a message is sent in the priority band specified by `band`. If a control part and data part are not specified and `flags` is set to `MSG_BAND`, no message is sent and 0 is returned.

Normally, `putmsg()` will block if the stream write queue is full due to internal flow control conditions. For high-priority messages, `putmsg()` does not block on this condition. For other messages, `putmsg()` does not block when the write queue is full and `O_NDELAY` or `O_NONBLOCK` is set. Instead, it fails and sets `errno` to `EAGAIN`.

`putmsg` or `putpmsg` also blocks, unless prevented by lack of internal resources, waiting for the availability of message blocks in the stream, regardless of priority or whether `O_NDELAY` or `O_NONBLOCK` has been specified. No partial message is sent.

`putmsg` fails if one or more of the following are true:

|               |                                                                                                                                                                                                                                                                                                                                                                                                                |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EAGAIN</b> | A non-priority message was specified, the <code>O_NDELAY</code> or <code>O_NONBLOCK</code> flag is set and the stream write queue is full due to internal flow control conditions.                                                                                                                                                                                                                             |
| <b>EBADF</b>  | <code>fd</code> is not a valid file descriptor open for writing.                                                                                                                                                                                                                                                                                                                                               |
| <b>EFAULT</b> | <code>ctlptr</code> or <code>dataptr</code> points outside the allocated address space.                                                                                                                                                                                                                                                                                                                        |
| <b>EINTR</b>  | A signal was caught during the <code>putmsg</code> system call.                                                                                                                                                                                                                                                                                                                                                |
| <b>EINVAL</b> | An undefined value was specified in <code>flags</code> , or <code>flags</code> is set to <code>RS_HIPRI</code> and no control part was supplied.                                                                                                                                                                                                                                                               |
| <b>EINVAL</b> | The stream referenced by <code>fd</code> is linked below a multiplexor.                                                                                                                                                                                                                                                                                                                                        |
| <b>EINVAL</b> | For <code>putpmsg</code> , if <code>flags</code> is set to <code>MSG_HIPRI</code> and <code>band</code> is nonzero.                                                                                                                                                                                                                                                                                            |
| <b>ENOSR</b>  | Buffers could not be allocated for the message that was to be created due to insufficient STREAMS memory resources.                                                                                                                                                                                                                                                                                            |
| <b>ENOSTR</b> | A stream is not associated with <code>fd</code> .                                                                                                                                                                                                                                                                                                                                                              |
| <b>ENXIO</b>  | A hangup condition was generated downstream for the specified stream, or the other end of the pipe is closed.                                                                                                                                                                                                                                                                                                  |
| <b>ERANGE</b> | The size of the data part of the message does not fall within the range specified by the maximum and minimum packet sizes of the topmost stream module. This value is also returned if the control part of the message is larger than the maximum configured size of the control part of a message, or if the data part of a message is larger than the maximum configured size of the data part of a message. |

`putmsg` also fails if a STREAMS error message had been processed by the stream head before the call to `putmsg`. The error returned is the value contained in the STREAMS error message.



**putmsg(2)**

**putmsg(2)**

**SEE ALSO**

`getmsg(2)`, `intro(2)`, `poll(2)`, `putmsg(2)`, `read(2)`, `write(2)`.

*Programmer's Guide: STREAMS.*

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

read – read from file

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/uio.h>
#include <unistd.h>

int read(int fildes, void *buf, unsigned nbyte);
int readv(int fildes, struct iovec *iov, int iovcnt);
```

**DESCRIPTION**

read attempts to read *nbyte* bytes from the file associated with *fildes* into the buffer pointed to by *buf*. If *nbyte* is zero, read returns zero and has no other results. *fildes* is a file descriptor obtained from a *creat*, *open*, *dup*, *fcntl*, or pipe system call.

On devices capable of seeking, the read starts at a position in the file given by the file pointer associated with *fildes*. On return from read, the file pointer is incremented by the number of bytes actually read.

Devices that are incapable of seeking always read from the current position. The value of a file pointer associated with such a file is undefined.

*readv* performs the same action as *read*, but places the input data into the *iovcnt* buffers specified by the members of the *iov* array: *iov*[0], *iov*[1], ..., *iov*[*iovcnt*– 1].

For *readv*, the *iovec* structure contains the following members:

```
addr_t iov_base;
size_t iov_len;
```

Each *iovec* entry specifies the base address and length of an area in memory where data should be placed. *readv* always fills one buffer completely before proceeding to the next.

On success, *read* and *readv* return the number of bytes actually read and placed in the buffer; this number may be less than *nbyte* if the file is associated with a communication line [see *ioctl*(2) and *termio*(7)], or if the number of bytes left in the file is less than *nbyte*, or if the file is a pipe or a special file. A value of 0 is returned when an end-of-file has been reached.

*read* reads data previously written to a file. If any portion of an ordinary file prior to the end of file has not been written, *read* returns the number of bytes read as 0. For example, the *lseek* routine allows the file pointer to be set beyond the end of existing data in the file. If additional data is written at this point, subsequent reads in the gap between the previous end of data and newly written data return bytes with a value of 0 until data is written into the gap.

A *read* or *readv* from a STREAMS [see *intro*(2)] file can operate in three different modes: byte-stream mode, message-nondiscard mode, and message-discard mode. The default is byte-stream mode. This can be changed using the *I\_SRDOPT* *ioctl*(2) request [see *streamio*(7)], and can be tested with the *I\_GRDOPT* *ioctl*(2) request. In byte-stream mode, *read* and *readv* usually retrieve data from the stream until they have retrieved *nbyte* bytes, or until there

is no more data to be retrieved. Byte-stream mode usually ignores message boundaries.

In STREAMS message-nondiscard mode, `read` and `readv` retrieve data until they have read *nbyte* bytes, or until they reach a message boundary. If `read` or `readv` does not retrieve all the data in a message, the remaining data is replaced on the stream and can be retrieved by the next `read` or `readv` call. Message-discard mode also retrieves data until it has retrieved *nbyte* bytes, or it reaches a message boundary. However, unread data remaining in a message after the `read` or `readv` returns is discarded, and is not available for a subsequent `read`, `readv`, or `getmsg` [see `getmsg(2)`].

When attempting to read from a regular file with mandatory file/record locking set [see `chmod(2)`], and there is a write lock owned by another process on the segment of the file to be read:

If `O_NDELAY` or `O_NONBLOCK` is set, `read` returns `-1` and sets `errno` to `EAGAIN`.

If `O_NDELAY` and `O_NONBLOCK` are clear, `read` sleeps until the blocking record lock is removed.

When attempting to read from an empty pipe (or FIFO):

If no process has the pipe open for writing, `read` returns `0` to indicate end-of-file.

If some process has the pipe open for writing and `O_NDELAY` is set, `read` returns `0`.

If some process has the pipe open for writing and `O_NONBLOCK` is set, `read` returns `-1` and sets `errno` to `EAGAIN`.

If `O_NDELAY` and `O_NONBLOCK` are clear, `read` blocks until data is written to the pipe or the pipe is closed by all processes that had opened the pipe for writing.

When attempting to read a file associated with a terminal that has no data currently available:

If `O_NDELAY` is set, `read` returns `0`.

If `O_NONBLOCK` is set, `read` returns `-1` and sets `errno` to `EAGAIN`.

If `O_NDELAY` and `O_NONBLOCK` are clear, `read` blocks until data becomes available.

When attempting to read a file associated with a stream that is not a pipe or FIFO, or terminal, and that has no data currently available:

If `O_NDELAY` or `O_NONBLOCK` is set, `read` returns `-1` and sets `errno` to `EAGAIN`.

If `O_NDELAY` and `O_NONBLOCK` are clear, `read` blocks until data becomes available.

When reading from a STREAMS file, handling of zero-byte messages is determined by the current read mode setting. In byte-stream mode, `read` accepts data until it has read *nbyte* bytes, or until there is no more data to read, or until a zero-byte message block is encountered. `read` then returns the number of bytes read, and places the zero-byte message back on the stream to be retrieved by the next `read` or `getmsg` [see `getmsg(2)`]. In the two other modes, a zero-byte message returns a value of 0 and the message is removed from the stream. When a zero-byte message is read as the first message on a stream, a value of 0 is returned regardless of the read mode.

A `read` or `readv` from a STREAMS file returns the data in the message at the front of the stream head read queue, regardless of the priority band of the message.

Normally, a `read` from a STREAMS file can only process messages with data and without control information. The `read` fails if a message containing control information is encountered at the stream head. This default action can be changed by placing the stream in either control-data mode or control-discard mode with the `I_SRDOPT ioctl(2)`. In control-data mode, control messages are converted to data messages by `read`. In control-discard mode, control messages are discarded by `read`, but any data associated with the control messages is returned to the user.

`read` and `readv` fail if one or more of the following are true:

|         |                                                                                                                                                                                                                                                                             |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EAGAIN  | Mandatory file/record locking was set, <code>O_NDELAY</code> or <code>O_NONBLOCK</code> was set, and there was a blocking record lock.                                                                                                                                      |
| EAGAIN  | Total amount of system memory available when reading via raw I/O is temporarily insufficient.                                                                                                                                                                               |
| EAGAIN  | No data is waiting to be read on a file associated with a tty device and <code>O_NONBLOCK</code> was set.                                                                                                                                                                   |
| EAGAIN  | No message is waiting to be read on a stream and <code>O_NDELAY</code> or <code>O_NONBLOCK</code> was set.                                                                                                                                                                  |
| EBADF   | <i>fdes</i> is not a valid file descriptor open for reading.                                                                                                                                                                                                                |
| EBADMSG | Message waiting to be read on a stream is not a data message.                                                                                                                                                                                                               |
| EDEADLK | The read was going to go to sleep and cause a deadlock to occur.                                                                                                                                                                                                            |
| EFAULT  | <i>buf</i> points outside the allocated address space.                                                                                                                                                                                                                      |
| EINTR   | A signal was caught during the <code>read</code> or <code>readv</code> system call.                                                                                                                                                                                         |
| EINVAL  | Attempted to read from a stream linked to a multiplexor.                                                                                                                                                                                                                    |
| EIO     | A physical I/O error has occurred, or the process is in a background process group and is attempting to read from its controlling terminal, and either the process is ignoring or blocking the <code>SIGTTIN</code> signal or the process group of the process is orphaned. |
| ENOLCK  | The system record lock table was full, so the <code>read</code> or <code>readv</code> could not go to sleep until the blocking record lock was removed.                                                                                                                     |

## read(2)

## read(2)

- ENOLINK** *files* is on a remote machine and the link to that machine is no longer active.
- ENXIO** The device associated with *files* is a block special or character special file and the value of the file pointer is out of range.

In addition, `readv` may return one of the following errors:

- EFAULT** *iov* points outside the allocated address space.
- EINVAL** *iovcnt* was less than or equal to 0 or greater than 16.
- EINVAL** The sum of the *iov\_len* values in the *iov* array overflowed a 32-bit integer.

A read from a STREAMS file also fails if an error message is received at the stream head. In this case, `errno` is set to the value returned in the error message. If a hangup occurs on the stream being read, `read` continues to operate normally until the stream head read queue is empty. Thereafter, it returns 0.

### SEE ALSO

`intro(2)`, `creat(2)`, `dup(2)`, `fcntl(2)`, `getmsg(2)`, `ioctl(2)`, `open(2)`, `pipe(2)`  
`streamio(7)`, `termio(7)` in the *System Administrator's Reference Manual*

### DIAGNOSTICS

On success a non-negative integer is returned indicating the number of bytes actually read. Otherwise, a -1 is returned and `errno` is set to indicate the error.

**NAME**

readlink – read the value of a symbolic link

**SYNOPSIS**

```
#include <unistd.h>
```

```
int readlink(const char *path, void *buf, size_t bufsiz);
```

**DESCRIPTION**

readlink places the contents of the symbolic link referred to by *path* in the buffer *buf*, which has size *bufsiz*. The contents of the link are not null-terminated when returned.

readlink fails and the buffer remains unchanged if:

|                     |                                                                                                                                                                                     |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied for a component of the path prefix of <i>path</i> .                                                                                                     |
| <b>EFAULT</b>       | <i>path</i> or <i>buf</i> extends outside the allocated address space of the process.                                                                                               |
| <b>EINVAL</b>       | The named file is not a symbolic link.                                                                                                                                              |
| <b>EIO</b>          | An I/O error occurs while reading from or writing to the file system.                                                                                                               |
| <b>ELOOP</b>        | Too many symbolic links are encountered in translating <i>path</i> .                                                                                                                |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds { <b>PATH_MAX</b> }, or the length of a <i>path</i> component exceeds { <b>NAME_MAX</b> } while <b>_POSIX_NO_TRUNC</b> is in effect. |
| <b>ENOENT</b>       | The named file does not exist.                                                                                                                                                      |
| <b>ENOSYS</b>       | The file system does not support symbolic links.                                                                                                                                    |

**DIAGNOSTICS**

Upon successful completion readlink returns the number of characters placed in the buffer; otherwise, it returns -1 and places an error code in **errno**.

**SEE ALSO**

lstat(2), stat(2), symlink(2)

**NAME**

rename – change the name of a file

**SYNOPSIS**

```
#include <stdio.h>
```

```
int rename(const char *old, const char *new);
```

**DESCRIPTION**

**rename** renames a file. *old* is a pointer to the pathname of the file or directory to be renamed. *new* is a pointer to the new pathname of the file or directory. Both *old* and *new* must be of the same type (either both files, or both directories) and must reside on the same file system.

If *new* already exists, it is removed. Thus, if *new* names an existing directory, the directory must not have any entries other than, possibly, "." and "..". When renaming directories, the *new* pathname must not name a descendant of *old*. The implementation of **rename** ensures that upon successful completion a link named *new* will always exist.

If the final component of *old* is a symbolic link, the symbolic link is renamed, not the file or directory to which it points.

Write permission is required for both the directory containing *old* and the directory containing *new*. Furthermore, if *old* and *new* are directories, write permission is required for the directory named by *old*, and if it exists, the directory named by *new*. **rename** fails, *old* is not changed, and no *new* file is created if one or more of the following are true:

|               |                                                                                                                                                                                                                                           |
|---------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b> | A component of either path prefix denies search permission; one of the directories containing <i>old</i> or <i>new</i> denies write permission; or one of the directories pointed to by <i>old</i> or <i>new</i> denies write permission. |
| <b>EBUSY</b>  | <i>new</i> is a directory and the mount point for a mounted file system.                                                                                                                                                                  |
| <b>EDQUOT</b> | The directory in which the entry for the new name is being placed cannot be extended because the user's quota of disk blocks on the file system containing the directory has been exhausted.                                              |
| <b>EEXIST</b> | The link named by <i>new</i> is a directory containing entries other than "." and "..".                                                                                                                                                   |
| <b>EFAULT</b> | <i>old</i> or <i>new</i> points outside the process's allocated address space.                                                                                                                                                            |
| <b>EINVAL</b> | <i>old</i> is a parent directory of <i>new</i> , or an attempt is made to rename "." or "..".                                                                                                                                             |
| <b>EINTR</b>  | A signal was caught during execution of the <b>rename</b> system call.                                                                                                                                                                    |
| <b>EIO</b>    | An I/O error occurred while making or updating a directory entry.                                                                                                                                                                         |

## rename(2)

## rename(2)

|                     |                                                                                                                                                                                                                              |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EISDIR</b>       | <i>new</i> points to a directory but <i>old</i> points to a file that is not a directory.                                                                                                                                    |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>old</i> or <i>new</i> .                                                                                                                                           |
| <b>EMULTIHOP</b>    | Components of pathnames require hopping to multiple remote machines and the file system type does not allow it.                                                                                                              |
| <b>ENAMETOOLONG</b> | The length of the <i>old</i> or <i>new</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>old</i> or <i>new</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOENT</b>       | A component of either <i>old</i> or <i>new</i> does not exist, or the file referred to by either <i>old</i> or <i>new</i> does not exist.                                                                                    |
| <b>ENOLINK</b>      | Pathnames point to a remote machine and the link to that machine is no longer active.                                                                                                                                        |
| <b>ENOSPC</b>       | The directory that would contain <i>new</i> is out of space.                                                                                                                                                                 |
| <b>ENOTDIR</b>      | A component of either path prefix is not a directory; or the <i>old</i> parameter names a directory and the <i>new</i> parameter names a file.                                                                               |
| <b>EROFS</b>        | The requested operation requires writing in a directory on a read-only file system.                                                                                                                                          |
| <b>EXDEV</b>        | The links named by <i>old</i> and <i>new</i> are on different file systems.                                                                                                                                                  |

### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

### NOTES

The system can deadlock if there is a loop in the file system graph. Such a loop takes the form of an entry in directory *a*, say *a/foo*, being a hard link to directory *b*, and an entry in directory *b*, say *b/bar*, being a hard link to directory *a*. When such a loop exists and two separate processes attempt to perform `rename a/foo b/bar` and `rename b/bar a/foo`, respectively, the system may deadlock attempting to lock both directories for modification. The system administrator should replace hard links to directories by symbolic links.

### SEE ALSO

`link(2)`, `unlink(2)`



**NAME**

`rmdir` - remove a directory

**SYNOPSIS**

```
#include <unistd.h>

int rmdir(const char *path);
```

**DESCRIPTION**

`rmdir` removes the directory named by the path name pointed to by *path*. The directory must not have any entries other than `."` and `".."`.

If the directory's link count becomes zero and no process has the directory open, the space occupied by the directory is freed and the directory is no longer accessible. If one or more processes have the directory open when the last link is removed, the `."` and `".."` entries, if present, are removed before `rmdir` returns and no new entries may be created in the directory, but the directory is not removed until all references to the directory have been closed.

If *path* is a symbolic link, it is not followed.

Upon successful completion `rmdir` marks for update the `st_ctime` and `st_mtime` fields of the parent directory.

The named directory is removed unless one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied for a component of the path prefix.                                                                                                                                    |
| <b>EACCES</b>       | Write permission is denied on the directory containing the directory to be removed.                                                                                                                |
| <b>EACCES</b>       | The parent directory has the sticky bit set and is not owned by the user; the directory is not owned by the user and is not writable by the user; the user is not a super-user.                    |
| <b>EBUSY</b>        | The directory to be removed is the mount point for a mounted file system.                                                                                                                          |
| <b>EEXIST</b>       | The directory contains entries other than those for <code>."</code> and <code>".."</code> .                                                                                                        |
| <b>EFAULT</b>       | <i>path</i> points outside the process's allocated address space.                                                                                                                                  |
| <b>EINVAL</b>       | The directory to be removed is the current directory.                                                                                                                                              |
| <b>EINVAL</b>       | The directory to be removed is the <code>."</code> entry of a directory.                                                                                                                           |
| <b>EIO</b>          | An I/O error occurred while accessing the file system.                                                                                                                                             |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and the file system does not allow it.                                                                                       |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |

**rmdir(2)**

**rmdir(2)**

|                |                                                                                           |
|----------------|-------------------------------------------------------------------------------------------|
| <b>ENOTDIR</b> | A component of the path prefix is not a directory.                                        |
| <b>ENOENT</b>  | The named directory does not exist or is the null pathname.                               |
| <b>EROFS</b>   | The directory entry to be removed is part of a read-only file system.                     |
| <b>ENOLINK</b> | <i>path</i> points to a remote machine, and the link to that machine is no longer active. |

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

**SEE ALSO**

**mkdir(2)**,  
**rmdir(1)**, **rm(1)**, and **mkdir(1)** in the *User's Reference Manual*.

**NAME**

semctl - semaphore control operations

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/sem.h>

union semun {
 int val;
 struct semid_ds *buf;
 ushort *array;
};

int semctl(int semid, int semnum, int cmd, ... /* union semun arg
*/);
```

**DESCRIPTION**

semctl provides a variety of semaphore control operations as specified by *cmd*.

The following *cmds* are executed with respect to the semaphore specified by *semid* and *semnum*:

|         |                                                                                                                                                                                                       |
|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GETVAL  | Return the value of <i>semval</i> [see intro(2)]. {READ}                                                                                                                                              |
| SETVAL  | Set the value of <i>semval</i> to <i>arg.val</i> . {ALTER}. When this command is successfully executed, the <i>semadj</i> value corresponding to the specified semaphore in all processes is cleared. |
| GETPID  | Return the value of (int) <i>sempid</i> . {READ}                                                                                                                                                      |
| GETNCNT | Return the value of <i>semncnt</i> . {READ}                                                                                                                                                           |
| GETZCNT | Return the value of <i>semzcnt</i> . {READ}                                                                                                                                                           |

The following *cmds* return and set, respectively, every *semval* in the set of semaphores.

|        |                                                                                                                                                                                                                              |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GETALL | Place <i>semvals</i> into array pointed to by <i>arg.array</i> . {READ}                                                                                                                                                      |
| SETALL | Set <i>semvals</i> according to the array pointed to by <i>arg.array</i> . {ALTER}. When this cmd is successfully executed, the <i>semadj</i> values corresponding to each specified semaphore in all processes are cleared. |

The following *cmds* are also available:

|          |                                                                                                                                                                                                                                                                 |
|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| IPC_STAT | Place the current value of each member of the data structure associated with <i>semid</i> into the structure pointed to by <i>arg.buf</i> . The contents of this structure are defined in intro(2). {READ}                                                      |
| IPC_SET  | Set the value of the following members of the data structure associated with <i>semid</i> to the corresponding value found in the structure pointed to by <i>arg.buf</i> : <pre>sem_perm.uid sem_perm.gid sem_perm.mode /* only access permission bits */</pre> |

This command can be executed only by a process that has an effective user ID equal to either that of super-user, or to the value of `sem_perm.cuid` or `sem_perm.uid` in the data structure associated with `semid`.

**IPC\_RMID** Remove the semaphore identifier specified by `semid` from the system and destroy the set of semaphores and data structure associated with it. This command only be executed only by a process that has an effective user ID equal to either that of super-user, or to the value of `sem_perm.cuid` or `sem_perm.uid` in the data structure associated with `semid`.

`semctl` fails if one or more of the following are true:

|                  |                                                                                                                                                                                                                                                                                                       |
|------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>    | Operation permission is denied to the calling process [see <code>intro(2)</code> ].                                                                                                                                                                                                                   |
| <b>EINVAL</b>    | <code>semid</code> is not a valid semaphore identifier.                                                                                                                                                                                                                                               |
| <b>EINVAL</b>    | <code>semnum</code> is less than 0 or greater than <code>sem_nsems</code> .                                                                                                                                                                                                                           |
| <b>EINVAL</b>    | <code>cmd</code> is not a valid command.                                                                                                                                                                                                                                                              |
| <b>EINVAL</b>    | <code>cmd</code> is <code>IPC_SET</code> and <code>sem_perm.uid</code> or <code>sem_perm.gid</code> is not valid.                                                                                                                                                                                     |
| <b>EOVERFLOW</b> | <code>cmd</code> is <code>IPC_STAT</code> and <code>uid</code> or <code>gid</code> is too large to be stored in the structure pointed to by <code>arg.buf</code> .                                                                                                                                    |
| <b>ERANGE</b>    | <code>cmd</code> is <code>SETVAL</code> or <code>SETALL</code> and the value to which <code>semval</code> is to be set is greater than the system imposed maximum.                                                                                                                                    |
| <b>EPERM</b>     | <code>cmd</code> is equal to <code>IPC_RMID</code> or <code>IPC_SET</code> and the effective user ID of the calling process is not equal to that of super-user, or to the value of <code>sem_perm.cuid</code> or <code>sem_perm.uid</code> in the data structure associated with <code>semid</code> . |
| <b>EFAULT</b>    | <code>arg.buf</code> points to an illegal address.                                                                                                                                                                                                                                                    |

#### SEE ALSO

`intro(2)`, `semget(2)`, `semop(2)`.

#### DIAGNOSTICS

Upon successful completion, the value returned depends on `cmd` as follows:

|                |                                        |
|----------------|----------------------------------------|
| <b>GETVAL</b>  | the value of <code>semval</code>       |
| <b>GETPID</b>  | the value of (int) <code>sempid</code> |
| <b>GETNCNT</b> | the value of <code>semncnt</code>      |
| <b>GETZCNT</b> | the value of <code>semzcnt</code>      |
| all others     | a value of 0                           |

Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

`semget` – get set of semaphores

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/sem.h>
```

```
int semget(key_t key, int nsems, int semflg);
```

**DESCRIPTION**

`semget` returns the semaphore identifier associated with *key*.

A semaphore identifier and associated data structure and set containing *nsems* semaphores [see `intro(2)`] are created for *key* if one of the following is true:

*key* is equal to `IPC_PRIVATE`.

*key* does not already have a semaphore identifier associated with it, and `(semflg&IPC_CREAT)` is true.

On creation, the data structure associated with the new semaphore identifier is initialized as follows:

`sem_perm.cuid`, `sem_perm.uid`, `sem_perm.cgid`, and `sem_perm.gid` are set equal to the effective user ID and effective group ID, respectively, of the calling process.

The access permission bits of `sem_perm.mode` are set equal to the access permission bits of *semflg*.

`sem_nsems` is set equal to the value of *nsems*.

`sem_otime` is set equal to 0 and `sem_ctime` is set equal to the current time.

`semget` fails if one or more of the following are true:

- |               |                                                                                                                                                                                  |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | <i>nsems</i> is either less than or equal to zero or greater than the system-imposed limit.                                                                                      |
| <b>EACCES</b> | A semaphore identifier exists for <i>key</i> , but operation permission [see <code>intro(2)</code> ] as specified by the low-order 9 bits of <i>semflg</i> would not be granted. |
| <b>EINVAL</b> | A semaphore identifier exists for <i>key</i> , but the number of semaphores in the set associated with it is less than <i>nsems</i> , and <i>nsems</i> is not equal to zero.     |
| <b>ENOENT</b> | A semaphore identifier does not exist for <i>key</i> and <code>(semflg&amp;IPC_CREAT)</code> is false.                                                                           |
| <b>ENOSPC</b> | A semaphore identifier is to be created but the system-imposed limit on the maximum number of allowed semaphore identifiers system wide would be exceeded.                       |
| <b>ENOSPC</b> | A semaphore identifier is to be created but the system-imposed limit on the maximum number of allowed semaphores system wide would be exceeded.                                  |

## **semget(2)**

## **semget(2)**

**EEXIST** A semaphore identifier exists for *key* but both (*semflg*&IPC\_CREAT) and (*semflg*&IPC\_EXCL) are both true.

### **SEE ALSO**

*intro(2)*, *semctl(2)*, *semop(2)*, *stdipc(3C)*.

### **DIAGNOSTICS**

Upon successful completion, a non-negative integer, namely a semaphore identifier, is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

## NAME

semop – semaphore operations

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/sem.h>
```

```
int semop(int semid, struct sembuf *sops, size_t nsops);
```

## DESCRIPTION

**semop** is used to perform atomically an array of semaphore operations on the set of semaphores associated with the semaphore identifier specified by *semid*. *sops* is a pointer to the array of semaphore-operation structures. *nsops* is the number of such structures in the array. The contents of each structure includes the following members:

```
short sem_num; /* semaphore number */
short sem_op; /* semaphore operation */
short sem_flg; /* operation flags */
```

Each semaphore operation specified by *sem\_op* is performed on the corresponding semaphore specified by *semid* and *sem\_num*.

*sem\_op* specifies one of three semaphore operations as follows, depending on whether its value is negative, positive, or zero:

If *sem\_op* is a negative integer, one of the following occurs: {ALTER}

If *semval* [see [intro\(2\)](#)] is greater than or equal to the absolute value of *sem\_op*, the absolute value of *sem\_op* is subtracted from *semval*. Also, if (*sem\_flg*&**SEM\_UNDO**) is true, the absolute value of *sem\_op* is added to the calling process's *semadj* value [see [exit\(2\)](#)] for the specified semaphore.

If *semval* is less than the absolute value of *sem\_op* and (*sem\_flg*&**IPC\_NOWAIT**) is true, **semop** returns immediately.

If *semval* is less than the absolute value of *sem\_op* and (*sem\_flg*&**IPC\_NOWAIT**) is false, **semop** increments the *semncnt* associated with the specified semaphore and suspends execution of the calling process until one of the following conditions occur.

*semval* becomes greater than or equal to the absolute value of *sem\_op*. When this occurs, the value of *semncnt* associated with the specified semaphore is decremented, the absolute value of *sem\_op* is subtracted from *semval* and, if (*sem\_flg*&**SEM\_UNDO**) is true, the absolute value of *sem\_op* is added to the calling process's *semadj* value for the specified semaphore.

The *semid* for which the calling process is awaiting action is removed from the system [see [semctl\(2\)](#)]. When this occurs, *errno* is set equal to **EIDRM**, and a value of **-1** is returned.

The calling process receives a signal that is to be caught. When this occurs, the value of *semncnt* associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in [signal\(2\)](#).

If *sem\_op* is a positive integer, the value of *sem\_op* is added to *semval* and, if (*sem\_flg*&**SEM\_UNDO**) is true, the value of *sem\_op* is subtracted from the calling process's *semadj* value for the specified semaphore. {ALTER}

If *sem\_op* is zero, one of the following occurs: {READ}

If *semval* is zero, **semop** returns immediately.

If *semval* is not equal to zero and (*sem\_flg*&**IPC\_NOWAIT**) is true, **semop** returns immediately.

If *semval* is not equal to zero and (*sem\_flg*&**IPC\_NOWAIT**) is false, **semop** increments the *semzcnt* associated with the specified semaphore and suspends execution of the calling process until one of the following occurs:

*semval* becomes zero, at which time the value of *semzcnt* associated with the specified semaphore is decremented.

The *semid* for which the calling process is awaiting action is removed from the system. When this occurs, *errno* is set equal to **EIDRM**, and a value of **-1** is returned.

The calling process receives a signal that is to be caught. When this occurs, the value of *semzcnt* associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in **signal(2)**.

**semop** fails if one or more of the following are true for any of the semaphore operations specified by *sops*:

|               |                                                                                                                                 |
|---------------|---------------------------------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | <i>semid</i> is not a valid semaphore identifier.                                                                               |
| <b>EFBIG</b>  | <i>sem_num</i> is less than zero or greater than or equal to the number of semaphores in the set associated with <i>semid</i> . |
| <b>E2BIG</b>  | <i>nsops</i> is greater than the system-imposed maximum.                                                                        |
| <b>EACCES</b> | Operation permission is denied to the calling process [see <b>intro(2)</b> ].                                                   |
| <b>EAGAIN</b> | The operation would result in suspension of the calling process but ( <i>sem_flg</i> & <b>IPC_NOWAIT</b> ) is true.             |
| <b>ENOSPC</b> | The limit on the number of individual processes requesting an <b>SEM_UNDO</b> would be exceeded.                                |
| <b>EINVAL</b> | The number of individual semaphores for which the calling process requests a <b>SEM_UNDO</b> would exceed the limit.            |
| <b>ERANGE</b> | An operation would cause a <i>semval</i> to overflow the system-imposed limit.                                                  |
| <b>ERANGE</b> | An operation would cause a <i>semadj</i> value to overflow the system-imposed limit.                                            |
| <b>EFAULT</b> | <i>sops</i> points to an illegal address.                                                                                       |

Upon successful completion, the value of *semopid* for each semaphore specified in the array pointed to by *sops* is set equal to the process ID of the calling process.



**semop(2)**

**semop(2)**

**SEE ALSO**

*intro(2)*, *exec(2)*, *exit(2)*, *fork(2)*, *semctl(2)*, *semget(2)*.

**DIAGNOSTICS**

If *semop* returns due to the receipt of a signal, a value of -1 is returned to the calling process and *errno* is set to **EINTR**. If it returns due to the removal of a *semid* from the system, a value of -1 is returned and *errno* is set to **EIDRM**.

Upon successful completion, a value of zero is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

**NAME**

setpgid – set process group ID

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

int setpgid(pid_t pid, pid_t pgid);
```

**DESCRIPTION**

setpgid sets the process group ID of the process with ID *pid* to *pgid*. If *pgid* is equal to *pid*, the process becomes a process group leader. If *pgid* is not equal to *pid*, the process becomes a member of an existing process group.

If *pid* is equal to 0, the process ID of the calling process is used. If *pgid* is equal to 0, the process specified by *pid* becomes a process group leader.

setpgid fails and returns an error if one or more of the following are true:

|               |                                                                                                                                                                                                                    |
|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b> | <i>pid</i> matches the process ID of a child process of the calling process and the child process has successfully executed an exec(2) function.                                                                   |
| <b>EINVAL</b> | <i>pgid</i> is less than (pid_t) 0, or greater than or equal to {PID_MAX}.                                                                                                                                         |
| <b>EINVAL</b> | The calling process has a controlling terminal that does not support job control.                                                                                                                                  |
| <b>EPERM</b>  | The process indicated by the <i>pid</i> argument is a session leader.                                                                                                                                              |
| <b>EPERM</b>  | <i>pid</i> matches the process ID of a child process of the calling process and the child process is not in the same session as the calling process.                                                               |
| <b>EPERM</b>  | <i>pgid</i> does not match the process ID of the process indicated by the <i>pid</i> argument and there is no process with a process group ID that matches <i>pgid</i> in the same session as the calling process. |
| <b>ESRCH</b>  | <i>pid</i> does not match the process ID of the calling process or of a child process of the calling process.                                                                                                      |

**SEE ALSO**

exec(2), exit(2), fork(2), getpid(2), getpgid(2), setsid(2).

**DIAGNOSTICS**

Upon successful completion, setpgid returns a value of 0. Otherwise, a value of -1 is returned and errno is set to indicate the error.

## setpgrp(2)

## setpgrp(2)

### NAME

**setpgrp** – set process group ID

### SYNOPSIS

```
#include <sys/types.h>
#include <unistd.h>

pid_t setpgrp (void);
```

### DESCRIPTION

If the calling process is not already a session leader, **setpgrp** sets the process group ID and session ID of the calling process to the process ID of the calling process, and releases the calling process's controlling terminal.

### SEE ALSO

**intro(2)**, **exec(2)**, **fork(2)**, **getpid(2)**, **kill(2)**, **setsid(2)**, **signal(2)**.

### DIAGNOSTICS

**setpgrp** returns the value of the new process group ID.

### NOTES

**setpgrp** will be phased out in favor of the **setsid(2)** function.

**NAME**

**setsid** - set session ID

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

pid_t setsid(void);
```

**DESCRIPTION**

If the calling process is not already a process group leader, **setsid** sets the process group ID and session ID of the calling process to the process ID of the calling process, and releases the process's controlling terminal.

**setsid** will fail and return an error if the following is true:

**EPERM**           The calling process is already a process group leader, or there are processes other than the calling process whose process group ID is equal to the process ID of the calling process.

**SEE ALSO**

**intro(2)**, **exec(2)**, **exit(2)**, **fork(2)**, **getpid(2)**, **getpgid(2)**, **getsid(2)**, **setpgid(2)**, **setpgrp**, **signal(2)**, **sigsend(2)**.

**WARNING**

If the calling process is the last member of a pipeline started by a job control shell, the shell may make the calling process a process group leader. The other processes of the pipeline become members of that process group. In this case, the call to **setsid** will fail. For this reason, a process that calls **setsid** and expects to be part of a pipeline should always first fork; the parent should exit and the child should call **setsid**, thereby insuring that the process will work reliably when started by both job control shells and non-job control shells.

**DIAGNOSTICS**

Upon successful completion, **setsid** returns the calling process's session ID. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

**NAME**

setuid, setgid – set user and group IDs

**SYNOPSIS**

```
#include <sys/types.h>
#include <unistd.h>

int setuid(uid_t uid);
int setgid(gid_t gid);
```

**DESCRIPTION**

The `setuid` system call sets the real user ID, effective user ID, and saved user ID of the calling process. The `setgid` system call sets the real group ID, effective group ID, and saved group ID of the calling process.

At login time, the real user ID, effective user ID, and saved user ID of the login process are set to the login ID of the user responsible for the creation of the process. The same is true for the real, effective, and saved group IDs; they are set to the group ID of the user responsible for the creation of the process.

When a process calls `exec(2)` to execute a file (program), the user and/or group identifiers associated with the process can change. If the file executed is a set-user-ID file, the effective and saved user IDs of the process are set to the owner of the file executed. If the file executed is a set-group-ID file, the effective and saved group IDs of the process are set to the group of the file executed. If the file executed is not a set-user-ID or set-group-ID file, the effective user ID, saved user ID, effective group ID, and saved group ID are not changed.

The following subsections describe the behavior of `setuid` and `setgid` with respect to the three types of user and group IDs.

**setuid**

If the effective user ID of the process calling `setuid` is the superuser, the real, effective, and saved user IDs are set to the `uid` parameter.

If the effective user ID of the calling process is not the superuser, but `uid` is either the real user ID or the saved user ID of the calling process, the effective user ID is set to `uid`.

**setgid**

If the effective user ID of the process calling `setgid` is the superuser, the real, effective, and saved group IDs are set to the `gid` parameter.

If the effective user ID of the calling process is not the superuser, but `gid` is either the real group ID or the saved group ID of the calling process, the effective group ID is set to `gid`.

`setuid` and `setgid` fail if one or more of the following is true:

**EPERM** For `setuid`, if the effective user ID is not the superuser, and the `uid` parameter does not match either the real or saved user IDs. For `setgid`, if the effective user ID is not the superuser, and the `gid` parameter does not match either the real or saved group IDs.

## setuid(2)

## setuid(2)

**EINVAL** The *uid* or *gid* is out of range.

### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

### SEE ALSO

**intro(2)**, **exec(2)**, **getgroups(2)**, **getuid(2)**, **stat(5)**.

## NAME

shmctl - shared memory control operations

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

int shmctl (int shmid, int cmd, struct shm_id *buf);
```

## DESCRIPTION

shmctl provides a variety of shared memory control operations as specified by *cmd*. The following *cmds* are available:

**IPC\_STAT** Place the current value of each member of the data structure associated with *shmid* into the structure pointed to by *buf*. The contents of this structure are defined in *intro(2)*. {READ}

**IPC\_SET** Set the value of the following members of the data structure associated with *shmid* to the corresponding value found in the structure pointed to by *buf*:

```
shm_perm.uid
shm_perm.gid
shm_perm.mode /* only access permission bits */
```

This command can be executed only by a process that has an effective user ID equal to that of super-user, or to the value of *shm\_perm.cuid* or *shm\_perm.uid* in the data structure associated with *shmid*.

**IPC\_RMID** Remove the shared memory identifier specified by *shmid* from the system and destroy the shared memory segment and data structure associated with it. This command can be executed only by a process that has an effective user ID equal to that of super-user, or to the value of *shm\_perm.cuid* or *shm\_perm.uid* in the data structure associated with *shmid*.

**SHM\_LOCK** Lock the shared memory segment specified by *shmid* in memory. This command can be executed only by a process that has an effective user ID equal to super-user.

**SHM\_UNLOCK** Unlock the shared memory segment specified by *shmid*. This command can be executed only by a process that has an effective user ID equal to super-user.

shmctl fails if one or more of the following are true:

**EACCES** *cmd* is equal to **IPC\_STAT** and {READ} operation permission is denied to the calling process [see *intro(2)*].

**EINVAL** *shmid* is not a valid shared memory identifier.

**EINVAL** *cmd* is not a valid command.

- EINVAL** *cmd* is `IPC_SET` and `shm_perm.uid` or `shm_perm.gid` is not valid.
- EOVERFLOW** *cmd* is `IPC_STAT` and *uid* or *gid* is too large to be stored in the structure pointed to by *buf*.
- EPERM** *cmd* is equal to `IPC_RMID` or `IPC_SET` and the effective user ID of the calling process is not equal to that of super-user, or to the value of `shm_perm.cuid` or `shm_perm.uid` in the data structure associated with *shmid*.
- EPERM** *cmd* is equal to `SHM_LOCK` or `SHM_UNLOCK` and the effective user ID of the calling process is not equal to that of super-user.
- EFAULT** *buf* points to an illegal address.
- ENOMEM** *cmd* is equal to `SHM_LOCK` and there is not enough memory.

**SEE ALSO**

`shmget(2)`, `shmop(2)`.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NOTES**

The user must explicitly remove shared memory segments after the last reference to them has been removed.



**NAME**

**shmget** – get shared memory segment identifier

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

int shmget(key_t key, int size, int shmflg);
```

**DESCRIPTION**

**shmget** returns the shared memory identifier associated with *key*.

A shared memory identifier and associated data structure and shared memory segment of at least *size* bytes [see [intro\(2\)](#)] are created for *key* if one of the following are true:

*key* is equal to `IPC_PRIVATE`.

*key* does not already have a shared memory identifier associated with it, and  $(shmflg \& IPC\_CREAT)$  is true.

Upon creation, the data structure associated with the new shared memory identifier is initialized as follows:

`shm_perm.cuid`, `shm_perm.uid`, `shm_perm.cgid`, and `shm_perm.gid` are set equal to the effective user ID and effective group ID, respectively, of the calling process.

The access permission bits of `shm_perm.mode` are set equal to the access permission bits of *shmflg*. `shm_segsz` is set equal to the value of *size*.

`shm_lpid`, `shm_nattch`, `shm_atime`, and `shm_dtime` are set equal to 0.

`shm_ctime` is set equal to the current time.

**shmget** fails if one or more of the following are true:

- |               |                                                                                                                                                                                       |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | <i>size</i> is less than the system-imposed minimum or greater than the system-imposed maximum.                                                                                       |
| <b>EACCES</b> | A shared memory identifier exists for <i>key</i> but operation permission [see <a href="#">intro(2)</a> ] as specified by the low-order 9 bits of <i>shmflg</i> would not be granted. |
| <b>EINVAL</b> | A shared memory identifier exists for <i>key</i> but the size of the segment associated with it is less than <i>size</i> and <i>size</i> is not equal to zero.                        |
| <b>ENOENT</b> | A shared memory identifier does not exist for <i>key</i> and $(shmflg \& IPC\_CREAT)$ is false.                                                                                       |
| <b>ENOSPC</b> | A shared memory identifier is to be created but the system-imposed limit on the maximum number of allowed shared memory identifiers system wide would be exceeded.                    |
| <b>ENOMEM</b> | A shared memory identifier and associated shared memory segment are to be created but the amount of available memory is not sufficient to fill the request.                           |

## shmget(2)

## shmget(2)

**EEXIST** A shared memory identifier exists for *key* but both (*shmflg*&IPC\_CREAT) and (*shmflg*&IPC\_EXCL) are true.

### SEE ALSO

intro(2), shmctl(2), shmop(2), stdipc(3C).

### DIAGNOSTICS

Upon successful completion, a non-negative integer, namely a shared memory identifier is returned. Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

### NOTES

The user must explicitly remove shared memory segments after the last reference to them has been removed.

**NAME**

**shmop:** *shmat*, *shmdt* - shared memory operations

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
#include <sys/shm.h>

void *shmat(int shmid, void *shmaddr, int shmflg);
int shmdt(void *shmaddr);
```

**DESCRIPTION**

*shmat* attaches the shared memory segment associated with the shared memory identifier specified by *shmid* to the data segment of the calling process. The segment is attached at the address specified by one of the following criteria:

If *shmaddr* is equal to (void \*) 0, the segment is attached at the first available address as selected by the system.

If *shmaddr* is not equal to (void \*) 0 and (*shmflg*&*SHM\_RND*) is true, the segment is attached at the address given by (*shmaddr* - (*shmaddr* modulus *SHMLBA*)).

If *shmaddr* is not equal to (void \*) 0 and (*shmflg*&*SHM\_RND*) is false, the segment is attached at the address given by *shmaddr*.

*shmdt* detaches from the calling process's data segment the shared memory segment located at the address specified by *shmaddr*.

The segment is attached for reading if (*shmflg*&*SHM\_RDONLY*) is true {*READ*}, otherwise it is attached for reading and writing {*READ/WRITE*}.

*shmat* fails and does not attach the shared memory segment if one or more of the following are true:

- EINVAL** *shmid* is not a valid shared memory identifier.
- EACCESS** Operation permission is denied to the calling process [see *intro(2)*].
- ENOMEM** The available data space is not large enough to accommodate the shared memory segment.
- EINVAL** *shmaddr* is not equal to zero, and the value of (*shmaddr* - (*shmaddr* modulus *SHMLBA*)). is an illegal address.
- EINVAL** *shmaddr* is not equal to zero, (*shmflg*&*SHM\_RND*) is false, and the value of *shmaddr* is an illegal address.
- EMFILE** The number of shared memory segments attached to the calling process would exceed the system-imposed limit.
- EINVAL** *shmdt* fails and does not detach the shared memory segment if *shmaddr* is not the data segment start address of a shared memory segment.

**SEE ALSO**

`intro(2)`, `exec(2)`, `exit(2)`, `fork(2)`, `shmctl(2)`, `shmget(2)`.

**DIAGNOSTICS**

Upon successful completion, the return value is as follows:

`shmat` returns the data segment start address of the attached shared memory segment.

`shmdt` returns a value of 0.

Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NOTES**

The user must explicitly remove shared memory segments after the last reference to them has been removed.

**NAME**

sigaction – detailed signal management

**SYNOPSIS**

```
#include <signal.h>

int sigaction(int sig, const struct sigaction *act,
 struct sigaction *oact);
```

**DESCRIPTION**

sigaction allows the calling process to examine and/or specify the action to be taken on delivery of a specific signal. [See signal(5) for an explanation of general signal concepts.]

sig specifies the signal and can be assigned any of the signals specified in signal(5) except SIGKILL and SIGSTOP

If the argument act is not NULL, it points to a structure specifying the new action to be taken when delivering sig. If the argument oact is not NULL, it points to a structure where the action previously associated with sig is to be stored on return from sigaction.

The sigaction structure includes the following members:

```
void (*sa_handler) ();
sigset_t sa_mask;
int sa_flags;
```

sa\_handler specifies the disposition of the signal and may take any of the values specified in signal(5).

sa\_mask specifies a set of signals to be blocked while the signal handler is active. On entry to the signal handler, that set of signals is added to the set of signals already being blocked when the signal is delivered. In addition, the signal that caused the handler to be executed will also be blocked, unless the SA\_NODEFER flag has been specified. SIGSTOP and SIGKILL cannot be blocked (the system silently enforces this restriction).

sa\_flags specifies a set of flags used to modify the delivery of the signal. It is formed by a logical OR of any of the following values:

|              |                                                                                                                                                                                                                                                                                 |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| SA_ONSTACK   | If set and the signal is caught and an alternate signal stack has been declared with sigaltstack(2), the signal is delivered to the calling process on that stack. Otherwise, the signal is delivered on the same stack as the main program.                                    |
| SA_RESETHAND | If set and the signal is caught, the disposition of the signal is reset to SIG_DFL and the signal will not be blocked on entry to the signal handler (SIGILL, SIGTRAP, and SIGPWR cannot be automatically reset when delivered; the system silently enforces this restriction). |

|                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>SA_NODEFER</b>   | If set and the signal is caught, the signal will not be automatically blocked by the kernel while it is being caught.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>SA_RESTART</b>   | If set and the signal is caught, a system call that is interrupted by the execution of this signal's handler is transparently restarted by the system. Otherwise, that system call returns an <b>EINTR</b> error.                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>SA_SIGINFO</b>   | If cleared and the signal is caught, <i>sig</i> is passed as the only argument to the signal-catching function. If set and the signal is caught, pending signals of type <i>sig</i> are reliably queued to the calling process and two additional arguments are passed to the signal-catching function. If the second argument is not equal to <b>NULL</b> , it points to a <b>siginfo_t</b> structure containing the reason why the signal was generated [see <b>siginfo(5)</b> ]; the third argument points to a <b>ucontext_t</b> structure containing the receiving process's context when the signal was delivered [see <b>ucontext(5)</b> ]. |
| <b>SA_NOCLDWAIT</b> | If set and <i>sig</i> equals <b>SIGCHLD</b> , the system will not create zombie processes when children of the calling process exit. If the calling process subsequently issues a <b>wait(2)</b> , it blocks until all of the calling process's child processes terminate, and then returns a value of <b>-1</b> with <b>errno</b> set to <b>ECHILD</b> .                                                                                                                                                                                                                                                                                          |
| <b>SA_NOCLDSTOP</b> | If set and <i>sig</i> equals <b>SIGCHLD</b> , <i>sig</i> will not be sent to the calling process when its child processes stop or continue.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**sigaction** fails if any of the following is true:

|               |                                                                                                                     |
|---------------|---------------------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | The value of the <i>sig</i> argument is not a valid signal number or is equal to <b>SIGKILL</b> or <b>SIGSTOP</b> . |
| <b>EFAULT</b> | <i>act</i> or <i>oact</i> points outside the process's allocated address space.                                     |

#### DIAGNOSTICS

On success, **sigaction** returns zero. On failure, it returns **-1** and sets **errno** to indicate the error.

#### SEE ALSO

**intro(2)**, **exit(2)**, **kill(2)**, **pause(2)**, **sigaltstack(2)**, **signal(2)**, **sigprocmask(2)**, **sigsend(2)**, **sigsuspend(2)**, **wait(2)**, **sigsetops(3C)**, **siginfo(5)**, **signal(5)**, **ucontext(5)**.

**kill(1)** in the *User's Reference Manual*.

#### NOTES

If the system call is reading from or writing to a terminal and the terminal's **NOFLSH** bit is cleared, data may be flushed [see **termio(7)**].

## NAME

sigaltstack – set or get signal alternate stack context

## SYNOPSIS

```
#include <signal.h>

int sigaltstack(const stack_t *ss, stack_t *oss);
```

## DESCRIPTION

sigaltstack allows users to define an alternate stack area on which signals are to be processed. If *ss* is non-zero, it specifies a pointer to, and the size of a stack area on which to deliver signals, and tells the system if the process is currently executing on that stack. When a signal's action indicates its handler should execute on the alternate signal stack [specified with a `sigaction(2)` call], the system checks to see if the process is currently executing on that stack. If the process is not currently executing on the signal stack, the system arranges a switch to the alternate signal stack for the duration of the signal handler's execution.

The structure `sigaltstack` includes the following members.

```
int *ss_sp
long ss_size
int ss_flags
```

If *ss* is not `NULL`, it points to a structure specifying the alternate signal stack that will take effect upon return from `sigaltstack`. The `ss_sp` and `ss_size` fields specify the new base and size of the stack, which is automatically adjusted for direction of growth and alignment. The `ss_flags` field specifies the new stack state and may be set to the following:

**SS\_DISABLE** The stack is to be disabled and `ss_sp` and `ss_size` are ignored. If **SS\_DISABLE** is not set, the stack will be enabled.

If *oss* is not `NULL`, it points to a structure specifying the alternate signal stack that was in effect prior to the call to `sigaltstack`. The `ss_sp` and `ss_size` fields specify the base and size of that stack. The `ss_flags` field specifies the stack's state, and may contain the following values:

**SS\_ONSTACK** The process is currently executing on the alternate signal stack. Attempts to modify the alternate signal stack while the process is executing on it will fail.

**SS\_DISABLE** The alternate signal stack is currently disabled.

`sigaltstack` fails if any of the following is true:

**EFAULT** Either *ss* or *oss* points outside the process's allocated address space.

**EINVAL** An attempt was made to disable an active stack or the `ss_flags` field specifies invalid flags.

**ENOMEM** The size of the alternate stack area is less than `MINSIGSTKSZ`.

## NOTES

The value `SIGSTKSZ` is defined to be the number of bytes that would be used to cover the usual case when allocating an alternate stack area. The value `MINSIGSTKSZ` is defined to be the minimum stack size for a signal handler. In

computing an alternate stack size, a program should add that amount to its stack requirements to allow for the operating system overhead.

The following code fragment is typically used to allocate an alternate stack.

```
if ((sigstk.ss_sp = (char *)malloc(SIGSTKSZ)) == NULL)
 /* error return */;

sigstk.ss_size = SIGSTKSZ;
sigstk.ss_flags = 0;
if (sigaltstack(&sigstk, (stack_t *)0) < 0)
 perror("sigaltstack");
```

**SEE ALSO**

getcontext(2), sigaction(2), sigsetjmp(3C), ucontext(5).

**DIAGNOSTICS**

On success, `sigaltstack` returns zero. On failure, it returns `-1` and sets `errno` to indicate the error.



**NAME**

`signal`, `sigset`, `sighold`, `sigrelse`, `sigignore`, `sigpause` – simplified signal management

**SYNOPSIS**

```
#include <signal.h>

void (*signal(int sig, void (*disp)(int)))(int);
void (*sigset(int sig, void (*disp)(int)))(int);

int sighold(int sig);
int sigrelse(int sig);
int sigignore(int sig);
int sigpause(int sig);
```

**DESCRIPTION**

These functions provide simplified signal management for application processes. See `signal(5)` for an explanation of general signal concepts.

`signal` and `sigset` are used to modify signal dispositions. *sig* specifies the signal, which may be any signal except `SIGKILL` and `SIGSTOP`. *disp* specifies the signal's disposition, which may be `SIG_DFL`, `SIG_IGN`, or the address of a signal handler. If `signal` is used, *disp* is the address of a signal handler, and *sig* is not `SIGILL`, `SIGTRAP`, or `SIGPWR`, the system first sets the signal's disposition to `SIG_DFL` before executing the signal handler. If `sigset` is used and *disp* is the address of a signal handler, the system adds *sig* to the calling process's signal mask before executing the signal handler; when the signal handler returns, the system restores the calling process's signal mask to its state prior to the delivery of the signal. In addition, if `sigset` is used and *disp* is equal to `SIG_HOLD`, *sig* is added to the calling process's signal mask and the signal's disposition remains unchanged.

`sighold` adds *sig* to the calling process's signal mask.

`sigrelse` removes *sig* from the calling process's signal mask.

`sigignore` sets the disposition of *sig* to `SIG_IGN`.

`sigpause` removes *sig* from the calling process's signal mask and suspends the calling process until a signal is received.

These functions fail if any of the following are true.

**EINVAL**           The value of the *sig* argument is not a valid signal or is equal to `SIGKILL` or `SIGSTOP`.

**EINTR**            A signal was caught during the system call `sigpause`.

**NOTES**

`sighold` in conjunction with `sigrelse` or `sigpause` may be used to establish critical regions of code that require the delivery of a signal to be temporarily deferred.

## signal(2)

## signal(2)

If `signal` or `sigset` is used to set `SIGCHLD`'s disposition to a signal handler, `SIGCHLD` will not be sent when the calling process's children are stopped or continued.

If any of the above functions are used to set `SIGCHLD`'s disposition to `SIG_IGN`, the calling process's child processes will not create zombie processes when they terminate [see `exit(2)`]. If the calling process subsequently waits for its children, it blocks until all of its children terminate; it then returns a value of `-1` with `errno` set to `ECHILD` [see `wait(2)`, `waitid(2)`].

### DIAGNOSTICS

On success, `signal` returns the signal's previous disposition. On failure, it returns `SIG_ERR` and sets `errno` to indicate the error.

On success, `sigset` returns `SIG_HOLD` if the signal had been blocked or the signal's previous disposition if it had not been blocked. On failure, it returns `SIG_ERR` and sets `errno` to indicate the error.

All other functions return zero on success. On failure, they return `-1` and set `errno` to indicate the error.

### SEE ALSO

`kill(2)`, `pause(2)`, `sigaction(2)`, `sigsend(2)`, `wait(2)`, `waitid(2)`, `signal(5)`.

**NAME**

**sigpending** – examine signals that are blocked and pending

**SYNOPSIS**

```
#include <signal.h>
int sigpending(sigset_t *set);
```

**DESCRIPTION**

The **sigpending** function retrieves those signals that have been sent to the calling process but are being blocked from delivery by the calling process's signal mask. The signals are stored in the space pointed to by the argument *set*.

**sigpending** fails if the following is true:

**EFAULT**           The *set* argument points outside the process's allocated address space.

**SEE ALSO**

**sigaction(2)**, **sigprocmask(2)**, **sigsetops(3C)**.

**DIAGNOSTICS**

On success, **sigpending** returns zero. On failure, it returns -1 and sets **errno** to indicate the error.

**NAME**

sigprocmask - change or examine signal mask

**SYNOPSIS**

```
#include <signal.h>
```

```
int sigprocmask(int how, const sigset_t *set, sigset_t *oset);
```

**DESCRIPTION**

The `sigprocmask` function is used to examine and/or change the calling process's signal mask. If the value is `SIG_BLOCK`, the set pointed to by the argument `set` is added to the current signal mask. If the value is `SIG_UNBLOCK`, the set pointed to by the argument `set` is removed from the current signal mask. If the value is `SIG_SETMASK`, the current signal mask is replaced by the set pointed to by the argument `set`. If the argument `oset` is not `NULL`, the previous mask is stored in the space pointed to by `oset`. If the value of the argument `set` is `NULL`, the value `how` is not significant and the process's signal mask is unchanged; thus, the call can be used to enquire about currently blocked signals.

If there are any pending unblocked signals after the call to `sigprocmask`, at least one of those signals will be delivered before the call to `sigprocmask` returns.

It is not possible to block those signals that cannot be ignored [see `sigaction(2)`]; this restriction is silently imposed by the system.

If `sigprocmask` fails, the process's signal mask is not changed.

`sigprocmask` fails if any of the following is true:

- |               |                                                                                                          |
|---------------|----------------------------------------------------------------------------------------------------------|
| <b>EINVAL</b> | The value of the <code>how</code> argument is not equal to one of the defined values.                    |
| <b>EFAULT</b> | The value of <code>set</code> or <code>oset</code> points outside the process's allocated address space. |

**SEE ALSO**

`sigaction(2)`, `signal(2)`, `sigsetopts(3C)`, `signal(5)`.

**DIAGNOSTICS**

On success, `sigprocmask` returns zero. On failure, it returns `-1` and sets `errno` to indicate the error.

## NAME

`sigsend`, `sigsendset` – send a signal to a process or a group of processes

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/signal.h>
#include <sys/procset.h>

int sigsend(idtype_t idtype, id_t id, int sig);
int sigsendset(procset_t *psp, int sig);
```

## DESCRIPTION

`sigsend` sends a signal to the process or group of processes specified by *id* and *idtype*. The signal to be sent is specified by *sig* and is either zero or one of the values listed in `signal(5)`. If *sig* is zero (the null signal), error checking is performed but no signal is actually sent. This value can be used to check the validity of *id* and *idtype*.

The real or effective user ID of the sending process must match the real or effective user ID of the receiving process, unless the effective user ID of the sending process is super-user, or *sig* is `SIGCONT` and the sending process has the same session ID as the receiving process.

If *idtype* is `P_PID`, *sig* is sent to the process with process ID *id*.

If *idtype* is `P_PGID`, *sig* is sent to any process with process group ID *id*.

If *idtype* is `P_SID`, *sig* is sent to any process with session ID *id*.

If *idtype* is `P_UID`, *sig* is sent to any process with effective user ID *id*.

If *idtype* is `P_GID`, *sig* is sent to any process with effective group ID *id*.

If *idtype* is `P_CID`, *sig* is sent to any process with scheduler class ID *id* [see `priocntl(2)`].

If *idtype* is `P_ALL`, *sig* is sent to all processes and *id* is ignored.

If *id* is `P_MYID`, the value of *id* is taken from the calling process.

The process with a process ID of 0 is always excluded. The process with a process ID of 1 is excluded unless *idtype* is equal to `P_PID`.

`sigsendset` provides an alternate interface for sending signals to sets of processes. This function sends signals to the set of processes specified by *psp*. *psp* is a pointer to a structure of type `procset_t`, defined in `sys/procset.h`, which includes the following members:

```
idop_t p_op;
idtype_t p_lidtype;
id_t p_lid;
idtype_t p_ridtype;
id_t p_rid;
```

`p_lidtype` and `p_lid` specify the ID type and ID of one ("left") set of processes; `p_ridtype` and `p_rid` specify the ID type and ID of a second ("right") set of processes. ID types and IDs are specified just as for the *idtype* and *id* arguments to `sigsend`. `p_op` specifies the operation to be performed on the two sets of

processes to get the set of processes the system call is to apply to. The valid values for `p_op` and the processes they specify are:

`POP_DIFF` set difference: processes in left set and not in right set

`POP_AND` set intersection: processes in both left and right sets

`POP_OR` set union: processes in either left or right set or both

`POP_XOR` set exclusive-or: processes in left or right set but not in both

`sigsend` and `sigsendset` fail if one or more of the following are true:

`EINVAL` `sig` is not a valid signal number.

`EINVAL` `idtype` is not a valid `idtype` field.

`EINVAL` `sig` is `SIGKILL`, `idtype` is `P_PID` and `id` is 1 (`procl`).

`ESRCH` No process can be found corresponding to that specified by `id` and `idtype`.

`EPERM` The user ID of the sending process is not super-user, and its real or effective user ID does not match the real or effective user ID of the receiving process, and the calling process is not sending `SIGCONT` to a process that shares the same session.

In addition, `sigsendset` fails if:

`EFAULT` `psp` points outside the process's allocated address space.

#### SEE ALSO

`getpid(2)`, `getpgrp(2)`, `kill(2)`, `prctl(2)`, `setpid(2)`, `signal(2)`, `signal(5)`.

`kill(1)` in the *User's Reference Manual*.

#### DIAGNOSTICS

On success, `sigsend` returns zero. On failure, it returns `-1` and sets `errno` to indicate the error.

## **sigsuspend(2)**

## **sigsuspend(2)**

### **NAME**

**sigsuspend** – install a signal mask and suspend process until signal

### **SYNOPSIS**

```
#include <signal.h>
int sigsuspend(const sigset_t *set);
```

### **DESCRIPTION**

**sigsuspend** replaces the process's signal mask with the set of signals pointed to by the argument *set* and then suspends the process until delivery of a signal whose action is either to execute a signal catching function or to terminate the process.

If the action is to terminate the process, **sigsuspend** does not return. If the action is to execute a signal catching function, **sigsuspend** returns after the signal catching function returns. On return, the signal mask is restored to the set that existed before the call to **sigsuspend**.

It is not possible to block those signals that cannot be ignored [see [signal\(5\)](#)]; this restriction is silently imposed by the system.

**sigsuspend** fails if either of the following is true:

- |               |                                                                                                      |
|---------------|------------------------------------------------------------------------------------------------------|
| <b>EINTR</b>  | A signal is caught by the calling process and control is returned from the signal catching function. |
| <b>EFAULT</b> | The <i>set</i> argument points outside the process's allocated address space.                        |

### **DIAGNOSTICS**

Since **sigsuspend** suspends process execution indefinitely, there is no successful completion return value. On failure, it returns -1 and sets `errno` to indicate the error.

### **SEE ALSO**

[sigaction\(2\)](#), [sigprocmask\(2\)](#), [sigpause\(2\)](#), [sigsetops\(3C\)](#), [signal\(5\)](#).

## NAME

stat, lstat, fstat - get file status

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/stat.h>

int stat(const char *path, struct stat *buf);
int lstat(const char *path, struct stat *buf);
int fstat(int fildes, struct stat *buf);
```

## DESCRIPTION

*path* points to a path name naming a file. Read, write, or execute permission of the named file is not required, but all directories listed in the path name leading to the file must be searchable. *stat* obtains information about the named file.

Note that in a Remote File Sharing environment, the information returned by *stat* depends on the user/group mapping set up between the local and remote computers. [See *idload(1M)*.]

*lstat* obtains file attributes similar to *stat*, except when the named file is a symbolic link; in that case *lstat* returns information about the link, while *stat* returns information about the file the link references.

*fstat* obtains information about an open file known by the file descriptor *fildes*, obtained from a successful *open*, *creat*, *dup*, *fcntl*, or *pipe* system call.

*buf* is a pointer to a *stat* structure into which information is placed concerning the file.

The contents of the structure pointed to by *buf* include the following members:

```
mode_t st_mode; /* File mode [see mknod(2)] */
ino_t st_ino; /* Inode number */
dev_t st_dev; /* ID of device containing */
 /* a directory entry for this file */
dev_t st_rdev; /* ID of device */
 /* This entry is defined only for */
 /* char special or block special files */
nlink_t st_nlink; /* Number of links */
uid_t st_uid; /* User ID of the file's owner */
gid_t st_gid; /* Group ID of the file's group */
off_t st_size; /* File size in bytes */
time_t st_atime; /* Time of last access */
time_t st_mtime; /* Time of last data modification */
time_t st_ctime; /* Time of last file status change */
 /* Times measured in seconds since */
 /* 00:00:00 UTC, Jan. 1, 1970 */
long st_blksize; /* Preferred I/O block size */
long st_blocks; /* Number st_blksize blocks allocated */
```



**stat(2)****stat(2)**

- st\_mode** The mode of the file as described in `mknod(2)`. In addition to the modes described in `mknod(2)`, the mode of a file may also be `S_IFLNK` if the file is a symbolic link. (Note that `S_IFLNK` may only be returned by `lstat`.)
- st\_ino** This field uniquely identifies the file in a given file system. The pair `st_ino` and `st_dev` uniquely identifies regular files.
- st\_dev** This field uniquely identifies the file system that contains the file. Its value may be used as input to the `ustat` system call to determine more information about this file system. No other meaning is associated with this value.
- st\_rdev** This field should be used only by administrative commands. It is valid only for block special or character special files and only has meaning on the system where the file was configured.
- st\_nlink** This field should be used only by administrative commands.
- st\_uid** The user ID of the file's owner.
- st\_gid** The group ID of the file's group.
- st\_size** For regular files, this is the address of the end of the file. For block special or character special, this is not defined. See also `pipe(2)`.
- st\_atime** Time when file data was last accessed. Changed by the following system calls: `creat`, `mknod`, `pipe`, `utime`, and `read`.
- st\_mtime** Time when data was last modified. Changed by the following system calls: `creat`, `mknod`, `pipe`, `utime`, and `write`.
- st\_ctime** Time when file status was last changed. Changed by the following system calls: `chmod`, `chown`, `creat`, `link`, `mknod`, `pipe`, `unlink`, `utime`, and `write`.
- st\_blksize**  
A hint as to the "best" unit size for I/O operations. This field is not defined for block-special or character-special files.
- st\_blocks**  
The total number of physical blocks of size 512 bytes actually allocated on disk. This field is not defined for block-special or character-special files.
- stat** and **lstat** fail if one or more of the following are true:
- EACCES** Search permission is denied for a component of the path prefix.
- EFAULT** *buf* or *path* points to an invalid address.
- EINTR** A signal was caught during the `stat` or `lstat` system call.
- ELOOP** Too many symbolic links were encountered in translating *path*.

|                                                              |                                                                                                                                                                                     |
|--------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EMULTIHOP</b>                                             | Components of <i>path</i> require hopping to multiple remote machines and the file system does not allow it.                                                                        |
| <b>ENAMETOOLONG</b>                                          | The length of the <i>path</i> argument exceeds { <b>PATH_MAX</b> }, or the length of a <i>path</i> component exceeds { <b>NAME_MAX</b> } while <b>_POSIX_NO_TRUNC</b> is in effect. |
| <b>ENOENT</b>                                                | The named file does not exist or is the null pathname.                                                                                                                              |
| <b>ENOTDIR</b>                                               | A component of the path prefix is not a directory.                                                                                                                                  |
| <b>ENOLINK</b>                                               | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                                                                            |
| <b>E_OVERFLOW</b>                                            | A component is too large to store in the structure pointed to by <i>buf</i> .                                                                                                       |
| <b>fstat</b> fails if one or more of the following are true: |                                                                                                                                                                                     |
| <b>EBADF</b>                                                 | <i>fdes</i> is not a valid open file descriptor.                                                                                                                                    |
| <b>EFAULT</b>                                                | <i>buf</i> points to an invalid address.                                                                                                                                            |
| <b>EINTR</b>                                                 | A signal was caught during the <b>fstat</b> system call.                                                                                                                            |
| <b>ENOLINK</b>                                               | <i>fdes</i> points to a remote machine and the link to that machine is no longer active.                                                                                            |
| <b>E_OVERFLOW</b>                                            | A component is too large to store in the structure pointed to by <i>buf</i> .                                                                                                       |

**SEE ALSO**

**chmod(2)**, **chown(2)**, **creat(2)**, **link(2)**, **mknod(2)**, **pipe(2)**, **read(2)**, **time(2)**, **unlink(2)**, **utime(2)**, **write(2)**, **fattach(3C)**, **stat(5)**.

**DIAGNOSTICS**

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

## NAME

statvfs, fstatvfs - get file system information

## SYNOPSIS

```
#include <sys/types.h>
#include <sys/statvfs.h>

int statvfs (const char *path, struct statvfs *buf);
int fstatvfs (int fildes, struct statvfs *buf);
```

## DESCRIPTION

**statvfs** returns a "generic superblock" describing a file system; it can be used to acquire information about mounted file systems. *buf* is a pointer to a structure (described below) that is filled by the system call.

*path* should name a file that resides on that file system. The file system type is known to the operating system. Read, write, or execute permission for the named file is not required, but all directories listed in the path name leading to the file must be searchable.

The **statvfs** structure pointed to by *buf* includes the following members:

```
ulong f_bsize; /* preferred file system block size */
ulong f_frsize; /* fundamental filesystem block size
 (if supported) */
ulong f_blocks; /* total # of blocks on file system
 in units of f_frsize */
ulong f_bfree; /* total # of free blocks */
ulong f_bavail; /* # of free blocks avail to
 non-superuser */
ulong f_files; /* total # of file nodes (inodes) */
ulong f_ffree; /* total # of free file nodes */
ulong f_favail; /* # of inodes avail to
 non-superuser */
fsid_t f_fsid; /* file system id (dev for now) */
char f_basetype[FSTYPSZ]; /* target fs type name,
 null-terminated */
ulong f_flag; /* bit mask of flags */
ulong f_namemax; /* maximum file name length */
char f_fstr[32]; /* file system specific string */
ulong f_filler[16]; /* reserved for future expansion */
```

*f\_basetype* contains a null-terminated FSType name of the mounted target (e.g. *s5* mounted over *rfs* will contain *s5*).

The following flags can be returned in the *f\_flag* field:

```
ST_RDONLY 0x01 /* read-only file system */
ST_NOSUID 0x02 /* does not support setuid/setgid
 semantics */
ST_NOTRUNC 0x04 /* does not truncate file names
 longer than {NAME_MAX}*/
```

**fstatvfs** is similar to **statvfs**, except that the file named by *path* in **statvfs** is instead identified by an open file descriptor *fdes* obtained from a successful **open**, **creat**, **dup**, **fcntl**, or **pipe** system call.

**statvfs** fails if one or more of the following are true:

|                     |                                                                                                                                  |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied on a component of the path prefix.                                                                   |
| <b>EFAULT</b>       | <i>path</i> or <i>buf</i> points outside the process's allocated address space.                                                  |
| <b>EINTR</b>        | A signal was caught during <b>statvfs</b> execution.                                                                             |
| <b>EIO</b>          | An I/O error occurred while reading the file system.                                                                             |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                            |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it.                    |
| <b>ENAMETOOLONG</b> | The length of a <i>path</i> component exceeds {NAME_MAX} characters, or the length of <i>path</i> exceeds {PATH_MAX} characters. |
| <b>ENOENT</b>       | Either a component of the path prefix or the file referred to by <i>path</i> does not exist.                                     |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                         |
| <b>ENOTDIR</b>      | A component of the path prefix of <i>path</i> is not a directory.                                                                |

**fstatvfs** fails if one or more of the following are true:

|               |                                                       |
|---------------|-------------------------------------------------------|
| <b>EFAULT</b> | <i>buf</i> points to an invalid address.              |
| <b>EBADF</b>  | <i>fdes</i> is not an open file descriptor.           |
| <b>EINTR</b>  | A signal was caught during <b>fstatvfs</b> execution. |
| <b>EIO</b>    | An I/O error occurred while reading the file system.  |

#### DIAGNOSTICS

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

#### SEE ALSO

**chmod(2)**, **chown(2)**, **creat(2)**, **link(2)**, **mknod(2)**, **pipe(2)**, **read(2)**, **time(2)**, **unlink(2)**, **utime(2)**, **write(2)**.

**stime(2)**

**stime(2)**

**NAME**

`stime` - set time

**SYNOPSIS**

```
#include <unistd.h>

int stime(const time_t *tp);
```

**DESCRIPTION**

`stime` sets the system's idea of the time and date. *tp* points to the value of time as measured in seconds from 00:00:00 UTC January 1, 1970.

`stime` will fail if:

**EPERM**           the effective user ID of the calling process is not super-user.

**SEE ALSO**

`time(2)`.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

## NAME

swapctl - manage swap space

## SYNOPSIS

```
#include <sys/stat.h>
#include <sys/swap.h>

int swapctl(int cmd, void *arg);
```

## DESCRIPTION

swapctl adds, deletes, or returns information about swap resources. *cmd* specifies one of the following options contained in `<sys/swap.h>`:

```
SC_ADD /* add a resource for swapping */
SC_LIST /* list the resources for swapping */
SC_REMOVE /* remove a resource for swapping */
SC_GETNSWP /* return number of swap resources */
```

When `SC_ADD` or `SC_REMOVE` is specified, *arg* is a pointer to a `swapres` structure containing the following members:

```
char *sr_name; /* pathname of resource */
off_t sr_start; /* offset to start of swap area */
off_t sr_length; /* length of swap area */
```

`sr_start` and `sr_length` are specified in 512-byte blocks. When `SC_LIST` is specified, *arg* is a pointer to a `swaptable` structure containing the following members:

```
int swt_n; /* number of swapents following */
struct swapent swt_ent[]; /* array of swt_n swapents */
```

A `swapent` structure contains the following members:

```
char *ste_path; /* name of the swap file */
off_t ste_start; /* starting block for swapping */
off_t ste_length; /* length of swap area */
long ste_pages; /* number of pages for swapping */
long ste_free; /* number of ste_pages free */
long ste_flags; /* ST_INDEL bit set if swap file */
 /* is now being deleted */
```

`SC_LIST` causes `swapctl` to return at most `swt_n` entries. The return value of `swapctl` is the number actually returned. The `ST_INDEL` bit is turned on in `ste_flags` if the swap file is in the process of being deleted. When `SC_GETNSWP` is specified, `swapctl` returns as its value the number of swap resources in use. *arg* is ignored for this operation. The `SC_ADD` and `SC_REMOVE` functions will fail if calling process does not have appropriate privileges.

## RETURN VALUE

Upon successful completion, the function `swapctl` returns a value of 0 for `SC_ADD` or `SC_REMOVE`, the number of `struct swapent` entries actually returned for `SC_LIST`, or the number of swap resources in use for `SC_GETNSWP`. Upon failure, the function `swapctl` returns a value of -1 and sets `errno` to indicate an error.

## ERRORS

Under the following conditions, the function `swapctl` fails and sets `errno` to:

|                           |                                                                                                                                                                                                                                                                                                                                         |
|---------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>EEXIST</code>       | Part of the range specified by <code>sr_start</code> and <code>sr_length</code> is already being used for swapping on the specified resource ( <code>SC_ADD</code> ).                                                                                                                                                                   |
| <code>EFAULT</code>       | <code>arg</code> , <code>sr_name</code> , or <code>ste_path</code> points outside the allocated address space.                                                                                                                                                                                                                          |
| <code>EINVAL</code>       | The specified function value is not valid, the path specified is not a swap resource ( <code>SC_REMOVE</code> ), part of the range specified by <code>sr_start</code> and <code>sr_length</code> lies outside the resource specified ( <code>SC_ADD</code> ), or the specified swap area is less than one page ( <code>SC_ADD</code> ). |
| <code>EISDIR</code>       | The path specified for <code>SC_ADD</code> is a directory.                                                                                                                                                                                                                                                                              |
| <code>ELOOP</code>        | Too many symbolic links were encountered in translating the pathname provided to <code>SC_ADD</code> or <code>SC_REMOVE</code> .                                                                                                                                                                                                        |
| <code>ENAMETOOLONG</code> | The length of a component of the path specified for <code>SC_ADD</code> or <code>SC_REMOVE</code> exceeds <code>{NAME_MAX}</code> characters or the length of the path exceeds <code>{PATH_MAX}</code> characters and <code>{_POSIX_NO_TRUNC}</code> is in effect.                                                                      |
| <code>ENOENT</code>       | The pathname specified for <code>SC_ADD</code> or <code>SC_REMOVE</code> does not exist.                                                                                                                                                                                                                                                |
| <code>ENOMEM</code>       | An insufficient number of <code>struct swaptent</code> structures were provided to <code>SC_LIST</code> , or there were insufficient system storage resources available during an <code>SC_ADD</code> or <code>SC_REMOVE</code> , or the system would not have enough swap space after an <code>SC_REMOVE</code> .                      |
| <code>ENOSYS</code>       | The pathname specified for <code>SC_ADD</code> or <code>SC_REMOVE</code> is not a file or block special device.                                                                                                                                                                                                                         |
| <code>ENOTDIR</code>      | Pathname provided to <code>SC_ADD</code> or <code>SC_REMOVE</code> contained a component in the path prefix that was not a directory.                                                                                                                                                                                                   |
| <code>EPERM</code>        | The process does not have appropriate privileges.                                                                                                                                                                                                                                                                                       |
| <code>EROFS</code>        | The pathname specified for <code>SC_ADD</code> is a read-only file system.                                                                                                                                                                                                                                                              |

**NAME**

**symlink** – make a symbolic link to a file

**SYNOPSIS**

```
#include <unistd.h> int symlink(const char *name1, const char
 *name2);
```

**DESCRIPTION**

**symlink** creates a symbolic link *name2* to the file *name1*. Either name may be an arbitrary pathname, the files need not be on the same file system, and *name1* may be nonexistent.

The file to which the symbolic link points is used when an **open(2)** operation is performed on the link. A **stat(2)** on a symbolic link returns the linked-to file, while an **lstat** returns information about the link itself. This can lead to surprising results when a symbolic link is made to a directory. To avoid confusion in programs, the **readlink(2)** call can be used to read the contents of a symbolic link.

The symbolic link is made unless one or more of the following are true:

|                     |                                                                                                                                                                                                                       |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied for a component of the path prefix of <i>name2</i> .                                                                                                                                      |
| <b>EDQUOT</b>       | The directory in which the entry for the new symbolic link is being placed cannot be extended because the user's quota of disk blocks on the file system containing the directory has been exhausted.                 |
| <b>EDQUOT</b>       | The new symbolic link cannot be created because the user's quota of disk blocks on the file system which will contain the link has been exhausted.                                                                    |
| <b>EDQUOT</b>       | The user's quota of inodes on the file system on which the file is being created has been exhausted.                                                                                                                  |
| <b>EEXIST</b>       | The file referred to by <i>name2</i> already exists.                                                                                                                                                                  |
| <b>EFAULT</b>       | <i>name1</i> or <i>name2</i> points outside the allocated address space for the process.                                                                                                                              |
| <b>EIO</b>          | An I/O error occurs while reading from or writing to the file system.                                                                                                                                                 |
| <b>ELOOP</b>        | Too many symbolic links are encountered in translating <i>name2</i> .                                                                                                                                                 |
| <b>ENAMETOOLONG</b> | The length of the <i>name1</i> or <i>name2</i> argument exceeds <b>{PATH_MAX}</b> , or the length of a <i>name1</i> or <i>name2</i> component exceeds <b>{NAME_MAX}</b> while <b>( _POSIX_NO_TRUNC)</b> is in effect. |
| <b>ENOENT</b>       | A component of the path prefix of <i>name2</i> does not exist.                                                                                                                                                        |
| <b>ENOSPC</b>       | The directory in which the entry for the new symbolic link is being placed cannot be extended because no space is left on the file system containing the directory.                                                   |



## symlink(2)

## symlink(2)

- ENOSPC           The new symbolic link cannot be created because no space is left on the file system which will contain the link.
- ENOSPC           There are no free inodes on the file system on which the file is being created.
- ENOSYS           The file system does not support symbolic links
- ENOTDIR          A component of the path prefix of *name2* is not a directory.
- EROFS            The file *name2* would reside on a read-only file system.

### DIAGNOSTICS

Upon successful completion `symlink` returns a value of 0; otherwise, it returns -1 and places an error code in `errno`.

### SEE ALSO

`link(2)`, `readlink(2)`, `unlink(2)`. `cp(1)` in the *User's Reference Manual*.

**sync(2)**

**sync(2)**

**NAME**

**sync** - update super block

**SYNOPSIS**

```
#include <unistd.h>

void sync(void);
```

**DESCRIPTION**

**sync** causes all information in memory that should be on disk to be written out. This includes modified super blocks, modified i-nodes, and delayed block I/O.

It should be used by programs that examine a file system, such as **fsck(1M)**, **df(1M)**, etc. It is mandatory before a re-boot.

The writing, although scheduled, is not necessarily completed before **sync** returns. The **fsync** system call completes the writing before it returns.

**SEE ALSO**

**fsync(2)**

**NAME**

sys3b – machine-specific functions

**SYNOPSIS**

```
#include <sys/sys3b.h>
int sys3b(int cmd, ...);
```

**DESCRIPTION**

sys3b implements machine-specific functions. The *cmd* argument determines the function performed. The type and number of arguments expected depends on the function.

**Command GRNFLASH**

When *cmd* is GRNFLASH, no arguments are expected. This function starts the green LED flashing. This command is only available to the super-user.

**Command GRNON**

When *cmd* is GRNON, no arguments are expected. This function turns the green LED to a solid on state. This command is available only to the super-user.

**Command RNVR**

When *cmd* is RNVR, an argument of type `const struct nvparams *` is expected.

