LisaEm User's Guide

by Ray Arachelian

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The World's First Fully Functional Lisa Emulator

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http://lisaem.sunder.net

About LisaEm

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LisaEm emulates Apple Computer's Lisa 2/5 computer.

LisaEm is the world's first Lisa emulator project, started in late 1997, and it is the first to be able to emulate enough of the Lisa hardware accurately enough so as to be run the Lisa Office 7/7. While other emulators for the Lisa exist now, they do so because of the efforts of this project.

LisaEm attempts not just to emulate the Lisa computer, but also provide as much of the experience of using an actual Lisa and several of its peripherals.

LisaEm currently runs on the win32, OS X, and Linux platforms. It should run on any platform where wxWidgets 2.8 will compile, possibly requiring some modifications.

LisaEm is built around James Ponder's Generator CPU core, which has been heavily modified to fully support Lisa's memory management unit.

Historical Note:

The Apple Lisa was a machine of historical importance. Its design, while based on the Xerox Alto, signifies the beginning of ubiquitous user friendly computing. The Lisa was a revolutionary computer in many ways, itself building upon, and extending the ideas invented at Xerox PARC.

While many believe that the Macintosh signifies the start of the user friendly computer revolution, despite the infamous 1984 SuperBowl commercial, the Mac is actually the Lisa's descendant, and includes software that was both built on and also used on the Lisa. Macintosh computers include QuickDraw in their ROMs which was first designed on the Lisa. Building software for the Mac required a Lisa due to the limitations of the original Mac.

The introduction of the Lisa also sparked the creation of Microsoft's Windows environment, and modern user friendly computing, and the office suite.

Due to its limited run, and the destruction of many machines for tax benefits, actual Lisa computers and parts tend to be rare to find in good working condition, and are expensive.

While component level parts are mostly available, there are many components that are no longer available and cannot be replaced, except from other Lisas. (i.e. the COPS421 microcontroller, the CRT, etc.)

Because of this realization, and the Lisa's historical significance, I felt the need to build an emulator for this machine to allow it to continue past the point where no actual Lisa's will still function.

This emulator was designed to both be open source and to use only open source components, in order to ensure that it will be both available, and maintainable on future machines. It was also built to be portable, so that it handle various types of host machines, whether they run on big or little endian CPU's.

As various platforms evolve, no one can predict which will survive and which will go extinct. With this in mind, I've chosen the wxWidgets framework as it allows me to write code for multiple platforms, and easily port to others as they are available.

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LisaEm uses the libdc42 library, which was created for, and is a part of this project. Libdc42 provides support for Disk Copy 4.2 disk images as well as DART images.

The routines for the LZH compression compatibility in libdc42 which provide DART support are additionally subject to the following restrictions:

LZHUF.C (c)1989 by Haruyasu Yoshizaki, Haruhiko Okumura, and Kenji Rikitake.
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Requirements

Requirements

Host CPU and memory:

LisaEm needs a fairly fast machine. It provides decent performance on machines such as a Intel PIII-750Mhz with ample free memory. It is able to emulate a 5Mhz Lisa on a 500Mhz G4 with 512MB of memory on Mac OS X 10.3.9.

LisaEm makes extensive use of memory as part of its operation in order to speed up its operations. Its footprint has been noted to rise above 64MB on some environments depending on the options used.

In particular, the virtual ImageWriter/ADMP printers tend to be memory hungry. It is highly recommended to only configure a single printer. Each virtual printer requires at least 4MB as a frame buffer, however, once the page is ready to printed or save, its requirements will temporarily rise to 12MB.

Lisa Software and ROMs:

To use the emulator, you will need to extract a copy of the Lisa boot ROM from your Lisa, preferably version H, and an operating system such as Lisa Office System or MacWorks. (At this time the Xenix Operating System does not yet run.)

You will need to make disk images of the Lisa Operating System disks using the Disk Copy 4.2 or DART programs as the emulator cannot read the original diskettes. This is because only classic 68k and early PowerPC Maci machines with GCR capable drives are able to read the 400K floppies used by the Lisa.

Disk Images made from Disk Copy versions greater than 4.2 will not work. Disk Images converted from DART to Disk Copy 4.2 by use of any program other than LisaFSH-Tool will not work on real Lisa hardware, nor, LisaEm.

Software tools will eventually be provided to allow ROM extraction. Please read and follow the documentation that comes with them.

NOTE: If your ROM version is 3A, you will only be able to run the MacWorks environment as your Lisa has the screen modification kit for square pixels. Using the 3A ROM with LisaEm will also disable the raw, anti-aliased, anti-aliased with gray replacement display modes.

If you happen to have a copy of the ROM from the Dual Parallel Card, the emulator will support upto three virtual dual parallel cards, providing six additional parallel ports to which you can attach virtual profile hard drives or virtual Apple Dot Matrix Printers (ADMPs).

Downloading and building LisaEm

Downloading Binary and Source Versions:

LisaEm is available for download from http://lisaem.sunder.net/downloads.html

Pre-Compiled versions of LisaEm are available for Mac OS X (intel and PPC), win32, and Ubuntu Linux. Note that due to the variation between Linux distributions, it is recommended to compile your own version for your system from source.

Some Linux distributions may provide precompiled packages and binaries for their distribution. If these are available, and you prefer to use them, use your distro's preferred installation method (i.e. apt-get install or rpm -ihv and so forth.)

If LisaEm is not provided for your platform in binary form, you can compile your own version, provided you have proper development environment/software including wxWidgets 2.8, the GNU C compiler toolchain, the bash shell, the netpbm package, and other standard open source tools available on most open source systems.

Compiling LisaEm for your system:

Prerequisites:

On Unix, BSD, and Macintosh systems:

You'll need to download, compile, and install wxWidgets 2.8.4 from http://www.wxwidgets.org. and the netpbm package for your system.

NOTE: For Macintosh, you'll need to edit wxWidgets as follows before compiling wxWidgets or the graphics display by LisaEm may not work properly.

in your wxWidgets directory, edit the file include/wx/mac/carbon/chkconf.h

```
change the line with '#define wxMAC_USE_CORE_GRAPHICS 1'
to                   '#define wxMAC_USE_CORE_GRAPHICS 0'
```

(Many thanks to Brian Foley for finding this!)

On Microsoft Windows systems:

You'll need to install both Cygwin and the wxDev-Cpp 6.10-2 environment. Download wxDev-CPP 6.10-2 from http://wxdsgn.sourceforge.net/ and install it in c:\wxDev-Cpp. Do NOT allow the installer to install it underneath the C:\Program Files directory.

wxDev-Cpp was chosen because it contains both wxWidgets for win32 as well as the MINGW gcc/g++ compilers toolchain, however, the use of Cygwin is required for the build.sh script to function.

The Cygwin environment can be downloaded from http://cygwin.com. When you install Cygwin, be sure to enable the netpbm graphical tools. The bash shell should be installed by default, but you should check to make sure that it is enabled.

Building LisaEm:

From your OS's shell or terminal program (use cygwin on win32), run the following commands:

```
bzip2 -cd lisaem-1.0.0RC2 | tar xvf -   # Extract the archive
cd lisaem-1.0.0RC2                       # enter the directory
./build.sh clean build                   # build the software
sudo ./build.sh install                  # optionally install it.
```

On win32, remove the sudo command. Just issue `./build.sh install` by itself.

Additional options can be found by running ./build.sh –help.

On Mac OS X systems, the –with-rawbitmap option is automatically enabled. On other platforms, it is disabled, as the rawbitmap options causes win32 to crash, and Linux to display a black screen.

On Windows, the install command will install LisaEm to [C:\Program Files\Sunder.NET\LisaEm](C:\Program Files\Sunder.NET\LisaEm)

On Unix Systems, except for OS X, it will install the binaries to /usr/local/bin, and resources to /usr/local/share/LisaEm.

On Mac OS X, it will install the binary to /Applications/LisaEm.app, which will not be a universal binary. If you wish to build a universal binary, you'll have to repeat the build process on the alternate architecture, and use the lipo command to merge the binaries together. The lisafsh-tool and lisadiskinfo command line tools willl be installed to /usr/local/bin.

The –with-rawbitmap option enables the use of the undocumented rawbmp.h wxWidgets interface. This allows very fast access to the individual RGB colors in a wxBitmap, so it allows for fast display refreshes. When this option isn't available (any platform other than OS X for the current version), an alternate method is used.

The alternate method uses a wxImage, and the SetRGB method to achieve what rawbmp.h does, with a small slowdown induced by the conversion of the wxImage to a wxBitmap since wxImages cannot be directly Blitted to the display.   This is the display method used on Linux, and Windows currently.