```
struct nvparams{
 char *addr;
 char *data;
 unsigned short cnt;
};
```

This function reads *cnt* bytes at address *addr* in NVRAM (non-volatile RAM) into address *data*. This command is available only to the super-user.

**Command RTODC**

When *cmd* is RTODC, an argument of type `struct todc *` is expected.

```
struct todc {
 short htenths; short hsecs; short hmins;
 short hhours; short hdays; short hweekday;
 short hmonth; short hyear;
};
```

This function reads the hardware time-of-day clock and returns the data in the structure referred to by the argument. This command is available only to the super-user.

**Command S3BSYM**

When *cmd* is S3BSYM, the symbol table created when a new bootable operating system is configured may be accessed. The symbols available via this command are defined in one of two places: the driver routines loaded or the variable specifications in the files in the `/etc/master.d` directory. Two arguments are expected: the first must be a pointer to a buffer into which the symbol table is copied, and the second must be an integer containing the total size of the buffer. The format of the symbol table is:

```

int size; /* symbol size in bytes */
int count; /* total number of symbols */

/* for each symbol: */
char name[]; /* name of symbol, padded */
/* with '\0' to next */
/* sizeof(long) boundary */
char symbol[1]; /* long value; value of symbol */

```

The `S3BSVAL` macro in `sys/sys3b.h` takes a pointer to a symbol name in the table and returns its value. The `S3BNXTSYM` macro takes a pointer to a symbol name in the table and returns a pointer to the next entry. Include `sys/inline.h` to use these macros.

Typically, the symbol table would be retrieved with two calls to `sys3b`. First, the size of the symbol table is obtained by calling `sys3b` with a buffer of one integer. This integer is then used to obtain a buffer large enough to contain the entire symbol table. The second invocation of `sys3b` with this newly obtained buffer retrieves the entire symbol table.

```

#include <sys/sys3b.h>

int size; /* size of buffer needed */
struct s3bsym *buffer; /* buffer pointer */

sys3b(S3BSYM, (struct s3bsym *) &size, sizeof(size));
buffer = (struct s3bsym *) malloc(size);
sys3b(S3BSYM, buffer, size);

```

#### Command S3BCONF

When `cmd` is `S3BCONF`, the configuration table created during the configuration of a new bootable operating system may be accessed. This table contains the names and locations of the devices supported by the currently running UNIX system, the names of all software modules included in the system, and the names of all devices in the EDT that were ignored. Two arguments are expected: the first must be a pointer to a buffer into which the configuration table is copied, and the second must be an integer containing the total size of the buffer. The format of the configuration table is:

```

int ndev; /* total number of entries */

/* for each entry ... */
long timestamp; /* f_tindat from file header */
char name[14]; /* name of device/module */
char flag; /* configuration information */
/* 0x80: device ignored */
/* 0x40: name[] is a driver */
/* 0x20: name[] is a software module */
char board; /* local bus address of device */

```

Typically, the configuration table would be retrieved with two calls to `sys3b`. First, the number of entries is obtained by calling `sys3b` with a buffer of one integer. This integer is then used to calculate and obtain a buffer large enough to contain the entire configuration table. The second invocation of `sys3b` with this newly obtained buffer retrieves the configuration table.

```
#include <sys/sys3b.h>

int count; /* total number of devices */
int size; /* size of buffer needed */
struct s3bconf *buffer; /* buffer pointer */

sys3b(S3BCONF, (struct s3bconf *)&count, sizeof(count));
size = sizeof(int);
size += count * sizeof(struct s3bc);
buffer = (struct s3bconf *)malloc(size);
sys3b(S3BCONF, buffer, size);
```

**Command S3BBOOT**

When *cmd* is S3BBOOT, the timestamp and path name of the program last used to bootstrap the machine may be accessed. The path name of the a.out format file which was booted, and the timestamp from the file header [see a.out(4)] are saved. One argument is expected: a pointer to a buffer into which the information is copied. The format of this information is:

```
long timestamp; /* f_tindat from file header */
char path[100]; /* path name */
```

This information would be retrieved with a single call to `sys3b`.

```
#include <sys/sys3b.h>

struct s3bboot buffer; /* buffer */

sys3b(S3BBOOT, &buffer);
```

**Command S3BAUTO**

When *cmd* is S3BAUTO, no arguments are expected. This function returns a boolean value in answer to the question, "Was the operating system reconfigured during the last boot, or was an existing bootable operating system booted?" The value returned is zero if an existing bootable (such as `/stand/stand/unix` or `/stand/unix`) was booted. The integer value 1 is returned if the bootable operating system was configured during the preceding boot process. The value is undefined if the system was booted in "magic mode." This command is available only to the super-user.

**Command S3BFPHW**

When *cmd* is S3BFPHW, an indication of whether or not a MAU is present is returned. (See the *Introduction* to this manual for a description of the MAU.) One argument, the address of an `int`, is expected. On return from the system call, this `int` contains a 1 if a MAU is present or a 0 if a MAU is not present. If the address of the `int` is not valid (for example, not word aligned, not user accessible) EFAULT is returned.

The following example determines whether a MAU is present:

```
#include <sys/sys3b.h>

int mau_present;
sys3b(S3BFPHW, &mau_present);
```

If this command succeeds, it returns 0 to the calling process. The call fails and returns -1 if one or more of the following is true:

EFAULT `mau_present` is not an integer.  
 EFAULT `&mau_present` is an invalid address.

### Command S3BSWPI

Note: This *cmd* is available only with UNIX System V Release 2.1 and Release 3 software. Its function is subsumed by the `swap` command; see `swap(1M)`.

When *cmd* is S3BSWPI, individual swapping areas may be added, deleted or the current areas determined. The address of an appropriately primed swap buffer is passed as the only argument. (Refer to the `sys/swap.h` header file for details of loading the buffer.)

The format of the swap buffer is:

```

struct swapint {
 char si_cmd; /*command: list, add, delete*/
 char *si_buf; /*swap file path pointer*/
 int si_swpl0; /*start block*/
 int si_nblks; /*swap size*/
}

```

Note that the add and delete options of the command may be exercised only by the super-user.

Typically, a swap area is added by a single call to `sys3b`. First, the swap buffer is primed with appropriate entries for the structure members. Then `sys3b` is invoked.

```

#include <sys/sys3b.h>
#include <sys/swap.h>

struct swapint swapbuf; /*swap into buffer ptr*/
sys3b(S3BSWPI, &swapbuf);

```

If this command succeeds, it returns 0 to the calling process. It fails and returns -1 if one or more of the following is true:

EFAULT `swapbuf` points to an invalid address.  
 EFAULT `swapbuf.si_buf` points to an invalid address.  
 ENOTBLK The swap area specified is not a block special device.  
 EEXIST The swap area specified has already been added.  
 ENOSPC Too many swap areas are in use (if adding).  
 ENOMEM The swap area specified is the last remaining swap area.  
 ENOMEM There is no place to put swapped pages when deleting a swap area.  
 EINVAL An argument is invalid.

**Command STIME**

When *cmd* is *STIME*, an argument of type *long* is expected. This function sets the system time and date. The argument contains the time as measured in seconds from 00:00:00 UTC January 1, 1970. This command is available only to the super-user.

**Command WNVR**

When *cmd* is *WNVR*, an argument of type *struct nvparams \** is expected (see command *RNVR*). This function writes *cnt* bytes into address *addr* in NVRAM (non-volatile RAM) from address *data*. This command is available only to the super-user.

**Command S3BTAPLOCORE**

Prior to release 4.0, user processes could read low memory (for example, read accesses using *NULL* pointers were permitted from user programs). When *cmd* is *S3BTAPLOCORE*, user level access permission on low core memory can be changed and user accesses of low core memory can be trapped. Only read access is affected; user level write access to low core is not allowed under any circumstances.

A single argument of type *int* is expected. This argument may have one of the following four values, defined in `<sys/sys3b.h>`:

**S3BTLC\_DISABLE**

Disable low core trapping. Read accesses to low core are allowed from user processes.

**S3BTLC\_SIGNAL**

Trap low core accesses. Any user process which attempts to read low core will be sent a *SIGSEGV* signal with *si\_code* set to *SEGV\_MAPERR*.

**S3BTLC\_PRINT**

Trap low core accesses. Any user process which attempts to read low core will be sent a *SIGSEGV* signal with *si\_code* set to *SEGV\_MAPERR*. In addition, a message will be printed on the system console each time a process attempts to read low core.

**S3BTLC\_STATUS**

Return current state of low core trapping. The state of low core trapping is unchanged.

If this command succeeds, it returns one of *S3BTLC\_DISABLE*, *S3BTLC\_SIGNAL*, *S3BTLC\_PRINT*, to indicate the setting of low core protection prior to the call. The command fails and returns -1 if one or more of the following is true:

- EPERM** The caller is not super-user (not required for *S3BTLC\_STATUS*).
- EINVAL** An argument is invalid.

**DIAGNOSTICS**

On success, **sys3b** returns a value that depends on *cmd* as follows:

|                      |                                                                                                                                                                                                                                    |
|----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>S3BSYM</b>        | A value of zero.                                                                                                                                                                                                                   |
| <b>S3BCONF</b>       | A value of zero.                                                                                                                                                                                                                   |
| <b>S3BBOOT</b>       | A value of zero.                                                                                                                                                                                                                   |
| <b>S3BAUTO</b>       | A value of zero if an existing bootable operating system (such as <i>/stand/stand/unix</i> or <i>/stand/unix</i> ) was last booted. A value of one if a new bootable operating system was configured during the last boot process. |
| <b>S3BTRAPLOCORE</b> | Returns the setting of low core protection prior to the call.                                                                                                                                                                      |

Otherwise, a value of **-1** is returned and **errno** is set to indicate the error. When *cmd* is invalid, **errno** is set to **EINVAL** on return.

**SEE ALSO**

**sync(2)**, **a.out(4)**.

**cunix(1M)**, **swap(1M)**, in the *System Administrator's Reference Manual*.



**NAME**

**sysfs** – get file system type information

**SYNOPSIS**

```
#include <sys/fstyp.h>
#include <sys/fsid.h>

int sysfs(int opcode, const char *fsname);
int sysfs(int opcode, int fs_index, char *buf);
int sysfs(int opcode);
```

**DESCRIPTION**

**sysfs** returns information about the file system types configured in the system. The number of arguments accepted by **sysfs** varies and depends on the *opcode*. The currently recognized *opcodes* and their functions are:

**GETFSIND** Translate *fsname*, a null-terminated file-system type identifier, into a file-system type index.

**GETFSTYP** Translate *fs\_index*, a file-system type index, into a null-terminated file-system type identifier and write it into the buffer pointed to by *buf*; this buffer must be at least of size **FSTYPSZ** as defined in `<sys/fstyp.h>`.

**GETNFSYP** Return the total number of file system types configured in the system.

**sysfs** fails if one or more of the following are true:

**EINVAL** *fsname* points to an invalid file-system identifier; *fs\_index* is zero, or invalid; *opcode* is invalid.

**EFAULT** *buf* or *fsname* points to an invalid user address.

**DIAGNOSTICS**

Upon successful completion, **sysfs** returns the file-system type index if the *opcode* is **GETFSIND**, a value of 0 if the *opcode* is **GETFSTYP**, or the number of file system types configured if the *opcode* is **GETNFSYP**. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

## NAME

`sysinfo` – get and set system information strings

## SYNOPSIS

```
#include <sys/systeminfo.h>
```

```
long sysinfo (int command, char *buf, long count);
```

## DESCRIPTION

`sysinfo` copies information relating to the UNIX system on which the process is executing into the buffer pointed to by `buf`; `sysinfo` can also set certain information where appropriate *commands* are available. *count* is the size of the buffer.

The POSIX P1003.1 interface `sysconf` [see `sysconf(2)`] provides a similar class of configuration information, but returns an integer rather than a string.

The *commands* available are:

`SI_SYSNAME` Copy into the array pointed to by `buf` the string that would be returned by `uname` [see `uname(2)`] in the *sysname* field. This is the name of the implementation of the operating system, e.g., *System V* or *UTS*.

`SI_HOSTNAME`

Copy into the array pointed to by `buf` a string that names the present host machine. This is the string that would be returned by `uname` [see `uname(2)`] in the *nodename* field. This hostname or nodename is often the name the machine is known by locally.

The *hostname* is the name of this machine as a node in some network; different networks may have different names for the node, but presenting the nodename to the appropriate network Directory or name-to-address mapping service should produce a transport end point address. The name may not be fully qualified.

Internet host names may be up to 256 bytes in length (plus the terminating null).

`SI_SET_HOSTNAME`

Copy the null-terminated contents of the array pointed to by `buf` into the string maintained by the kernel whose value will be returned by succeeding calls to `sysinfo` with the command `SI_HOSTNAME`. This command requires that the effective-user-id be super-user.

`SI_RELEASE` Copy into the array pointed to by `buf` the string that would be returned by `uname` [see `uname(2)`] in the *release* field. Typical values might be *4.0* or *3.2*.

`SI_VERSION` Copy into the array pointed to by `buf` the string that would be returned by `uname` [see `uname(2)`] in the *version* field. The syntax and semantics of this string are defined by the system provider.

`SI_MACHINE`

Copy into the array pointed to by `buf` the string that would be returned by `uname` [see `uname(2)`] in the *machine* field, e.g., *3b2* or *580*.

**SI\_ARCHITECTURE**

Copy into the array pointed to by *buf* a string describing the instruction set architecture of the current system, e.g., *mc68030*, *m32100*, or *i80486*. These names may not match predefined names in the C language compilation system.

**SI\_HW\_PROVIDER**

Copies the name of the hardware manufacturer into the array pointed to by *buf*.

**SI\_HW\_SERIAL**

Copy into the array pointed to by *buf* a string which is the ASCII representation of the hardware-specific serial number of the physical machine on which the system call is executed. Note that this may be implemented in Read-Only Memory, via software constants set when building the operating system, or by other means, and may contain non-numeric characters. It is anticipated that manufacturers will not issue the same "serial number" to more than one physical machine. The pair of strings returned by **SI\_HW\_PROVIDER** and **SI\_HW\_SERIAL** is likely to be unique across all vendor's System V implementations.

**SI\_SRPC\_DOMAIN**

Copies the Secure Remote Procedure Call domain name into the array pointed to by *buf*.

**SI\_SET\_SRPC\_DOMAIN**

Set the string to be returned by **sysinfo** with the **SI\_SRPC\_DOMAIN** command to the value contained in the array pointed to by *buf*. This command requires that the effective-user-id be super-user.

**sysinfo** will fail if one or both of the following are true:

**EPERM** The process does not have appropriate privilege for a SET commands.

**EINVAL**

*buf* does not point to a valid address, or the data for a SET command exceeds the limits established by the implementation.

**DIAGNOSTICS**

Upon successful completion, the value returned indicates the buffer size in bytes required to hold the complete value and the terminating null character. If this value is no greater than the value passed in *count*, the entire string was copied; if this value is greater than *count*, the string copied into *buf* has been truncated to *count*-1 bytes plus a terminating null character.

Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

**USAGE**

There is in many cases no corresponding programmatic interface to set these values; such strings are typically settable only by the system administrator modifying entries in the *master.d* directory or the code provided by the particular OEM reading a serial number or code out of read-only memory, or hard-coded in the version of the operating system.

A good starting guess for *count* is 257, which is likely to cover all strings returned by this interface in typical installations.

**SEE ALSO**

`uname(2)`, `sysconf(2)`;

BSD compatibility package interfaces `gethostname(3)`, `gethostid(3)`.

**NAME**

termios: tcgetattr, tcsetattr, tcsendbreak, tcdrain, tcflush, tcflow, cfgetospeed, cfgetispeed, cfsetispeed, cfsetospeed, tcgetpgrp, tcsetpgrp, tcgetsid - general terminal interface

**SYNOPSIS**

```
#include <termios.h>

int tcgetattr(int fildes, struct termios *termios_p);
int tcsetattr(int fildes, int optional_actions,
 const struct termios *termios_p);
int tcsendbreak(int fildes, int duration);
int tcdrain(int fildes);
int tcflush(int fildes, int queue_selector);
int tcflow(int fildes, int action);
speed_t cfgetospeed(struct termios *termios_p);
int cfsetospeed(const struct termios *termios_p, speed_t speed);
speed_t cfgetispeed(struct termios *termios_p);
int cfsetispeed(const struct termios *termios_p, speed_t speed);
#include <sys/types.h>
#include <termios.h>

pid_t tcgetpgrp(int fildes);
int tcsetpgrp(int fildes, pid_t pgrp);
pid_t tcgetsid(int fildes);
```

**DESCRIPTION**

These functions describe a general terminal interface for controlling asynchronous communications ports. A more detailed overview of the terminal interface can be found in [termio\(7\)](#), which also describes an [ioctl\(2\)](#) interface that provides the same functionality. However, the function interface described here is the preferred user interface.

Many of the functions described here have a *termios\_p* argument that is a pointer to a `termios` structure. This structure contains the following members:

```
tcflag_t c_iflag; /* input modes */
tcflag_t c_oflag; /* output modes */
tcflag_t c_cflag; /* control modes */
tcflag_t c_lflag; /* local modes */
cc_t c_cc[NCCS]; /* control chars */
```

These structure members are described in detail in [termio\(7\)](#).

**Get and Set Terminal Attributes**

The `tcgetattr` function gets the parameters associated with the object referred by *fildes* and stores them in the `termios` structure referenced by *termios\_p*. This function may be invoked from a background process; however, the terminal

attributes may be subsequently changed by a foreground process.

The `tcsetattr` function sets the parameters associated with the terminal (unless support is required from the underlying hardware that is not available) from the `termios` structure referenced by `termios_p` as follows:

If `optional_actions` is `TCSANOW`, the change occurs immediately.

If `optional_actions` is `TCSADRAIN`, the change occurs after all output written to `fildev` has been transmitted. This function should be used when changing parameters that affect output.

If `optional_actions` is `TCSAFLUSH`, the change occurs after all output written to the object referred by `fildev` has been transmitted, and all input that has been received but not read is discarded before the change is made.

The symbolic constants for the values of `optional_actions` are defined in `<termios.h>`.

### Line Control

If the terminal is using asynchronous serial data transmission, the `tcsendbreak` function causes transmission of a continuous stream of zero-valued bits for a specific duration. If `duration` is zero, it causes transmission of zero-valued bits for at least 0.25 seconds, and not more than 0.5 seconds. If `duration` is not zero, it behaves in a way similar to `tcdrain`.

If the terminal is not using asynchronous serial data transmission, the `tcsendbreak` function sends data to generate a break condition or returns without taking any action.

The `tcdrain` function waits until all output written to the object referred to by `fildev` has been transmitted.

The `tcflush` function discards data written to the object referred to by `fildev` but not transmitted, or data received but not read, depending on the value of `queue_selector`:

If `queue_selector` is `TCIFLUSH`, it flushes data received but not read.

If `queue_selector` is `TCOFLUSH`, it flushes data written but not transmitted.

If `queue_selector` is `TCIOFLUSH`, it flushes both data received but not read, and data written but not transmitted.

The `tcflow` function suspends transmission or reception of data on the object referred to by `fildev`, depending on the value of `action`:

If `action` is `TCOOFF`, it suspends output.

If `action` is `TCOON`, it restarts suspended output.

If `action` is `TCIOFF`, the system transmits a STOP character, which causes the terminal device to stop transmitting data to the system.

If `action` is `TCION`, the system transmits a START character, which causes the terminal device to start transmitting data to the system.

**Get and Set Baud Rate**

The baud rate functions get and set the values of the input and output baud rates in the `termios` structure. The effects on the terminal device described below do not become effective until the `tcsetattr` function is successfully called.

The input and output baud rates are stored in the `termios` structure. The values shown in the table are supported. The names in this table are defined in `<termios.h>`.

| Name | Description | Name   | Description |
|------|-------------|--------|-------------|
| B0   | Hang up     | B600   | 600 baud    |
| B50  | 50 baud     | B1200  | 1200 baud   |
| B75  | 75 baud     | B1800  | 1800 baud   |
| B110 | 110 baud    | B2400  | 2400 baud   |
| B134 | 134.5 baud  | B4800  | 4800 baud   |
| B150 | 150 baud    | B9600  | 9600 baud   |
| B200 | 200 baud    | B19200 | 19200 baud  |
| B300 | 300 baud    | B38400 | 38400 baud  |

`cfgetospeed` gets the output baud rate and stores it in the `termios` structure pointed to by `termios_p`.

`cfsetospeed` sets the output baud rate stored in the `termios` structure pointed to by `termios_p` to `speed`. The zero baud rate, B0, is used to terminate the connection. If B0 is specified, the modem control lines are no longer asserted. Normally, this disconnects the line.

`cfgetispeed` gets the input baud rate and stores it in the `termios` structure pointed to by `termios_p`.

`cfsetispeed` sets the input baud rate stored in the `termios` structure pointed to by `termios_p` to `speed`. If the input baud rate is set to zero, the input baud rate is specified by the value of the output baud rate. Both `cfsetispeed` and `cfsetospeed` return a value of zero if successful and `-1` to indicate an error. Attempts to set unsupported baud rates are ignored. This refers both to changes to baud rates not supported by the hardware, and to changes setting the input and output baud rates to different values if the hardware does not support this.

**Get and Set Terminal Foreground Process Group ID**

`tcsetpgrp` sets the foreground process group ID of the terminal specified by `fildev` to `pgid`. The file associated with `fildev` must be the controlling terminal of the calling process and the controlling terminal must be currently associated with the session of the calling process. `pgid` must match a process group ID of a process in the same session as the calling process.

`tcgetpgrp` returns the foreground process group ID of the terminal specified by `fildev`. `tcgetpgrp` is allowed from a process that is a member of a background process group; however, the information may be subsequently changed by a process that is a member of a foreground process group.

**Get Terminal Session ID**

`tcgetsid` returns the session ID of the terminal specified by `fildev`.

## DIAGNOSTICS

On success, `tcgetpgrp` returns the process group ID of the foreground process group associated with the specified terminal. Otherwise, it returns `-1` and sets `errno` to indicate the error.

On success, `tcgetsid` returns the session ID associated with the specified terminal. Otherwise, it returns `-1` and sets `errno` to indicate the error.

On success, all other functions return a value of 0. Otherwise, they return `-1` and set `errno` to indicate the error.

All of the functions fail if one of more of the following is true:

**EBADF**           The *fildev* argument is not a valid file descriptor.

**ENOTTY**          The file associated with *fildev* is not a terminal.

`tcsetattr` also fails if the following is true:

**EINVAL**          The *optional\_actions* argument is not a proper value, or an attempt was made to change an attribute represented in the `termios` structure to an unsupported value.

`tcsendbreak` also fails if the following is true:

**EINVAL**          The device does not support the `tcsendbreak` function.

`tcdrain` also fails if one or more of the following is true:

**EINTR**           A signal interrupted the `tcdrain` function.

**EINVAL**          The device does not support the `tcdrain` function.

`tcflush` also fails if the following is true:

**EINVAL**          The device does not support the `tcflush` function or the *queue\_selector* argument is not a proper value.

`tcflow` also fails if the following is true:

**EINVAL**          The device does not support the `tcflow` function or the *action* argument is not a proper value.

`tcgetpgrp` also fails if the following is true:

**ENOTTY**          the calling process does not have a controlling terminal, or *fildev* does not refer to the controlling terminal.

`tcsetpgrp` also fails if the following is true:

**EINVAL**          *pgid* is not a valid process group ID.

**ENOTTY**          the calling process does not have a controlling terminal, or *fildev* does not refer to the controlling terminal, or the controlling terminal is no longer associated with the session of the calling process.

**EPERM**           *pgid* does not match the process group of an existing process in the same session as the calling process.



**termios(2)**

**termios(2)**

tcgetsid also fails if the following is true:

**EACCES** *fildev* is a terminal that is not allocated to a session.

**SEE ALSO**

**setsid(2)**, **setpgid(2)**.

**termio(7)** in the *System Administrator's Reference Manual*.

**NAME**

`time` - get time

**SYNOPSIS**

```
#include <sys/types.h>
#include <time.h>

time_t time(time_t *tloc);
```

**DESCRIPTION**

`time` returns the value of time in seconds since 00:00:00 UTC, January 1, 1970.

If `tloc` is non-zero, the return value is also stored in the location to which `tloc` points.

**SEE ALSO**

`stime(2)`, `ctime(3C)`

**NOTES**

`time` fails and its actions are undefined if `tloc` points to an illegal address.

**DIAGNOSTICS**

Upon successful completion, `time` returns the value of time. Otherwise, a value of `(time_t)-1` is returned and `errno` is set to indicate the error.

**times(2)**

**times(2)**

**NAME**

**times** - get process and child process times

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/times.h>

clock_t times(struct tms *buffer);
```

**DESCRIPTION**

**times** fills the **tms** structure pointed to by *buffer* with time-accounting information. The **tms** structure is defined in `<sys/times.h>` as follows:

```
struct tms {
 clock_t tms_utime;
 clock_t tms_stime;
 clock_t tms_cutime;
 clock_t tms_cstime;
};
```

This information comes from the calling process and each of its terminated child processes for which it has executed a wait routine. All times are reported in clock ticks per second. Clock ticks are a system-dependent parameter. The specific value for an implementation is defined by the variable `CLK_TCK`, found in the include file `limits.h`. (On a 3B2 Computer clock ticks occur 100 times per second.)

**tms\_utime** is the CPU time used while executing instructions in the user space of the calling process.

**tms\_stime** is the CPU time used by the system on behalf of the calling process.

**tms\_cutime** is the sum of the **tms\_utime** and the **tms\_cutime** of the child processes.

**tms\_cstime** is the sum of the **tms\_stime** and the **tms\_cstime** of the child processes.

**times** fails if:

**EFAULT**        *buffer* points to an illegal address.

**SEE ALSO**

`exec(2)`, `fork(2)`, `time(2)`, `wait(2)`, `waitid(2)`, `waitpid(3C)`,  
`time(1)`, `timex(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, **times** returns the elapsed real time, in clock ticks per second, from an arbitrary point in the past (e.g., system start-up time). This point does not change from one invocation of **times** to another. If **times** fails, a -1 is returned and `errno` is set to indicate the error.

**NAME**

uadmin - administrative control

**SYNOPSIS**

```
#include <sys/uadmin.h>

int uadmin(int cmd, int fcn, int mdep);
```

**DESCRIPTION**

uadmin provides control for basic administrative functions. This system call is tightly coupled to the system administrative procedures and is not intended for general use. The argument *mdep* is provided for machine-dependent use and is not defined here.

As specified by *cmd*, the following commands are available:

**A\_SHUTDOWN** The system is shut down. All user processes are killed, the buffer cache is flushed, and the root file system is unmounted. The action to be taken after the system has been shut down is specified by *fcn*. The functions are generic; the hardware capabilities vary on specific machines.

**AD\_HALT** Halt the processor and turn off the power.

**AD\_BOOT** Reboot the system, using */stand/unix*.

**AD\_IBOOT** Interactive reboot; user is prompted for bootable program name.

**A\_REBOOT** The system stops immediately without any further processing. The action to be taken next is specified by *fcn* as above.

**A\_REMOUNT** The root file system is mounted again after having been fixed. This should be used only during the startup process.

uadmin fails if any of the following are true:

**EPERM** The effective user ID is not super-user.

**DIAGNOSTICS**

Upon successful completion, the value returned depends on *cmd* as follows:

|                   |                |
|-------------------|----------------|
| <b>A_SHUTDOWN</b> | Never returns. |
| <b>A_REBOOT</b>   | Never returns. |
| <b>A_REMOUNT</b>  | 0              |

Otherwise, a value of -1 is returned and *errno* is set to indicate the error.

**NAME**

`ulimit` - get and set user limits

**SYNOPSIS**

```
#include <ulimit.h>
long ulimit(int cmd, ... /* newlimit */);
```

**DESCRIPTION**

This function provides for control over process limits. The *cmd* values available are:

- UL\_GETFSIZE** Get the regular file size limit of the process. The limit is in units of 512-byte blocks and is inherited by child processes. Files of any size can be read.
- UL\_SETFSIZE** Set the regular file size limit of the process to the value of *newlimit*, taken as a long. Any process may decrease this limit, but only a process with an effective user ID of super-user may increase the limit.
- UL\_GMEMLIM** Get the maximum possible break value [see `brk(2)`].
- UL\_GDESLIM** Get the current value of the maximum number of open files per process configured in the system.

The `getrlimit` system call provides a more general interface for controlling process limits.

`ulimit` fails if the following is true:

- EINVAL** The *cmd* argument is not valid.
- EPERM** A process with an effective user ID other than super user attempts to increase its file size limit.

**SEE ALSO**

`brk(2)`, `getrlimit(2)`, `write(2)`

**NOTES**

`ulimit` is effective in limiting the growth of regular files. Pipes are currently limited to `{PIPE_MAX}`.

**DIAGNOSTICS**

Upon successful completion, a non-negative value is returned. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.

**NAME**

umask – set and get file creation mask

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>

mode_t umask(mode_t cmask);
```

**DESCRIPTION**

umask sets the process's file mode creation mask to *cmask* and returns the previous value of the mask. Only the access permission bits of *cmask* and the file mode creation mask are used.

**SEE ALSO**

chmod(2), creat(2), mknod(2), open(2), stat(5).  
mkdir(1), sh(1) in the *User's Reference Manual*.

**DIAGNOSTICS**

The previous value of the file mode creation mask is returned.

**NAME**

`umount` – unmount a file system

**SYNOPSIS**

```
#include <sys/mount.h>

int umount(const char *file);
```

**DESCRIPTION**

`umount` requests that a previously mounted file system contained on the block special device or directory identified by *file* be unmounted. *file* is a pointer to a path name. After unmounting the file system, the directory upon which the file system was mounted reverts to its ordinary interpretation.

`umount` may be invoked only by the super-user.

`umount` will fail if one or more of the following are true:

|                     |                                                                                                                                                                                                       |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EPERM</b>        | The process's effective user ID is not super-user.                                                                                                                                                    |
| <b>EINVAL</b>       | <i>file</i> does not exist.                                                                                                                                                                           |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating the path pointed to by <i>file</i> .                                                                                                          |
| <b>ENAMETOOLONG</b> | The length of the <i>file</i> argument exceeds { <code>PATH_MAX</code> }, or the length of a <i>file</i> component exceeds { <code>NAME_MAX</code> } while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOTBLK</b>      | <i>file</i> is not a block special device.                                                                                                                                                            |
| <b>EINVAL</b>       | <i>file</i> is not mounted.                                                                                                                                                                           |
| <b>EBUSY</b>        | A file on <i>file</i> is busy.                                                                                                                                                                        |
| <b>EFAULT</b>       | <i>file</i> points to an illegal address.                                                                                                                                                             |
| <b>EREMOTE</b>      | <i>file</i> is remote.                                                                                                                                                                                |
| <b>ENOLINK</b>      | <i>file</i> is on a remote machine, and the link to that machine is no longer active.                                                                                                                 |
| <b>EMULTIHOP</b>    | Components of the path pointed to by <i>file</i> require hopping to multiple remote machines.                                                                                                         |

**SEE ALSO**

`mount(2)`.

**DIAGNOSTICS**

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

`uname` – get name of current UNIX system

**SYNOPSIS**

```
#include <sys/utsname.h>

int uname(struct utsname *name);
```

**DESCRIPTION**

`uname` stores information identifying the current UNIX system in the structure pointed to by *name*.

`uname` uses the structure `utsname` defined in `<sys/utsname.h>` whose members are:

```
char sysname[SYS_NMLN];
char nodename[SYS_NMLN];
char release[SYS_NMLN];
char version[SYS_NMLN];
char machine[SYS_NMLN];
```

`uname` returns a null-terminated character string naming the current UNIX system in the character array *sysname*. Similarly, *nodename* contains the name that the system is known by on a communications network. *release* and *version* further identify the operating system. *machine* contains a standard name that identifies the hardware that the UNIX system is running on.

**EFAULT** `uname` fails if *name* points to an invalid address.

**SEE ALSO**

`uname(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, a non-negative value is returned. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.



**NAME**

unlnk - remove directory entry

**SYNOPSIS**

```
#include <unistd.h>

int unlnk(const char *path);
```

**DESCRIPTION**

unlnk removes the directory entry named by the path name pointed to by *path*, and decrements the link count of the file referenced by the directory entry. When all links to a file have been removed and no process has the file open, the space occupied by the file is freed and the file ceases to exist. If one or more processes have the file open when the last link is removed, space occupied by the file is not released until all references to the file have been closed. If *path* is a symbolic link, the symbolic link is removed. *path* should not name a directory unless the process has appropriate privileges. Applications should use `rmdir` to remove directories.

Upon successful completion unlnk marks for update the `st_ctime` and `st_mtime` fields of the parent directory. Also, if the file's link count is not zero, the `st_ctime` field of the file is marked for update.

The named file is unlinked unless one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied for a component of the <i>path</i> prefix.                                                                                                                             |
| <b>EACCES</b>       | Write permission is denied on the directory containing the link to be removed.                                                                                                                     |
| <b>EACCES</b>       | The parent directory has the sticky bit set and the file is not writable by the user; the user does not own the parent directory and the user does not own the file;                               |
| <b>EBUSY</b>        | The entry to be unlinked is the mount point for a mounted file system.                                                                                                                             |
| <b>EFAULT</b>       | <i>path</i> points outside the process's allocated address space.                                                                                                                                  |
| <b>EINTR</b>        | A signal was caught during the unlnk system call.                                                                                                                                                  |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and the file system does not allow it.                                                                                       |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |
| <b>ENOENT</b>       | The named file does not exist or is a null pathname. The user is not a super-user.                                                                                                                 |
| <b>ENOTDIR</b>      | A component of the <i>path</i> prefix is not a directory.                                                                                                                                          |

## unlink(2)

## unlink(2)

|                |                                                                                                          |
|----------------|----------------------------------------------------------------------------------------------------------|
| <b>EPERM</b>   | The named file is a directory and the effective user ID of the process is not super-user.                |
| <b>ETXTBSY</b> | The entry to be unlinked is the last link to a pure procedure (shared text) file that is being executed. |
| <b>EROFS</b>   | The directory entry to be unlinked is part of a read-only file system.                                   |
| <b>ENOLINK</b> | <i>path</i> points to a remote machine and the link to that machine is no longer active.                 |

### SEE ALSO

`close(2)`, `link(2)`, `open(2)`, `rmdir(2)`,  
`rm(1)` in the *User's Reference Manual*.

### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

ustat – get file system statistics

**SYNOPSIS**

```
#include <sys/types.h>
#include <ustat.h>

int ustat(dev_t dev, struct ustat *buf);
```

**DESCRIPTION**

ustat returns information about a mounted file system. *dev* is a device number identifying a device containing a mounted file system [see [mkdev\(3C\)](#)]. *buf* is a pointer to a ustat structure that includes the following elements:

```
daddr_t f_tfree; /* Total free blocks */
ino_t f_tinode; /* Number of free inodes */
char f_fname[6]; /* Filsys name */
char f_fpack[6]; /* Filsys pack name */
```

ustat fails if one or more of the following are true:

|                |                                                                                     |
|----------------|-------------------------------------------------------------------------------------|
| <b>EINVAL</b>  | <i>dev</i> is not the device number of a device containing a mounted file system.   |
| <b>EFAULT</b>  | <i>buf</i> points outside the process's allocated address space.                    |
| <b>EINTR</b>   | A signal was caught during a ustat system call.                                     |
| <b>ENOLINK</b> | <i>dev</i> is on a remote machine and the link to that machine is no longer active. |
| <b>ECOMM</b>   | <i>dev</i> is on a remote machine and the link to that machine is no longer active. |

**SEE ALSO**

[stat\(2\)](#), [statvfs\(2\)](#), [mkdev\(3C\)](#), [fs\(4\)](#).

**NOTES**

ustat will be phased out in favor of the [statvfs](#) function.

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and [errno](#) is set to indicate the error.

**NAME**

`utime` - set file access and modification times

**SYNOPSIS**

```
#include <sys/types.h>
#include <utime.h>

int utime(const char *path, const struct utimbuf *times);
```

**DESCRIPTION**

*path* points to a path name naming a file. `utime` sets the access and modification times of the named file.

If *times* is `NULL`, the access and modification times of the file are set to the current time. A process must be the owner of the file or have write permission to use `utime` in this manner.

If *times* is not `NULL`, *times* is interpreted as a pointer to a `utimbuf` structure (defined in `utime.h`) and the access and modification times are set to the values contained in the designated structure. Only the owner of the file or the super-user may use `utime` this way.

The times in the following structure are measured in seconds since 00:00:00 UTC, Jan. 1, 1970.

```
struct utimbuf{
 time_t actime; /* access time */
 time_t modtime; /* modification time */
};
```

`utime` also causes the time of the last file status change (`st_ctime`) to be updated.

`utime` will fail if one or more of the following are true:

|                     |                                                                                                                                                                                                    |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied by a component of the <i>path</i> prefix.                                                                                                                              |
| <b>EACCES</b>       | The effective user ID is not super-user and not the owner of the file and <i>times</i> is <code>NULL</code> and write access is denied.                                                            |
| <b>EFAULT</b>       | <i>times</i> is not <code>NULL</code> and points outside the process's allocated address space.                                                                                                    |
| <b>EFAULT</b>       | <i>path</i> points outside the process's allocated address space.                                                                                                                                  |
| <b>EINTR</b>        | A signal was caught during the <code>utime</code> system call.                                                                                                                                     |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                                                                                              |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and the file system does not allow it.                                                                                       |
| <b>ENAMETOOLONG</b> | The length of the <i>path</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>path</i> component exceeds <code>{NAME_MAX}</code> while <code>_POSIX_NO_TRUNC</code> is in effect. |

## utime(2)

## utime(2)

|                |                                                                                                             |
|----------------|-------------------------------------------------------------------------------------------------------------|
| <b>ENOENT</b>  | The named file does not exist or is a null pathname.                                                        |
| <b>ENOLINK</b> | <i>path</i> points to a remote machine and the link to that machine is no longer active.                    |
| <b>ENOTDIR</b> | A component of the <i>path</i> prefix is not a directory.                                                   |
| <b>EPERM</b>   | The effective user ID is not super-user and not the owner of the file and <i>times</i> is not <b>NULL</b> . |
| <b>EROFS</b>   | The file system containing the file is mounted read-only.                                                   |

### SEE ALSO

`stat(2)`.

### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

**vfork** – spawn new process in a virtual memory efficient way

**SYNOPSIS**

```
#include <unistd.h>
```

```
pid_t vfork (void);
```

**DESCRIPTION**

**vfork** can be used to create new processes without fully copying the address space of the old process, which is horrendously inefficient in a paged environment. It is useful when the purpose of **fork** would have been to create a new system context for an **execve**. **vfork** differs from **fork** in that the child borrows the parent's memory and thread of control until a call to **execve** or an **exit** (either by a call to **exit** or abnormally.) The parent process is suspended while the child is using its resources.

**vfork** returns 0 in the child's context and (later) the process ID (PID) of the child in the parent's context.

**vfork** can normally be used just like **fork**. It does not work, however, to return while running in the child's context from the procedure which called **vfork** since the eventual return from **vfork** would then return to a no longer existent stack frame. Be careful, also, to call **\_exit** rather than **exit** if you cannot **execve**, since **exit** will flush and close standard I/O channels, and thereby mess up the parent processes standard I/O data structures. Even with **fork** it is wrong to call **exit** since buffered data would then be flushed twice.

**DIAGNOSTICS**

Upon successful completion, **vfork** returns a value of 0 to the child process and returns the process ID of the child process to the parent process. Otherwise, a value of -1 is returned to the parent process, no child process is created, and the global variable **errno** is set to indicate the error.

**vfork** will fail and no child process will be created if one or more of the following are true:

- |               |                                                                                                                                                                      |
|---------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EAGAIN</b> | The system-imposed limit on the total number of processes under execution would be exceeded. This limit is determined when the system is generated.                  |
| <b>EAGAIN</b> | The system-imposed limit on the total number of processes under execution by a single user would be exceeded. This limit is determined when the system is generated. |
| <b>ENOMEM</b> | There is insufficient swap space for the new process.                                                                                                                |

**SEE ALSO**

**exec(2)**, **exit(2)**, **fork(2)**, **ioctl(2)**, **wait(2)**.

**NOTES**

This system call will be eliminated in a future release. System implementation changes are making the efficiency gain of **vfork** over **fork** smaller. The memory sharing semantics of **vfork** can be obtained through other mechanisms.

To avoid a possible deadlock situation, processes that are children in the middle of a `vfork` are never sent `SIGTTOU` or `SIGTTIN` signals; rather, output or *ioctl*s are allowed and input attempts result in an EOF indication.

On some systems, the implementation of `vfork` causes the parent to inherit register values from the child. This can create problems for certain optimizing compilers if `<unistd.h>` is not included in the source calling `vfork`.

**NAME**

wait – wait for child process to stop or terminate

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/wait.h>

pid_t wait(int *stat_loc);
```

**DESCRIPTION**

wait suspends the calling process until one of its immediate children terminates or until a child that is being traced stops because it has received a signal. The wait system call will return prematurely if a signal is received. If all child processes stopped or terminated prior to the call on wait, return is immediate.

If wait returns because the status of a child process is available, it returns the process ID of the child process. If the calling process had specified a non-zero value for *stat\_loc*, the status of the child process will be stored in the location pointed to by *stat\_loc*. It may be evaluated with the macros described on `wstat(5)`. In the following, *status* is the object pointed to by *stat\_loc*:

If the child process stopped, the high order 8 bits of *status* will contain the number of the signal that caused the process to stop and the low order 8 bits will be set equal to `WSTOPFLG`.

If the child process terminated due to an `exit` call, the low order 8 bits of *status* will be 0 and the high order 8 bits will contain the low order 8 bits of the argument that the child process passed to `exit`; see `exit(2)`.

If the child process terminated due to a signal, the high order 8 bits of *status* will be 0 and the low order 8 bits will contain the number of the signal that caused the termination. In addition, if `WCOREFLG` is set, a “core image” will have been produced; see `signal(2)`.

If wait returns because the status of a child process is available, then that status may be evaluated with the macros defined by `wstat(5)`.

If a parent process terminates without waiting for its child processes to terminate, the parent process ID of each child process is set to 1. This means the initialization process inherits the child processes; see `intro(2)`.

wait will fail if one or both of the following is true:

- ECHILD**           The calling process has no existing unwaited-for child processes.
- EINTR**            The function was interrupted by a signal.

**SEE ALSO**

`exec(2)`, `exit(2)`, `fork(2)`, `intro(2)`, `pause(2)`, `ptrace(2)`, `signal(2)`, `signal(5)`, `wstat(5)`.

**NOTES**

See NOTES in `signal(2)`.

If `SIGCLD` is held, then wait does not recognize death of children.



**wait(2)**

**wait(2)**

**DIAGNOSTICS**

If **wait** returns due to a stopped or terminated child process, the process ID of the child is returned to the calling process. Otherwise, a value of **-1** is returned and **errno** is set to indicate the error.

**NAME**

waitid - wait for child process to change state

**SYNOPSIS**

```
#include <sys/types.h>
#include <wait.h>

int waitid(idtype_t idtype, id_t id, siginfo_t *infop, int
options);
```

**DESCRIPTION**

waitid suspends the calling process until one of its children changes state. It records the current state of a child in the structure pointed to by *infop*. If a child process changed state prior to the call to *waitid*, *waitid* returns immediately.

The *idtype* and *id* arguments specify which children *waitid* is to wait for.

If *idtype* is *P\_PID*, *waitid* waits for the child with a process ID equal to (*pid\_t*) *id*.

If *idtype* is *P\_PGID*, *waitid* waits for any child with a process group ID equal to (*pid\_t*) *id*.

If *idtype* is *P\_ALL*, *waitid* waits for any children and *id* is ignored.

The *options* argument is used to specify which state changes *waitid* is to wait for. It is formed by an OR of any of the following flags:

|                   |                                                                                                |
|-------------------|------------------------------------------------------------------------------------------------|
| <b>WEXITED</b>    | Wait for process(es) to exit.                                                                  |
| <b>WTRAPPED</b>   | Wait for traced process(es) to become trapped or reach a break-point [see <i>ptrace(2)</i> ].  |
| <b>WSTOPPED</b>   | Wait for and return the process status of any child that has stopped upon receipt of a signal. |
| <b>WCONTINUED</b> | Return the status for any child that was stopped and has been continued.                       |
| <b>WNOHANG</b>    | Return immediately.                                                                            |
| <b>WNOWAIT</b>    | Keep the process in a waitable state.                                                          |

*infop* must point to a *siginfo\_t* structure, as defined in *siginfo(5)*. *siginfo\_t* is filled in by the system with the status of the process being waited for.

*waitid* fails if one or more of the following is true.

|               |                                                                                                            |
|---------------|------------------------------------------------------------------------------------------------------------|
| <b>EFAULT</b> | <i>infop</i> points to an invalid address.                                                                 |
| <b>EINTR</b>  | <i>waitid</i> was interrupted due to the receipt of a signal by the calling process.                       |
| <b>EINVAL</b> | An invalid value was specified for <i>options</i> .                                                        |
| <b>EINVAL</b> | <i>idtype</i> and <i>id</i> specify an invalid set of processes.                                           |
| <b>ECHILD</b> | The set of processes specified by <i>idtype</i> and <i>id</i> does not contain any unwaited-for processes. |

**waitid(2)**

**waitid(2)**

**DIAGNOSTICS**

If `waitid` returns due to a change of state of one of its children, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**SEE ALSO**

`intro(2)`, `exec(2)`, `exit(2)`, `fork(2)`, `pause(2)`, `ptrace(2)`, `signal(2)`, `sigaction(2)`, `wait(2)`, `siginfo(5)`.

**NAME**

waitpid – wait for child process to change state

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/wait.h>
```

```
pid_t waitpid (pid_t pid, int *stat_loc, int options);
```

**DESCRIPTION**

waitpid suspends the calling process until one of its children changes state; if a child process changed state prior to the call to waitpid, return is immediate. *pid* specifies a set of child processes for which status is requested.

If *pid* is equal to (pid\_t)-1, status is requested for any child process.

If *pid* is greater than (pid\_t)0, it specifies the process ID of the child process for which status is requested.

If *pid* is equal to (pid\_t)0 status is requested for any child process whose process group ID is equal to that of the calling process.

If *pid* is less than (pid\_t)-1, status is requested for any child process whose process group ID is equal to the absolute value of *pid*.

If waitpid returns because the status of a child process is available, then that status may be evaluated with the macros defined by wstat(5). If the calling process had specified a non-zero value of *stat\_loc*, the status of the child process will be stored in the location pointed to by *stat\_loc*.

The *options* argument is constructed from the bitwise inclusive OR of zero or more of the following flags, defined in the header file <sys/wait.h>:

- |                   |                                                                                                                                                                                           |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WCONTINUED</b> | the status of any continued child process specified by <i>pid</i> , whose status has not been reported since it continued, shall also be reported to the calling process.                 |
| <b>WNOHANG</b>    | waitpid will not suspend execution of the calling process if status is not immediately available for one of the child processes specified by <i>pid</i> .                                 |
| <b>WNOWAIT</b>    | keep the process whose status is returned in <i>stat_loc</i> in a waitable state. The process may be waited for again with identical results.                                             |
| <b>WUNTRACED</b>  | the status of any child processes specified by <i>pid</i> that are stopped, and whose status has not yet been reported since they stopped, shall also be reported to the calling process. |

waitpid with *options* equal to WUNTRACED and *pid* equal to (pid\_t)-1 is identical to a call to wait(2).

waitpid will fail if one or more of the following is true:

- |              |                                                                                     |
|--------------|-------------------------------------------------------------------------------------|
| <b>EINTR</b> | waitpid was interrupted due to the receipt of a signal sent by the calling process. |
|--------------|-------------------------------------------------------------------------------------|

## waitpid (2)

## waitpid (2)

**EINVAL** An invalid value was specified for *options*.

**ECHILD** The process or process group specified by *pid* does not exist or is not a child of the calling process or can never be in the states specified by *options*.

### SEE ALSO

`exec(2)`, `exit(2)`, `fork(2)`, `intro(2)`, `pause(2)`, `ptrace(2)`, `signal(2)`, `sigaction(2)`, `siginfo(5)`, `wstat(5)`

### DIAGNOSTICS

If `waitpid` returns because the status of a child process is available, this function shall return a value equal to the process ID of the child process for which status is reported. If `waitpid` returns due to the delivery of a signal to the calling process, a value of `-1` shall be returned and `errno` shall be set to `EINTR`. If this function was invoked with `WNOHANG` set in *options*, it has at least one child process specified by *pid* for which status is not available, and status is not available for any process specified by *pid*, a value of `0` shall be returned. Otherwise, a value of `-1` shall be returned, and `errno` shall be set to indicate the error.

## NAME

write, writev – write on a file

## SYNOPSIS

```
#include <unistd.h>
int write(int fildes, const void *buf, unsigned nbytes);

#include <sys/types.h>
#include <sys/uio.h>

int writev(int fildes, const struct iovec *iov, int iovcnt);
```

## DESCRIPTION

write attempts to write *nbyte* bytes from the buffer pointed to by *buf* to the file associated with *fildes*. If *nbyte* is zero and the file is a regular file, write returns zero and has no other results. *fildes* is a file descriptor obtained from a `creat`, `open`, `dup`, `fcntl`, or pipe system call.

writev performs the same action as write, but gathers the output data from the *iovcnt* buffers specified by the members of the *iov* array: *iov*[0], *iov*[1], ..., *iov*[*iovcnt* - 1]. The *iovcnt* is invalid if greater than 0 and less than or equal to {IOV\_MAX}.

For writev, the iovec structure contains the following members:

```
 caddr_t iov_base;
 int iov_len;
```

Each iovec entry specifies the base address and length of an area in memory from which data should be written. writev always writes a complete area before proceeding to the next.

On devices capable of seeking, the actual writing of data proceeds from the position in the file indicated by the file pointer. On return from write, the file pointer is incremented by the number of bytes actually written. On a regular file, if the incremented file pointer is greater than the length of the file, the length of the file is set to the new file pointer.

On devices incapable of seeking, writing always takes place starting at the current position. The value of a file pointer associated with such a device is undefined.

If the O\_APPEND flag of the file status flags is set, the file pointer is set to the end of the file prior to each write.

For regular files, if the O\_SYNC flag of the file status flags is set, write does not return until both the file data and file status have been physically updated. This function is for special applications that require extra reliability at the cost of performance. For block special files, if O\_SYNC is set, write does not return until the data has been physically updated.

A write to a regular file is blocked if mandatory file/record locking is set [see `chmod(2)`], and there is a record lock owned by another process on the segment of the file to be written:

If `O_NDELAY` or `O_NONBLOCK` is set, `write` returns `-1` and sets `errno` to `EAGAIN`.

If `O_NDELAY` and `O_NONBLOCK` are clear, `write` sleeps until all blocking locks are removed or the `write` is terminated by a signal.

If a `write` requests that more bytes be written than there is room for—for example, if the `write` would exceed the process file size limit [see `getrlimit(2)` and `ulimit(2)`], the system file size limit, or the free space on the device—only as many bytes as there is room for will be written. For example, suppose there is space for 20 bytes more in a file before reaching a limit. A `write` of 512-bytes returns 20. The next `write` of a non-zero number of bytes gives a failure return (except as noted for pipes and FIFO below).

Write requests to a pipe or FIFO are handled the same as a regular file with the following exceptions:

There is no file offset associated with a pipe, hence each `write` request appends to the end of the pipe.

Write requests of `{PIPE_BUF}` bytes or less are guaranteed not to be interleaved with data from other processes doing writes on the same pipe. Writes of greater than `{PIPE_BUF}` bytes may have data interleaved, on arbitrary boundaries, with writes by other processes, whether or not the `O_NONBLOCK` or `O_NDELAY` flags are set.

If `O_NONBLOCK` and `O_NDELAY` are clear, a `write` request may cause the process to block, but on normal completion it returns *nbyte*.

If `O_NONBLOCK` is set, `write` requests are handled in the following way: the `write` does not block the process; `write` requests for `{PIPE_BUF}` or fewer bytes either succeed completely and return *nbyte*, or return `-1` and set `errno` to `EAGAIN`. A `write` request for greater than `{PIPE_BUF}` bytes either transfers what it can and returns the number of bytes written, or transfers no data and returns `-1` with `errno` set to `EAGAIN`. Also, if a request is greater than `{PIPE_BUF}` bytes and all data previously written to the pipe has been read, `write` transfers at least `{PIPE_BUF}` bytes.

If `O_NDELAY` is set, `write` requests are handled in the following way: the `write` does not block the process; `write` requests for `{PIPE_BUF}` or fewer bytes either succeed completely and return *nbyte*, or return 0. A `write` request for greater than `{PIPE_BUF}` bytes either transfers what it can and returns the number of bytes written, or transfers no data and returns 0. Also, if a request is greater than `{PIPE_BUF}` bytes and all data previously written to the pipe has been read, `write` transfers at least `{PIPE_BUF}` bytes.

When attempting to write to a file descriptor (other than a pipe or FIFO) that supports nonblocking writes and cannot accept the data immediately:

If `O_NONBLOCK` and `O_NDELAY` are clear, `write` blocks until the data can be accepted.

If `O_NONBLOCK` or `O_NDELAY` is set, `write` does not block the process. If some data can be written without blocking the process, `write` writes what it can and returns the number of bytes written. Otherwise, if `O_NONBLOCK` is set, it returns `-1` and sets `errno` to `EAGAIN` or if `O_NDELAY` is set, it returns `0`.

For STREAMS files [see `intro(2)`], the operation of `write` is determined by the values of the minimum and maximum `nbyte` range ("packet size") accepted by the stream. These values are contained in the topmost stream module. Unless the user pushes the topmost module [see `I_PUSH` in `streamio(7)`], these values can not be set or tested from user level. If `nbyte` falls within the packet size range, `nbyte` bytes are written. If `nbyte` does not fall within the range and the minimum packet size value is zero, `write` breaks the buffer into maximum packet size segments prior to sending the data downstream (the last segment may be smaller than the maximum packet size). If `nbyte` does not fall within the range and the minimum value is non-zero, `write` fails and sets `errno` to `ERANGE`. Writing a zero-length buffer (`nbyte` is zero) to a STREAMS device sends a zero length message with zero returned. However, writing a zero-length buffer to a pipe or FIFO sends no message and zero is returned. The user program may issue the `I_SWROPT` `ioctl(2)` to enable zero-length messages to be sent across the pipe or FIFO [see `streamio(7)`].

When writing to a stream, data messages are created with a priority band of zero. When writing to a stream that is not a pipe or FIFO:

If `O_NDELAY` and `O_NONBLOCK` are not set, and the stream cannot accept data (the stream write queue is full due to internal flow control conditions), `write` blocks until data can be accepted.

If `O_NDELAY` or `O_NONBLOCK` is set and the stream cannot accept data, `write` returns `-1` and sets `errno` to `EAGAIN`.

If `O_NDELAY` or `O_NONBLOCK` is set and part of the buffer has already been written when a condition occurs in which the stream cannot accept additional data, `write` terminates and returns the number of bytes written.

`write` and `writew` fail and the file pointer remains unchanged if one or more of the following are true:

|               |                                                                                                                                                               |
|---------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EAGAIN</b> | Mandatory file/record locking is set, <code>O_NDELAY</code> or <code>O_NONBLOCK</code> is set, and there is a blocking record lock.                           |
| <b>EAGAIN</b> | Total amount of system memory available when reading via raw I/O is temporarily insufficient.                                                                 |
| <b>EAGAIN</b> | An attempt is made to write to a stream that can not accept data with the <code>O_NDELAY</code> or <code>O_NONBLOCK</code> flag set.                          |
| <b>EAGAIN</b> | If a <code>write</code> to a pipe or FIFO of <code>{PIPE_BUF}</code> bytes or less is requested and less than <code>nbytes</code> of free space is available. |
| <b>EBADF</b>  | <i>files</i> is not a valid file descriptor open for writing.                                                                                                 |



|                          |                                                                                                                                                                                                                                   |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| EDEADLK                  | The write was going to go to sleep and cause a deadlock situation to occur.                                                                                                                                                       |
| EFAULT                   | <i>buf</i> points outside the process's allocated address space.                                                                                                                                                                  |
| EFBIG                    | An attempt is made to write a file that exceeds the process's file size limit or the maximum file size [see <code>getrlimit(2)</code> and <code>ulimit(2)</code> ].                                                               |
| EINTR                    | A signal was caught during the write system call.                                                                                                                                                                                 |
| EINVAL                   | An attempt is made to write to a stream linked below a multiplexor.                                                                                                                                                               |
| EIO                      | The process is in the background and is attempting to write to its controlling terminal whose TOSTOP flag is set; the process is neither ignoring nor blocking SIGTTOU signals, and the process group of the process is orphaned. |
| ENOLCK                   | The system record lock table was full, so the write could not go to sleep until the blocking record lock was removed.                                                                                                             |
| ENOLINK                  | <i>fildev</i> is on a remote machine and the link to that machine is no longer active.                                                                                                                                            |
| ENOSR                    | An attempt is made to write to a stream with insufficient STREAMS memory resources available in the system.                                                                                                                       |
| ENOSPC                   | During a write to an ordinary file, there is no free space left on the device.                                                                                                                                                    |
| ENXIO                    | A hangup occurred on the stream being written to.                                                                                                                                                                                 |
| EPIPE and SIGPIPE signal | An attempt is made to write to a pipe that is not open for reading by any process.                                                                                                                                                |
| EPIPE                    | An attempt is made to write to a FIFO that is not open for reading by any process.                                                                                                                                                |
| EPIPE                    | An attempt is made to write to a pipe that has only one end open.                                                                                                                                                                 |
| ERANGE                   | An attempt is made to write to a stream with <i>nbyte</i> outside specified minimum and maximum write range, and the minimum value is non-zero.                                                                                   |
| ENOLCK                   | Enforced record locking was enabled and {LOCK_MAX} regions are already locked in the system.                                                                                                                                      |

In addition, `writew` may return one of the following errors:

|        |                                                                                           |
|--------|-------------------------------------------------------------------------------------------|
| EINVAL | <i>iovcnt</i> was less than or equal to 0, or greater than 16.                            |
| EINVAL | One of the <i>iov_len</i> values in the <i>iov</i> array was negative.                    |
| EINVAL | The sum of the <i>iov_len</i> values in the <i>iov</i> array overflowed a 32-bit integer. |

**write(2)****write(2)**

A `write` to a STREAMS file can fail if an error message has been received at the stream head. In this case, `errno` is set to the value included in the error message.

Upon successful completion `write` and `writew` mark for update the `st_ctime` and `st_mtime` fields of the file.

**SEE ALSO**

`intro(2)`, `creat(2)`, `dup(2)`, `fcntl(2)`, `getrlimit(2)`, `lseek(2)`, `open(2)`, `pipe(2)`, `ulimit(2)`.

**DIAGNOSTICS**

On success, `write` returns the number of bytes actually written. Otherwise, it returns `-1` and sets `errno` to indicate the error.

SUBROUTINES (3)

SUBROUTINES (3)

3C AND 3S

3C AND 3S

**NAME**

intro – introduction to functions and libraries

**DESCRIPTION**

This section describes functions found in various libraries, other than those functions that directly invoke UNIX system primitives, which are described in Section 2 of this volume. Function declarations can be obtained from the `#include` files indicated on each page. Certain major collections are identified by a letter after the section number:

- (3C) These functions, together with those of Section 2 and those marked (3S), constitute the standard C library, `libc`, which is automatically linked by the C compilation system. The standard C library is implemented as a shared object, `libc.so`, and an archive, `libc.a`. C programs are linked with the shared object version of the standard C library by default. Specify `-dn` on the `cc` command line to link with the archive version. [See `cc(1)` for other overrides, and the “C Compilation System” chapter of the *Programmer’s Guide: ANSI C and Programming Support Tools* for a discussion.]
- (3S) These functions constitute the “standard I/O package” [see `stdio(3S)`].
- (3E) These functions constitute the ELF access library, `libelf`. This library is not implemented as a shared object, and is not automatically linked by the C compilation system. Specify `-lelf` on the `cc` command line to link with this library.
- (3G) These functions constitute the general-purpose library, `libgen`. This library is not implemented as a shared object, and is not automatically linked by the C compilation system. Specify `-lgen` on the `cc` command line to link with this library.
- (3M) These functions constitute the math library, `libm`. [See `intro(3M)` and `math(5)`.] This library is not implemented as a shared object, and is not automatically linked by the C compilation system. Specify `-lm` on the `cc` command line to link with this library.
- (3X) Specialized libraries. The files in which these libraries are found are given on the appropriate pages.

**DEFINITIONS**

A character is any bit pattern able to fit into a byte on the machine. The null character is a character with value 0, conventionally represented in the C language as `\0`. A character array is a sequence of characters. A null-terminated character array (a *string*) is a sequence of characters, the last of which is the null character. The null string is a character array containing only the terminating null character. A `NULL` pointer is the value that is obtained by casting 0 into a pointer. C guarantees that this value will not match that of any legitimate pointer, so many functions that return pointers return `NULL` to indicate an error. The macro `NULL` is defined in `stdio.h`. Types of the form `size_t` are defined in the appropriate header files.

## FILES

*INCDIR* usually */usr/include*  
*LIBDIR* usually */usr/ccs/lib*  
*LIBDIR/libc.so*  
*LIBDIR/libc.a*  
*LIBDIR/libgen.a*  
*LIBDIR/libm.a*  
*LIBDIR/libsfm.sa*  
*/usr/lib/libc.so.1*

## SEE ALSO

*ar(1)*, *cc(1)*, *ld(1)*, *lint(1)*, *nm(1)*, *intro(2)*, *intro(3M)*, *stdio(3S)*, *math(5)*.  
 The "C Compilation System" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

## DIAGNOSTICS

For functions that return floating-point values, error handling varies according to compilation mode. Under the *-Xt* (default) option to *cc*, these functions return the conventional values 0,  $\pm$ HUGE, or NaN when the function is undefined for the given arguments or when the value is not representable. In the *-Xa* and *-Xc* compilation modes,  $\pm$ HUGE\_VAL is returned instead of  $\pm$ HUGE. (HUGE\_VAL and HUGE are defined in *math.h* to be infinity and the largest-magnitude single-precision number, respectively.)

## NOTES

None of the functions, external variables, or macros should be redefined in the user's programs. Any other name may be redefined without affecting the behavior of other library functions, but such redefinition may conflict with a declaration in an included header file.

The header files in *INCDIR* provide function prototypes (function declarations including the types of arguments) for most of the functions listed in this manual. Function prototypes allow the compiler to check for correct usage of these functions in the user's program. The *lint* program checker may also be used and will report discrepancies even if the header files are not included with *#include* statements. Definitions for Sections 2, 3C, and 3S are checked automatically. Other definitions can be included by using the *-l* option to *lint*. (For example, *-lm* includes definitions for *libm*.) Use of *lint* is highly recommended.

Users should carefully note the difference between *STREAMS* and *stream*. *STREAMS* is a set of kernel mechanisms that support the development of network services and data communication drivers. It is composed of utility routines, kernel facilities, and a set of data structures. A *stream* is a file with its associated buffering. It is declared to be a pointer to a type *FILE* defined in *stdio.h*.

In detailed definitions of components, it is sometimes necessary to refer to symbolic names that are implementation-specific, but which are not necessarily expected to be accessible to an application program. Many of these symbolic names describe boundary conditions and system limits.



In this section, for readability, these implementation-specific values are given symbolic names. These names always appear enclosed in curly brackets to distinguish them from symbolic names of other implementation-specific constants that are accessible to application programs by header files. These names are not necessarily accessible to an application program through a header file, although they may be defined in the documentation for a particular system.

In general, a portable application program should not refer to these symbolic names in its code. For example, an application program would not be expected to test the length of an argument list given to a routine to determine if it was greater than `{ARG_MAX}`.

**NAME**

a64l, l64a – convert between long integer and base-64 ASCII string

**SYNOPSIS**

```
#include <stdlib.h>
long a64l (const char *s);
char *l64a (long l);
```

**DESCRIPTION**

These functions are used to maintain numbers stored in base-64 ASCII characters. These characters define a notation by which long integers can be represented by up to six characters; each character represents a "digit" in a radix-64 notation.

The characters used to represent "digits" are . for 0, / for 1, 0 through 9 for 2–11, A through Z for 12–37, and a through z for 38–63.

a64l takes a pointer to a null-terminated base-64 representation and returns a corresponding long value. If the string pointed to by s contains more than six characters, a64l will use the first six.

a64l scans the character string from left to right with the least significant digit on the left, decoding each character as a 6-bit radix-64 number.

l64a takes a long argument and returns a pointer to the corresponding base-64 representation. If the argument is 0, l64a returns a pointer to a null string.

**NOTES**

The value returned by l64a is a pointer into a static buffer, the contents of which are overwritten by each call.

**NAME**

**abort** – generate an abnormal termination signal

**SYNOPSIS**

```
#include <stdlib.h>
void abort (void);
```

**DESCRIPTION**

**abort** first closes all open files, **stdio(3S)** streams, directory streams and message catalogue descriptors, if possible, then causes the signal **SIGABRT** to be sent to the calling process.

**SEE ALSO**

**sdb(1)**, **exit(2)**, **kill(2)**, **signal(2)**, **catopen(3C)**, **stdio(3S)**,  
**sh(1)** in the *User's Reference Manual*.

**DIAGNOSTICS**

If **SIGABRT** is neither caught nor ignored, and the current directory is writable, a core dump is produced and the message **abort - core dumped** is written by the shell [see **sh(1)**].

**abs(3C)**

**abs(3C)**

**NAME**

**abs**, **labs** – return integer absolute value

**SYNOPSIS**

```
#include <stdlib.h>
int abs (int val);
long labs (long lval);
```

**DESCRIPTION**

**abs** returns the absolute value of its **int** operand. **labs** returns the absolute value of its **long** operand.

**SEE ALSO**

**floor(3M)**.

**NOTES**

In 2's-complement representation, the absolute value of the largest magnitude negative integral value is undefined.

## addseverity(3C)

## addseverity(3C)

### NAME

`addseverity` - build a list of severity levels for an application for use with `fntmsg`

### SYNOPSIS

```
#include <fntmsg.h>

int addseverity(int severity, const char *string);
```

### DESCRIPTION

The `addseverity` function builds a list of severity levels for an application to be used with the message formatting facility, `fntmsg`. `severity` is an integer value indicating the seriousness of the condition, and `string` is a pointer to a string describing the condition (string is not limited to a specific size).

If `addseverity` is called with an integer value that has not been previously defined, the function adds that new severity value and print string to the existing set of standard severity levels.

If `addseverity` is called with an integer value that has been previously defined, the function redefines that value with the new print string. Previously defined severity levels may be removed by supplying the `NULL` string. If `addseverity` is called with a negative number or an integer value of 0, 1, 2, 3, or 4, the function fails and returns -1. The values 0-4 are reserved for the standard severity levels and cannot be modified. Identifiers for the standard levels of severity are:

|                         |                                                                                                                                                     |
|-------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>MM_HALT</code>    | indicates that the application has encountered a severe fault and is halting. Produces the print string <code>HALT</code> .                         |
| <code>MM_ERROR</code>   | indicates that the application has detected a fault. Produces the print string <code>ERROR</code> .                                                 |
| <code>MM_WARNING</code> | indicates a condition that is out of the ordinary, that might be a problem, and should be watched. Produces the print string <code>WARNING</code> . |
| <code>MM_INFO</code>    | provides information about a condition that is not in error. Produces the print string <code>INFO</code> .                                          |
| <code>MM_NOSEV</code>   | indicates that no severity level is supplied for the message.                                                                                       |

Severity levels may also be defined at run time using the `SEV_LEVEL` environment variable [see `fntmsg(3C)`].

### EXAMPLES

When the function `addseverity` is used as follows:

```
addseverity(7, "ALERT")
```

the following call to `fntmsg`:

```
fntmsg(MM_PRINT, "UX:cat", 7, "invalid syntax", "refer to manual", "UX:cat:001")
```

produces:

```
UX:cat: ALERT: invalid syntax
TO FIX: refer to manual UX:cat:001
```

**addseverity(3C)**

**addseverity(3C)**

**SEE ALSO**

`fmtmsg(1M)`, `fmtmsg(3C)`, `gettext(3C)`, `printf(3S)`.

**DIAGNOSTICS**

`addseverity` returns `MM_OK` on success or `MM_NOTOK` on failure.

**NAME**

atexit – add program termination routine

**SYNOPSIS**

```
#include <stdlib.h>

int atexit (void (*func) (void));
```

**DESCRIPTION**

atexit adds the function *func* to a list of functions to be called without arguments on normal termination of the program. Normal termination occurs by either a call to the `exit` system call or a return from `main`. At most 32 functions may be registered by `atexit`; the functions will be called in the reverse order of their registration.

`atexit` returns 0 if the registration succeeds, nonzero if it fails.

**SEE ALSO**

`exit(2)`.

**NAME**

bsearch – binary search a sorted table

**SYNOPSIS**

```
#include <stdlib.h>

void *bsearch (const void *key, const void *base, size_t nel,
 size_t size, int (*compar) (const void *, const void *));
```

**DESCRIPTION**

bsearch is a binary search routine generalized from Knuth (6.2.1) Algorithm B. It returns a pointer into a table (an array) indicating where a datum may be found or a null pointer if the datum cannot be found. The table must be previously sorted in increasing order according to a comparison function pointed to by *compar*. *key* points to a datum instance to be sought in the table. *base* points to the element at the base of the table. *nel* is the number of elements in the table. *size* is the number of bytes in each element. The function pointed to by *compar* is called with two arguments that point to the elements being compared. The function must return an integer less than, equal to, or greater than 0 as accordingly the first argument is to be considered less than, equal to, or greater than the second.

**EXAMPLE**

The example below searches a table containing pointers to nodes consisting of a string and its length. The table is ordered alphabetically on the string in the node pointed to by each entry.

This program reads in strings and either finds the corresponding node and prints out the string and its length, or prints an error message.

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

struct node { /* these are stored in the table */
 char *string;
 int length;
};
static struct node table[] = /* table to be searched */
{
 { "asparagus", 10 },
 { "beans", 6 },
 { "tomato", 7 },
 { "watermelon", 11 },
};

main()
{
 struct node *node_ptr, node;
 /* routine to compare 2 nodes */
 static int node_compare(const void *, const void *);
 char str_space[20]; /* space to read string into */
```



```

node.string = str_space;
while (scanf("%20s", node.string) != EOF) {
 node_ptr = bsearch(&node,
 table, sizeof(table)/sizeof(struct node),
 sizeof(struct node), node_compare);
 if (node_ptr != NULL) {
 (void) printf("string = %20s, length = %d\n",
 node_ptr->string, node_ptr->length);
 } else {
 (void)printf("not found: %20s\n", node.string);
 }
}
return(0);
}

/* routine to compare two nodes based on an */
/* alphabetical ordering of the string field */
static int
node_compare(const void *node1, const void *node2)
{
 return (strcmp(
 ((const struct node *)node1)->string,
 ((const struct node *)node2)->string));
}

```

**SEE ALSO**

bsearch(3C), lsearch(3C), qsort(3C), tsearch(3C).

**DIAGNOSTICS**

A null pointer is returned if the key cannot be found in the table.

**NOTES**

The pointers to the key and the element at the base of the table should be of type pointer-to-*element*.

The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

If the number of elements in the table is less than the size reserved for the table, *nel* should be the lower number.

**NAME**

catgets – read a program message

**SYNOPSIS**

```
#include <nl_types.h>
char *catgets (nl_catd catd, int set_num, int msg_num, char *s);
```

**DESCRIPTION**

catgets attempts to read message *msg\_num*, in set *set\_num*, from the message catalogue identified by *catd*. *catd* is a catalogue descriptor returned from an earlier call to *catopen*. *s* points to a default message string which will be returned by *catgets* if the identified message catalogue is not currently available.

**SEE ALSO**

*catopen(3C)*.

**DIAGNOSTICS**

If the identified message is retrieved successfully, *catgets* returns a pointer to an internal buffer area containing the null terminated message string. If the call is unsuccessful because the message catalogue identified by *catd* is not currently available, a pointer to *s* is returned.

**NAME**

catopen, catclose – open/close a message catalogue

**SYNOPSIS**

```
#include <nl_types.h>

nl_catd catopen (char *name, int oflag);
int catclose (nl_catd catd);
```

**DESCRIPTION**

catopen opens a message catalogue and returns a catalogue descriptor. *name* specifies the name of the message catalogue to be opened. If *name* contains a "/" then *name* specifies a pathname for the message catalogue. Otherwise, the environment variable NLSPATH is used. If NLSPATH does not exist in the environment, or if a message catalogue cannot be opened in any of the paths specified by NLSPATH, then the default path is used [see nl\_types(5)].

The names of message catalogues, and their location in the filestore, can vary from one system to another. Individual applications can choose to name or locate message catalogues according to their own special needs. A mechanism is therefore required to specify where the catalogue resides.

The NLSPATH variable provides both the location of message catalogues, in the form of a search path, and the naming conventions associated with message catalogue files. For example:

```
NLSPATH=/nlslib/%L/%N.cat:/nlslib/%N/%L
```

The metacharacter % introduces a substitution field, where %L substitutes the current setting of the LANG environment variable (see following section), and %N substitutes the value of the *name* parameter passed to catopen. Thus, in the above example, catopen will search in /nlslib/\$LANG/*name*.cat, then in /nlslib/*name*/\$LANG, for the required message catalogue.

NLSPATH will normally be set up on a system wide basis (e.g., in /etc/profile) and thus makes the location and naming conventions associated with message catalogues transparent to both programs and users.

The full set of metacharacters is:

- %N The value of the name parameter passed to catopen.
- %L The value of LANG.
- %l The value of the language element of LANG.
- %t The value of the territory element of LANG.
- %c The value of the codeset element of LANG.
- %% A single %.

The LANG environment variable provides the ability to specify the user's requirements for native languages, local customs and character set, as an ASCII string in the form

```
LANG=language[_territory[.codeset]]
```

A user who speaks German as it is spoken in Austria and has a terminal which operates in ISO 8859/1 codeset, would want the setting of the `LANG` variable to be

```
LANG=De_A.88591
```

With this setting it should be possible for that user to find any relevant catalogues should they exist.

Should the `LANG` variable not be set then the value of `LC_MESSAGES` as returned by `setlocale` is used. If this is `NULL` then the default path as defined in `nl_types` is used.

*oflag* is reserved for future use and should be set to 0. The results of setting this field to any other value are undefined.

`catclose` closes the message catalogue identified by *catd*.

**SEE ALSO**

`catgets(3C)`, `setlocale(3C)`, `environ(5)`, `nl_types(5)`.

**DIAGNOSTICS**

If successful, `catopen` returns a message catalogue descriptor for use on subsequent calls to `catgets` and `catclose`. Otherwise `catopen` returns `(nl_catd) -1`.

`catclose` returns 0 if successful, otherwise `-1`.

**NAME**

**clock** - report CPU time used

**SYNOPSIS**

```
#include <time.h>
clock_t clock (void);
```

**DESCRIPTION**

**clock** returns the amount of CPU time (in microseconds) used since the first call to **clock** in the calling process. The time reported is the sum of the user and system times of the calling process and its terminated child processes for which it has executed the **wait** system call, the **pclose** function, or the **system** function.

Dividing the value returned by **clock** by the constant **CLOCKS\_PER\_SEC**, defined in the **time.h** header file, will give the time in seconds.

The resolution of the clock is 10 milliseconds on AT&T 3B computers.

**SEE ALSO**

**times(2)**, **wait(2)**, **popen(3S)**, **system(3S)**.

**NOTES**

The value returned by **clock** is defined in microseconds for compatibility with systems that have CPU clocks with much higher resolution. Because of this, the value returned will wrap around after accumulating only 2147 seconds of CPU time (about 36 minutes). If the process time used is not available or cannot be represented, **clock** returns the value **(clock\_t)-1**.

**NAME**

conv: toupper, tolower, \_toupper, \_tolower, toascii - translate characters

**SYNOPSIS**

```
#include <ctype.h>

int toupper (int c);
int tolower (int c);
int _toupper (int c);
int _tolower (int c);
int toascii (int c);
```

**DESCRIPTION**

`toupper` and `tolower` have as their domain the range of the function `getc`: all values represented in an unsigned `char` and the value of the macro `EOF` as defined in `stdio.h`. If the argument of `toupper` represents a lower-case letter, the result is the corresponding upper-case letter. If the argument of `tolower` represents an upper-case letter, the result is the corresponding lower-case letter. All other arguments in the domain are returned unchanged.

The macros `_toupper` and `_tolower` accomplish the same things as `toupper` and `tolower`, respectively, but have restricted domains and are faster. `_toupper` requires a lower-case letter as its argument; its result is the corresponding upper-case letter. `_tolower` requires an upper-case letter as its argument; its result is the corresponding lower-case letter. Arguments outside the domain cause undefined results.

`toascii` yields its argument with all bits turned off that are not part of a standard 7-bit ASCII character; it is intended for compatibility with other systems.

`toupper`, `tolower`, `_toupper`, and `_tolower` are affected by `LC_CTYPE`. In the C locale, or in a locale where shift information is not defined, these functions determine the case of characters according to the rules of the ASCII-coded character set. Characters outside the ASCII range of characters are returned unchanged.

**SEE ALSO**

`ctype(3C)`, `getc(3S)`, `setlocale(3C)`, `environ(5)`.

**NAME**

`crypt`, `setkey`, `encrypt` – generate encryption

**SYNOPSIS**

```
#include <crypt.h>
char *crypt (const char *key, const char *salt);
void setkey (const char *key);
void encrypt (char *block, int edflag);
```

**DESCRIPTION**

`crypt` is the password encryption function. It is based on a one-way encryption algorithm with variations intended (among other things) to frustrate use of hardware implementations of a key search.

`key` is the input string to encrypt, for instance, a user's typed password. Only the first eight characters are used; the rest are ignored. `salt` is a two-character string chosen from the set `a-zA-Z0-9./`; this string is used to perturb the hashing algorithm in one of 4096 different ways, after which the input string is used as the key to encrypt repeatedly a constant string. The returned value points to the encrypted input string. The first two characters of the return value are the `salt` itself.

The `setkey` and `encrypt` functions provide (rather primitive) access to the actual hashing algorithm. The argument of `setkey` is a character array of length 64 containing only the characters with numerical value 0 and 1. This string is divided into groups of 8, the low-order bit in each group is ignored; this gives a 56-bit key that is set into the machine. This is the key that will be used with the hashing algorithm to encrypt the string `block` with the `encrypt` function.

The `block` argument of `encrypt` is a character array of length 64 containing only the characters with numerical value 0 and 1. The argument array is modified in place to a similar array representing the bits of the argument after having been subjected to the hashing algorithm using the key set by `setkey`. The argument `edflag`, indicating decryption rather than encryption, is ignored; use `encrypt` in `libcrypt` [see `crypt(3X)`] for decryption.

**SEE ALSO**

`getpass(3C)`, `crypt(3X)`, `passwd(4)`,  
`login(1)`, `passwd(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

If `edflag` is set to anything other than zero, `errno` will be set to `ENOSYS`.

**NOTES**

The return value for `crypt` points to static data that are overwritten by each call.

**NAME**

`ctermid` – generate file name for terminal

**SYNOPSIS**

```
#include <stdio.h>

char *ctermid (char *s);
```

**DESCRIPTION**

`ctermid` generates the path name of the controlling terminal for the current process, and stores it in a string.

If `s` is a `NULL` pointer, the string is stored in an internal static area, the contents of which are overwritten at the next call to `ctermid`, and the address of which is returned. Otherwise, `s` is assumed to point to a character array of at least `L_ctermid` elements; the path name is placed in this array and the value of `s` is returned. The constant `L_ctermid` is defined in the `stdio.h` header file.

**SEE ALSO**

`ttyname(3C)`.

**NOTES**

The difference between `ctermid` and `ttyname(3C)` is that `ttyname` must be handed a file descriptor and returns the actual name of the terminal associated with that file descriptor, while `ctermid` returns a string (`/dev/tty`) that will refer to the terminal if used as a file name. Thus `ttyname` is useful only if the process already has at least one file open to a terminal.



## NAME

ctime, localtime, gmtime, asctime, tzset - convert date and time to string

## SYNOPSIS

```
#include <time.h>

char *ctime (const time_t *clock);
struct tm *localtime (const time_t *clock);
struct tm *gmtime (const time_t *clock);
char *asctime (const struct tm *tm);
extern time_t timezone, altzone;
extern int daylight;
extern char *tzname[2];
void tzset (void);
```

## DESCRIPTION

ctime, localtime, and gmtime accept arguments of type time\_t, pointed to by clock, representing the time in seconds since 00:00:00 UTC, January 1, 1970. ctime returns a pointer to a 26-character string as shown below. Time zone and daylight savings corrections are made before the string is generated. The fields are constant in width:

```
Fri Sep 13 00:00:00 1986\n\0
```

localtime and gmtime return pointers to tm structures, described below. localtime corrects for the main time zone and possible alternate ("daylight savings") time zone; gmtime converts directly to Coordinated Universal Time (UTC), which is the time the UNIX system uses internally.

asctime converts a tm structure to a 26-character string, as shown in the above example, and returns a pointer to the string.

Declarations of all the functions and externals, and the tm structure, are in the time.h header file. The structure declaration is:

```
struct tm {
 int tm_sec; /* seconds after the minute - [0, 61] */
 /* for leap seconds */
 int tm_min; /* minutes after the hour - [0, 59] */
 int tm_hour; /* hour since midnight - [0, 23] */
 int tm_mday; /* day of the month - [1, 31] */
 int tm_mon; /* months since January - [0, 11] */
 int tm_year; /* years since 1900 */
 int tm_wday; /* days since Sunday - [0, 6] */
 int tm_yday; /* days since January 1 - [0, 365] */
 int tm_isdst; /* flag for alternate daylight */
 /* savings time */
};
```

The value of `tm_isdst` is positive if daylight savings time is in effect, zero if daylight savings time is not in effect, and negative if the information is not available. (Previously, the value of `tm_isdst` was defined as non-zero if daylight savings time was in effect.)

The external `time_t` variable `altzone` contains the difference, in seconds, between Coordinated Universal Time and the alternate time zone. The external variable `timezone` contains the difference, in seconds, between UTC and local standard time. The external variable `daylight` indicates whether time should reflect daylight savings time. Both `timezone` and `altzone` default to 0 (UTC). The external variable `daylight` is non-zero if an alternate time zone exists. The time zone names are contained in the external variable `tzname`, which by default is set to:

```
char *tzname[2] = { "GMT", " " };
```

These functions know about the peculiarities of this conversion for various time periods for the U.S. (specifically, the years 1974, 1975, and 1987). They will handle the new daylight savings time starting with the first Sunday in April, 1987.

`tzset` uses the contents of the environment variable `TZ` to override the value of the different external variables. The function `tzset` is called by `asctime` and may also be called by the user. See `environ(5)` for a description of the `TZ` environment variable.

`tzset` scans the contents of the environment variable and assigns the different fields to the respective variable. For example, the most complete setting for New Jersey in 1986 could be

```
EST5EDT4,116/2:00:00,298/2:00:00
```

or simply

```
EST5EDT
```

An example of a southern hemisphere setting such as the Cook Islands could be

```
KDT9:30KST10:00,63/5:00,302/20:00
```

In the longer version of the New Jersey example of `TZ`, `tzname[0]` is EST, `timezone` will be set to `5*60*60`, `tzname[1]` is EDT, `altzone` will be set to `4*60*60`, the starting date of the alternate time zone is the 117th day at 2 AM, the ending date of the alternate time zone is the 299th day at 2 AM (using zero-based Julian days), and `daylight` will be set positive. Starting and ending times are relative to the alternate time zone. If the alternate time zone start and end dates and the time are not provided, the days for the United States that year will be used and the time will be 2 AM. If the start and end dates are provided but the time is not provided, the time will be 2 AM. The effects of `tzset` are thus to change the values of the external variables `timezone`, `altzone`, `daylight`, and `tzname`. `ctime`, `localtime`, `mktime`, and `strftime` will also update these external variables as if they had called `tzset` at the time specified by the `time_t` or `struct tm` value that they are converting.

Note that in most installations, `TZ` is set to the correct value by default when the user logs on, via the local `/etc/profile` file [see `profile(4)` and `timezone(4)`].

**FILES**

*/usr/lib/locale/language/LC\_TIME* - file containing locale specific date and time information

**SEE ALSO**

*time(2), getenv(3C), mktime(3C), putenv(3C), printf(3S), setlocale(3C), strftime(3C), cftime(4), profile(4), timezone(4), environ(5).*

**NOTES**

The return values for *ctime*, *localtime*, and *gmtime* point to static data whose content is overwritten by each call.

Setting the time during the interval of change from *timezone* to *altzone* or vice versa can produce unpredictable results. The system administrator must change the Julian start and end days annually.

## NAME

ctype: isdigit, isxdigit, islower, isupper, isalpha, isalnum, isspace, iscntrl, ispunct, isprint, isgraph, isascii - character handling

## SYNOPSIS

```
#include <ctype.h>

int isalpha(int c);
int isupper(int c);
int islower(int c);
int isdigit(int c);
int isxdigit(int c);
int isalnum(int c);
int isspace(int c);
int ispunct(int c);
int isprint(int c);
int isgraph(int c);
int iscntrl(int c);
int isascii(int c);
```

## DESCRIPTION

These macros classify character-coded integer values. Each is a predicate returning non-zero for true, zero for false. The behavior of these macros, except `isascii`, is affected by the current locale [see `setlocale(3C)`]. To modify the behavior, change the `LC_TYPE` category in `setlocale`, that is, `setlocale(LC_CTYPE, newlocale)`. In the C locale, or in a locale where character type information is not defined, characters are classified according to the rules of the US-ASCII 7-bit coded character set.

The macro `isascii` is defined on all integer values; the rest are defined only where the argument is an `int`, the value of which is representable as an unsigned `char`, or `EOF`, which is defined by the `stdio.h` header file and represents end-of-file.

`isalpha` tests for any character for which `isupper` or `islower` is true, or any character that is one of an implementation-defined set of characters for which none of `iscntrl`, `isdigit`, `ispunct`, or `isspace` is true. In the C locale, `isalpha` returns true only for the characters for which `isupper` or `islower` is true.

`isupper` tests for any character that is an upper-case letter or is one of an implementation-defined set of characters for which none of `iscntrl`, `isdigit`, `ispunct`, `isspace`, or `islower` is true. In the C locale, `isupper` returns true only for the characters defined as upper-case ASCII characters.

|                       |                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>islower</code>  | tests for any character that is a lower-case letter or is one of an implementation-defined set of characters for which none of <code>iscntrl</code> , <code>isdigit</code> , <code>ispunct</code> , <code>isspace</code> , or <code>isupper</code> is true. In the C locale, <code>islower</code> returns true only for the characters defined as lower-case ASCII characters. |
| <code>isdigit</code>  | tests for any decimal-digit character.                                                                                                                                                                                                                                                                                                                                         |
| <code>isxdigit</code> | tests for any hexadecimal-digit character ([0-9], [A-F] or [a-f]).                                                                                                                                                                                                                                                                                                             |
| <code>isalnum</code>  | tests for any character for which <code>isalpha</code> or <code>isdigit</code> is true (letter or digit).                                                                                                                                                                                                                                                                      |
| <code>isspace</code>  | tests for any space, tab, carriage-return, newline, vertical-tab or form-feed (standard white-space characters) or for one of an implementation-defined set of characters for which <code>isalnum</code> is false. In the C locale, <code>isspace</code> returns true only for the standard white-space characters.                                                            |
| <code>ispunct</code>  | tests for any printing character which is neither a space nor a character for which <code>isalnum</code> is true.                                                                                                                                                                                                                                                              |
| <code>isprint</code>  | tests for any printing character, including space (" ").                                                                                                                                                                                                                                                                                                                       |
| <code>isgraph</code>  | tests for any printing character, except space.                                                                                                                                                                                                                                                                                                                                |
| <code>iscntrl</code>  | tests for any "control character" as defined by the character set.                                                                                                                                                                                                                                                                                                             |
| <code>isascii</code>  | tests for any ASCII character, code between 0 and 0177 inclusive.                                                                                                                                                                                                                                                                                                              |

All the character classification macros and the conversion functions and macros use a table lookup.

Functions exist for all the above-defined macros. To get the function form, the macro name must be undefined (e.g., `#undef isdigit`).

#### FILES

`/usr/lib/locale/locale/LC_CTYPE`

#### SEE ALSO

`chrtbl(1M)`, `setlocale(3C)`, `stdio(3S)`, `ascii(5)`, `environ(5)`.

#### DIAGNOSTICS

If the argument to any of the character handling macros is not in the domain of the function, the result is undefined.

**NAME**

`cuserid` – get character login name of the user

**SYNOPSIS**

```
#include <stdio.h>

char *cuserid (char *s);
```

**DESCRIPTION**

`cuserid` generates a character-string representation of the login name that the owner of the current process is logged in under. If `s` is a `NULL` pointer, this representation is generated in an internal static area, the address of which is returned. Otherwise, `s` is assumed to point to an array of at least `L_cuserid` characters; the representation is left in this array. The constant `L_cuserid` is defined in the `stdio.h` header file.

**SEE ALSO**

`getlogin(3C)`, `getpwent(3C)`.

**DIAGNOSTICS**

If the login name cannot be found, `cuserid` returns a `NULL` pointer; if `s` is not a `NULL` pointer, a null character `'\0'` will be placed at `s[0]`.

**NAME**

deconv: `_s2dec`, `_d2dec`, `_dec2s`, `_dec2d` - convert between binary and decimal values

**SYNOPSIS**

```
#include <ieeefp.h>

void _s2dec (float *x, decimal *d, int p);
void _d2dec (double *x, decimal *d, int p);
void _dec2s (decimal *d, float *x, int p);
void _dec2d (decimal *d, double *x, int p);
```

**DESCRIPTION**

The `_s2dec` function returns a decimal floating-point value, given a pointer to a single-precision binary floating-point number and a precision specification.

On input, the value of the `ilen` field in the decimal should be set to tell how many decimal digits should be output in the mantissa for rounding purposes. If the `ilen` field is not in the range  $1 \leq \text{ilen} \leq 9$ , a NaN is returned. If the input binary value `x` is a NaN or infinity, the returned decimal `d` will be a NaN or infinity with the appropriate sign. The exponential component of the returned decimal value is always two digits. The structure `decimal` is defined in the `ieeefp.h` header file.

The parameter `p` ( $0 \leq p \leq \text{ilen}$ ) specifies how many of the digits in the output decimal mantissa string are to be considered to be to the right of the implicit decimal point. If `p` is out of range, a NaN is returned.

The `_d2dec` function works like the `_s2dec` function except that it takes a pointer to a double-precision value for `x`. The `ilen` field must be in the range of  $1 \leq \text{ilen} \leq 17$ , and the exponential component of the returned decimal will contain three digits.

The `_dec2s` function returns a single-precision binary floating-point value, given a decimal value and a precision specification.

The parameter `p` ( $0 \leq p \leq \text{ilen}$ ) tells how many of the digits in the mantissa string are to be considered to be to the right of an implicit decimal point.

Because the decimal format can represent a larger range of numbers than the binary formats, this conversion may overflow or underflow. Upon overflow or underflow, a signed infinity (signed zero) is returned, and the appropriate sticky bit is set.

The mantissa and exponent strings may contain leading zero characters. But, once all leading 0 characters are removed, the mantissa string should have a length  $>0$  and  $\leq 9$ . The exponent string should have a length  $>0$  and  $\leq 2$ . The special case of `d == 0` (decimal) is detected, in which case the trailing 0 characters in the string are not removed.

The `_dec2d` function is analogous to the `_dec2s` function except that it returns a double-precision value. After leading 0 characters are removed, the mantissa string should contain no more than 17 digits and the exponent string should contain no more than three digits.

Rounding is performed according to the current rounding mode. The default is round-to-nearest.

Calling these functions may result in the following exceptions: overflow, underflow, inexact result, invalid operation.

**SEE ALSO**

`fpgetround(3C)`.

The "Floating Point Operations" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.



**NAME**

**difftime** - computes the difference between two calendar times

**SYNOPSIS**

```
#include <time.h>
double difftime (time_t time1, time_t time0);
```

**DESCRIPTION**

**difftime** computes the difference between two calendar times. **difftime** returns the difference ( $time1-time0$ ) expressed in seconds as a double. This function is provided because there are no general arithmetic properties defined for type **time\_t**.

**SEE ALSO**

**ctime(3C)**.

**NAME**

directory: `opendir`, `readdir`, `telldir`, `seekdir`, `rewinddir`, `closedir` - directory operations

**SYNOPSIS**

```
#include <dirent.h>

DIR *opendir (const char *filename);
struct dirent *readdir (DIR *dirp);
long telldir (DIR *dirp);
void seekdir (DIR *dirp, long loc);
void rewinddir (DIR *dirp);
int closedir (DIR *dirp);
```

**DESCRIPTION**

`opendir` opens the directory named by *filename* and associates a directory stream with it. `opendir` returns a pointer to be used to identify the directory stream in subsequent operations. The directory stream is positioned at the first entry. A null pointer is returned if *filename* cannot be accessed or is not a directory, or if it cannot `malloc(3C)` enough memory to hold a `DIR` structure or a buffer for the directory entries.

`readdir` returns a pointer to the next active directory entry and positions the directory stream at the next entry. No inactive entries are returned. It returns `NULL` upon reaching the end of the directory or upon detecting an invalid location in the directory. `readdir` buffers several directory entries per actual read operation; `readdir` marks for update the `st_atime` field of the directory each time the directory is actually read.

`telldir` returns the current location associated with the named directory stream.

`seekdir` sets the position of the next `readdir` operation on the directory stream. The new position reverts to the position associated with the directory stream at the time the `telldir` operation that provides *loc* was performed. Values returned by `telldir` are valid only if the directory has not changed because of compaction or expansion. This situation is not a problem with System V, but it may be a problem with some file system types.

`rewinddir` resets the position of the named directory stream to the beginning of the directory. It also causes the directory stream to refer to the current state of the corresponding directory, as a call to `opendir` would.

`closedir` closes the named directory stream and frees the `DIR` structure.

The following errors can occur as a result of these operations.

`opendir` returns `NULL` on failure and sets `errno` to one of the following values:

|                      |                                                          |
|----------------------|----------------------------------------------------------|
| <code>ENOTDIR</code> | A component of <i>filename</i> is not a directory.       |
| <code>EACCES</code>  | A component of <i>filename</i> denies search permission. |

|                     |                                                                                                                                                                                                              |
|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Read permission is denied on the specified directory.                                                                                                                                                        |
| <b>EMFILE</b>       | The maximum number of file descriptors are currently open.                                                                                                                                                   |
| <b>ENFILE</b>       | The system file table is full.                                                                                                                                                                               |
| <b>EFAULT</b>       | <i>filename</i> points outside the allocated address space.                                                                                                                                                  |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>filename</i> .                                                                                                                                    |
| <b>ENAMETOOLONG</b> | The length of the <i>filename</i> argument exceeds <code>{PATH_MAX}</code> , or the length of a <i>filename</i> component exceeds <code>{NAME_MAX}</code> while <code>{_POSIX_NO_TRUNC}</code> is in effect. |
| <b>ENOENT</b>       | A component of <i>filename</i> does not exist or is a null path-name.                                                                                                                                        |

`readdir` returns `NULL` on failure and sets `errno` to one of the following values:

|               |                                                                                                                            |
|---------------|----------------------------------------------------------------------------------------------------------------------------|
| <b>ENOENT</b> | The current file pointer for the directory is not located at a valid entry.                                                |
| <b>EBADF</b>  | The file descriptor determined by the DIR stream is no longer valid. This result occurs if the DIR stream has been closed. |

`telldir`, `seekdir`, and `closedir` return `-1` on failure and set `errno` to the following value:

|              |                                                                                                                      |
|--------------|----------------------------------------------------------------------------------------------------------------------|
| <b>EBADF</b> | The file descriptor determined by the DIR stream is no longer valid. This results if the DIR stream has been closed. |
|--------------|----------------------------------------------------------------------------------------------------------------------|

#### EXAMPLE

Here is a sample program that prints the names of all the files in the current directory:

```
#include <stdio.h>
#include <dirent.h>

main()
{
 DIR *dirp;
 struct dirent *direntp;

 dirp = opendir(".");
 while ((direntp = readdir(dirp)) != NULL)
 (void)printf("%s\n", direntp->d_name);
 closedir(dirp);
 return (0);
}
```

**directory(3C)**

**directory(3C)**

**SEE ALSO**

`getdents(2)`, `dirent(4)`.

**NOTES**

`rewinddir` is implemented as a macro, so its function address cannot be taken.

**NAME**

`div`, `ldiv` – compute the quotient and remainder

**SYNOPSIS**

```
#include <stdlib.h>

div_t div (int numer, int denom);

ldiv_t ldiv (long int numer, long int denom);
```

**DESCRIPTION**

`div` computes the quotient and remainder of the division of the numerator *numer* by the denominator *denom*. This function provides a well-defined semantics for the signed integral division and remainder operations, unlike the implementation-defined semantics of the built-in operations. The sign of the resulting quotient is that of the algebraic quotient, and, if the division is inexact, the magnitude of the resulting quotient is the largest integer less than the magnitude of the algebraic quotient. If the result cannot be represented, the behavior is undefined; otherwise, *quotient \* denom + remainder* will equal *numer*.

`div` returns a structure of type `div_t`, comprising both the quotient and remainder:

```
typedef struct div_t {
 int quot; /*quotient*/
 int rem; /*remainder*/
} div_t;
```

`ldiv` is similar to `div`, except that the arguments and the members of the returned structure (which has type `ldiv_t`) all have type `long int`.

**drand48(3C)****drand48(3C)****NAME**

**drand48, erand48, lrand48, nrand48, mrand48, jrand48, srand48, seed48, lcong48** – generate uniformly distributed pseudo-random numbers

**SYNOPSIS**

```
#include <stdlib.h>

double drand48 (void);
double erand48 (unsigned short xsubi[3]);
long lrand48 (void);
long nrand48 (unsigned short xsubi[3]);
long mrand48 (void);
long jrand48 (unsigned short xsubi[3]);
void srand48 (long seedval);
unsigned short *seed48 (unsigned short seed16v[3]);
void lcong48 (unsigned short param[7]);
```

**DESCRIPTION**

This family of functions generates pseudo-random numbers using the well-known linear congruential algorithm and 48-bit integer arithmetic.

Functions **drand48** and **erand48** return non-negative double-precision floating-point values uniformly distributed over the interval [0.0, 1.0).

Functions **lrand48** and **nrand48** return non-negative long integers uniformly distributed over the interval [0,  $2^{31}$ ).

Functions **mrnd48** and **jrnd48** return signed long integers uniformly distributed over the interval [ $-2^{31}$ ,  $2^{31}$ ).

Functions **srand48**, **seed48**, and **lcong48** are initialization entry points, one of which should be invoked before either **drand48**, **lrand48**, or **mrnd48** is called. (Although it is not recommended practice, constant default initializer values will be supplied automatically if **drand48**, **lrand48**, or **mrnd48** is called without a prior call to an initialization entry point.) Functions **erand48**, **nrand48**, and **jrnd48** do not require an initialization entry point to be called first.

All the routines work by generating a sequence of 48-bit integer values,  $X_i$ , according to the linear congruential formula

$$X_{n+1} = (aX_n + c)_{\text{mod } m} \quad n \geq 0.$$

The parameter  $m = 2^{48}$ ; hence 48-bit integer arithmetic is performed. Unless **lcong48** has been invoked, the multiplier value  $a$  and the addend value  $c$  are given by

$$a = 5DEECE66D_{16} = 273673163155_8$$

$$c = B_{16} = 13_8.$$

The value returned by any of the functions **drand48**, **erand48**, **lrand48**, **nrand48**, **mrnd48**, or **jrnd48** is computed by first generating the next 48-bit  $X_i$  in the sequence. Then the appropriate number of bits, according to the type of

data item to be returned, are copied from the high-order (leftmost) bits of  $X_i$  and transformed into the returned value.

The functions `drand48`, `lrand48`, and `mrnd48` store the last 48-bit  $X_i$  generated in an internal buffer.  $X_i$  must be initialized prior to being invoked. The functions `erand48`, `nrnd48`, and `jrnd48` require the calling program to provide storage for the successive  $X_i$  values in the array specified as an argument when the functions are invoked. These routines do not have to be initialized; the calling program must place the desired initial value of  $X_i$  into the array and pass it as an argument. By using different arguments, functions `erand48`, `nrnd48`, and `jrnd48` allow separate modules of a large program to generate several *independent* streams of pseudo-random numbers, i.e., the sequence of numbers in each stream will *not* depend upon how many times the routines have been called to generate numbers for the other streams.

The initializer function `srand48` sets the high-order 32 bits of  $X_i$  to the 32 bits contained in its argument. The low-order 16 bits of  $X_i$  are set to the arbitrary value  $330E_{16}$ .

The initializer function `seed48` sets the value of  $X_i$  to the 48-bit value specified in the argument array. In addition, the previous value of  $X_i$  is copied into a 48-bit internal buffer, used only by `seed48`, and a pointer to this buffer is the value returned by `seed48`. This returned pointer, which can just be ignored if not needed, is useful if a program is to be restarted from a given point at some future time — use the pointer to get at and store the last  $X_i$  value, and then use this value to reinitialize via `seed48` when the program is restarted.

The initialization function `lcong48` allows the user to specify the initial  $X_i$ , the multiplier value  $a$ , and the addend value  $c$ . Argument array elements `param[0-2]` specify  $X_i$ , `param[3-5]` specify the multiplier  $a$ , and `param[6]` specifies the 16-bit addend  $c$ . After `lcong48` has been called, a subsequent call to either `srand48` or `seed48` will restore the “standard” multiplier and addend values,  $a$  and  $c$ , specified on the previous page.

**SEE ALSO**

`rand(3C)`.

**NAME**

dup2 – duplicate an open file descriptor

**SYNOPSIS**

```
#include <unistd.h>
int dup2 (int fildes, int fildes2);
```

**DESCRIPTION**

*fildes* is a file descriptor referring to an open file, and *fildes2* is a non-negative integer less than {OPEN\_MAX} (the maximum number of open files). dup2 causes *fildes2* to refer to the same file as *fildes*. If *fildes2* already referred to an open file, not *fildes*, it is closed first. If *fildes2* refers to *fildes*, or if *fildes* is not a valid open file descriptor, *fildes2* will not be closed first.

dup2 will fail if one or more of the following are true:

- EBADF**            *fildes* is not a valid open file descriptor.
- EBADF**            *fildes2* is negative or greater than or equal to {OPEN\_MAX}.
- EINTR**            a signal was caught during the dup2 call.
- % [EMFILE**        {OPEN\_MAX} file descriptors are currently open.

**SEE ALSO**

creat(2), close(2), exec(2), fcntl(2), open(2), pipe(2), lockf(3C), limits(4).

**DIAGNOSTICS**

Upon successful completion a non-negative integer, namely, the file descriptor, is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.



**NAME**

`ecvt`, `fcvt`, `gcvt` – convert floating-point number to string

**SYNOPSIS**

```
#include <stdlib.h>

char *ecvt (double value, int ndigit, int *decpt, int *sign);
char *fcvt (double value, int ndigit, int *decpt, int *sign);
char *gcvt (double value, int ndigit, char *buf);
```

**DESCRIPTION**

`ecvt` converts *value* to a null-terminated string of *ndigit* digits and returns a pointer thereto. The high-order digit is non-zero, unless the value is zero. The low-order digit is rounded. The position of the decimal point relative to the beginning of the string is stored indirectly through *decpt* (negative means to the left of the returned digits). The decimal point is not included in the returned string. If the sign of the result is negative, the word pointed to by *sign* is non-zero, otherwise it is zero.

`fcvt` is identical to `ecvt`, except that the correct digit has been rounded for `printf %f` output of the number of digits specified by *ndigit*.

`gcvt` converts the *value* to a null-terminated string in the array pointed to by *buf* and returns *buf*. It attempts to produce *ndigit* significant digits in `%f` format if possible, otherwise `%e` format (scientific notation), ready for printing. A minus sign, if there is one, or a decimal point will be included as part of the returned string. Trailing zeros are suppressed.

**SEE ALSO**

`printf(3S)`.

**NOTES**

The values returned by `ecvt` and `fcvt` point to a single static data array whose content is overwritten by each call.

**NAME**

`end`, `etext`, `edata` – last locations in program

**SYNOPSIS**

```
extern etext;
extern edata;
extern end;
```

**DESCRIPTION**

These names refer neither to routines nor to locations with interesting contents; only their addresses are meaningful.

`etext` The address of `etext` is the first address above the program text.

`edata` The address of `edata` is the first address above the initialized data region.

`end` The address of `end` is the first address above the uninitialized data region.

**SEE ALSO**

`cc(1)`, `brk(2)`, `malloc(3C)`, `stdio(3S)`.

**NOTE**

When execution begins, the program break (the first location beyond the data) coincides with `end`, but the program break may be reset by the routines `brk`, `malloc`, the standard input/output library [see `stdio(3S)`], by the profile (`-p`) option of `cc`, and so on. Thus, the current value of the program break should be determined by `sbrk ((char *)0)` [see `brk(2)`].

**NAME**

fclose, fflush - close or flush a stream

**SYNOPSIS**

```
#include <stdio.h>

int fclose (FILE *stream);
int fflush (FILE *stream);
```

**DESCRIPTION**

fclose causes any buffered data waiting to be written for the named *stream* [see intro(3)] to be written out, and the *stream* to be closed. If the underlying file pointer is not already at end of file, and the file is one capable of seeking, the file pointer is adjusted so that the next operation on the open file pointer deals with the byte after the last one read from or written to the file being closed.

fclose is performed automatically for all open files upon calling exit.

If *stream* points to an output stream or an update stream on which the most recent operation was not input, fflush causes any buffered data waiting to be written for the named *stream* to be written to that file. Any unread data buffered in *stream* is discarded. The *stream* remains open. If *stream* is open for reading, the underlying file pointer is not already at end of file, and the file is one capable of seeking, the file pointer is adjusted so that the next operation on the open file pointer deals with the byte after the last one read from or written to the stream.

When calling fflush, if *stream* is a null pointer, all files open for writing are flushed.

**SEE ALSO**

close(2), exit(2), intro(3), fopen(3S), setbuf(3S), stdio(3S).

**DIAGNOSTICS**

Upon successful completion these functions return a value of zero. Otherwise EOF is returned.

**NAME**

**ferror, feof, clearerr, fileno** – stream status inquiries

**SYNOPSIS**

```
#include <stdio.h>
int ferror (FILE *stream);
int feof (FILE *stream);
void clearerr (FILE *stream);
int fileno (FILE *stream);
```

**DESCRIPTION**

**ferror** returns non-zero when an error has previously occurred reading from or writing to the named *stream* [see [intro\(3\)](#)], otherwise zero.

**feof** returns non-zero when EOF has previously been detected reading the named input *stream*, otherwise zero.

**clearerr** resets the error indicator and EOF indicator to zero on the named *stream*.

**fileno** returns the integer file descriptor associated with the named *stream*; see [open\(2\)](#).

**SEE ALSO**

[open\(2\)](#), [fopen\(3S\)](#), [stdio\(3S\)](#).

**ffs(3C)**

**ffs(3C)**

**NAME**

`ffs` - find first set bit

**SYNOPSIS**

```
#include <string.h>

int ffs(const int i);
```

**DESCRIPTION**

`ffs` finds the first bit set in the argument passed it and returns the index of that bit. Bits are numbered starting at 1 from the low order bit. A return value of zero indicates that the value passed is zero.

**NAME**

`fmtmsg` – display a message on `stderr` or system console

**SYNOPSIS**

```
#include <fmtmsg.h>

int fmtmsg(long classification, const char *label, int severity,
 const char *text, const char *action, const char *tag);
```

**DESCRIPTION**

Based on a message's classification component, `fmtmsg` writes a formatted message to `stderr`, to the console, or to both.

`fmtmsg` can be used instead of the traditional `printf` interface to display messages to `stderr`. `fmtmsg`, in conjunction with `gettext`, provides a simple interface for producing language-independent applications.

A formatted message consists of up to five standard components as defined below. The component, *classification*, is not part of the standard message displayed to the user, but rather defines the source of the message and directs the display of the formatted message.

*classification*

Contains identifiers from the following groups of major classifications and subclassifications. Any one identifier from a subclass may be used in combination by ORing the values together with a single identifier from a different subclass. Two or more identifiers from the same subclass should not be used together, with the exception of identifiers from the display subclass. (Both display subclass identifiers may be used so that messages can be displayed to both `stderr` and the system console).

“Major classifications” identify the source of the condition. Identifiers are: `MM_HARD` (hardware), `MM_SOFT` (software), and `MM_FIRM` (firmware).

“Message source subclassifications” identify the type of software in which the problem is spotted. Identifiers are: `MM_APPL` (application), `MM_UTIL` (utility), and `MM_OPSYS` (operating system).

“Display subclassifications” indicate where the message is to be displayed. Identifiers are: `MM_PRINT` to display the message on the standard error stream, `MM_CONSOLE` to display the message on the system console. Neither, either, or both identifiers may be used.

“Status subclassifications” indicate whether the application will recover from the condition. Identifiers are: `MM_RECOVER` (recoverable) and `MM_NRECOV` (non-recoverable).

An additional identifier, `MM_NULLMC`, indicates that no classification component is supplied for the message.

*label* Identifies the source of the message. The format of this component is two fields separated by a colon. The first field is up to 10 characters long; the second is up to 14 characters. Suggested usage is that *label* identifies the package in which the application resides as well as the program or application name. For example, the *label* `UX:cat` indicates the UNIX System V package and the `cat` application.

*severity*

Indicates the seriousness of the condition. Identifiers for the standard levels of *severity* are:

**MM\_HALT** indicates that the application has encountered a severe fault and is halting. Produces the print string **HALT**.

**MM\_ERROR** indicates that the application has detected a fault. Produces the print string **ERROR**.

**MM\_WARNING** indicates a condition out of the ordinary that might be a problem and should be watched. Produces the print string **WARNING**.

**MM\_INFO** provides information about a condition that is not in error. Produces the print string **INFO**.

**MM\_NOSEV** indicates that no severity level is supplied for the message.

Other severity levels may be added by using the **addseverity** routine.

*text* Describes the condition that produced the message. The *text* string is not limited to a specific size.

*action* Describes the first step to be taken in the error recovery process. **fmtmsg** precedes each action string with the prefix: **TO FIX:.** The *action* string is not limited to a specific size.

*tag* An identifier which references on-line documentation for the message. Suggested usage is that *tag* includes the *label* and a unique identifying number. A sample *tag* is **UX:cat:146**.

### Environment Variables

There are two environment variables that control the behavior of **fmtmsg**: **MSGVERB** and **SEV\_LEVEL**.

**MSGVERB** tells **fmtmsg** which message components it is to select when writing messages to **stderr**. The value of **MSGVERB** is a colon-separated list of optional keywords. **MSGVERB** can be set as follows:

```
MSGVERB=[keyword[:keyword[:...]]]
export MSGVERB
```

Valid *keywords* are: **label**, **severity**, **text**, **action**, and **tag**. If **MSGVERB** contains a keyword for a component and the component's value is not the component's null value, **fmtmsg** includes that component in the message when writing the message to **stderr**. If **MSGVERB** does not include a keyword for a message component, that component is not included in the display of the message. The keywords may appear in any order. If **MSGVERB** is not defined, if its value is the null-string, if its value is not of the correct format, or if it contains keywords other than the valid ones listed above, **fmtmsg** selects all components.

The first time **fmtmsg** is called, it examines the **MSGVERB** environment variable to see which message components it is to select when generating a message to write to the standard error stream, **stderr**. The values accepted on the initial call are saved for future calls.

**MSGVERB** affects only which components are selected for display to the standard error stream. All message components are included in console messages.

**SEV\_LEVEL** defines severity levels and associates print strings with them for use by **fmtmsg**. The standard severity levels shown below cannot be modified. Additional severity levels can also be defined, redefined, and removed using **addseverity** [see **addseverity(3C)**]. If the same severity level is defined by both **SEV\_LEVEL** and **addseverity**, the definition by **addseverity** is controlling.

```

0 (no severity is used)
1 HALT
2 ERROR
3 WARNING
4 INFO

```

**SEV\_LEVEL** can be set as follows:

```

SEV_LEVEL={description[:description[:...]]}
export SEV_LEVEL

```

*description* is a comma-separated list containing three fields:

```

description=severity_keyword, level, printstring

```

*severity\_keyword* is a character string that is used as the keyword on the **-s severity** option to the **fmtmsg** command. (This field is not used by the **fmtmsg** function.)

*level* is a character string that evaluates to a positive integer (other than 0, 1, 2, 3, or 4, which are reserved for the standard severity levels). If the keyword *severity\_keyword* is used, *level* is the severity value passed on to the **fmtmsg** function.

*printstring* is the character string used by **fmtmsg** in the standard message format whenever the severity value *level* is used.

If a *description* in the colon list is not a three-field comma list, or, if the second field of a comma list does not evaluate to a positive integer, that *description* in the colon list is ignored.

The first time **fmtmsg** is called, it examines the **SEV\_LEVEL** environment variable, if defined, to see whether the environment expands the levels of severity beyond the five standard levels and those defined using **addseverity**. The values accepted on the initial call are saved for future calls.

### Use in Applications

One or more message components may be systematically omitted from messages generated by an application by using the null value of the argument for that component.

The table below indicates the null values and identifiers for **fmtmsg** arguments.



| Argument        | Type  | Null-Value   | Identifier |
|-----------------|-------|--------------|------------|
| <i>label</i>    | char* | (char*) NULL | MM_NULLLBL |
| <i>severity</i> | int   | 0            | MM_NULLSEV |
| <i>class</i>    | long  | 0L           | MM_NULLMC  |
| <i>text</i>     | char* | (char*) NULL | MM_NULLTXT |
| <i>action</i>   | char* | (char*) NULL | MM_NULLACT |
| <i>tag</i>      | char* | (char*) NULL | MM_NULLTAG |

Another means of systematically omitting a component is by omitting the component keyword(s) when defining the MSGVERB environment variable (see the "Environment Variables" section).

### EXAMPLES

Example 1:

The following example of `fmtmsg`:

```
fmtmsg(MM_PRINT, "UX:cat", MM_ERROR, "invalid syntax", "refer
to manual", "UX:cat:001")
```

produces a complete message in the standard message format:

```
UX:cat: ERROR: invalid syntax
 TO FIX: refer to manual UX:cat:001
```

Example 2:

When the environment variable MSGVERB is set as follows:

```
MSGVERB=severity:text:action
```

and the Example 1 is used, `fmtmsg` produces:

```
ERROR: invalid syntax
 TO FIX: refer to manual
```

Example 3:

When the environment variable SEV\_LEVEL is set as follows:

```
SEV_LEVEL=note,5,NOTE
```

the following call to `fmtmsg`:

```
fmtmsg(MM_UTIL | MM_PRINT, "UX:cat", 5, "invalid syntax",
"refer to manual", "UX:cat:001")
```

produces:

```
UX:cat: NOTE: invalid syntax
 TO FIX: refer to manual UX:cat:001
```

### SEE ALSO

`addseverity(3C)`, `gettxt(3C)`, `printf(3S)`,  
`fmtmsg(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

The exit codes for `fmtmsg` are the following:

- MM\_OK**           The function succeeded.
- MM\_NOTOK**       The function failed completely.
- MM\_NCMMSG**      The function was unable to generate a message on the standard error stream, but otherwise succeeded.
- MM\_NOCON**       The function was unable to generate a console message, but otherwise succeeded.

## NAME

fopen, freopen, fdopen – open a stream

## SYNOPSIS

```
#include <stdio.h>
```

```
FILE *fopen (const char *filename, const char *type);
```

```
FILE *freopen (const char *filename, const char *type, FILE
 *stream);
```

```
FILE *fdopen (int fildes, const char *type);
```

## DESCRIPTION

*fopen* opens the file named by *filename* and associates a *stream* with it. *fopen* returns a pointer to the **FILE** structure associated with the *stream*.

*filename* points to a character string that contains the name of the file to be opened.

*type* is a character string beginning with one of the following sequences:

"r" or "rb" open for reading

"w" or "wb" truncate to zero length or create for writing

"a" or "ab" append; open for writing at end of file, or create for writing

"r+", "r+b" or "rb+"  
open for update (reading and writing)

"w+", "w+b" or "wb+"  
truncate or create for update

"a+", "a+b" or "ab+"  
append; open or create for update at end-of-file

The "b" is ignored in the above *types*. The "b" exists to distinguish binary files from text files. However, there is no distinction between these types of files on a UNIX system.

*freopen* substitutes the named file in place of the open *stream*. A flush is first attempted, and then the original *stream* is closed, regardless of whether the open ultimately succeeds. Failure to flush or close *stream* successfully is ignored. *freopen* returns a pointer to the **FILE** structure associated with *stream*.

*freopen* is typically used to attach the preopened *streams* associated with `stdin`, `stdout`, and `stderr` to other files. `stderr` is by default unbuffered, but the use of *freopen* will cause it to become buffered or line-buffered.

*fdopen* associates a *stream* with a file descriptor. File descriptors are obtained from `open`, `dup`, `creat`, or `pipe`, which open files but do not return pointers to a **FILE** structure *stream*. Streams are necessary input for almost all of the Section 3S library routines. The *type* of *stream* must agree with the mode of the open file. The file position indicator associated with *stream* is set to the position indicated by the file offset associated with *fildes*.

When a file is opened for update, both input and output may be done on the resulting *stream*. However, output may not be directly followed by input without an intervening `fflush`, `fseek`, `fsetpos`, or `rewind`, and input may not be directly followed by output without an intervening `fseek`, `fsetpos`, or `rewind`, or an input operation that encounters end-of-file.

When a file is opened for append (i.e., when *type* is "a", "ab", "a+", or "ab+"), it is impossible to overwrite information already in the file. `fseek` may be used to reposition the file pointer to any position in the file, but when output is written to the file, the current file pointer is disregarded. All output is written at the end of the file and causes the file pointer to be repositioned at the end of the output. If two separate processes open the same file for append, each process may write freely to the file without fear of destroying output being written by the other. The output from the two processes will be intermixed in the file in the order in which it is written.

When opened, a *stream* is fully buffered if and only if it can be determined not to refer to an interactive device. The error and end-of-file indicators are cleared for the *stream*.

**SEE ALSO**

`close(2)`, `creat(2)`, `dup(2)`, `open(2)`, `pipe(2)`, `write(2)`, `fclose(3S)`, `fseek(3S)`, `setbuf(3S)`, `stdio(3S)`.

**DIAGNOSTICS**

The functions `fopen` and `freopen` return a null pointer if *path* cannot be accessed, or if *type* is invalid, or if the file cannot be opened.

The function `fdopen` returns a null pointer if *fdes* is not an open file descriptor, or if *type* is invalid, or if the file cannot be opened.

The functions `fopen` or `fdopen` may fail and not set `errno` if there are no free `stdio` streams.

File descriptors used by `fdopen` must be less than 255.

**NAME**

fpgetround, fpsetround, fpgetmask, fpsetmask, fpgetsticky, fpsetsticky - IEEE floating-point environment control

**SYNOPSIS**

```
#include <ieeefp.h>
fp_rnd fpgetround (void);
fp_rnd fpsetround (fp_rnd rnd_dir);
fp_except fpgetmask (void);
fp_except fpsetmask (fp_except mask);
fp_except fpgetsticky (void);
fp_except fpsetsticky (fp_except sticky);
```

**DESCRIPTION**

There are five floating-point exceptions: divide-by-zero, overflow, underflow, imprecise (inexact) result, and invalid operation. When a floating-point exception occurs, the corresponding sticky bit is set (1), and if the mask bit is enabled (1), the trap takes place. These routines let the user change the behavior on occurrence of any of these exceptions, as well as change the rounding mode for floating-point operations.

```
FP_X_INV /* invalid operation exception */
FP_X_OFL /* overflow exception */
FP_X_UFL /* underflow exception */
FP_X_DZ /* divide-by-zero exception */
FP_X_IMP /* imprecise (loss of precision) */
FP_RN /* round to nearest representative number */
FP_RP /* round to plus infinity */
FP_RM /* round to minus infinity */
FP_RZ /* round to zero (truncate) */
```

fpgetround returns the current rounding mode.

fpsetround sets the rounding mode and returns the previous rounding mode.

fpgetmask returns the current exception masks.

fpsetmask sets the exception masks and returns the previous setting.

fpgetsticky returns the current exception sticky flags.

fpsetsticky sets (clears) the exception sticky flags and returns the previous setting.

The default environment is rounding mode set to nearest (FP\_RN) and all traps disabled.

Individual bits may be examined using the constants defined in ieeefp.h.

**SEE ALSO**

isnan(3C).

**NOTES**

**fpsetsticky** modifies all sticky flags. **fpsetmask** changes all mask bits. **fpset-mask** clears the sticky bit corresponding to any exception being enabled.

C requires truncation (round to zero) for floating point to integral conversions. The current rounding mode has no effect on these conversions.

One must clear the sticky bit to recover from the trap and to proceed. If the sticky bit is not cleared before the next trap occurs, a wrong exception type may be signaled.

**NAME**

fread, fwrite - binary input/output

**SYNOPSIS**

```
#include <stdio.h>

size_t fread (void *ptr, size_t size, size_t nitems, FILE *stream);
size_t fwrite (const void *ptr, size_t size, size_t nitems, FILE
 *stream);
```

**DESCRIPTION**

**fread** reads into an array pointed to by *ptr* up to *nitems* items of data from *stream*, where an item of data is a sequence of bytes (not necessarily terminated by a null byte) of length *size*. **fread** stops reading bytes if an end-of-file or error condition is encountered while reading *stream*, or if *nitems* items have been read. **fread** increments the data pointer in *stream* to point to the byte following the last byte read if there is one. **fread** does not change the contents of *stream*. **fread** returns the number of items read.

**fwrite** writes to the named output *stream* at most *nitems* items of data from the array pointed to by *ptr*, where an item of data is a sequence of bytes (not necessarily terminated by a null byte) of length *size*. **fwrite** stops writing when it has written *nitems* items of data or if an error condition is encountered on *stream*. **fwrite** does not change the contents of the array pointed to by *ptr*. **fwrite** increments the data-pointer in *stream* by the number of bytes written. **fwrite** returns the number of items written.

If *size* or *nitems* is zero, then **fread** and **fwrite** return a value of 0 and do not effect the state of *stream*.

The **ferror** or **feof** routines must be used to distinguish between an error condition and end-of-file condition.

**SEE ALSO**

**exit(2)**, **lseek(2)**, **read(2)**, **write(2)**, **abort(3C)**, **fclose(3S)**, **fopen(3S)**, **getc(3S)**, **gets(3S)**, **printf(3S)**, **putc(3S)**, **puts(3S)**, **scanf(3S)**, **stdio(3S)**.

**DIAGNOSTICS**

If an error occurs, the error indicator for *stream* is set.

**NAME**

`frexp`, `ldexp`, `logb`, `modf`, `modff`, `nextafter`, `scalb` – manipulate parts of floating-point numbers

**SYNOPSIS**

```
#include <math.h>

double frexp (double value, int *eptr);
double ldexp (double value, int exp);
double logb (double value);
double nextafter (double value1, double value2);
double scalb (double value, double exp);
double modf (double value, double *iptr);
float modff (float value, float *iptr);
```

**DESCRIPTION**

Every non-zero number can be written uniquely as  $x * 2^n$ , where the “mantissa” (fraction)  $x$  is in the range  $0.5 \leq |x| < 1.0$ , and the “exponent”  $n$  is an integer. `frexp` returns the mantissa of a double *value*, and stores the exponent indirectly in the location pointed to by *eptr*. If *value* is zero, both results returned by `frexp` are zero.

`ldexp` and `scalb` return the quantity  $value * 2^{exp}$ . The only difference between the two is that `scalb` of a signaling NaN will result in the invalid operation exception being raised.

`logb` returns the unbiased exponent of its floating-point argument as a double-precision floating-point value.

`modf` and `modff` (single-precision version) return the signed fractional part of *value* and store the integral part indirectly in the location pointed to by *iptr*.

`nextafter` returns the next representable double-precision floating-point value following *value1* in the direction of *value2*. Thus, if *value2* is less than *value1*, `nextafter` returns the largest representable floating-point number less than *value1*.

**SEE ALSO**

`cc(1)`, `intro(3M)`.

**DIAGNOSTICS**

If `ldexp` would cause overflow, `±HUGE` (defined in `math.h`) is returned (according to the sign of *value*), and `errno` is set to `ERANGE`. If `ldexp` would cause underflow, zero is returned and `errno` is set to `ERANGE`. If the input *value* to `ldexp` is NaN or infinity, that input is returned and `errno` is set to `EDOM`. The same error conditions apply to `scalb` except that a signaling NaN as input will result in the raising of the invalid operation exception.

`logb` of NaN returns that NaN, `logb` of infinity returns positive infinity, and `logb` of zero returns negative infinity and results in the raising of the divide by zero exception. In each of these conditions `errno` is set to `EDOM`.



## frexp(3C)

## frexp(3C)

If input *value1* to `nextafter` is positive or negative infinity, that input is returned and `errno` is set to `EDOM`. The overflow and inexact exceptions are signalled when input *value1* is finite, but `nextafter(value1, value2)` is not. The underflow and inexact exceptions are signalled when `nextafter(value1, value2)` lies strictly between  $\pm 2^{-1022}$ . In both cases `errno` is set to `ERANGE`.

When the program is compiled with the `cc` options `-Xc` or `-Xa`, `HUGE_VAL` is returned instead of `HUGE`.

**NAME**

**fseek**, **rewind**, **ftell** – reposition a file pointer in a stream

**SYNOPSIS**

```
#include <stdio.h>

int fseek (FILE *stream, long offset, int ptrname);
void rewind (FILE *stream);
long ftell (FILE *stream);
```

**DESCRIPTION**

**fseek** sets the position of the next input or output operation on the *stream* [see [intro\(3\)](#)]. The new position is at the signed distance *offset* bytes from the beginning, from the current position, or from the end of the file, according to a *ptrname* value of **SEEK\_SET**, **SEEK\_CUR**, or **SEEK\_END** (defined in `stdio.h`) as follows:

**SEEK\_SET** set position equal to *offset* bytes.

**SEEK\_CUR** set position to current location plus *offset*.

**SEEK\_END** set position to EOF plus *offset*.

**fseek** allows the file position indicator to be set beyond the end of the existing data in the file. If data is later written at this point, subsequent reads of data in the gap will return zero until data is actually written into the gap. **fseek**, by itself, does not extend the size of the file.

**rewind** (*stream*) is equivalent to:

```
(void) fseek (stream, 0L, SEEK_SET);
```

except that **rewind** also clears the error indicator on *stream*.

**fseek** and **rewind** clear the EOF indicator and undo any effects of **ungetc** on *stream*. After **fseek** or **rewind**, the next operation on a file opened for update may be either input or output.

If *stream* is writable and buffered data has not been written to the underlying file, **fseek** and **rewind** cause the unwritten data to be written to the file.

**ftell** returns the offset of the current byte relative to the beginning of the file associated with the named *stream*.

**SEE ALSO**

[lseek\(2\)](#), [write\(2\)](#), [fopen\(3S\)](#), [popen\(3S\)](#), [stdio\(3S\)](#), [ungetc\(3S\)](#).

**DIAGNOSTICS**

**fseek** returns **-1** for improper seeks, otherwise zero. An improper seek can be, for example, an **fseek** done on a file that has not been opened via **fopen**; in particular, **fseek** may not be used on a terminal or on a file opened via **popen**. After a stream is closed, no further operations are defined on that stream.

**NOTES**

Although on the UNIX system an offset returned by **ftell** is measured in bytes, and it is permissible to seek to positions relative to that offset, portability to non-UNIX systems requires that an offset be used by **fseek** directly. Arithmetic may not meaningfully be performed on such an offset, which is not necessarily measured in bytes.

**NAME**

**fsetpos**, **fgetpos** – reposition a file pointer in a stream

**SYNOPSIS**

```
#include <stdio.h>

int fsetpos (FILE *stream, const fpos_t *pos);
int fgetpos (FILE *stream, fpos_t *pos);
```

**DESCRIPTION**

**fsetpos** sets the position of the next input or output operation on the *stream* according to the value of the object pointed to by *pos*. The object pointed to by *pos* must be a value returned by an earlier call to **fgetpos** on the same stream.

**fsetpos** clears the end-of-file indicator for the stream and undoes any effects of the **ungetc** function on the same stream. After **fsetpos**, the next operation on a file opened for update may be either input or output.

**fgetpos** stores the current value of the file position indicator for *stream* in the object pointed to by *pos*. The value stored contains information usable by **fsetpos** for repositioning the stream to its position at the time of the call to **fgetpos**.

If successful, both **fsetpos** and **fgetpos** return zero. Otherwise, they both return nonzero.

**SEE ALSO**

**fseek(3S)**, **lseek(2)** **ungetc(3S)**.

## NAME

`ftw`, `nftw` - walk a file tree

## SYNOPSIS

```
#include <ftw.h>

int ftw (const char *path, int (*fn) (const char *, const struct
 stat *, int), int depth);

int nftw (const char *path, int (*fn) (const char *, const struct
 stat *, int, struct FTW*), int depth, int flags);
```

## DESCRIPTION

`ftw` recursively descends the directory hierarchy rooted in *path*. For each object in the hierarchy, `ftw` calls the user-defined function *fn*, passing it a pointer to a null-terminated character string containing the name of the object, a pointer to a `stat` structure (see `stat(2)`) containing information about the object, and an integer. Possible values of the integer, defined in the `ftw.h` header file, are:

**FTW\_F**        The object is a file.

**FTW\_D**        The object is a directory.

**FTW\_DNR**      The object is a directory that cannot be read. Descendants of the directory will not be processed.

**FTW\_NS**      `stat` failed on the object because of lack of appropriate permission or the object is a symbolic link that points to a non-existent file. The `stat` buffer passed to *fn* is undefined.

`ftw` visits a directory before visiting any of its descendants.

The tree traversal continues until the tree is exhausted, an invocation of *fn* returns a nonzero value, or some error is detected within `ftw` (such as an I/O error). If the tree is exhausted, `ftw` returns zero. If *fn* returns a nonzero value, `ftw` stops its tree traversal and returns whatever value was returned by *fn*. If `ftw` detects an error other than `EACCES`, it returns `-1`, and sets the error type in `errno`.

The function `nftw` is similar to `ftw` except that it takes an additional argument, *flags*. The *flags* field is used to specify:

**FTW\_PHYS**    Physical walk, does not follow symbolic links. Otherwise, `nftw` will follow links but will not walk down any path that crosses itself.

**FTW\_MOUNT**   The walk will not cross a mount point.

**FTW\_DEPTH**   All subdirectories will be visited before the directory itself.

**FTW\_CHDIR**   The walk will change to each directory before reading it.

The function `nftw` calls *fn* with four arguments at each file and directory. The first argument is the pathname of the object, the second is a pointer to the `stat` buffer, the third is an integer giving additional information, and the fourth is a `struct FTW` that contains the following members:

```
int base;
int level;
```

*base* is the offset into the pathname of the base name of the object. *level* indicates the depth relative to the rest of the walk, where the root level is zero.

The values of the third argument are as follows:

- FTW\_F**        The object is a file.
- FTW\_D**        The object is a directory.
- FTW\_DP**      The object is a directory and subdirectories have been visited.
- FTW\_SLN**     The object is a symbolic link that points to a non-existent file.
- FTW\_DNR**     The object is a directory that cannot be read. *fn* will not be called for any of its descendants.
- FTW\_NS**      *stat* failed on the object because of lack of appropriate permission. The *stat* buffer passed to *fn* is undefined. *stat* failure other than lack of appropriate permission (**EACCES**) is considered an error and *nftw* will return  $-1$ .

Both *ftw* and *nftw* use one file descriptor for each level in the tree. The *depth* argument limits the number of file descriptors so used. If *depth* is zero or negative, the effect is the same as if it were 1. *depth* must not be greater than the number of file descriptors currently available for use. *ftw* will run faster if *depth* is at least as large as the number of levels in the tree. When *ftw* and *nftw* return, they close any file descriptors they have opened; they do not close any file descriptors that may have been opened by *fn*.

#### SEE ALSO

*stat*(2), *malloc*(3C).

#### NOTES

Because *ftw* is recursive, it is possible for it to terminate with a memory fault when applied to very deep file structures.

*ftw* uses *malloc*(3C) to allocate dynamic storage during its operation. If *ftw* is forcibly terminated, such as by *longjmp* being executed by *fn* or an interrupt routine, *ftw* will not have a chance to free that storage, so it will remain permanently allocated. A safe way to handle interrupts is to store the fact that an interrupt has occurred, and arrange to have *fn* return a nonzero value at its next invocation.

**NAME**

getc, getchar, fgetc, getw – get character or word from a stream

**SYNOPSIS**

```
#include <stdio.h>
int getc (FILE *stream);
int getchar (void);
int fgetc (FILE *stream);
int getw (FILE *stream);
```

**DESCRIPTION**

getc returns the next character (i.e., byte) from the named input *stream* [see intro(3)] as an unsigned `char` converted to an `int`. It also moves the file pointer, if defined, ahead one character in *stream*. `getchar` is defined as `getc(stdin)`. `getc` and `getchar` are macros.

`fgetc` behaves like `getc`, but is a function rather than a macro. `fgetc` runs more slowly than `getc`, but it takes less space per invocation and its name can be passed as an argument to a function.

`getw` returns the next word (i.e., integer) from the named input *stream*. `getw` increments the associated file pointer, if defined, to point to the next word. The size of a word is the size of an integer and varies from machine to machine. `getw` assumes no special alignment in the file.

**SEE ALSO**

`fclose(3S)`, `ferror(3S)`, `fopen(3S)`, `fread(3S)`, `gets(3S)`, `putc(3S)`, `scanf(3S)`, `stdio(3S)`, `ungetc(3S)`.

**DIAGNOSTICS**

These functions return the constant `EOF` at end-of-file or upon an error and set the `EOF` or error indicator of *stream*, respectively. Because `EOF` is a valid integer, `ferror` should be used to detect `getw` errors.

**NOTES**

If the integer value returned by `getc`, `getchar`, or `fgetc` is stored into a character variable and then compared against the integer constant `EOF`, the comparison may never succeed, because sign-extension of a character on widening to integer is implementation dependent.

The macro version of `getc` evaluates a *stream* argument more than once and may treat side effects incorrectly. In particular, `getc(*f++)` does not work sensibly. Use `fgetc` instead.

Because of possible differences in word length and byte ordering, files written using `putw` are implementation dependent, and may not be read using `getw` on a different processor.

Functions exist for all the above-defined macros. To get the function form, the macro name must be undefined (e.g., `#undef getc`).

**NAME**

getcwd – get pathname of current working directory

**SYNOPSIS**

```
#include <unistd.h>

char *getcwd (char *buf, int size);
```

**DESCRIPTION**

getcwd returns a pointer to the current directory pathname. The value of *size* must be at least one greater than the length of the pathname to be returned.

If *buf* is not NULL, the pathname will be stored in the space pointed to by *buf*.

If *buf* is a NULL pointer, getcwd will obtain *size* bytes of space using malloc(3C). In this case, the pointer returned by getcwd may be used as the argument in a subsequent call to free.

getcwd will fail if one or more of the following are true:

- EACCES** A parent directory cannot be read to get its name.
- EINVAL** *size* is less than or equal to 0.
- ERANGE** *size* is greater than 0 and less than the length of the pathname plus 1.

**EXAMPLE**

Here is a program that prints the current working directory.

```
#include <unistd.h>
#include <stdio.h>

main()
{
 char *cwd;
 if ((cwd = getcwd(NULL, 64)) == NULL)
 {
 perror("pwd");
 exit(2);
 }
 (void)printf("%s\n", cwd);
 return(0);
}
```

**SEE ALSO**

malloc(3C).

**DIAGNOSTICS**

Returns NULL with *errno* set if *size* is not large enough, or if an error occurs in a lower-level function.

**NAME**

getdate – convert user format date and time

**SYNOPSIS**

```
#include <time.h>
struct tm *getdate (const char *string);
extern int getdate_err;
```

**DESCRIPTION**

getdate converts user-definable date and/or time specifications pointed to by *string* into a `tm` structure. The structure declaration is in the `time.h` header file [see also `ctime(3C)`].

User-supplied templates are used to parse and interpret the input string. The templates are text files created by the user and identified via the environment variable `DATETMSK`. Each line in the template represents an acceptable date and/or time specification using some of the same field descriptors as the ones used by the `date` command. The first line in the template that matches the input specification is used for interpretation and conversion into the internal time format. If successful, the function `getdate` returns a pointer to a `tm` structure; otherwise, it returns `NULL` and sets the global variable `getdate_err` to indicate the error.

The following field descriptors are supported:

```
%% same as %
%a abbreviated weekday name
%A full weekday name
%b abbreviated month name
%B full month name
%c locale's appropriate date and time representation
%d day of month (01-31; the leading 0 is optional)
%e same as %d
%D date as %m/%d/%y
%h abbreviated month name
%H hour (00-23)
%I hour (01-12)
%m month number (01-12)
%M minute (00-59)
%n same as \n
%p locale's equivalent of either AM or PM
%r time as %I:%M:%S %p
%R time as %H:%M
%S seconds (00-59)
%t insert a tab
%T time as %H:%M:%S
%w weekday number (0-6; Sunday = 0)
%x locale's appropriate date representation
```



%X locale's appropriate time representation  
 %y year with century (00-99)  
 %Y year as ccyymm (e.g., 1986)  
 %Z time zone name or no characters if no time zone exists

The month and weekday names can consist of any combination of upper and lower case letters. The user can request that the input date or time specification be in a specific language by setting the categories `LC_TIME` and `LC_CTYPE` of `setlocale`.

The following example shows the possible contents of a template:

```

%m
%A %B %d %Y, %H:%M:%S
%A
%B
%m/%d/%y %I %p
%d, %m, %Y %H:%M
at %A the %dst of %B in %Y
run job at %I %p, %B %dnd
%A den %d. %B %Y %H.%M Uhr

```

The following are examples of valid input specifications for the above template:

```

getdate("10/1/87 4 PM")
getdate("Friday")
getdate("Friday September 19 1987, 10:30:30")
getdate("24,9,1986 10:30")
getdate("at monday the 1st of december in 1986")
getdate("run job at 3 PM, december %2nd")

```

If the `LANG` environment variable is set to `german`, the following is valid:

```
getdate("freitag den 10. oktober 1986 10.30 Uhr")
```

Local time and date specification are also supported. The following examples show how local date and time specification can be defined in the template.

| Invocation                              | Line in Template         |
|-----------------------------------------|--------------------------|
| <code>getdate("11/27/86")</code>        | <code>%m/%d/%y</code>    |
| <code>getdate("27.11.86")</code>        | <code>%d.%m.%y</code>    |
| <code>getdate("86-11-27")</code>        | <code>%y-%m-%d</code>    |
| <code>getdate("Friday 12:00:00")</code> | <code>%A %H:%M:%S</code> |

The following rules are applied for converting the input specification into the internal format:

If only the weekday is given, today is assumed if the given day is equal to the current day and next week if it is less.

If only the month is given, the current month is assumed if the given month is equal to the current month and next year if it is less and no year is given. (The first day of month is assumed if no day is given.)

## getdate(3C)

## getdate(3C)

If no hour, minute, and second are given, the current hour, minute, and second are assumed.

If no date is given, today is assumed if the given hour is greater than the current hour and tomorrow is assumed if it is less.

The following examples illustrate the above rules. Assume that the current date is Mon Sep 22 12:19:47 EDT 1986 and the `LANG` environment variable is not set.

| Input        | Line in Template | Date                         |
|--------------|------------------|------------------------------|
| Mon          | %a               | Mon Sep 22 12:19:48 EDT 1986 |
| Sun          | %a               | Sun Sep 28 12:19:49 EDT 1986 |
| Fri          | %a               | Fri Sep 26 12:19:49 EDT 1986 |
| September    | %B               | Mon Sep 1 12:19:49 EDT 1986  |
| January      | %B               | Thu Jan 1 12:19:49 EST 1987  |
| December     | %B               | Mon Dec 1 12:19:49 EST 1986  |
| Sep Mon      | %b %a            | Mon Sep 1 12:19:50 EDT 1986  |
| Jan Fri      | %b %a            | Fri Jan 2 12:19:50 EST 1987  |
| Dec Mon      | %b %a            | Mon Dec 1 12:19:50 EST 1986  |
| Jan Wed 1989 | %b %a %Y         | Wed Jan 4 12:19:51 EST 1989  |
| Fri 9        | %a %H            | Fri Sep 26 09:00:00 EDT 1986 |
| Feb 10:30    | %b %H:%S         | Sun Feb 1 10:00:30 EST 1987  |
| 10:30        | %H:%M            | Tue Sep 23 10:30:00 EDT 1986 |
| 13:30        | %H:%M            | Mon Sep 22 13:30:00 EDT 1986 |

### FILES

`/usr/lib/locale/<locale>/LC_TIME` language specific printable files  
`/usr/lib/locale/<locale>/LC_CTYPE` code set specific printable files

### SEE ALSO

`setlocale(3C)`, `ctype(3C)`, `environ(5)`.

### DIAGNOSTICS

On failure `getdate` returns `NULL` and sets the variable `getdate_err` to indicate the error.

The following is a complete list of the `getdate_err` settings and their meanings.

- 1 The `DATETIME` environment variable is null or undefined.
- 2 The template file cannot be opened for reading.
- 3 Failed to get file status information.
- 4 The template file is not a regular file.
- 5 An error is encountered while reading the template file.
- 6 `malloc` failed (not enough memory is available).
- 7 There is no line in the template that matches the input.
- 8 The input specification is invalid (e.g., February 31).

**getdate(3C)**

**getdate(3C)**

**NOTES**

Subsequent calls to **getdate** alter the contents of **getdate\_err**.

Dates before 1970 and after 2037 are illegal.

**getdate** makes explicit use of macros described in **ctype(3C)**.

**NAME**

getenv - return value for environment name

**SYNOPSIS**

```
#include <stdlib.h>
char *getenv (const char *name);
```

**DESCRIPTION**

getenv searches the environment list [see environ(5)] for a string of the form *name=value* and, if the string is present, returns a pointer to the *value* in the current environment. Otherwise, it returns a null pointer.

**SEE ALSO**

exec(2), putenv(3C), environ(5).

**NAME**

getgrent, getgrgid, getgrnam, setgrent, endgrent, fgetgrent - get group file entry

**SYNOPSIS**

```
#include <grp.h>
struct group *getgrent (void);
struct group *getgrgid (gid_t gid);
struct group *getgrnam (const char *name);
void setgrent (void);
void endgrent (void);
struct group *fgetgrent (FILE *f);
```

**DESCRIPTION**

getgrent, getgrgid, and getgrnam each return pointers to an object containing the broken-out fields of a line in the `/etc/group` file. Each line contains a "group" structure, defined in the `grp.h` header file with the following members:

```
char *gr_name; /* the name of the group */
char *gr_passwd; /* the encrypted group password */
gid_t gr_gid; /* the numerical group ID */
char **gr_mem; /* vector of pointers to member names */
```

When first called, `getgrent` returns a pointer to the first group structure in the file; thereafter, it returns a pointer to the next group structure in the file; so, successive calls may be used to search the entire file. `getgrgid` searches from the beginning of the file until a numerical group id matching `gid` is found and returns a pointer to the particular structure in which it was found.

`getgrnam` searches from the beginning of the file until a group name matching `name` is found and returns a pointer to the particular structure in which it was found. If an end-of-file or an error is encountered on reading, these functions return a null pointer.

A call to `setgrent` has the effect of rewinding the group file to allow repeated searches. `endgrent` may be called to close the group file when processing is complete.

`fgetgrent` returns a pointer to the next group structure in the stream `f`, which matches the format of `/etc/group`.

**FILES**

`/etc/group`

**SEE ALSO**

`getlogin(3C)`, `getpwent(3C)`.  
`group(4)` in the *System Administrator's Reference Manual*.

**getgrent(3C)**

**getgrent(3C)**

**DIAGNOSTICS**

`getgrent`, `getgrgid`, `getgrnam`, and `fgetgrent` return a null pointer on EOF or error.

**NOTES**

All information is contained in a static area, so it must be copied if it is to be saved.

**NAME**

getitimer, setitimer – get/set value of interval timer

**SYNOPSIS**

```
#include <sys/time.h>

int getitimer(int which, struct itimerval *value);

int setitimer(int which, struct itimerval *value, struct itimerval
 *ovalue);
```

**DESCRIPTION**

The system provides each process with three interval timers, defined in `sys/time.h`. The `getitimer` call stores the current value of the timer specified by *which* into the structure pointed to by *value*. The `setitimer` call sets the value of the timer specified by *which* to the value specified in the structure pointed to by *value*, and if *ovalue* is not `NULL`, stores the previous value of the timer in the structure pointed to by *ovalue*.

A timer value is defined by the `itimerval` structure [see `gettimeofday(3C)` for the definition of `timeval`], which includes the following members:

```
struct timeval it_interval; /* timer interval */
struct timeval it_value; /* current value */
```

If `it_value` is non-zero, it indicates the time to the next timer expiration. If `it_interval` is non-zero, it specifies a value to be used in reloading `it_value` when the timer expires. Setting `it_value` to zero disables a timer, regardless of the value of `it_interval`. Setting `it_interval` to zero disables a timer after its next expiration (assuming `it_value` is non-zero).

Time values smaller than the resolution of the system clock are rounded up to this resolution.

The three timers are:

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>ITIMER_REAL</code>    | Decrements in real time. A <code>SIGALRM</code> signal is delivered when this timer expires.                                                                                                                                                                                                                                                                                                                                                                 |
| <code>ITIMER_VIRTUAL</code> | Decrements in process virtual time. It runs only when the process is executing. A <code>SIGVTALRM</code> signal is delivered when it expires.                                                                                                                                                                                                                                                                                                                |
| <code>ITIMER_PROF</code>    | Decrements both in process virtual time and when the system is running on behalf of the process. It is designed to be used by interpreters in statistically profiling the execution of interpreted programs. Each time the <code>ITIMER_PROF</code> timer expires, the <code>SIGPROF</code> signal is delivered. Because this signal may interrupt in-progress system calls, programs using this timer must be prepared to restart interrupted system calls. |

**SEE ALSO**

`alarm(2)`, `gettimeofday(3C)`.

**DIAGNOSTICS**

If the calls succeed, a value of 0 is returned. If an error occurs, the value -1 is returned, and an error code is placed in the global variable `errno`.

Under the following conditions, the functions `getitimer` and `setitimer` fail and set `errno` to:

**EINVAL** The specified number of seconds is greater than 100,000,000, the number of microseconds is greater than or equal to 1,000,000, or the *which* parameter is unrecognized.

**NOTES**

The microseconds field should not be equal to or greater than one second.

`setitimer` is independent of the `alarm` system call.

Do not use `setitimer` with the `sleep` routine. A `sleep` following a `setitimer` wipes out knowledge of the user signal handler.



**NAME**

getlogin - get login name

**SYNOPSIS**

```
#include <stdlib.h>
char *getlogin (void);
```

**DESCRIPTION**

getlogin returns a pointer to the login name as found in `/var/adm/utmp`. It may be used in conjunction with `getpwnam` to locate the correct password file entry when the same user id is shared by several login names.

If `getlogin` is called within a process that is not attached to a terminal, it returns a null pointer. The correct procedure for determining the login name is to call `cuserid`, or to call `getlogin` and if it fails to call `getpwuid`.

**FILES**

`/var/adm/utmp`

**SEE ALSO**

`cuserid(3S)`, `getgrent(3C)`, `getpwent(3C)`, `utmp(4)`.

**DIAGNOSTICS**

Returns a null pointer if the login name is not found.

**NOTES**

The return values point to static data whose content is overwritten by each call.

**NAME**

getmntent, getmntany – get mnttab file entry

**SYNOPSIS**

```
#include <stdio.h>
#include <sys/mnttab.h>

int getmntent (FILE *fp, struct mnttab *mp);

int getmntany (FILE *fp, struct mnttab *mp, struct mnttab *mpref);
```

**DESCRIPTION**

getmntent and getmntany each fill in the structure pointed to by *mp* with the broken-out fields of a line in the */etc/mnttab* file. Each line in the file contains a *mnttab* structure, declared in the *sys/mnttab.h* header file:

```
struct mnttab {
 char *mnt_special;
 char *mnt_mountp;
 char *mnt_fstype;
 char *mnt_mntopts;
 char *mnt_time;
};
```

The fields have meanings described in *mnttab(4)*.

*getmntent* returns a pointer to the next *mnttab* structure in the file; so successive calls can be used to search the entire file. *getmntany* searches the file referenced by *fp* until a match is found between a line in the file and *mpref*. *mpref* matches the line if all non-null entries in *mpref* match the corresponding fields in the file. Note that these routines do not open, close, or rewind the file.

**FILES**

*/etc/mnttab*

**SEE ALSO**

*mnttab(4)*.

**DIAGNOSTICS**

If the next entry is successfully read by *getmntent* or a match is found with *getmntany*, 0 is returned. If an end-of-file is encountered on reading, these functions return -1. If an error is encountered, a value greater than 0 is returned. The possible error values are:

|                    |                                                                               |
|--------------------|-------------------------------------------------------------------------------|
| <b>MNT_TOOLONG</b> | A line in the file exceeded the internal buffer size of <b>MNT_LINE_MAX</b> . |
| <b>MNT_TOOMANY</b> | A line in the file contains too many fields.                                  |
| <b>MNT_TOOFEW</b>  | A line in the file contains too few fields.                                   |

**NOTES**

The members of the *mnttab* structure point to information contained in a static area, so it must be copied if it is to be saved.

**NAME**

`getopt` – get option letter from argument vector

**SYNOPSIS**

```
#include <stdlib.h>

int getopt (int argc, char * const *argv, const char *optstring);
extern char *optarg;
extern int optind, opterr, optopt;
```

**DESCRIPTION**

`getopt` returns the next option letter in *argv* that matches a letter in *optstring*. It supports all the rules of the command syntax standard [see `intro(1)`]. Since all new commands are intended to adhere to the command syntax standard, they should use `getopts(1)`, `getopt(3C)`, or `getsubopts(3C)` to parse positional parameters and check for options that are legal for that command.

*optstring* must contain the option letters the command using `getopt` will recognize; if a letter is followed by a colon, the option is expected to have an argument, or group of arguments, which may be separated from it by white space. *optarg* is set to point to the start of the option argument on return from `getopt`.

`getopt` places in *optind* the *argv* index of the next argument to be processed. *optind* is external and is initialized to 1 before the first call to `getopt`. When all options have been processed (i.e., up to the first non-option argument), `getopt` returns EOF. The special option "--" (two hyphens) may be used to delimit the end of the options; when it is encountered, EOF is returned and "--" is skipped. This is useful in delimiting non-option arguments that begin with "-" (hyphen).

**EXAMPLE**

The following code fragment shows how one might process the arguments for a command that can take the mutually exclusive options a and b, and the option o, which requires an argument:

```
#include <stdlib.h>
#include <stdio.h>

main (int argc, char **argv)
{
 int c;
 extern char *optarg;
 extern int optind;
 int aflag = 0;
 int bflag = 0;
 int errflag = 0;
 char *ofile = NULL;

 while ((c = getopt(argc, argv, "abo:")) != EOF)
 switch (c) {
 case 'a':
 if (bflag)
 errflag++;
```

```

 else
 aflag++;
 break;
 case 'b':
 if (aflag)
 errflag++;
 else
 bflag++;
 break;
 case 'o':
 ofile = optarg;
 (void)printf("ofile = %s\n", ofile);
 break;
 case '?':
 errflag++;
 }
 if (errflag) {
 (void)fprintf(stderr,
 "usage: cmd [-a|-b] [-o<file>] files...\n");
 exit (2);
 }
 for (; optind < argc; optind++)
 (void)printf("%s\n", argv[optind]);
 return 0;
}

```

**SEE ALSO**

getsubopt(3C).  
 getopt(1), intro(1) in the *User's Reference Manual*.

**DIAGNOSTICS**

getopt prints an error message on the standard error and returns a "?" (question mark) when it encounters an option letter not included in *optstring* or no argument after an option that expects one. This error message may be disabled by setting *opterr* to 0. The value of the character that caused the error is in *optopt*.

**NOTES**

The library routine `getopt` does not fully check for mandatory arguments. That is, given an option string *a:b* and the input `-a -b`, `getopt` assumes that `-b` is the mandatory argument to the option `-a` and not that `-a` is missing a mandatory argument.

It is a violation of the command syntax standard [see *intro(1)*] for options with arguments to be grouped with other options, as in `cmd -aoxxx file`, where *a* and *b* are options, *o* is an option that requires an argument, and *xxx* is the argument to *o*. Although this syntax is permitted in the current implementation, it should not be used because it may not be supported in future releases. The correct syntax is `cmd -ab -oxxx file`.

**NAME**

`getpass` - read a password

**SYNOPSIS**

```
#include <stdlib.h>

char *getpass (const char *prompt);
```

**DESCRIPTION**

`getpass` reads up to a newline or EOF from the file `/dev/tty`, after prompting on the standard error output with the null-terminated string *prompt* and disabling echoing. A pointer is returned to a null-terminated string of at most 8 characters. If `/dev/tty` cannot be opened, a null pointer is returned. An interrupt will terminate input and send an interrupt signal to the calling program before returning.

**FILES**

`/dev/tty`

**NOTE**

The return value points to static data whose content is overwritten by each call.

**NAME**

getpw – get name from UID

**SYNOPSIS**

```
#include <stdlib.h>

int getpw (uid_t uid, char *buf);
```

**DESCRIPTION**

getpw searches the password file for a user id number that equals *uid*, copies the line of the password file in which *uid* was found into the array pointed to by *buf*, and returns 0. getpw returns non-zero if *uid* cannot be found.

This routine is included only for compatibility with prior systems and should not be used; see getpwent(3C) for routines to use instead.

**FILES**

/etc/passwd

**SEE ALSO**

getpwent(3C).  
passwd(4) in the *System Administrator's Reference Manual*.

**DIAGNOSTICS**

getpw returns non-zero on error.

## NAME

getpwent, getpwuid, getpwnam, setpwent, endpwent, fgetpwent - manipulate password file entry

## SYNOPSIS

```
#include <pwd.h>

struct passwd *getpwent (void);
struct passwd *getpwuid (uid_t uid);
struct passwd *getpwnam (const char *name);
void setpwent (void);
void endpwent (void);
struct passwd *fgetpwent (FILE *f);
```

## DESCRIPTION

getpwent, getpwuid, and getpwnam each returns a pointer to an object with the following structure containing the broken-out fields of a line in the `/etc/passwd` file. Each line in the file contains a `passwd` structure, declared in the `pwd.h` header file:

```
struct passwd {
 char *pw_name;
 char *pw_passwd;
 uid_t pw_uid;
 gid_t pw_gid;
 char *pw_age;
 char *pw_comment;
 char *pw_gecos;
 char *pw_dir;
 char *pw_shell;
};
```

getpwent when first called returns a pointer to the first `passwd` structure in the file; thereafter, it returns a pointer to the next `passwd` structure in the file; so successive calls can be used to search the entire file. getpwuid searches from the beginning of the file until a numerical user id matching `uid` is found and returns a pointer to the particular structure in which it was found. getpwnam searches from the beginning of the file until a login name matching `name` is found, and returns a pointer to the particular structure in which it was found. If an end-of-file or an error is encountered on reading, these functions return a null pointer.

A call to `setpwent` has the effect of rewinding the password file to allow repeated searches. `endpwent` may be called to close the password file when processing is complete.

fgetpwent returns a pointer to the next `passwd` structure in the stream `f`, which matches the format of `/etc/passwd`.

## FILES

`/etc/passwd`

**getpwent(3C)**

**getpwent(3C)**

**SEE ALSO**

getlogin(3C), getgrent(3C),  
passwd(4) in the *System Administrator's Reference Manual*.

**DIAGNOSTICS**

getpwent, getpwnid, getpwnam, and fgetpwent return a null pointer on EOF or error.

**NOTES**

All information is contained in a static area, so it must be copied if it is to be saved.



**NAME**

**gets, fgets** – get a string from a stream

**SYNOPSIS**

```
#include <stdio.h>
char *gets (char *s);
char *fgets (char *s, int n, FILE *stream);
```

**DESCRIPTION**

**gets** reads characters from the standard input stream [see [intro\(3\)](#)], **stdin**, into the array pointed to by *s*, until a newline character is read or an end-of-file condition is encountered. The newline character is discarded and the string is terminated with a null character.

**fgets** reads characters from the *stream* into the array pointed to by *s*, until *n*-1 characters are read, or a newline character is read and transferred to *s*, or an end-of-file condition is encountered. The string is then terminated with a null character.