Extra debugging options are provided on OS X and Linux via the use of the –with-debug and –with-tracelog options. When used together, these enable a new menu option called Trace Log. This option is a boolean, that is when enabled, it logs every executed opcode as well as any I/O, and memory accesses including MMU translations, and I/O timer events (IRQ's). Trace logs generate very large logs at the rate of megabytes for every second of runtime.

This option is intended to help the reverse engineering of operating systems running on the Lisa, and also the debugging of the emulator. It is not intended for end users, and will not be discussed further in this document.

Compatibility

Compatibility

If you are unfamiliar with the Apple Lisa computer, reading the LisaFAQ is highly recommended. see: http://lisafaq.sunder.net as it also contains pointers to other Lisa information such as operation manuals and guides.

The following software has been reported to work under the emulator:

- Lisa Office System 3.x
- Lisa Pascal Workshop 3.x
- MacWorks XL
- MacWorks Plus
- LisaTest (video timing test fails, the VIA tests pass internally, but lock up LisaTest.)
- LisaMonitor

The focus of this project is to provide emulation for the Lisa Office System, so the other environments may not be fully functional. This may vary from release to release.

NOTE: The current version of LisaEm has bugs preventing the use of MacWorks! The 2007.01.28 Preview version of LisaEm is the only one that works with MacWorks!

The following hardware is emulated by the emulator:

- Display
- Keyboard
- Mouse
- Sound
- VIA
- Parallel Ports (including the dual parallel card.)
- Serial Ports
- Profile hard drives (5M, 10M under LOS/LPW, other sizes under MacWorks.)
- ImageWriter I printer (serial port connection)
- Apple Dot Matrix Printer (ImageWriter on a parallel port connection)

The following software **does not** (yet) work under the emulator:

- Microsoft/SCO Xenix 3.x

The following hardware **is not** supported by the emulator, and will likely not be supported in the future due to lack of technical documentation:

- Inkjet/Laser printers
- SCSI/Priam hard drives
- Quad port serial card
- Priam hard drive

Configuring LisaEm

Configuring LisaEm

The screenshots in this documentation come from the Mac OS X version. Your display may vary from these. The screenshots come from various different versions of LisaEm, and because of this, the coloring will vary slightly.

To use LisaEm, you must first tell it where to find the boot ROM. To do this, open the Preferences dialog box which can be found under the File Menu, except on Mac OS X, where it can be found under the LisaEm menu.

The Preferences Dialog box:
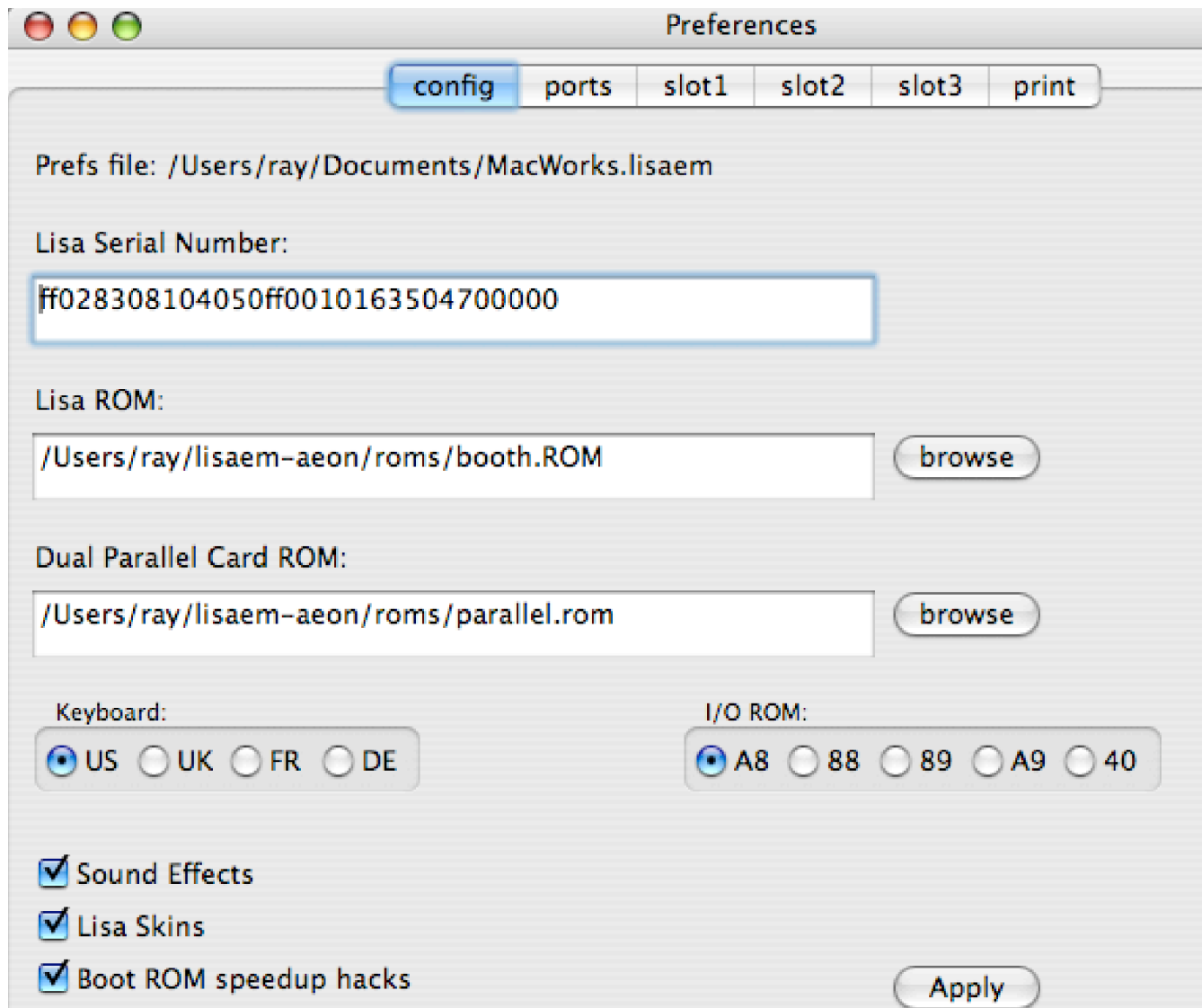
The **Preferences** dialog box allows you to configure the emulator's settings.

Once you are happy with your changes, press the **Apply** button which will save them and dismiss the Preferences dialog. If you close the window, your changes will not be saved. Note that your changes will take effect the next time you power on the emulator.

The Lisa ROM

The emulator can support several formats for the Lisa boot ROM. If you have extracted the ROMs from your Lisa's CPU board and read them in with a ROM dumper, you should save them as booth.lo and booth.hi.   The naming of these files are important if you're using the split ROM. These are labeled 341-0175-H and 341-0176-H for the H version of the ROM.

The Lisa's ROM are split into odd/even bytes which the emulator will stitch together into a single file for you in the same location as the booth.hi or booth.lo files and change its preferences to point to the merged ROM file.

The emulator will run the same checksum routine that the Power On Self Test (POST) uses to check the ROM. Should it notice a problem with the checksum it will alert you and offer the option to continue anyway.

NOTE: Corrupted, or improperly merged ROM files will cause the emulator to crash. The same is true of defective software run under MacWorks or other environments; should it attempt to execute opcodes that are not handled by the Generator core, LisaEm may unexpectedly quit.

The Lisa Boot ROM has a diagnostic mode called Service Mode which can be reached by attempting to boot from a non-existant drive, and then sending Command-S. You can use the Keyboard menu to send this command and enter this mode.

If you are an expert on your machine's operating system, you can directly edit the path in the text field under the Lisa ROM entry in the Preferences dialog box under the **config** tab, otherwise you should click on the **browse** button and use the file picker to select the ROM file.

NOTE: both the ROMs and operating systems used on the Lisa are copyrighted and subject to license restrictions. Please use only the ROMs and operating systems which are licensed for your own Lisas.

Please do not ask me to provide copies of the ROMs or other Lisa software. I prefer not to break Apple's copyright.

If you do not own a Lisa, and wish to legally obtain a copy of the ROM, you'll need to either own a real Lisa, or buy a Lisa CPU board and extract the ROM yourself.

If you need Lisa Office System, you'll find eBay sellers offering an Apple CD titled "Service Source" which contains legal disk images of the Lisa Office System in DART format.