When using **gets**, if the length of an input line exceeds the size of *s*, indeterminate behavior may result. For this reason, it is strongly recommended that **gets** be avoided in favor of **fgets**.

**SEE ALSO**

[lseek\(2\)](#), [read\(2\)](#), [ferror\(3S\)](#), [fopen\(3S\)](#), [fread\(3S\)](#), [getc\(3S\)](#), [scanf\(3S\)](#), [stdio\(3S\)](#), [ungetc\(3S\)](#).

**DIAGNOSTICS**

If end-of-file is encountered and no characters have been read, no characters are transferred to *s* and a null pointer is returned. If a read error occurs, such as trying to use these functions on a file that has not been opened for reading, a null pointer is returned and the error indicator for the stream is set. If end-of-file is encountered, the **EOF** indicator for the stream is set. Otherwise *s* is returned.

**NAME**

getspent, getsppnam, setspent, endspent, fgetspent, lckpwwdf, ulckpwwdf -  
manipulate shadow password file entry

**SYNOPSIS**

```
#include <shadow.h>

struct spwd *getspent (void);
struct spwd *getsppnam (const char *name);
int lckpwwdf (void);
int ulckpwwdf (void);
void setspent (void);
void endspent (void);
struct spwd *fgetspent (FILE *fp);
```

**DESCRIPTION**

The `getspent` and `getsppnam` routines each return a pointer to an object with the following structure containing the broken-out fields of a line in the `/etc/shadow` file. Each line in the file contains a "shadow password" structure, declared in the `shadow.h` header file:

```
struct spwd{
 char *sp_namp;
 char *sp_pwwdp;
 long sp_lstchg;
 long sp_min;
 long sp_max;
 long sp_warn;
 long sp_inact;
 long sp_expire;
 unsigned long sp_flag;
};
```

The `getspent` routine when first called returns a pointer to the first `spwd` structure in the file; thereafter, it returns a pointer to the next `spwd` structure in the file; so successive calls can be used to search the entire file. The `getsppnam` routine searches from the beginning of the file until a login name matching `name` is found, and returns a pointer to the particular structure in which it was found. The `getspent` and `getsppnam` routines populate the `sp_min`, `sp_max`, `sp_lstchg`, `sp_warn`, `sp_inact`, `sp_expire`, or `sp_flag` field with `-1` if the corresponding field in `/etc/shadow` is empty. If an end-of-file or an error is encountered on reading, or there is a format error in the file, these functions return a null pointer and set `errno` to `EINVAL`.

`/etc/.pww.lock` is the lock file. It is used to coordinate modification access to the password files `/etc/passwd` and `/etc/shadow`. `lckpwwdf` and `ulckpwwdf` are routines that are used to gain modification access to the password files, through the lock file. A process first uses `lckpwwdf` to lock the lock file, thereby gaining exclusive rights to modify the `/etc/passwd` or `/etc/shadow` password file. Upon completing modifications, a process should release the lock on the lock file

## getspent(3C)

## getspent(3C)

via `ulckpwn`. This mechanism prevents simultaneous modification of the password files.

`lckpwn` attempts to lock the file `/etc/.pwd.lock` within 15 seconds. If unsuccessful, e.g., `/etc/.pwd.lock` is already locked, it returns `-1`. If successful, a return code other than `-1` is returned.

`ulckpwn` attempts to unlock the file `/etc/.pwd.lock`. If unsuccessful, e.g., `/etc/.pwd.lock` is already unlocked, it returns `-1`. If successful, it returns `0`.

A call to the `setspent` routine has the effect of rewinding the shadow password file to allow repeated searches. The `endspent` routine may be called to close the shadow password file when processing is complete.

The `fgetspent` routine returns a pointer to the next `spwd` structure in the stream `fp`, which matches the format of `/etc/shadow`.

### FILES

`/etc/shadow`  
`/etc/passwd`  
`/etc/.pwd.lock`

### SEE ALSO

`getpwn(3C)`, `putpwn(3C)`, `putspent(3C)`.

### DIAGNOSTICS

`getspent`, `getspnam`, `lckpwn`, `ulckpwn`, and `fgetspent` return a null pointer on EOF or error.

### NOTES

This routine is for internal use only; compatibility is not guaranteed.

All information is contained in a static area, so it must be copied if it is to be saved.

**NAME**

getsubopt – parse suboptions from a string

**SYNOPSIS**

```
#include <stdlib.h>
```

```
int getsubopt (char **optionp, char * const *tokens, char **valuep);
```

**DESCRIPTION**

getsubopt parses suboptions in a flag argument that was initially parsed by getopt. These suboptions are separated by commas and may consist of either a single token or a token-value pair separated by an equal sign. Since commas delimit suboptions in the option string, they are not allowed to be part of the suboption or the value of a suboption. A command that uses this syntax is mount(1M), which allows the user to specify mount parameters with the -o option as follows:

```
mount -o rw,hard,bg,wsiz=1024 speed:/usr /usr
```

In this example there are four suboptions: *rw*, *hard*, *bg*, and *wsiz*, the last of which has an associated value of 1024.

getsubopt takes the address of a pointer to the option string, a vector of possible tokens, and the address of a value string pointer. It returns the index of the token that matched the suboption in the input string or -1 if there was no match. If the option string at *optionp* contains only one suboption, getsubopt updates *optionp* to point to the null character at the end of the string; otherwise it isolates the suboption by replacing the comma separator with a null character, and updates *optionp* to point to the start of the next suboption. If the suboption has an associated value, getsubopt updates *valuep* to point to the value's first character. Otherwise it sets *valuep* to NULL.

The token vector is organized as a series of pointers to null strings. The end of the token vector is identified by a null pointer.

When getsubopt returns, if *valuep* is not NULL, then the suboption processed included a value. The calling program may use this information to determine if the presence or lack of a value for this suboption is an error.

Additionally, when getsubopt fails to match the suboption with the tokens in the *tokens* array, the calling program should decide if this is an error, or if the unrecognized option should be passed to another program.

**EXAMPLE**

The following code fragment shows how to process options to the mount command using getsubopt.

```
#include <stdlib.h>

char *myopts[] = {
#define READONLY 0
 "ro",
#define READWRITE 1
 "rw",
```

```

#define WRITESIZE 2
 "wsize",
#define READSIZE 3
 "rsize",
 NULL);

main(argc, argv)
 int argc;
 char **argv;
{
 int sc, c, errflag;
 char *options, *value;
 extern char *optarg;
 extern int optind;
 .
 .
 .
 while((c = getopt(argc, argv, "abf:o:")) != -1) {
 switch (c) {
 case 'a': /* process a option */
 break;
 case 'b': /* process b option */
 break;
 case 'f':
 ofile = optarg;
 break;
 case '?':
 errflag++;
 break;
 case 'o':
 options = optarg;
 while (*options != '\0') {
 switch(getsubopt(&options, myopts, &value) {
 case READONLY : /* process ro option */
 break;
 case READWRITE : /* process rw option */
 break;
 case WRITESIZE : /* process wsize option */
 if (value == NULL) {
 error_no_arg();
 errflag++;
 } else
 write_size = atoi(value);
 break;
 case READSIZE : /* process rsize option */
 if (value == NULL) {
 error_no_arg();
 errflag++;
 } else

```

```

 read_size = atoi(value);
 break;
 default :
 /* process unknown token */
 error_bad_token(value);
 errflag++;
 break;
 }
}
break;
}
}
if (errflag) {
 /* print usage instructions etc. */
}
for (; optind < argc; optind++) {
 /* process remaining arguments */
}
.
.
.
}

```

**SEE ALSO**

getopt(3C).

**DIAGNOSTICS**

getsubopt returns -1 when the token it is scanning is not in the token vector. The variable addressed by *valuep* contains a pointer to the first character of the token that was not recognized rather than a pointer to a value for that token.

The variable addressed by *optionp* points to the next option to be parsed, or a null character if there are no more options.

**NOTES**

During parsing, commas in the option input string are changed to null characters. White space in tokens or token-value pairs must be protected from the shell by quotes.

**NAME**

`gettimeofday`, `settimeofday` – get or set the date and time

**SYNOPSIS**

```
#include <sys/time.h>

int gettimeofday (struct timeval *tp);
int settimeofday (struct timeval *tp);
```

**DESCRIPTION**

`gettimeofday` gets and `settimeofday` sets the system's notion of the current time. The current time is expressed in elapsed seconds and microseconds since 00:00 Universal Coordinated Time, January 1, 1970. The resolution of the system clock is hardware dependent; the time may be updated continuously or in clock ticks.

*tp* points to a `timeval` structure, which includes the following members:

```
 long tv_sec; /* seconds since Jan. 1, 1970 */
 long tv_usec; /* and microseconds */
```

If *tp* is a null pointer, the current time information is not returned or set.

The `TZ` environment variable holds time zone information. See `timezone(4)`.

Only the privileged user may set the time of day.

**SEE ALSO**

`adjtime(2)`, `ctime(3C)`, `timezone(4)`.

**DIAGNOSTICS**

A `-1` return value indicates that an error occurred and `errno` has been set. The following error codes may be set in `errno`:

|               |                                                                               |
|---------------|-------------------------------------------------------------------------------|
| <b>EINVAL</b> | <i>tp</i> specifies an invalid time.                                          |
| <b>EPERM</b>  | A user other than the privileged user attempted to set the time or time zone. |

**NOTES**

The implementation of `settimeofday` ignores the `tv_usec` field of *tp*. If the time needs to be set with better than one second accuracy, call `settimeofday` for the seconds and then `adjtime` for finer accuracy.

**NAME**

gettxt – retrieve a text string

**SYNOPSIS**

```
#include <unistd.h>
```

```
char *gettxt (const char *msgid, const char *dflt_str);
```

**DESCRIPTION**

gettxt retrieves a text string from a message file. The arguments to the function are a message identification *msgid* and a default string *dflt\_str* to be used if the retrieval fails.

The text strings are in files created by the `mksmsg` utility [see `mksmsg(1)`] and installed in directories in `/usr/lib/locale/<locale>/LC_MESSAGES`.

The directory `<locale>` can be viewed as the language in which the text strings are written. The user can request that messages be displayed in a specific language by setting the environment variable `LC_MESSAGES`. If `LC_MESSAGES` is not set, the environment variable `LANG` will be used. If `LANG` is not set, the files containing the strings are in `/usr/lib/locale/C/LC_MESSAGES/*`.

The user can also change the language in which the messages are displayed by invoking the `setlocale` function with the appropriate arguments.

If `gettxt` fails to retrieve a message in a specific language it will try to retrieve the same message in U.S. English. On failure, the processing depends on what the second argument *dflt\_str* points to. A pointer to the second argument is returned if the second argument is not the null string. If *dflt\_str* points to the null string, a pointer to the U.S. English text string "Message not found!!\n" is returned.

The following depicts the acceptable syntax of *msgid* for a call to `gettxt`.

```
<msgid> = <msgfilename>:<msgnumber>
```

The first field is used to indicate the file that contains the text strings and must be limited to 14 characters. These characters must be selected from the set of all character values excluding `\0` (null) and the ASCII code for `/` (slash) and `:` (colon). The names of message files must be the same as the names of files created by `mksmsg` and installed in `/usr/lib/locale/<locale>/LC_MESSAGES/*`. The numeric field indicates the sequence number of the string in the file. The strings are numbered from 1 to *n* where *n* is the number of strings in the file.

On failure to pass the correct *msgid* or a valid message number to `gettxt` a pointer to the text string "Message not found!!\n" is returned.

**EXAMPLE**

```
gettxt ("UX:10", "hello world\n")
gettxt ("UX:10", "")
```

UX is the name of the file that contains the messages. 10 is the message number.

**FILES**

```
/usr/lib/locale/C/LC_MESSAGES/* contains default message files created by
mksmsg
```



**gettext(3C)**

**gettext(3C)**

`/usr/lib/locale/locale/LC_MESSAGES/*` contains message files for different languages created by `mkmsgs`

**SEE ALSO**

`fmtmsg(3C)`, `setlocale(3C)`, `environ(5)`,  
`exstr(1)`, `mkmsgs(1)`, `srchtxt(1)` in the *User's Reference Manual*.

**NAME**

getut: getutent, getutid, getutline, pututline, setutent, endutent, utmpname - access utmp file entry

**SYNOPSIS**

```
#include <utmp.h>

struct utmp *getutent (void);
struct utmp *getutid (const struct utmp *id);
struct utmp *getutline (const struct utmp *line);
struct utmp *pututline (const struct utmp *utmp);
void setutent (void);
void endutent (void);
int utmpname (const char *file);
```

**DESCRIPTION**

getutent, getutid, getutline, and pututline each return a pointer to a structure with the following members:

```
char ut_user[8]; /* user login name */
char ut_id[4]; /* /sbin/inittab id (usually line #) */
char ut_line[12]; /* device name (console, lxxx) */
short ut_pid; /* process id */
short ut_type; /* type of entry */
struct exit_status {
} ut_exit; /* exit status of a process */
/* marked as DEAD_PROCESS */
time_t ut_time; /* time entry was made */
```

The structure exit status includes the following members:

```
short e_termination; /* termination status */
short e_exit; /* exit status */
```

getutent reads in the next entry from a utmp-like file. If the file is not already open, it opens it. If it reaches the end of the file, it fails.

getutid searches forward from the current point in the utmp file until it finds an entry with a *ut\_type* matching *id->ut\_type* if the type specified is *RUN\_LVL*, *BOOT\_TIME*, *OLD\_TIME*, or *NEW\_TIME*. If the type specified in *id* is *INIT\_PROCESS*, *LOGIN\_PROCESS*, *USER\_PROCESS*, or *DEAD\_PROCESS*, then *getutid* will return a pointer to the first entry whose type is one of these four and whose *ut\_id* field matches *id->ut\_id*. If the end of file is reached without a match, it fails.

getutline searches forward from the current point in the utmp file until it finds an entry of the type *LOGIN\_PROCESS* or *USER\_PROCESS* that also has a *ut\_line* string matching the *line->ut\_line* string. If the end of file is reached without a match, it fails.

pututline writes out the supplied utmp structure into the utmp file. It uses getutid to search forward for the proper place if it finds that it is not already at the proper place. It is expected that normally the user of pututline will have searched for the proper entry using one of the getut routines. If so, pututline will not search. If pututline does not find a matching slot for the new entry, it will add a new entry to the end of the file. It returns a pointer to the utmp structure.

setutent resets the input stream to the beginning of the file. This reset should be done before each search for a new entry if it is desired that the entire file be examined.

endutent closes the currently open file.

utmpname allows the user to change the name of the file examined, from /var/adm/utmp to any other file. It is most often expected that this other file will be /var/adm/wtmp. If the file does not exist, this will not be apparent until the first attempt to reference the file is made. utmpname does not open the file. It just closes the old file if it is currently open and saves the new file name. If the file name given is longer than 79 characters, utmpname returns 0. Otherwise, it will return 1.

#### FILES

/var/adm/utmp  
/var/adm/wtmp

#### SEE ALSO

ttyslot(3C), utmp(4).

#### DIAGNOSTICS

A null pointer is returned upon failure to read, whether for permissions or having reached the end of file, or upon failure to write.

#### NOTES

The most current entry is saved in a static structure. Multiple accesses require that it be copied before further accesses are made. On each call to either getutid or getutline, the routine examines the static structure before performing more I/O. If the contents of the static structure match what it is searching for, it looks no further. For this reason, to use getutline to search for multiple occurrences, it would be necessary to zero out the static area after each success, or getutline would just return the same structure over and over again. There is one exception to the rule about emptying the structure before further reads are done. The implicit read done by pututline (if it finds that it is not already at the correct place in the file) will not hurt the contents of the static structure returned by the getutent, getutid or getutline routines, if the user has just modified those contents and passed the pointer back to pututline.

These routines use buffered standard I/O for input, but pututline uses an unbuffered non-standard write to avoid race conditions between processes trying to modify the utmp and wtmp files.

## NAME

getutx: getutxent, getutxid, getutxline, pututxline, setutxent, endutxent, utmpxname, getutmp, getutmpx, updwtmp, updwtmpx - access utmpx file entry

## SYNOPSIS

```
#include <utmpx.h>

struct utmpx *getutxent (void);
struct utmpx *getutxid (const struct utmpx *id);
struct utmpx *getutxline (const struct utmpx *line);
struct utmpx *pututxline (const struct utmpx *utmpx);
void setutxent (void);
void endutxent (void);
int utmpxname (const char *file);
void getutmp (struct utmpx *utmpx, struct utmp *utmp);
void getutmpx (struct utmp *utmp, struct utmpx *utmpx);
void updwtmp (char *wfile, struct utmp *utmp);
void updwtmpx (char *wfilex, struct utmpx *utmpx);
```

## DESCRIPTION

getutxent, getutxid, and getutxline each return a pointer to a structure of the following type:

```
struct utmpx {
 char ut_user[32]; /* user login name */
 char ut_id[4]; /* /sbin/inittab id (usually */
 /* line #) */
 char ut_line[32]; /* device name (console, lnxx) */
 pid_t ut_pid; /* process id */
 short ut_type; /* type of entry */
 struct exit_status {
 short e_termination; /* termination status */
 short e_exit; /* exit status */
 } ut_exit; /* exit status of a process
 /* marked as DEAD_PROCESS */
 struct timeval ut_tv; /* time entry was made */
 short ut_syslen; /* significant length of ut host */
 /* including terminating null */
 char ut_host[257]; /* host name, if remote */
};
```

getutxent reads in the next entry from a utmpx-like file. If the file is not already open, it opens it. If it reaches the end of the file, it fails.

getutxid searches forward from the current point in the utmpx file until it finds an entry with a ut\_type matching id->ut\_type if the type specified is RUN\_LVL, BOOT\_TIME, OLD\_TIME, or NEW\_TIME. If the type specified in id is INIT\_PROCESS, LOGIN\_PROCESS, USER\_PROCESS, or DEAD\_PROCESS, then

`getutxid` will return a pointer to the first entry whose type is one of these four and whose `ut_id` field matches `id->ut_id`. If the end of file is reached without a match, it fails.

`getutxline` searches forward from the current point in the `utmpx` file until it finds an entry of the type `LOGIN_PROCESS` or `USER_PROCESS` which also has a `ut_line` string matching the `line->ut_line` string. If the end of file is reached without a match, it fails.

`pututxline` writes out the supplied `utmpx` structure into the `utmpx` file. It uses `getutxid` to search forward for the proper place if it finds that it is not already at the proper place. It is expected that normally the user of `pututxline` will have searched for the proper entry using one of the `getutx` routines. If so, `pututxline` will not search. If `pututxline` does not find a matching slot for the new entry, it will add a new entry to the end of the file. It returns a pointer to the `utmpx` structure.

`setutxent` resets the input stream to the beginning of the file. This should be done before each search for a new entry if it is desired that the entire file be examined.

`endutxent` closes the currently open file.

`utmpxname` allows the user to change the name of the file examined, from `/var/adm/utmpx` to any other file. It is most often expected that this other file will be `/var/adm/wtmpx`. If the file does not exist, this will not be apparent until the first attempt to reference the file is made. `utmpxname` does not open the file. It just closes the old file if it is currently open and saves the new file name. The new file name must end with the "x" character to allow the name of the corresponding `utmp` file to be easily obtainable (otherwise an error code of 1 is returned).

`getutmp` copies the information stored in the fields of the `utmpx` structure to the corresponding fields of the `utmp` structure. If the information in any field of `utmpx` does not fit in the corresponding `utmp` field, the data is truncated.

`getutmpx` copies the information stored in the fields of the `utmp` structure to the corresponding fields of the `utmpx` structure.

`updwtmp` checks the existence of `wfile` and its parallel file, whose name is obtained by appending an "x" to `wfile`. If only one of them exists, the second one is created and initialized to reflect the state of the existing file. `utmp` is written to `wfile` and the corresponding `utmpx` structure is written to the parallel file.

`updwtmpx` checks the existence of `wfilex` and its parallel file, whose name is obtained by truncating the final "x" from `wfilex`. If only one of them exists, the second one is created and initialized to reflect the state of the existing file. `utmpx` is written to `wfilex`, and the corresponding `utmp` structure is written to the parallel file.

## FILES

`/var/adm/utmp`, `/var/adm/utmpx`  
`/var/adm/wtmp`, `/var/adm/wtmpx`

**SEE ALSO**

`ttyslot(3C)`, `utmp(4)`, `utmpx(4)`.

**DIAGNOSTICS**

A null pointer is returned upon failure to read, whether for permissions or having reached the end of file, or upon failure to write.

**NOTES**

The most current entry is saved in a static structure. Multiple accesses require that it be copied before further accesses are made. On each call to either `getutxid` or `getutxline`, the routine examines the static structure before performing more I/O. If the contents of the static structure match what it is searching for, it looks no further. For this reason, to use `getutxline` to search for multiple occurrences it would be necessary to zero out the static after each success, or `getutxline` would just return the same structure over and over again. There is one exception to the rule about emptying the structure before further reads are done. The implicit read done by `pututxline` (if it finds that it is not already at the correct place in the file) will not hurt the contents of the static structure returned by the `getutxent`, `getutxid`, or `getutxline` routines, if the user has just modified those contents and passed the pointer back to `pututxline`.

These routines use buffered standard I/O for input, but `pututxline` uses an unbuffered write to avoid race conditions between processes trying to modify the `utmpx` and `wtmpx` files.

**NAME**

getvfsent, getvdfsfile, getvfsspec, getvdfsany – get *vfstab* file entry

**SYNOPSIS**

```
#include <stdio.h>
#include <sys/vfstab.h>

int getvfsent (FILE *fp, struct vfstab *vp);
int getvdfsfile (FILE *fp, struct vfstab *vp, char *file);
int getvfsspec (FILE *, struct vfstab *vp, char *spec);
int getvdfsany (FILE *, struct vfstab *vp, vfstab *vref);
```

**DESCRIPTION**

getvfsent, getvdfsfile, getvfsspec, and getvdfsany each fill in the structure pointed to by *vp* with the broken-out fields of a line in the */etc/vfstab* file. Each line in the file contains a *vfstab* structure, declared in the *sys/vfstab.h* header file:

```
char *vfs_special;
char *vfs_fsckdev;
char *vfs_mountp;
char *vfs_fstype;
char *vfs_fsckpass;
char *vfs_automnt;
char *vfs_mntopts;
```

The fields have meanings described in *vfstab*(4).

getvfsent returns a pointer to the next *vfstab* structure in the file; so successive calls can be used to search the entire file. getvdfsfile searches the file referenced by *fp* until a mount point matching *file* is found and fills *vp* with the fields from the line in the file. getvfsspec searches the file referenced by *fp* until a special device matching *spec* is found and fills *vp* with the fields from the line in the file. *spec* will try to match on device type (block or character special) and major and minor device numbers. If it cannot match in this manner, then it compares the strings. getvdfsany searches the file referenced by *fp* until a match is found between a line in the file and *vref*. *vref* matches the line if all non-null entries in *vref* match the corresponding fields in the file.

Note that these routines do not open, close, or rewind the file.

**FILES**

*/etc/vfstab*

**DIAGNOSTICS**

If the next entry is successfully read by getvfsent or a match is found with getvdfsfile, getvfsspec, or getvdfsany, 0 is returned. If an end-of-file is encountered on reading, these functions return -1. If an error is encountered, a value greater than 0 is returned. The possible error values are:

**getvfsent(3C)****getvfsent(3C)**

|                    |                                                                               |
|--------------------|-------------------------------------------------------------------------------|
| <b>VFS_TOOLONG</b> | A line in the file exceeded the internal buffer size of <b>VFS_LINE_MAX</b> . |
| <b>VFS_TOOMANY</b> | A line in the file contains too many fields.                                  |
| <b>VFS_TOOFEW</b>  | A line in the file contains too few fields.                                   |

**NOTES**

The members of the **vfstab** structure point to information contained in a static area, so it must be copied if it is to be saved.



**NAME**

hsearch, hcreate, hdestroy – manage hash search tables

**SYNOPSIS**

```
#include <search.h>
ENTRY *hsearch (ENTRY item, ACTION action);
int hcreate (size_t nel);
void hdestroy (void);
```

**DESCRIPTION**

**hsearch** is a hash-table search routine generalized from Knuth (6.4) Algorithm D. It returns a pointer into a hash table indicating the location at which an entry can be found. The comparison function used by **hsearch** is **strcmp** [see **string(3C)**]. *item* is a structure of type **ENTRY** (defined in the **search.h** header file) containing two pointers: *item.key* points to the comparison key, and *item.data* points to any other data to be associated with that key. (Pointers to types other than void should be cast to pointer-to-void.) *action* is a member of an enumeration type **ACTION** (defined in **search.h**) indicating the disposition of the entry if it cannot be found in the table. **ENTER** indicates that the item should be inserted in the table at an appropriate point. Given a duplicate of an existing item, the new item is not entered and **hsearch** returns a pointer to the existing item. **FIND** indicates that no entry should be made. Unsuccessful resolution is indicated by the return of a null pointer.

**hcreate** allocates sufficient space for the table, and must be called before **hsearch** is used. *nel* is an estimate of the maximum number of entries that the table will contain. This number may be adjusted upward by the algorithm in order to obtain certain mathematically favorable circumstances.

**hdestroy** destroys the search table, and may be followed by another call to **hcreate**.

**EXAMPLE**

The following example will read in strings followed by two numbers and store them in a hash table, discarding duplicates. It will then read in strings and find the matching entry in the hash table and print it out.

```
#include <stdio.h>
#include <search.h>
#include <string.h>
#include <stdlib.h>

struct info { /* this is the info stored in table */
 int age, room; /* other than the key */
};

#define NUM_EMPL 5000 /* # of elements in search table */

main()
{
 /* space to store strings */
```

```

char string_space[NUM_EMPL*20];
/* space to store employee info */
struct info info_space[NUM_EMPL];
/* next avail space in string_space */
char *str_ptr = string_space;
/* next avail space in info_space */
struct info *info_ptr = info_space;
ENTRY item, *found_item;
/* name to look for in table */
char name_to_find[30];
int i = 0;

/* create table */
(void) hcreate(NUM_EMPL);
while (scanf("%s%d%d", str_ptr, &info_ptr->age,
 &info_ptr->room) != EOF && i++ < NUM_EMPL) {
 /* put info in structure, and structure in item */
 item.key = str_ptr;
 item.data = (void *)info_ptr;
 str_ptr += strlen(str_ptr) + 1;
 info_ptr++;
 /* put item into table */
 (void) hsearch(item, ENTER);
}

/* access table */
item.key = name_to_find;
while (scanf("%s", item.key) != EOF) {
 if ((found_item = hsearch(item, FIND)) != NULL) {
 /* if item is in the table */
 (void)printf("found %s, age = %d, room = %d\n",
 found_item->key,
 ((struct info *)found_item->data)->age,
 ((struct info *)found_item->data)->room);
 } else {
 (void)printf("no such employee %s\n",
 name_to_find);
 }
}
return 0;
}

```

**hsearch(3C)**

**hsearch(3C)**

**SEE ALSO**

**bsearch(3C), lsearch(3C), malloc(3C), malloc(3X), string(3C), tsearch(3C).**

**DIAGNOSTICS**

**hsearch** returns a null pointer if either the action is **FIND** and the item could not be found or the action is **ENTER** and the table is full.

**hcreate** returns zero if it cannot allocate sufficient space for the table.

**NOTES**

**hsearch** and **hcreate** use **malloc(3C)** to allocate space.

Only one hash search table may be active at any given time.

**NAME**

initgroups – initialize the supplementary group access list

**SYNOPSIS**

```
#include <grp.h>
#include <sys/types.h>

int initgroups (const char *name, gid_t basegid)
```

**DESCRIPTION**

initgroups reads the group file, using `getgrent`, to get the group membership for the user specified by *name* and then initializes the supplementary group access list of the calling process using `setgroups`. The *basegid* group id is also included in the supplementary group access list. This is typically the real group id from the password file.

While scanning the group file, if the number of groups, including the *basegid* entry, exceeds `{NGROUPS_MAX}`, subsequent group entries are ignored.

initgroups will fail and not change the supplementary group access list if:

**EPERM**           The effective user id is not superuser.

**SEE ALSO**

setgroups(2), getgrent(3C).

**DIAGNOSTICS**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

*insque*, *remque* – insert/remove element from a queue

**SYNOPSIS**

```
include <search.h>
void insque(struct qelem *elem, struct qelem *pred);
void remque(struct qelem *elem);
```

**DESCRIPTION**

*insque* and *remque* manipulate queues built from doubly linked lists. Each element in the queue must be in the following form:

```
struct qelem {
 struct qelem *q_forw;
 struct qelem *q_back;
 char q_data[];
};
```

*insque* inserts *elem* in a queue immediately after *pred*. *remque* removes an entry *elem* from a queue.

**NAME**

`isnan`, `isnand`, `isnanf`, `finite`, `fpclass`, `unordered` - determine type of floating-point number

**SYNOPSIS**

```
#include <ieeefp.h>
int isnand (double dsrc);
int isnanf (float fsrc);
int finite (double dsrc);
fpclass_t fpclass (double dsrc);
int unordered (double dsrc1, double dsrc2);
#include <math.h>
int isnan (double dsrc);
```

**DESCRIPTION**

`isnan`, `isnand`, and `isnanf` return true (1) if the argument *dsrc* or *fsrc* is a NaN; otherwise they return false (0). The functionality of `isnan` is identical to that of `isnand`.

`isnanf` is implemented as a macro included in the `ieeefp.h` header file.

`fpclass` returns the class the *dsrc* belongs to. The 10 possible classes are as follows:

|                         |                                |
|-------------------------|--------------------------------|
| <code>FP_SNAN</code>    | signaling NaN                  |
| <code>FP_QNAN</code>    | quiet NaN                      |
| <code>FP_NINF</code>    | negative infinity              |
| <code>FP_PINF</code>    | positive infinity              |
| <code>FP_NDENORM</code> | negative denormalized non-zero |
| <code>FP_PDENORM</code> | positive denormalized non-zero |
| <code>FP_NZERO</code>   | negative zero                  |
| <code>FP_PZERO</code>   | positive zero                  |
| <code>FP_NNORM</code>   | negative normalized non-zero   |
| <code>FP_PNORM</code>   | positive normalized non-zero   |

`finite` returns true (1) if the argument *dsrc* is neither infinity nor NaN; otherwise it returns false (0).

`unordered` returns true (1) if one of its two arguments is unordered with respect to the other argument. This is equivalent to reporting whether either argument is NaN. If neither of the arguments is NaN, false (0) is returned.

None of these routines generate any exception, even for signaling NaNs.

**SEE ALSO**

`fpgetround(3C)`, `intro(3M)`.

**NAME**

**l3tol, ltol3** – convert between 3-byte integers and long integers

**SYNOPSIS**

```
#include <stdlib.h>
void l3tol (long *lp, const char *cp, int n);
void ltol3 (char *cp, const long *lp, int n);
```

**DESCRIPTION**

**l3tol** converts a list of *n* three-byte integers packed into a character string pointed to by *cp* into a list of long integers pointed to by *lp*.

**ltol3** performs the reverse conversion from long integers (*lp*) to three-byte integers (*cp*).

These functions are useful for file-system maintenance where the block numbers are three bytes long.

**SEE ALSO**

**fs(4)**.

**NOTES**

Because of possible differences in byte ordering, the numerical values of the long integers are machine-dependent.

**NAME**

localeconv – get numeric formatting information

**SYNOPSIS**

```
#include <locale.h>

struct lconv *localeconv (void);
```

**DESCRIPTION**

localeconv sets the components of an object with type `struct lconv` (defined in `locale.h`) with the values appropriate for the formatting of numeric quantities (monetary and otherwise) according to the rules of the current locale [see `setlocale(3C)`]. The definition of `struct lconv` is given below (the values for the fields in the C locale are given in comments):

```
char *decimal_point; /* "." */
char *thousands_sep; /* "" (zero length string) */
char *grouping; /* "" */
char *int_curr_symbol; /* "" */
char *currency_symbol; /* "" */
char *mon_decimal_point; /* "" */
char *mon_thousands_sep; /* "" */
char *mon_grouping; /* "" */
char *positive_sign; /* "" */
char *negative_sign; /* "" */
char int_frac_digits; /* CHAR_MAX */
char frac_digits; /* CHAR_MAX */
char p_cs_precedes; /* CHAR_MAX */
char p_sep_by_space; /* CHAR_MAX */
char n_cs_precedes; /* CHAR_MAX */
char n_sep_by_space; /* CHAR_MAX */
char p_sign_posn; /* CHAR_MAX */
char n_sign_posn; /* CHAR_MAX */
```

The members of the structure with type `char *` are strings, any of which (except `decimal_point`) can point to "", to indicate that the value is not available in the current locale or is of zero length. The members with type `char` are nonnegative numbers, any of which can be `CHAR_MAX` (defined in the `limits.h` header file) to indicate that the value is not available in the current locale. The members are the following:

**char \*decimal\_point**

The decimal-point character used to format non-monetary quantities.

**char \*thousands\_sep**

The character used to separate groups of digits to the left of the decimal-point character in formatted non-monetary quantities.

**char \*grouping**

A string in which each element is taken as an integer that indicates the number of digits that comprise the current group in a formatted non-monetary quantity. The elements of `grouping` are interpreted according to the following:



- CHAR-MAX** No further grouping is to be performed.
- 0** The previous element is to be repeatedly used for the remainder of the digits.
- other** The value is the number of digits that comprise the current group. The next element is examined to determine the size of the next group of digits to the left of the current group.
- char \*int\_curr\_symbol**  
The international currency symbol applicable to the current locale, left-justified within a four-character space-padded field. The character sequences should match with those specified in: *ISO 4217 Codes for the Representation of Currency and Funds*.
- char \*currency\_symbol**  
The local currency symbol applicable to the current locale.
- char \*mon\_decimal\_point**  
The decimal point used to format monetary quantities.
- char \*mon\_thousands\_sep**  
The separator for groups of digits to the left of the decimal point in formatted monetary quantities.
- char \*mon\_grouping**  
A string in which each element is taken as an integer that indicates the number of digits that comprise the current group in a formatted monetary quantity. The elements of `mon_grouping` are interpreted according to the rules described under `grouping`.
- char \*positive\_sign**  
The string used to indicate a nonnegative-valued formatted monetary quantity.
- char \*negative\_sign**  
The string used to indicate a negative-valued formatted monetary quantity.
- char int\_frac\_digits**  
The number of fractional digits (those to the right of the decimal point) to be displayed in an internationally formatted monetary quantity.
- char frac\_digits**  
The number of fractional digits (those to the right of the decimal point) to be displayed in a formatted monetary quantity.
- char p\_cs\_precedes**  
Set to 1 or 0 if the `currency_symbol` respectively precedes or succeeds the value for a nonnegative formatted monetary quantity.
- char p\_sep\_by\_space**  
Set to 1 or 0 if the `currency_symbol` respectively is or is not separated by a space from the value for a nonnegative formatted monetary quantity.

**char n\_cs\_precedes**  
 Set to 1 or 0 if the `currency_symbol` respectively precedes or succeeds the value for a negative formatted monetary quantity.

**char n\_sep\_by\_space**  
 Set to 1 or 0 if the `currency_symbol` respectively is or is not separated by a space from the value for a negative formatted monetary quantity.

**char p\_sign\_posn**  
 Set to a value indicating the positioning of the `positive_sign` for a non-negative formatted monetary quantity. The value of `p_sign_posn` is interpreted according to the following:

- 0 Parentheses surround the quantity and `currency_symbol`.
- 1 The sign string precedes the quantity and `currency_symbol`.
- 2 The sign string succeeds the quantity and `currency_symbol`.
- 3 The sign string immediately precedes the `currency_symbol`.
- 4 The sign string immediately succeeds the `currency_symbol`.

**char n\_sign\_posn**  
 Set to a value indicating the positioning of the `negative_sign` for a negative formatted monetary quantity. The value of `n_sign_posn` is interpreted according to the rules described under `p_sign_posn`.

**RETURNS**

`localeconv` returns a pointer to the filled-in object. The structure pointed to by the return value may be overwritten by a subsequent call to `localeconv`.

**EXAMPLES**

The following table illustrates the rules used by four countries to format monetary quantities.

| Country     | Positive format | Negative format | International format |
|-------------|-----------------|-----------------|----------------------|
| Italy       | L.1.234         | -L.1.234        | ITL.1.234            |
| Netherlands | F 1.234,56      | F -1.234,56     | NLG 1.234,56         |
| Norway      | kr1.234,56      | kr1.234,56-     | NOK 1.234,56         |
| Switzerland | SFrs.1,234.56   | SFrs.1,234.56C  | CHF 1,234.56         |

For these four countries, the respective values for the monetary members of the structure returned by `localeconv` are as follows:

|                                | Italy  | Netherlands | Norway | Switzerland |
|--------------------------------|--------|-------------|--------|-------------|
| <code>int_curr_symbol</code>   | "ITL." | "NLG "      | "NOK " | "CHF "      |
| <code>currency_symbol</code>   | "L."   | "F"         | "kr"   | "SFrs."     |
| <code>mon_decimal_point</code> | " "    | ","         | ","    | ."          |
| <code>mon_thousands_sep</code> | ."     | ."          | ."     | ."          |
| <code>mon_grouping</code>      | "\3"   | "\3"        | "\3"   | "\3"        |
| <code>positive_sign</code>     | " "    | " "         | " "    | " "         |
| <code>negative_sign</code>     | "-"    | "-"         | "-"    | "C"         |
| <code>int_frac_digits</code>   | 0      | 2           | 2      | 2           |
| <code>frac_digits</code>       | 0      | 2           | 2      | 2           |

**localeconv(3C)****localeconv(3C)**

|                             |   |   |   |   |
|-----------------------------|---|---|---|---|
| <code>p_cs_precedes</code>  | 1 | 1 | 1 | 1 |
| <code>p_sep_by_space</code> | 0 | 1 | 0 | 0 |
| <code>n_cs_precedes</code>  | 1 | 1 | 1 | 1 |
| <code>n_sep_by_space</code> | 0 | 1 | 0 | 0 |
| <code>p_sign_posn</code>    | 1 | 1 | 1 | 1 |
| <code>n_sign_posn</code>    | 1 | 4 | 2 | 2 |

**FILES**

`/usr/lib/locale/locale/LC_MONETARY` LC\_MONETARY database for *locale*  
`/usr/lib/locale/locale/LC_NUMERIC` LC\_NUMERIC database for *locale*

**SEE ALSO**

`setlocale(3C)`.  
`chrtbl(1M)`, `montbl(1M)` in the *System Administrator's Reference Manual*.

**NAME**

lockf – record locking on files

**SYNOPSIS**

```
#include <unistd.h>

int lockf (int fildes, int function, long size);
```

**DESCRIPTION**

lockf allows sections of a file to be locked; advisory or mandatory write locks depending on the mode bits of the file [see `chmod(2)`]. Locking calls from other processes that attempt to lock the locked file section will either return an error value or be put to sleep until the resource becomes unlocked. All the locks for a process are removed when the process terminates. [See `fcntl(2)` for more information about record locking.]

*fildes* is an open file descriptor. The file descriptor must have `O_WRONLY` or `O_RDWR` permission in order to establish locks with this function call.

*function* is a control value that specifies the action to be taken. The permissible values for *function* are defined in `unistd.h` as follows:

```
#define F_ULOCK 0 /* unlock previously locked section */
#define F_LOCK 1 /* lock section for exclusive use */
#define F_TLOCK 2 /* test & lock section for exclusive use */
#define F_TEST 3 /* test section for other locks */
```

All other values of *function* are reserved for future extensions and will result in an error return if not implemented.

`F_TEST` is used to detect if a lock by another process is present on the specified section. `F_LOCK` and `F_TLOCK` both lock a section of a file if the section is available. `F_ULOCK` removes locks from a section of the file.

*size* is the number of contiguous bytes to be locked or unlocked. The resource to be locked or unlocked starts at the current offset in the file and extends forward for a positive *size* and backward for a negative *size* (the preceding bytes up to but not including the current offset). If *size* is zero, the section from the current offset through the largest file offset is locked (i.e., from the current offset through the present or any future end-of-file). An area need not be allocated to the file in order to be locked as such locks may exist past the end-of-file.

The sections locked with `F_LOCK` or `F_TLOCK` may, in whole or in part, contain or be contained by a previously locked section for the same process. Locked sections will be unlocked starting at the the point of the offset through *size* bytes or to the end of file if *size* is (`off_t`) 0. When this situation occurs, or if this situation occurs in adjacent sections, the sections are combined into a single section. If the request requires that a new element be added to the table of active locks and this table is already full, an error is returned, and the new section is not locked.

`F_LOCK` and `F_TLOCK` requests differ only by the action taken if the resource is not available. `F_LOCK` will cause the calling process to sleep until the resource is available. `F_TLOCK` will cause the function to return a -1 and set `errno` to `EACCES` if the section is already locked by another process.

**F\_ULOCK** requests may, in whole or in part, release one or more locked sections controlled by the process. When sections are not fully released, the remaining sections are still locked by the process. Releasing the center section of a locked section requires an additional element in the table of active locks. If this table is full, an **errno** is set to **ENOLK** and the requested section is not released.

A potential for deadlock occurs if a process controlling a locked resource is put to sleep by requesting another process's locked resource. Thus calls to **lockf** or **fcntl** scan for a deadlock prior to sleeping on a locked resource. An error return is made if sleeping on the locked resource would cause a deadlock.

Sleeping on a resource is interrupted with any signal. The **alarm** system call may be used to provide a timeout facility in applications that require this facility.

**lockf** will fail if one or more of the following are true:

- EBADF** *files* is not a valid open descriptor.
- EAGAIN** *cmd* is **F\_TLOCK** or **F\_TEST** and the section is already locked by another process.
- EDEADLK** *cmd* is **F\_LOCK** and a deadlock would occur.
- ENOLK** *cmd* is **F\_LOCK**, **F\_TLOCK**, or **F\_ULOCK** and the number of entries in the lock table would exceed the number allocated on the system.
- ECOMM** *files* is on a remote machine and the link to that machine is no longer active.

#### SEE ALSO

**intro(2)**, **alarm(2)**, **chmod(2)**, **close(2)**, **creat(2)**, **fcntl(2)**, **open(2)**, **read(2)**, **write(2)**.

#### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

#### NOTES

Unexpected results may occur in processes that do buffering in the user address space. The process may later read/write data that is/was locked. The standard I/O package is the most common source of unexpected buffering.

Because in the future the variable **errno** will be set to **EAGAIN** rather than **EACCES** when a section of a file is already locked by another process, portable application programs should expect and test for either value.

**NAME**

`lsearch`, `lfind` – linear search and update

**SYNOPSIS**

```
#include <search.h>

void *lsearch (const void *key, void * base, size_t *nel,
 size_t width, int (*compar) (const void *, const void *));

void *lfind (const void *key, const void *base, size_t *nel,
 size_t width, int (*compar) (const void *, const void *));
```

**DESCRIPTION**

`lsearch` is a linear search routine generalized from Knuth (6.1) Algorithm S. It returns a pointer into a table indicating where a datum may be found. If the datum does not occur, it is added at the end of the table. *key* points to the datum to be sought in the table. *base* points to the first element in the table. *nel* points to an integer containing the current number of elements in the table. The integer is incremented if the datum is added to the table. *width* is the size of an element in bytes. *compar* is a pointer to the comparison function that the user must supply (`strcmp`, for example). It is called with two arguments that point to the elements being compared. The function must return zero if the elements are equal and non-zero otherwise.

`lfind` is the same as `lsearch` except that if the datum is not found, it is not added to the table. Instead, a null pointer is returned.

**NOTES**

The pointers to the key and the element at the base of the table may be pointers to any type.

The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

The value returned should be cast into type pointer-to-element.

**EXAMPLE**

This program will read in less than `TABSIZE` strings of length less than `ELSIZE` and store them in a table, eliminating duplicates, and then will print each entry.

```
#include <search.h>
#include <string.h>
#include <stdlib.h>
#include <stdio.h>

#define TABSIZE 50
#define ELSIZE 120

main()
{
 char line[ELSIZE]; /* buffer to hold input string */
 char tab[TABSIZE][ELSIZE]; /* table of strings */
 size_t nel = 0; /* number of entries in tab */
 int i;
```

## lsearch(3C)

## lsearch(3C)

```
while (fgets(line, ELSIZE, stdin) != NULL &&
 nel < TABSIZE)
 (void) lsearch(line, tab, &nel, ELSIZE, mycmp);
for(i = 0; i < nel; i++)
 (void) fputs(tab[i], stdout);
return 0;
}
```

### SEE ALSO

bsearch(3C), hsearch(3C), string(3C), tsearch(3C).

### NOTES

If the searched-for datum is found, both `lsearch` and `lfind` return a pointer to it. Otherwise, `lfind` returns `NULL` and `lsearch` returns a pointer to the newly added element.

Undefined results can occur if there is not enough room in the table to add a new item.

**NAME**

makecontext, swapcontext – manipulate user contexts

**SYNOPSIS**

```
#include <ucontext.h>

void makecontext (ucontext_t *ucp, (void(*)())func, int argc, ...);
int swapcontext (ucontext_t *oucp, ucontext_t *ucp);
```

**DESCRIPTION**

These functions are useful for implementing user-level context switching between multiple threads of control within a process.

`makecontext` modifies the context specified by `ucp`, which has been initialized using `getcontext`; when this context is resumed using `swapcontext` or `setcontext` [see `getcontext(2)`], program execution continues by calling the function `func`, passing it the arguments that follow `argc` in the `makecontext` call. The integer value of `argc` must match the number of arguments that follow `func`. Otherwise the behavior is undefined.

`swapcontext` saves the current context in the context structure pointed to by `oucp` and sets the context to the context structure pointed to by `ucp`.

These functions will fail if either of the following is true:

|               |                                                                             |
|---------------|-----------------------------------------------------------------------------|
| <b>ENOMEM</b> | <code>ucp</code> does not have enough stack left to complete the operation. |
| <b>EFAULT</b> | <code>ucp</code> or <code>oucp</code> points to an invalid address.         |

**SEE ALSO**

`exit(2)`, `getcontext(2)`, `sigaction(2)`, `sigprocmask(2)`, `ucontext(5)`.

**DIAGNOSTICS**

On successful completion, `swapcontext` return a value of zero. Otherwise, a value of `-1` is returned and `errno` is set to indicate the error.

**NOTES**

The size of the `ucontext_t` structure may change in future releases. To remain binary compatible, users of these features must always use `makecontext` or `getcontext` to create new instances of them.



**NAME**

`makedev`, `major`, `minor` - manage a device number

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/mkdev.h>

dev_t makedev(major_t maj, minor_t min);
major_t major(dev_t device);
minor_t minor(dev_t device);
```

**DESCRIPTION**

The `makedev` routine returns a formatted device number on success and `NODEV` on failure. *maj* is the major number. *min* is the minor number. `makedev` can be used to create a device number for input to `mknod(2)`.

The `major` routine returns the major number component from *device*.

The `minor` routine returns the minor number component from *device*.

`makedev` will fail if one or more of the following are true:

- EINVAL** One or both of the arguments *maj* and *min* is too large.
- EINVAL** The *device* number created from *maj* and *min* is `NODEV`.

`major` will fail if one or more of the following are true:

- EINVAL** The *device* argument is `NODEV`.
- EINVAL** The major number component of *device* is too large.

`minor` will fail if the following is true:

- EINVAL** The *device* argument is `NODEV`.

**SEE ALSO**

`stat(2)`, `mknod(2)`, `...`

**DIAGNOSTICS**

On failure, `NODEV` is returned and `errno` is set to indicate the error.

**NAME**

`malloc`, `free`, `realloc`, `calloc`, `memalign`, `valloc`, - memory allocator

**SYNOPSIS**

```
#include <stdlib.h>

void *malloc (size_t size);

void free (void *ptr);

void *realloc (void *ptr, size_t size);

void *calloc (size_t nelem, size_t elsize);

void *memalign(size_t alignment, size_t size);

void *valloc(size_t size);
```

**DESCRIPTION**

`malloc` and `free` provide a simple general-purpose memory allocation package. `malloc` returns a pointer to a block of at least *size* bytes suitably aligned for any use.

The argument to `free` is a pointer to a block previously allocated by `malloc`, `calloc` or `realloc`. After `free` is performed this space is made available for further allocation. If *ptr* is a `NULL` pointer, no action occurs.

Undefined results will occur if the space assigned by `malloc` is overrun or if some random number is handed to `free`.

`realloc` changes the size of the block pointed to by *ptr* to *size* bytes and returns a pointer to the (possibly moved) block. The contents will be unchanged up to the lesser of the new and old sizes. If *ptr* is `NULL`, `realloc` behaves like `malloc` for the specified size. If *size* is zero and *ptr* is not a null pointer, the object pointed to is freed.

`calloc` allocates space for an array of *nelem* elements of size *elsize*. The space is initialized to zeros.

`memalign` allocates *size* bytes on a specified alignment boundary, and returns a pointer to the allocated block. The value of the returned address is guaranteed to be an even multiple of *alignment*. Note: the value of *alignment* must be a power of two, and must be greater than or equal to the size of a word.

`valloc(size)` is equivalent to `memalign(sysconf(_SC_PAGESIZE), size)`.

Each of the allocation routines returns a pointer to space suitably aligned (after possible pointer coercion) for storage of any type of object.

`malloc`, `realloc`, `calloc`, `memalign`, and `valloc` will fail if there is not enough available memory.

**SEE ALSO**

`malloc(3X)`.

**DIAGNOSTICS**

If there is no available memory, `malloc`, `realloc`, `memalign`, `valloc`, and `calloc` return a null pointer. When `realloc` returns `NULL`, the block pointed to by *ptr* is left intact. If *size*, *nelem*, or *elsize* is 0, a unique pointer to the arena is returned.

## NAME

**mbchar:** `mbtowc`, `mblen`, `wctomb` – multibyte character handling

## SYNOPSIS

```
#include <stdlib.h>

int mbtowc (wchar_t *pwc, const char *s, size_t n);
int mblen (const char *s, size_t n);
int wctomb (char *s, wchar_t wchar);
```

## DESCRIPTION

Multibyte characters are used to represent characters in an extended character set. This is needed for locales where 8 bits are not enough to represent all the characters in the character set.

The multibyte character handling functions provide the means of translating multibyte characters into wide characters and back again. Wide characters have type `wchar_t` (defined in `stdlib.h`), which is an integral type whose range of values can represent distinct codes for all members of the largest extended character set specified among the supported locales.

A maximum of 3 extended character sets are supported for each locale. The number of bytes in an extended character set is defined by the `LC_CTYPE` category of the locale [see `setlocale(3C)`]. However, the maximum number of bytes in any multibyte character will never be greater than `MB_LEN_MAX`, which is defined in `stdlib.h`. The maximum number of bytes in a character in an extended character set in the current locale is given by the macro, `MB_CUR_MAX`, also defined in `stdlib.h`.

`mbtowc` determines the number of bytes that comprise the multibyte character pointed to by `s`. Also, if `pwc` is not a null pointer, `mbtowc` converts the multibyte character to a wide character and places the result in the object pointed to by `pwc`. (The value of the wide character corresponding to the null character is zero.) At most `n` characters will be examined, starting at the character pointed to by `s`.

If `s` is a null pointer, `mbtowc` simply returns 0. If `s` is not a null pointer, then, if `s` points to the null character, `mbtowc` returns 0; if the next `n` or fewer bytes form a valid multibyte character, `mbtowc` returns the number of bytes that comprise the converted multibyte character; otherwise, `s` does not point to a valid multibyte character and `mbtowc` returns -1.

`mblen` determines the number of bytes comprising the multibyte character pointed to by `s`. It is equivalent to

```
mbtowc ((wchar_t *)0, s, n);
```

`wctomb` determines the number of bytes needed to represent the multibyte character corresponding to the code whose value is `wchar`, and, if `s` is not a null pointer, stores the multibyte character representation in the array pointed to by `s`. At most `MB_CUR_MAX` characters are stored.

If `s` is a null pointer, `wctomb` simply returns 0. If `s` is not a null pointer, `wctomb` returns -1 if the value of `wchar` does not correspond to a valid multibyte character; otherwise it returns the number of bytes that comprise the multibyte character corresponding to the value of `wchar`.

**mbchar (3C)**

**mbchar (3C)**

**SEE ALSO**

**mbstring(3C), setlocale(3C), environ(5),  
chrtbl(1M)** in the *System Administrator's Reference Manual*.

**NAME**

`mbstring`: `mbstowcs`, `wcstombs` - multibyte string functions

**SYNOPSIS**

```
#include <stdlib.h>

size_t mbstowcs (wchar_t *pwcs, const char *s, size_t n);
size_t wcstombs (char *s, const wchar_t *pwcs, size_t n);
```

**DESCRIPTION**

`mbstowcs` converts a sequence of multibyte characters from the array pointed to by `s` into a sequence of corresponding wide character codes and stores these codes into the array pointed to by `pwcs`, stopping after `n` codes are stored or a code with value zero (a converted null character) is stored. If an invalid multibyte character is encountered, `mbstowcs` returns `(size_t)-1`. Otherwise, `mbstowcs` returns the number of array elements modified, not including the terminating zero code, if any.

`wcstombs` converts a sequence of wide character codes from the array pointed to by `pwcs` into a sequence of multibyte characters and stores these multibyte characters into the array pointed to by `s`, stopping if a multibyte character would exceed the limit of `n` total bytes or if a null character is stored. If a wide character code is encountered that does not correspond to a valid multibyte character, `wcstombs` returns `(size_t)-1`. Otherwise, `wcstombs` returns the number of bytes modified, not including a terminating null character, if any.

**SEE ALSO**

`mbchar(3C)`, `setlocale(3C)`, `environ(5)`.  
`chrtbl(1M)` in the *System Administrator's Reference Manual*.

**NAME**

**memory:** `memcpy`, `memchr`, `memcmp`, `memcpy`, `memmove`, `memset` - memory operations

**SYNOPSIS**

```
#include <string.h>

void *memcpy (void *s1, const void *s2, int c, size_t n);
void *memchr (const void *s, int c, size_t n);
int memcmp (const void *s1, const void *s2, size_t n);
void *memcpy (void *s1, const void *s2, size_t n);
void *memmove (void *s1, const void *s2, size_t n);
void *memset (void *s, int c, size_t n);
```

**DESCRIPTION**

These functions operate as efficiently as possible on memory areas (arrays of bytes bounded by a count, not terminated by a null character). They do not check for the overflow of any receiving memory area.

`memcpy` copies bytes from memory area `s2` into `s1`, stopping after the first occurrence of `c` (converted to an `unsigned char`) has been copied, or after `n` bytes have been copied, whichever comes first. It returns a pointer to the byte after the copy of `c` in `s1`, or a null pointer if `c` was not found in the first `n` bytes of `s2`.

`memchr` returns a pointer to the first occurrence of `c` (converted to an `unsigned char`) in the first `n` bytes (each interpreted as an `unsigned char`) of memory area `s`, or a null pointer if `c` does not occur.

`memcmp` compares its arguments, looking at the first `n` bytes (each interpreted as an `unsigned char`), and returns an integer less than, equal to, or greater than 0, according as `s1` is lexicographically less than, equal to, or greater than `s2` when taken to be unsigned characters.

`memcpy` copies `n` bytes from memory area `s2` to `s1`. It returns `s1`.

`memmove` copies `n` bytes from memory areas `s2` to `s1`. Copying between objects that overlap will take place correctly. It returns `s1`.

`memset` sets the first `n` bytes in memory area `s` to the value of `c` (converted to an `unsigned char`). It returns `s`.

**SEE ALSO**

`string(3C)`.

**NAME**

mkfifo - create a new FIFO

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>

int mkfifo (const char *path, mode_t mode);
```

**DESCRIPTION**

The `mkfifo` routine creates a new FIFO special file named by the pathname pointed to by `path`. The mode of the new FIFO is initialized from `mode`. The file permission bits of the `mode` argument are modified by the process's file creation mask [see `umask(2)`].

The FIFO's owner id is set to the process's effective user id. The FIFO's group id is set to the process's effective group id, or if the `S_ISGID` bit is set in the parent directory then the group id of the FIFO is inherited from the parent.

`mkfifo` calls the system call `mknod` to make the file.

**SEE ALSO**

`chmod(2)`, `exec(2)`, `mknod(2)`, `umask(2)`, `fs(4)`, `stat(5)`.  
`mkdir(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NOTES**

Bits other than the file permission bits in `mode` are ignored.

**NAME**

mktemp - make a unique file name

**SYNOPSIS**

```
#include <stdlib.h>

char *mktemp(char *template);
```

**DESCRIPTION**

mktemp replaces the contents of the string pointed to by *template* with a unique file name, and returns *template*. The string in *template* should look like a file name with six trailing Xs; mktemp will replace the Xs with a character string that can be used to create a unique file name.

**SEE ALSO**

tmpfile(3S), tmpnam(3S).

**DIAGNOSTIC**

mktemp will assign to *template* the empty string if it cannot create a unique name.

**NOTES**

mktemp can create only 26 unique file names per process for each unique *template*.



**NAME**

`mktime` – converts a `tm` structure to a calendar time

**SYNOPSIS**

```
#include <time.h>

time_t mktime (struct tm *timeptr);
```

**DESCRIPTION**

`mktime` converts the time represented by the `tm` structure pointed to by `timeptr` into a calendar time (the number of seconds since 00:00:00 UTC, January 1, 1970).

The `tm` structure has the following format.

```
struct tm {
 int tm_sec; /* seconds after the minute [0, 61] */
 int tm_min; /* minutes after the hour [0, 59] */
 int tm_hour; /* hour since midnight [0, 23] */
 int tm_mday; /* day of the month [1, 31] */
 int tm_mon; /* months since January [0, 11] */
 int tm_year; /* years since 1900 */
 int tm_wday; /* days since Sunday [0, 6] */
 int tm_yday; /* days since January 1 [0, 365] */
 int tm_isdst; /* flag for daylight savings time */
};
```

In addition to computing the calendar time, `mktime` normalizes the supplied `tm` structure. The original values of the `tm_wday` and `tm_yday` components of the structure are ignored, and the original values of the other components are not restricted to the ranges indicated in the definition of the structure. On successful completion, the values of the `tm_wday` and `tm_yday` components are set appropriately, and the other components are set to represent the specified calendar time, but with their values forced to be within the appropriate ranges. The final value of `tm_mday` is not set until `tm_mon` and `tm_year` are determined.

The original values of the components may be either greater than or less than the specified range. For example, a `tm_hour` of `-1` means 1 hour before midnight, `tm_mday` of `0` means the day preceding the current month, and `tm_mon` of `-2` means 2 months before January of `tm_year`.

If `tm_isdst` is positive, the original values are assumed to be in the alternate timezone. If it turns out that the alternate timezone is not valid for the computed calendar time, then the components are adjusted to the main timezone. Likewise, if `tm_isdst` is zero, the original values are assumed to be in the main timezone and are converted to the alternate timezone if the main timezone is not valid. If `tm_isdst` is negative, the correct timezone is determined and the components are not adjusted.

Local timezone information is used as if `mktime` had called `tzset`.

`mktime` returns the specified calendar time. If the calendar time cannot be represented, the function returns the value `(time_t)-1`.

**EXAMPLE**

What day of the week is July 4, 2001?

```
#include <stdio.h>
#include <time.h>

static char *const wday[] = {
 "Sunday", "Monday", "Tuesday", "Wednesday",
 "Thursday", "Friday", "Saturday", "-unknown-"
};
struct tm time_str;
/*...*/
time_str.tm_year= 2001 - 1900;
time_str.tm_mon = 7 - 1;
time_str.tm_mday= 4;
time_str.tm_hour= 0;
time_str.tm_min = 0;
time_str.tm_sec = 1;
time_str.tm_isdst = -1;
if (mktime(&time_str) == -1)
 time_str.tm_wday=7;
printf("%s\n", wday[time_str.tm_wday]);
```

**SEE ALSO**

ctime(3C), getenv(3C), timezone(4).

**NOTES**

tm\_year of the tm structure must be for year 1970 or later. Calendar times before 00:00:00 UTC, January 1, 1970 or after 03:14:07 UTC, January 19, 2038 cannot be represented.

**NAME**

**mlock**, **munlock** – lock (or unlock) pages in memory

**SYNOPSIS**

```
#include <sys/types.h>

int mlock(caddr_t addr, size_t len);
int munlock(caddr_t addr, size_t len);
```

**DESCRIPTION**

The function **mlock** uses the mappings established for the address range [*addr*, *addr + len*) to identify pages to be locked in memory. The effect of **mlock**(*addr*, *len*) is equivalent to **mlock(1)**(*addr*, *len*, **MC\_LOCK**, 0, 0, 0).

**munlock** removes locks established with **mlock**. The effect of **munlock**(*addr*, *len*) is equivalent to **mlock(1)**(*addr*, *len*, **MC\_UNLOCK**, 0, 0, 0).

Locks established with **mlock** are not inherited by a child process after a **fork** and are not nested.

**SEE ALSO**

**fork(2)**, **mlock(1)**, **mmap(2)**, **mlockall(3C)**, **plock(2)**, **sysconf(3C)**.

**DIAGNOSTICS**

Upon successful completion, the functions **mlock** and **munlock** return 0; otherwise, they return -1 and set **errno** to indicate the error.

**NOTES**

Use of **mlock** and **munlock** requires that the user have appropriate privileges.

**NAME**

mlockall, munlockall - lock or unlock address space

**SYNOPSIS**

```
#include <sys/mman.h>

int mlockall(int flags);
int munlockall(void);
```

**DESCRIPTION**

The function `mlockall` causes all pages mapped by an address space to be locked in memory. The effect of `mlockall` (*flags*) is equivalent to:

```
mementl(0, 0, MC_LOCKAS, flags, 0, 0)
```

The value of *flags* determines whether the pages to be locked are those currently mapped by the address space, those that will be mapped in the future, or both:

```
MCL_CURRENT Lock current mappings
MCL_FUTURE Lock future mappings
```

The function `munlockall` removes address space locks and locks on mappings in the address space. The effect of `munlockall` is equivalent to:

```
mementl(0, 0, MC_UNLOCKAS, 0, 0, 0)
```

Locks established with `mlockall` are not inherited by a child process after a `fork` and are not nested.

**SEE ALSO**

`fork(2)`, `mementl(2)`, `mlock(3C)`, `mmap(2)`, `plock(2)`, `sysconf(3C)`.

**DIAGNOSTICS**

Upon successful completion, the functions `mlockall` and `munlockall` return 0; otherwise, they return -1 and set `errno` to indicate the error.

**NOTES**

Use of `mlockall` and `munlockall` requires that the user have appropriate privileges.

**NAME**

**monitor** - prepare execution profile

**SYNOPSIS**

```
#include <mon.h>

void monitor (int (*lowpc)(), int (*highpc)(), WORD *buffer,
 size_t bufsize, size_t nfunc);
```

**DESCRIPTION**

**monitor** is an interface to **profil**, and is called automatically with default parameters by any program created by **cc -p**. Except to establish further control over profiling activity, it is not necessary to explicitly call **monitor**.

When used, **monitor** is called at least at the beginning and the end of a program. The first call to **monitor** initiates the recording of two different kinds of execution-profile information: execution-time distribution and function call count. Execution-time distribution data is generated by **profil** and the function call counts are generated by code supplied to the object file (or files) by **cc -p**. Both types of information are collected as a program executes. The last call to **monitor** writes this collected data to the output file **mon.out**.

*lowpc* and *highpc* are the beginning and ending addresses of the region to be profiled.

*buffer* is the address of a user-supplied array of **WORD** (**WORD** is defined in the header file **mon.h**). *buffer* is used by **monitor** to store the histogram generated by **profil** and the call counts.

*bufsize* identifies the number of array elements in *buffer*.

*nfunc* is the number of call count cells that have been reserved in *buffer*. Additional call count cells will be allocated automatically as they are needed.

*bufsize* should be computed using the following formula:

```
size_of_buffer =
 sizeof(struct hdr) +
 nfunc * sizeof(struct cnt) +
 ((highpc-lowpc)/BARSIZE) * sizeof(WORD) +
 sizeof(WORD) - 1 ;
```

```
bufsize = (size_of_buffer / sizeof(WORD)) ;
```

where:

*lowpc*, *highpc*, *nfunc* are the same as the arguments to **monitor**;

**BARSIZE** is the number of program bytes that correspond to each histogram bar, or cell, of the **profil** buffer;

the **hdr** and **cnt** structures and the type **WORD** are defined in the header file **mon.h**.

The default call to `monitor` is shown below:

```
monitor (&eprol, &etext, wbuf, wbufsz, 600);
```

where:

`eprol` is the beginning of the user's program when linked with `cc -p` [see `end(3C)`];

`etext` is the end of the user's program [see `end(3C)`];

`wbuf` is an array of `WORD` with `wbufsz` elements;

`wbufsz` is computed using the `bufsize` formula shown above with `BARSIZE` of 8;

600 is the number of call count cells that have been reserved in `buffer`.

These parameter settings establish the computation of an execution-time distribution histogram that uses `profil` for the entire program, initially reserves room for 600 call count cells in `buffer`, and provides for enough histogram cells to generate significant distribution-measurement results. [For more information on the effects of `bufsize` on execution-distribution measurements, see `profil(2)`.]

To stop execution monitoring and write the results to a file, use the following:

```
monitor((int (*)())0, (int (*)())0, (WORD *)0, 0, 0);
```

Use `prof` to examine the results.

#### FILES

`mon.out`

#### SEE ALSO

`cc(1)`, `prof(1)`, `profil(2)`, `end(3C)`.

#### NOTE

Additional calls to `monitor` after `main` has been called and before `exit` has been called will add to the function-call count capacity, but such calls will also replace and restart the `profil` histogram computation.

The name of the file written by `monitor` is controlled by the environment variable `PROFDIR`. If `PROFDIR` does not exist, the file `mon.out` is created in the current directory. If `PROFDIR` exists but has no value, `monitor` does no profiling and creates no output file. If `PROFDIR` is `dirname`, and `monitor` is called automatically by compilation with `cc -p`, the file created is `dirname/pid.progname` where `progname` is the name of the program.

**NAME**

`msync` – synchronize memory with physical storage

**SYNOPSIS**

```
#include <sys/types.h>
```

```
#include <sys/mman.h>
```

```
int msync(caddr_t addr, size_t len, int flags);
```

**DESCRIPTION**

The function `msync` writes all modified copies of pages over the range [*addr*, *addr* + *len*) to their backing storage locations. `msync` optionally invalidates any copies so that further references to the pages will be obtained by the system from their backing storage locations. The backing storage for a modified `MAP_SHARED` mapping is the file the page is mapped to; the backing storage for a modified `MAP_PRIVATE` mapping is its swap area.

*flags* is a bit pattern built from the following values:

|                            |                             |
|----------------------------|-----------------------------|
| <code>MS_ASYNC</code>      | perform asynchronous writes |
| <code>MS_SYNC</code>       | perform synchronous writes  |
| <code>MS_INVALIDATE</code> | invalidate mappings         |

If `MS_ASYNC` is set, `msync` returns immediately once all write operations are scheduled; if `MS_SYNC` is set, `msync` does not return until all write operations are completed.

`MS_INVALIDATE` invalidates all cached copies of data in memory, so that further references to the pages will be obtained by the system from their backing storage locations.

The effect of `msync(addr, len, flags)` is equivalent to:

```
mementl(addr, len, MS_SYNC, flags, 0, 0)
```

**SEE ALSO**

`mementl(2)`, `mmap(2)`, `sysconf(3C)`.

**DIAGNOSTICS**

Upon successful completion, the function `msync` returns 0; otherwise, it returns `-1` and sets `errno` to indicate the error.

**NOTES**

`msync` should be used by programs that require a memory object to be in a known state, for example, in building transaction facilities.

**NAME**

nl\_langinfo - language information

**SYNOPSIS**

```
#include <nl_types.h>
#include <langinfo.h>

char *nl_langinfo (nl_item item);
```

**DESCRIPTION**

nl\_langinfo returns a pointer to a null-terminated string containing information relevant to a particular language or cultural area defined in the programs locale. The manifest constant names and values of *item* are defined by langinfo.h.

For example:

```
nl_langinfo (ABDAY_1);
```

would return a pointer to the string "Dim" if the identified language was French and a French locale was correctly installed; or "Sun" if the identified language was English.

**SEE ALSO**

gettext(3C), localeconv(3C), setlocale(3C), strftime(3C), langinfo(5), nl\_types(5).

**DIAGNOSTICS**

If setlocale has not been called successfully, or if langinfo data for a supported language is either not available or *item* is not defined therein, then nl\_langinfo returns a pointer to the corresponding string in the C locale. In all locales, nl\_langinfo returns a pointer to an empty string if *item* contains an invalid setting.

**WARNING**

The array pointed to by the return value should not be modified by the program. Subsequent calls to nl\_langinfo may overwrite the array.

The nl\_langinfo function is built upon the functions localeconv, strftime, and gettext [see langinfo(5)]. Where possible users are advised to use these interfaces to the required data instead of using calls to nl\_langinfo.



**offsetof(3C)**

**offsetof(3C)**

**NAME**

`offsetof` - offset of structure member

**SYNOPSIS**

```
#include <stddef.h>
size_t offsetof (type, member-designator);
```

**DESCRIPTION**

`offsetof` is a macro defined in `stddef.h` which expands to an integral constant expression that has type `size_t`, the value of which is the offset in bytes, to the structure member (designated by *member-designator*), from the beginning of its structure (designated by *type*).

**NAME**

**perror** - print system error messages

**SYNOPSIS**

```
#include <stdio.h>
void perror (const char *s);
```

**DESCRIPTION**

**perror** produces a message on the standard error output (file descriptor 2), describing the last error encountered during a call to a system or library function. The argument string *s* is printed first, then a colon and a blank, then the message and a newline. (However, if *s* is a null pointer or points to a null string, the colon is not printed.) To be of most use, the argument string should include the name of the program that incurred the error. The error number is taken from the external variable *errno*, which is set when errors occur but not cleared when non-erroneous calls are made.

**SEE ALSO**

*intro(2)*, *fmtmsg(3C)*, *strerror(3C)*.

**NAME**

**popen**, **pclose** – initiate pipe to/from a process

**SYNOPSIS**

```
#include <stdio.h>
FILE *popen (const char *command, const char *type);
int pclose (FILE *stream);
```

**DESCRIPTION**

**popen** creates a pipe between the calling program and the command to be executed. The arguments to **popen** are pointers to null-terminated strings. *command* consists of a shell command line. *type* is an I/O mode, either *r* for reading or *w* for writing. The value returned is a stream pointer such that one can write to the standard input of the command, if the I/O mode is *w*, by writing to the file *stream* [see **intro(3)**]; and one can read from the standard output of the command, if the I/O mode is *r*, by reading from the file *stream*.

A stream opened by **popen** should be closed by **pclose**, which waits for the associated process to terminate and returns the exit status of the command.

Because open files are shared, a type *r* command may be used as an input filter and a type *w* as an output filter.

**EXAMPLE**

Here is an example of a typical call:

```
#include <stdio.h>
#include <stdlib.h>

main()
{
 char *cmd = "/usr/bin/ls *.c";
 char buf[BUFSIZ];
 FILE *ptr;

 if ((ptr = popen(cmd, "r")) != NULL)
 while (fgets(buf, BUFSIZ, ptr) != NULL)
 (void) printf("%s", buf);
 return 0;
}
```

This program will print on the standard output [see **stdio(3S)**] all the file names in the current directory that have a *.c* suffix.

**SEE ALSO**

**pipe(2)**, **wait(2)**, **fclose(3S)**, **fopen(3S)**, **stdio(3S)**, **system(3S)**.

**DIAGNOSTICS**

**popen** returns a null pointer if files or processes cannot be created.

**pclose** returns *-1* if *stream* is not associated with a **popen**ed command.

**NOTES**

If the original and `popened` processes concurrently read or write a common file, neither should use buffered I/O. Problems with an output filter may be forestalled by careful buffer flushing, e.g., with `fflush` [see `fclose(3S)`].

A security hole exists through the `IFS` and `PATH` environment variables. Full pathnames should be used (or `PATH` reset) and `IFS` should be set to space and tab (" \t").

## NAME

printf, fprintf, sprintf – print formatted output

## SYNOPSIS

```
#include <stdio.h>

int printf(const char *format, .../* args */);
int fprintf(FILE *strm, const char *format, .../* args */);
int sprintf(char *s, const char *format, .../* args */);
```

## DESCRIPTION

printf places output on the standard output stream `stdout`.

fprintf places output on `strm`.

sprintf places output, followed by the null character (`\0`), in consecutive bytes starting at `s`. It is the user's responsibility to ensure that enough storage is available. Each function returns the number of characters transmitted (not including the `\0` in the case of `sprintf`) or a negative value if an output error was encountered.

Each of these functions converts, formats, and prints its *args* under control of the *format*. The *format* is a character string that contains three types of objects defined below:

1. plain characters that are simply copied to the output stream;
2. escape sequences that represent non-graphic characters;
3. conversion specifications.

The following escape sequences produce the associated action on display devices capable of the action:

- `\a` Alert. Ring the bell.
- `\b` Backspace. Move the printing position to one character before the current position, unless the current position is the start of a line.
- `\f` Form feed. Move the printing position to the initial printing position of the next logical page.
- `\n` Newline. Move the printing position to the start of the next line.
- `\r` Carriage return. Move the printing position to the start of the current line.
- `\t` Horizontal tab. Move the printing position to the next implementation-defined horizontal tab position on the current line.
- `\v` Vertical tab. Move the printing position to the start of the next implementation-defined vertical tab position.

All forms of the `printf` functions allow for the insertion of a language-dependent decimal-point character. The decimal-point character is defined by the program's locale (category `LC_NUMERIC`). In the `C` locale, or in a locale where the decimal-point character is not defined, the decimal-point character defaults to a period (`.`).

Each conversion specification is introduced by the character `%`. After the character `%`, the following appear in sequence:

An optional field, consisting of a decimal digit string followed by a `$`, specifying the next *args* to be converted. If this field is not provided, the *args* following the last *args* converted will be used.

Zero or more *flags*, which modify the meaning of the conversion specification.

An optional string of decimal digits to specify a minimum *field width*. If the converted value has fewer characters than the field width, it will be padded on the left (or right, if the left-adjustment flag (`-`), described below, has been given) to the field width.

An optional precision that gives the minimum number of digits to appear for the `d`, `i`, `o`, `u`, `x`, or `X` conversions (the field is padded with leading zeros), the number of digits to appear after the decimal-point character for the `e`, `E`, and `f` conversions, the maximum number of significant digits for the `g` and `G` conversions, or the maximum number of characters to be printed from a string in `s` conversion. The precision takes the form of a period (`.`) followed by a decimal digit string; a null digit string is treated as zero. Padding specified by the precision overrides the padding specified by the field width.

An optional `h` specifies that a following `d`, `i`, `o`, `u`, `x`, or `X` conversion specifier applies to a `short int` or `unsigned short int` argument (the argument will be promoted according to the integral promotions and its value converted to `short int` or `unsigned short int` before printing); an optional `h` specifies that a following `n` conversion specifier applies to a pointer to a `short int` argument. An optional `l` (`ell`) specifies that a following `d`, `i`, `o`, `u`, `x`, or `X` conversion specifier applies to a `long int` or `unsigned long int` argument; an optional `l` (`ell`) specifies that a following `n` conversion specifier applies to a pointer to `long int` argument. An optional `L` specifies that a following `e`, `E`, `f`, `g`, or `G` conversion specifier applies to a `long double` argument. If an `h`, `l`, or `L` appears before any other conversion specifier, the behavior is undefined.

A conversion character (see below) that indicates the type of conversion to be applied.

A field width or precision may be indicated by an asterisk (`*`) instead of a digit string. In this case, an integer *args* supplies the field width or precision. The *args* that is actually converted is not fetched until the conversion letter is seen, so the *args* specifying field width or precision must appear before the *args* (if any) to be converted. If the *precision* argument is negative, it will be changed to zero. A negative field width argument is taken as a `-` flag, followed by a positive field width.

In format strings containing the `*digits$` form of a conversion specification, a field width or precision may also be indicated by the sequence `*digits$`, giving the position in the argument list of an integer *args* containing the field width or precision.

When numbered argument specifications are used, specifying the *N*th argument requires that all the leading arguments, from the first to the (*N*-1)th, be specified in the format string.

The *flag* characters and their meanings are:

- The result of the conversion will be left-justified within the field. (It will be right-justified if this flag is not specified.)
- + The result of a signed conversion will always begin with a sign (+ or -). (It will begin with a sign only when a negative value is converted if this flag is not specified.)
- space If the first character of a signed conversion is not a sign, a space will be placed before the result. This means that if the space and + flags both appear, the space flag will be ignored.
- # The value is to be converted to an alternate form. For *c*, *d*, *i*, *s*, and *u* conversions, the flag has no effect. For an *o* conversion, it increases the precision to force the first digit of the result to be a zero. For *x* (or *X*) conversion, a non-zero result will have *0x* (or *0X*) prepended to it. For *e*, *E*, *f*, *g*, and *G* conversions, the result will always contain a decimal-point character, even if no digits follow the point (normally, a decimal point appears in the result of these conversions only if a digit follows it). For *g* and *G* conversions, trailing zeros will not be removed from the result as they normally are.
- 0 For *d*, *i*, *o*, *u*, *x*, *X*, *e*, *E*, *f*, *g*, and *G* conversions, leading zeros (following any indication of sign or base) are used to pad to the field width; no space padding is performed. If the 0 and - flags both appear, the 0 flag will be ignored. For *d*, *i*, *o*, *u*, *x*, and *X* conversions, if a precision is specified, the 0 flag will be ignored. For other conversions, the behavior is undefined.

Each conversion character results in fetching zero or more *args*. The results are undefined if there are insufficient *args* for the format. If the format is exhausted while *args* remain, the excess *args* are ignored.

The conversion characters and their meanings are:

- d,i,o,u,x,X** The integer *arg* is converted to signed decimal (*d* or *i*), (unsigned octal (*o*), unsigned decimal (*u*), or unsigned hexadecimal notation (*x* and *X*). The *x* conversion uses the letters *abcdef* and the *X* conversion uses the letters *ABCDEF*. The precision specifies the minimum number of digits to appear. If the value being converted can be represented in fewer digits than the specified minimum, it will be expanded with leading zeros. The default precision is 1. The result of converting a zero value with a precision of zero is no characters.
- f** The double *args* is converted to decimal notation in the style *[-]ddd.ddd*, where the number of digits after the decimal-point character [see `setlocale(3C)`] is equal to the precision specification. If the precision is omitted from *arg*, six digits are output; if the precision is explicitly zero and the # flag is not specified, no decimal-point character appears. If a decimal-point

character appears, at least 1 digit appears before it. The value is rounded to the appropriate number of digits.

- e,E      The double *args* is converted to the style [-]d.ddde±dd, where there is one digit before the decimal-point character (which is non-zero if the argument is non-zero) and the number of digits after it is equal to the precision. When the precision is missing, six digits are produced; if the precision is zero and the # flag is not specified, no decimal-point character appears. The E conversion character will produce a number with E instead of e introducing the exponent. The exponent always contains at least two digits. The value is rounded to the appropriate number of digits.
- g,G      The double *args* is printed in style f or e (or in style E in the case of a G conversion character), with the precision specifying the number of significant digits. If the precision is zero, it is taken as one. The style used depends on the value converted: style e (or E) will be used only if the exponent resulting from the conversion is less than -4 or greater than or equal to the precision. Trailing zeros are removed from the fractional part of the result. A decimal-point character appears only if it is followed by a digit.
- c        The int *args* is converted to an unsigned char, and the resulting character is printed.
- s        The *args* is taken to be a string (character pointer) and characters from the string are written up to (but not including) a terminating null character; if the precision is specified, no more than that many characters are written. If the precision is not specified, it is taken to be infinite, so all characters up to the first null character are printed. A NULL value for *args* will yield undefined results.
- p        The *args* should be a pointer to void. The value of the pointer is converted to an implementation-defined set of sequences of printable characters, which should be the same as the set of sequences that are matched by the %p conversion of the scanf function.
- n        The argument should be a pointer to an integer into which is written the number of characters written to the output standard I/O stream so far by this call to printf, fprintf, or sprintf. No argument is converted.
- %        Print a %; no argument is converted.