At various times, you may find actual Lisa Office System diskettes, which may or may not work due to the age of the actual media.
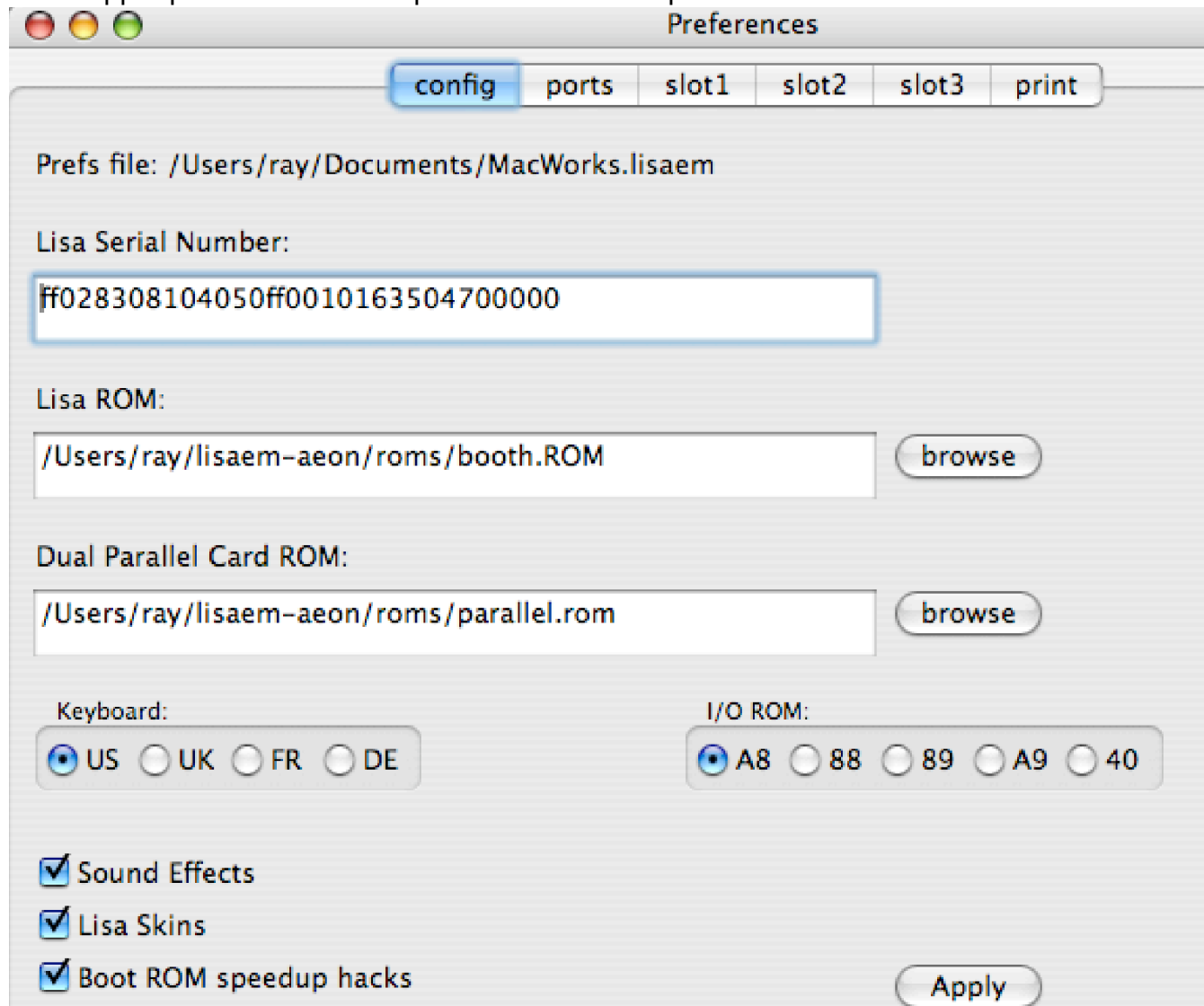
The Dual Parallel Card ROM

One of the more popular expansion cards for the Lisa was the Dual Parallel Card. This card allowed Lisa users to expand the Lisa's storage by adding extra ProFile hard drives and also allowed connections to the Apple Dot Matrix Printer.

If you have this card on your Lisa and dumped its ROM, point the emulator at its ROM file. Doing so will enable the Dual Parallel card options under the Preferences slot tabs.

If you power use of your host operating system, you can directly type the path to the Dual Parallel Card ROM file into the text field, otherwise press the **browse** button to use your operating system's file selector.

The tab for slot 2 shows an enabled dual parallel port card with a ProFile hard drive attached to the upper port and an ADMP printer on the lower port:
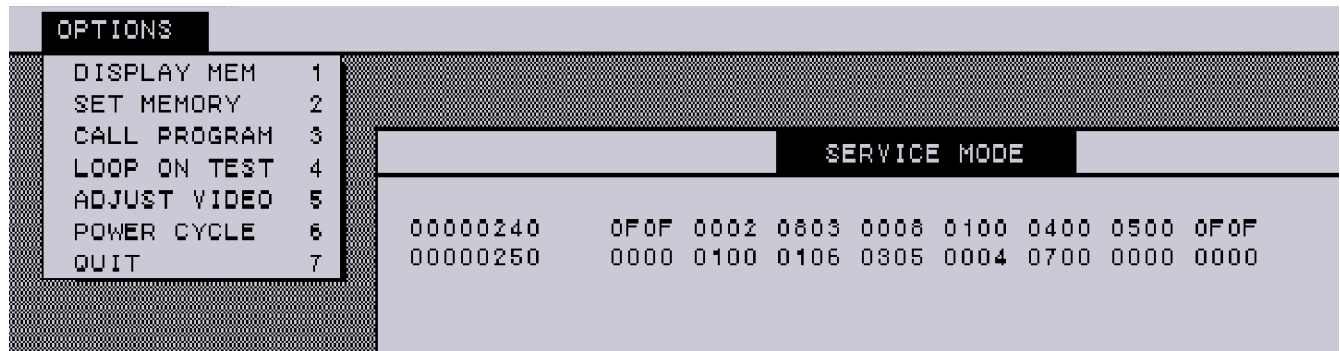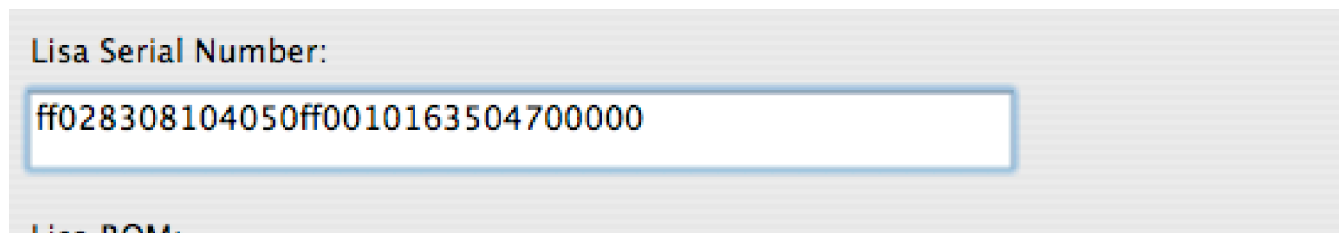
The Lisa Serial Number:

To properly make use of your Lisa Office System disks in the emulator, you'll have to use the same serial number on LisaEm as on your real Lisa, otherwise the Lisa tools will fail to install.

Enter Service Mode by attempting to boot off a non existent drive, such as a powered off profile, or from the floppy drive without an actual disk in the drive, then press the Apple-S key.

Next, click on the 1 in the Options menu, or press 1 on the keyboard. You'll be asked for address, enter 240. You'll be asked for count, enter 20. You'll see something similar to the display below:

```
OPTIONS
    DISPLAY MEM     1
    SET MEMORY      2
    CALL PROGRAM    3
    LOOP ON TEST    4                          SERVICE MODE
    ADJUST VIDEO    5
    POWER CYCLE     6        00000240    0F0F 0002 0803 0008 0100 0400 0500 0F0F
    QUIT            7        00000250    0000 0100 0106 0305 0004 0700 0000 0000
```

Copy the hex numbers above from the service mode hex dump display into the Lisa Serial Number field in Preferences, omitting every alternate zero starting with the first one. This is your Lisa's serial number. Please double check this number as your Lisa Office Software will not work properly if it doesn't match.

Lisa Serial Number:

```
ff028308104050ff0010163504700000
```

Lisa ROM:

For example, the leading 0f0f 0002 becomes ff02 in the serial number, the next two numbers 0803 0008 becomes 8308, 0100 0400 becomes 1040, 0500 0f0f becomes 50ff, and so on.

In the above example, the actual Serial Number for this Lisa is 101635, and this number will be used to serialize Lisa Office System installation diskettes as well as the Office System Tools (i.e. LisaWrite.)

The other numbers contain information about when the Lisa was built, the AppleNet ID number, and various checksums and sync bytes.

See David T. Craig's Lisa Tool Deserialization papers for further details.

The I/O ROM version:

The Lisa emulator does not actually use the I/O ROM itself, all it needs is the ROM version to report to the running operating system.