If the character after the % or %digits\$ sequence is not a valid conversion character, the results of the conversion are undefined.

If a floating-point value is the internal representation for infinity, the output is [±]inf, where inf is either inf or INF, depending on the conversion character. Printing of the sign follows the rules described above.



## printf(3S)

## printf(3S)

If a floating-point value is the internal representation for "not-a-number," the output is  $[\pm]nan0xm$ . Depending on the conversion character, *nan* is either *nan* or *NAN*. Additionally,  $0xm$  represents the most significant part of the mantissa. Again depending on the conversion character, *x* will be *x* or *X*, and *m* will use the letters *abcdef* or *ABCDEF*. Printing of the sign follows the rules described above.

In no case does a non-existent or small field width cause truncation of a field; if the result of a conversion is wider than the field width, the field is simply expanded to contain the conversion result. Characters generated by `printf` and `fprintf` are printed as if the `putc` routine had been called.

### EXAMPLE

To print a date and time in the form *Sunday, July 3, 10:02*, where *weekday* and *month* are pointers to null-terminated strings:

```
printf("%s, %s %i, %d:%.2d",
 weekday, month, day, hour, min);
```

To print  $\pi$  to 5 decimal places:

```
printf("pi = %.5f", 4 * atan(1.0));
```

### SEE ALSO

`exit(2)`, `lseek(2)`, `write(2)`, `abort(3C)`, `ecvt(3C)`, `putc(3S)`, `scanf(3S)`, `setlocale(3C)`, `stdio(3S)`.

### DIAGNOSTICS

`printf`, `fprintf`, and `sprintf` return the number of characters transmitted, or return a negative value if an error was encountered.

**NAME**

`psignal`, `psiginfo` - system signal messages

**SYNOPSIS**

```
#include <siginfo.h>
void psignal (int sig, const char *s);
void psiginfo (siginfo_t *pinfo, char *s);
```

**DESCRIPTION**

`psignal` and `psiginfo` produce messages on the standard error output describing a signal. *sig* is a signal that may have been passed as the first argument to a signal handler. *pinfo* is a pointer to a `siginfo` structure that may have been passed as the second argument to an enhanced signal handler [see `sigaction(2)`]. The argument string *s* is printed first, then a colon and a blank, then the message and a newline.

**SEE ALSO**

`sigaction(2)`, `perror(3)`, `siginfo(5)`, `signal(5)`.

**NAME**

putc, putchar, fputc, putw – put character or word on a stream

**SYNOPSIS**

```
#include <stdio.h>
int putc (int c, FILE *stream);
int putchar (int c);
int fputc (int c, FILE *stream);
int putw (int w, FILE *stream);
```

**DESCRIPTION**

putc writes *c* (converted to an unsigned char) onto the output *stream* [see intro(3)] at the position where the file pointer (if defined) is pointing, and advances the file pointer appropriately. If the file cannot support positioning requests, or *stream* was opened with append mode, the character is appended to the output *stream*. putchar(*c*) is defined as putc(*c*, stdout). putc and putchar are macros.

fputc behaves like putc, but is a function rather than a macro. fputc runs more slowly than putc, but it takes less space per invocation and its name can be passed as an argument to a function.

putw writes the word (i.e., integer) *w* to the output *stream* (where the file pointer, if defined, is pointing). The size of a word is the size of an integer and varies from machine to machine. putw neither assumes nor causes special alignment in the file.

**SEE ALSO**

exit(2), lseek(2), write(2), abort(3C), fclose(3S), perror(3S), fopen(3S), fread(3S), printf(3S), puts(3S), setbuf(3S), stdio(3S).

**DIAGNOSTICS**

On success, these functions (with the exception of putw) each return the value they have written. putw returns perror(*stream*). On failure, they return the constant EOF. This result will occur, for example, if the file *stream* is not open for writing or if the output file cannot grow.

**NOTES**

Because it is implemented as a macro, putc evaluates a *stream* argument more than once. In particular, putc(*c*, \*f++); doesn't work sensibly. fputc should be used instead.

Because of possible differences in word length and byte ordering, files written using putw are machine-dependent, and may not be read using getw on a different processor.

Functions exist for all the above defined macros. To get the function form, the macro name must be undefined (e.g., #undef putc).

## puts(3S)

## puts(3S)

### NAME

puts, fputs – put a string on a stream

### SYNOPSIS

```
#include <stdio.h>
int puts (const char *s);
int fputs (const char *s, FILE *stream);
```

### DESCRIPTION

**puts** writes the string pointed to by *s*, followed by a new-line character, to the standard output stream `stdout` [see `intro(3)`].

**fputs** writes the null-terminated string pointed to by *s* to the named output *stream*.

Neither function writes the terminating null character.

### SEE ALSO

`exit(2)`, `lseek(2)`, `write(2)`, `abort(3C)`, `fclose(3S)`, `ferror(3S)`, `fopen(3S)`, `fread(3S)`, `printf(3S)`, `putc(3S)`, `stdio(3S)`.

### DIAGNOSTICS

On success both routines return the number of characters written; otherwise they return EOF.

### NOTES

**puts** appends a new-line character while **fputs** does not.

**NAME**

putenv – change or add value to environment

**SYNOPSIS**

```
#include <stdlib.h>

int putenv (char *string);
```

**DESCRIPTION**

*string* points to a string of the form "*name=value*." putenv makes the value of the environment variable *name* equal to *value* by altering an existing variable or creating a new one. In either case, the string pointed to by *string* becomes part of the environment, so altering the string will change the environment. The space used by *string* is no longer used once a new string-defining *name* is passed to putenv. Because of this limitation, *string* should be declared static if it is declared within a function.

**SEE ALSO**

exec(2), getenv(3C), malloc(3C), environ(5).

**DIAGNOSTICS**

putenv returns non-zero if it was unable to obtain enough space via malloc for an expanded environment, otherwise zero.

**NOTES**

putenv manipulates the environment pointed to by *environ*, and can be used in conjunction with *getenv*. However, *envp* (the third argument to *main*) is not changed.

This routine uses *malloc(3C)* to enlarge the environment.

After putenv is called, environmental variables are not in alphabetical order. A potential error is to call the function putenv with a pointer to an automatic variable as the argument and to then exit the calling function while *string* is still part of the environment.

**NAME**

putpwent - write password file entry

**SYNOPSIS**

```
#include <pwd.h>

int putpwent (const struct passwd *p, FILE *f);
```

**DESCRIPTION**

putpwent is the inverse of getpwent(3C). Given a pointer to a passwd structure created by getpwent (or getpwuid or getpwnam), putpwent writes a line on the stream *f*, which matches the format of /etc/passwd.

**SEE ALSO**

getpwent(3C).

**DIAGNOSTICS**

putpwent returns non-zero if an error was detected during its operation, otherwise zero.

**NAME**

putspent – write shadow password file entry

**SYNOPSIS**

```
#include <shadow.h>
```

```
int putspent (const struct spwd *p, FILE *fp);
```

**DESCRIPTION**

The putspent routine is the inverse of getspent. Given a pointer to a spwd structure created by the getspent routine (or the getspnam routine), the putspent routine writes a line on the stream *fp*, which matches the format of */etc/shadow*.

If the *sp\_min*, *sp\_max*, *sp\_lstchg*, *sp\_warn*, *sp\_inact*, or *sp\_expire* field of the spwd structure is -1, or if *sp\_flag* is 0, the corresponding */etc/shadow* field is cleared.

**SEE ALSO**

getspent(3C), getpwent(3C), putpwent(3C).

**DIAGNOSTICS**

The putspent routine returns non-zero if an error was detected during its operation, otherwise zero.

**NOTES**

This routine is for internal use only, compatibility is not guaranteed.

**NAME**

qsort – quicker sort

**SYNOPSIS**

```
#include <stdlib.h>

void qsort (void* base, size_t nel, size_t width), int (*compar)
 (const void *, const void *));
```

**DESCRIPTION**

qsort is an implementation of the quicker-sort algorithm. It sorts a table of data in place. The contents of the table are sorted in ascending order according to the user-supplied comparison function.

*base* points to the element at the base of the table. *nel* is the number of elements in the table. *width* specifies the size of each element in bytes. *compar* is the name of the comparison function, which is called with two arguments that point to the elements being compared. The function must return an integer less than, equal to, or greater than zero to indicate if the first argument is to be considered less than, equal to, or greater than the second.

The contents of the table are sorted in ascending order according to the user supplied comparison function.

**SEE ALSO**

**bsearch(3C)**, **lsearch(3C)**, **string(3C)**.  
**sort(1)** in the *User's Reference Manual*.

**NOTES**

The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

The relative order in the output of two items that compare as equal is unpredictable.



**raise(3C)**

**raise(3C)**

**NAME**

raise – send signal to program

**SYNOPSIS**

```
#include <signal.h>
int raise (int sig);
```

**DESCRIPTION**

raise sends the signal *sig* to the executing program.

raise returns zero if the operation succeeds. Otherwise, raise returns -1 and *errno* is set to indicate the error. raise uses kill to send the signal to the executing program:

```
kill(getpid(), sig);
```

See kill(2) for a detailed list of failure conditions. See signal(2) for a list of signals.

**SEE ALSO**

getpid(2), kill(2), signal(2).

**NAME**

rand, srand – simple random-number generator

**SYNOPSIS**

```
#include <stdlib.h>
int rand (void);
void srand (unsigned int seed);
```

**DESCRIPTION**

rand uses a multiplicative congruential random-number generator with period  $2^{32}$  that returns successive pseudo-random numbers in the range from 0 to `RAND_MAX` (defined in `stdlib.h`).

The function `srand` uses the argument *seed* as a seed for a new sequence of pseudo-random numbers to be returned by subsequent calls to the function `rand`. If the function `srand` is then called with the same *seed* value, the sequence of pseudo-random numbers will be repeated. If the function `rand` is called before any calls to `srand` have been made, the same sequence will be generated as when `srand` is first called with a *seed* value of 1.

**NOTES**

The spectral properties of `rand` are limited. `drand48(3C)` provides a much better, though more elaborate, random-number generator.

**SEE ALSO**

`drand48(3C)`.

**NAME**

`realpath` - returns the real file name

**SYNOPSIS**

```
#include <stdlib.h>
#include <sys/param.h>

char *realpath (char * file_name, char * resolved_name);
```

**DESCRIPTION**

`realpath` resolves all links and references to "." and ".." in *file\_name* and stores it in *resolved\_name*.

It can handle both relative and absolute path names. For absolute path names and the relative names whose resolved name cannot be expressed relatively (e.g., `../../reldir`), it returns the *resolved absolute* name. For the other relative path names, it returns the *resolved relative* name.

*resolved\_name* must be big enough (`MAXPATHLEN`) to contain the fully resolved path name.

**SEE ALSO**

`getcwd(3C)`.

**DIAGNOSTICS**

If there is no error, `realpath` returns a pointer to the *resolved name*. Otherwise it returns a null pointer and places the name of the offending file in *resolved\_name*. The global variable `errno` is set to indicate the error.

**NOTES**

`realpath` operates on null-terminated strings.

One should have execute permission on all the directories in the given and the resolved path.

`realpath` may fail to return to the current directory if an error occurs.

**remove(3C)**

**remove(3C)**

**NAME**

`remove` – remove file

**SYNOPSIS**

```
#include <stdio.h>

int remove(const char *path);
```

**DESCRIPTION**

`remove` causes the file or empty directory whose name is the string pointed to by *path* to be no longer accessible by that name. A subsequent attempt to open that file using that name will fail, unless the file is created anew.

For files, `remove` is identical to `unlink`. For directories, `remove` is identical to `rmdir`.

See `rmdir(2)` and `unlink(2)` for a detailed list of failure conditions.

**SEE ALSO**

`rmdir(2)`, `unlink(2)`.

**RETURN VALUE**

Upon successful completion, `remove` returns a value of 0; otherwise, it returns a value of -1 and sets `errno` to indicate an error.

## NAME

`scanf`, `fscanf`, `sscanf` – convert formatted input

## SYNOPSIS

```
#include <stdio.h>

int scanf(const char *format, ...);
int fscanf(FILE *stream, const char *format, ...);
int sscanf(const char *s, const char *format, ...);
```

## DESCRIPTION

`scanf` reads from the standard input stream, `stdin`.

`fscanf` reads from the stream `stream`.

`sscanf` reads from the character string `s`.

Each function reads characters, interprets them according to a format, and stores the results in its arguments. Each expects, as arguments, a control string, *format*, described below and a set of pointer arguments indicating where the converted input should be stored. If there are insufficient arguments for the format, the behavior is undefined. If the format is exhausted while arguments remain, the excess arguments are simply ignored.

The control string usually contains conversion specifications, which are used to direct interpretation of input sequences. The control string may contain:

1. White-space characters (blanks, tabs, new-lines, or form-feeds) that, except in two cases described below, cause input to be read up to the next non-white-space character.
2. An ordinary character (not %) that must match the next character of the input stream.
3. Conversion specifications consisting of the character % or the character sequence *%digits\$*, an optional assignment suppression character \*, a decimal digit string that specifies an optional numerical maximum field width, an optional letter l (ell), L, or h indicating the size of the receiving object, and a conversion code. The conversion specifiers `d`, `i`, and `n` should be preceded by `h` if the corresponding argument is a pointer to `short int` rather than a pointer to `int`, or by `l` if it is a pointer to `long int`. Similarly, the conversion specifiers `o`, `u`, and `x` should be preceded by `h` if the corresponding argument is a pointer to `unsigned short int` rather than a pointer to `unsigned int`, or by `l` if it is a pointer to `unsigned long int`. Finally, the conversion specifiers `e`, `f`, and `g` should be preceded by `l` if the corresponding argument is a pointer to `double` rather than a pointer to `float`, or by `L` if it is a pointer to `long double`. The `h`, `l`, or `L` modifier is ignored with any other conversion specifier.

A conversion specification directs the conversion of the next input field; the result is placed in the variable pointed to by the corresponding argument unless assignment suppression was indicated by the character \*. The suppression of assignment provides a way of describing an input field that is to be skipped. An input field is defined as a string of non-space characters; it extends to the next

inappropriate character or until the maximum field width, if one is specified, is exhausted. For all descriptors except the character `[]` and the character `c`, white space leading an input field is ignored.

Conversions can be applied to the *n*th argument in the argument list, rather than to the next unused argument. In this case, the conversion character `%` (see above) is replaced by the sequence `%digits$` where *digits* is a decimal integer *n*, giving the position of the argument in the argument list. The first such argument, `%1$`, immediately follows *format*. The control string can contain either form of a conversion specification, i.e., `%` or `%digits$`, although the two forms cannot be mixed within a single control string.

The conversion code indicates the interpretation of the input field; the corresponding pointer argument must usually be of a restricted type. For a suppressed field, no pointer argument is given. The following conversion codes are valid:

- `%` A single `%` is expected in the input at this point; no assignment is done.
- `d` Matches an optionally signed decimal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 10 for the *base* argument. The corresponding argument should be a pointer to integer.
- `u` Matches an optionally signed decimal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 10 for the *base* argument. The corresponding argument should be a pointer to unsigned integer.
- `o` Matches an optionally signed octal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 8 for the *base* argument. The corresponding argument should be a pointer to unsigned integer.
- `x` Matches an optionally signed hexadecimal integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 16 for the *base* argument. The corresponding argument should be a pointer to unsigned integer.
- `i` Matches an optionally signed integer, whose format is the same as expected for the subject sequence of the `strtoul` function with the value 0 for the *base* argument. The corresponding argument should be a pointer to integer.
- `n` No input is consumed. The corresponding argument should be a pointer to integer into which is to be written the number of characters read from the input stream so far by the call to the function. Execution of a `%n` directive does not increment the assignment count returned at the completion of execution of the function.
- `e,f,g` Matches an optionally signed floating point number, whose format is the same as expected for the subject string of the `strtod` function. The corresponding argument should be a pointer to floating.

- s A character string is expected; the corresponding argument should be a character pointer pointing to an array of characters large enough to accept the string and a terminating `\0`, which will be added automatically. The input field is terminated by a white-space character.
- c Matches a sequence of characters of the number specified by the field width (1 if no field width is present in the directive). The corresponding argument should be a pointer to the initial character of an array large enough to accept the sequence. No null character is added. The normal skip over white space is suppressed.
- [ Matches a nonempty sequence of characters from a set of expected characters (the *scanset*). The corresponding argument should be a pointer to the initial character of an array large enough to accept the sequence and a terminating null character, which will be added automatically. The conversion specifier includes all subsequent characters in the *format* string, up to and including the matching right bracket (`]`). The characters between the brackets (the *scanlist*) comprise the scanset, unless the character after the left bracket is a circumflex (`^`), in which case the scanset contains all characters that do not appear in the scanlist between the circumflex and the right bracket. If the conversion specifier begins with `[]` or `[^]`, the right bracket character is in the scanlist and the next right bracket character is the matching right bracket that ends the specification; otherwise the first right bracket character is the one that ends the specification.

A range of characters in the scanset may be represented by the construct *first* - *last*; thus `[0123456789]` may be expressed `[0-9]`. Using this convention, *first* must be lexically less than or equal to *last*, or else the dash will stand for itself. The character `-` will also stand for itself whenever it is the first or the last character in the scanlist. To include the right bracket as an element of the scanset, it must appear as the first character (possibly preceded by a circumflex) of the scanlist and in this case it will not be syntactically interpreted as the closing bracket. At least one character must match for this conversion to be considered successful.

- p Matches an implementation-defined set of sequences, which should be the same as the set of sequences that may be produced by the `%p` conversion of the `printf` function. The corresponding argument should be a pointer to `void`. The interpretation of the input item is implementation-defined. If the input item is a value converted earlier during the same program execution, the pointer that results shall compare equal to that value; otherwise, the behavior of the `%p` conversion is undefined.

If an invalid conversion character follows the `%`, the results of the operation may not be predictable.

The conversion specifiers `E`, `G`, and `X` are also valid and, under the `-Xa` and `-Xc` compilation modes [see `cc(1)`], behave the same as `e`, `g`, and `x`, respectively. Under the `-Xt` compilation mode, `E`, `G`, and `X` behave the same as `le`, `lg`, and `lx`, respectively.

Each function allows for detection of a language-dependent decimal point character in the input string. The decimal point character is defined by the program's locale (category `LC_NUMERIC`). In the "C" locale, or in a locale where the decimal point character is not defined, the decimal point character defaults to a period (`.`).

The `scanf` conversion terminates at end of file, at the end of the control string, or when an input character conflicts with the control string.

If end-of-file is encountered during input, conversion is terminated. If end-of-file occurs before any characters matching the current directive have been read (other than leading white space, where permitted), execution of the current directive terminates with an input failure; otherwise, unless execution of the current directive is terminated with a matching failure, execution of the following directive (if any) is terminated with an input failure.

If conversion terminates on a conflicting input character, the offending input character is left unread in the input stream. Trailing white space (including new-line characters) is left unread unless matched by a directive. The success of literal matches and suppressed assignments is not directly determinable other than via the `%n` directive.

#### EXAMPLES

The call to the function `scanf`:

```
int i, n; float x; char name[50];
n = scanf ("%d%f%s", &i, &x, name);
```

with the input line:

```
25 54.32E-1 thompson
```

will assign to `n` the value 3, to `i` the value 25, to `x` the value 5.432, and `name` will contain `thompson\0`.

The call to the function `scanf`:

```
int i; float x; char name[50];
(void) scanf ("%2d%f*d %[0-9]", &i, &x, name);
```

with the input line:

```
56789 0123 56a72
```

will assign 56 to `i`, 789.0 to `x`, skip 0123, and place the characters 56\0 in `name`. The next character read from `stdin` will be `a`.

#### SEE ALSO

`cc(1)`, `printf(3S)`, `strtod(3C)`, `strtol(3C)`, `strtoul(3C)`.

#### DIAGNOSTICS

These routines return the number of successfully matched and assigned input items; this number can be zero in the event of an early matching failure between an input character and the control string. If the input ends before the first matching failure or conversion, `EOF` is returned.



## NAME

setbuf, setvbuf – assign buffering to a stream

## SYNOPSIS

```
#include <stdio.h>

void setbuf (FILE *stream, char *buf);
int setvbuf (FILE *stream, char *buf, int type, size_t size);
```

## DESCRIPTION

setbuf may be used after a *stream* [see intro(3)] has been opened but before it is read or written. It causes the array pointed to by *buf* to be used instead of an automatically allocated buffer. If *buf* is the NULL pointer input/output will be completely unbuffered.

While there is no limitation on the size of the buffer, the constant BUFSIZ, defined in the <stdio.h> header file, is typically a good buffer size:

```
char buf[BUFSIZ];
```

setvbuf may be used after a stream has been opened but before it is read or written. *type* determines how *stream* will be buffered. Legal values for *type* (defined in *stdio.h*) are:

- \_IOFBF causes input/output to be fully buffered.
- \_IOLBF causes output to be line buffered; the buffer will be flushed when a newline is written, the buffer is full, or input is requested.
- \_IONBF causes input/output to be completely unbuffered.

If *buf* is not the NULL pointer, the array it points to will be used for buffering, instead of an automatically allocated buffer. *size* specifies the size of the buffer to be used. If input/output is unbuffered, *buf* and *size* are ignored.

For a further discussion of buffering, see *stdio(3S)*.

## SEE ALSO

*fopen(3S)*, *getc(3S)*, *malloc(3C)*, *putc(3S)*, *stdio(3S)*.

## DIAGNOSTICS

If an illegal value for *type* is provided, *setvbuf* returns a non-zero value. Otherwise, it returns zero.

## NOTES

A common source of error is allocating buffer space as an “automatic” variable in a code block, and then failing to close the stream in the same block.

Parts of *buf* will be used for internal bookkeeping of the stream and, therefore, *buf* will contain less than *size* bytes when full. It is recommended that the automatically allocated buffer is used when using *setvbuf*.

## NAME

setjmp, longjmp – non-local goto

## SYNOPSIS

```
#include <setjmp.h>
int setjmp (jmp_buf env);
void longjmp (jmp_buf env, int val);
```

## DESCRIPTION

These functions are useful for dealing with errors and interrupts encountered in a low-level subroutine of a program.

`setjmp` saves its stack environment in `env` (whose type, `jmp_buf`, is defined in the `<setjmp.h>` header file) for later use by `longjmp`. It returns the value 0.

`longjmp` restores the environment saved by the last call of `setjmp` with the corresponding `env` argument. After `longjmp` is completed, program execution continues as if the corresponding call of `setjmp` had just returned the value `val`. (The caller of `setjmp` must not have returned in the interim.) `longjmp` cannot cause `setjmp` to return the value 0. If `longjmp` is invoked with a second argument of 0, `setjmp` will return 1. At the time of the second return from `setjmp`, all external and static variables have values as of the time `longjmp` is called (see example). The values of register and automatic variables are undefined.

Register or automatic variables whose value must be relied upon must be declared as `volatile`.

## EXAMPLE

```
#include <stdio.h>
#include <stdlib.h>
#include <setjmp.h>

jmp_buf env;
int i = 0;
main ()
{
 void exit();

 if(setjmp(env) != 0) {
 (void) printf("value of i on 2nd return from setjmp: %d\n", i);
 exit(0);
 }
 (void) printf("value of i on 1st return from setjmp: %d\n", i);
 i = 1;
 g();
 /* NOTREACHED */
}
g()
{
 longjmp(env, 1);
 /* NOTREACHED */
}
```

**setjmp(3C)**

**setjmp(3C)**

If the a.out resulting from this C language code is run, the output will be:

value of i on 1st return from setjmp: 0

value of i on 2nd return from setjmp: 1

**SEE ALSO**

signal(2), sigsetjmp(3C).

**NOTES**

If longjmp is called even though env was never primed by a call to setjmp, or when the last such call was in a function that has since returned, absolute chaos is guaranteed.

## NAME

setlocale – modify and query a program's locale

## SYNOPSIS

```
#include <locale.h>

char *setlocale (int category, const char *locale);
```

## DESCRIPTION

setlocale selects the appropriate piece of the program's locale as specified by the *category* and *locale* arguments. The *category* argument may have the following values: LC\_CTYPE, LC\_NUMERIC, LC\_TIME, LC\_COLLATE, LC\_MONETARY, LC\_MESSAGES and LC\_ALL. These names are defined in the locale.h header file. LC\_CTYPE affects the behavior of the character handling functions (isdigit, tolower, etc.) and the multibyte character functions (such as mbtowc and wctomb). LC\_NUMERIC affects the decimal-point character for the formatted input/output functions and the string conversion functions as well as the non-monetary formatting information returned by localeconv. [See localeconv(3C).] LC\_TIME affects the behavior of ascftime, cftime, getdate and strftime. LC\_COLLATE affects the behavior of strcoll and strxfrm. LC\_MONETARY affects the monetary formatted information returned by localeconv. LC\_MESSAGES affects the behavior of gettext, catopen, catclose, and catgets. [See catopen(3C) and catgets(3C).] LC\_ALL names the program's entire locale.

Each category corresponds to a set of databases which contain the relevant information for each defined locale. The location of a database is given by the following path, /usr/lib/locale/locale/category, where *locale* and *category* are the names of locale and category, respectively. For example, the database for the LC\_CTYPE category for the "german" locale would be found in /usr/lib/locale/german/LC\_CTYPE.

A value of "C" for *locale* specifies the default environment.

A value of "" for *locale* specifies that the locale should be taken from environment variables. The order in which the environment variables are checked for the various categories is given below:

| Category     | 1st Env. Var. | 2nd Env. Var |
|--------------|---------------|--------------|
| LC_CTYPE:    | LC_CTYPE      | LANG         |
| LC_COLLATE:  | LC_COLLATE    | LANG         |
| LC_TIME:     | LC_TIME       | LANG         |
| LC_NUMERIC:  | LC_NUMERIC    | LANG         |
| LC_MONETARY: | LC_MONETARY   | LANG         |
| LC_MESSAGES: | LC_MESSAGES   | LANG         |

At program startup, the equivalent of

```
setlocale(LC_ALL, "C")
```

is executed. This has the effect of initializing each category to the locale described by the environment "C".

If a pointer to a string is given for *locale*, `setlocale` attempts to set the locale for the given category to *locale*. If `setlocale` succeeds, *locale* is returned. If `setlocale` fails, a null pointer is returned and the program's locale is not changed.

For category `LC_ALL`, the behavior is slightly different. If a pointer to a string is given for *locale* and `LC_ALL` is given for *category*, `setlocale` attempts to set the locale for all the categories to *locale*. The *locale* may be a simple locale, consisting of a single locale, or a composite locale. A composite locale is a string beginning with a "/" followed by the locale of each category separated by a "/". If `setlocale` fails to set the locale for any category, a null pointer is returned and the program's locale for all categories is not changed. Otherwise, *locale* is returned.

A null pointer for *locale* causes `setlocale` to return the current locale associated with the *category*. The program's locale is not changed.

#### FILES

`/usr/lib/locale/C/LC_CTYPE` - `LC_CTYPE` database for the C locale.  
`/usr/lib/locale/C/LC_NUMERIC` - `LC_NUMERIC` database for the C locale.  
`/usr/lib/locale/C/LC_TIME` - `LC_TIME` database for the C locale.  
`/usr/lib/locale/C/LC_COLLATE` - `LC_COLLATE` database for the C locale.  
`/usr/lib/locale/C/LC_MESSAGES` - `LC_MESSAGES` database for the C locale.  
`/usr/lib/locale/locale/category` - files containing the locale specific information for each locale and category.

#### SEE ALSO

`ctime(3C)`, `ctype(3C)`, `getdate(3C)`, `gettext(3C)`, `localeconv(3C)`, `mbtowc(3C)`, `printf(3S)`, `strcoll(3C)`, `strftime(3C)`, `strtod(3C)`, `strxfrm(3C)`, `wctomb(3C)`, `environ(5)`.

## NAME

sigsetjmp, siglongjmp - a non-local goto with signal state

## SYNOPSIS

```
#include <setjmp.h>
int sigsetjmp (sigjmp_buf env, int savemask);
void siglongjmp (sigjmp_buf env, int val);
```

## DESCRIPTION

These functions are useful for dealing with errors and interrupts encountered in a low-level subroutine of a program.

**sigsetjmp** saves the calling process's registers and stack environment [see **sigaltstack(2)**] in *env* (whose type, **sigjmp\_buf**, is defined in the **<setjmp.h>** header file) for later use by **siglongjmp**. If *savemask* is non-zero, the calling process's signal mask [see **sigprocmask(2)**] and scheduling parameters [see **pricnt1(2)**] are also saved. **sigsetjmp** returns the value 0.

**siglongjmp** restores the environment saved by the last call of **sigsetjmp** with the corresponding *env* argument. After **siglongjmp** is completed, program execution continues as if the corresponding call of **sigsetjmp** had just returned the value *val*. **siglongjmp** cannot cause **sigsetjmp** to return the value zero. If **siglongjmp** is invoked with a second argument of zero, **sigsetjmp** will return 1. At the time of the second return from **sigsetjmp**, all external and static variables have values as of the time **siglongjmp** is called. The values of register and automatic variables are undefined. Register or automatic variables whose value must be relied upon must be declared as **volatile**.

If a signal-catching function interrupts **sleep** and calls **siglongjmp** to restore an environment saved prior to the **sleep** call, the action associated with **SIGALRM** and time it is scheduled to be generated are unspecified. It is also unspecified whether the **SIGALRM** signal is blocked, unless the process's signal mask is restored as part of the environment.

The function **siglongjmp** restores the saved signal mask if and only if the *env* argument was initialized by a call to the **sigsetjmp** function with a non-zero *savemask* argument.

## SEE ALSO

**getcontext(2)**, **pricnt1(2)**, **sigaction(2)**, **sigaltstack(2)**, **sigprocmask(2)**, **setjmp(3C)**.

## NOTES

If **siglongjmp** is called even though *env* was never primed by a call to **sigsetjmp**, or when the last such call was in a function that has since returned, absolute chaos is guaranteed.

**NAME**

**sigemptyset**, **sigfillset**, **sigaddset**, **sigdelset**, **sigismember** - manipulate sets of signals.

**SYNOPSIS**

```
#include <signal.h>

int sigemptyset (sigset_t *set);
int sigfillset (sigset_t *set);
int sigaddset (sigset_t *set, int signo);
int sigdelset (sigset_t *set, int signo);
int sigismember (sigset_t *set, int signo);
```

**DESCRIPTION**

These functions manipulate *sigset\_t* data types, representing the set of signals supported by the implementation.

**sigemptyset** initializes the set pointed to by *set* to exclude all signals defined by the system.

**sigfillset** initializes the set pointed to by *set* to include all signals defined by the system.

**sigaddset** adds the individual signal specified by the value of *signo* to the set pointed to by *set*.

**sigdelset** deletes the individual signal specified by the value of *signo* from the set pointed to by *set*.

**sigismember** checks whether the signal specified by the value of *signo* is a member of the set pointed to by *set*.

Any object of type *sigset\_t* must be initialized by applying either **sigemptyset** or **sigfillset** before applying any other operation.

**sigaddset**, **sigdelset** and **sigismember** will fail if the following is true:

**EINVAL**           The value of the *signo* argument is not a valid signal number.

**sigfillset** will fail if the following is true:

**EFAULT**           The *set* argument specifies an invalid address.

**SEE ALSO**

**sigaction(2)**, **sigprocmask(2)**, **sigpending(2)**, **sigsuspend(2)**, **signal(5)**.

**DIAGNOSTICS**

Upon successful completion, the **sigismember** function returns a value of one if the specified signal is a member of the specified set, or a value of zero if it is not. Upon successful completion, the other functions return a value of zero. Otherwise a value of -1 is returned and *errno* is set to indicate the error.

**NAME**

`sleep` – suspend execution for interval

**SYNOPSIS**

```
#include <unistd.h>
```

```
unsigned sleep (unsigned seconds);
```

**DESCRIPTION**

The current process is suspended from execution for the number of *seconds* specified by the argument. The actual suspension time may be less than that requested because any caught signal will terminate the `sleep` following execution of that signal's catching routine. Also, the suspension time may be longer than requested by an arbitrary amount because of the scheduling of other activity in the system. The value returned by `sleep` will be the "unslept" amount (the requested time minus the time actually slept) in case the caller had an alarm set to go off earlier than the end of the requested `sleep` time, or premature arousal because of another caught signal.

The routine is implemented by setting an alarm signal and pausing until it (or some other signal) occurs. The previous state of the alarm signal is saved and restored. The calling program may have set up an alarm signal before calling `sleep`. If the `sleep` time exceeds the time until such alarm signal, the process sleeps only until the alarm signal would have occurred. The caller's alarm catch routine is executed just before the `sleep` routine returns. But if the `sleep` time is less than the time till such alarm, the prior alarm time is reset to go off at the same time it would have without the intervening `sleep`.

**SEE ALSO**

`alarm(2)`, `pause(2)`, `signal(2)`, `wait(2)`.



**NAME**

`ssignal`, `gsignal` – software signals

**SYNOPSIS**

```
#include <signal.h>

int (*ssignal (int sig, int (*action) (int))) (int);
int gsignal (int sig);
```

**DESCRIPTION**

`ssignal` and `gsignal` implement a software facility similar to `signal(2)`. This facility is made available to users for their own purposes.

Software signals made available to users are associated with integers in the inclusive range 1 through 17. A call to `ssignal` associates a procedure, *action*, with the software signal *sig*; the software signal, *sig*, is raised by a call to `gsignal`. Raising a software signal causes the action established for that signal to be *taken*.

The first argument to `ssignal` is a number identifying the type of signal for which an action is to be established. The second argument defines the action; it is either the name of a (user-defined) *action function* or one of the manifest constants `SIG_DFL` (default) or `SIG_IGN` (ignore). `ssignal` returns the action previously established for that signal type; if no action has been established or the signal number is illegal, `ssignal` returns `SIG_DFL`.

`gsignal` raises the signal identified by its argument, *sig*:

If an action function has been established for *sig*, then that action is reset to `SIG_DFL` and the action function is entered with argument *sig*. `gsignal` returns the value returned to it by the action function.

If the action for *sig* is `SIG_IGN`, `gsignal` returns the value 1 and takes no other action.

If the action for *sig* is `SIG_DFL`, `gsignal` returns the value 0 and takes no other action.

If *sig* has an illegal value or no action was ever specified for *sig*, `gsignal` returns the value 0 and takes no other action.

**SEE ALSO**

`signal(2)`, `sigset(2)`, `raise(3C)`.

**NAME**

stdio – standard buffered input/output package

**SYNOPSIS**

```
#include <stdio.h>
```

```
FILE *stdin, *stdout, *stderr;
```

**DESCRIPTION**

The functions described in the entries of sub-class 3S of this manual constitute an efficient, user-level I/O buffering scheme. The in-line macros `getc` and `putc` handle characters quickly. The macros `getchar` and `putchar`, and the higher-level routines `fgetc`, `fgets`, `fprintf`, `fputc`, `fputs`, `fread`, `fscanf`, `fwrite`, `gets`, `getw`, `printf`, `puts`, `putw`, and `scanf` all use or act as if they use `getc` and `putc`; they can be freely intermixed.

A file with associated buffering is called a *stream* [see `intro(3)`] and is declared to be a pointer to a defined type `FILE`. `fopen` creates certain descriptive data for a stream and returns a pointer to designate the stream in all further transactions. Normally, there are three open streams with constant pointers declared in the `<stdio.h>` header file and associated with the standard open files:

```
stdin standard input file
stdout standard output file
stderr standard error file
```

The following symbolic values in `<unistd.h>` define the file descriptors that will be associated with the C-language `stdin`, `stdout` and `stderr` when the application is started:

```
STDIN_FILENO Standard input value, stdin. It has the value of 0.
STDOUT_FILENO Standard output value, stdout. It has the value of 1.
STDERR_FILENO Standard error value, stderr. It has the value of 2.
```

A constant `null` designates a null pointer.

An integer-constant `EOF` (-1) is returned upon end-of-file or error by most integer functions that deal with streams (see the individual descriptions for details).

An integer constant `BUFSIZ` specifies the size of the buffers used by the particular implementation.

An integer constant `FILENAME_MAX` specifies the size needed for an array of `char` large enough to hold the longest file name string that the implementation guarantees can be opened.

An integer constant `FOPEN_MAX` specifies the minimum number of files that the implementation guarantees can be open simultaneously. Note that no more than 255 files may be opened via `fopen`, and only file descriptors 0 through 255 are valid.

Any program that uses this package must include the header file of pertinent macro definitions, as follows:

```
#include <stdio.h>
```

The functions and constants mentioned in the entries of sub-class 3S of this manual are declared in that header file and need no further declaration. The constants and the following "functions" are implemented as macros (redeclaration of these names is perilous): `getc`, `getchar`, `putc`, `putchar`, `ferror`, `feof`, `clearerr`, and `fileno`. There are also function versions of `getc`, `getchar`, `putc`, `putchar`, `ferror`, `feof`, `clearerr`, and `fileno`.

Output streams, with the exception of the standard error stream `stderr`, are by default buffered if the output refers to a file and line-buffered if the output refers to a terminal. The standard error output stream `stderr` is by default unbuffered, but use of `freopen` [see `fopen(3S)`] will cause it to become buffered or line-buffered. When an output stream is unbuffered, information is queued for writing on the destination file or terminal as soon as written; when it is buffered, many characters are saved up and written as a block. When it is line-buffered, each line of output is queued for writing on the destination terminal as soon as the line is completed (that is, as soon as a new-line character is written or terminal input is requested). `setbuf` or `setvbuf` [both described in `setbuf(3S)`] may be used to change the stream's buffering strategy.

#### SEE ALSO

`open(2)`, `close(2)`, `lseek(2)`, `pipe(2)`, `read(2)`, `write(2)`, `ctermid(3S)`, `cuserid(3S)`, `fclose(3S)`, `ferror(3S)`, `fopen(3S)`, `fread(3S)`, `fseek(3S)`, `getc(3S)`, `gets(3S)`, `popen(3S)`, `printf(3S)`, `putc(3S)`, `puts(3S)`, `scanf(3S)`, `setbuf(3S)`, `system(3S)`, `tmpfile(3S)`, `tmpnam(3S)`, `ungetc(3S)`.

#### DIAGNOSTICS

Invalid *stream* pointers usually cause grave disorder, possibly including program termination. Individual function descriptions describe the possible error conditions.

**NAME**

stdipc: ftok - standard interprocess communication package

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/ipc.h>
```

```
key_t ftok(const char *path, int id);
```

**DESCRIPTION**

All interprocess communication facilities require the user to supply a key to be used by the `msgget(2)`, `semget(2)`, and `shmget(2)` system calls to obtain interprocess communication identifiers. One suggested method for forming a key is to use the `ftok` subroutine described below. Another way to compose keys is to include the project ID in the most significant byte and to use the remaining portion as a sequence number. There are many other ways to form keys, but it is necessary for each system to define standards for forming them. If some standard is not adhered to, it will be possible for unrelated processes to unintentionally interfere with each other's operation. It is still possible to interface intentionally. Therefore, it is strongly suggested that the most significant byte of a key in some sense refer to a project so that keys do not conflict across a given system.

`ftok` returns a key based on *path* and *id* that is usable in subsequent `msgget`, `semget`, and `shmget` system calls. *path* must be the path name of an existing file that is accessible to the process. *id* is a character that uniquely identifies a project. Note that `ftok` will return the same key for linked files when called with the same *id* and that it will return different keys when called with the same file name but different *ids*.

**SEE ALSO**

`intro(2)`, `msgget(2)`, `semget(2)`, `shmget(2)`.

**DIAGNOSTICS**

`ftok` returns (`key_t`) `-1` if *path* does not exist or if it is not accessible to the process.

**NOTES**

If the file whose *path* is passed to `ftok` is removed when keys still refer to the file, future calls to `ftok` with the same *path* and *id* will return an error. If the same file is recreated, then `ftok` is likely to return a different key than it did the original time it was called.

## strcoll(3C)

## strcoll(3C)

### NAME

strcoll - string collation

### SYNOPSIS

```
#include <string.h>
```

```
int strcoll (const char *s1, const char *s2);
```

### DESCRIPTION

strcoll returns an integer greater than, equal to, or less than zero in direct correlation to whether string *s1* is greater than, equal to, or less than the string *s2*. The comparison is based on strings interpreted as appropriate to the program's locale for category `LC_COLLATE` [see `setlocale(3C)`].

Both `strcoll` and `strxfrm` provide for locale-specific string sorting. `strcoll` is intended for applications in which the number of comparisons per string is small. When strings are to be compared a number of times, `strxfrm` is a more appropriate utility because the transformation process occurs only once.

### FILES

`/usr/lib/locale/LC_COLLATE`

`LC_COLLATE` database for *locale*.

### SEE ALSO

`setlocale(3C)`, `string(3C)`, `strxfrm(3C)`, `environ(5)`.

`colltbl(1M)` in the *System Administrator's Reference Manual*.

**NAME**

**strerror** - get error message string

**SYNOPSIS**

```
#include <string.h>
char *strerror (int errnum);
```

**DESCRIPTION**

**strerror** maps the error number in *errnum* to an error message string, and returns a pointer to that string. **strerror** uses the same set of error messages as **perror**. The returned string should not be overwritten.

**SEE ALSO**

**perror(3C)**.

## NAME

strptime, cftime, ascftime - convert date and time to string

## SYNOPSIS

```
#include <time.h>

size_t *strptime (char *s, size_t maxsize, const char *format,
 const struct tm *timeptr);

int cftime (char *s, char *format, const time_t *clock);

int ascftime (char *s, const char *format, const struct tm
 *timeptr);
```

## DESCRIPTION

strptime, ascftime, and cftime place characters into the array pointed to by *s* as controlled by the string pointed to by *format*. The *format* string consists of zero or more directives and ordinary characters. All ordinary characters (including the terminating null character) are copied unchanged into the array. For strptime, no more than *maxsize* characters are placed into the array.

If *format* is (char \*0), then the locale's default format is used. For strptime the default format is the same as "%c", for cftime and ascftime the default format is the same as "%C". cftime and ascftime first try to use the value of the environment variable CFTIME, and if that is undefined or empty, the default format is used.

Each directive is replaced by appropriate characters as described in the following list. The appropriate characters are determined by the LC\_TIME category of the program's locale and by the values contained in the structure pointed to by *timeptr* for strptime and ascftime, and by the time represented by *clock* for cftime.

|    |                                                              |
|----|--------------------------------------------------------------|
| %% | same as %                                                    |
| %a | locale's abbreviated weekday name                            |
| %A | locale's full weekday name                                   |
| %b | locale's abbreviated month name                              |
| %B | locale's full month name                                     |
| %c | locale's appropriate date and time representation            |
| %C | locale's date and time representation as produced by date(1) |
| %d | day of month ( 01 - 31 )                                     |
| %D | date as %m/%d/%y                                             |
| %e | day of month (1-31; single digits are preceded by a blank)   |
| %h | locale's abbreviated month name.                             |
| %H | hour ( 00 - 23 )                                             |
| %I | hour ( 01 - 12 )                                             |
| %j | day number of year ( 001 - 366 )                             |
| %m | month number ( 01 - 12 )                                     |
| %M | minute ( 00 - 59 )                                           |
| %n | same as \n                                                   |
| %p | locale's equivalent of either AM or PM                       |

|    |                                                                    |
|----|--------------------------------------------------------------------|
| %r | time as %I:%M:%S [AM PM]                                           |
| %R | time as %H:%M                                                      |
| %S | seconds ( 00 - 61 ), allows for leap seconds                       |
| %t | insert a tab                                                       |
| %T | time as %H:%M:%S                                                   |
| %U | week number of year ( 00 - 53 ), Sunday is the first day of week 1 |
| %w | weekday number ( 0 - 6 ), Sunday = 0                               |
| %W | week number of year ( 00 - 53 ), Monday is the first day of week 1 |
| %x | locale's appropriate date representation                           |
| %X | locale's appropriate time representation                           |
| %y | year within century ( 00 - 99 )                                    |
| %Y | year as cccy ( e.g. 1986)                                          |
| %Z | time zone name or no characters if no time zone exists             |

The difference between %U and %W lies in which day is counted as the first of the week. Week number 01 is the first week in January starting with a Sunday for %U or a Monday for %W. Week number 00 contains those days before the first Sunday or Monday in January for %U and %W, respectively.

If the total number of resulting characters including the terminating null character is not more than *maxsize*, *strptime*, *cftime* and *ascftime* return the number of characters placed into the array pointed to by *s* not including the terminating null character. Otherwise, zero is returned and the contents of the array are indeterminate. *cftime* and *ascftime* return the number of characters placed into the array pointed to by *s* not including the terminating null character.

### Selecting the Output's Language

By default, the output of *strptime*, *cftime*, and *ascftime* appear in US English. The user can request that the output of *strptime*, *cftime* or *ascftime* be in a specific language by setting the *locale* for *category LC\_TIME* in *setlocale*.

### Timezone

The timezone is taken from the environment variable *TZ* [see *ctime(3C)* for a description of *TZ*].

### EXAMPLES

The example illustrates the use of *strptime*. It shows what the string in *str* would look like if the structure pointed to by *tm\_ptr* contains the values corresponding to Thursday, August 28, 1986 at 12:44:36 in New Jersey.

```
strptime (str, strsize, "%A %b %d %j", tm_ptr)
```

This results in *str* containing "Thursday Aug 28 240".

### FILES

*/usr/lib/locale/language/LC\_TIME* - file containing locale specific date and time information

### SEE ALSO

*ctime(3C)*, *getenv(3C)*, *setlocale(3C)*, *strptime(4)*, *timezone(4)*, *environ(5)*.

### NOTE

*cftime* and *ascftime* are obsolete. *strptime* should be used instead.



## NAME

string: `strcat`, `strdup`, `strncat`, `strcmp`, `strncmp`, `strcpy`, `strncpy`, `strlen`, `strchr`, `strrchr`, `strpbrk`, `strspn`, `strcspn`, `strtok`, `strstr` - string operations

## SYNOPSIS

```
#include <string.h>

char *strcat (char *s1, const char *s2);
char *strdup (const char *s1);
char *strncat (char *s1, const char *s2, size_t n);
int strcmp (const char *s1, const char *s2);
int strncmp (const char *s1, const char *s2, size_t n);
char *strcpy (char *s1, const char *s2);
char *strncpy (char *s1, const char *s2, size_t n);
size_t strlen (const char *s);
char *strchr (const char *s, int c);
char *strrchr (const char *s, int c);
char *strpbrk (const char *s1, const char *s2);
size_t strspn (const char *s1, const char *s2);
size_t strcspn (const char *s1, const char *s2);
char *strtok (char *s1, const char *s2);
char *strstr (const char *s1, const char *s2);
```

## DESCRIPTION

The arguments *s*, *s1*, and *s2* point to strings (arrays of characters terminated by a null character). The functions `strcat`, `strncat`, `strcpy`, `strncpy`, and `strtok` all alter *s1*. These functions do not check for overflow of the array pointed to by *s1*.

`strcat` appends a copy of string *s2*, including the terminating null character, to the end of string *s1*. `strncat` appends at most *n* characters. Each returns a pointer to the null-terminated result. The initial character of *s2* overrides the null character at the end of *s1*.

`strcmp` compares its arguments and returns an integer less than, equal to, or greater than 0, based upon whether *s1* is lexicographically less than, equal to, or greater than *s2*. `strncmp` makes the same comparison but looks at at most *n* characters. Characters following a null character are not compared.

`strcpy` copies string *s2* to *s1* including the terminating null character, stopping after the null character has been copied. `strncpy` copies exactly *n* characters, truncating *s2* or adding null characters to *s1* if necessary. The result will not be null-terminated if the length of *s2* is *n* or more. Each function returns *s1*.

**strdup** returns a pointer to a new string which is a duplicate of the string pointed to by *s1*. The space for the new string is obtained using `malloc(3C)`. If the new string can not be created, a NULL pointer is returned.

**strlen** returns the number of characters in *s*, not including the terminating null character.

**strchr** (or **strrchr**) returns a pointer to the first (last) occurrence of *c* (converted to a `char`) in string *s*, or a NULL pointer if *c* does not occur in the string. The null character terminating a string is considered to be part of the string.

**strpbrk** returns a pointer to the first occurrence in string *s1* of any character from string *s2*, or a NULL pointer if no character from *s2* exists in *s1*.

**strspn** (or **strcspn**) returns the length of the initial segment of string *s1* which consists entirely of characters from (not from) string *s2*.

**strtok** considers the string *s1* to consist of a sequence of zero or more text tokens separated by spans of one or more characters from the separator string *s2*. The first call (with pointer *s1* specified) returns a pointer to the first character of the first token, and will have written a null character into *s1* immediately following the returned token. The function keeps track of its position in the string between separate calls, so that subsequent calls (which must be made with the first argument a NULL pointer) will work through the string *s1* immediately following that token. In this way subsequent calls will work through the string *s1* until no tokens remain. The separator string *s2* may be different from call to call. When no token remains in *s1*, a NULL pointer is returned.

**strstr** locates the first occurrence in string *s1* of the sequence of characters (excluding the terminating null character) in string *s2*. **strstr** returns a pointer to the located string, or a null pointer if the string is not found. If *s2* points to a string with zero length (i.e., the string ""), the function returns *s1*.

#### SEE ALSO

`malloc(3C)`, `setlocale(3C)`, `strxfrm(3C)`.

#### NOTES

All of these functions assume the default locale "C." For some locales, `strxfrm` should be applied to the strings before they are passed to the functions.

**NAME**

strtod, atof, - convert string to double-precision number

**SYNOPSIS**

```
#include <stdlib.h>

double strtod (const char *nptr, char **endptr);
double atof (const char *nptr);
```

**DESCRIPTION**

strtod returns as a double-precision floating-point number the value represented by the character string pointed to by *nptr*. The string is scanned up to the first unrecognized character.

strtod recognizes an optional string of "white-space" characters [as defined by *isspace* in *ctype(3C)*], then an optional sign, then a string of digits optionally containing a decimal point character, then an optional exponent part including an *e* or *E* followed by an optional sign, followed by an integer.

If the value of *endptr* is not `(char **)NULL`, a pointer to the character terminating the scan is returned in the location pointed to by *endptr*. If no number can be formed, *\*endptr* is set to *nptr*, and zero is returned.

*atof*(*nptr*) is equivalent to:  
     **strtod**(*nptr*, (char \*\*)NULL).

**SEE ALSO**

*ctype(3C)*, *scanf(3S)*, *strtol(3C)*.

**DIAGNOSTICS**

If the correct value would cause overflow,  $\pm$ HUGE is returned (according to the sign of the value), and *errno* is set to ERANGE.

If the correct value would cause underflow, zero is returned and *errno* is set to ERANGE.

When the *-Xc* or *-Xa* compilation options are used, HUGE\_VAL is returned instead of HUGE.

**NAME**

strtol, strtoul, atol, atoi – convert string to integer

**SYNOPSIS**

```
#include <stdlib.h>

long strtol (const char *str, char **ptr, int base);
unsigned long strtoul (const char *str, char **ptr, int base);
long atol (const char *str);
int atoi (const char *str);
```

**DESCRIPTION**

strtol returns as a long integer the value represented by the character string pointed to by *str*. The string is scanned up to the first character inconsistent with the base. Leading “white-space” characters [as defined by *isspace*(3C)] are ignored.

If the value of *ptr* is not (char \*\*)NULL, a pointer to the character terminating the scan is returned in the location pointed to by *ptr*. If no integer can be formed, that location is set to *str*, and zero is returned.

If *base* is positive (and not greater than 36), it is used as the base for conversion. After an optional leading sign, leading zeros are ignored, and “0x” or “0X” is ignored if *base* is 16.

If *base* is zero, the string itself determines the base as follows: After an optional leading sign a leading zero indicates octal conversion, and a leading “0x” or “0X” hexadecimal conversion. Otherwise, decimal conversion is used.

Truncation from long to int can, of course, take place upon assignment or by an explicit cast.

If the value represented by *str* would cause overflow, LONG\_MAX or LONG\_MIN is returned (according to the sign of the value), and *errno* is set to the value, ERANGE.

strtoul is similar to strtol except that strtoul returns as an unsigned long integer the value represented by *str*. If the value represented by *str* would cause overflow, ULONG\_MAX is returned, and *errno* is set to the value, ERANGE.

Except for behavior on error, atol(*str*) is equivalent to: strtol(*str*, (char \*\*)NULL, 10).

Except for behavior on error, atoi(*str*) is equivalent to: (int) strtol(*str*, (char \*\*)NULL, 10).

**DIAGNOSTICS**

If strtol is given a *base* greater than 36, it returns 0 and sets *errno* to EINVAL.

**SEE ALSO**

ctype(3C), scanf(3S), strtod(3C).

**NOTES**

strtol no longer accepts values greater than LONG\_MAX as valid input. Use strtoul instead.

**NAME**

strxfrm - string transformation

**SYNOPSIS**

```
#include <string.h>

size_t strxfrm (char *s1, const char *s2, size_t n);
```

**DESCRIPTION**

strxfrm transforms the string *s2* and places the resulting string into the array *s1*. The transformation is such that if `strcmp` is applied to two transformed strings, it will return the same result as `strcoll` applied to the same two original strings. The transformation is based on the program's locale for category `LC_COLLATE` [see `setlocale(3C)`].

No more than *n* characters will be placed into the resulting array pointed to by *s1*, including the terminating null character. If *n* is 0, then *s1* is permitted to be a null pointer. If copying takes place between objects that overlap, the behavior is undefined.

strxfrm returns the length of the transformed string (not including the terminating null character). If the value returned is *n* or more, the contents of the array *s1* are indeterminate.

**EXAMPLE**

The value of the following expression is the size of the array needed to hold the transformation of the string pointed to by *s*.

```
1 + strxfrm(NULL, s, 0);
```

**FILES**

`/usr/lib/locale/locale/LC_COLLATE` LC\_COLLATE database for *locale*.

**SEE ALSO**

`colltbl(1M)` in the *System Administrator's Reference Manual*.  
`setlocale(3C)`, `strcoll(3C)`, `string(3C)`, `environ(5)`.

**DIAGNOSTICS**

On failure, strxfrm returns (`size_t`) -1.

**NAME**

*swab* - swap bytes

**SYNOPSIS**

```
#include <stdlib.h>
```

```
void swab (const char *from, char *to, int nbytes);
```

**DESCRIPTION**

*swab* copies *nbytes* bytes pointed to by *from* to the array pointed to by *to*, exchanging adjacent even and odd bytes. *nbytes* should be even and non-negative. If *nbytes* is odd and positive, *swab* uses *nbytes*-1 instead. If *nbytes* is negative, *swab* does nothing.

## sysconf(3C)

## sysconf(3C)

### NAME

`sysconf` – get configurable system variables

### SYNOPSIS

```
#include <unistd.h>

long sysconf(int name);
```

### DESCRIPTION

The `sysconf` function provides a method for the application to determine the current value of a configurable system limit or option (variable).

The *name* argument represents the system variable to be queried. The following table lists the minimal set of system variables from `<limits.h>` and `<unistd.h>` that can be returned by `sysconf`, and the symbolic constants, defined in `<unistd.h>` that are the corresponding values used for *name*.

| NAME                           | RETURN VALUE                    |
|--------------------------------|---------------------------------|
| <code>_SC_ARG_MAX</code>       | <code>ARG_MAX</code>            |
| <code>_SC_CHILD_MAX</code>     | <code>CHILD_MAX</code>          |
| <code>_SC_CLK_TCK</code>       | <code>CLK_TCK</code>            |
| <code>_SC_NGROUPS_MAX</code>   | <code>NGROUPS_MAX</code>        |
| <code>_SC_OPEN_MAX</code>      | <code>OPEN_MAX</code>           |
| <code>_SC_PASS_MAX</code>      | <code>PASS_MAX</code>           |
| <code>_SC_PAGESIZE</code>      | <code>PAGESIZE</code>           |
| <code>_SC_JOB_CONTROL</code>   | <code>_POSIX_JOB_CONTROL</code> |
| <code>_SC_SAVED_IDS</code>     | <code>_POSIX_SAVED_IDS</code>   |
| <code>_SC_VERSION</code>       | <code>_POSIX_VERSION</code>     |
| <code>_SC_XOPEN_VERSION</code> | <code>_XOPEN_VERSION</code>     |
| <code>_SC_LOGNAME_MAX</code>   | <code>LOGNAME_MAX</code>        |

The value of `CLK_TCK` may be variable and it should not be assumed that `CLK_TCK` is a compile-time constant. The value of `CLK_TCK` is the same as the value of `sysconf(_SC_CLK_TCK)`.

### SEE ALSO

`fpathconf(3C)`.

### DIAGNOSTICS

If *name* is an invalid value, `sysconf` will return `-1` and set `errno` to indicate the error. If `sysconf` fails due to a value of *name* that is not defined on the system, the function will return a value of `-1` without changing the value of `errno`.

### NOTES

A call to `setrlimit` may cause the value of `OPEN_MAX` to change.

**NAME**

`system` - issue a shell command

**SYNOPSIS**

```
#include <stdlib.h>

int system (const char *string);
```

**DESCRIPTION**

`system` causes the *string* to be given to the shell [see `sh(1)`] as input, as if the string had been typed as a command at a terminal. The current process waits until the shell has completed, then returns the exit status of the shell in the format specified by `waitpid`.

If *string* is a `NULL` pointer, `system` checks if `/sbin/sh` exists and is executable. If `/sbin/sh` is available, `system` returns non-zero; otherwise it returns zero.

`system` fails if one or more of the following are true:

**EAGAIN** The system-imposed limit on the total number of processes under execution by a single user would be exceeded.

**EINTR** `system` was interrupted by a signal.

**ENOMEM** The new process requires more memory than is allowed by the system-imposed maximum `MAXMEM`.

**SEE ALSO**

`exec(2)`, `waitpid(3C)`.  
`sh(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

`system` forks to create a child process that in turn execs `/sbin/sh` in order to execute *string*. If the fork or exec fails, `system` returns a value of -1 and sets `errno`.



**NAME**

**tcsetpgrp** – set terminal foreground process group id

**SYNOPSIS**

```
#include <unistd.h>

int tcsetpgrp (int fildes, pid_t pgid)
```

**DESCRIPTION**

**tcsetpgrp** sets the foreground process group ID of the terminal specified by *fildes* to *pgid*. The file associated with *fildes* must be the controlling terminal of the calling process and the controlling terminal must be currently associated with the session of the calling process. The value of *pgid* must match a process group ID of a process in the same session as the calling process.

**tcsetpgrp** fails if one or more of the following is true:

- |               |                                                                                                                                                                                                     |
|---------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>EBADF</b>  | The <i>fildes</i> argument is not a valid file descriptor.                                                                                                                                          |
| <b>EINVAL</b> | The <i>fildes</i> argument is a terminal that does not support <b>tcsetpgrp</b> , or <i>pgid</i> is not a valid process group ID.                                                                   |
| <b>ENOTTY</b> | The calling process does not have a controlling terminal, or the file is not the controlling terminal, or the controlling terminal is no longer associated with the session of the calling process. |
| <b>EPERM</b>  | <i>pgid</i> does not match the process group ID of an existing process in the same session as the calling process.                                                                                  |

**SEE ALSO**

**tcsetpgrp(3C)**, **tcsetsid(3C)**,  
**termio(7)** in the *System Administrator's Reference Manual*.

**DIAGNOSTICS**

Upon successful completion, **tcsetpgrp** returns a value of 0. Otherwise, a value of -1 is returned and **errno** is set to indicate the error.

**NAME**

tmpfile - create a temporary file

**SYNOPSIS**

```
#include <stdio.h>
```

```
FILE *tmpfile (void);
```

**DESCRIPTION**

tmpfile creates a temporary file using a name generated by the tmpnam routine and returns a corresponding FILE pointer. If the file cannot be opened, a NULL pointer is returned. The file is automatically deleted when the process using it terminates or when the file is closed. The file is opened for update ("w+").

**SEE ALSO**

creat(2), open(2), unlink(2), fopen(3S), mktemp(3C), perror(3C), stdio(3S), tmpnam(3S).

**NAME**

tmpnam, tmpnam - create a name for a temporary file

**SYNOPSIS**

```
#include <stdio.h>
char *tmpnam (char *s);
char *tmpnam (const char *dir, const char *pfx);
```

**DESCRIPTION**

These functions generate file names that can safely be used for a temporary file.

tmpnam always generates a file name using the path-prefix defined as P\_tmpdir in the <stdio.h> header file. If *s* is NULL, tmpnam leaves its result in an internal static area and returns a pointer to that area. The next call to tmpnam will destroy the contents of the area. If *s* is not NULL, it is assumed to be the address of an array of at least L\_tmpnam bytes, where L\_tmpnam is a constant defined in <stdio.h>; tmpnam places its result in that array and returns *s*.

tmpnam allows the user to control the choice of a directory. The argument *dir* points to the name of the directory in which the file is to be created. If *dir* is NULL or points to a string that is not a name for an appropriate directory, the path-prefix defined as P\_tmpdir in the <stdio.h> header file is used. If that directory is not accessible, /tmp will be used as a last resort. This entire sequence can be up-staged by providing an environment variable TMPDIR in the user's environment, whose value is the name of the desired temporary-file directory.

Many applications prefer their temporary files to have certain favorite initial letter sequences in their names. Use the *pfx* argument for this. This argument may be NULL or point to a string of up to five characters to be used as the first few characters of the temporary-file name.

tmpnam uses malloc to get space for the constructed file name, and returns a pointer to this area. Thus, any pointer value returned from tmpnam may serve as an argument to free [see malloc(3C)]. If tmpnam cannot return the expected result for any reason—e.g., malloc failed—or none of the above mentioned attempts to find an appropriate directory was successful, a NULL pointer will be returned.

tmpnam fails if there is not enough space.

**FILES**

p\_tmpdir /var/tmp

**SEE ALSO**

creat(2), unlink(2), fopen(3S), malloc(3C), mktemp(3C), tmpfile(3S).

**NOTES**

These functions generate a different file name each time they are called.

Files created using these functions and either fopen or creat are temporary only in the sense that they reside in a directory intended for temporary use, and their names are unique. It is the user's responsibility to remove the file when its use is ended.

If called more than `TMP_MAX` (defined in `stdio.h`) times in a single process, these functions start recycling previously used names.

Between the time a file name is created and the file is opened, it is possible for some other process to create a file with the same name. This can never happen if that other process is using these functions or `mktemp` and the file names are chosen to render duplication by other means unlikely.

**NAME**

truncate, ftruncate – set a file to a specified length

**SYNOPSIS**

```
#include <unistd.h>
int truncate (const char *path, off_t length);
int ftruncate (int fildes, off_t length);
```

**DESCRIPTION**

The file whose name is given by *path* or referenced by the descriptor *fildes* has its size set to *length* bytes.

If the file was previously longer than *length*, bytes past *length* will no longer be accessible. If it was shorter, bytes from the EOF before the call to the EOF after the call will be read in as zeros. The effective user ID of the process must have write permission for the file, and for *ftruncate* the file must be open for writing.

*truncate* fails if one or more of the following are true:

|                     |                                                                                                                                  |
|---------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>EACCES</b>       | Search permission is denied on a component of the path prefix.                                                                   |
| <b>EACCES</b>       | Write permission is denied for the file referred to by <i>path</i> .                                                             |
| <b>EFAULT</b>       | <i>path</i> points outside the process's allocated address space.                                                                |
| <b>EINTR</b>        | A signal was caught during execution of the <i>truncate</i> routine.                                                             |
| <b>EINVAL</b>       | <i>path</i> is not an ordinary file.                                                                                             |
| <b>EIO</b>          | An I/O error occurred while reading from or writing to the file system.                                                          |
| <b>EISDIR</b>       | The file referred to by <i>path</i> is a directory.                                                                              |
| <b>ELOOP</b>        | Too many symbolic links were encountered in translating <i>path</i> .                                                            |
| <b>EMFILE</b>       | The maximum number of file descriptors available to the process has been reached.                                                |
| <b>EMULTIHOP</b>    | Components of <i>path</i> require hopping to multiple remote machines and file system type does not allow it.                    |
| <b>ENAMETOOLONG</b> | The length of a <i>path</i> component exceeds {NAME_MAX} characters, or the length of <i>path</i> exceeds {PATH_MAX} characters. |
| <b>ENFILE</b>       | Could not allocate any more space for the system file table.                                                                     |
| <b>ENOENT</b>       | Either a component of the path prefix or the file referred to by <i>path</i> does not exist.                                     |
| <b>ENOLINK</b>      | <i>path</i> points to a remote machine and the link to that machine is no longer active.                                         |
| <b>ENOTDIR</b>      | A component of the path prefix of <i>path</i> is not a directory.                                                                |

**EROFS** The file referred to by *path* resides on a read-only file system.  
**ETXTBSY** The file referred to by *path* is a pure procedure (shared text) file that is being executed.

**ftruncate** fails if one or more of the following are true:

**EAGAIN** The file exists, mandatory file/record locking is set, and there are outstanding record locks on the file [see `chmod(2)`].

**EBADF** *fdes* is not a file descriptor open for writing.

**EINTR** A signal was caught during execution of the `ftruncate` routine.

**EIO** An I/O error occurred while reading from or writing to the file system.

**ENOLINK** *fdes* points to a remote machine and the link to that machine is no longer active.

**EINVAL** *fdes* does not correspond to an ordinary file.

#### SEE ALSO

`fcntl(2)`, `open(2)`

#### DIAGNOSTICS

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `errno` is set to indicate the error.

**NAME**

tsearch, tfind, tdelete, twalk – manage binary search trees

**SYNOPSIS**

```
#include <search.h>

void *tsearch (const void *key, void **rootp, int (*compar)
 (const void *, const void *));

void *tfind (const void *key, void * const *rootp, int (*compar)
 (const void *, const void *));

void *tdelete (const void *key, void **rootp, int (*compar)
 (const void *, const void *));

void twalk (void *root, void(*action) (void *, VISIT, int));
```

**DESCRIPTION**

tsearch, tfind, tdelete, and twalk are routines for manipulating binary search trees. They are generalized from Knuth (6.2.2) Algorithms T and D. All comparisons are done with a user-supplied routine. This routine is called with two arguments, the pointers to the elements being compared. It returns an integer less than, equal to, or greater than 0, according to whether the first argument is to be considered less than, equal to or greater than the second argument. The comparison function need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

tsearch is used to build and access the tree. *key* is a pointer to a datum to be accessed or stored. If there is a datum in the tree equal to \*key (the value pointed to by *key*), a pointer to this found datum is returned. Otherwise, \*key is inserted, and a pointer to it returned. Only pointers are copied, so the calling routine must store the data. *rootp* points to a variable that points to the root of the tree. A NULL value for the variable pointed to by *rootp* denotes an empty tree; in this case, the variable will be set to point to the datum which will be at the root of the new tree.

Like tsearch, tfind will search for a datum in the tree, returning a pointer to it if found. However, if it is not found, tfind will return a NULL pointer. The arguments for tfind are the same as for tsearch.

tdelete deletes a node from a binary search tree. The arguments are the same as for tsearch. The variable pointed to by *rootp* will be changed if the deleted node was the root of the tree. tdelete returns a pointer to the parent of the deleted node, or a NULL pointer if the node is not found.

twalk traverses a binary search tree. *root* is the root of the tree to be traversed. (Any node in a tree may be used as the root for a walk below that node.) *action* is the name of a routine to be invoked at each node. This routine is, in turn, called with three arguments. The first argument is the address of the node being visited. The second argument is a value from an enumeration data type *typedef enum { preorder, postorder, endorder, leaf } VISIT;* (defined in the search.h header file), depending on whether this is the first, second or third time that the node has been visited (during a depth-first, left-to-right traversal of the tree), or whether the node is a leaf. The third argument is the level of the node in the tree, with the root being level zero.

The pointers to the key and the root of the tree should be of type pointer-to-element, and cast to type pointer-to-character. Similarly, although declared as type pointer-to-character, the value returned should be cast into type pointer-to-element.

**EXAMPLE**

The following code reads in strings and stores structures containing a pointer to each string and a count of its length. It then walks the tree, printing out the stored strings and their lengths in alphabetical order.

```
#include <string.h>
#include <stdio.h>
#include <search.h>

struct node {
 char *string;
 int length;
};
char string_space[10000];
struct node nodes[500];
void *root = NULL;

int node_compare(const void *node1, const void *node2) {
 return strcmp(((const struct node *) node1)->string,
 ((const struct node *) node2)->string);
}

void print_node(void **node, VISIT order, int level) {
 if (order == preorder || order == leaf) {
 printf("length=%d, string=%20s\n",
 (*(struct node **)node)->length,
 (*(struct node **)node)->string);
 }
}

main() {
 char *strptr = string_space;
 struct node *nodeptr = nodes;
 int i = 0;

 while (gets(strptr) != NULL && i++ < 500) {
 nodeptr->string = strptr;
 nodeptr->length = strlen(strptr);
 (void) tsearch((void *)nodeptr,
 &root, node_compare);
 strptr += nodeptr->length + 1;
 nodeptr++;
 }
 twalk(root, print_node);
}
```



**SEE ALSO**

**bsearch(3C), hsearch(3C), lsearch(3C).**

**DIAGNOSTICS**

A **NULL** pointer is returned by **tsearch** if there is not enough space available to create a new node.

A **NULL** pointer is returned by **tfind** and **tdelete** if *rootp* is **NULL** on entry.

If the datum is found, both **tsearch** and **tfind** return a pointer to it. If not, **tfind** returns **NULL**, and **tsearch** returns a pointer to the inserted item.

**NOTES**

The *root* argument to **twalk** is one level of indirection less than the *rootp* arguments to **tsearch** and **tdelete**.

There are two nomenclatures used to refer to the order in which tree nodes are visited. **tsearch** uses preorder, postorder and endorder to refer respectively to visiting a node before any of its children, after its left child and before its right, and after both its children. The alternate nomenclature uses preorder, inorder and postorder to refer to the same visits, which could result in some confusion over the meaning of postorder.

If the calling function alters the pointer to the root, results are unpredictable.

**NAME**

`ttyname`, `isatty` – find name of a terminal

**SYNOPSIS**

```
#include <stdlib.h>
char *ttyname (int fildes);
int isatty (int fildes);
```

**DESCRIPTION**

`ttyname` returns a pointer to a string containing the null-terminated path name of the terminal device associated with file descriptor *fildes*.

`isatty` returns 1 if *fildes* is associated with a terminal device, 0 otherwise.

**FILES**

`/dev/*`

**DIAGNOSTICS**

`ttyname` returns a `NULL` pointer if *fildes* does not describe a terminal device in directory `/dev`.

**NOTES**

The return value points to static data whose content is overwritten by each call.

**NAME**

**ttyslot** - find the slot in the utmp file of the current user

**SYNOPSIS**

```
#include <stdlib.h>

int ttyslot (void);
```

**DESCRIPTION**

**ttyslot** returns the index of the current user's entry in the `/var/adm/utmp` file. The returned index is accomplished by scanning files in `/dev` for the name of the terminal associated with the standard input, the standard output, or the standard error output (0, 1, or 2).

**FILES**

`/var/adm/utmp`

**SEE ALSO**

`getut(3C)`, `ttynam(3C)`.

**DIAGNOSTICS**

A value of `-1` is returned if an error was encountered while searching for the terminal name or if none of the above file descriptors are associated with a terminal device.

**NAME**

ungetc - push character back onto input stream

**SYNOPSIS**

```
#include <stdio.h>
int ungetc (int c, FILE *stream);
```

**DESCRIPTION**

ungetc inserts the character specified by *c* (converted to an unsigned char) into the buffer associated with an input *stream* [see [intro\(3\)](#)]. That character, *c*, will be returned by the next [getc\(3S\)](#) call on that *stream*. ungetc returns *c*, and leaves the file corresponding to *stream* unchanged. A successful call to ungetc clears the EOF indicator for stream.

Four bytes of pushback are guaranteed.

The value of the file position indicator for *stream* after reading or discarding all pushed-back characters will be the same as it was before the characters were pushed back.

If *c* equals EOF, ungetc does nothing to the buffer and returns EOF.

[fseek](#), [rewind](#) [both described on [fseek\(3S\)](#)], and [fsetpos](#) erase the memory of inserted characters for the stream on which they are applied.

**SEE ALSO**

[fseek\(3S\)](#), [fsetpos\(3C\)](#), [getc\(3S\)](#), [setbuf\(3S\)](#), [stdio\(3S\)](#).

**DIAGNOSTICS**

ungetc returns EOF if it cannot insert the character.

**NAME**

vprintf, vfprintf, vsprintf – print formatted output of a variable argument list

**SYNOPSIS**

```
#include <stdio.h>
#include <stdarg.h>

int vprintf(const char *format, va_list ap);
int vfprintf(FILE *stream, const char *format, va_list ap);
int vsprintf(char *s, const char *format, va_list ap);
```

**DESCRIPTION**

vprintf, vfprintf and vsprintf are the same as printf, fprintf, and sprintf respectively, except that instead of being called with a variable number of arguments, they are called with an argument list as defined by the <stdarg.h> header file.

The <stdarg.h> header file defines the type va\_list and a set of macros for advancing through a list of arguments whose number and types may vary. The argument *ap* to the vprint family of routines is of type va\_list. This argument is used with the <stdarg.h> header file macros va\_start, va\_arg and va\_end [see va\_start, va\_arg, and va\_end in stdarg(5)]. The EXAMPLE section below shows their use with vprintf.

**EXAMPLE**

The following demonstrates how vfprintf could be used to write an error routine:

```
#include <stdio.h>
#include <stdarg.h>
/*
 * error should be called like
 * error(function_name, format, arg1, ...);
 */
void error(char *function_name, char *format, ...)
{
 va_list ap;
 va_start(ap, format);
 /* print out name of function causing error */
 (void) fprintf(stderr, "ERR in %s: ", function_name);
 va_arg(ap, char*);
 /* print out remainder of message */
 (void) vfprintf(stderr, format, ap);
 va_end(ap);
 (void) abort;
}
```

**vprintf(3S)**

**vprintf(3S)**

**SEE ALSO**

`printf(3S)`, `stdarg(5)`.

**DIAGNOSTICS**

`vprintf` and `vfprintf` return the number of characters transmitted, or return `-1` if an error was encountered.



3E



**NAME**

elf - object file access library

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>
```

**DESCRIPTION**

Functions in the ELF access library let a program manipulate ELF (Executable and Linking Format) object files, archive files, and archive members. The header file provides type and function declarations for all library services.

Programs communicate with many of the higher-level routines using an *ELF descriptor*. That is, when the program starts working with a file, `elf_begin` creates an ELF descriptor through which the program manipulates the structures and information in the file. These ELF descriptors can be used both to read and to write files. After the program establishes an ELF descriptor for a file, it may then obtain *section descriptors* to manipulate the sections of the file [see `elf_getscn(3E)`]. Sections hold the bulk of an object file's real information, such as text, data, the symbol table, and so on. A section descriptor "belongs" to a particular ELF descriptor, just as a section belongs to a file. Finally, *data descriptors* are available through section descriptors, allowing the program to manipulate the information associated with a section. A data descriptor "belongs" to a section descriptor.

Descriptors provide private handles to a file and its pieces. In other words, a data descriptor is associated with one section descriptor, which is associated with one ELF descriptor, which is associated with one file. Although descriptors are private, they give access to data that may be shared. Consider programs that combine input files, using incoming data to create or update another file. Such a program might get data descriptors for an input and an output section. It then could update the output descriptor to reuse the input descriptor's data. That is, the descriptors are distinct, but they could share the associated data bytes. This sharing avoids the space overhead for duplicate buffers and the performance overhead for copying data unnecessarily.

**FILE CLASSES**

ELF provides a framework in which to define a family of object files, supporting multiple processors and architectures. An important distinction among object files is the *class*, or capacity, of the file. The 32-bit class supports architectures in which a 32-bit object can represent addresses, file sizes, etc., as in the following.

| Name                       | Purpose                 |
|----------------------------|-------------------------|
| <code>Elf32_Addr</code>    | Unsigned address        |
| <code>Elf32_Half</code>    | Unsigned medium integer |
| <code>Elf32_Off</code>     | Unsigned file offset    |
| <code>Elf32_Sword</code>   | Signed large integer    |
| <code>Elf32_Word</code>    | Unsigned large integer  |
| <code>unsigned char</code> | Unsigned small integer  |

Other classes will be defined as necessary, to support larger (or smaller) machines. Some library services deal only with data objects for a specific class, while others are class-independent. To make this distinction clear, library function names reflect their status, as described below.

#### DATA REPRESENTATIONS

Conceptually, two parallel sets of objects support cross compilation environments. One set corresponds to file contents, while the other set corresponds to the native memory image of the program manipulating the file. Type definitions supplied by the header files work on the native machine, which may have different data encodings (size, byte order, etc.) than the target machine. Although native memory objects should be at least as big as the file objects (to avoid information loss), they may be bigger if that is more natural for the host machine.

Translation facilities exist to convert between file and memory representations. Some library routines convert data automatically, while others leave conversion as the program's responsibility. Either way, programs that create object files must write file-typed objects to those files; programs that read object files must take a similar view. See `elf_xlate(3E)` and `elf_fsize(3E)` for more information.

Programs may translate data explicitly, taking full control over the object file layout and semantics. If the program prefers not to have and exercise complete control, the library provides a higher-level interface that hides many object file details. `elf_begin` and related functions let a program deal with the native memory types, converting between memory objects and their file equivalents automatically when reading or writing an object file.

#### ELF VERSIONS

Object file versions allow ELF to adapt to new requirements. Three— independent—versions can be important to a program. First, an application program knows about a particular version by virtue of being compiled with certain header files. Second, the access library similarly is compiled with header files that control what versions it understands. Third, an ELF object file holds a value identifying its version, determined by the ELF version known by the file's creator. Ideally, all three versions would be the same, but they may differ.

If a program's version is newer than the access library, the program might use information unknown to the library. Translation routines might not work properly, leading to undefined behavior. This condition merits installing a new library.

The library's version might be newer than the program's and the file's. The library understands old versions, thus avoiding compatibility problems in this case.

Finally, a file's version might be newer than either the program or the library understands. The program might or might not be able to process the file properly, depending on whether the file has extra information and whether that information can be safely ignored. Again, the safe alternative is to install a new library that understands the file's version.

To accommodate these differences, a program must use `elf_version` to pass its version to the library, thus establishing the *working version* for the process. Using this, the library accepts data from and presents data to the program in the proper representations. When the library reads object files, it uses each file's version to interpret the data. When writing files or converting memory types to the file equivalents, the library uses the program's working version for the file data.

### SYSTEM SERVICES

As mentioned above, `elf_begin` and related routines provide a higher-level interface to ELF files, performing input and output on behalf of the application program. These routines assume a program can hold entire files in memory, without explicitly using temporary files. When reading a file, the library routines bring the data into memory and perform subsequent operations on the memory copy. Programs that wish to read or write large object files with this model must execute on a machine with a large process virtual address space. If the underlying operating system limits the number of open files, a program can use `elf_cntl` to retrieve all necessary data from the file, allowing the program to close the file descriptor and reuse it.