The I/O ROM version most commonly used in the Lisa 2/5 is A8.   Version 88 is for the Lisa 2/10. The emulator does not support Widget drives, so you should stick to A8. Versions 88, 89, A9 are meant to be used with Xenix to fool it into using the right sized drive. Version 40 is used for the Lisa 1, however the emulator does not emulate enough of a Lisa 1 yet.

The Keyboard Language:

The Lisa automatically detects the type of keyboard attached and switches its language based on this selection. The emulator provides this as an option for US English, British English, French of German. Other languages may have existed, if you happen to know the keyboard IDs for them, please contact me and I'll add them to the emulator.
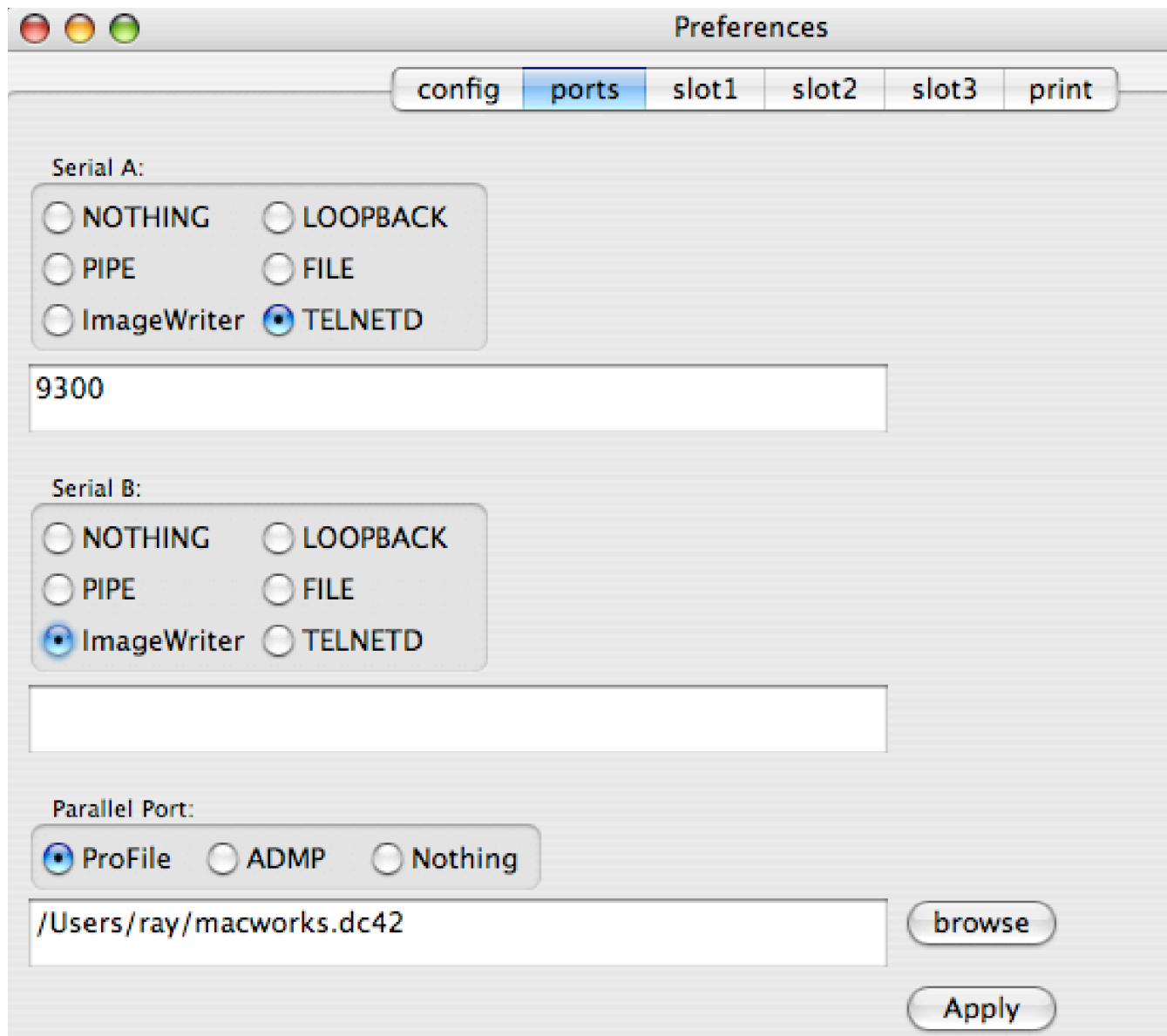
The Extra options:

Sound Effects: Enables playback of sound effects such as the power switch clicks, floppy insertion, eject, motor, and the power off click.

Skins: Enables or disables the Lisa skin. This provides for animations of power on, power off, floppies being inserted or ejected at the cost of a larger memory footprint. It is intended for machines with lots of memory and large displays.

Boot ROM speedup hacks: this option enables patches (also known as cheats in the emulator world) that speed up the boot ROM. Specifically they disable the long memory tests, checksums and other tests to provide a quicker startup. If you have the Dual Parallel port ROM, this option will skip the lengthy Power On Self test for this card.

The ports tab:

Preferences

config | ports | slot1 | slot2 | slot3 | print

Serial A:

○ NOTHING   ○ LOOPBACK
○ PIPE   ○ FILE
○ ImageWriter ● TELNETD

9300

Serial B:

○ NOTHING   ○ LOOPBACK
○ PIPE   ○ FILE
● ImageWriter ○ TELNETD

Parallel Port:

● ProFile   ○ ADMP   ○ Nothing

/Users/ray/macworks.dc42   browse

Apply

Serial Ports:

The ports tab allows you to configure LisaEm's connections. At the top are serial ports A, and B. These can be connected to nothing, a loopback plug, an OS pipe, a file, an ImageWriter printer, or on some systems (linux, or OS X) can run a telnet daemon.

The loopback plug connects both serial ports together. If you select this plug on either port, both will be connected.

For file, the file will be connected to either an actual file, which will be read, or to a device, such as /dev/ttya.

Pipe is used to run an external program using the popen call.

If you select the telnetd, provide a port number to listen to. For example 9300. The Lisa emulator will then listen on 127.0.0.1:9300. You can then telnet to this port from another terminal window on the same machine and communicate with LisaTerm or ZTerm for example.

The Imagewriter option allows you to connect a printer to one of the serial ports, using the settings from the printer tab.

The Parallel Port:

The Parallel Port is mainly used to attach a ProFile hard drive. It can also be used to attach an ADMP printer, however, it is preferable to attach an ImageWriter to a serial port if you do not have a dual parallel card ROM, otherwise to one of the ports on the dual parallel card.

You should select the Profile option, then click on the **browse** button to save the location for a profile drive, or to select an existing profile drive image.

The first time you power on the emulator you will be asked for the size of the profile drive to create. A 10M image is optimal.

Notes:

The hard drive format used by LisaEm is the same format as the Disk Copy 4.2, but with an interleave of 5 to match what Lisa Office System uses. Note that you will not be able to do anything with the virtual ProFile disk images in the actual Disk Copy program.

I reused the floppy drive code because it was a convenient storage format for disk images and it can also be used with lisafsh-tool.

Profile hard drive creation:

The first time you power on the emulator, if a specified virtual profile drive file does not exist, you will be asked what size drive to create. Note that only the 5MB and 10MB profiles will work with the Lisa Office System.