Although the `elf_begin` interfaces are convenient and efficient for many programs, they might be inappropriate for some. In those cases, an application may invoke the `elf_xlate` data translation routines directly. These routines perform no input or output, leaving that as the application's responsibility. By assuming a larger share of the job, an application controls its input and output model.

### LIBRARY NAMES

Names associated with the library take several forms.

|                             |                                                                                                                                                                                                                                     |
|-----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>elf_name</code>       | These class-independent names perform some service, <i>name</i> , for the program.                                                                                                                                                  |
| <code>elf32_name</code>     | Service names with an embedded class, 32 here, indicate they work only for the designated class of files.                                                                                                                           |
| <code>Elf_Type</code>       | Data types can be class-independent as well, distinguished by <i>Type</i> .                                                                                                                                                         |
| <code>Elf32_Type</code>     | Class-dependent data types have an embedded class name, 32 here.                                                                                                                                                                    |
| <code>ELF_C_CMD</code>      | Several functions take commands that control their actions. These values are members of the <code>Elf_Cmd</code> enumeration; they range from zero through <code>ELF_C_NUM-1</code> .                                               |
| <code>ELF_F_FLAG</code>     | Several functions take flags that control library status and/or actions. Flags are bits that may be combined.                                                                                                                       |
| <code>ELF32_FSZ_TYPE</code> | These constants give the file sizes in bytes of the basic ELF types for the 32-bit class of files. See <code>elf_fsize</code> for more information.                                                                                 |
| <code>ELF_K_KIND</code>     | The function <code>elf_kind</code> identifies the <i>KIND</i> of file associated with an ELF descriptor. These values are members of the <code>Elf_Kind</code> enumeration; they range from zero through <code>ELF_K_NUM-1</code> . |

**ELF\_T\_TYPE** When a service function, such as `elf_xlate`, deals with multiple types, names of this form specify the desired *TYPE*. Thus, for example, `ELF_T_EHDR` is directly related to `Elf32_Ehdr`. These values are members of the `Elf_Type` enumeration; they range from zero through `ELF_T_NUM-1`.

**SEE ALSO**

`cof2elf(1)`, `elf_begin(3E)`, `elf_cntl(3E)`, `elf_end(3E)`, `elf_error(3E)`, `elf_fill(3E)`, `elf_flag(3E)`, `elf_fsize(3E)`, `elf_getarhdr(3E)`, `elf_getarsym(3E)`, `elf_getbase(3E)`, `elf_getdata(3E)`, `elf_getehdr(3E)`, `elf_getident(3E)`, `elf_getphdr(3E)`, `elf_getscn(3E)`, `elf_getshdr(3E)`, `elf_hash(3E)`, `elf_kind(3E)`, `elf_next(3E)`, `elf_rand(3E)`, `elf_rawfile(3E)`, `elf_strpstr(3E)`, `elf_update(3E)`, `elf_version(3E)`, `elf_xlate(3E)`, `a.out(4)`  
`ar(4)`

The "Object Files" in the chapter *Programmer's Guide: ANSI C and Programming Support Tools*.

**NOTES**

Information in the ELF header files is separated into common parts and processor-specific parts. A program can make a processor's information available by including the appropriate header file: `<sys/elf_NAME.h>` where *NAME* matches the processor name as used in the ELF file header.

| Symbol             | Processor      |
|--------------------|----------------|
| <code>M32</code>   | AT&T WE 32100  |
| <code>SPARC</code> | SPARC          |
| <code>386</code>   | Intel 80386    |
| <code>486</code>   | Intel 80486    |
| <code>860</code>   | Intel 80860    |
| <code>68K</code>   | Motorola 68000 |
| <code>88K</code>   | Motorola 88000 |

Other processors will be added to the table as necessary. To illustrate, a program could use the following code to "see" the processor-specific information for the WE 32100.

```
#include <libelf.h>
#include <sys/elf_M32.h>
```

Without the `<sys/elf_M32.h>` definition, only the common ELF information would be visible.

## NAME

elf\_begin - make a file descriptor

## SYNOPSIS

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
Elf *elf_begin(int fildes, Elf_Cmd cmd, Elf *ref);
```

## DESCRIPTION

elf\_begin, elf\_next, elf\_rand, and elf\_end work together to process ELF object files, either individually or as members of archives. After obtaining an ELF descriptor from elf\_begin, the program may read an existing file, update an existing file, or create a new file. fildes is an open file descriptor that elf\_begin uses for reading or writing. The initial file offset [see lseek(2)] is unconstrained, and the resulting file offset is undefined.

cmd may have the following values.

**ELF\_C\_NULL** When a program sets cmd to this value, elf\_begin returns a null pointer, without opening a new descriptor. ref is ignored for this command. See elf\_next(3E) and the examples below for more information.

**ELF\_C\_READ** When a program wishes to examine the contents of an existing file, it should set cmd to this value. Depending on the value of ref, this command examines archive members or entire files. Three cases can occur.

First, if ref is a null pointer, elf\_begin allocates a new ELF descriptor and prepares to process the entire file. If the file being read is an archive, elf\_begin also prepares the resulting descriptor to examine the initial archive member on the next call to elf\_begin, as if the program had used elf\_next or elf\_rand to "move" to the initial member.

Second, if ref is a non-null descriptor associated with an archive file, elf\_begin lets a program obtain a separate ELF descriptor associated with an individual member. The program should have used elf\_next or elf\_rand to position ref appropriately (except for the initial member, which elf\_begin prepares; see the example below). In this case, fildes should be the same file descriptor used for the parent archive.

Finally, if ref is a non-null ELF descriptor that is not an archive, elf\_begin increments the number of activations for the descriptor and returns ref, without allocating a new descriptor and without changing the descriptor's read/write permissions. To terminate the descriptor for ref, the program must call elf\_end once for each activation. See elf\_next(3E) and the examples below for more information.

**ELF\_C\_RDWR** This command duplicates the actions of **ELF\_C\_READ** and additionally allows the program to update the file image [see **elf\_update(3E)**]. That is, using **ELF\_C\_READ** gives a read-only view of the file, while **ELF\_C\_RDWR** lets the program read *and* write the file. **ELF\_C\_RDWR** is not valid for archive members. If *ref* is non-null, it must have been created with the **ELF\_C\_RDWR** command.

**ELF\_C\_WRITE** If the program wishes to ignore previous file contents, presumably to create a new file, it should set *cmd* to this value. *ref* is ignored for this command.

**elf\_begin** “works” on all files (including files with zero bytes), providing it can allocate memory for its internal structures and read any necessary information from the file. Programs reading object files thus may call **elf\_kind** or **elf\_getehdr** to determine the file type (only object files have an ELF header). If the file is an archive with no more members to process, or an error occurs, **elf\_begin** returns a null pointer. Otherwise, the return value is a non-null ELF descriptor.

Before the first call to **elf\_begin**, a program must call **elf\_version** to coordinate versions.

## SYSTEM SERVICES

When processing a file, the library decides when to read or write the file, depending on the program’s requests. Normally, the library assumes the file descriptor remains usable for the life of the ELF descriptor. If, however, a program must process many files simultaneously and the underlying operating system limits the number of open files, the program can use **elf\_cntl** to let it reuse file descriptors. After calling **elf\_cntl** with appropriate arguments, the program may close the file descriptor without interfering with the library.

All data associated with an ELF descriptor remain allocated until **elf\_end** terminates the descriptor’s last activation. After the descriptors have been terminated, the storage is released; attempting to reference such data gives undefined behavior. Consequently, a program that deals with multiple input (or output) files must keep the ELF descriptors active until it finishes with them.

## EXAMPLES

A prototype for reading a file appears below. If the file is a simple object file, the program executes the loop one time, receiving a null descriptor in the second iteration. In this case, both **elf** and **arf** will have the same value, the activation count will be two, and the program calls **elf\_end** twice to terminate the descriptor. If the file is an archive, the loop processes each archive member in turn, ignoring those that are not object files.

```

if (elf_version(EV_CURRENT) == EV_NONE)
{
 /* library out of date */
 /* recover from error */
}
cmd = ELF_C_READ;
arf = elf_begin(fildes, cmd, (Elf *)0);
while ((elf = elf_begin(fildes, cmd, arf)) != 0)
{
 if ((ehdr = elf32_getehdr(elf)) != 0)
 {
 /* process the file ... */
 }
 cmd = elf_next(elf);
 elf_end(elf);
}
elf_end(arf);

```

Alternatively, the next example illustrates random archive processing. After identifying the file as an archive, the program repeatedly processes archive members of interest. For clarity, this example omits error checking and ignores simple object files. Additionally, this fragment preserves the ELF descriptors for all archive members, because it does not call `elf_end` to terminate them.

```

elf_version(EV_CURRENT);
arf = elf_begin(fildes, ELF_C_READ, (Elf *)0);
if (elf_kind(arf) != ELF_K_AR)
{
 /* not an archive */
}
/* initial processing */
/* set offset = ... for desired member header */
while (elf_rand(arf, offset) == offset)
{
 if ((elf = elf_begin(fildes, ELF_C_READ, arf)) == 0)
 break;
 if ((ehdr = elf32_getehdr(elf)) != 0)
 {
 /* process archive member ... */
 }
 /* set offset = ... for desired member header */
}

```

The following outline shows how one might create a new ELF file. This example is simplified to show the overall flow.

```

elf_version(EV_CURRENT);
fildes = open("path/name", O_RDWR|O_TRUNC|O_CREAT, 0666);
if ((elf = elf_begin(fildes, ELF_C_WRITE, (Elf *)0)) == 0)
 return;
ehdr = elf32_newehdr(elf);
phdr = elf32_newphdr(elf, count);
scn = elf_newscn(elf);
shdr = elf32_getshdr(scn);
data = elf_newdata(scn);
elf_update(elf, ELF_C_WRITE);
elf_end(elf);

```

Finally, the following outline shows how one might update an existing ELF file. Again, this example is simplified to show the overall flow.

```

elf_version(EV_CURRENT);
fildes = open("path/name", O_RDWR);
elf = elf_begin(fildes, ELF_C_RDWR, (Elf *)0);

/* add new or delete old information ... */

close(creat("path/name", 0666));
elf_update(elf, ELF_C_WRITE);
elf_end(elf);

```

In the example above, the call to `creat` truncates the file, thus ensuring the resulting file will have the "right" size. Without truncation, the updated file might be as big as the original, even if information were deleted. The library truncates the file, if it can, with `ftruncate` [see `truncate(2)`]. Some systems, however, do not support `ftruncate`, and the call to `creat` protects against this.

Notice that both file creation examples open the file with *write and read* permissions. On systems that support `mmap`, the library uses it to enhance performance, and `mmap` requires a readable file descriptor. Although the library can use a write-only file descriptor, the application will not obtain the performance advantages of `mmap`.

#### SEE ALSO

`cof2elf(1)`, `creat(2)`, `lseek(2)`, `mmap(2)`, `open(2)`, `truncate(2)`, `elf(3E)`, `elf_cntl(3E)`, `elf_end(3E)`, `elf_getarhdr(3E)`, `elf_getbase(3E)`, `elf_getdata(3E)`, `elf_getehdr(3E)`, `elf_getphdr(3E)`, `elf_getscn(3E)`, `elf_kind(3E)`, `elf_next(3E)`, `elf_rand(3E)`, `elf_rawfile(3E)`, `elf_update(3E)`, `elf_version(3E)`, `ar(4)`.

#### NOTES

COFF is an object file format that preceded ELF. When a program calls `elf_begin` on a COFF file, the library translates COFF structures to their ELF equivalents, allowing programs to read (but not to write) a COFF file as if it were ELF. This conversion happens only to the memory image and *not* to the file itself. After the initial `elf_begin`, file offsets and addresses in the ELF header, the program headers, and the section headers retain the original COFF values [see `elf_getehdr`, `elf_getphdr`, and `elf_getshdr`]. A program may call `elf_update` to adjust these values (without writing the file), and the library will



then present a consistent, ELF view of the file. Data obtained through `elf_getdata` are translated (the COFF symbol table is presented as ELF , etc.). Data viewed through `elf_rawdata` undergo no conversion, allowing the program to view the bytes from the file itself.

Some COFF debugging information is not translated, though this does not affect the semantics of a running program.

Although the ELF library supports COFF , programmers are strongly encouraged to recompile their programs, obtaining ELF object files.

**NAME**

elf\_cntl - control a file descriptor

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

int elf_cntl(Elf *elf, Elf_Cmd cmd);
```

**DESCRIPTION**

elf\_cntl instructs the library to modify its behavior with respect to an ELF descriptor, *elf*. As elf\_begin(3E) describes, an ELF descriptor can have multiple activations, and multiple ELF descriptors may share a single file descriptor. Generally, elf\_cntl commands apply to all activations of *elf*. Moreover, if the ELF descriptor is associated with an archive file, descriptors for members within the archive will also be affected as described below. Unless stated otherwise, operations on archive members do not affect the descriptor for the containing archive.

The *cmd* argument tells what actions to take and may have the following values.

**ELF\_C\_FDDONE**

This value tells the library not to use the file descriptor associated with *elf*. A program should use this command when it has requested all the information it cares to use and wishes to avoid the overhead of reading the rest of the file. The memory for all completed operations remains valid, but later file operations, such as the initial elf\_getdata for a section, will fail if the data are not in memory already.

**ELF\_C\_FDREAD**

This command is similar to ELF\_C\_FDDONE, except it forces the library to read the rest of the file. A program should use this command when it must close the file descriptor but has not yet read everything it needs from the file. After elf\_cntl completes the ELF\_C\_FDREAD command, future operations, such as elf\_getdata, will use the memory version of the file without needing to use the file descriptor.

If elf\_cntl succeeds, it returns zero. Otherwise *elf* was null or an error occurred, and the function returns -1.

**SEE ALSO**

elf(3E), elf\_begin(3E), elf\_getdata(3E), elf\_rawfile(3E).

**NOTE**

If the program wishes to use the "raw" operations [see elf\_rawdata, which elf\_getdata(3E) describes, and elf\_rawfile(3E)] after disabling the file descriptor with ELF\_C\_FDDONE or ELF\_C\_FDREAD, it must execute the raw operations explicitly beforehand. Otherwise, the raw file operations will fail. Calling elf\_rawfile makes the entire image available, thus supporting subsequent elf\_rawdata calls.

**NAME**

elf\_end - finish using an object file

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>
int elf_end(Elf *elf);
```

**DESCRIPTION**

A program uses `elf_end` to terminate an ELF descriptor, `elf`, and to deallocate data associated with the descriptor. Until the program terminates a descriptor, the data remain allocated. `elf` should be a value previously returned by `elf_begin`; a null pointer is allowed as an argument, to simplify error handling. If the program wishes to write data associated with the ELF descriptor to the file, it must use `elf_update` before calling `elf_end`.

As `elf_begin(3E)` explains, a descriptor can have more than one activation. Calling `elf_end` removes one activation and returns the remaining activation count. The library does not terminate the descriptor until the activation count reaches zero. Consequently, a zero return value indicates the ELF descriptor is no longer valid.

**SEE ALSO**

`elf(3E)`, `elf_begin(3E)`, `elf_update(3E)`.

**NAME**

elf\_errmsg, elf\_errno - error handling

**SYNOPSIS**cc [*flag ...*] *file ...* -l`elf` [*library ...*]

#include &lt;libelf.h&gt;

const char \*elf\_errmsg(int *err*);

int elf\_errno(void);

**DESCRIPTION**

If an ELF library function fails, a program may call `elf_errno` to retrieve the library's internal error number. As a side effect, this function resets the internal error number to zero, which indicates no error.

`elf_errmsg` takes an error number, *err*, and returns a null-terminated error message (with no trailing new-line) that describes the problem. A zero *err* retrieves a message for the most recent error. If no error has occurred, the return value is a null pointer (not a pointer to the null string). Using *err* of -1 also retrieves the most recent error, except it guarantees a non-null return value, even when no error has occurred. If no message is available for the given number, `elf_errmsg` returns a pointer to an appropriate message. This function does not have the side effect of clearing the internal error number.

**EXAMPLE**

The following fragment clears the internal error number and checks it later for errors. Unless an error occurs after the first call to `elf_errno`, the next call will return zero.

```
(void)elf_errno();
while (more_to_do)
{
 /* processing ... */
 if ((err = elf_errno()) != 0)
 {
 msg = elf_errmsg(err);
 /* print msg */
 }
}
```

**SEE ALSO**`elf(3E)`, `elf_version(3E)`.

**elf\_fill(3E)**

**elf\_fill(3E)**

**NAME**

**elf\_fill** - set fill byte

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
void elf_fill(int fill);
```

**DESCRIPTION**

Alignment constraints for ELF files sometimes require the presence of "holes." For example, if the data for one section are required to begin on an eight-byte boundary, but the preceding section is too "short," the library must fill the intervening bytes. These bytes are set to the *fill* character. The library uses zero bytes unless the application supplies a value. See [elf\\_getdata\(3E\)](#) for more information about these holes.

**SEE ALSO**

[elf\(3E\)](#), [elf\\_getdata\(3E\)](#), [elf\\_flag\(3E\)](#), [elf\\_update\(3E\)](#).

**NOTE**

An application can assume control of the object file organization by setting the `ELF_F_LAYOUT` bit [see [elf\\_flag\(3E\)](#)]. When this is done, the library does *not* fill holes.

## NAME

`elf_flagdata`, `elf_flagehdr`, `elf_flagelf`, `elf_flagphdr`, `elf_flagscn`,  
`elf_flagshdr` – manipulate flags

## SYNOPSIS

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

unsigned elf_flagdata(Elf_Data *data, Elf_Cmd cmd, unsigned flags);
unsigned elf_flagehdr(Elf *elf, Elf_Cmd cmd, unsigned flags);
unsigned elf_flagelf(Elf *elf, Elf_Cmd cmd, unsigned flags);
unsigned elf_flagphdr(Elf *elf, Elf_Cmd cmd, unsigned flags);
unsigned elf_flagscn(Elf_Scn *scn, Elf_Cmd cmd, unsigned flags);
unsigned elf_flagshdr(Elf_Scn *scn, Elf_Cmd cmd, unsigned flags);
```

## DESCRIPTION

These functions manipulate the flags associated with various structures of an ELF file. Given an ELF descriptor (*elf*), a data descriptor (*data*), or a section descriptor (*scn*), the functions may set or clear the associated status bits, returning the updated bits. A null descriptor is allowed, to simplify error handling; all functions return zero for this degenerate case.

*cmd* may have the following values.

**ELF\_C\_CLR**           The functions clear the bits that are asserted in *flags*. Only the non-zero bits in *flags* are cleared; zero bits do not change the status of the descriptor.

**ELF\_C\_SET**           The functions set the bits that are asserted in *flags*. Only the non-zero bits in *flags* are set; zero bits do not change the status of the descriptor.

Descriptions of the defined *flags* bits appear below.

**ELF\_F\_DIRTY**       When the program intends to write an ELF file, this flag asserts the associated information needs to be written to the file. Thus, for example, a program that wished to update the ELF header of an existing file would call `elf_flagehdr` with this bit set in *flags* and *cmd* equal to `ELF_C_SET`. A later call to `elf_update` would write the marked header to the file.

**ELF\_F\_LAYOUT**     Normally, the library decides how to arrange an output file. That is, it automatically decides where to place sections, how to align them in the file, etc. If this bit is set for an ELF descriptor, the program assumes responsibility for determining all file positions. This bit is meaningful only for `elf_flagelf` and applies to the entire file associated with the descriptor.

When a flag bit is set for an item, it affects all the subitems as well. Thus, for example, if the program sets the **ELF\_F\_DIRTY** bit with `elf_flagelf`, the entire logical file is "dirty."

**EXAMPLE**

The following fragment shows how one might mark the ELF header to be written to the output file.

```
ehdr = elf32_getehdr(elf);
/* dirty ehdr ... */
elf_flagehdr(elf, ELF_C_SET, ELF_F_DIRTY);
```

**SEE ALSO**

`elf(3E)`, `elf_end(3E)`, `elf_getdata(3E)`, `elf_getehdr(3E)`, `elf_update(3E)`.

**NAME**

elf\_fsize: elf32\_fsize - return the size of an object file type

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

size_t elf32_fsize(Elf_Type type, size_t count, unsigned ver);
```

**DESCRIPTION**

elf32\_fsize gives the size in bytes of the 32-bit file representation of *count* data objects with the given *type*. The library uses version *ver* to calculate the size [see elf(3E) and elf\_version(3E)].

Constant values are available for the sizes of fundamental types.

| Elf_Type    | File Size       | Memory Size           |
|-------------|-----------------|-----------------------|
| ELF_T_ADDR  | ELF32_FSZ_ADDR  | sizeof(Elf32_Addr)    |
| ELF_T_BYTE  | 1               | sizeof(unsigned char) |
| ELF_T_HALF  | ELF32_FSZ_HALF  | sizeof(Elf32_Half)    |
| ELF_T_OFF   | ELF32_FSZ_OFF   | sizeof(Elf32_Off)     |
| ELF_T_SWORD | ELF32_FSZ_SWORD | sizeof(Elf32_Sword)   |
| ELF_T_WORD  | ELF32_FSZ_WORD  | sizeof(Elf32_Word)    |

elf32\_fsize returns zero if the value of *type* or *ver* is unknown. See elf\_xlate(3E) for a list of the *type* values.

**SEE ALSO**

elf(3E), elf\_version(3E), elf\_xlate(3E).



## NAME

elf\_getarhdr - retrieve archive member header

## SYNOPSIS

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>
Elf_Arhdr *elf_getarhdr(Elf *elf);
```

## DESCRIPTION

elf\_getarhdr returns a pointer to an archive member header, if one is available for the ELF descriptor *elf*. Otherwise, no archive member header exists, an error occurred, or *elf* was null; elf\_getarhdr then returns a null value. The header includes the following members.

|               |              |
|---------------|--------------|
| char          | *ar_name;    |
| time_t        | ar_date;     |
| long          | ar_uid;      |
| long          | ar_gid;      |
| unsigned long | ar_mode;     |
| off_t         | ar_size;     |
| char          | *ar_rawname; |

An archive member name, available through *ar\_name*, is a null-terminated string, with the *ar* format control characters removed. The *ar\_rawname* member holds a null-terminated string that represents the original name bytes in the file, including the terminating slash and trailing blanks as specified in the archive format.

In addition to "regular" archive members, the archive format defines some special members. All special member names begin with a slash (/), distinguishing them from regular members (whose names may not contain a slash). These special members have the names (*ar\_name*) defined below.

- / This is the archive symbol table. If present, it will be the first archive member. A program may access the archive symbol table through *elf\_getarsym*. The information in the symbol table is useful for random archive processing [see *elf\_rand(3E)*].
- // This member, if present, holds a string table for long archive member names. An archive member's header contains a 16-byte area for the name, which may be exceeded in some file systems. The library automatically retrieves long member names from the string table, setting *ar\_name* to the appropriate value.

Under some error conditions, a member's name might not be available. Although this causes the library to set *ar\_name* to a null pointer, the *ar\_rawname* member will be set as usual.

## SEE ALSO

elf(3E), elf\_begin(3E), elf\_getarsym(3E), elf\_rand(3E), ar(4).

**NAME**

`elf_getarsym` - retrieve archive symbol table

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

Elf_Arsym *elf_getarsym(Elf *elf, size_t *ptr);
```

**DESCRIPTION**

`elf_getarsym` returns a pointer to the archive symbol table, if one is available for the ELF descriptor `elf`. Otherwise, the archive doesn't have a symbol table, an error occurred, or `elf` was null; `elf_getarsym` then returns a null value. The symbol table is an array of structures that include the following members.

```
char *as_name;
size_t as_off;
unsigned long as_hash;
```

These members have the following semantics.

- `as_name` A pointer to a null-terminated symbol name resides here.
- `as_off` This value is a byte offset from the beginning of the archive to the member's header. The archive member residing at the given offset defines the associated symbol. Values in `as_off` may be passed as arguments to `elf_rand` to access the desired archive member.
- `as_hash` This is a hash value for the name, as computed by `elf_hash`.

If `ptr` is non-null, the library stores the number of table entries in the location to which `ptr` points. This value is set to zero when the return value is null. The table's last entry, which is included in the count, has a null `as_name`, a zero value for `as_off`, and `~0UL` for `as_hash`.

**SEE ALSO**

`elf`(3E), `elf_getarhdr`(3E), `elf_hash`(3E), `elf_rand`(3E), `ar`(4).

**NAME**

elf\_getbase - get the base offset for an object file

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
off_t elf_getbase(Elf *elf);
```

**DESCRIPTION**

elf\_getbase returns the file offset of the first byte of the file or archive member associated with *elf*, if it is known or obtainable, and -1 otherwise. A null *elf* is allowed, to simplify error handling; the return value in this case is -1. The base offset of an archive member is the beginning of the member's information, *not* the beginning of the archive member header.

**SEE ALSO**

elf(3E), elf\_begin(3E), ar(4).

## NAME

elf\_getdata, elf\_newdata, elf\_rawdata – get section data

## SYNOPSIS

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>
Elf_Data *elf_getdata(Elf_Scn *scn, Elf_Data *data);
Elf_Data *elf_newdata(Elf_Scn *scn);
Elf_Data *elf_rawdata(Elf_Scn *scn, Elf_Data *data);
```

## DESCRIPTION

These functions access and manipulate the data associated with a section descriptor, *scn*. When reading an existing file, a section will have a single data buffer associated with it. A program may build a new section in pieces, however, composing the new data from multiple data buffers. For this reason, “the” data for a section should be viewed as a list of buffers, each of which is available through a data descriptor.

*elf\_getdata* lets a program step through a section’s data list. If the incoming data descriptor, *data*, is null, the function returns the first buffer associated with the section. Otherwise, *data* should be a data descriptor associated with *scn*, and the function gives the program access to the next data element for the section. If *scn* is null or an error occurs, *elf\_getdata* returns a null pointer.

*elf\_getdata* translates the data from file representations into memory representations [see *elf\_xlate(3E)*] and presents objects with memory data types to the program, based on the file’s *class* [see *elf(3E)*]. The working library version [see *elf\_version(3E)*] specifies what version of the memory structures the program wishes *elf\_getdata* to present.

*elf\_newdata* creates a new data descriptor for a section, appending it to any data elements already associated with the section. As described below, the new data descriptor appears empty, indicating the element holds no data. For convenience, the descriptor’s type (*d\_type* below) is set to **ELF\_T\_BYTE**, and the version (*d\_version* below) is set to the working version. The program is responsible for setting (or changing) the descriptor members as needed. This function implicitly sets the **ELF\_F\_DIRTY** bit for the section’s data [see *elf\_flag(3E)*]. If *scn* is null or an error occurs, *elf\_newdata* returns a null pointer.

*elf\_rawdata* differs from *elf\_getdata* by returning only uninterpreted bytes, regardless of the section type. This function typically should be used only to retrieve a section image from a file being read, and then only when a program must avoid the automatic data translation described below. Moreover, a program may not close or disable [see *elf\_cntl(3E)*] the file descriptor associated with *elf* before the initial raw operation, because *elf\_rawdata* might read the data from the file to ensure it doesn’t interfere with *elf\_getdata*. See *elf\_rawfile(3E)* for a related facility that applies to the entire file. When *elf\_getdata* provides the right translation, its use is recommended over *elf\_rawdata*. If *scn* is null or an error occurs, *elf\_rawdata* returns a null pointer.

The `Elf_Data` structure includes the following members.

```

void *d_buf;
Elf_Type d_type;
size_t d_size;
off_t d_off;
size_t d_align;
unsigned d_version;

```

These members are available for direct manipulation by the program. Descriptions appear below.

- d\_buf**            A pointer to the data buffer resides here. A data element with no data has a null pointer.
- d\_type**           This member's value specifies the type of the data to which `d_buf` points. A section's type determines how to interpret the section contents, as summarized below.
- d\_size**           This member holds the total size, in bytes, of the memory occupied by the data. This may differ from the size as represented in the file. The size will be zero if no data exist. [See the discussion of `SHT_NOBITS` below for more information.]
- d\_off**            This member gives the offset, within the section, at which the buffer resides. This offset is relative to the file's section, not the memory object's.
- d\_align**          This member holds the buffer's required alignment, from the beginning of the section. That is, `d_off` will be a multiple of this member's value. For example, if this member's value is four, the beginning of the buffer will be four-byte aligned within the section. Moreover, the entire section will be aligned to the maximum of its constituents, thus ensuring appropriate alignment for a buffer within the section and within the file.
- d\_version**        This member holds the version number of the objects in the buffer. When the library originally read the data from the object file, it used the working version to control the translation to memory objects.

#### DATA ALIGNMENT

As mentioned above, data buffers within a section have explicit alignment constraints. Consequently, adjacent buffers sometimes will not abut, causing "holes" within a section. Programs that create output files have two ways of dealing with these holes.

First, the program can use `elf_fill` to tell the library how to set the intervening bytes. When the library must generate gaps in the file, it uses the fill byte to initialize the data there. The library's initial fill value is zero, and `elf_fill` lets the application change that.

Second, the application can generate its own data buffers to occupy the gaps, filling the gaps with values appropriate for the section being created. A program might even use different fill values for different sections. For example, it could set text sections' bytes to no-operation instructions, while filling data section holes

with zero. Using this technique, the library finds no holes to fill, because the application eliminated them.

### SECTION AND MEMORY TYPES

`elf_getdata` interprets sections' data according to the section type, as noted in the section header available through `elf_getshdr`. The following table shows the section types and how the library represents them with memory data types for the 32-bit file class. Other classes would have similar tables. By implication, the memory data types control translation by `elf_xlate`.

| Section Type | Elf_Type    | 32-Bit Type   |
|--------------|-------------|---------------|
| SHT_DYNAMIC  | ELF_T_DYN   | Elf32_Dyn     |
| SHT_DYNSYM   | ELF_T_SYM   | Elf32_Sym     |
| SHT_HASH     | ELF_T_WORD  | Elf32_Word    |
| SHT_NOBITS   | ELF_T_BYTE  | unsigned char |
| SHT_NOTE     | ELF_T_BYTE  | unsigned char |
| SHT_NULL     | <i>none</i> | <i>none</i>   |
| SHT_PROGBITS | ELF_T_BYTE  | unsigned char |
| SHT_REL      | ELF_T_REL   | Elf32_Rel     |
| SHT_RELA     | ELF_T_RELA  | Elf32_Rela    |
| SHT_STRTAB   | ELF_T_BYTE  | unsigned char |
| SHT_SYMTAB   | ELF_T_SYM   | Elf32_Sym     |
| <i>other</i> | ELF_T_BYTE  | unsigned char |

`elf_rawdata` creates a buffer with type `ELF_T_BYTE`.

As mentioned above, the program's working version controls what structures the library creates for the application. The library similarly interprets section types according to the versions. If a section type "belongs" to a version newer than the application's working version, the library does not translate the section data. Because the application cannot know the data format in this case, the library presents an untranslated buffer of type `ELF_T_BYTE`, just as it would for an unrecognized section type.

A section with a special type, `SHT_NOBITS`, occupies no space in an object file, even when the section header indicates a non-zero size. `elf_getdata` and `elf_rawdata` "work" on such a section, setting the `data` structure to have a null buffer pointer and the type indicated above. Although no data are present, the `d_size` value is set to the size from the section header. When a program is creating a new section of type `SHT_NOBITS`, it should use `elf_newdata` to add data buffers to the section. These "empty" data buffers should have the `d_size` members set to the desired size and the `d_buf` members set to null.

### EXAMPLE

The following fragment obtains the string table that holds section names (ignoring error checking). See `elf_strptr(3E)` for a variation of string table handling.

```

ehdr = elf32_getehdr(elf);
scn = elf_getscn(elf, (size_t)ehdr->e_shstrndx);
shdr = elf32_getshdr(scn);
if (shdr->sh_type != SHT_STRTAB)
{
 /* not a string table */
}
data = 0;
if ((data = elf_getdata(scn, data)) == 0 || data->d_size == 0)
{
 /* error or no data */
}

```

The `e_shstrndx` member in an ELF header holds the section table index of the string table. The program gets a section descriptor for that section, verifies it is a string table, and then retrieves the data. When this fragment finishes, `data->d_buf` points at the first byte of the string table, and `data->d_size` holds the string table's size in bytes.

#### SEE ALSO

`elf(3E)`, `elf_cntl(3E)`, `elf_fill(3E)`, `elf_flag(3E)`, `elf_getehdr(3E)`, `elf_getscn(3E)`, `elf_getshdr(3E)`, `elf_rawfile(3E)`, `elf_version(3E)`, `elf_xlate(3E)`.

**NAME**

`elf_getehdr`: `elf32_getehdr`, `elf32_newehdr` – retrieve class-dependent object file header

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

Elf32_Ehdr *elf32_getehdr(Elf *elf);
Elf32_Ehdr *elf32_newehdr(Elf *elf);
```

**DESCRIPTION**

For a 32-bit class file, `elf32_getehdr` returns a pointer to an ELF header, if one is available for the ELF descriptor `elf`. If no header exists for the descriptor, `elf32_newehdr` allocates a "clean" one, but it otherwise behaves the same as `elf32_getehdr`. It does not allocate a new header if one exists already. If no header exists (for `elf_getehdr`), one cannot be created (for `elf_newehdr`), a system error occurs, the file is not a 32-bit class file, or `elf` is null, both functions return a null pointer.

The header includes the following members.

```
unsigned char e_ident[EI_NIDENT];
Elf32_Half e_type;
Elf32_Half e_machine;
Elf32_Word e_version;
Elf32_Addr e_entry;
Elf32_Off e_phoff;
Elf32_Off e_shoff;
Elf32_Word e_flags;
Elf32_Half e_ehsize;
Elf32_Half e_phentsize;
Elf32_Half e_phnum;
Elf32_Half e_shentsize;
Elf32_Half e_shnum;
Elf32_Half e_shstrndx;
```

`elf32_newehdr` automatically sets the `ELF_F_DIRTY` bit [see `elf_flag(3E)`]. A program may use `elf_getident` to inspect the identification bytes from a file.

**SEE ALSO**

`elf(3E)`, `elf_begin(3E)`, `elf_flag(3E)`, `elf_getident(3E)`.



**NAME**

elf\_getident - retrieve file identification data

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
char *elf_getident(Elf *elf, size_t *ptr);
```

**DESCRIPTION**

As elf(3E) explains, ELF provides a framework for various classes of files, where basic objects may have 32 bits, 64 bits, etc. To accommodate these differences, without forcing the larger sizes on smaller machines, the initial bytes in an ELF file hold identification information common to all file classes. Every ELF header's `e_ident` has `EI_NIDENT` bytes with the following interpretation.

| e_ident Index           | Value                                                                            | Purpose             |
|-------------------------|----------------------------------------------------------------------------------|---------------------|
| <code>EI_MAG0</code>    | <code>ELFMAG0</code>                                                             | File identification |
| <code>EI_MAG1</code>    | <code>ELFMAG1</code>                                                             |                     |
| <code>EI_MAG2</code>    | <code>ELFMAG2</code>                                                             |                     |
| <code>EI_MAG3</code>    | <code>ELFMAG3</code>                                                             |                     |
| <code>EI_CLASS</code>   | <code>ELFCLASSNONE</code><br><code>ELFCLASS32</code><br><code>ELFCLASS64</code>  | File class          |
| <code>EI_DATA</code>    | <code>ELFDATANONE</code><br><code>ELFDATA2LSB</code><br><code>ELFDATA2MSB</code> | Data encoding       |
| <code>EI_VERSION</code> | <code>EV_CURRENT</code>                                                          | File version        |
| 7-15                    | 0                                                                                | Unused, set to zero |

Other kinds of files [see `elf_kind(3E)`] also may have identification data, though they would not conform to `e_ident`.

`elf_getident` returns a pointer to the file's "initial bytes." If the library recognizes the file, a conversion from the file image to the memory image may occur. In any case, the identification bytes are guaranteed not to have been modified, though the size of the unmodified area depends on the file type. If `ptr` is non-null, the library stores the number of identification bytes in the location to which `ptr` points. If no data are present, `elf` is null, or an error occurs, the return value is a null pointer, with zero optionally stored through `ptr`.

**SEE ALSO**

`elf(3E)`, `elf_begin(3E)`, `elf_getehdr(3E)`, `elf_kind(3E)`, `elf_rawfile(3E)`.

**NAME**

**elf\_getphdr**: **elf32\_getphdr**, **elf32\_newphdr** - retrieve class-dependent program header table

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

Elf32_Phdr *elf32_getphdr(Elf *elf);
Elf32_Phdr *elf32_newphdr(Elf *elf, size_t count);
```

**DESCRIPTION**

For a 32-bit class file, **elf32\_getphdr** returns a pointer to the program execution header table, if one is available for the ELF descriptor *elf*.

**elf32\_newphdr** allocates a new table with *count* entries, regardless of whether one existed previously, and sets the **ELF\_F\_DIRTY** bit for the table [see **elf\_flag(3E)**]. Specifying a zero *count* deletes an existing table. Note this behavior differs from that of **elf32\_newehdr** [see **elf32\_getehdr(3E)**], allowing a program to replace or delete the program header table, changing its size if necessary.

If no program header table exists, the file is not a 32-bit class file, an error occurs, or *elf* is null, both functions return a null pointer. Additionally, **elf32\_newphdr** returns a null pointer if *count* is zero.

The table is an array of **Elf32\_Phdr** structures, each of which includes the following members.

|                   |                  |
|-------------------|------------------|
| <b>Elf32_Word</b> | <b>p_type;</b>   |
| <b>Elf32_Off</b>  | <b>p_offset;</b> |
| <b>Elf32_Addr</b> | <b>p_vaddr;</b>  |
| <b>Elf32_Addr</b> | <b>p_paddr;</b>  |
| <b>Elf32_Word</b> | <b>p_filesz;</b> |
| <b>Elf32_Word</b> | <b>p_memsz;</b>  |
| <b>Elf32_Word</b> | <b>p_flags;</b>  |
| <b>Elf32_Word</b> | <b>p_align;</b>  |

The ELF header's **e\_phnum** member tells how many entries the program header table has [see **elf\_getehdr(3E)**]. A program may inspect this value to determine the size of an existing table; **elf32\_newphdr** automatically sets the member's value to *count*. If the program is building a new file, it is responsible for creating the file's ELF header before creating the program header table.

**SEE ALSO**

**elf(3E)**, **elf\_begin(3E)**, **elf\_flag(3E)**, **elf\_getehdr(3E)**.

**NAME**

`elf_getscn`, `elf_ndxscn`, `elf_newscn`, `elf_nextscn` – get section information

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

Elf_Scn *elf_getscn(Elf *elf, size_t index);
size_t elf_ndxscn(Elf_Scn *scn);
Elf_Scn *elf_newscn(Elf *elf);
Elf_Scn *elf_nextscn(Elf *elf, Elf_Scn *scn);
```

**DESCRIPTION**

These functions provide indexed and sequential access to the sections associated with the ELF descriptor `elf`. If the program is building a new file, it is responsible for creating the file's ELF header before creating sections; see `elf_getehdr(3E)`.

`elf_getscn` returns a section descriptor, given an *index* into the file's section header table. Note the first "real" section has index 1. Although a program can get a section descriptor for the section whose *index* is 0 (`SHN_UNDEF`, the undefined section), the section has no data and the section header is "empty" (though present). If the specified section does not exist, an error occurs, or `elf` is null, `elf_getscn` returns a null pointer.

`elf_newscn` creates a new section and appends it to the list for `elf`. Because the `SHN_UNDEF` section is required and not "interesting" to applications, the library creates it automatically. Thus the first call to `elf_newscn` for an ELF descriptor with no existing sections returns a descriptor for section 1. If an error occurs or `elf` is null, `elf_newscn` returns a null pointer.

After creating a new section descriptor, the program can use `elf_getshdr` to retrieve the newly created, "clean" section header. The new section descriptor will have no associated data [see `elf_getdata(3E)`]. When creating a new section in this way, the library updates the `e_shnum` member of the ELF header and sets the `ELF_F_DIRTY` bit for the section [see `elf_flag(3E)`]. If the program is building a new file, it is responsible for creating the file's ELF header [see `elf_getehdr(3E)`] before creating new sections.

`elf_nextscn` takes an existing section descriptor, `scn`, and returns a section descriptor for the next higher section. One may use a null `scn` to obtain a section descriptor for the section whose index is 1 (skipping the section whose index is `SHN_UNDEF`). If no further sections are present or an error occurs, `elf_nextscn` returns a null pointer.

`elf_ndxscn` takes an existing section descriptor, `scn`, and returns its section table index. If `scn` is null or an error occurs, `elf_ndxscn` returns `SHN_UNDEF`.

**EXAMPLE**

An example of sequential access appears below. Each pass through the loop processes the next section in the file; the loop terminates when all sections have been processed.

**elf\_getscn(3E)**

**elf\_getscn(3E)**

```
 scn = 0;
 while ((scn = elf_nextscn(elf, scn)) != 0)
 {
 /* process section */
 }
```

**SEE ALSO**

**elf(3E), elf\_begin(3E), elf\_flag(3E), elf\_getdata(3E), elf\_getehdr(3E),  
elf\_getshdr(3E).**

**NAME**

elf\_getshdr: elf32\_getshdr – retrieve class-dependent section header

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
Elf32_Shdr *elf32_getshdr(Elf_Scn *scn);
```

**DESCRIPTION**

For a 32-bit class file, `elf32_getshdr` returns a pointer to a section header for the section descriptor `scn`. Otherwise, the file is not a 32-bit class file, `scn` was null, or an error occurred; `elf32_getshdr` then returns null.

The header includes the following members.

```
Elf32_Word sh_name;
Elf32_Word sh_type;
Elf32_Word sh_flags;
Elf32_Addr sh_addr;
Elf32_Off sh_offset;
Elf32_Word sh_size;
Elf32_Word sh_link;
Elf32_Word sh_info;
Elf32_Word sh_addralign;
Elf32_Word sh_entsize;
```

If the program is building a new file, it is responsible for creating the file's ELF header before creating sections.

**SEE ALSO**

`elf(3E)`, `elf_flag(3E)`, `elf_getscn(3E)`, `elf_strptr(3E)`.

**NAME**

elf\_hash - compute hash value

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

unsigned long elf_hash(const char *name);
```

**DESCRIPTION**

elf\_hash computes a hash value, given a null terminated string, *name*. The returned hash value, *h*, can be used as a bucket index, typically after computing  $h \bmod x$  to ensure appropriate bounds.

Hash tables may be built on one machine and used on another because elf\_hash uses unsigned arithmetic to avoid possible differences in various machines' signed arithmetic. Although *name* is shown as `char*` above, elf\_hash treats it as `unsigned char*` to avoid sign extension differences. Using `char*` eliminates type conflicts with expressions such as `elf_hash("name")`.

ELF files' symbol hash tables are computed using this function [see elf\_getdata(3E) and elf\_xlate(3E)]. The hash value returned is guaranteed not to be the bit pattern of all ones (~0UL).

**SEE ALSO**

elf(3E), elf\_getdata(3E), elf\_xlate(3E).

**NAME**

`elf_kind` – determine file type

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
Elf_Kind elf_kind(Elf *elf);
```

**DESCRIPTION**

This function returns a value identifying the kind of file associated with an ELF descriptor (*elf*). Currently defined values appear below.

**ELF\_K\_AR**           The file is an archive [see `ar(4)`]. An ELF descriptor may also be associated with an archive *member*, not the archive itself, and then `elf_kind` identifies the member's type.

**ELF\_K\_COFF**        The file is a COFF object file. `elf_begin(3E)` describes the library's handling for COFF files.

**ELF\_K\_ELF**         The file is an ELF file. The program may use `elf_getident` to determine the class. Other functions, such as `elf_getehdr`, are available to retrieve other file information.

**ELF\_K\_NONE**        This indicates a kind of file unknown to the library.

Other values are reserved, to be assigned as needed to new kinds of files. *elf* should be a value previously returned by `elf_begin`. A null pointer is allowed, to simplify error handling, and causes `elf_kind` to return `ELF_K_NONE`.

**SEE ALSO**

`elf(3E)`, `elf_begin(3E)`, `elf_getehdr(3E)`, `elf_getident(3E)`, `ar(4)`.

**NAME**

elf\_next – sequential archive member access

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>
Elf_Cmd elf_next(Elf *elf);
```

**DESCRIPTION**

elf\_next, elf\_rand, and elf\_begin manipulate simple object files and archives. elf is an ELF descriptor previously returned from elf\_begin.

elf\_next provides sequential access to the next archive member. That is, having an ELF descriptor, elf, associated with an archive member, elf\_next prepares the containing archive to access the following member when the program calls elf\_begin. After successfully positioning an archive for the next member, elf\_next returns the value ELF\_C\_READ. Otherwise, the open file was not an archive, elf was null, or an error occurred, and the return value is ELF\_C\_NULL. In either case, the return value may be passed as an argument to elf\_begin, specifying the appropriate action.

**SEE ALSO**

elf(3E), elf\_begin(3E), elf\_getarsym(3E), elf\_rand(3E), ar(4).



**NAME**

elf\_rand – random archive member access

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

size_t elf_rand(Elf *elf, size_t offset);
```

**DESCRIPTION**

elf\_rand, elf\_next, and elf\_begin manipulate simple object files and archives. elf is an ELF descriptor previously returned from elf\_begin.

elf\_rand provides random archive processing, preparing elf to access an arbitrary archive member. elf must be a descriptor for the archive itself, not a member within the archive. offset gives the byte offset from the beginning of the archive to the archive header of the desired member. See elf\_getarsym(3E) for more information about archive member offsets. When elf\_rand works, it returns offset. Otherwise it returns 0, because an error occurred, elf was null, or the file was not an archive (no archive member can have a zero offset). A program may mix random and sequential archive processing.

**EXAMPLE**

An archive starts with a “magic string” that has SARMAG bytes; the initial archive member follows immediately. An application could thus provide the following function to rewind an archive (the function returns -1 for errors and 0 otherwise).

```
#include <ar.h>
#include <libelf.h>

int
rewindelf(Elf *elf)
{
 if (elf_rand(elf, (size_t)SARMAG) == SARMAG)
 return 0;
 return -1;
}
```

**SEE ALSO**

elf(3E), elf\_begin(3E), elf\_getarsym(3E), elf\_next(3E), ar(4).

**NAME**

`elf_rawfile` - retrieve uninterpreted file contents

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

char *elf_rawfile(Elf *elf, size_t *ptr);
```

**DESCRIPTION**

`elf_rawfile` returns a pointer to an uninterpreted byte image of the file. This function should be used only to retrieve a file being read. For example, a program might use `elf_rawfile` to retrieve the bytes for an archive member.

A program may not close or disable [see `elf_cntl(3E)`] the file descriptor associated with `elf` before the initial call to `elf_rawfile`, because `elf_rawfile` might have to read the data from the file if it does not already have the original bytes in memory. Generally, this function is more efficient for unknown file types than for object files. The library implicitly translates object files in memory, while it leaves unknown files unmodified. Thus asking for the uninterpreted image of an object file may create a duplicate copy in memory.

`elf_rawdata` [see `elf_getdata(3E)`] is a related function, providing access to sections within a file.

If `ptr` is non-null, the library also stores the file's size, in bytes, in the location to which `ptr` points. If no data are present, `elf` is null, or an error occurs, the return value is a null pointer, with zero optionally stored through `ptr`.

**SEE ALSO**

`elf(3E)`, `elf_begin(3E)`, `elf_cntl(3E)`, `elf_getdata(3E)`, `elf_getehdr(3E)`, `elf_getident(3E)`, `elf_kind(3E)`.

**NOTE**

A program that uses `elf_rawfile` and that also interprets the same file as an object file potentially has two copies of the bytes in memory. If such a program requests the raw image first, before it asks for translated information (through such functions as `elf_getehdr`, `elf_getdata`, and so on), the library "freezes" its original memory copy for the raw image. It then uses this frozen copy as the source for creating translated objects, without reading the file again. Consequently, the application should view the raw file image returned by `elf_rawfile` as a read-only buffer, unless it wants to alter its own view of data subsequently translated. In any case, the application may alter the translated objects without changing bytes visible in the raw image.

Multiple calls to `elf_rawfile` with the same ELF descriptor return the same value; the library does not create duplicate copies of the file.

**NAME**

elf\_strptr - make a string pointer

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
```

```
#include <libelf.h>
```

```
char *elf_strptr(Elf *elf, size_t section, size_t offset);
```

**DESCRIPTION**

This function converts a string section *offset* to a string pointer. *elf* identifies the file in which the string section resides, and *section* gives the section table index for the strings. `elf_strptr` normally returns a pointer to a string, but it returns a null pointer when *elf* is null, *section* is invalid or is not a section of type `SHT_STRTAB`, the section data cannot be obtained, *offset* is invalid, or an error occurs.

**EXAMPLE**

A prototype for retrieving section names appears below. The file header specifies the section name string table in the `e_shstrndx` member. The following code loops through the sections, printing their names.

```
if ((ehdr = elf32_getehdr(elf)) == 0)
{
 /* handle the error */
 return;
}
ndx = ehdr->e_shstrndx;
scn = 0;
while ((scn = elf_nextscn(elf, scn)) != 0)
{
 char *name = 0;
 if ((shdr = elf32_getshdr(scn)) != 0)
 name = elf_strptr(elf, ndx, (size_t)shdr->sh_name);
 printf("%s\n", name? name: "(null)");
}
```

**SEE ALSO**

`elf(3E)`, `elf_getdata(3E)`, `elf_getshdr(3E)`, `elf_xlate(3E)`.

**NOTE**

A program may call `elf_getdata` to retrieve an entire string table section. For some applications, that would be both more efficient and more convenient than using `elf_strptr`.

**NAME**

`elf_update` - update an ELF descriptor

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

off_t elf_update(Elf *elf, Elf_Cmd cmd);
```

**DESCRIPTION**

`elf_update` causes the library to examine the information associated with an ELF descriptor, *elf*, and to recalculate the structural data needed to generate the file's image.

*cmd* may have the following values.

**ELF\_C\_NULL** This value tells `elf_update` to recalculate various values, updating only the ELF descriptor's memory structures. Any modified structures are flagged with the `ELF_F_DIRTY` bit. A program thus can update the structural information and then reexamine them without changing the file associated with the ELF descriptor. Because this does not change the file, the ELF descriptor may allow reading, writing, or both reading and writing [see `elf_begin(3E)`].

**ELF\_C\_WRITE** If *cmd* has this value, `elf_update` duplicates its `ELF_C_NULL` actions and also writes any "dirty" information associated with the ELF descriptor to the file. That is, when a program has used `elf_getdata` or the `elf_flag` facilities to supply new (or update existing) information for an ELF descriptor, those data will be examined, coordinated, translated if necessary [see `elf_xlate(3E)`], and written to the file. When portions of the file are written, any `ELF_F_DIRTY` bits are reset, indicating those items no longer need to be written to the file [see `elf_flag(3E)`]. The sections' data are written in the order of their section header entries, and the section header table is written to the end of the file.

When the ELF descriptor was created with `elf_begin`, it must have allowed writing the file. That is, the `elf_begin` command must have been either `ELF_C_RDWR` or `ELF_C_WRITE`.

If `elf_update` succeeds, it returns the total size of the file image (not the memory image), in bytes. Otherwise an error occurred, and the function returns -1.

When updating the internal structures, `elf_update` sets some members itself. Members listed below are the application's responsibility and retain the values given by the program.

|            | Member           | Notes                                                                                                           |
|------------|------------------|-----------------------------------------------------------------------------------------------------------------|
| ELF Header | e_ident[EI_DATA] | Library controls other e_ident values<br><br>Only when ELF_F_LAYOUT asserted<br>Only when ELF_F_LAYOUT asserted |
|            | e_type           |                                                                                                                 |
|            | e_machine        |                                                                                                                 |
|            | e_version        |                                                                                                                 |
|            | e_entry          |                                                                                                                 |
|            | e_phoff          |                                                                                                                 |
|            | e_shoff          |                                                                                                                 |
|            | e_flags          |                                                                                                                 |
|            | e_shstrndx       |                                                                                                                 |

|                | Member   | Notes                                               |
|----------------|----------|-----------------------------------------------------|
| Program Header | p_type   | The application controls all program header entries |
|                | p_offset |                                                     |
|                | p_vaddr  |                                                     |
|                | p_paddr  |                                                     |
|                | p_filesz |                                                     |
|                | p_memsz  |                                                     |
|                | p_flags  |                                                     |
|                | p_align  |                                                     |

|                | Member       | Notes                                                                                                     |
|----------------|--------------|-----------------------------------------------------------------------------------------------------------|
| Section Header | sh_name      | Only when ELF_F_LAYOUT asserted<br>Only when ELF_F_LAYOUT asserted<br><br>Only when ELF_F_LAYOUT asserted |
|                | sh_type      |                                                                                                           |
|                | sh_flags     |                                                                                                           |
|                | sh_addr      |                                                                                                           |
|                | sh_offset    |                                                                                                           |
|                | sh_size      |                                                                                                           |
|                | sh_link      |                                                                                                           |
|                | sh_info      |                                                                                                           |
|                | sh_addralign |                                                                                                           |
|                | sh_entsize   |                                                                                                           |

|                 | Member    | Notes                                        |
|-----------------|-----------|----------------------------------------------|
| Data Descriptor | d_buf     |                                              |
|                 | d_type    |                                              |
|                 | d_size    |                                              |
|                 | d_off     | Only when <code>ELF_F_LAYOUT</code> asserted |
|                 | d_align   |                                              |
|                 | d_version |                                              |
|                 |           |                                              |

Note the program is responsible for two particularly important members (among others) in the ELF header. The `e_version` member controls the version of data structures written to the file. If the version is `EV_NONE`, the library uses its own internal version. The `e_ident[EI_DATA]` entry controls the data encoding used in the file. As a special case, the value may be `ELFDATANONE` to request the native data encoding for the host machine. An error occurs in this case if the native encoding doesn't match a file encoding known by the library.

Further note that the program is responsible for the `sh_entsize` section header member. Although the library sets it for sections with known types, it cannot reliably know the correct value for all sections. Consequently, the library relies on the program to provide the values for unknown section type. If the entry size is unknown or not applicable, the value should be set to zero.

When deciding how to build the output file, `elf_update` obeys the alignments of individual data buffers to create output sections. A section's most strictly aligned data buffer controls the section's alignment. The library also inserts padding between buffers, as necessary, to ensure the proper alignment of each buffer.

#### SEE ALSO

`elf(3E)`, `elf_begin(3E)`, `elf_flag(3E)`, `elf_fsize(3E)`, `elf_getdata(3E)`, `elf_getehdr(3E)`, `elf_getshdr(3E)`, `elf_xlate(3E)`.

#### NOTE

As mentioned above, the `ELF_C_WRITE` command translates data as necessary, before writing them to the file. This translation is *not* always transparent to the application program. If a program has obtained pointers to data associated with a file [for example, see `elf_getehdr(3E)` and `elf_getdata(3E)`], the program should reestablish the pointers after calling `elf_update`.

As `elf_begin(3E)` describes, a program may "update" a COFF file to make the image consistent for ELF. The `ELF_C_NULL` command updates only the memory image; one can use the `ELF_C_WRITE` command to modify the file as well. Absolute executable files (`a.out` files) require special alignment, which cannot normally be preserved between COFF and ELF. Consequently, one may not update an executable COFF file with the `ELF_C_WRITE` command (though `ELF_C_NULL` is allowed).

**NAME**

elf\_version - coordinate ELF library and application versions

**SYNOPSIS**

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>
unsigned elf_version(unsigned ver);
```

**DESCRIPTION**

As elf(3E) explains, the program, the library, and an object file have independent notions of the "latest" ELF version. elf\_version lets a program determine the ELF library's *internal version*. It further lets the program specify what memory types it uses by giving its own *working version*, *ver*, to the library. Every program that uses the ELF library must coordinate versions as described below.

The header file <libelf.h> supplies the version to the program with the macro EV\_CURRENT. If the library's internal version (the highest version known to the library) is lower than that known by the program itself, the library may lack semantic knowledge assumed by the program. Accordingly, elf\_version will not accept a working version unknown to the library.

Passing *ver* equal to EV\_NONE causes elf\_version to return the library's internal version, without altering the working version. If *ver* is a version known to the library, elf\_version returns the previous (or initial) working version number. Otherwise, the working version remains unchanged and elf\_version returns EV\_NONE.

**EXAMPLE**

The following excerpt from an application program protects itself from using an older library.

```
if (elf_version(EV_CURRENT) == EV_NONE)
{
 /* library out of date */
 /* recover from error */
}
```

**NOTES**

The working version should be the same for all operations on a particular elf descriptor. Changing the version between operations on a descriptor will probably not give the expected results.

**SEE ALSO**

elf(3E), elf\_begin(3E), elf\_xlate(3E).

## NAME

elf\_xlate: elf32\_xlatetof, elf32\_xlatetom - class-dependent data translation

## SYNOPSIS

```
cc [flag ...] file ... -lelf [library ...]
#include <libelf.h>

Elf_Data *elf32_xlatetof(Elf_Data *dst, const Elf_Data *src,
 unsigned encode);

Elf_Data *elf32_xlatetom(Elf_Data *dst, const Elf_Data *src,
 unsigned encode);
```

## DESCRIPTION

elf32\_xlatetom translates various data structures from their 32-bit class file representations to their memory representations; elf32\_xlatetof provides the inverse. This conversion is particularly important for cross development environments. *src* is a pointer to the source buffer that holds the original data; *dst* is a pointer to a destination buffer that will hold the translated copy. *encode* gives the byte encoding in which the file objects are (to be) represented and must have one of the encoding values defined for the ELF header's *e\_ident* [EI\_DATA] entry [see elf\_getident(3E)]. If the data can be translated, the functions return *dst*. Otherwise, they return null because an error occurred, such as incompatible types, destination buffer overflow, etc.

elf\_getdata(3E) describes the Elf\_Data descriptor, which the translation routines use as follows.

|                  |                                                                                                                                                                                                                                                                                                                                                                                                                       |
|------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>d_buf</b>     | Both the source and destination must have valid buffer pointers.                                                                                                                                                                                                                                                                                                                                                      |
| <b>d_type</b>    | This member's value specifies the type of the data to which <i>d_buf</i> points and the type of data to be created in the destination. The program supplies a <i>d_type</i> value in the source; the library sets the destination's <i>d_type</i> to the same value. These values are summarized below.                                                                                                               |
| <b>d_size</b>    | This member holds the total size, in bytes, of the memory occupied by the source data and the size allocated for the destination data. If the destination buffer is not large enough, the routines do not change its original contents. The translation routines reset the destination's <i>d_size</i> member to the actual size required, after the translation occurs. The source and destination sizes may differ. |
| <b>d_version</b> | This member holds version number of the objects (desired) in the buffer. The source and destination versions are independent.                                                                                                                                                                                                                                                                                         |

Translation routines allow the source and destination buffers to coincide. That is, *dst->d\_buf* may equal *src->d\_buf*. Other cases where the source and destination buffers overlap give undefined behavior.



| Elf_Type    | 32-Bit Memory Type |
|-------------|--------------------|
| ELF_T_ADDR  | Elf32_Addr         |
| ELF_T_BYTE  | unsigned char      |
| ELF_T_DYN   | Elf32_Dyn          |
| ELF_T_EHDR  | Elf32_Ehdr         |
| ELF_T_HALF  | Elf32_Half         |
| ELF_T_OFF   | Elf32_Off          |
| ELF_T_PHDR  | Elf32_Phdr         |
| ELF_T_REL   | Elf32_Rel          |
| ELF_T_RELA  | Elf32_Rela         |
| ELF_T_SHDR  | Elf32_Shdr         |
| ELF_T_SWORD | Elf32_Sword        |
| ELF_T_SYM   | Elf32_Sym          |
| ELF_T_WORD  | Elf32_Word         |

“Translating” buffers of type `ELF_T_BYTE` does not change the byte order.

**SEE ALSO**

`elf(3E)`, `elf_fsize(3E)`, `elf_getdata(3E)`, `elf_getident(3E)`.

**NAME**

nlist - get entries from name list

**SYNOPSIS**

```
cc [flag ...] file ... -lself [library ...]
```

```
#include <nlist.h>
```

```
int nlist (const char *filename, struct nlist *nl);
```

**DESCRIPTION**

nlist examines the name list in the executable file whose name is pointed to by *filename*, and selectively extracts a list of values and puts them in the array of nlist structures pointed to by *nl*. The name list *nl* consists of an array of structures containing names of variables, types, and values. The list is terminated with a null name, that is, a null string is in the name position of the structure. Each variable name is looked up in the name list of the file. If the name is found, the type, value, storage class, and section number of the name are inserted in the other fields. The type field may be set to 0 if the file was not compiled with the -g option to cc(1). nlist will always return the information for an external symbol of a given name if the name exists in the file. If an external symbol does not exist, and there is more than one symbol with the specified name in the file (such as static symbols defined in separate files), the values returned will be for the last occurrence of that name in the file. If the name is not found, all fields in the structure except *n\_name* are set to 0.

This function is useful for examining the system name list kept in the file /stand/unix. In this way programs can obtain system addresses that are up to date.

**SEE ALSO**

a.out(4).

**DIAGNOSTICS**

All value entries are set to 0 if the file cannot be read or if it does not contain a valid name list.

nlist returns 0 on success, -1 on error.



3G

**NAME**

basename – return the last element of a path name

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
char *basename (char *path);
```

**DESCRIPTION**

Given a pointer to a null-terminated character string that contains a path name, `basename` returns a pointer to the last element of *path*. Trailing "/" characters are deleted.

If *path* or *\*path* is zero, pointer to a static constant "." is returned.

**EXAMPLES**

| <u>Input string</u> | <u>Output pointer</u> |
|---------------------|-----------------------|
| /usr/lib            | lib                   |
| /usr/               | usr                   |
| /                   | /                     |

**SEE ALSO**

`dirname(3G)`.  
`basename(1)` in the *User's Reference Manual*.

**NAME**

bgets – read stream up to next delimiter

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
char *bgets (char *buffer, size_t *count, FILE *stream,
 const char *breakstring);
```

**DESCRIPTION**

bgets reads characters from *stream* into *buffer* until either *count* is exhausted or one of the characters in *breakstring* is encountered in the stream. The read data is terminated with a null byte ('\0') and a pointer to the trailing null is returned. If a *breakstring* character is encountered, the last non-null is the delimiter character that terminated the scan.

Note that, except for the fact that the returned value points to the end of the read string rather than to the beginning, the call

```
bgets (buffer, sizeof buffer, stream, "\n");
```

is identical to

```
fgets (buffer, sizeof buffer, stream);
```

There is always enough room reserved in the buffer for the trailing null.

If *breakstring* is a null pointer, the value of *breakstring* from the previous call is used. If *breakstring* is null at the first call, no characters will be used to delimit the string.

**EXAMPLES**

```
#include <libgen.h>

char buffer[8];
/* read in first user name from /etc/passwd */
fp = fopen("/etc/passwd", "r");
bgets(buffer, 8, fp, ":");
```

**DIAGNOSTICS**

NULL is returned on error or end-of-file. Reporting the condition is delayed to the next call if any characters were read but not yet returned.

**SEE ALSO**

gets(3S).

**NAME**

bufsplit – split buffer into fields

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
size_t bsplit (char *buf, size_t n, char **a);
```

**DESCRIPTION**

bufsplit examines the buffer, *buf*, and assigns values to the pointer array, *a*, so that the pointers point to the first *n* fields in *buf* that are delimited by tabs or new-lines.

To change the characters used to separate fields, call bsplit with *buf* pointing to the string of characters, and *n* and *a* set to zero. For example, to use ':', '.', and ',' as separators along with tab and new-line:

```
bufsplit (":.,\t\n", 0, (char**)0);
```

**RETURN VALUE**

The number of fields assigned in the array *a*. If *buf* is zero, the return value is zero and the array is unchanged. Otherwise the value is at least one. The remainder of the elements in the array are assigned the address of the null byte at the end of the buffer.

**EXAMPLES**

```
/*
 * set a[0] = "This", a[1] = "is", a[2] = "a",
 * a[3] = "test"
 */
bufsplit("This\tis\ta\ttest\n", 4, a);
```

**NOTES**

bufsplit changes the delimiters to null bytes in *buf*.

**NAME**

copylist - copy a file into memory

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
char *copylist (const char *filenm, off_t *szptr);
```

**DESCRIPTION**

copylist copies a list of items from a file into freshly allocated memory, replacing new-lines with null characters. It expects two arguments: a pointer *filenm* to the name of the file to be copied, and a pointer *szptr* to a variable where the size of the file will be stored.

Upon success, copylist returns a pointer to the memory allocated. Otherwise it returns NULL if it has trouble finding the file, calling malloc, or opening the file.

**EXAMPLES**

```
/* read "file" into buf */
off_t size;
char *buf;
buf = copylist("file", &size);
for (i = 0; i < size; i++)
 if(buf[i])
 putchar(buf[i]);
 else
 putchar('\n');
```

**SEE ALSO**

malloc(3C).



**NAME**

`dirname` – report the parent directory name of a file path name

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
char *dirname (char *path);
```

**DESCRIPTION**

Given a pointer to a null-terminated character string that contains a file system path name, `dirname` returns a pointer to a static constant string that is the parent directory of that file. In doing this, it sometimes places a null byte in the path name after the next to last element, so the content of *path* must be disposable. Trailing `"/` characters in the path are not counted as part of the path.

If *path* or *\*path* is zero, a pointer to a static constant `“.”` is returned.

`dirname` and `basename` together yield a complete path name. `dirname (path)` is the directory where `basename (path)` is found.

**EXAMPLES**

A simple file name and the strings `“.”` and `“..”` all have `“.”` as their return value.

| <u>Input string</u>   | <u>Output pointer</u> |
|-----------------------|-----------------------|
| <code>/usr/lib</code> | <code>/usr</code>     |
| <code>/usr/</code>    | <code>/</code>        |
| <code>usr</code>      | <code>.</code>        |
| <code>/</code>        | <code>/</code>        |
| <code>.</code>        | <code>.</code>        |
| <code>..</code>       | <code>.</code>        |

The following code reads a path name, changes directory to the appropriate directory [see `chdir(2)`], and opens the file.

```
char path[100], *pathcopy;
int fd;
gets (path);
pathcopy = strdup (path);
chdir (dirname (pathcopy));
fd = open (basename (path), O_RDONLY);
```

**SEE ALSO**

`chdir(2)`, `basename(3G)`.  
`basename(1)` in the *User's Reference Manual*.

**NAME**

`gmatch` - shell global pattern matching

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
int gmatch (const char *str, const char *pattern);
```

**DESCRIPTION**

`gmatch` checks whether the null-terminated string *str* matches the null-terminated pattern string *pattern*. See the `sh(1)` section "File Name Generation" for a discussion of pattern matching. `gmatch` returns non-zero if the pattern matches the string, zero if the pattern doesn't. A backslash ('\') is used as an escape character in pattern strings.

**EXAMPLE**

```
char *s;
gmatch (s, "[a\-")
```

`gmatch` returns non-zero (true) for all strings with 'a' or '-' as their last character.

**SEE ALSO**

`sh(1)` in the *User's Reference Manual*

**NAME**

**isencrypt** - determine whether a character buffer is encrypted

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
int isencrypt (const char *fbuf, size_t ninbuf);
```

**DESCRIPTION**

**isencrypt** uses heuristics to determine whether a buffer of characters is encrypted. It requires two arguments: a pointer to an array of characters and the number of characters in the buffer.

**isencrypt** assumes that the file is not encrypted if all the characters in the first block are ASCII characters. If there are non-ASCII characters in the first *ninbuf* characters, **isencrypt** assumes that the buffer is encrypted if the **setlocale** **LC\_CTYPE** category is set to **C** or **ascii**.

If the **LC\_CTYPE** category is set to a value other than **C** or **ascii**, then **isencrypt** uses a combination of heuristics to determine if the buffer is encrypted. If *ninbuf* has at least 64 characters, a chi-square test is used to determine if the bytes in the buffer have a uniform distribution; and **isencrypt** assumes the buffer is encrypted if it does. If the buffer has less than 64 characters, a check is made for null characters and a terminating new-line to determine whether the buffer is encrypted.

**DIAGNOSTICS**

If the buffer is encrypted, 1 is returned; otherwise zero is returned.

**SEE ALSO**

**setlocale(3C)**.

**NAME**

mknod, rmdir - create, remove directories in a path

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
int mknod (const char *path, mode_t mode);
int rmdir (char *d, char *d1);
```

**DESCRIPTION**

mknod creates all the missing directories in the given *path* with the given *mode*. [See chmod(2) for the values of *mode*.]

rmdir removes directories in path *d*. This removal starts at the end of the path and moves back toward the root as far as possible. If an error occurs, the remaining path is stored in *d1*. rmdir returns a 0 only if it is able to remove every directory in the path.

**EXAMPLES**

```
/* create scratch directories */
if(mknod("/tmp/sub1/sub2/sub3", 0755) == -1) {
 fprintf(stderr, "cannot create directory");
 exit(1);
}
chdir("/tmp/sub1/sub2/sub3");
.
.
.
/* cleanup */
chdir("/tmp");
rmdir("sub1/sub2/sub3");
```

**SEE ALSO**

mknod(2), rmdir(2).

**DIAGNOSTICS**

If a needed directory cannot be created, mknod returns -1 and sets *errno* to one of the mknod error numbers. If all the directories are created, or existed to begin with, it returns zero.

**NOTES**

mknod uses malloc to allocate temporary space for the string.

rmdir returns -2 if a "." or ".." is in the path and -3 if an attempt is made to remove the current directory. If an error occurs other than one of the above, -1 is returned.

**NAME**

p2open, p2close – open, close pipes to and from a command

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
int p2open (const char *cmd, FILE *fp[2]);
int p2close (FILE *fp[2]);
```

**DESCRIPTION**

p2open forks and execs a shell running the command line pointed to by *cmd*. On return, *fp[0]* points to a *FILE* pointer to write the command's standard input and *fp[1]* points to a *FILE* pointer to read from the command's standard output. In this way the program has control over the input and output of the command.

The function returns 0 if successful; otherwise it returns -1.

p2close is used to close the file pointers that p2open opened. It waits for the process to terminate and returns the process status. It returns 0 if successful; otherwise it returns -1.

**EXAMPLES**

```
#include <stdio.h>
#include <libgen.h>

main(argc, argv)
int argc;
char **argv;
{
 FILE *fp[2];
 pid_t pid;
 char buf[16];

 pid=p2open("/usr/bin/cat", fp);
 if (pid == 0) {
 fprintf(stderr, "p2open failed\n");
 exit(1);
 }
 write(fileno(fp[0]), "This is a test\n", 16);
 if(read(fileno(fp[1]), buf, 16) <=0)
 fprintf(stderr, "p2open failed\n");
 else
 write(1, buf, 16);
 (void)p2close(fp);
}
```

**SEE ALSO**

fclose(3S), popen(3S), setbuf(3S).

**DIAGNOSTICS**

A common problem is having too few file descriptors. p2close returns -1 if the two file pointers are not from the same p2open.

**NOTES**

Buffered writes on `fp[0]` can make it appear that the command is not listening. Judiciously placed `fflush` calls or unbuffering `fp[0]` can be a big help; see `fclose(3S)`.

Many commands use buffered output when connected to a pipe. That, too, can make it appear as if things are not working.

Usage is not the same as for `popen`, although it is closely related.

**NAME**

pathfind - search for named file in named directories

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
char *pathfind (const char *path, const char *name, const char
 *mode);
```

**DESCRIPTION**

pathfind searches the directories named in *path* for the file *name*. The directories named in *path* are separated by semicolons. *mode* is a string of option letters chosen from the set `rwxfbcdpugks`:

| Letter | Meaning           |
|--------|-------------------|
| r      | readable          |
| w      | writable          |
| x      | executable        |
| f      | normal file       |
| b      | block special     |
| c      | character special |
| d      | directory         |
| p      | FIFO (pipe)       |
| u      | set user ID bit   |
| g      | set group ID bit  |
| k      | sticky bit        |
| s      | size nonzero      |

Options read, write, and execute are checked relative to the real (not the effective) user ID and group ID of the current process.

If the file *name*, with all the characteristics specified by *mode*, is found in any of the directories specified by *path*, then pathfind returns a pointer to a string containing the member of *path*, followed by a slash character (/), followed by *name*.

If *name* begins with a slash, it is treated as an absolute path name, and *path* is ignored.

An empty *path* member is treated as the current directory. ./ is not prepended at the occurrence of the first match; rather, the unadorned *name* is returned.

**EXAMPLES**

To find the `ls` command using the `PATH` environment variable:

```
pathfind (getenv ("PATH"), "ls", "rx")
```

**SEE ALSO**

access(2), mknod(2), stat(2), getenv(3C).  
sh(1), test(1) in the *User's Reference Manual*.

**DIAGNOSTICS**

If no match is found, pathname returns a null pointer, ((char \*) 0).

**pathfind (3G)**

**pathfind (3G)**

**NOTES**

The string pointed to by the returned pointer is stored in a static area that is reused on subsequent calls to **pathfind**.



## NAME

regcmp, regex – compile and execute regular expression

## SYNOPSIS

```
#include <libgen.h>
cc [flag ...] file ... -lgen [library ...]
char *regcmp (const char *string1 [, char *string2, ...],
 (char *)0);
char *regex (const char *re, const char *subject
 [, char *ret0, ...]);
extern char *__loc1;
```

## DESCRIPTION

regcmp compiles a regular expression (consisting of the concatenated arguments) and returns a pointer to the compiled form. malloc(3C) is used to create space for the compiled form. It is the user's responsibility to free unneeded space so allocated. A NULL return from regcmp indicates an incorrect argument. regcmp(1) has been written to generally preclude the need for this routine at execution time.

regex executes a compiled pattern against the subject string. Additional arguments are passed to receive values back. regex returns NULL on failure or a pointer to the next unmatched character on success. A global character pointer \_\_loc1 points to where the match began. regcmp and regex were mostly borrowed from the editor, ed(1); however, the syntax and semantics have been changed slightly. The following are the valid symbols and associated meanings.

- [ ] \* . ^ These symbols retain their meaning in ed(1).
- \$ Matches the end of the string; \n matches a newline.
- Within brackets the minus means *through*. For example, [a-z] is equivalent to [abcd . . .xyz]. The - can appear as itself only if used as the first or last character. For example, the character class expression [ ]- matches the characters ] and -.
- + A regular expression followed by + means *one or more times*. For example, [0-9]+ is equivalent to [0-9] [0-9]\*.
- {m} {m,} {m,u} Integer values enclosed in {} indicate the number of times the preceding regular expression is to be applied. The value *m* is the minimum number and *u* is a number, less than 256, which is the maximum. If only *m* is present (i.e., {m}), it indicates the exact number of times the regular expression is to be applied. The value {m,} is analogous to {m,*infinity*}. The plus (+) and star (\*) operations are equivalent to {1,} and {0,} respectively.

( . . . ) \$n The value of the enclosed regular expression is to be returned. The value will be stored in the (*n*+1)th argument following the subject argument. At most, ten enclosed regular expressions are allowed. regex makes its assignments unconditionally.

( . . . ) Parentheses are used for grouping. An operator, e.g., \*, +, { }, can work on a single character or a regular expression enclosed in parentheses. For example, (a\* (cb+)\* )\$0.

By necessity, all the above defined symbols are special. They must, therefore, be escaped with a \ (backslash) to be used as themselves.

#### EXAMPLES

The following example matches a leading newline in the subject string pointed at by cursor.

```
char *cursor, *newcursor, *ptr;
. . .
newcursor = regex((ptr = regcmp("^\\n", (char *)0)), cursor);
free(ptr);
```

The following example matches through the string Testing3 and returns the address of the character after the last matched character (the "4"). The string Testing3 is copied to the character array ret0.

```
char ret0[9];
char *newcursor, *name;
. . .
name = regcmp("([A-Za-z][A-Za-z0-9]{0,7})$0", (char *)0);
newcursor = regex(name, "012Testing345", ret0);
```

The following example applies a precompiled regular expression in file.i [see regcmp(1)] against string.

```
#include "file.i"
char *string, *newcursor;
. . .
newcursor = regex(name, string);
```

#### SEE ALSO

regcmp(1), malloc(3C).  
ed(1) in the *User's Reference Manual*.

#### NOTES

The user program may run out of memory if regcmp is called iteratively without freeing the vectors no longer required.

**NAME**

regexr: compile, step, advance – regular expression compile and match routines

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <regexr.h>
char *compile (const char *instring, char *expbuf, char *endbuf);
int step (const char *string, char *expbuf);
int advance (const char *string, char *expbuf);
extern char *loc1, *loc2, *locs;
extern int nbra, regerrno, reglength;
extern char *braslist[], *braelist[];
```

**DESCRIPTION**

These routines are used to compile regular expressions and match the compiled expressions against lines. The regular expressions compiled are in the form used by ed.

The syntax of the `compile` routine is as follows:

```
compile (instring, expbuf, endbuf)
```

The parameter *instring* is a null-terminated string representing the regular expression.

The parameter *expbuf* points to the place where the compiled regular expression is to be placed. If *expbuf* is `NULL`, `compile` uses `malloc` to allocate the space for the compiled regular expression. If an error occurs, this space is freed. It is the user's responsibility to free unneeded space after the compiled regular expression is no longer needed.

The parameter *endbuf* is one more than the highest address where the compiled regular expression may be placed. This argument is ignored if *expbuf* is `NULL`. If the compiled expression cannot fit in (*endbuf* - *expbuf*) bytes, `compile` returns `NULL` and `regerrno` (see below) is set to 50.

If `compile` succeeds, it returns a non-`NULL` pointer whose value depends on *expbuf*. If *expbuf* is non-`NULL`, `compile` returns a pointer to the byte after the last byte in the compiled regular expression. The length of the compiled regular expression is stored in `reglength`. Otherwise, `compile` returns a pointer to the space allocated by `malloc`.

If an error is detected when compiling the regular expression, a `NULL` pointer is returned from `compile` and `regerrno` is set to one of the non-zero error numbers indicated below:

| ERROR | MEANING                                |
|-------|----------------------------------------|
| 11    | Range endpoint too large.              |
| 16    | Bad number.                            |
| 25    | "\digit" out of range.                 |
| 36    | Illegal or missing delimiter.          |
| 41    | No remembered search string.           |
| 42    | \ ( ~\ ) imbalance.                    |
| 43    | Too many \ (.                          |
| 44    | More than 2 numbers given in \{ ~\}.   |
| 45    | } expected after \.                    |
| 46    | First number exceeds second in \{ ~\}. |
| 49    | [ ] imbalance.                         |
| 50    | Regular expression overflow.           |

The call to `step` is as follows:

```
step (string, expbuf)
```

The first parameter to `step` is a pointer to a string of characters to be checked for a match. This string should be null-terminated.

The parameter `expbuf` is the compiled regular expression obtained by a call of the function `compile`.

The function `step` returns non-zero if the given string matches the regular expression, and zero if the expressions do not match. If there is a match, two external character pointers are set as a side effect to the call to `step`. The variable set in `step` is `loc1`. `loc1` is a pointer to the first character that matched the regular expression. The variable `loc2` points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire line, `loc1` points to the first character of `string` and `loc2` points to the null at the end of `string`.

The purpose of `step` is to step through the `string` argument until a match is found or until the end of `string` is reached. If the regular expression begins with `^`, `step` tries to match the regular expression at the beginning of the string only.