If you use any other size, only the first 5MB will be used, wasting the rest of the space.
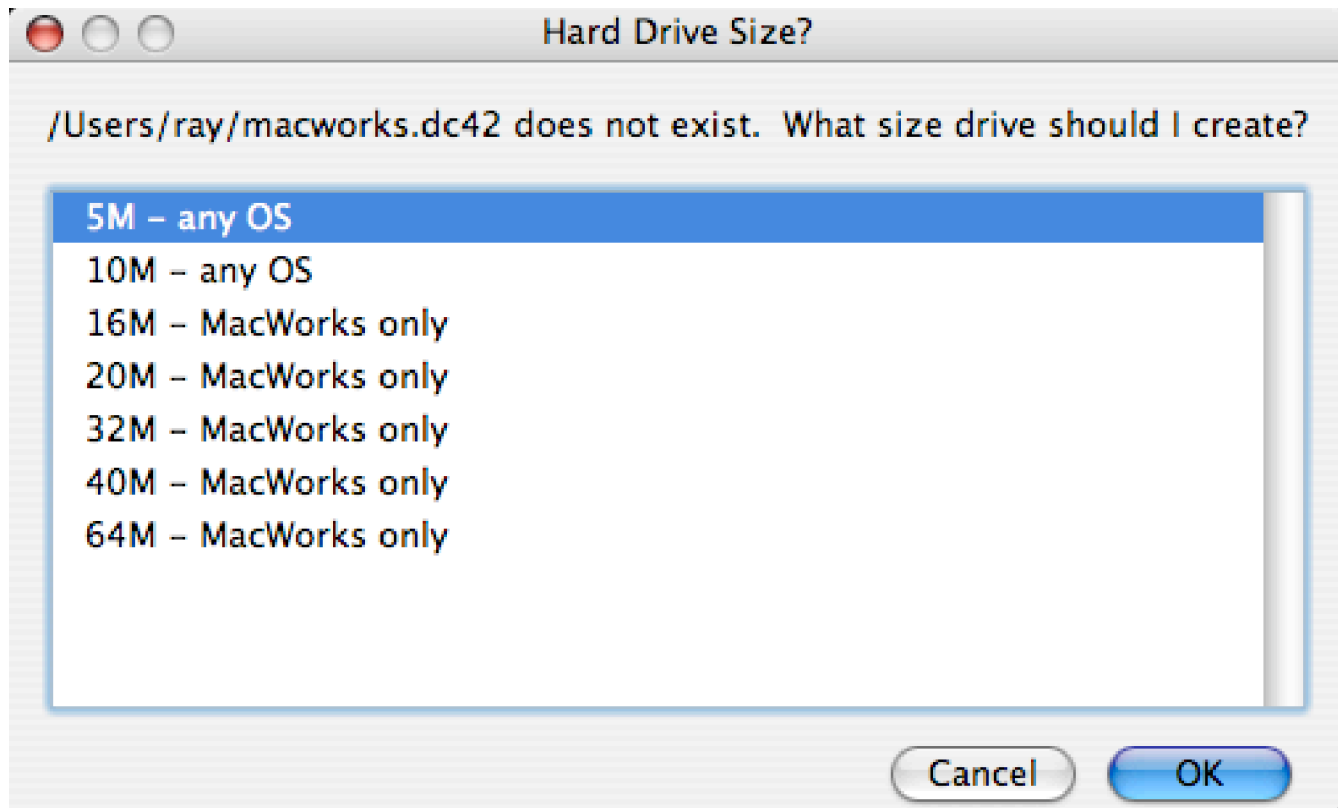
The newly created drive will not be bootable. Should you attempt to boot from it, the Lisa ROM will throw error #84, or #85:

You'll need to install a Lisa compatible operating system on the newly created virtual drive before you'll be able to boot from it.

The printer tab:

The printer tab in the Preferences dialog box allows you to set the ImageWriter/ADMP's DIP switches. The defaults for the Lisa are automatically selected:
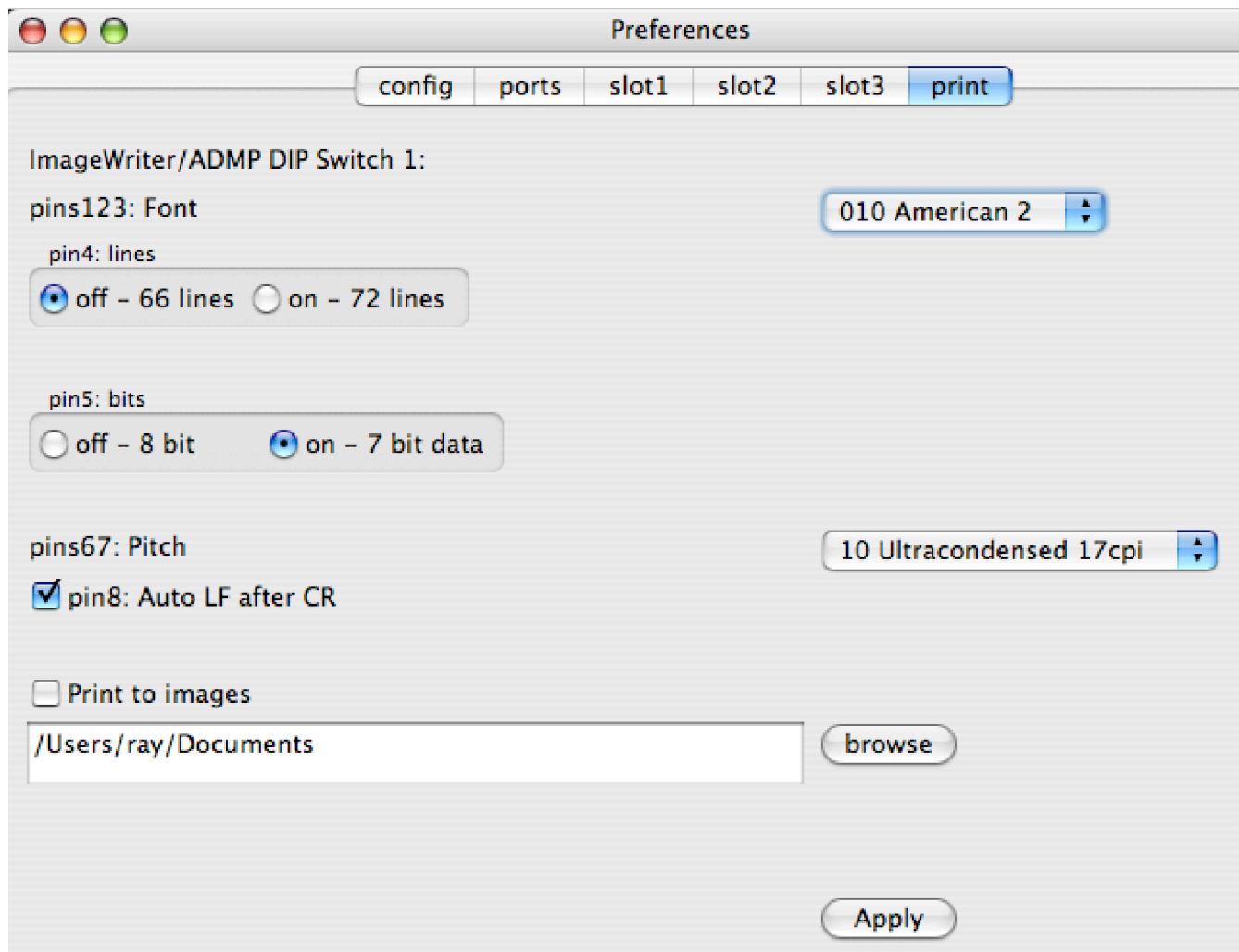
The Print to Images check box allows you to redirect printouts to image files. Depending on how wxWidgets or the availability of image libraries in your operating system these may be saved as PNG's, TIF's or BMP's. The text field allows you to chose a directory to save the printouts in. The **browse button** will allow you to select this directory. If the check box isn't selected, printouts will go to the host OS's printing system.

Printing is page oriented, so it is difficult for the emulator to tell apart one print job from another.

This may cause several printed documents to be batched together. For most systems this will be just fine, however if you are printing to a file on your host OS such as PostScript or PDF, you may have issues.

Because of this, there is a **Flush Printer jobs** menu item under the File menu. Use this option between print jobs to separate them.

Running the emulator for the first time

Once you have configured the emulator's preferences, you should press the **Apply** button to save your preferences. The Preferences dialog box will then be dismissed. If you forget this step and close the dialog box using the X button, you will lose your changes.

When you are ready, you can power on the virtual Lisa. There are several ways to do this.

You can use the File menu's run command, or the key menu's Power command.

If you are running with the skins enabled, you can press the power button located underneath the floppy drive. If your display isn't large enough, you will have to scroll around to see it.

The Lisa will then power on, and if your ROM file is good, it will go through the self tests. If the ROM file is bad, it may cause the emulator to crash.

You may see a hard drive error 84 or 85 since you are running with a blank profile hard drive. This is normal.

Inserting a micro-diskette:

If you wish to install the Lisa Office System, you should now insert the disk called "Lisa Office System 1/5" into the virtual floppy drive. You can do this using the File menu's Insert diskette command.   Continue following the instructions in the Installing Lisa Office System chapter.

If you are running with skins, you can simply click on the floppy drive.

A file selector dialog box will appear allowing you to browse to the Disk Copy 4.2 or DART image file.

Note that DART images will take longer to open. This is because they will be converted to Disk Copy 4.2 format since that is the emulator's preferred disk image format. Consequently you shouldn't place disk images on read only media such as CDROM's DVD-ROM's or file servers where you only have remote access.

DART image support is experimental and might not always work. It has worked with the disk images we have tried, both the fast RLE and the higher LZH compressed versions, but there are no guarantees that it will work with every image.

Always use Disk Copy 4.2 to image Lisa diskettes. Using newer versions will result in non-functional disk images as vital data called tags will be stripped off.