The function `advance` has the same arguments and side effects as `step`, but it always restricts matches to the beginning of the string.

If one is looking for successive matches in the same string of characters, `locs` should be set equal to `loc2`, and `step` should be called with `string` equal to `loc2`. `locs` is used by commands like `ed` and `sed` so that global substitutions like `s/y*/g` do not loop forever, and is `NULL` by default.

The external variable `nbra` is used to determine the number of subexpressions in the compiled regular expression. `braslist` and `braelist` are arrays of character pointers that point to the start and end of the `nbra` subexpressions in the matched string. For example, after calling `step` or `advance` with `string` `abcdefg` and regular expression `\(abcdef\)`, `braslist[0]` will point at `a` and `braelist[0]` will point at `g`. These arrays are used by commands like `ed` and `sed` for substitute replacement patterns that contain the `\n` notation for subexpressions.

Note that it isn't necessary to use the external variables `regerrno`, `nbra`, `loc1`, `loc2`, `locs`, `braelist`, and `braslist` if one is only checking whether or not a string matches a regular expression.

**EXAMPLES**

The following is similar to the regular expression code from `grep`:

```
#include <regexpr.h>
. . .
if(compile(*argv, (char *)0, (char *)0) == (char *)0)
 regerr(regerrno);
. . .
if (step(linebuf, expbuf))
 succeed();
```

**SEE ALSO**

`regexp(5)`.  
`ed(1)`, `grep(1)`, `sed(1)` in the *User's Reference Manual*.

**NAME**

str: strfind, strrspn, strtrns - string manipulations

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>

int strfind (const char *as1, const char *as2);
char *strrspn (const char *string, const char *tc);
char * strtrns (const char *str, const char *old, const char *new,
 char *result);
```

**DESCRIPTION**

*strfind* returns the offset of the second string, *as2*, if it is a substring of string *as1*.

*strrspn* returns a pointer to the first character in the string to be trimmed (all characters from the first character to the end of *string* are in *tc*).

*strtrns* transforms *str* and copies it into *result*. Any character that appears in *old* is replaced with the character in the same position in *new*. The *new* result is returned.

**EXAMPLES**

```
/* find pointer to substring "hello" in as1 */
i = strfind(as1, "hello");

/* trim junk from end of string */
s2 = strrspn(s1, ".*#$%");
*s2 = '\0';

/* transform lower case to upper case */
a1[] = "abcdefghijklmnopqrstuvwxyz";
a2[] = "ABCDEFGHIJKLMNOPQRSTUVWXYZ";
s2 = strtrns(s1, a1, a2, s2);
```

**SEE ALSO**

string(3C).

**DIAGNOSTICS**

If the second string is not a substring of the first string *strfind* returns -1.

**NAME**

**strncpy**: **streadd**, **strcadd**, **strecpy** - copy strings, compressing or expanding escape codes

**SYNOPSIS**

```
cc [flag ...] file ... -lgen [library ...]
#include <libgen.h>
char *strncpy (char *output, const char *input);
char *strcadd (char *output, const char *input);
char *strecpy (char *output, const char *input, const char
 *exceptions);
char *streadd (char *output, const char *input, const char
 *exceptions);
```

**DESCRIPTION**

**strncpy** copies the *input* string, up to a null byte, to the *output* string, compressing the C-language escape sequences (for example, `\n`, `\001`) to the equivalent character. A null byte is appended to the output. The *output* argument must point to a space big enough to accommodate the result. If it is as big as the space pointed to by *input* it is guaranteed to be big enough. **strncpy** returns the *output* argument.

**strcadd** is identical to **strncpy**, except that it returns the pointer to the null byte that terminates the output.

**strecpy** copies the *input* string, up to a null byte, to the *output* string, expanding non-graphic characters to their equivalent C-language escape sequences (for example, `\n`, `\001`). The *output* argument must point to a space big enough to accommodate the result; four times the space pointed to by *input* is guaranteed to be big enough (each character could become `\` and 3 digits). Characters in the *exceptions* string are not expanded. The *exceptions* argument may be zero, meaning all non-graphic characters are expanded. **strecpy** returns the *output* argument.

**streadd** is identical to **strecpy**, except that it returns the pointer to the null byte that terminates the output.

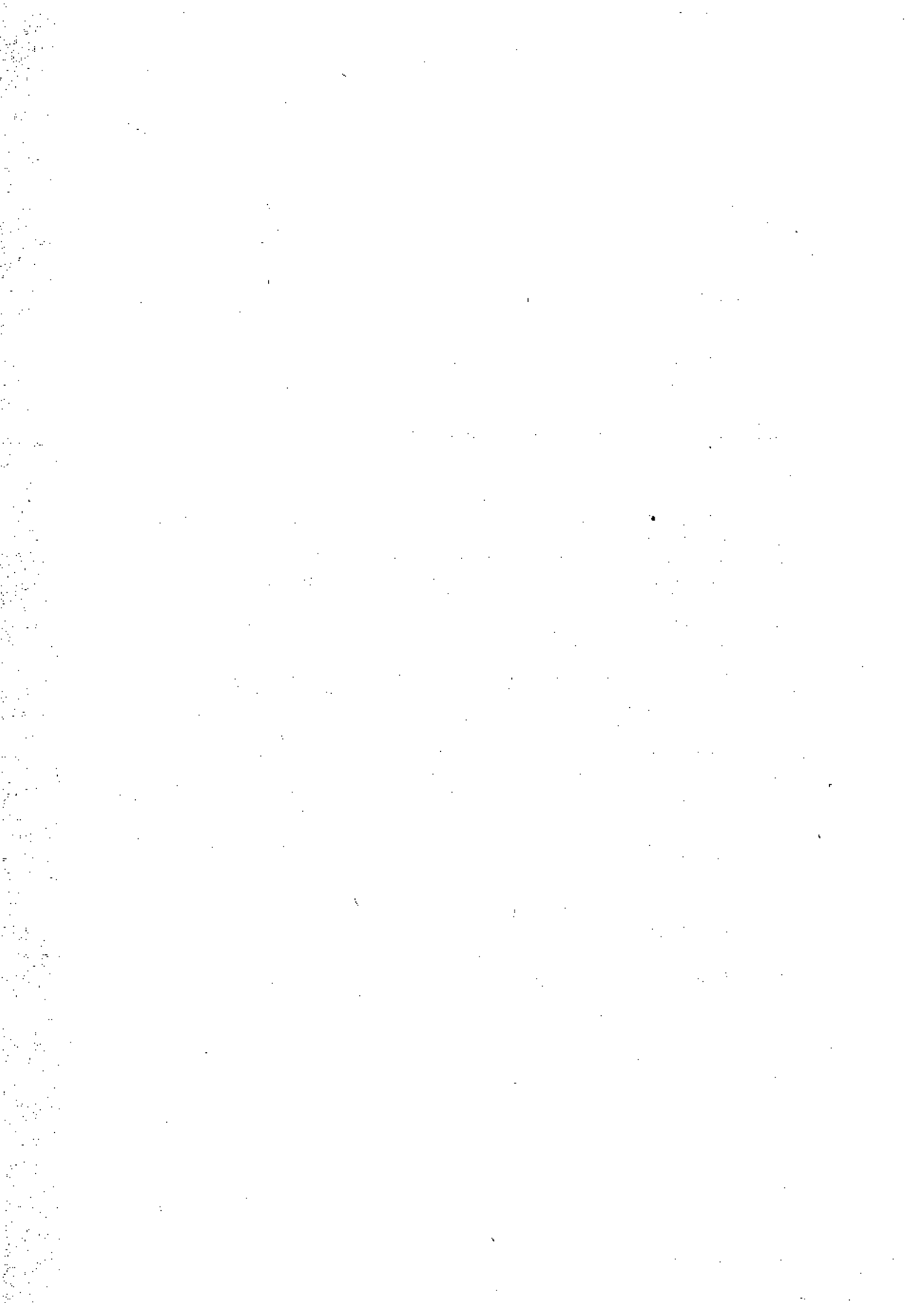
**EXAMPLES**

```
/* expand all but newline and tab */
strecpy(output, input, "\n\t");

/* concatenate and compress several strings */
cp = strcadd(output, input1);
cp = strcadd(cp, input2);
cp = strcadd(cp, input3);
```

**SEE ALSO**

**string(3C)**, **str(3G)**.









3M

**NAME**

**intro** - introduction to math libraries

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
cc -O -Ksd [flag ...] file ... -J sfm [library ...]
#include <math.h>
```

**DESCRIPTION**

This section describes the functions in the math libraries, **libm** and **libsfm**. Declarations for these functions may be obtained from the **#include** file **math.h**. Several generally useful mathematical constants are also defined there [see **intro(3)** and **math(5)**].

The math libraries are not automatically loaded by the C compilation system; use the **-l** or **-J** options to **cc** to access the libraries as follows:

- lm** Search the regular math library, **libm**.
- J sfm** Do in-line expansion of functions from the fast single-precision assembly source math library, **libsfm**. Specify **-O -Ksd** to optimize for speed.

**libm** Contains the full set of double-precision routines plus some single-precision routines (designated by the suffix **f**) that give better performance with less precision. Selected routines are hand-optimized for performance. The optimized routines include **sin**, **cos**, **tan**, **atan**, **atan2**, **exp**, **log**, **log10**, **pow**, and **sqrt** and their single-precision equivalents.

**libsfm** Contains the functions **sinf**, **cosf**, **tanf**, **asinf**, **acosf**, **atanf**, **expf**, **logf**, **log10f**, **powf**, and **sqrtf**. The source library routines are in-line expanded by the optimizer to provide faster execution by reducing the overhead of argument passing, function calling and returning, and return value passing. The source library is designed for applications that desire an increase in speed at the potential cost of size.

**libsfm** should be used only when necessary and with extreme caution. It is a special purpose library that does not do error checking or domain reduction. In other words, these functions never call **matherr**, and arguments aren't reduced to be within a finite range.

Inputs to **sinf** and **cosf** must be in the range

$$-\frac{\pi}{2} \leq x \leq \frac{\pi}{2}$$

Inputs to **tanf** must be in the range

$$-\frac{\pi}{2} < x < \frac{\pi}{2}$$

Inputs to **sqrtf**, **logf**, and **log10f** must be greater than 0.

**DEFINITIONS**

See **intro(3)** for C language definitions.

## FILES

`LIBDIR` usually `/usr/ccs/lib`  
`LIBDIR/libm.a`  
`LIBDIR/libsfm.sa`

## SEE ALSO

`cc(1)`, `intro(2)`, `intro(3)`, `math(5)`.  
The "Floating Point Operations" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

## DIAGNOSTICS

Error handling varies according to compilation mode. Under the `-xt` (default) option to `cc`, these functions return the conventional values 0, `±HUGE`, or NaN when the function is undefined for the given arguments or when the value is not representable. In the `-Xa` and `-Xc` compilation modes, `±HUGE_VAL` is returned instead of `±HUGE`. (`HUGE_VAL` and `HUGE` are defined in `math.h` to be infinity and the largest-magnitude single-precision number, respectively.) In every case, the external variable `errno` [see `intro(2)`] is set to the value `EDOM` or `ERANGE`, although the value may vary for a given error depending on compilation mode. See the table under `matherr(3M)` below.

**NAME**

bessel: *j0*, *j1*, *jn*, *y0*, *y1*, *yn* - Bessel functions

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>
double j0 (double x);
double j1 (double x);
double jn (int n, double x);
double y0 (double x);
double y1 (double x);
double yn (int n, double x);
```

**DESCRIPTION**

*j0* and *j1* return Bessel functions of *x* of the first kind of orders 0 and 1, respectively. *jn* returns the Bessel function of *x* of the first kind of order *n*.

*y0* and *y1* return Bessel functions of *x* of the second kind of orders 0 and 1, respectively. *yn* returns the Bessel function of *x* of the second kind of order *n*. The value of *x* must be positive.

**SEE ALSO**

[matherr\(3M\)](#).

**DIAGNOSTICS**

Non-positive arguments cause *y0*, *y1*, and *yn* to return the value `-HUGE` and to set `errno` to `EDOM`. In addition, a message indicating `DOMAIN` error is printed on the standard error output.

Arguments too large in magnitude cause *j0*, *j1*, *y0*, and *y1* to return 0 and to set `errno` to `ERANGE`. In addition, a message indicating `TLOSS` error is printed on the standard error output.

Except when the `-Xc` compilation option is used, these error-handling procedures may be changed with the function `matherr`. When the `-Xa` or `-Xc` compilation options are used, `HUGE_VAL` is returned instead of `HUGE` and no error messages are printed.

**NAME**

erf, erfc – error function and complementary error function

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>
double erf (double x);
double erfc (double x);
```

**DESCRIPTION**

erf returns the error function of  $x$ , defined as

$$\frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

erfc, which returns  $1.0 - \text{erf}(x)$ , is provided because of the extreme loss of relative accuracy if erf( $x$ ) is called for large  $x$  and the result subtracted from 1.0 (e.g., for  $x = 5$ , 12 places are lost).

**SEE ALSO**

exp(3M).

**NAME**

**exp**, **expf**, **cbrt**, **log**, **logf**, **log10**, **log10f**, **pow**, **powf**, **sqrt**, **sqrtf** - exponential, logarithm, power, square root functions

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
cc -O -Ksd [flag ...] file ... -J sfm [library ...]
#include <math.h>

double exp (double x);
float expf (float x);
double cbrt (double x);
double log (double x);
float logf (float x);
double log10 (double x);
float log10f (float x);
double pow (double x, double y);
float powf (float x, float y);
double sqrt (double x);
float sqrtf (float x);
```

**DESCRIPTION**

**exp** and **expf** return  $e^x$ .

**cbrt** returns the cube root of  $x$ .

**log** and **logf** return the natural logarithm of  $x$ . The value of  $x$  must be positive.

**log10** and **log10f** return the base ten logarithm of  $x$ . The value of  $x$  must be positive.

**pow** and **powf** return  $x^y$ . If  $x$  is 0,  $y$  must be positive. If  $x$  is negative,  $y$  must be an integer.

**sqrt** and **sqrtf** return the non-negative square root of  $x$ . The value of  $x$  may not be negative.

**SEE ALSO**

**hypot(3M)**, **matherr(3M)**, **sinh(3M)**.

**DIAGNOSTICS**

**exp** and **expf** return **HUGE** when the correct value would overflow, or 0 when the correct value would underflow, and set **errno** to **ERANGE**.

**log**, **logf**, **log10**, and **log10f** return **-HUGE** and set **errno** to **EDOM** when  $x$  is non-positive. A message indicating **DOMAIN** error is printed on standard error.

**pow** and **powf** return 0 and set **errno** to **EDOM** when  $x$  is 0 and  $y$  is non-positive, or when  $x$  is negative and  $y$  is not an integer. In these cases, a message indicating **DOMAIN** error is printed on standard error. When the correct value for **pow** or **powf** would overflow or underflow, these functions return  $\pm$ **HUGE** or 0, respectively, and set **errno** to **ERANGE**.

`sqrt` and `sqrtf` return 0 and set `errno` to `EDOM` when  $x$  is negative. A message indicating `DOMAIN` error is printed on standard error.

Except when the `-Xc` compilation option is used, these error-handling procedures may be changed with the function `matherr`. When the `-Xa` or `-Xc` compilation options are used, `HUGE_VAL` is returned instead of `HUGE` and no error messages are printed. In these compilation modes, `pow` and `powf` return 1, with no error, when both  $x$  and  $y$  are 0; when  $x$  is 0 and  $y$  is negative, they return `-HUGE_VAL` and set `errno` to `EDOM`. Under `-Xc`, `log` and `logf` return `-HUGE_VAL` and set `errno` to `ERANGE` when  $x$  is 0. Under `-Xc`, `sqrt` and `sqrtf` return NaN when  $x$  is negative.



## NAME

floor, floorf, ceil, ceilf, copysign, fmod, fmodf, fabs, fabsf, rint, remainder - floor, ceiling, remainder, absolute value functions

## SYNOPSIS

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>

double floor (double x);
float floorf (float x);
double ceil (double x);
float ceilf (float x);
double copysign (double x, double y);
double fmod (double x, double y);
float fmodf (float x, float y);
double fabs (double x);
float fabsf (float x);
double rint (double x);
double remainder (double x, double y);
```

## DESCRIPTION

floor and floorf return the largest integer not greater than  $x$ . ceil and ceilf return the smallest integer not less than  $x$ .

copysign returns  $x$  but with the sign of  $y$ .

fmod and fmodf return the floating point remainder of the division of  $x$  by  $y$ . More precisely, they return the number  $f$  with the same sign as  $x$ , such that  $x = iy + f$  for some integer  $i$ , and  $|f| < |y|$ .

fabs and fabsf return the absolute value of  $x$ ,  $|x|$ .

rint returns the nearest integer value to its floating point argument  $x$  as a double-precision floating point number. The returned value is rounded according to the currently set machine rounding mode. If round-to-nearest (the default mode) is set and the difference between the function argument and the rounded result is exactly 0.5, then the result will be rounded to the nearest even integer.

remainder returns the floating point remainder of the division of  $x$  by  $y$ . More precisely, it returns the value  $r = x - yn$ , where  $n$  is the integer nearest the exact value  $x/y$ . Whenever  $|n - x/y| = 1/2$ , then  $n$  is even.

## SEE ALSO

abs(3C), matherr(3M).

## DIAGNOSTICS

fmod and fmodf return  $x$  when  $y$  is 0 and set errno to EDOM. remainder returns NaN when  $y$  is 0 and sets errno to EDOM. In both cases, except in compilation modes  $-Xa$  or  $-Xc$ , a message indicating DOMAIN error is printed on standard error. Except under  $-Xc$ , these error-handling procedures may be changed with the function matherr.

**NAME**

gamma, lgamma - log gamma function

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>
double gamma (double x);
double lgamma (double x);
extern int signgam;
```

**DESCRIPTION**

gamma and lgamma return

$$\ln(|\Gamma(x)|)$$

where  $\Gamma(x)$  is defined as

$$\int_0^{\infty} e^{-t} t^{x-1} dt$$

The sign of  $\Gamma(x)$  is returned in the external integer `signgam`. The argument  $x$  may not be a non-positive integer.

The following C program fragment might be used to calculate  $\Gamma$ :

```
if ((y = gamma(x)) > LN_MAXDOUBLE)
 error();
y = signgam * exp(y);
```

where `LN_MAXDOUBLE` is the least value that causes `exp` to return a range error, and is defined in the `values.h` header file.

**SEE ALSO**

`exp(3M)`, `matherr(3M)`, `values(5)`.

**DIAGNOSTICS**

For non-positive integer arguments `HUGE` is returned and `errno` is set to `EDOM`. A message indicating `SING` error is printed on the standard error output.

If the correct value would overflow, `gamma` and `lgamma` return `HUGE` and set `errno` to `ERANGE`.

Except when the `-Xc` compilation option is used, these error-handling procedures may be changed with the function `matherr`. When the `-Xa` or `-Xc` compilation options are used, `HUGE_VAL` is returned instead of `HUGE` and no error messages are printed.

**NAME**

**hypot** - Euclidean distance function

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>
double hypot (double x, double y);
```

**DESCRIPTION**

**hypot** returns

```
sqrt(x * x + y * y)
```

taking precautions against unwarranted overflows.

**SEE ALSO**

**matherr(3M)**.

**DIAGNOSTICS**

When the correct value would overflow, **hypot** returns **HUGE** and sets **errno** to **ERANGE**.

Except when the **-Xc** compilation option is used, these error-handling procedures may be changed with the function **matherr**. When the **-Xa** or **-Xc** compilation options are used, **HUGE\_VAL** is returned instead of **HUGE**.

**NAME**

**matherr** - error-handling function

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>
int matherr (struct exception *x);
```

**DESCRIPTION**

**matherr** is invoked by functions in the math libraries when errors are detected. Note that **matherr** is not invoked when the **-Xc** compilation option is used. Users may define their own procedures for handling errors, by including a function named **matherr** in their programs. **matherr** must be of the form described above. When an error occurs, a pointer to the exception structure *x* will be passed to the user-supplied **matherr** function. This structure, which is defined in the **math.h** header file, is as follows:

```
struct exception {
 int type;
 char *name;
 double arg1, arg2, retval;
};
```

The element **type** is an integer describing the type of error that has occurred, from the following list of constants (defined in the header file):

|                  |                              |
|------------------|------------------------------|
| <b>DOMAIN</b>    | argument domain error        |
| <b>SING</b>      | argument singularity         |
| <b>OVERFLOW</b>  | overflow range error         |
| <b>UNDERFLOW</b> | underflow range error        |
| <b>TLOSS</b>     | total loss of significance   |
| <b>PLOSS</b>     | partial loss of significance |

The element **name** points to a string containing the name of the function that incurred the error. The variables **arg1** and **arg2** are the arguments with which the function was invoked. **retval** is set to the default value that will be returned by the function unless the user's **matherr** sets it to a different value.

If the user's **matherr** function returns non-zero, no error message will be printed, and **errno** will not be set.

If **matherr** is not supplied by the user, the default error-handling procedures, described with the math functions involved, will be invoked upon error. These procedures are also summarized in the table below. In every case, **errno** is set to **EDOM** or **ERANGE** and the program continues.

| Default Error Handling Procedures                      |                   |             |              |             |             |             |
|--------------------------------------------------------|-------------------|-------------|--------------|-------------|-------------|-------------|
|                                                        | Types of Errors   |             |              |             |             |             |
| type                                                   | DOMAIN            | SING        | OVERFLOW     | UNDERFLOW   | TLOSS       | PLOSS       |
| errno                                                  | EDOM              | EDOM        | ERANGE       | ERANGE      | ERANGE      | ERANGE      |
| BESSEL:<br>y0, y1, yn (arg ≤ 0)                        | -<br>M, -H        | -<br>-      | -<br>-       | -<br>-      | M, 0<br>-   | -<br>-      |
| EXP, EXPF:                                             | -                 | -           | H            | 0           | -           | -           |
| LOG, LOG10:<br>LOGF, LOG10F:<br>(arg < 0)<br>(arg = 0) | M, -H<br>M, -H    | -<br>-      | -<br>-       | -<br>-      | -<br>-      | -<br>-      |
| POW, POWF:<br>neg ** non-int<br>0 ** non-pos           | -<br>M, 0<br>M, 0 | -<br>-<br>- | ±H<br>-<br>- | 0<br>-<br>- | -<br>-<br>- | -<br>-<br>- |
| SQRT, SQRTF:                                           | M, 0              | -           | -            | -           | -           | -           |
| FMOD, FMODF:<br>(arg2 = 0)                             | M, X              | -           | -            | -           | -           | -           |
| REMAINDER:<br>(arg2 = 0)                               | M, N              | -           | -            | -           | -           | -           |
| GAMMA, LGAMMA:                                         | -                 | M, H        | H            | -           | -           | -           |
| HYPOT:                                                 | -                 | -           | H            | -           | -           | -           |
| SINH, SINHF:                                           | -                 | -           | ±H           | -           | -           | -           |
| COSH, COSHF:                                           | -                 | -           | H            | -           | -           | -           |
| ASIN, ACOS, ATAN2:<br>ASINF, ACOSE, ATAN2F:            | M, 0              | -           | -            | -           | -           | -           |
| ACOSH:                                                 | M, N              | -           | -            | -           | -           | -           |
| ATANH:<br>(  arg   > 1)<br>(  arg   = 1)               | M, N<br>-         | -<br>M, N   | -<br>-       | -<br>-      | -<br>-      | -<br>-      |

| Abbreviations |                                                                                                              |
|---------------|--------------------------------------------------------------------------------------------------------------|
| M             | Message is printed (not with the <code>-Xa</code> or <code>-Xc</code> options).                              |
| H             | HUGE is returned (HUGE_VAL with the <code>-Xa</code> or <code>-Xc</code> options).                           |
| -H            | -HUGE is returned (-HUGE_VAL with the <code>-Xa</code> or <code>-Xc</code> options).                         |
| ±H            | HUGE or -HUGE is returned.<br>(HUGE_VAL or -HUGE_VAL with the <code>-Xa</code> or <code>-Xc</code> options). |
| 0             | 0 is returned.                                                                                               |
| X             | <i>arg1</i> is returned.                                                                                     |
| N             | NaN is returned.                                                                                             |

**EXAMPLE**

```

#include <math.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

int
matherr(register struct exception *x)
{
 switch (x->type) {
 case DOMAIN:
 /* change sqrt to return sqrt(-arg1), not 0 */
 if (!strcmp(x->name, "sqrt")) {
 x->retval = sqrt(-x->arg1);
 return (0); /* print message and set errno */
 }
 case SING:
 /* all other domain or sing errors, print message */
 /* and abort */
 fprintf(stderr, "domain error in %s\n", x->name);
 abort();
 case PLOSS:
 /* print detailed error message */
 fprintf(stderr, "loss of significance in %s(%g)=%g\n",
 x->name, x->arg1, x->retval);
 return (1); /* take no other action */
 }
 return (0); /* all other errors, execute default procedure */
}

```

**NOTES**

Error handling in `-Xa` and `-Xt` modes [see `cc(1)`] is described more completely on individual math library pages.

**NAME**

sinh, sinh<sub>f</sub>, cosh, cosh<sub>f</sub>, tanh, tanh<sub>f</sub>, asinh, acosh, atanh – hyperbolic functions

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
#include <math.h>
double sinh (double x);
float sinhf (float x);
double cosh (double x);
float coshf (float x);
double tanh (double x);
float tanhf (float x);
double asinh (double x);
double acosh (double x);
double atanh (double x);
```

**DESCRIPTION**

sinh, cosh, and tanh and the single-precision versions sinh<sub>f</sub>, cosh<sub>f</sub>, and tanh<sub>f</sub> return, respectively, the hyperbolic sine, cosine, and tangent of their argument.

asinh, acosh, and atanh return, respectively, the inverse hyperbolic sine, cosine, and tangent of their argument.

**SEE ALSO**

matherr(3M).

**DIAGNOSTICS**

sinh, sinh<sub>f</sub>, cosh, and cosh<sub>f</sub> return HUGE (and sinh and sinh<sub>f</sub> may return -HUGE for negative *x*) when the correct value would overflow and set `errno` to ERANGE.

acosh returns NaN and sets `errno` to EDOM when the argument *x* is less than 1. A message indicating DOMAIN error is printed on the standard error output.

atanh returns NaN and sets `errno` to EDOM if  $|x| \geq 1$ . If  $|x| = 1$ , a message indicating SING error is printed on the standard error output; if  $|x| > 1$  the message will indicate DOMAIN error.

Except when the -Xc compilation option is used, these error-handling procedures may be changed with the function matherr. When the -Xa or -Xc compilation options are used, HUGE\_VAL is returned instead of HUGE and no error messages are printed.

**NAME**

trig: `sin`, `sinf`, `cos`, `cosf`, `tan`, `tanf`, `asin`, `asinf`, `acos`, `acosf`, `atan`, `atanf`, `atan2`, `atan2f` – trigonometric functions

**SYNOPSIS**

```
cc [flag ...] file ... -lm [library ...]
cc -O -Ksd [flag ...] file ... -J sfm [library ...]
#include <math.h>
double sin (double x);
float sinf (float x);
double cos (double x);
float cosf (float x);
double tan (double x);
float tanf (float x);
double asin (double x);
float asinf (float x);
double acos (double x);
float acosf (float x);
double atan (double x);
float atanf (float x);
double atan2 (double y, double x);
float atan2f (float y, float x);
```

**DESCRIPTION**

`sin`, `cos`, and `tan` and the single-precision versions `sinf`, `cosf`, and `tanf` return, respectively, the sine, cosine, and tangent of their argument,  $x$ , measured in radians.

`asin` and `asinf` return the arcsine of  $x$ , in the range  $[-\pi/2, +\pi/2]$ .

`acos` and `acosf` return the arccosine of  $x$ , in the range  $[0, +\pi]$ .

`atan` and `atanf` return the arctangent of  $x$ , in the range  $(-\pi/2, +\pi/2)$ .

`atan2` and `atan2f` return the arctangent of  $y/x$ , in the range  $(-\pi, +\pi]$ , using the signs of both arguments to determine the quadrant of the return value.

**SEE ALSO**

`matherr(3M)`.

**DIAGNOSTICS**

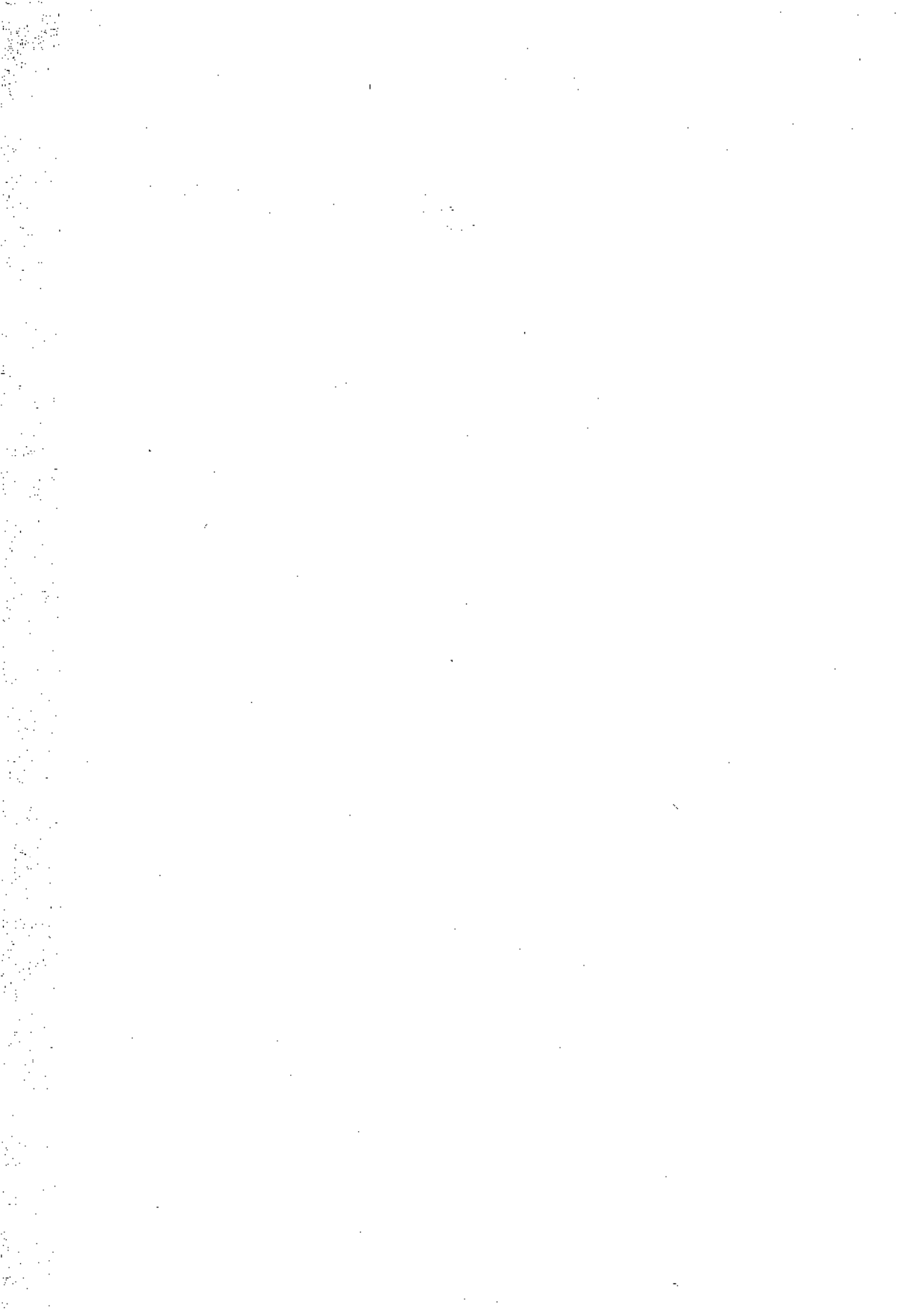
If the magnitude of the argument of `asin`, `asinf`, `acos`, or `acosf` is greater than 1, or if both arguments of `atan2` or `atan2f` are 0, 0 is returned and `errno` is set to `EDOM`. In addition, a message indicating `DOMAIN` error is printed on the standard error output.



**trig (3M)**

**trig (3M)**

Except when the `-Xc` compilation option is used, these error-handling procedures may be changed with the function `matherr`. When the `-Xa` or `-Xc` compilation options are used, no error messages are printed.





3X

**NAME**

assert - verify program assertion

**SYNOPSIS**

```
#include <assert.h>
void assert (int expression);
```

**DESCRIPTION**

This macro is useful for putting diagnostics into programs. When it is executed, if *expression* is false (zero), `assert` prints

Assertion failed: *expression*, file *xyz*, line *nnn*

on the standard error output and aborts. In the error message, *xyz* is the name of the source file and *nnn* the source line number of the `assert` statement. The latter are respectively the values of the preprocessor macros `__FILE__` and `__LINE__`.

Compiling with the preprocessor option `-DNDEBUG` [see `cc(1)`], or with the preprocessor control statement `#define NDEBUG` ahead of the `#include <assert.h>` statement, will stop assertions from being compiled into the program.

**SEE ALSO**

`cc(1)`, `abort(3C)`.

**NOTES**

Since `assert` is implemented as a macro, the *expression* may not contain any string literals.

## NAME

crypt - password and file encryption functions

## SYNOPSIS

```
cc [flag ...] file ... -lcrypt [library ...]
#include <crypt.h>
char *crypt (const char *key, const char *salt);
void setkey (const char *key);
void encrypt (char *block, int flag);
char *des_crypt (const char *key, const char *salt);
void des_setkey (const char *key);
void des_encrypt (char *block, int flag);
int run_setkey (int *p, const char *key);
int run_crypt (long offset, char *buffer, unsigned int count,
 int *p);
int crypt_close(int *p);
```

## DESCRIPTION

`des_crypt` is the password encryption function. It is based on a one-way hashing encryption algorithm with variations intended (among other things) to frustrate use of hardware implementations of a key search.

*key* is a user's typed password. *salt* is a two-character string chosen from the set [a-zA-Z0-9./]; this string is used to perturb the hashing algorithm in one of 4096 different ways, after which the password is used as the key to encrypt repeatedly a constant string. The returned value points to the encrypted password. The first two characters are the salt itself.

The `des_setkey` and `des_encrypt` entries provide (rather primitive) access to the actual hashing algorithm. The argument of `des_setkey` is a character array of length 64 containing only the characters with numerical value 0 and 1. If this string is divided into groups of 8, the low-order bit in each group is ignored, thereby creating a 56-bit key that is set into the machine. This key is the key that will be used with the hashing algorithm to encrypt the string *block* with the function `des_encrypt`.

The argument to the `des_encrypt` entry is a character array of length 64 containing only the characters with numerical value 0 and 1. The argument array is modified in place to a similar array representing the bits of the argument after having been subjected to the hashing algorithm using the key set by `des_setkey`. If *flag* is zero, the argument is encrypted; if non-zero, it is decrypted.

Note that decryption is not provided in the international version of `crypt`. The international version is part of the C Development Set, and the domestic version is part of the Security Administration Utilities. If decryption is attempted with the international version of `des_encrypt`, an error message is printed.

`crypt`, `setkey`, and `encrypt` are front-end routines that invoke `des_crypt`, `des_setkey`, and `des_encrypt` respectively.

The routines `run_setkey` and `run_crypt` are designed for use by applications that need cryptographic capabilities [such as `ed(1)` and `vi(1)`] that must be compatible with the `crypt(1)` user-level utility. `run_setkey` establishes a two-way pipe connection with the `crypt` utility, using `key` as the password argument. `run_crypt` takes a block of characters and transforms the cleartext or ciphertext into their ciphertext or cleartext using the `crypt` utility. `offset` is the relative byte position from the beginning of the file that the block of text provided in `block` is coming from. `count` is the number of characters in `block`, and `connection` is an array containing indices to a table of input and output file streams. When encryption is finished, `crypt_close` is used to terminate the connection with the `crypt` utility.

`run_setkey` returns `-1` if a connection with the `crypt` utility cannot be established. This result will occur in international versions of the UNIX system in which the `crypt` utility is not available. If a null key is passed to `run_setkey`, `0` is returned. Otherwise, `1` is returned. `run_crypt` returns `-1` if it cannot write output or read input from the pipe attached to `crypt`. Otherwise it returns `0`.

The program must be linked with the object file access routine library `libcrypt.a`.

**SEE ALSO**

`getpass(3C)`, `passwd(4)`,  
`crypt(1)`, `login(1)`, `passwd(1)` in the *User's Reference Manual*.

**DIAGNOSTICS**

In the international version of `crypt(3X)`, a flag argument of `1` to `encrypt` or `des_encrypt` is not accepted, and `errno` is set to `ENOSYS` to indicate that the functionality is not available.

**NOTES**

The return value in `crypt` points to static data that are overwritten by each call.

**NAME**

**dlclose** - close a shared object

**SYNOPSIS**

```
cc [flag ...] file ... -ldl [library ...]
#include <dlfcn.h>
int dlclosel(void *handle);
```

**DESCRIPTION**

**dlclose** disassociates a shared object previously opened by **dlopen** from the current process. Once an object has been closed using **dlclose**, its symbols are no longer available to **dlsym**. All objects loaded automatically as a result of invoking **dlopen** on the referenced object [see **dlopen(3X)**] are also closed. *handle* is the value returned by a previous invocation of **dlopen**.

**SEE ALSO**

**dLError(3X)**, **dlopen(3X)**, **dlsym(3X)**.

**DIAGNOSTICS**

If the referenced object was successfully closed, **dlclose** returns 0. If the object could not be closed, or if *handle* does not refer to an open object, **dlclose** returns a non-0 value. More detailed diagnostic information will be available through **dLError**.

**NOTES**

A successful invocation of **dlclose** does not guarantee that the objects associated with *handle* will actually be removed from the address space of the process. Objects loaded by one invocation of **dlopen** may also be loaded by another invocation of **dlopen**. The same object may also be opened multiple times. An object will not be removed from the address space until all references to that object through an explicit **dlopen** invocation have been closed and all other objects implicitly referencing that object have also been closed.

Once an object has been closed by **dlclose**, referencing symbols contained in that object can cause undefined behavior.



**NAME**

**dlerror** - get diagnostic information

**SYNOPSIS**

```
cc [flag ...] file ... -ldl [library ...]
#include <dlfcn.h>
char *dlerror(void);
```

**DESCRIPTION**

**dlerror** returns a null-terminated character string (with no trailing newline) that describes the last error that occurred during dynamic linking processing. If no dynamic linking errors have occurred since the last invocation of **dlerror**, **dlerror** returns **NULL**. Thus, invoking **dlerror** a second time, immediately following a prior invocation, will result in **NULL** being returned.

**SEE ALSO**

**dlerror(3X)**, **dlopen(3X)**, **dlsym(3X)**.

**NOTES**

The messages returned by **dlerror** may reside in a static buffer that is overwritten on each call to **dlerror**. Application code should not write to this buffer. Programs wishing to preserve an error message should make their own copies of that message.

**NAME**

dlopen – open a shared object

**SYNOPSIS**

```
cc [flag ...] file ... -ldl [library ...]
#include <dlfcn.h>
void *dlopen(char *pathname, int mode);
```

**DESCRIPTION**

dlopen is one of a family of routines that give the user direct access to the dynamic linking facilities. (See “C Compilation System” in the *Programmer’s Guide: ANSI C and Programming Support Tools*). These routines are available in a library which is loaded if the option `-ldl` is used with `cc` or `ld`.

dlopen makes a shared object available to a running process. dlopen returns to the process a *handle* which the process may use on subsequent calls to `dlsym` and `dlclose`. This value should not be interpreted in any way by the process. *pathname* is the path name of the object to be opened; it may be an absolute path or relative to the current directory. If the value of *pathname* is 0, dlopen will make the symbols contained in the original `a.out`, and all of the objects that were loaded at program startup with the `a.out`, available through `dlsym`.

When a shared object is brought into the address space of a process, it may contain references to symbols whose addresses are not known until the object is loaded. These references must be relocated before the symbols can be accessed. The *mode* parameter governs when these relocations take place and may have the following values:

**RTLD\_LAZY**

Under this *mode*, only references to data symbols are relocated when the object is loaded. References to functions are not relocated until a given function is invoked for the first time. This *mode* should result in better performance, since a process may not reference all of the functions in any given shared object.

**RTLD\_NOW**

Under this *mode*, all necessary relocations are performed when the object is first loaded. This may result in some wasted effort, if relocations are performed for functions that are never referenced, but is useful for applications that need to know as soon as an object is loaded that all symbols referenced during execution will be available.

**SEE ALSO**

`cc(1)`, `ld(1)`, `sh(1)`, `exec(2)`, `dlclose(3X)`, `dlderror(3X)`, `dlsym(3X)`.  
The “C Compilation System” chapter in the *Programmer’s Guide: ANSI C and Programming Support Tools*.

**DIAGNOSTICS**

If *pathname* cannot be found, cannot be opened for reading, is not a shared object, or if an error occurs during the process of loading *pathname* or relocating its symbolic references, dlopen will return `NULL`. More detailed diagnostic information will be available through `dlderror`.

## NOTES

If other shared objects were link edited with *pathname* when *pathname* was built, those objects will automatically be loaded by `dlopen`. The directory search path that will be used to find both *pathname* and the other *needed* objects may be specified by setting the environment variable `LD_LIBRARY_PATH`. This environment variable should contain a colon-separated list of directories, in the same format as the `PATH` variable [see `sh(1)`]. `LD_LIBRARY_PATH` will be ignored if the process is running `setuid` or `setgid` [see `exec(2)`] or if the name specified is not a simple file name (*i.e.* contains a `/` character). Objects whose names resolve to the same absolute or relative path name may be opened any number of times using `dlopen`, however, the object referenced will only be loaded once into the address space of the current process. The same object referenced by two different path names, however, may be loaded multiple times. For example, given the object `/usr/home/me/mylibs/mylib.so`, and assuming the current working directory is `/usr/home/me/workdir`,

```
...
void *handle1;
void *handle2;

handle1 = dlopen("../mylibs/mylib.so", RTLD_LAZY);
handle2 = dlopen("/usr/home/me/mylibs/mylib.so", RTLD_LAZY);
...
```

will result in `mylibs.so` being loaded twice for the current process. On the other hand, given the same object and current working directory, if `LD_LIBRARY_PATH=/usr/home/me/mylibs`, then

```
...
void *handle1;
void *handle2;

handle1 = dlopen("mylib.so", RTLD_LAZY);
handle2 = dlopen("/usr/home/me/mylibs/mylib.so", RTLD_LAZY);
...
```

will result in `mylibs.so` being loaded only once.

Objects loaded by a single invocation of `dlopen` may import symbols from one another or from any object loaded automatically during program startup, but objects loaded by one `dlopen` invocation may not directly reference symbols from objects loaded by a different `dlopen` invocation. Those symbols may, however, be referenced indirectly using `dlsym`.

Users who wish to gain access to the symbol table of the `a.out` itself using `dlsym(0, mode)` should be aware that some symbols defined in the `a.out` may not be available to the dynamic linker. The symbol table created by `ld` for use by the dynamic linker might contain only a subset of the symbols defined in the `a.out`: specifically those referenced by the shared objects with which the `a.out` is linked.

**NAME**

`dlsym` - get the address of a symbol in shared object

**SYNOPSIS**

```
cc [flag ...] file ... -ldl [library ...]
#include <dlfcn.h>
void *dlsym(void *handle, char *name);
```

**DESCRIPTION**

`dlsym` allows a process to obtain the address of a symbol defined within a shared object previously opened by `dlopen`. *handle* is a value returned by a call to `dlopen`; the corresponding shared object must not have been closed using `dlclose`. *name* is the symbol's name as a character string. `dlsym` will search for the named symbol in all shared objects loaded automatically as a result of loading the object referenced by *handle* [see `dlopen(3X)`].

**EXAMPLES**

The following example shows how one can use `dlopen` and `dlsym` to access either function or data objects. For simplicity, error checking has been omitted.

```
void *handle;
int i, *iptr;
int (*fptr)(int);

/* open the needed object */
handle = dlopen("/usr/mydir/libx.so", RTLD_LAZY);

/* find address of function and data objects */
fptr = (int (*)(int))dlsym(handle, "some_function");

iptr = (int *)dlsym(handle, "int_object");

/* invoke function, passing value of integer as a parameter */
i = (*fptr)(*iptr);
```

**SEE ALSO**

`dlerror(3X)`, `dlopen(3X)`, `dlsym(3X)`.

**DIAGNOSTICS**

If *handle* does not refer to a valid object opened by `dlopen`, or if the named symbol cannot be found within any of the objects associated with *handle*, `dlsym` will return `NULL`. More detailed diagnostic information will be available through `dlerror`.

**NAME**

libwindows - windowing terminal function library

**SYNOPSIS**

```
cc [flag ...] file ... -lwindows [library ...]
int openagent (void);
int New (int cntlfd, int origin_x, int origin_y,
 int corner_x, int corner_y);
int Newlayer (int cntlfd, int origin_x, int origin_y,
 int corner_x, int corner_y);
int openchan (int chan);
int Runlayer (int chan, char *command);
int Current (int cntlfd, int chan);
int Delete (int cntlfd, int chan);
int Top (int cntlfd, int chan);
int Bottom (int cntlfd, int chan);
int Move (int cntlfd, int chan, int origin_x, int origin_y);
int Reshape (int cntlfd, int chan, int origin_x, int origin_y,
 int corner_x, int corner_y);
int Exit (int cntlfd);
```

**DESCRIPTION**

This library of routines enables a program running on a host UNIX system to perform windowing terminal functions [see `layers(1)`].

The `openagent` routine opens the control channel of the `xt(7)` channel group to which the calling process belongs. Upon successful completion, `openagent` returns a file descriptor that can be passed to any of the other `libwindows` routines except `openchan` and `Runlayer`. (The file descriptor can also be passed to the `close` system call.) Otherwise, the value `-1` is returned.

The `New` routine creates a new layer with a separate shell. The `origin_x`, `origin_y`, `corner_x`, and `corner_y` arguments are the coordinates of the layer rectangle. If all the coordinate arguments are 0, the user must define the layer's rectangle interactively. The layer appears on top of any overlapping layers. The layer is not made current (i.e., the keyboard is not attached to the new layer). Upon successful completion, `New` returns the `xt(7)` channel number associated with the layer. Otherwise, the value `-1` is returned.

The `Newlayer` routine creates a new layer without executing a separate shell. Otherwise it is identical to `New`, described above.

The `openchan` routine opens the channel argument `chan` which is obtained from the `New` or `Newlayer` routine. Upon successful completion, `openchan` returns a file descriptor that can be used as input to `write(2)` or `close(2)`. Otherwise, the value `-1` is returned.

The `Runlayer` routine runs the specified *command* in the layer associated with the channel argument *chan*. This layer is usually a layer previously created with `Newlayer`. Any processes currently attached to this layer will be killed, and the new process will have the environment of the `layers` process.

The `Current` routine makes the layer associated with the channel argument *chan* current (i.e., attached to the keyboard).

The `Delete` routine deletes the layer associated with the channel argument *chan* and kills all host processes associated with the layer.

The `Top` routine makes the layer associated with the channel argument *chan* appear on top of all overlapping layers.

The `Bottom` routine puts the layer associated with the channel argument *chan* under all overlapping layers.

The `Move` routine moves the layer associated with the channel argument *chan* from its current screen location to a new screen location at the origin point (*origin\_x*, *origin\_y*). The size and contents of the layer are maintained.

The `Reshape` routine reshapes the layer associated with the channel argument *chan*. The arguments *origin\_x*, *origin\_y*, *corner\_x*, and *corner\_y* are the new coordinates of the layer rectangle. If all the coordinate arguments are 0, the user is allowed to define the layer's rectangle interactively.

The `Exit` routine causes the `layers` program to exit, killing all processes associated with it.

#### FILES

`ULIBDIR/libwindows.a` windowing terminal function library  
`ULIBDIR` usually `/usr/lib`

#### SEE ALSO

`close(2)`, `write(2)`, `jagent(5)`.  
`layers(1)` in the *User's Reference Manual*.

#### DIAGNOSTICS

Upon successful completion, `Runlayer`, `Current`, `Delete`, `Top`, `Bottom`, `Move`, `Reshape`, and `Exit` return 0, while `openagent`, `New`, `Newlayer`, and `openchan` return values as described above under each routine. If an error occurs, -1 is returned.

#### NOTES

The values of layer rectangle coordinates are dependent on the type of terminal. This dependency affects the routines that pass layer rectangle coordinates: `Move`, `New`, `Newlayer`, and `Reshape`. Some terminals will expect these numbers to be passed as character positions (bytes); others will expect the information to be in pixels (bits).

For example, for the AT&T 5620 DMD terminal, **New**, **Newlayer**, and **Reshape** take minimum values of 8 (pixels) for *origin\_x* and *origin\_y* and maximum values of 792 (pixels) for *corner\_x* and 1016 (pixels) for *corner\_y*. The minimum layer size is 28 by 28 pixels and the maximum layer size is 784 by 1008 pixels.

It is recommended that applications use `/dev/xt/??[0-7]` instead of `/dev/xt??[0-7]` when accessing the `xt` driver.

**NAME**

maillock - manage lockfile for user's mailbox

**SYNOPSIS**

```
cc [flag ...] file ... -lmail [library ...]
#include <maillock.h>
int maillock (const char *user, int retrycnt);
int mailunlock (void);
```

**DESCRIPTION**

The maillock function attempts to create a lockfile for the user's mailfile. If a lockfile already exists, maillock assumes the contents of the file is the process ID (as a null-terminated ASCII string) of the process that created the lockfile (presumably with a call to maillock). If the process that created the lockfile is still alive, maillock will sleep and try again *retrycnt* times before returning with an error indication. The sleep algorithm is to sleep for 5 seconds times the attempt number. That is, the first sleep will be for 5 seconds, the next sleep will be for 10 seconds, etc. until the number of attempts reaches *retrycnt*. When the lockfile is no longer needed, it should be removed by calling mailunlock.

*user* is the login name of the user for whose mailbox the lockfile will be created. maillock assumes that users' mailfiles are in the "standard" place as defined in maillock.h.

**RETURN VALUE**

The following return code definitions are contained in maillock.h.

```
#define L_SUCCESS 0 /* Lockfile created or removed */
#define L_NAMELEN 1 /* Recipient name > 13 chars */
#define L_TMPLOCK 2 /* Can't create tmp file */
#define L_TMPWRITE 3 /* Can't write pid into lockfile */
#define L_MAXTRY 4 /* Failed after retrycnt attempts */
#define L_ERROR 5 /* Check errno for reason */
```

**FILES**

- LIBDIR/lib-mail.ln
- LIBDIR/mail.a
- /var/mail/\*
- /var/mail/\*.lock

**NOTES**

mailunlock will only remove the lockfile created from the most previous call to maillock. Calling maillock for different users without intervening calls to mailunlock will cause the initially created lockfile(s) to remain, potentially blocking subsequent message delivery until the current process finally terminates.



## NAME

malloc, free, realloc, calloc, mallocopt, mallinfo - memory allocator

## SYNOPSIS

```
cc [flag ...] file ... -lmalloc [library ...]
#include <stdlib.h>
void *malloc (size_t size)
void free (void *ptr)
void *realloc (void *ptr, size_t size)
void *calloc (size_t nelem, size_t elsize)
#include <malloc.h>
int mallocopt (int cmd, int value)
struct mallinfo mallinfo (void)
```

## DESCRIPTION

malloc and free provide a simple general-purpose memory allocation package.

malloc returns a pointer to a block of at least *size* bytes suitably aligned for any use.

The argument to free is a pointer to a block previously allocated by malloc; after free is performed this space is made available for further allocation, and its contents have been destroyed (but see mallocopt below for a way to change this behavior). If *ptr* is a null pointer, no action occurs.

Undefined results occur if the space assigned by malloc is overrun or if some random number is handed to free.

realloc changes the size of the block pointed to by *ptr* to *size* bytes and returns a pointer to the (possibly moved) block. The contents are unchanged up to the lesser of the new and old sizes. If *ptr* is a null pointer, realloc behaves like malloc for the specified size. If *size* is zero and *ptr* is not a null pointer, the object it points to is freed.

calloc allocates space for an array of *nelem* elements of size *elsize*. The space is initialized to zeros.

mallocopt provides for control over the allocation algorithm. The available values for *cmd* are:

- M\_MXFAST** Set *maxfast* to *value*. The algorithm allocates all blocks below the size of *maxfast* in large groups and then doles them out very quickly. The default value for *maxfast* is 24.
- M\_NLELKS** Set *numlblks* to *value*. The above mentioned "large groups" each contain *numlblks* blocks. *numlblks* must be greater than 0. The default value for *numlblks* is 100.
- M\_GRAIN** Set *grain* to *value*. The sizes of all blocks smaller than *maxfast* are considered to be rounded up to the nearest multiple of *grain*. *grain* must be greater than 0. The default value of *grain* is the smallest number of bytes that will allow alignment of any data type. Value will be rounded up to a multiple of the default when *grain* is set.

**M\_KEEP** Preserve data in a freed block until the next `malloc`, `realloc`, or `calloc`. This option is provided only for compatibility with the old version of `malloc` and is not recommended.

These values are defined in the `malloc.h` header file.

`malloc` may be called repeatedly, but may not be called after the first small block is allocated.

`mallinfo` provides instrumentation describing space usage. It returns the structure:

```

struct mallinfo {
 int arena; /* total space in arena */
 int ordblks; /* number of ordinary blocks */
 int smlblks; /* number of small blocks */
 int hblkhd; /* space in holding block headers */
 int hblks; /* number of holding blocks */
 int usmlblks; /* space in small blocks in use */
 int fsmblks; /* space in free small blocks */
 int uordblks; /* space in ordinary blocks in use */
 int fordblks; /* space in free ordinary blocks */
 int keepcost; /* space penalty if keep option */
 /* is used */
}

```

This structure is defined in the `malloc.h` header file.

Each of the allocation routines returns a pointer to space suitably aligned (after possible pointer coercion) for storage of any type of object.

#### SEE ALSO

`brk(2)`, `malloc(3C)`.

#### DIAGNOSTICS

`malloc`, `realloc`, and `calloc` return a `NULL` pointer if there is not enough available memory. When `realloc` returns `NULL`, the block pointed to by `ptr` is left intact. If `malloc` is called after any allocation or if `cmd` or `value` are invalid, non-zero is returned. Otherwise, it returns zero.

#### NOTES

Note that unlike `malloc(3C)`, this package does not preserve the contents of a block when it is freed, unless the `M_KEEP` option of `malloc` is used.

Undocumented features of `malloc(3C)` have not been duplicated.

Function prototypes for `malloc`, `realloc`, `calloc` and `free` are also defined in the `<malloc.h>` header file for compatibility with old applications. New applications should include `<stdlib.h>` to access the prototypes for these functions.

**NAME**

**sputl**, **sgetl** - access long integer data in a machine-independent fashion

**SYNOPSIS**

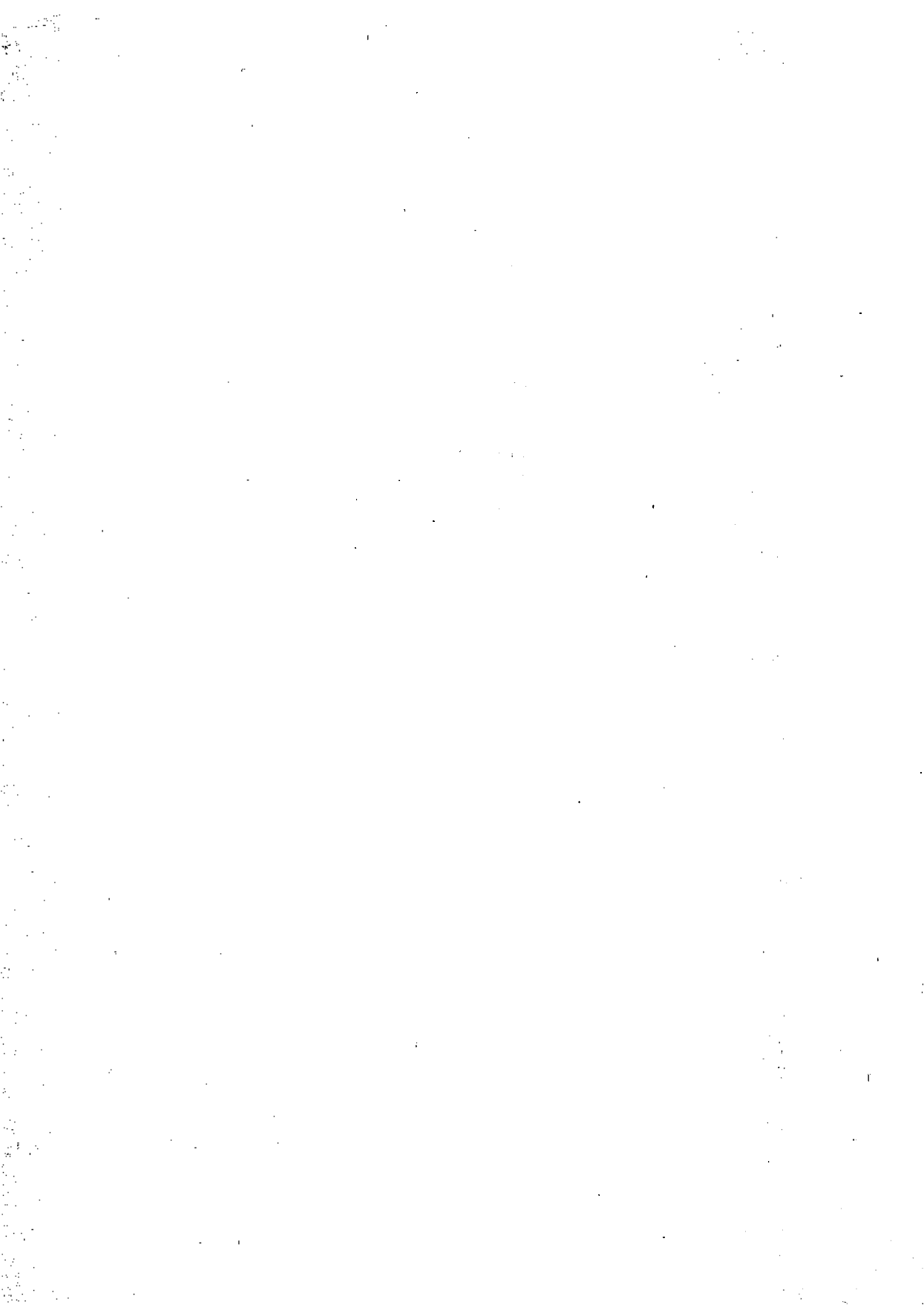
```
cc [flag ...] file ... -lld [library ...]
#include <ldfcn.h>
void sputl (long value, char *buffer);
long sgetl (const char *buffer);
```

**DESCRIPTION**

**sputl** takes the four bytes of the long integer *value* and places them in memory starting at the address pointed to by *buffer*. The ordering of the bytes is the same across all machines.

**sgetl** retrieves the four bytes in memory starting at the address pointed to by *buffer* and returns the long integer value in the byte ordering of the host machine.

The combination of **sputl** and **sgetl** provides a machine-independent way of storing long numeric data in a file in binary form without conversion to characters.





FILE FORMATS (4)

**NAME**

`intro` - introduction to file formats

**DESCRIPTION**

This section outlines the formats of various files. The C structure declarations for the file formats are given where applicable. Usually, the header files containing these structure declarations can be found in the directories `/usr/include` or `/usr/include/sys`. For inclusion in C language programs, however, the syntax `#include <filename.h>` or `#include <sys/filename.h>` should be used.

**NAME**

a.out – ELF (Executable and Linking Format) files

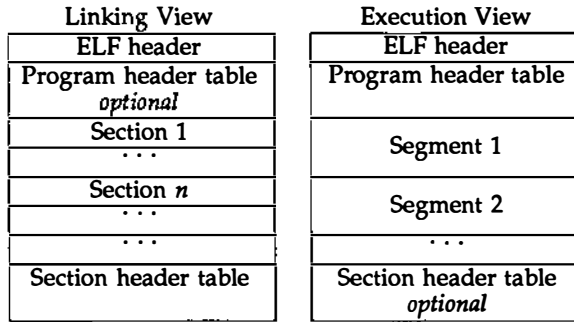
**SYNOPSIS**

`#include <elf.h>`

**DESCRIPTION**

The file name `a.out` is the default output file name from the link editor, `ld(1)`. The link editor will make an `a.out` executable if there were no errors in linking. The output file of the assembler, `as(1)`, also follows the format of the `a.out` file although its default file name is different.

Programs that manipulate ELF files may use the library that `elf(3E)` describes. An overview of the file format follows. For more complete information, see the references given below.



An ELF header resides at the beginning and holds a “road map” describing the file’s organization. Sections hold the bulk of object file information for the linking view: instructions, data, symbol table, relocation information, and so on. Segments hold the object file information for the program execution view. As shown, a segment may contain one or more sections.

A program header table, if present, tells the system how to create a process image. Files used to build a process image (execute a program) must have a program header table; relocatable files do not need one. A section header table contains information describing the file’s sections. Every section has an entry in the table; each entry gives information such as the section name, the section size, etc. Files used during linking must have a section header table; other object files may or may not have one.

Although the figure shows the program header table immediately after the ELF header, and the section header table following the sections, actual files may differ. Moreover, sections and segments have no specified order. Only the ELF header has a fixed position in the file.

When an `a.out` file is loaded into memory for execution, three logical segments are set up: the text segment, the data segment (initialized data followed by uninitialized, the latter actually being initialized to all 0’s), and a stack. The text segment is not writable by the program; if other processes are executing the same `a.out` file, the processes will share a single text segment.



**a.out(4)**

**a.out(4)**

The data segment starts at the next maximal page boundary past the last text address. (If the system supports more than one page size, the "maximal page" is the largest supported size.) When the process image is created, the part of the file holding the end of text and the beginning of data may appear twice. The duplicated chunk of text that appears at the beginning of data is never executed; it is duplicated so that the operating system may bring in pieces of the file in multiples of the actual page size without having to realign the beginning of the data section to a page boundary. Therefore, the first data address is the sum of the next maximal page boundary past the end of text plus the remainder of the last text address divided by the maximal page size. If the last text address is a multiple of the maximal page size, no duplication is necessary. The stack is automatically extended as required. The data segment is extended as requested by the `brk(2)` system call.

**SEE ALSO**

`as(1)`, `cc(1)`, `ld(1)`, `brk(2)`, `elf(3E)`.

The "Object Files" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

**NAME**

ar - archive file format

**SYNOPSIS**

```
#include <ar.h>
```

**DESCRIPTION**

The archive command `ar` is used to combine several files into one. Archives are used mainly as libraries to be searched by the link editor `ld`.

Each archive begins with the archive magic string.

```
#define ARMAG "!<arch>\n" /* magic string */
#define SARFAG 8 /* length of magic string */
```

Following the archive magic string are the archive file members. Each file member is preceded by a file member header which is of the following format:

```
#define ARFMAG "`\n" /* header trailer string */
struct ar_hdr /* file member header */
{
 char ar_name[16]; /* '/' terminated file member name */
 char ar_date[12]; /* file member date */
 char ar_uid[6]; /* file member user identification */
 char ar_gid[6]; /* file member group identification */
 char ar_mode[8]; /* file member mode (octal) */
 char ar_size[10]; /* file member size */
 char ar_fmags[2]; /* header trailer string */
};
```

All information in the file member headers is in printable ASCII. The numeric information contained in the headers is stored as decimal numbers (except for `ar_mode` which is in octal). Thus, if the archive contains printable files, the archive itself is printable.

If the file member name fits, the `ar_name` field contains the name directly, and is terminated by a slash (/) and padded with blanks on the right. If the member's name does not fit, `ar_name` contains a slash (/) followed by a decimal representation of the name's offset in the archive string table described below.

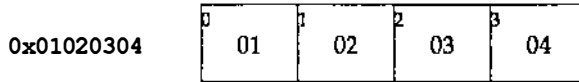
The `ar_date` field is the modification date of the file at the time of its insertion into the archive. Common format archives can be moved from system to system as long as the portable archive command `ar` is used.

Each archive file member begins on an even byte boundary; a newline is inserted between files if necessary. Nevertheless, the size given reflects the actual size of the file exclusive of padding.

Notice there is no provision for empty areas in an archive file.

Each archive that contains object files [see a.out(4)] includes an archive symbol table. This symbol table is used by the link editor ld to determine which archive members must be loaded during the link edit process. The archive symbol table (if it exists) is always the first file in the archive (but is never listed) and is automatically created and/or updated by ar.

The archive symbol table has a zero length name (i.e., ar\_name[0] is '/', ar\_name[1]=' ', etc.). All "words" in this symbol table have four bytes, using the machine-independent encoding shown below. (All machines use the encoding described here for the symbol table, even if the machine's "natural" byte order is different.)



The contents of this file are as follows:

1. The number of symbols. Length: 4 bytes.
2. The array of offsets into the archive file. Length: 4 bytes \* "the number of symbols".
3. The name string table. Length: ar\_size - 4 bytes \* ("the number of symbols" + 1).

As an example, the following symbol table defines 4 symbols. The archive member at file offset 114 defines name and object. The archive member at file offset 426 defines function and a second version of name.

| Offset | +0  | +1 | +2 | +3 |                  |
|--------|-----|----|----|----|------------------|
| 0      | 4   |    |    |    | 4 offset entries |
| 4      | 114 |    |    |    | name             |
| 8      | 114 |    |    |    | object           |
| 12     | 426 |    |    |    | function         |
| 16     | 426 |    |    |    | name             |
| 20     | n   | a  | m  | e  |                  |
| 24     | \0  | o  | b  | j  |                  |
| 28     | e   | c  | t  | \0 |                  |
| 32     | f   | u  | n  | c  |                  |
| 36     | t   | i  | o  | n  |                  |
| 40     | \0  | n  | a  | m  |                  |
| 44     | e   | \0 |    |    |                  |

The number of symbols and the array of offsets are managed with sget1 and sput1. The string table contains exactly as many null terminated strings as there are elements in the offsets array. Each offset from the array is associated with the corresponding name from the string table (in order). The names in the string table are all the defined global symbols found in the common object files in the archive. Each offset is the location of the archive header for the associated symbol.

If some archive member's name is more than 15 bytes long, a special archive member contains a table of file names, each followed by a slash and a new-line. This string table member, if present, will precede all "normal" archive members. The special archive symbol table is not a "normal" member, and must be first if it exists. The *ar\_name* entry of the string table's member header holds a zero length name *ar\_name*[0]='/', followed by one trailing slash (*ar\_name*[1]='/'), followed by blanks (*ar\_name*[2]=' ', etc.). Offsets into the string table begin at zero. Example *ar\_name* values for short and long file names appear below.

|        |    |    |    |    |    |    |    |    |    |    |
|--------|----|----|----|----|----|----|----|----|----|----|
| Offset | +0 | +1 | +2 | +3 | +4 | +5 | +6 | +7 | +8 | +9 |
| 0      | f  | i  | l  | e  | _  | n  | a  | m  | e  |    |
| 10     | s  | a  | m  | p  | l  | e  | /  | \n | l  | o  |
| 20     | n  | g  | e  | r  | f  | i  | l  | e  | n  | a  |
| 30     | m  | e  | x  | a  | m  | p  | l  | e  | /  | \n |

| Member Name           | <i>ar_name</i> | Note                      |
|-----------------------|----------------|---------------------------|
| short-name            | short-name/    | Not in string table       |
| file_name_sample      | /0             | Offset 0 in string table  |
| longerfilenameexample | /18            | Offset 18 in string table |

**SEE ALSO**

ar(1), ld(1), strip(1), sput1(3X), a.out(4).

**NOTES**

strip will remove all archive symbol entries from the header. The archive symbol entries must be restored via the *-ts* options of the *ar* command before the archive can be used with the link editor *ld*.

**NAME**

core - core image file

**DESCRIPTION**

The UNIX system writes out a core image of a process when it is terminated due to the receipt of some signals. The core image is called `core` and is written in the process's working directory (provided it can be; normal access controls apply). A process with an effective user ID different from the real user ID will not produce a core image.

The core file contains all the process information pertinent to debugging: contents of hardware registers, process status and process data. The format of a core file is object file specific.

For ELF executable programs [see `a.out(4)`], the core file generated is also an ELF file, containing ELF program and file headers. The `e_type` field in the file header has type `ET_CORE`. The program header contains an entry for every loadable and writeable segment that was part of the process address space, including shared library segments. The contents of the segments themselves are also part of the core image.

The program header of an ELF core file also contains a `NOTE` segment. This segment may contain the following entries. Each has entry name "CORE" and presents the contents of a system structure:

**prstatus\_t**

The entry containing this structure has a `NOTE` type of 1. This structure contains things of interest to a debugger from the operating system's u-area, such as the general registers, signal dispositions, state, reason for stopping, process ID and so forth. The structure is defined in `<sys/procfs.h>`.

**fpregset\_t**

This entry is present only if the process used the floating-point hardware. It has a `NOTE` type of 2 and contains the floating-point registers. The `fpregset_t` structure is defined in `<sys/regset.h>`.

**prpsinfo\_t**

The entry containing this structure has a `NOTE` type of 3. It contains information of interest to the `ps(1)` command, such as process status, cpu usage, "nice" value, controlling terminal, user ID, process ID, the name of the executable and so forth. The structure is defined in `<sys/procfs.h>`.

COFF executable programs produce core files consisting of two parts: the first section is a copy of the system's per-user data for the process, including the general registers. The format of this section is defined in the header files `<sys/user.h>` and `<sys/reg.h>`. The remainder of a COFF core image represents the actual contents of the process data space.

The size of the core file created by a process may be controlled by the user [see `getrlimit(2)`].

**core(4)**

**core(4)**

**SEE ALSO**

**sdb(1)**, **getrlimit(2)**, **setuid(2)**, **elf(3E)**, **a.out(4)**, **signal(5)**,  
**crash(1M)** in the *System Administrator's Reference Manual*.

The "Object Files" chapter in the *Programmer's Guide: ANSI C and Programming Support Tools*.

## NAME

limits - header file for implementation-specific constants

## SYNOPSIS

```
#include <limits.h>
```

## DESCRIPTION

The header file `limits.h` is a list of minimal magnitude limitations imposed by a specific implementation of the operating system.

```
ARG_MAX 5120 /* max length of arguments to exec */
CHAR_BIT 8 /* max # of bits in a "char" */
CHAR_MAX 255 /* max value of a "char" */
CHAR_MIN 0 /* min value of a "char" */
CHILD_MAX 25 /* max # of processes per user id */
CLK_TCK _sysconf(3) /* clock ticks per second */
DBL_DIG 15 /* digits of precision of a "double" */
DBL_MAX 1.7976931348623157E+308 /* max decimal value of a "double" */
DBL_MIN 2.2250738585072014E-308 /* min decimal value of a "double" */
FCHR_MAX 1048576 /* max size of a file in bytes */
FLT_DIG 6 /* digits of precision of a "float" */
FLT_MAX 3.40282347e+38F /* max decimal value of a "float" */
FLT_MIN 1.17549435E-38F /* min decimal value of a "float" */
INT_MAX 2147483647 /* max value of an "int" */
INT_MIN (-2147483647-1) /* min value of an "int" */
LINK_MAX 1000 /* max # of links to a single file */
LOGNAME_MAX 8 /* max # of characters in a login name */
LONG_BIT 32 /* # of bits in a "long" */
LONG_MAX 2147483647 /* max value of a "long int" */
LONG_MIN (-2147483647-1) /* min value of a "long int" */
MAX_CANON 256 /* max bytes in a line for canonical
processing */
MAX_INPUT 512 /* max size of a char input buffer */
MB_LEN_MAX 5 /* max # of bytes in a multibyte
character */
NAME_MAX 14 /* max # of characters in a file name */
NGROUPS_MAX 16 /* max # of groups for a user */
NL_ARGMAX 9 /* max value of "digit" in calls to the
NLS printf() and scanf() */
NL_LANGMAX 14 /* max # of bytes in a LANG name */
NL_MSGMAX 32767 /* max message number */
NL_NMAX 1 /* max # of bytes in N-to-1 mapping
characters */
NL_SETMAX 255 /* max set number */
NL_TEXTMAX 255 /* max # of bytes in a message string */
NZERO 20 /* default process priority */
OPEN_MAX 20 /* max # of files a process can have
open */
PASS_MAX 8 /* max # of characters in a password */
```

## limits(4)

```

PATH_MAX 1024
PID_MAX 30000
PIPE_BUF 5120
PIPE_MAX 5120

SCHAR_MAX 127
SCHAR_MIN (-128)
SHRT_MAX 32767
SHRT_MIN (-32768)
STD_BLK 1024
SYS_NMLN 257

SYSPID_MAX 1
TMP_MAX 17576

UCHAR_MAX 255
UID_MAX 60000
UINT_MAX 4294967295
ULONG_MAX 4294967295
USHRT_MAX 65535
USI_MAX 4294967295
WORD_BIT 32

```

## limits(4)

```

/* max # of characters in a path name */
/* max value for a process ID */
/* max # bytes atomic in write to a pipe */
/* max # bytes written to a pipe
in a write */
/* max value of a "signed char" */
/* min value of a "signed char" */
/* max value of a "short int" */
/* min value of a "short int" */
/* # bytes in a physical I/O block */
/* 4.0 size of utsname elements */
/* also defined in sys/utsname.h */
/* max pid of system processes */
/* max # of unique names generated
by tmpnam */
/* max value of an "unsigned char" */
/* max value for a user or group ID */
/* max value of an "unsigned int" */
/* max value of an "unsigned long int" */
/* max value of an "unsigned short int" */
/* max decimal value of an "unsigned" */
/* # of bits in a "word" or "int" */

```

The following POSIX definitions are the most restrictive values to be used by a POSIX conformant application. Conforming implementations shall provide values at least this large.

```

_POSIX_ARG_MAX 4096 /* max length of arguments to exec */
_POSIX_CHILD_MAX 6 /* max # of processes per user ID */
_POSIX_LINK_MAX 8 /* max # of links to a single file */
_POSIX_MAX_CANON 255 /* max # of bytes in a line of input */
_POSIX_MAX_INPUT 255 /* max # of bytes in terminal
input queue */
_POSIX_NAME_MAX 14 /* # of bytes in a filename */
_POSIX_NGROUPS_MAX 0 /* max # of groups in a process */
_POSIX_OPEN_MAX 16 /* max # of files a process can have open */
_POSIX_PATH_MAX 255 /* max # of characters in a pathname */
_POSIX_PIPE_BUF 512 /* max # of bytes atomic in write
to a pipe */

```



**NAME**

sccsfile - format of SCCS file

**DESCRIPTION**

An SCCS (Source Code Control System) file is an ASCII file. It consists of six logical parts: the checksum, the delta table (contains information about each delta), user names (contains login names and/or numerical group IDs of users who may add deltas), flags (contains definitions of internal keywords), comments (contains arbitrary descriptive information about the file), and the body (contains the actual text lines intermixed with control lines).

Throughout an SCCS file there are lines which begin with the ASCII SOH (start of heading) character (octal 001). This character is hereafter referred to as the control character and will be represented graphically as @. Any line described below that is not depicted as beginning with the control character is prevented from beginning with the control character.

Entries of the form DDDDD represent a five-digit string (a number between 00000 and 99999).

Each logical part of an SCCS file is described in detail below.

**Checksum**

The checksum is the first line of an SCCS file. The form of the line is:

```
@hDDDDDD
```

The value of the checksum is the sum of all characters, except those of the first line. The @h provides a magic number of (octal) 064001, depending on byte order.

**Delta table**

The delta table consists of a variable number of entries of one of the following forms:

```
@s DDDDD/DDDDDD/DDDDDD
@d <type> <SCCS ID> yr/mo/da hr:mi:se <pgmr> DDDDD DDDDD
@i DDDDD ...
@x DDDDD ...
@g DDDDD ...
@m <MR number>
...
@c <comments> ...
...
@e
```

The first line (@s) contains the number of lines inserted/deleted/unchanged, respectively. The second line (@d) contains the type of the delta (normal: D or removed: R), the SCCS ID of the delta, the date and time of creation of the delta, the login name corresponding to the real user ID at the time the delta was created, and the serial numbers of the delta and its predecessor, respectively.

The @i, @x, and @g lines contain the serial numbers of deltas included, excluded, and ignored, respectively. These lines are optional.

The @m lines (optional) each contain one MR number associated with the delta; the @c lines contain comments associated with the delta. The @e line ends the delta table entry.

### User names

The list of login names and/or numerical group IDs of users who may add deltas to the file, separated by new-lines. The lines containing these login names and/or numerical group IDs are surrounded by the bracketing lines @u and @U. An empty list allows anyone to make a delta. Any line starting with a ! prohibits the succeeding group or user from making deltas.

### Flags

Keywords used internally. See admin(1) for more information on their use. Each flag line takes the form:

```
@f <flag> <optional text>
```

The following flags are defined:

```
@f t <type of program>
@f v <program name>
@f i <keyword string>
@f b
@f m <module name>
@f f <floor>
@f c <ceiling>
@f d <default-sid>
@f n
@f j
@f l <lock-releases>
@f q <user defined>
@f z <reserved for use in interfaces>
```

The t flag defines the replacement for the %Y% identification keyword. The v flag controls prompting for MR numbers in addition to comments; if the optional text is present it defines an MR number validity checking program. The i flag controls the warning/error aspect of the "No id keywords" message. When the i flag is not present, this message is only a warning; when the i flag is present, this message causes a fatal error (the file will not be "gotten", or the delta will not be made). When the b flag is present the -b keyletter may be used on the get command to cause a branch in the delta tree. The m flag defines the first choice for the replacement text of the %M% identification keyword. The f flag defines the floor release; the release below which no deltas may be added. The c flag defines the ceiling release; the release above which no deltas may be added. The d flag defines the default SID to be used when none is specified on a get command. The n flag causes delta to insert a null delta (a delta that applies no changes) in those releases that are skipped when a delta is made in a new release (e.g., when delta 5.1 is made after delta 2.7, releases 3 and 4 are skipped). The absence of the n flag causes skipped releases to be completely empty. The j flag causes get to allow concurrent edits of the same base SID. The l flag defines a list of releases that are locked against editing. The q flag defines the replacement for the %Q% identification keyword. The z flag is used in specialized interface programs.

**Comments**

Arbitrary text is surrounded by the bracketing lines @t and @T. The comments section typically will contain a description of the file's purpose,

**Body**

The body consists of text lines and control lines. Text lines do not begin with the control character, control lines do. There are three kinds of control lines: insert, delete, and end, represented by:

@I DDDDD

@D DDDDD

@E DDDDD

respectively. The digit string is the serial number corresponding to the delta for the control line.

**SEE ALSO**

admin(1), delta(1), get(1), prs(1).

**NAME**

`strftime` - language specific strings

**DESCRIPTION**

There can exist one printable file per locale to specify its date and time formatting information. These files must be kept in the directory `/usr/lib/locale/<locale>/LC_TIME`. The contents of these files are:

1. abbreviated month names (in order)
2. month names (in order)
3. abbreviated weekday names (in order)
4. weekday names (in order)
5. default strings that specify formats for locale time (%X) and locale date (%x).
6. default format for ctime, if the argument for ctime is zero or null.
7. AM (ante meridian) string
8. PM (post meridian) string

Each string is on a line by itself. All white space is significant. The order of the strings in the above list is the same order in which they must appear in the file.