Tags were not used very often by Macintosh software so their use is deprecated, however the Lisa requires them in order to know that floppies are bootable.

Lisa Office System uses them to allow repairs to be made using a program called the scavenger.

Installing the Lisa Office System

Installing the Lisa Office System:

Once the Lisa self tests are done, you'll see the boot menu:
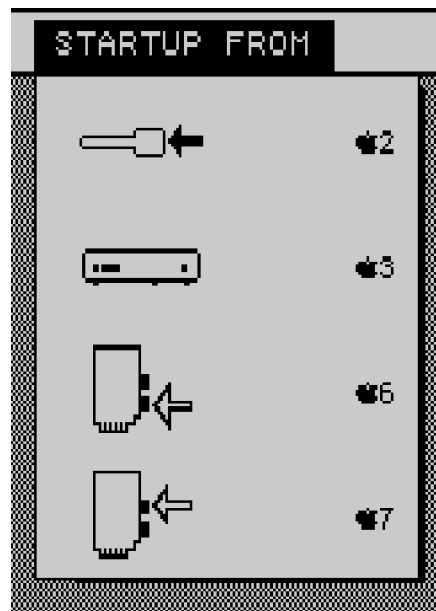
Insert the microdiskette labeled Lisa Office System 1, by using the **File** menu item named **Insert Diskette**. Alternatively, if you have skins enabled, click on the picture of the floppy drive.
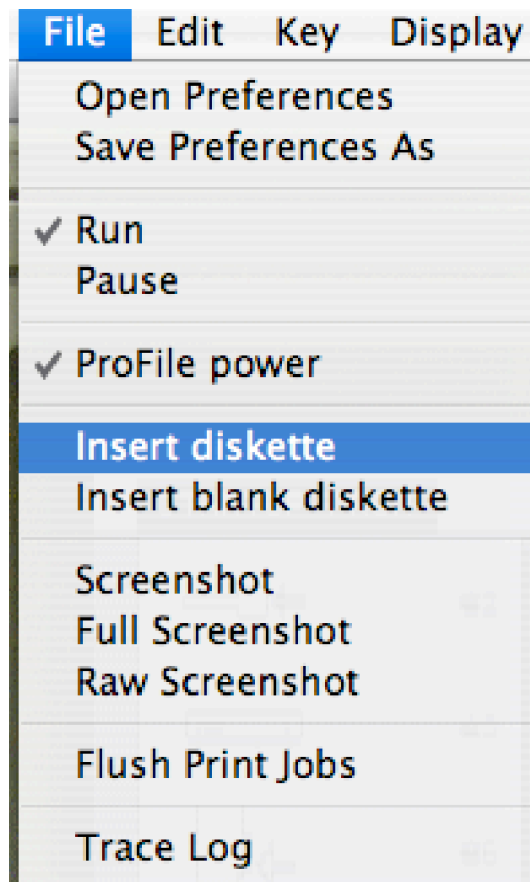
Select the Lisa Office System 1 of 5 disk image from the file picker dialog box.

You may need to pull down the Enable menu to select **All, Disk Copy 4.2,** or **DART** depending on the type and name of the disk images you have.   On some host OS's, such as Linux with GTK and some versions of OS X, you may have to click on a triangle button to get the dialog box to fully open.

	Insert a Lisa diskette	
	Enable: All (*.*)	
◀ ▶ ☰ ▥	ForEmulator	Q search

	Name ▲	Date Modified
🖥 umbra	Lisa Office System 3.1 1of5.dc42	8/20/04
⬤ Network	Lisa Office System 3.1 2of5.dc42	8/20/04
🗄 umbra	Lisa Office System 3.1 3of5.dc42	8/20/04
📀 sf0 ⏏	Lisa Office System 3.1 4of5.dc42	8/20/04
⬤ D$	Lisa Office System 3.1 5of5.dc42	12/21/03
💾 LisaEm-1.... ⏏	lica or images	0/16/04

Wait

Starting up from the disk.
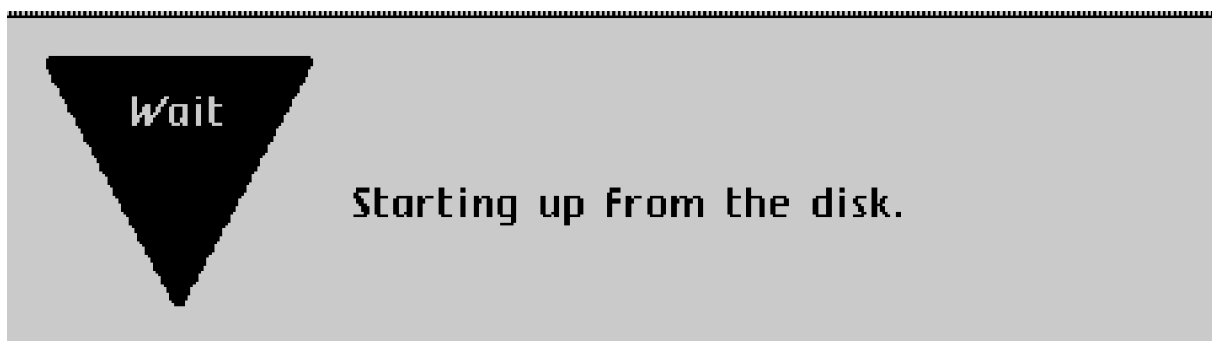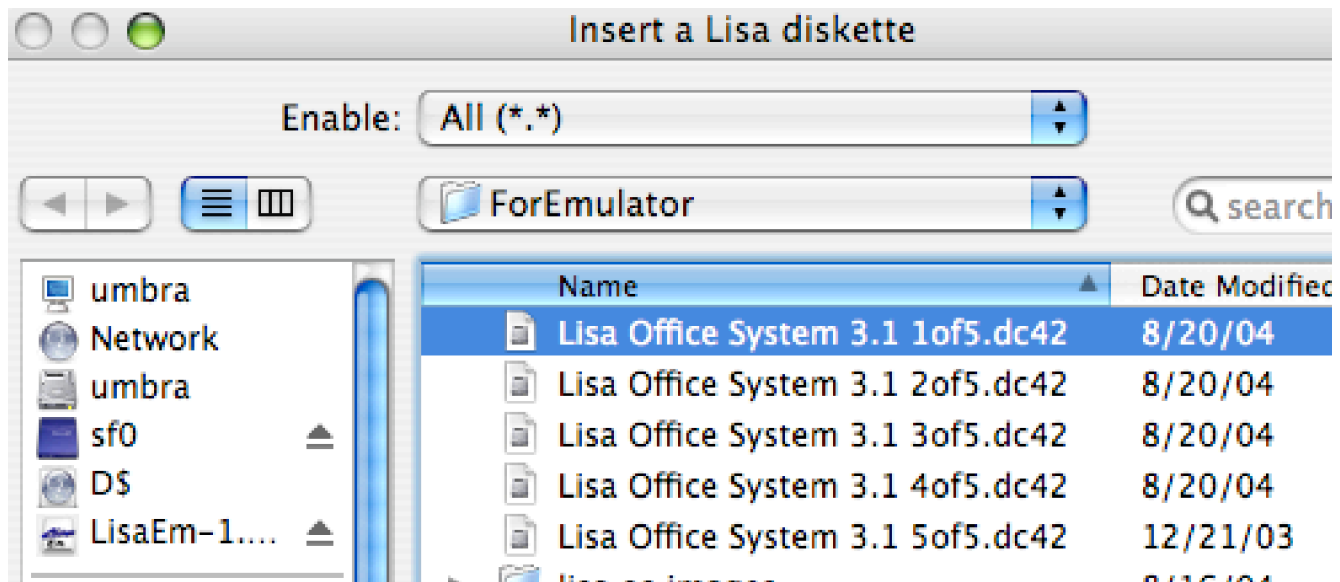
The LOS installation disk will now boot. In a few seconds you'll see the LOS splash screen.

Once the Lisa Office System installer has loaded, you'll see the installation menu:

```
                                                              ┌──────────┐
     ◆               Lisa  7/7                                │ Finished │
    ? ◆              Office System 3.0                        └──────────┘
   ◆                 ©1983, 1984 ⌘apple computer, inc.

                     This micro diskette is used to repair the Lisa
                     Office System startup disk and to install the     ┌────────┐
                     startup software.  The startup disk is currently  │ Repair │
                     not specified.                                    └────────┘

                     Click Finished if you are finished.

                     Click Repair to fix a damaged disk.               ███████████
                                                                       █ Install █
                                                                       ███████████
                     Click Install to put new startup software on the
                     disk.

                     Click Restore to restore the disk from backup     ┌─────────┐
                     diskettes or archive tapes.                       │ Restore │
                                                                       └─────────┘
```

Press the **Install** button at this screen to start the installation process.

```
                                                              ┌────────┐
     ◆               Do you want to use the disk attached to the       │ Cancel │
    ? ◆              parallel connector?                               └────────┘
   ◆
                     Click Cancel if you do not want to specify any    █████████
                     disk to use at this time.                         █  OK   █
                                                                       █████████
                     Click OK if you want to select this disk.

                                                                       ┌──────┐
                     Click More if you want to select a different disk.│ More │
                                                                       └──────┘
```
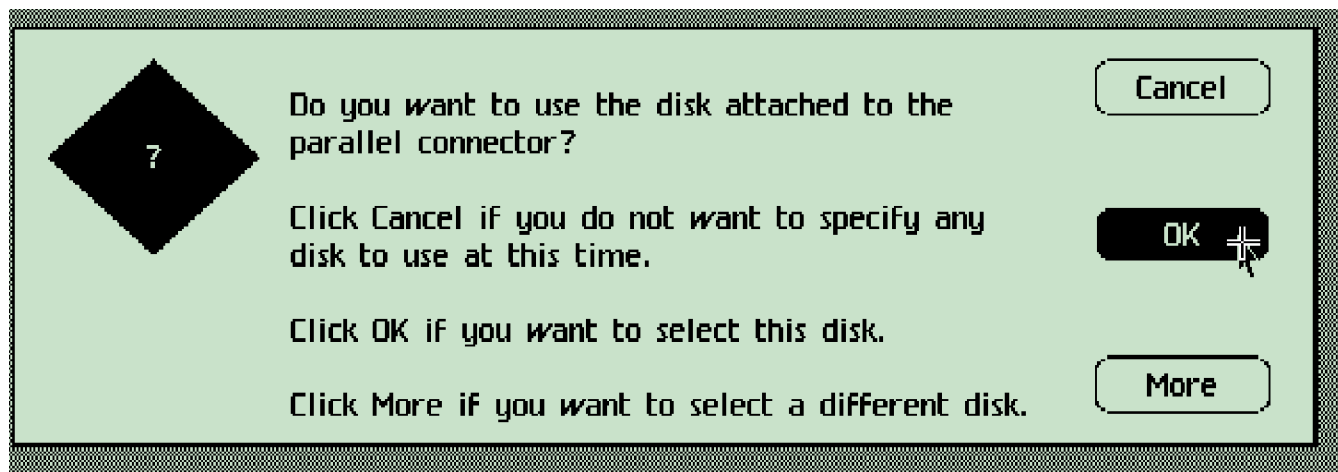
The Installer will now search for a ProFile hard drive to install The Lisa Office System onto. Ideally this should be the profile attached to the parallel port.

Press the **OK** button to allow the installer to use this Profile.

```
Do you wish to use part of the specified disk          [ Don't Share ]
with MacWorks?

Click Don't Share if you do not wish to split
the disk between the Lisa Office System and
MacWorks.

Click Share if you want to be able to use              (    Share    )
part of the disk with MacWorks.
```
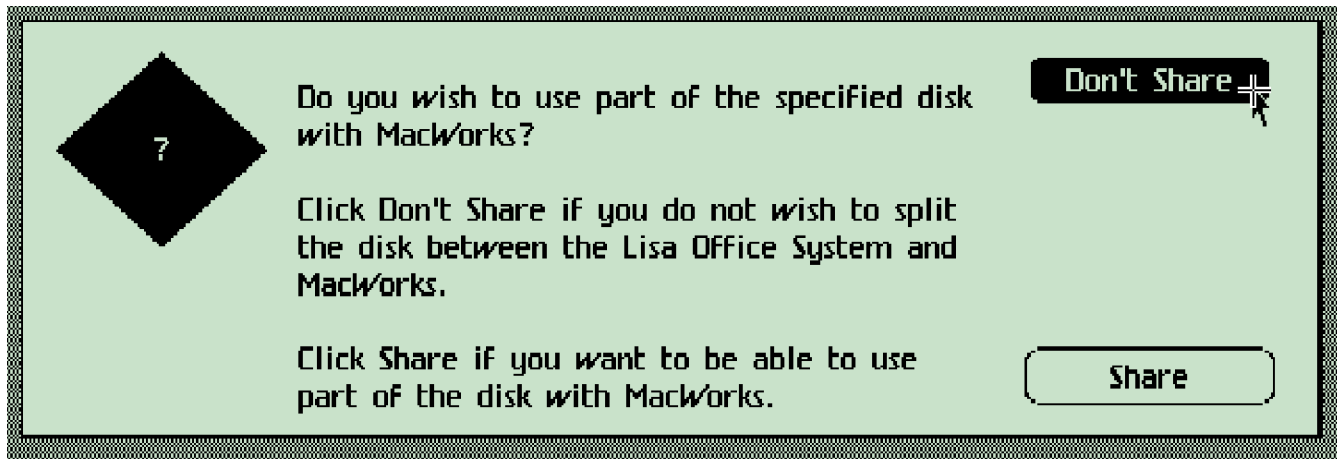
Click on the **Don't Share** button. If you would like to also use MacWorks, or another environment, you should create another Preferences file with its own profile drive instead.