**EXAMPLE**

```
/usr/lib/locale/C/LC_TIME
```

```
Jan
Feb
...
January
February
...
Sun
Mon
...
Sunday
Monday
...
%H:%M:%S
%m/%d/%y
%a %b %d %T %Z %Y
AM
PM
```

**FILES**

```
/usr/lib/locale/<locale>/LC_TIME
```

**SEE ALSO**

`ctime(3C)`, `setlocale(3C)`, `strftime(3C)`.

**timezone(4)**

**timezone(4)**

**NAME**

timezone - set default system time zone

**SYNOPSIS**

/etc/TIMEZONE

**DESCRIPTION**

This file sets and exports the time zone environmental variable TZ.

This file is "dotted" into other files that must know the time zone.

**EXAMPLES**

/etc/TIMEZONE for the east coast:

```
Time Zone
TZ=EST5EDT
export TZ
```

**SEE ALSO**

ctime(3C), environ(5).

rc2(1M), profile(4) in the *System Administrator's Reference Manual*.

**NAME**

utmp, wtmp - utmp and wtmp entry formats

**SYNOPSIS**

```
#include <utmp.h>
```

**DESCRIPTION**

These files, which hold user and accounting information for such commands as who, write, and login, have the following structure, defined in <utmp.h>:

```
#define UTMP_FILE "/var/adm/utmp"
#define WTMP_FILE "/var/adm/wtmp"
#define ut_name ut_user

struct utmp {
 char ut_user[8]; /* user login name */
 char ut_id[4]; /* /sbin/inittab id (created by */
 /* process that puts entry in utmp) */
 char ut_line[12]; /* device name (console, lxxx) */
 short ut_pid; /* process id */
 short ut_type; /* type of entry */
 struct exit_status {
 short e_termination; /* process termination status */
 short e_exit; /* process exit status */
 } ut_exit; /* exit status of a process
 * marked as DEAD_PROCESS */
 time_t ut_time; /* time entry was made */
};

/* Definitions for ut_type */
#define EMPTY 0
#define RUN_LVL 1
#define BOOT_TIME 2
#define OLD_TIME 3
#define NEW_TIME 4
#define INIT_PROCESS 5 /* process spawned by "init" */
#define LOGIN_PROCESS 6 /* a "getty" process waiting for login */
#define USER_PROCESS 7 /* a user process */
#define DEAD_PROCESS 8
#define ACCOUNTING 9
#define UTMXTYPE ACCOUNTING /* max legal value of ut_type */

/* Below are special strings or formats used in the "ut_line" */
/* field when accounting for something other than a process. */
/* No string for the ut_line field can be more than 11 chars + */
/* a null character in length. */
```

## utmp(4)

## utmp(4)

```
#define RUNLVL_MSG "run-level %c"
#define BOOT_MSG "system boot"
#define OTIME_MSG "old time"
#define NTIME_MSG "new time"
```

### FILES

```
/var/adm/utmp
/var/adm/wtmp
```

### SEE ALSO

getut(3C).  
login(1), who(1), write(1) in the *User's Reference Manual*.

NAME

utmpx, wtmpx - utmpx and wtmpx entry formats

SYNOPSIS

```
#include <utmpx.h>
```

DESCRIPTION

utmpx(4) is an extended version of utmp(4).

These files, which hold user and accounting information for such commands as who, write, and login, have the following structure as defined by <utmpx.h>:

```
#define UTMPX_FILE "/var/adm/utmpx"
#define WTMPX_FILE "/var/adm/wtmpx"
#define ut_name ut_user
#define ut_xtime ut_tv.tv_sec

struct utmpx {
 char ut_user[32]; /* user login name */
 char ut_id[4]; /* inittab id */
 char ut_line[32]; /* device name (console, lxxx) */
 pid_t ut_pid; /* process id */
 short ut_type; /* type of entry */
 struct exit_status ut_exit; /* process termination/exit status */
 struct timeval ut_tv; /* time entry was made */
 long ut_session; /* session ID, used for windowing */
 long pad[5]; /* reserved for future use */
 short ut_syslen; /* significant length of ut_host */
 char ut_host[257]; /* including terminating null */
};

/* Definitions for ut_type */

#define EMPTY 0
#define RUN_LVL 1
#define BOOT_TIME 2
#define OLD_TIME 3
#define NEW_TIME 4
#define INIT_PROCESS 5 /* Process spawned by "init" */
#define LOGIN_PROCESS 6 /* A "getty" process waiting for login */
#define USER_PROCESS 7 /* A user process */
#define DEAD_PROCESS 8
#define ACCOUNTING 9

#define UTMXATYPE ACCOUNTING /* Largest legal value of ut_type */

/* Below are special strings or formats used in the "ut_line" field
 when accounting for something other than a process.
 No string for the ut_line field can be more than 11 chars +
 a null character in length. */
```



## utmpx(4)

## utmpx(4)

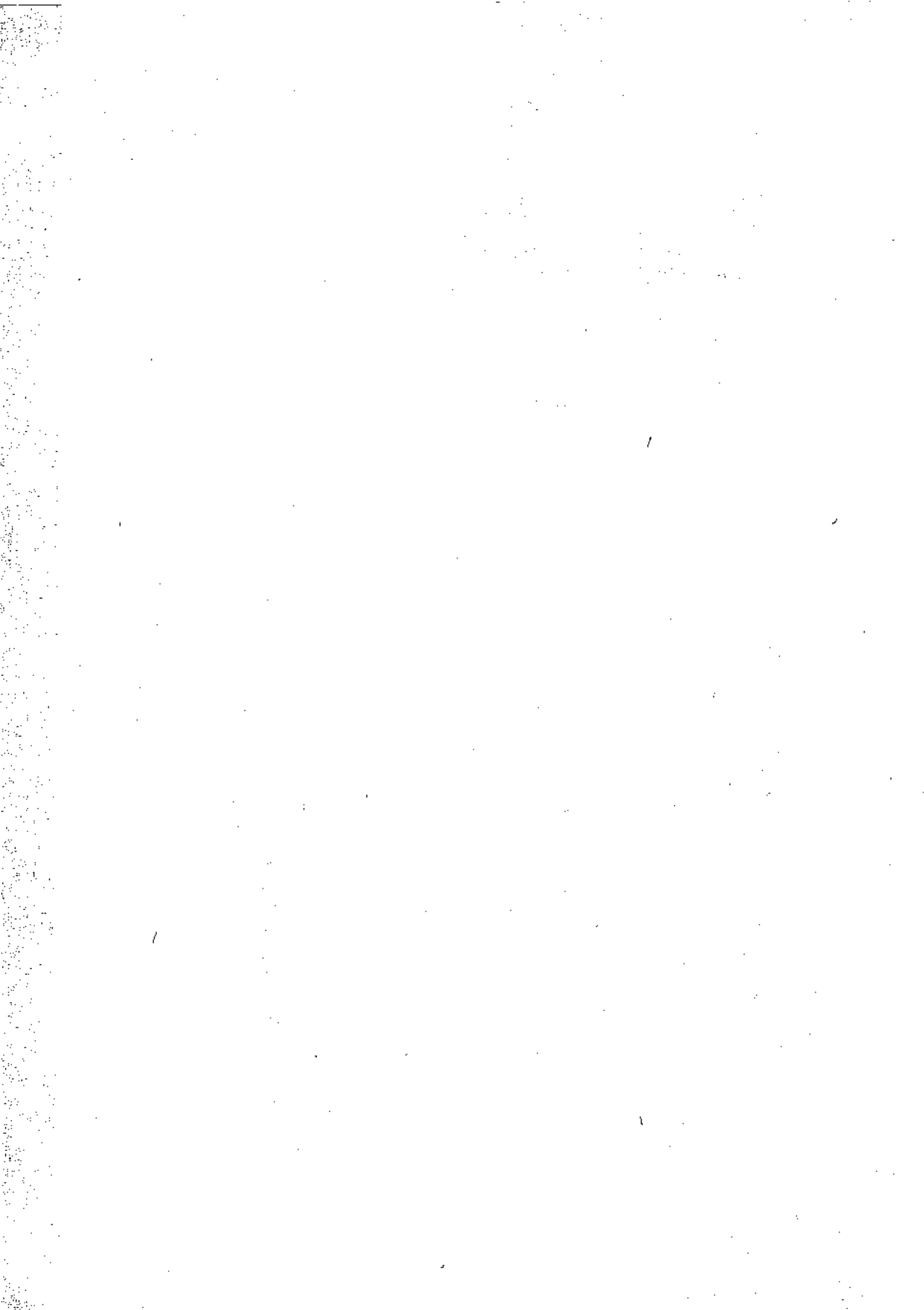
```
#define RUNLVL_MSG "run-level %c"
#define BOOT_MSG "system boot"
#define OTIME_MSG "old time"
#define NTIME_MSG "new time"
#define MOD_WIN 10
```

### FILES

```
/var/adm/utmpx
/var/adm/wtmpx
```

### SEE ALSO

getutx(3C).  
login(1), who(1), write(1) in the *User's Reference Manual*.



MISCELLANEOUS (5)

MISCELLANEOUS (5)

**intro (5)**

**intro (5)**

**NAME**

`intro` - introduction to miscellany

**DESCRIPTION**

This section describes miscellaneous facilities such as macro packages, character set tables, etc.

**NAME**

ascii - map of ASCII character set

**DESCRIPTION**

ascii is a map of the ASCII character set, giving both octal and hexadecimal equivalents of each character, to be printed as needed. It contains:

|         |         |         |         |         |         |         |         |
|---------|---------|---------|---------|---------|---------|---------|---------|
| 000 nul | 001 soh | 002 stx | 003 etx | 004 eot | 005 enq | 006 ack | 007 bel |
| 010 bs  | 011 ht  | 012 nl  | 013 vt  | 014 np  | 015 cr  | 016 so  | 017 si  |
| 020 dle | 021 dc1 | 022 dc2 | 023 dc3 | 024 dc4 | 025 nak | 026 syn | 027 etb |
| 030 can | 031 em  | 032 sub | 033 esc | 034 fs  | 035 gs  | 036 rs  | 037 us  |
| 040 sp  | 041 !   | 042 "   | 043 #   | 044 \$  | 045 %   | 046 &   | 047 '   |
| 050 (   | 051 )   | 052 *   | 053 +   | 054 ,   | 055 -   | 056 .   | 057 /   |
| 060 0   | 061 1   | 062 2   | 063 3   | 064 4   | 065 5   | 066 6   | 067 7   |
| 070 8   | 071 9   | 072 :   | 073 ;   | 074 <   | 075 =   | 076 >   | 077 ?   |
| 100 @   | 101 A   | 102 B   | 103 C   | 104 D   | 105 E   | 106 F   | 107 G   |
| 110 H   | 111 I   | 112 J   | 113 K   | 114 L   | 115 M   | 116 N   | 117 O   |
| 120 P   | 121 Q   | 122 R   | 123 S   | 124 T   | 125 U   | 126 V   | 127 W   |
| 130 X   | 131 Y   | 132 Z   | 133 [   | 134 \   | 135 ]   | 136 ^   | 137 _   |
| 140 `   | 141 a   | 142 b   | 143 c   | 144 d   | 145 e   | 146 f   | 147 g   |
| 150 h   | 151 i   | 152 j   | 153 k   | 154 l   | 155 m   | 156 n   | 157 o   |
| 160 p   | 161 q   | 162 r   | 163 s   | 164 t   | 165 u   | 166 v   | 167 w   |
| 170 x   | 171 y   | 172 z   | 173 {   | 174     | 175 }   | 176 ~   | 177 del |

|        |        |        |        |        |        |        |        |
|--------|--------|--------|--------|--------|--------|--------|--------|
| 00 nul | 01 soh | 02 stx | 03 etx | 04 eot | 05 enq | 06 ack | 07 bel |
| 08 bs  | 09 ht  | 0a nl  | 0b vt  | 0c np  | 0d cr  | 0e so  | 0f si  |
| 10 dle | 11 dc1 | 12 dc2 | 13 dc3 | 14 dc4 | 15 nak | 16 syn | 17 etb |
| 18 can | 19 em  | 1a sub | 1b esc | 1c fs  | 1d gs  | 1e rs  | 1f us  |
| 20 sp  | 21 !   | 22 "   | 23 #   | 24 \$  | 25 %   | 26 &   | 27 '   |
| 28 (   | 29 )   | 2a *   | 2b +   | 2c ,   | 2d -   | 2e .   | 2f /   |
| 30 0   | 31 1   | 32 2   | 33 3   | 34 4   | 35 5   | 36 6   | 37 7   |
| 38 8   | 39 9   | 3a :   | 3b ;   | 3c <   | 3d =   | 3e >   | 3f ?   |
| 40 @   | 41 A   | 42 B   | 43 C   | 44 D   | 45 E   | 46 F   | 47 G   |
| 48 H   | 49 I   | 4a J   | 4b K   | 4c L   | 4d M   | 4e N   | 4f O   |
| 50 P   | 51 Q   | 52 R   | 53 S   | 54 T   | 55 U   | 56 V   | 57 W   |
| 58 X   | 59 Y   | 5a Z   | 5b [   | 5c \   | 5d ]   | 5e ^   | 5f _   |
| 60 `   | 61 a   | 62 b   | 63 c   | 64 d   | 65 e   | 66 f   | 67 g   |
| 68 h   | 69 i   | 6a j   | 6b k   | 6c l   | 6d m   | 6e n   | 6f o   |
| 70 p   | 71 q   | 72 r   | 73 s   | 74 t   | 75 u   | 76 v   | 77 w   |
| 78 x   | 79 y   | 7a z   | 7b {   | 7c     | 7d }   | 7e ~   | 7f del |

**FILES**

/usr/pub/ascii

**NAME**

environ - user environment

**DESCRIPTION**

When a process begins execution, exec routines make available an array of strings called the environment [see `exec(2)`]. By convention, these strings have the form *variable=value*, for example, `PATH=/sbin:/usr/sbin`. These environmental variables provide a way to make information about a program's environment available to programs. The following environmental variables can be used by applications and are expected to be set in the target run-time environment.

**HOME** The name of the user's login directory, set by `login(1)` from the password file (see `passwd(4)`).

**LANG** The string used to specify localization information that allows users to work with different national conventions. The `setlocale(3C)` function looks for the `LANG` environment variable when it is called with "" as the *locale* argument. `LANG` is used as the default locale if the corresponding environment variable for a particular category is unset.

For example, when `setlocale()` is invoked as

```
setlocale(LC_CTYPE, ""),
```

`setlocale()` will query the `LC_CTYPE` environment variable first to see if it is set and non-null. If `LC_CTYPE` is not set or null, then `setlocale()` will check the `LANG` environment variable to see if it is set and non-null. If both `LANG` and `LC_CTYPE` are unset or null, the default C locale will be used to set the `LC_CTYPE` category.

Most commands will invoke

```
setlocale(LC_ALL, "")
```

prior to any other processing. This allows the command to be used with different national conventions by setting the appropriate environment variables.

The following environment variables are supported to correspond with each category of `setlocale(3C)`:

**LC\_COLLATE** This category specifies the collation sequence being used. The information corresponding to this category is stored in a database created by the `colltbl(1M)` command. This environment variable affects `strcoll(3C)` and `strxfrm(3C)`.

**LC\_CTYPE** This category specifies character classification, character conversion, and widths of multibyte characters. The information corresponding to this category is stored in a database created by the `chrtbl(1M)` command. The default C locale corresponds to the 7-bit ASCII character set. This environment variable is used by `ctype(3C)`,

- `mbchar(3C)`, and many commands; for example: `cat(1)`, `ed(1)`, `ls(1)`, and `vi(1)`.
- LC\_MESSAGES** This category specifies the language of the message database being used. For example, an application may have one message database with French messages, and another database with German messages. Message databases are created by the `mmsgs(1M)` command. This environment variable is used by `exstr(1)`, `gettext(1)`, `gettext(3C)`, and `srcgettext(1)`.
- LC\_MONETARY** This category specifies the monetary symbols and delimiters used for a particular locale. The information corresponding to this category is stored in a database created by the `montbl(1M)` command. This environment variable is used by `localeconv(3C)`.
- LC\_NUMERIC** This category specifies the decimal and thousands delimiters. The information corresponding to this category is stored in a database created by the `chrtbl(1M)` command. The default C locale corresponds to "." as the decimal delimiter and no thousands delimiter. This environment variable is used by `localeconv(3C)`, `printf(3C)`, and `strtod(3C)`.
- LC\_TIME** This category specifies date and time formats. The information corresponding to this category is stored in a database specified in `strptime(4)`. The default C locale corresponds to U.S. date and time formats. This environment variable is used by many commands and functions; for example: `at(1)`, `calendar(1)`, `date(1)`, `strptime(3C)`, and `getdate(3C)`.
- MSGVERB** Controls which standard format message components `fmtmsg` selects when messages are displayed to `stderr` [see `fmtmsg(1)` and `fmtmsg(3C)`].
- SEV\_LEVEL** Define severity levels and associate and print strings with them in standard format error messages [see `addseverity(3C)`, `fmtmsg(1)`, and `fmtmsg(3C)`].
- NETPATH** A colon-separated list of network identifiers. A network identifier is a character string used by the Network Selection component of the system to provide application-specific default network search paths. A network identifier must consist of non-NULL characters and must have a length of at least 1. No maximum length is specified. Network identifiers are normally chosen by the system administrator. A network identifier is also the first field in any `/etc/netconfig` file entry. `NETPATH` thus provides a link into the `/etc/netconfig` file and the information about a network contained in that network's entry. `/etc/netconfig` is maintained by the system administrator.



The library routines described in `getnetpath(3N)` access the `NET-PATH` environment variable.

**NLSPATH** Contains a sequence of templates which `catopen(3C)` uses when attempting to locate message catalogs. Each template consists of an optional prefix, one or more substitution fields, a filename and an optional suffix.

For example:

```
NLSPATH="/system/nlslib/%N.cat"
```

defines that `catopen()` should look for all message catalogs in the directory `/system/nlslib`, where the catalog name should be constructed from the `name` parameter passed to `catopen()`, `%N`, with the suffix `.cat`.

Substitution fields consist of a `%` symbol, followed by a single-letter keyword. The following keywords are currently defined:

|                 |                                                                                 |
|-----------------|---------------------------------------------------------------------------------|
| <code>%N</code> | The value of the <code>name</code> parameter passed to <code>catopen()</code> . |
| <code>%L</code> | The value of <code>LANG</code> .                                                |
| <code>%l</code> | The language element from <code>LANG</code> .                                   |
| <code>%t</code> | The territory element from <code>LANG</code> .                                  |
| <code>%c</code> | The codeset element from <code>LANG</code> .                                    |
| <code>%%</code> | A single <code>%</code> character.                                              |

An empty string is substituted if the specified value is not currently defined. The separators `"_"` and `"."` are not included in `%t` and `%c` substitutions.

Templates defined in `NLSPATH` are separated by colons (`:`). A leading colon or two adjacent colons (`::`) is equivalent to specifying `%N`.

For example:

```
NLSPATH=":%N.cat:/nlslib/%L/%N.cat"
```

indicates to `catopen()` that it should look for the requested message catalog in `name`, `name.cat` and `/nlslib/$LANG/name.cat`.

**PATH** The sequence of directory prefixes that `sh(1)`, `time(1)`, `nice(1)`, `nohup(1)`, etc., apply in searching for a file known by an incomplete path name. The prefixes are separated by colons (`:`). `login(1)` sets `PATH=/usr/bin`. (For more detail, see `sh(1)`.)

**TERM** The kind of terminal for which output is to be prepared. This information is used by commands, such as `mm(1)` or `vi(1)`, which may exploit special capabilities of that terminal.

**TZ** Time zone information. The contents of the environment variable named `TZ` are used by the functions `ctime(3C)`, `localtime()` (see `ctime(3C)`), `strftime(3C)` and `mktime(3C)` to override the default timezone. If the first character of `TZ` is a colon (`:`), the behavior is

implementation defined, otherwise TZ has the form:

*std offset [ dst [ offset ], [ start [ /time ], end [ /time ] ]*

*std* and *dst*

Three or more bytes that are the designation for the standard (*std*) and daylight savings time (*dst*) timezones. Only *std* is required, if *dst* is missing, then daylight savings time does not apply in this locale. Upper- and lower-case letters are allowed. Any characters except a leading colon (:), digits, a comma (,), a minus (-) or a plus (+) are allowed.

*offset* Indicates the value one must add to the local time to arrive at Coordinated Universal Time. The offset has the form:

*hh [ : mm [ : ss ] ]*

The minutes (*mm*) and seconds (*ss*) are optional. The hour (*hh*) is required and may be a single digit. The *offset* following *std* is required. If no *offset* follows *dst*, daylight savings time is assumed to be one hour ahead of standard time. One or more digits may be used; the value is always interpreted as a decimal number. The hour must be between 0 and 24, and the minutes (and seconds) if present between 0 and 59. Out of range values may cause unpredictable behavior. If preceded by a "-", the timezone is east of the Prime Meridian; otherwise it is west (which may be indicated by an optional preceding "+" sign).

*start/time, end/time*

Indicates when to change to and back from daylight savings time, where *start/time* describes when the change from standard time to daylight savings time occurs, and *end/time* describes when the change back happens. Each *time* field describes when, in current local time, the change is made.

The formats of *start* and *end* are one of the following:

*Jn* The Julian day *n* ( $1 \leq n \leq 365$ ). Leap days are not counted. That is, in all years, February 28 is day 59 and March 1 is day 60. It is impossible to refer to the occasional February 29.

*n* The zero-based Julian day ( $0 \leq n \leq 365$ ). Leap days are counted, and it is possible to refer to February 29.

*Mm.n.d*

The *d*<sup>th</sup> day, ( $0 \leq d \leq 6$ ) of week *n* of month *m* of the year ( $1 \leq n \leq 5, 1 \leq m \leq 12$ ), where week 5 means "the last *d*-day in month *m*" which may occur in either the fourth or the fifth week). Week 1 is the first week in which the *d*<sup>th</sup> day occurs. Day zero is Sunday.

Implementation specific defaults are used for *start* and *end* if these optional fields are not given.

The *time* has the same format as *offset* except that no leading sign ("-" or "+") is allowed. The default, if *time* is not given is 02:00:00.

Further names may be placed in the environment by the `export` command and *name=value* arguments in `sh(1)`, or by `exec(2)`. It is unwise to conflict with certain shell variables that are frequently exported by `.profile` files: `MAIL`, `PS1`, `PS2`, `IFS` (see `profile(4)`).

#### SEE ALSO

`chrtbl(1M)`, `colltbl(1M)`, `mkmsgs(1M)`, `montbl(1M)`, `netconfig(4)`, `strftime(4)`, `passwd(4)`, `profile(4)` in the *System Administrator's Reference Manual*.

`exec(2)`, `addseverity(3C)`, `catopen(3C)`, `ctime(3C)`, `ctype(3C)`, `fmtmsg(3C)`, `getdate(3C)`, `gettext(3C)`, `localeconv(3C)`, `mbchar(3C)`, `mktime(3C)`, `printf(3C)`, `strcoll(3C)`, `strftime(3C)`, `strtod(3C)`, `strxfrm(3C)`, `strftime(4)`, `timezone(4)`.

`cat(1)`, `date(1)`, `ed(1)`, `fmtmsg(1)`, `ls(1)`, `login(1)`, `nice(1)`, `nohup(1)`, `sh(1)`, `sort(1)`, `time(1)`, `vi(1)` in the *User's Reference Manual*.

`getnetpath(3N)`, in the *Programmer's Guide: Networking Interfaces*.

`mm(1)` in the *DOCUMENTER'S WORKBENCH Software Technical Discussion and Reference Manual*.

**NAME**

fcntl – file control options

**SYNOPSIS**

#include &lt;fcntl.h&gt;

**DESCRIPTION**

The <fcntl.h> header defines the following requests and arguments for use by the functions fcntl [see fcntl(2)] and open [see open(2)].

Values for *cmd* used by fcntl (the following values are unique):

|          |                                                    |
|----------|----------------------------------------------------|
| F_DUPFD  | Duplicate file descriptor                          |
| F_GETFD  | Get file descriptor flags                          |
| F_SETFD  | Set file descriptor flags                          |
| F_GETFL  | Get file status flags                              |
| F_SETFL  | Set file status flags                              |
| F_GETLK  | Get record locking information                     |
| F_SETLK  | Set record locking information                     |
| F_SETLKW | Set record locking information;<br>wait if blocked |

File descriptor flags used for fcntl:

|            |                                                                               |
|------------|-------------------------------------------------------------------------------|
| FD_CLOEXEC | Close the file descriptor upon<br>execution of an exec function [see exec(2)] |
|------------|-------------------------------------------------------------------------------|

Values for *l\_type* used for record locking with fcntl (the following values are unique):

|         |                         |
|---------|-------------------------|
| F_RDLCK | Shared or read lock     |
| F_UNLCK | Unlock                  |
| F_WRLCK | Exclusive or write lock |

The following three sets of values are bitwise distinct:

Values for *oflag* used by open:

|          |                                  |
|----------|----------------------------------|
| O_CREAT  | Create file if it does not exist |
| O_EXCL   | Exclusive use flag               |
| O_NOCTTY | Do not assign controlling tty    |
| O_TRUNC  | Truncate flag                    |

File status flags used for open and fcntl:

|            |                           |
|------------|---------------------------|
| O_APPEND   | Set append mode           |
| O_NDELAY   | Non-blocking mode         |
| O_NONBLOCK | Non-blocking mode (POSIX) |
| O_SYNC     | Synchronous writes        |

Mask for use with file access modes:

|           |                            |
|-----------|----------------------------|
| O_ACCMODE | Mask for file access modes |
|-----------|----------------------------|

File access modes used for open and fcntl:

|          |                              |
|----------|------------------------------|
| O_RDONLY | Open for reading only        |
| O_RDWR   | Open for reading and writing |
| O_WRONLY | Open for writing only        |

The structure flock describes a file lock. It includes the following members:

|       |           |                                 |
|-------|-----------|---------------------------------|
| short | l_type;   | /* Type of lock */              |
| short | l_whence; | /* Flag for starting offset */  |
| off_t | l_start;  | /* Relative offset in bytes */  |
| off_t | l_len;    | /* Size; if 0 then until EOF */ |
| long  | l_sysid;  | /* Returned with F_GETLK */     |
| pid_t | l_pid;    | /* Returned with F_GETLK */     |

**SEE ALSO**

creat(2), exec(2), fcntl(2), open(2).

**NAME**

jagent – host control of windowing terminal

**SYNOPSIS**

```
#include <sys/jioctl.h>

int ioctl (int cntlfd, JAGENT, &arg);
```

**DESCRIPTION**

The `ioctl` system call, when performed on an `xt(7)` device with the `JAGENT` request, allows a host program to send information to a windowing terminal.

`ioctl` has three arguments:

`cntlfd` the `xt(7)` control channel file descriptor

`JAGENT` the `xt` `ioctl` request to invoke a windowing terminal agent routine.

`&arg` the address of a `bagent` structure, defined in `<sys/jioctl.h>` as follows:

```
struct bagent {
 int size; /* size of src in & dest out */
 char *src; /* the source byte string */
 char *dest; /* the destination byte string */
};
```

The `src` pointer must be initialized to point to a byte string that is sent to the windowing terminal. See `layers(5)` for a list of `JAGENT` strings recognized by windowing terminals. Likewise, the `dest` pointer must be initialized to the address of a buffer to receive a byte string returned by the terminal. When `ioctl` is called, the `size` argument must be set to the length of the `src` string. Upon return, `size` is set by `ioctl` to the length of the destination byte string, `dest`.

**SEE ALSO**

`ioctl(2)`, `libwindows(3X)`, `layers(5)`.  
`xt(7)` in the *Programmer's Guide: STREAMS*.

**DIAGNOSTICS**

Upon successful completion, a non-negative value, the size of the destination byte string, is returned. If an error occurs, `-1` is returned.

**NAME**

langinfo – language information constants

**SYNOPSIS**

```
#include <langinfo.h>
```

**DESCRIPTION**

This header file contains the constants used to identify items of langinfo data. The mode of *items* is given in `nl_types`.

|                      |                                    |
|----------------------|------------------------------------|
| <code>DAY_1</code>   | Locale's equivalent of 'sunday'    |
| <code>DAY_2</code>   | Locale's equivalent of 'monday'    |
| <code>DAY_3</code>   | Locale's equivalent of 'tuesday'   |
| <code>DAY_4</code>   | Locale's equivalent of 'wednesday' |
| <code>DAY_5</code>   | Locale's equivalent of 'thursday'  |
| <code>DAY_6</code>   | Locale's equivalent of 'friday'    |
| <code>DAY_7</code>   | Locale's equivalent of 'saturday'  |
| <code>ABDAY_1</code> | Locale's equivalent of 'sun'       |
| <code>ABDAY_2</code> | Locale's equivalent of 'mon'       |
| <code>ABDAY_3</code> | Locale's equivalent of 'tue'       |
| <code>ABDAY_4</code> | Locale's equivalent of 'wed'       |
| <code>ABDAY_5</code> | Locale's equivalent of 'thur'      |
| <code>ABDAY_6</code> | Locale's equivalent of 'fri'       |
| <code>ABDAY_7</code> | Locale's equivalent of 'sat'       |
| <code>MON_1</code>   | Locale's equivalent of 'january'   |
| <code>MON_2</code>   | Locale's equivalent of 'february'  |
| <code>MON_3</code>   | Locale's equivalent of 'march'     |
| <code>MON_4</code>   | Locale's equivalent of 'april'     |
| <code>MON_5</code>   | Locale's equivalent of 'may'       |
| <code>MON_6</code>   | Locale's equivalent of 'june'      |
| <code>MON_7</code>   | Locale's equivalent of 'july'      |
| <code>MON_8</code>   | Locale's equivalent of 'august'    |
| <code>MON_9</code>   | Locale's equivalent of 'september' |
| <code>MON_10</code>  | Locale's equivalent of 'october'   |
| <code>MON_11</code>  | Locale's equivalent of 'november'  |
| <code>MON_12</code>  | Locale's equivalent of 'december'  |
| <code>ABMON_1</code> | Locale's equivalent of 'jan'       |

|           |                                           |
|-----------|-------------------------------------------|
| ABMON_2   | Locale's equivalent of 'feb'              |
| ABMON_3   | Locale's equivalent of 'mar'              |
| ABMON_4   | Locale's equivalent of 'apr'              |
| ABMON_5   | Locale's equivalent of 'may'              |
| ABMON_6   | Locale's equivalent of 'jun'              |
| ABMON_7   | Locale's equivalent of 'jul'              |
| ABMON_8   | Locale's equivalent of 'aug'              |
| ABMON_9   | Locale's equivalent of 'sep'              |
| ABMON_10  | Locale's equivalent of 'oct'              |
| ABMON_11  | Locale's equivalent of 'nov'              |
| ABMON_12  | Locale's equivalent of 'dec'              |
| RADIXCHAR | Locale's equivalent of '.'                |
| THOUSEP   | Locale's equivalent of ','                |
| YESSTR    | Locale's equivalent of 'yes'              |
| NOSTR     | Locale's equivalent of 'no'               |
| CRNCYSTR  | Locale's currency symbol                  |
| D_T_FMT   | Locale's default format for date and time |
| D_FMT     | Locale's default format for the date      |
| T_FMT     | Locale's default format for the time      |
| AM_STR    | Locale's equivalent of 'AM'               |
| PM_STR    | Locale's equivalent of 'PM'               |

This information is retrieved by `nl_langinfo`.

The items `CRNCYSTR`, `RADIXCHAR` and `THOUSEP` are extracted from the fields `currency_symbol`, `decimal_point` and `thousands_sep` in the structure returned by `localeconv`.

The items `T_FMT`, `D_FMT`, `D_T_FMT`, `YESSTR` and `NOSTR` are retrieved from a special message catalog named `Xopen_info` which should be generated for each locale supported and installed in the appropriate directory [see `gettext(3C)` and `msgs(1M)`]. This catalog should have the messages in the order `T_FMT`, `D_FMT`, `D_T_FMT`, `YESSTR` and `NOSTR`.

All other items are as returned by `strftime`.

#### SEE ALSO

`gettext(3C)`, `localeconv(3C)`, `nl_langinfo(3C)`, `strftime(3C)`, `cftime(4)`, `nl_types(5)`, `chrtbl(1)`, `msgs(1M)` in the *System Administrator's Reference Manual*.



**NAME**

**layers** – protocol used between host and windowing terminal under **layers(1)**

**DESCRIPTION**

Layers are asynchronous windows supported by the operating system in a windowing terminal. Communication between the UNIX System processes and terminal processes under the **layers** command [see **layers(1)**] occurs via multiplexed channels managed by the respective operating systems using a protocol as specified in **xtproto(5)**.

The contents of packets transferring data between a UNIX System process and a layer are asymmetric. Data sent from the UNIX System to a particular terminal process are undifferentiated and it is up to the terminal process to interpret the contents of packets.

Control information for terminal processes is sent via channel 0. Process 0 in the windowing terminal performs the designated functions on behalf of the process connected to the designated channel. These packets take the form:

*command, channel*

except for **JTIMOM** and **JAGENT** information, which takes the form

*command, data ...*

The commands are the bottom eight bits extracted from the following **ioctl(2)** codes:

- JBOOT** Prepare to load a new terminal program into the designated layer.
- JTERM** Kill the downloaded layer program, and restore the default window program.
- JTIMOM** Set the timeout parameters for the protocol. The data consist of four bytes in two groups: the value of the receive timeout in milliseconds (the low eight bits followed by the high eight bits) and the value of the transmit timeout (in the same format).
- JZOMBOOT** Like **JBOOT**, but do not execute the program after loading.
- JAGENT** Send a source byte string to the terminal agent routine and wait for a reply byte string to be returned.

The data are from a **bagent** structure [see **jagent(5)**] and consist of a one-byte size field followed by a two-byte agent command code and parameters. Two-byte integers transmitted as part of an agent command are sent with the high-order byte first. The response from the terminal is generally identical to the command packet, with the two command bytes replaced by the return code: 0 for success, -1 for failure. Note that the routines in the **libwindows(3X)** library all send parameters in an **agentrect** structure. The agent command codes and their parameters are as follows:

- A\_NEWLAYER** followed by a two-byte channel number and a rectangle structure (four two-byte coordinates).

|                     |                                                                                                                                                                           |
|---------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>A_CURRENT</b>    | followed by a two-byte channel number.                                                                                                                                    |
| <b>A_DELETE</b>     | followed by a two-byte channel number.                                                                                                                                    |
| <b>A_TOP</b>        | followed by a two-byte channel number.                                                                                                                                    |
| <b>A_BOTTOM</b>     | followed by a two-byte channel number.                                                                                                                                    |
| <b>A_MOVE</b>       | followed by a two-byte channel number and a point to move to (two two-byte coordinates).                                                                                  |
| <b>A_RESHAPE</b>    | followed by a two-byte channel number and the new rectangle (four two-byte coordinates).                                                                                  |
| <b>A_NEW</b>        | followed by a two-byte channel number and a rectangle structure (four two-byte coordinates).                                                                              |
| <b>A_EXIT</b>       | no parameters needed.                                                                                                                                                     |
| <b>A_ROMVERSION</b> | no parameters needed. The response packet contains the size byte, two-byte return code, two unused bytes, and the parameter part of the terminal ID string (e.g., 8;7;3). |

**JXTPROTO** Set *xt* protocol type [see *xtproto(5)*]. The data consist of one byte specifying maximum size for the data part of regular *xt* packets sent from the host to the terminal. This number may be lower than the number returned by **A\_XTPROTO** at lower baud rates or if the **-m** option was specified upon invocation of **layers(1)**. A size of 1 specifies network *xt* protocol.

Packets from the windowing terminal to the UNIX System all take the following form:

*command, data ...*

The single-byte commands are as follows:

|                   |                                                                                                                                                                                                                                                                                  |
|-------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>C_SENDCHAR</b> | Send the next byte to the UNIX System process.                                                                                                                                                                                                                                   |
| <b>C_NEW</b>      | Create a new UNIX System process group for this layer. Remember the window size parameters for this layer. The data for this command is in the form described by the <i>jwinsize</i> structure. The size of the window is specified by two 2-byte integers, sent low byte first. |
| <b>C_UNBLK</b>    | Unblock transmission to this layer. There are no data for this command.                                                                                                                                                                                                          |
| <b>C_DELETE</b>   | Delete the UNIX System process group attached to this layer. There are no data for this command.                                                                                                                                                                                 |
| <b>C_EXIT</b>     | Exit. Kill all UNIX System process groups associated with this terminal and terminate the session. There are no data for this command.                                                                                                                                           |
| <b>C_DEFUNCT</b>  | Layer program has died, send a terminate signal to the UNIX System process groups associated with this terminal. There are no data for this command.                                                                                                                             |

## layers(5)

## layers(5)

- C\_SENDCNCHARS** The rest of the data are characters to be passed to the UNIX System process.
- C\_RESHAPE** The layer has been reshaped. Change the window size parameters for this layer. The data take the same form as for the **C\_NEW** command. A **SIGWINCH** signal is also sent to the process in the window, so that the process knows that the window has been reshaped and it can get the new window parameters.
- C\_NOFLOW** Disable network **xt** flow control [see **xtproto(5)**].
- C\_YESFLOW** Enable network **xt** flow control [see **xtproto(5)**].

### FILES

`/usr/include/windows.h`  
`/usr/include/sys/jioctl.h`

### SEE ALSO

**layers(1)**, **libwindows(3X)**, **jagent(5)**, **xtproto(5)**,  
**xt(7)** in the *Programmer's Guide: STREAMS*.

**NAME**

math – math functions and constants

**SYNOPSIS**

```
#include <math.h>
```

**DESCRIPTION**

This file contains declarations of all the functions in the Math Library (described in Section 3M), as well as various functions in the C Library (Section 3C) that return floating-point values.

It defines the structure and constants used by the `matherr(3M)` error-handling mechanisms, including the following constant used as a error-return value:

**HUGE**           The maximum value of a single-precision floating-point number.

The following mathematical constants are defined for user convenience:

**M\_E**            The base of natural logarithms ( $e$ ).

**M\_LOG2E**       The base-2 logarithm of  $e$ .

**M\_LOG10E**      The base-10 logarithm of  $e$ .

**M\_LN2**          The natural logarithm of 2.

**M\_LN10**         The natural logarithm of 10.

**M\_PI**            $\pi$ , the ratio of the circumference of a circle to its diameter.

**M\_PI\_2**          $\pi/2$ .

**M\_PI\_4**          $\pi/4$ .

**M\_1\_PI**          $1/\pi$ .

**M\_2\_PI**          $2/\pi$ .

**M\_2\_SQRTPI**      $2/\sqrt{\pi}$ .

**M\_SQRT2**        The positive square root of 2.

**M\_SQRT1\_2**     The positive square root of  $1/2$ .

The following mathematical constants are also defined in this header file:

**MAXFLOAT**      The maximum value of a non-infinite single-precision floating point number.

**HUGE\_VAL**       positive infinity.

For the definitions of various machine-dependent constants, see `values(5)`.

**SEE ALSO**

`intro(3)`, `matherr(3M)`, `values(5)`.

**NAME**

nl\_types - native language data types

**SYNOPSIS**

```
#include <nl_types.h>
```

**DESCRIPTION**

This header file contains the following definitions:

- |             |                                                                                                                                                                                                                                  |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| nl_catd     | used by the message catalog functions <code>catopen</code> , <code>catgets</code> and <code>catclose</code> to identify a catalogue                                                                                              |
| nl_item     | used by <code>nl_langinfo</code> to identify items of <code>langinfo</code> data. Values for objects of type <code>nl_item</code> are defined in <code>langinfo.h</code> .                                                       |
| NL_SETD     | used by <code>gencat</code> when no <code>\$set</code> directive is specified in a message text source file. This constant can be used in subsequent calls to <code>catgets</code> as the value of the set identifier parameter. |
| NL_MGSMAX   | maximum number of messages per set                                                                                                                                                                                               |
| NL_SETMAX   | maximum number of sets per catalogue.                                                                                                                                                                                            |
| NL_TEXTMAX  | maximum size of a message.                                                                                                                                                                                                       |
| DEF_NLSPATH | the default search path for locating catalogues.                                                                                                                                                                                 |

**SEE ALSO**

`catgets(3C)`, `catopen(3C)`, `nl_langinfo(3C)`, `langinfo(5)`.  
`gencat(1M)` in the *System Administrator's Reference Manual*.

**NAME**

prof – profile within a function

**SYNOPSIS**

```
#define MARK
#include <prof.h>

void MARK (name);
```

**DESCRIPTION**

MARK introduces a mark called *name* that is treated the same as a function entry point. Execution of the mark adds to a counter for that mark, and program-counter time spent is accounted to the immediately preceding mark or to the function if there are no preceding marks within the active function.

*name* may be any combination of letters, numbers, or underscores. Each *name* in a single compilation must be unique, but may be the same as any ordinary program symbol.

For marks to be effective, the symbol MARK must be defined before the header file `prof.h` is included, either by a preprocessor directive as in the synopsis, or by a command line argument:

```
cc -p -DMARK foo.c
```

If MARK is not defined, the `MARK(name)` statements may be left in the source files containing them and are ignored. `prof -g` must be used to get information on all labels.

**EXAMPLE**

In this example, marks can be used to determine how much time is spent in each loop. Unless this example is compiled with MARK defined on the command line, the marks are ignored.

```
#include <prof.h>
foo()
{
 int i, j;
 . . .
 MARK(loop1);
 for (i = 0; i < 2000; i++) {
 . . .
 }
 MARK(loop2);
 for (j = 0; j < 2000; j++) {
 . . .
 }
}
```

**SEE ALSO**

prof(1), profil(2), monitor(3C).

**NAME**

regexp: compile, step, advance – regular expression compile and match routines

**SYNOPSIS**

```
#define INIT declarations
#define GETC(void) getc code
#define PEEKC(void) peekc code
#define UNGETC(void) ungetc code
#define RETURN(ptr) return code
#define ERROR(val) error code

#include <regexp.h>

char *compile(char *instring, char *expbuf, char *endbuf, int eof);
int step(char *string, char *expbuf);
int advance(char *string, char *expbuf);
extern char *loc1, *loc2, *locs;
```

**DESCRIPTION**

These functions are general purpose regular expression matching routines to be used in programs that perform regular expression matching. These functions are defined by the <regexp.h> header file.

The functions *step* and *advance* do pattern matching given a character string and a compiled regular expression as input.

The function *compile* takes as input a regular expression as defined below and produces a compiled expression that can be used with *step* or *advance*.

A regular expression specifies a set of character strings. A member of this set of strings is said to be matched by the regular expression. Some characters have special meaning when used in a regular expression; other characters stand for themselves.

The regular expressions available for use with the *regexp* functions are constructed as follows:

| <i>Expression</i> | <i>Meaning</i>                                                                                                                    |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------|
| <i>c</i>          | the character <i>c</i> where <i>c</i> is not a special character.                                                                 |
| <i>\c</i>         | the character <i>c</i> where <i>c</i> is any character, except a digit in the range 1–9.                                          |
| <i>^</i>          | the beginning of the line being compared.                                                                                         |
| <i>\$</i>         | the end of the line being compared.                                                                                               |
| <i>.</i>          | any character in the input.                                                                                                       |
| <i>[s]</i>        | any character in the set <i>s</i> , where <i>s</i> is a sequence of characters and/or a range of characters, e.g., <i>[c-c]</i> . |

|                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [^s]                               | any character not in the set <i>s</i> , where <i>s</i> is defined as above.                                                                                                                                                                                                                                                                                                                                                                                                |
| <i>r</i> *                         | zero or more successive occurrences of the regular expression <i>r</i> . The longest leftmost match is chosen.                                                                                                                                                                                                                                                                                                                                                             |
| <i>rx</i>                          | the occurrence of regular expression <i>r</i> followed by the occurrence of regular expression <i>x</i> . (Concatenation)                                                                                                                                                                                                                                                                                                                                                  |
| <i>r</i> \{ <i>m</i> , <i>n</i> \} | any number of <i>m</i> through <i>n</i> successive occurrences of the regular expression <i>r</i> . The regular expression <i>r</i> \{ <i>m</i> \} matches exactly <i>m</i> occurrences; <i>r</i> \{ <i>m</i> ,\} matches at least <i>m</i> occurrences,                                                                                                                                                                                                                   |
| \( <i>r</i> \)                     | the regular expression <i>r</i> . When \( <i>n</i> (where <i>n</i> is a number greater than zero) appears in a constructed regular expression, it stands for the regular expression <i>x</i> where <i>x</i> is the <i>n</i> <sup>th</sup> regular expression enclosed in \ ( and \) that appeared earlier in the constructed regular expression. For example, \( <i>r</i> \) <i>x</i> \( <i>y</i> \) <i>z</i> \2 is the concatenation of regular expressions <i>rxzy</i> . |

Characters that have special meaning except when they appear within square brackets ([]) or are preceded by \ are: ., \*, [, \. Other special characters, such as \$ have special meaning in more restricted contexts.

The character ^ at the beginning of an expression permits a successful match only immediately after a newline, and the character \$ at the end of an expression requires a trailing newline.

Two characters have special meaning only when used within square brackets. The character - denotes a range, [*c-c*], unless it is just after the open bracket or before the closing bracket, [-*c*] or [*c*-] in which case it has no special meaning. When used within brackets, the character ^ has the meaning *complement* of if it immediately follows the open bracket (example: [^*c*]); elsewhere between brackets (example: [*c*^]) it stands for the ordinary character ^.

The special meaning of the \ operator can be escaped only by preceding it with another \, e.g. \\.

Programs must have the following five macros declared before the #include <regexp.h> statement. These macros are used by the compile routine. The macros GETC, PEEKC, and UNGETC operate on the regular expression given as input to compile.

|        |                                                                                                                                                                                                                                                                                              |
|--------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| GETC   | This macro returns the value of the next character (byte) in the regular expression pattern. Successive calls to GETC should return successive characters of the regular expression.                                                                                                         |
| PEEKC  | This macro returns the next character (byte) in the regular expression. Immediately successive calls to PEEKC should return the same character, which should also be the next character returned by GETC.                                                                                    |
| UNGETC | This macro causes the argument <i>c</i> to be returned by the next call to GETC and PEEKC. No more than one character of pushback is ever needed and this character is guaranteed to be the last character read by GETC. The return value of the macro UNGETC( <i>c</i> ) is always ignored. |



- RETURN(*ptr*)** This macro is used on normal exit of the `compile` routine. The value of the argument *ptr* is a pointer to the character after the last character of the compiled regular expression. This is useful to programs which have memory allocation to manage.
- ERROR(*val*)** This macro is the abnormal return from the `compile` routine. The argument *val* is an error number [see ERRORS below for meanings]. This call should never return.

The syntax of the `compile` routine is as follows:

```
compile(instring, exbuf, endbuf, eof)
```

The first parameter, *instring*, is never used explicitly by the `compile` routine but is useful for programs that pass down different pointers to input characters. It is sometimes used in the `INIT` declaration (see below). Programs which call functions to input characters or have characters in an external array can pass down a value of `(char *)0` for this parameter.

The next parameter, *exbuf*, is a character pointer. It points to the place where the compiled regular expression will be placed.

The parameter *endbuf* is one more than the highest address where the compiled regular expression may be placed. If the compiled expression cannot fit in `(endbuf-exbuf)` bytes, a call to `ERROR(50)` is made.

The parameter *eof* is the character which marks the end of the regular expression. This character is usually a `/`.

Each program that includes the `<regexp.h>` header file must have a `#define` statement for `INIT`. It is used for dependent declarations and initializations. Most often it is used to set a register variable to point to the beginning of the regular expression so that this register variable can be used in the declarations for `GETC`, `PEEKC`, and `UNGETC`. Otherwise it can be used to declare external variables that might be used by `GETC`, `PEEKC` and `UNGETC`. [See EXAMPLE below.]

The first parameter to the `step` and `advance` functions is a pointer to a string of characters to be checked for a match. This string should be null terminated.

The second parameter, *exbuf*, is the compiled regular expression which was obtained by a call to the function `compile`.

The function `step` returns non-zero if some substring of *string* matches the regular expression in *exbuf* and zero if there is no match. If there is a match, two external character pointers are set as a side effect to the call to `step`. The variable `loc1` points to the first character that matched the regular expression; the variable `loc2` points to the character after the last character that matches the regular expression. Thus if the regular expression matches the entire input string, `loc1` will point to the first character of *string* and `loc2` will point to the null at the end of *string*.

The function `advance` returns non-zero if the initial substring of *string* matches the regular expression in *exbuf*. If there is a match, an external character pointer, `loc2`, is set as a side effect. The variable `loc2` points to the next character in *string* after the last character that matched.

When `advance` encounters a `*` or `\{ \}` sequence in the regular expression, it will advance its pointer to the string to be matched as far as possible and will recursively call itself trying to match the rest of the string to the rest of the regular expression. As long as there is no match, `advance` will back up along the string until it finds a match or reaches the point in the string that initially matched the `*` or `\{ \}`. It is sometimes desirable to stop this backing up before the initial point in the string is reached. If the external character pointer `locs` is equal to the point in the string at sometime during the backing up process, `advance` will break out of the loop that backs up and will return zero.

The external variables `circf`, `sed`, and `nbra` are reserved.

**DIAGNOSTICS**

The function `compile` uses the macro `RETURN` on success and the macro `ERROR` on failure (see above). The functions `step` and `advance` return non-zero on a successful match and zero if there is no match. Errors are:

- 11 range endpoint too large.
- 16 bad number.
- 25 `\digit` out of range.
- 36 illegal or missing delimiter.
- 41 no remembered search string.
- 42 `\( \)` imbalance.
- 43 too many `\(`.
- 44 more than 2 numbers given in `\{ \}`.
- 45 `}` expected after `\`.
- 46 first number exceeds second in `\{ \}`.
- 49 `[ ]` imbalance.
- 50 regular expression overflow.

**EXAMPLE**

The following is an example of how the regular expression macros and calls might be defined by an application program:

```
#define INIT register char *sp = instring;
#define GETC (*sp++)
#define PEEKC (*sp)
#define UNGETC(c) (--sp)
#define RETURN(c) return;
#define ERROR(c) regerr

#include <regexp.h>

. . .
 (void) compile(*argv, expbuf, &expbuf[ESIZE], '\0');
. . .
 if (step(linebuf, expbuf))
 succeed;
```

**NAME**

siginfo - signal generation information

**SYNOPSIS**

```
#include <siginfo.h>
```

**DESCRIPTION**

If a process is catching a signal, it may request information that tells why the system generated that signal [see `sigaction(2)`]. If a process is monitoring its children, it may receive information that tells why a child changed state [see `waitid(2)`]. In either case, the system returns the information in a structure of type `siginfo_t`, which includes the following information:

```
int si_signo /* signal number */
int si_errno /* error number */
int si_code /* signal code */
```

`si_signo` contains the system-generated signal number. (For the `waitid(2)` function, `si_signo` is always `SIGCHLD`.)

If `si_errno` is non-zero, it contains an error number associated with this signal, as defined in `errno.h`.

`si_code` contains a code identifying the cause of the signal. If the value of `si_code` is less than or equal to 0, then the signal was generated by a user process [see `kill(2)` and `sigsend(2)`] and the `siginfo` structure contains the following additional information:

```
pid_t si_pid /* sending process ID */
uid_t si_uid /* sending user ID */
```

Otherwise, `si_code` contains a signal-specific reason why the signal was generated, as follows:

| Signal     | Code       | Reason                           |
|------------|------------|----------------------------------|
| SIGILL     | ILL_ILLOPC | illegal opcode                   |
|            | ILL_ILLOPN | illegal operand                  |
|            | ILL_ILLADR | illegal addressing mode          |
|            | ILL_ILLTRP | illegal trap                     |
|            | ILL_PRVOPC | privileged opcode                |
|            | ILL_PRVREG | privileged register              |
|            | ILL_COPROC | coprocessor error                |
|            | ILL_BADSTK | internal stack error             |
|            | SIGFPE     | FPE_INTDIV                       |
| FPE_INTOVF |            | integer overflow                 |
| FPE_FLTDIV |            | floating point divide by zero    |
| FPE_FLTOVF |            | floating point overflow          |
| FPE_FLTUND |            | floating point underflow         |
| FPE_FLTRES |            | floating point inexact result    |
| FPE_FLTINV |            | invalid floating point operation |
| FPE_FLTSUB |            | subscript out of range           |

| Signal  | Code          | Reason                                |
|---------|---------------|---------------------------------------|
| SIGSEGV | SEGV_MAPERR   | address not mapped to object          |
|         | SEGV_ACCERR   | invalid permissions for mapped object |
| SIGBUS  | BUS_ADRALN    | invalid address alignment             |
|         | BUS_ADRERR    | non-existent physical address         |
|         | BUS_OBJERR    | object specific hardware error        |
| SIGTRAP | TRAP_BRKPT    | process breakpoint                    |
|         | TRAP_TRACE    | process trace trap                    |
| SIGCHLD | CLD_EXITED    | child has exited                      |
|         | CLD_KILLED    | child was killed                      |
|         | CLD_DUMPED    | child terminated abnormally           |
|         | CLD_TRAPPED   | traced child has trapped              |
|         | CLD_STOPPED   | child has stopped                     |
|         | CLD_CONTINUED | stopped child had continued           |
| SIGPOLL | POLL_IN       | data input available                  |
|         | POLL_OUT      | output buffers available              |
|         | POLL_MSG      | input message available               |
|         | POLL_ERR      | I/O error                             |
|         | POLL_PRI      | high priority input available         |
|         | POLL_HUP      | device disconnected                   |

In addition, the following signal-dependent information is available for kernel-generated signals:

| Signal  | Field           | Value                                         |
|---------|-----------------|-----------------------------------------------|
| SIGILL  | caddr_t si_addr | address of faulting instruction               |
| SIGFPE  |                 |                                               |
| SIGSEGV | caddr_t si_addr | address of faulting memory reference          |
| SIGBUS  |                 |                                               |
| SIGCHLD | pid_t si_pid    | child process ID                              |
|         | int si_status   | exit value or signal                          |
| SIGPOLL | long si_band    | band event for POLL_IN, POLL_OUT, or POLL_MSG |

#### SEE ALSO

sigaction(2), waitid(2), signal(5).

#### NOTES

For SIGCHLD signals, if `si_code` is equal to `CLD_EXITED`, then `si_status` is equal to the exit value of the process; otherwise, it is equal to the signal that caused the process to change state. For some implementations, the exact value of `si_addr` may not be available; in that case, `si_addr` is guaranteed to be on the same page as the faulting instruction or memory reference.

**NAME**

signal - base signals

**SYNOPSIS**

```
#include <signal.h>
```

**DESCRIPTION**

A signal is an asynchronous notification of an event. A signal is said to be generated for (or sent to) a process when the event associated with that signal first occurs. Examples of such events include hardware faults, timer expiration and terminal activity, as well as the invocation of the `kill` or `sigsend` system calls. In some circumstances, the same event generates signals for multiple processes. A process may request a detailed notification of the source of the signal and the reason why it was generated [see `siginfo(5)`].

Each process may specify a system action to be taken in response to each signal sent to it, called the signal's disposition. The set of system signal actions for a process is initialized from that of its parent. Once an action is installed for a specific signal, it usually remains installed until another disposition is explicitly requested by a call to either `sigaction`, `signal` or `sigset`, or until the process execs [see `sigaction(2)` and `signal(2)`]. When a process execs, all signals whose disposition has been set to catch the signal will be set to `SIG_DFL`. Alternatively, a process may request that the system automatically reset the disposition of a signal to `SIG_DFL` after it has been caught [see `sigaction(2)` and `signal(2)`].

A signal is said to be delivered to a process when the appropriate action for the process and signal is taken. During the time between the generation of a signal and its delivery, the signal is said to be pending [see `sigpending(2)`]. Ordinarily, this interval cannot be detected by an application. However, a signal can be blocked from delivery to a process [see `signal(2)` and `sigprocmask(2)`]. If the action associated with a blocked signal is anything other than to ignore the signal, and if that signal is generated for the process, the signal remains pending until either it is unblocked or the signal's disposition requests that the signal be ignored. If the signal disposition of a blocked signal requests that the signal be ignored, and if that signal is generated for the process, the signal is discarded immediately upon generation.

Each process has a signal mask that defines the set of signals currently blocked from delivery to it [see `sigprocmask(2)`]. The signal mask for a process is initialized from that of its parent.

The determination of which action is taken in response to a signal is made at the time the signal is delivered, allowing for any changes since the time of generation. This determination is independent of the means by which the signal was originally generated.

The signals currently defined in `<signal.h>` are as follows:

| Name      | Value | Default | Event                                                     |
|-----------|-------|---------|-----------------------------------------------------------|
| SIGHUP    | 1     | Exit    | Hangup [see <code>termio(7)</code> ]                      |
| SIGINT    | 2     | Exit    | Interrupt [see <code>termio(7)</code> ]                   |
| SIGQUIT   | 3     | Core    | Quit [see <code>termio(7)</code> ]                        |
| SIGILL    | 4     | Core    | Illegal Instruction                                       |
| SIGTRAP   | 5     | Core    | Trace/Breakpoint Trap                                     |
| SIGABRT   | 6     | Core    | Abort                                                     |
| SIGEMT    | 7     | Core    | Emulation Trap                                            |
| SIGFPE    | 8     | Core    | Arithmetic Exception                                      |
| SIGKILL   | 9     | Exit    | Killed                                                    |
| SIGBUS    | 10    | Core    | Bus Error                                                 |
| SIGSEGV   | 11    | Core    | Segmentation Fault                                        |
| SIGSYS    | 12    | Core    | Bad System Call                                           |
| SIGPIPE   | 13    | Exit    | Broken Pipe                                               |
| SIGALRM   | 14    | Exit    | Alarm Clock                                               |
| SIGTERM   | 15    | Exit    | Terminated                                                |
| SIGUSR1   | 16    | Exit    | User Signal 1                                             |
| SIGUSR2   | 17    | Exit    | User Signal 2                                             |
| SIGCHLD   | 18    | Ignore  | Child Status Changed                                      |
| SIGPWR    | 19    | Ignore  | Power Fail/Restart                                        |
| SIGWINCH  | 20    | Ignore  | Window Size Change                                        |
| SIGURG    | 21    | Ignore  | Urgent Socket Condition                                   |
| SIGPOLL   | 22    | Exit    | Pollable Event [see <code>streamio(7)</code> ]            |
| SIGSTOP   | 23    | Stop    | Stopped (signal)                                          |
| SIGTSTP   | 24    | Stop    | Stopped (user) [see <code>termio(7)</code> ]              |
| SIGCONT   | 25    | Ignore  | Continued                                                 |
| SIGTTIN   | 26    | Stop    | Stopped (tty input) [see <code>termio(7)</code> ]         |
| SIGTTOU   | 27    | Stop    | Stopped (tty output) [see <code>termio(7)</code> ]        |
| SIGVTALRM | 28    | Exit    | Virtual Timer Expired                                     |
| SIGPROF   | 29    | Exit    | Profiling Timer Expired                                   |
| SIGXCPU   | 30    | Core    | CPU time limit exceeded [see <code>getrlimit(2)</code> ]  |
| SIGXFSZ   | 31    | Core    | File size limit exceeded [see <code>getrlimit(2)</code> ] |

Using the `signal`, `sigset` or `sigaction` system call, a process may specify one of three dispositions for a signal: take the default action for the signal, ignore the signal, or catch the signal.

#### Default Action: SIG\_DFL

A disposition of `SIG_DFL` specifies the default action. The default action for each signal is listed in the table above and is selected from the following:

- Exit     When it gets the signal, the receiving process is to be terminated with all the consequences outlined in `exit(2)`.
- Core     When it gets the signal, the receiving process is to be terminated with all the consequences outlined in `exit(2)`. In addition, a "core image" of the process is constructed in the current working directory.
- Stop     When it gets the signal, the receiving process is to stop.

**Ignore** When it gets the signal, the receiving process is to ignore it. This is identical to setting the disposition to `SIG_IGN`.

**Ignore Signal:** `SIG_IGN`

A disposition of `SIG_IGN` specifies that the signal is to be ignored.

**Catch Signal:** *function address*

A disposition that is a function address specifies that, when it gets the signal, the receiving process is to execute the signal handler at the specified address. Normally, the signal handler is passed the signal number as its only argument; if the disposition was set with the `sigaction` function however, additional arguments may be requested [see `sigaction(2)`]. When the signal handler returns, the receiving process resumes execution at the point it was interrupted, unless the signal handler makes other arrangements. If an invalid function address is specified, results are undefined.

If the disposition has been set with the `sigset` or `sigaction` function, the signal is automatically blocked by the system while the signal catcher is executing. If a `longjmp` [see `setjmp(3C)`] is used to leave the signal catcher, then the signal must be explicitly unblocked by the user [see `signal(2)` and `sigprocmask(2)`].

If execution of the signal handler interrupts a blocked system call, the handler is executed and the interrupted system call returns a `-1` to the calling process with `errno` set to `EINTR`. However, if the `SA_RESTART` flag is set the system call will be transparently restarted.

**NOTES**

The dispositions of the `SIGKILL` and `SIGSTOP` signals cannot be altered from their default values. The system generates an error if this is attempted.

The `SIGKILL` and `SIGSTOP` signals cannot be blocked. The system silently enforces this restriction.

Whenever a process receives a `SIGSTOP`, `SIGTSTP`, `SIGTTIN`, or `SIGTTOU` signal, regardless of its disposition, any pending `SIGCONT` signal are discarded.

Whenever a process receives a `SIGCONT` signal, regardless of its disposition, any pending `SIGSTOP`, `SIGTSTP`, `SIGTTIN`, and `SIGTTOU` signals is discarded. In addition, if the process was stopped, it is continued.

`SIGPOLL` is issued when a file descriptor corresponding to a `STREAMS` [see `intro(2)`] file has a "selectable" event pending. A process must specifically request that this signal be sent using the `I_SETSIG` `ioctl` call. Otherwise, the process will never receive `SIGPOLL`.

If the disposition of the `SIGCHLD` signal has been set with `signal` or `sigset`, or with `sigaction` and the `SA_NOCLDSTOP` flag has been specified, it will only be sent to the calling process when its children exit; otherwise, it will also be sent when the calling process's children are stopped or continued due to job control.

The name `SIGCLD` is also defined in this header file and identifies the same signal as `SIGCHLD`. `SIGCLD` is provided for backward compatibility, new applications should use `SIGCHLD`.

**signal(5)**

**signal(5)**

The disposition of signals that are inherited as `SIG_IGN` should not be changed.

**SEE ALSO**

`exit(2)`, `getrlimit(2)`, `intro(2)`, `kill(2)`, `pause(2)`, `sigaction(2)`,  
`sigaltstack(2)`, `signal(2)`, `sigprocmask(2)`, `sigsend(2)`, `sigsuspend(2)`,  
`wait(2)`, `sigsetops(3C)`, `siginfo(5)`, `ucontext(5)`.



**NAME**

stat – data returned by stat system call

**SYNOPSIS**

```
#include <sys/types.h>
#include <sys/stat.h>
```

**DESCRIPTION**

The system calls `stat`, `lstat` and `fstat` return data in a `stat` structure, which is defined in `stat.h`.

The constants used in the `st_mode` field are also defined in this file:

```
#define S_IFMT /* type of file */
#define S_IAMB /* access mode bits */
#define S_IFIFO /* fifo */
#define S_IFCHR /* character special */
#define S_IFDIR /* directory */
#define S_IFNAM /* XENIX special named file */
#define S_INSEM /* XENIX semaphore subtype of IFNAM */
#define S_INSHD /* XENIX shared data subtype of IFNAM */
#define S_IFBLK /* block special */
#define S_IFREG /* regular */
#define S_IFLNK /* symbolic link */
#define S_ISUID /* set user id on execution */
#define S_ISGID /* set group id on execution */
#define S_ISVTX /* save swapped text even after use */
#define S_IREAD /* read permission, owner */
#define S_IWRITE /* write permission, owner */
#define S_IXEC /* execute/search permission, owner */
#define S_ENFMT /* record locking enforcement flag */
#define S_IRWXU /* read, write, execute: owner */
#define S_IRUSR /* read permission: owner */
#define S_IWUSR /* write permission: owner */
#define S_IXUSR /* execute permission: owner */
#define S_IRWXG /* read, write, execute: group */
#define S_IRGRP /* read permission: group */
#define S_IWGRP /* write permission: group */
#define S_IXGRP /* execute permission: group */
#define S_IRWXO /* read, write, execute: other */
#define S_IROTH /* read permission: other */
#define S_IWOTH /* write permission: other */
#define S_IXOTH /* execute permission: other */
```

The following macros are for POSIX conformance:

|                |                       |                        |
|----------------|-----------------------|------------------------|
| <b>#define</b> | <b>S_ISBLK(mode)</b>  | block special file     |
| <b>#define</b> | <b>S_ISCHR(mode)</b>  | character special file |
| <b>#define</b> | <b>S_ISDIR(mode)</b>  | directory file         |
| <b>#define</b> | <b>S_ISFIFO(mode)</b> | pipe or fifo file      |
| <b>#define</b> | <b>S_ISREG(mode)</b>  | regular file           |

**SEE ALSO**

**stat(2), types(5).**

## NAME

stdarg – handle variable argument list

## SYNOPSIS

```
#include <stdarg.h>

va_list pvar;

void va_start(va_list pvar, parmN);

type va_arg(va_list pvar, type);

void va_end(va_list pvar);
```

## DESCRIPTION

This set of macros allows portable procedures that accept variable numbers of arguments of variable types to be written. Routines that have variable argument lists [such as `printf`] but do not use *stdarg* are inherently non-portable, as different machines use different argument-passing conventions.

`va_list` is a type defined for the variable used to traverse the list.

The `va_start()` macro is invoked before any access to the unnamed arguments and initializes `pvar` for subsequent use by `va_arg()` and `va_end()`. The parameter *parmN* is the identifier of the rightmost parameter in the variable parameter list in the function definition (the one just before the `, ...`). If this parameter is declared with the `register` storage class or with a function or array type, or with a type that is not compatible with the type that results after application of the default argument promotions, the behavior is undefined.

The parameter *parmN* is required under strict ANSI C compilation. In other compilation modes, *parmN* need not be supplied and the second parameter to the `va_start()` macro can be left empty [e.g., `va_start(pvar, );`]. This allows for routines that contain no parameters before the `...` in the variable parameter list.

The `va_arg()` macro expands to an expression that has the type and value of the next argument in the call. The parameter `pvar` should have been previously initialized by `va_start()`. Each invocation of `va_arg()` modifies `pvar` so that the values of successive arguments are returned in turn. The parameter *type* is the type name of the next argument to be returned. The type name must be specified in such a way so that the type of a pointer to an object that has the specified type can be obtained simply by postfixing a `*` to *type*. If there is no actual next argument, or if *type* is not compatible with the type of the actual next argument (as promoted according to the default argument promotions), the behavior is undefined.

The `va_end()` macro is used to clean up.

Multiple traversals, each bracketed by `va_start` and `va_end`, are possible.

## EXAMPLE

This example gathers into an array a list of arguments that are pointers to strings (but not more than `MAXARGS` arguments) with function `f1`, then passes the array as a single argument to function `f2`. The number of pointers is specified by the first argument to `f1`.

```

#include <stdarg.h>
#define MAXARGS 31

void f1(int n_ptrs, ...)
{
 va_list ap;
 char *array[MAXARGS];
 int ptr_no = 0;

 if (n_ptrs > MAXARGS)
 n_ptrs = MAXARGS;
 va_start(ap, n_ptrs);
 while (ptr_no < n_ptrs)
 array[ptr_no++] = va_arg(ap, char*);
 va_end(ap);
 f2(n_ptrs, array);
}

```

Each call to `f1` shall have visible the definition of the function or a declaration such as

```
void f1(int, ...)
```

#### SEE ALSO

`vprintf(3S)`.

#### NOTES

It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, `exec1` is passed a zero pointer to signal the end of the list. `printf` can tell how many arguments there are by the format. It is non-portable to specify a second argument of `char`, `short`, or `float` to `va_arg`, because arguments seen by the called function are not `char`, `short`, or `float`. C converts `char` and `short` arguments to `int` and converts `float` arguments to `double` before passing them to a function.

## NAME

types - primitive system data types

## SYNOPSIS

```
#include <sys/types.h>
```

## DESCRIPTION

The data types defined in `types.h` are used in UNIX System code. Some data of these types are accessible to user code:

```
typedef struct { int r[1]; } *physadr;
typedef long clock_t;
typedef long daddr_t;
typedef char * caddr_t;
typedef unsigned char unchar;
typedef unsigned short ushort;
typedef unsigned int uint;
typedef unsigned long ulong;
typedef unsigned long ino_t;
typedef long uid_t;
typedef long gid_t;
typedef ulong nlink_t;
typedef ulong mode_t;
typedef short cnt_t;
typedef long time_t;
typedef int label_t[10];
typedef ulong dev_t;
typedef long off_t;
typedef long pid_t;
typedef long paddr_t;
typedef int key_t;
typedef unsigned char use_t;
typedef short sysid_t;
typedef short index_t;
typedef short lock_t;
typedef unsigned int size_t;
typedef long clock_t;
typedef long pid_t;
```

The form `daddr_t` is used for disk addresses except in an i-node on disk, see `fs(4)`. Times are encoded in seconds since 00:00:00 UTC, January 1, 1970. The major and minor parts of a device code specify kind and unit number of a device and are installation-dependent. Offsets are measured in bytes from the beginning of a file. The `label_t` variables are used to save the processor state while another process is running.

**NAME**

ucontext - user context

**SYNOPSIS**

```
#include <ucontext.h>
```

**DESCRIPTION**

The `ucontext` structure defines the context of a thread of control within an executing process.

This structure includes at least the following members:

```

 ucontext_t uc_link
 sigset_t uc_sigmask
 stack_t uc_stack
 mcontext_t uc_mcontext

```

`uc_link` is a pointer to the context that to be resumed when this context returns. If `uc_link` is equal to 0, then this context is the main context, and the process exits when this context returns.

`uc_sigmask` defines the set of signals that are blocked when this context is active [see `sigprocmask(2)`].

`uc_stack` defines the stack used by this context [see `sigaltstack(2)`].

`uc_mcontext` contains the saved set of machine registers and any implementation specific context data. Portable applications should not modify or access `uc_mcontext`.

**SEE ALSO**

`getcontext(2)`, `sigaction(2)`, `sigprocmask(2)`, `sigaltstack(2)`, `makecontext(3C)`.

**NAME**

values - machine-dependent values

**SYNOPSIS**

```
#include <values.h>
```

**DESCRIPTION**

This file contains a set of manifest constants, conditionally defined for particular processor architectures.

The model assumed for integers is binary representation (one's or two's complement), where the sign is represented by the value of the high-order bit.

- BITS** (*type*)     The number of bits in a specified type (e.g., `int`).
- HIBITS**            The value of a short integer with only the high-order bit set.
- HIBITL**            The value of a long integer with only the high-order bit set.
- HIBITI**            The value of a regular integer with only the high-order bit set.
- MAXSHORT**         The maximum value of a signed short integer.
- MAXLONG**          The maximum value of a signed long integer.
- MAXINT**            The maximum value of a signed regular integer.
- MAXFLOAT, LN\_MAXFLOAT**  
The maximum value of a single-precision floating-point number, and its natural logarithm.
- MAXDOUBLE, LN\_MAXDOUBLE**  
The maximum value of a double-precision floating-point number, and its natural logarithm.
- MINFLOAT, LN\_MINFLOAT**  
The minimum positive value of a single-precision floating-point number, and its natural logarithm.
- MINDOUBLE, LN\_MINDOUBLE**  
The minimum positive value of a double-precision floating-point number, and its natural logarithm.
- FSIGNIF**          The number of significant bits in the mantissa of a single-precision floating-point number.
- DSIGNIF**          The number of significant bits in the mantissa of a double-precision floating-point number.

**SEE ALSO**

`intro(3)`, `math(5)`.

**NAME**

varargs – handle variable argument list

**SYNOPSIS**

```
#include <varargs.h>
va_alist
va_dcl
va_list pvar;
void va_start(va_list pvar);
type va_arg(va_list pvar, type);
void va_end(va_list pvar);
```

**DESCRIPTION**

This set of macros allows portable procedures that accept variable argument lists to be written. Routines that have variable argument lists (such as `printf(3S)`) but do not use `varargs` are inherently non-portable, as different machines use different argument-passing conventions.

`va_alist` is used as the parameter list in a function header.

`va_dcl` is a declaration for `va_alist`. No semicolon should follow `va_dcl`.

`va_list` is a type defined for the variable used to traverse the list.

`va_start` is called to initialize `pvar` to the beginning of the list.

`va_arg` will return the next argument in the list pointed to by `pvar`. `type` is the type the argument is expected to be. Different types can be mixed, but it is up to the routine to know what type of argument is expected, as it cannot be determined at runtime.

`va_end` is used to clean up.

Multiple traversals, each bracketed by `va_start` and `va_end`, are possible.

**EXAMPLE**

This example is a possible implementation of `execl` [see `exec(2)`].

```
#include <unistd.h>
#include <varargs.h>
#define MAXARGS 100

/* execl is called by
 execl(file, arg1, arg2, ..., (char *)0);
*/
execl(va_alist)
va_dcl
{
 va_list ap;
 char *file;
 char *args[MAXARGS]; /* assumed big enough*/
 int argno = 0;
```



**varargs(5)****varargs(5)**

```
 va_start(ap);
 file = va_arg(ap, char *);
 while ((args[argno++] = va_arg(ap, char *)) != 0)
 ;
 va_end(ap);
 return execv(file, args);
}
```

**SEE ALSO**

`exec(2)`, `printf(3S)`, `vprintf(3S)`, `stdarg(5)`.

**NOTES**

It is up to the calling routine to specify in some manner how many arguments there are, since it is not always possible to determine the number of arguments from the stack frame. For example, `execl` is passed a zero pointer to signal the end of the list. `printf` can tell how many arguments are there by the format.

It is non-portable to specify a second argument of `char`, `short`, or `float` to `va_arg`, since arguments seen by the called function are not `char`, `short`, or `float`. C converts `char` and `short` arguments to `int` and converts `float` arguments to `double` before passing them to a function.

`stdarg` is the preferred interface.

**NAME**

wstat - wait status

**SYNOPSIS**

#include &lt;sys/wait.h&gt;

**DESCRIPTION**

When a process waits for status from its children via either the `wait` or `waitpid` function, the status returned may be evaluated with the following macros, defined in `sys/wait.h`. These macros evaluate to integral expressions. The *stat* argument to these macros is the integer value returned from `wait` or `waitpid`.

|                                     |                                                                                                                                                                                                                                                      |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>WIFEXITED</b> ( <i>stat</i> )    | Evaluates to a non-zero value if status was returned for a child process that terminated normally.                                                                                                                                                   |
| <b>WEXITSTATUS</b> ( <i>stat</i> )  | If the value of <b>WIFEXITED</b> ( <i>stat</i> ) is non-zero, this macro evaluates to the exit code that the child process passed to <code>_exit</code> or <code>exit</code> , or the value that the child process returned from <code>main</code> . |
| <b>WIFSIGNALED</b> ( <i>stat</i> )  | Evaluates to a non-zero value if status was returned for a child process that terminated due to the receipt of a signal.                                                                                                                             |
| <b>WTERMSIG</b> ( <i>stat</i> )     | If the value of <b>WIFSIGNALED</b> ( <i>stat</i> ) is non-zero, this macro evaluates to the number of the signal that caused the termination of the child process.                                                                                   |
| <b>WIFSTOPPED</b> ( <i>stat</i> )   | Evaluates to a non-zero value if status was returned for a child process that is currently stopped.                                                                                                                                                  |
| <b>WSTOPSIG</b> ( <i>stat</i> )     | If the value of <b>WIFSTOPPED</b> ( <i>stat</i> ) is non-zero, this macro evaluates to the number of the signal that caused the child process to stop.                                                                                               |
| <b>WIFCONTINUED</b> ( <i>stat</i> ) | Evaluates to a non-zero value if status was returned for a child process that has continued.                                                                                                                                                         |
| <b>WCOREDUMP</b> ( <i>stat</i> )    | If the value of <b>WIFSIGNALED</b> ( <i>stat</i> ) is non-zero, this macro evaluates to a non-zero value if a core image of the terminated child was created.                                                                                        |

**SEE ALSO**`exit(2)`, `wait(2)`, `waitpid(3C)`.

**NAME**

xtproto - multiplexed channels protocol used by xt driver

**DESCRIPTION**

This xt protocol is used for communication between multiple UNIX System host processes and an AT&T windowing terminal operating under the `layers` command; see `xt(7)`. It is a multiplexed protocol that directs traffic between host processes and terminal windows, thereby allowing multiple virtual terminal sessions over a single connection. The protocol is implemented by the xt host driver and corresponding firmware in a windowing terminal.

The xt driver implements two distinct low level protocols. Which protocol is used depends on the media used for communication with the terminal. The regular xt protocol is used when communicating over unreliable media such as RS-232. The regular xt protocol provides flow control and error correction, thereby guaranteeing error-free delivery of data. The network xt protocol is used when communicating over reliable media such as a local area network. In order to achieve maximum possible throughput, the network xt protocol relies on the underlying network to provide flow control and error correction.

The `layers` command queries the windowing terminal whether to use regular or network xt protocol through an `A_XTPROTO JAGENT ioctl` system call [see `layers(5)`]. The `layers` command then decides what protocol to use based on the return value of `A_XTPROTO`, baud rate, and the `-m` option of `layers`.

The regular xt protocol uses packets with a 2-byte header containing a 3-bit sequence number, 3-bit channel number, control flag, and one byte for data size. The data part of packets sent from the host to the terminal may not be larger than 252 bytes. The maximum data part size can be less than 252 at lower baud rates, or if the `-m` option of `layers` was specified. Also, when communicating with some earlier windowing terminals, maximum data part size is fixed at 32 bytes. The maximum data part size of packets sent from the terminal to the host is always fixed at 32 bytes. The trailer contains a CRC-16 code in 2 bytes. Each channel is double-buffered.

Correctly received regular xt packets in sequence are acknowledged with a control packet containing an ACK; however, out of sequence packets generate a control packet containing a NAK, which causes the retransmission in sequence of all unacknowledged packets.

Unacknowledged regular xt packets are retransmitted after a timeout interval that is dependent on baud rate. Another timeout parameter specifies the interval after which incomplete receive packets are discarded.

Network xt protocol uses a 3-byte header containing a 3-bit channel number, various control flags, and 2-bytes for data size. The data part of packets sent from the host to the terminal has no size limit. The data part of packets sent from the terminal to the host is restricted to 1025 bytes.

Since network xt protocol relies on the underlying media to guarantee error-free delivery of data, no CRC codes or timeouts are needed.

Network `xt` protocol provides a simple flow control mechanism to limit the amount of data sent to a window in the terminal before a `NETWORK XT ACK` acknowledgement is received by the host. The intent of this flow control is to limit the amount of data sent to a window in the terminal not reading its input because, for example, the user has pressed the scroll lock key. This is necessary to prevent data from backing up and blocking other data directed to other windows. To improve overall throughput, network `xt` flow control can be disabled by processes in the terminal that always read their input quickly.

**FILES**

`/usr/include/sys/xtproto.h` channel multiplexing protocol definitions

**SEE ALSO**

`jagent(5)`, `layers(5)`.  
`layers(1)` in the *User's Reference Manual*.  
`xt(7)` in the *Programmer's Guide: STREAMS*.