Sharing the drive results in limited space, which will cause space issues on a 5MB profile, preventing Lisa Office System from functioning when all of the tools are installed.

```
Wait          The Lisa is erasing and initializing the disk.
```
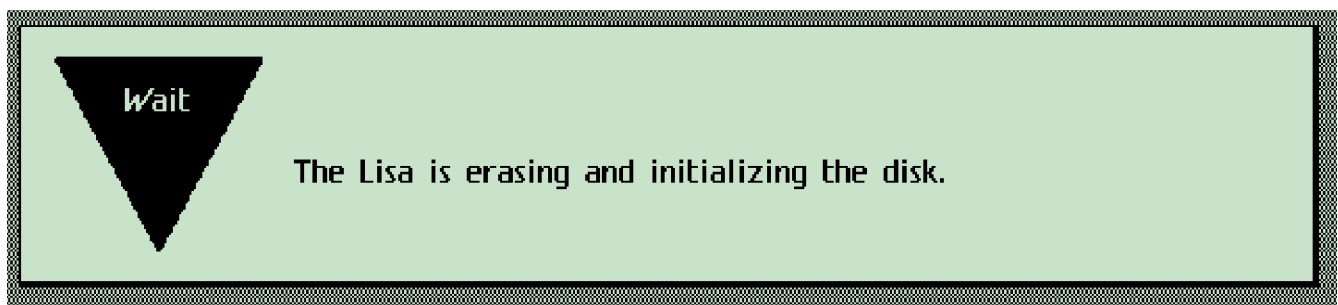
The installer will now erase the profile. If you had used a Profile disk image which had previous data, you would be asked to confirm if you are sure that you wish to erase the disk.
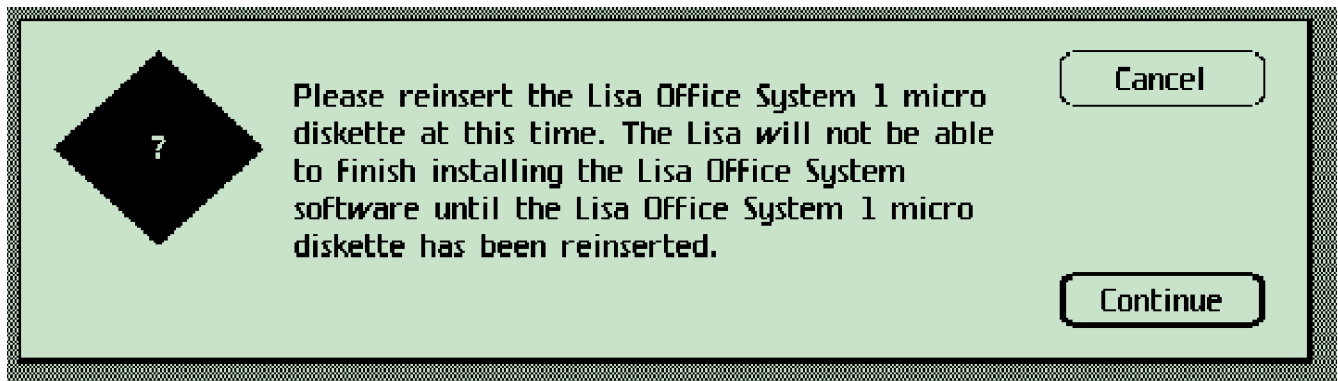
```
Wait          The Lisa is installing startup software version 3.0.
```
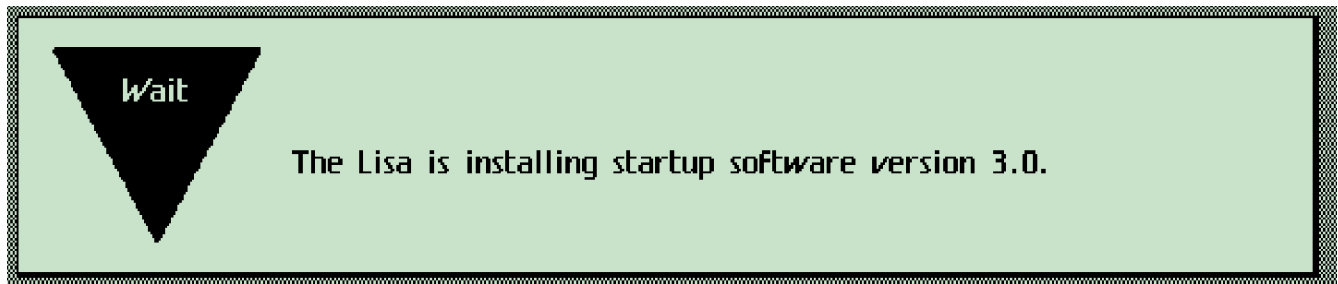
After a few minutes, the Lisa Installer will begin to copy itself to the ProFile hard drive.

```
┌─────────────────────────────────────────────────────────────┐
│                                          ┌─────────────┐      │
│    ◆◆◆◆                                   │   Cancel    │      │
│   ◆◆◆◆◆◆      Please insert the Lisa Office System 2 micro    │
│  ◆◆  7  ◆◆    diskette into the micro disk drive.            │
│   ◆◆◆◆◆◆                                                      │
│    ◆◆◆◆       Click Cancel to cancel installation.  ┌──────────┐ │
│                                          │  Continue  │      │
│                                          └──────────┘      │
└─────────────────────────────────────────────────────────────┘
```
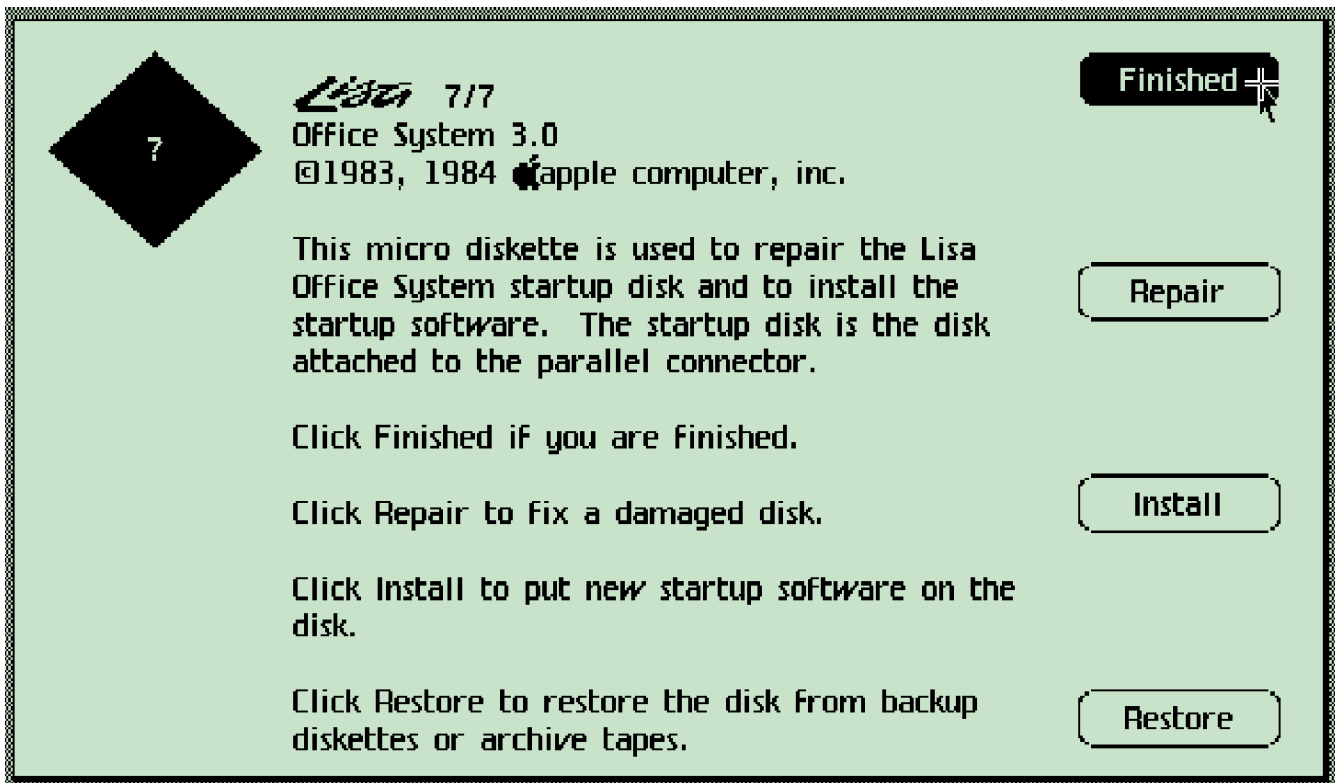
Once the disk is copied, the installer will then eject Lisa Office System 1/5 and ask for the next disk, disk 2. You do not have to press the **Continue** button as the installer will recognize that a floppy has been inserted and will be able to tell if it is the disk it wanted.

You'll repeat this process until LOS is fully installed.

```
┌─────────────────────────────────────────────────────────────┐
│                                          ┌─────────────┐      │
│    ◆◆◆◆         Please reinsert the Lisa Office System 1 micro │
│   ◆◆◆◆◆◆        diskette at this time. The Lisa will not be able │
│  ◆◆  7  ◆◆      to finish installing the Lisa Office System    │
│   ◆◆◆◆◆◆        software until the Lisa Office System 1 micro   │
│    ◆◆◆◆         diskette has been reinserted.                 │
│                                          ┌──────────┐       │
│                                          │  Continue  │       │
│                                          └──────────┘       │
└─────────────────────────────────────────────────────────────┘
```

At the end of the installation process, it will ask for the first disk again. You must insert the same disk image you first booted from in order to complete the install.   If you are given an option to deserialize Disk 1, say **No** at this time as this may cause the installation to fail.

Lisa 7/7
Office System 3.0
©1983, 1984 apple computer, inc.

This micro diskette is used to repair the Lisa
Office System startup disk and to install the
startup software. The startup disk is the disk
attached to the parallel connector.

Click Finished if you are finished.

Click Repair to fix a damaged disk.

Click Install to put new startup software on the
disk.

Click Restore to restore the disk from backup
diskettes or archive tapes.

| Finished |
| Repair |
| Install |
| Restore |

You'll soon be returned to the main menu. Since you're done installing, click on the **Finished**
button.

Should the Lisa turn off or start up from the
disk?

| Off |
| Start Up |
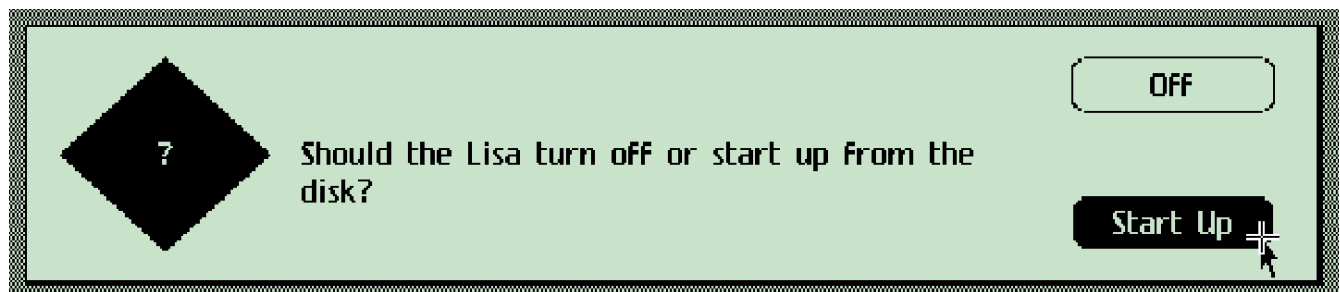
Select **Start Up** in order to boot from the freshly installed Lisa Office System on the profile.

Wait   Lisa 7/7

Office System   Release 3.1

©1983, 1984   apple computer, inc.

Lisa Office System has now been installed. If you are returned to the Power On boot menu,
click on the Profile icon. Lisa Office System will then boot.

Instaling the Lisa Office System Applications (also known as tools):

Once you see the Office System Desktop, you'll want to install some of the applications, which in Lisa speak are known as tools.

Next, insert one of the tool (Application) disketters such as LisaCalc. It's icon will show on the Lisa desktop.
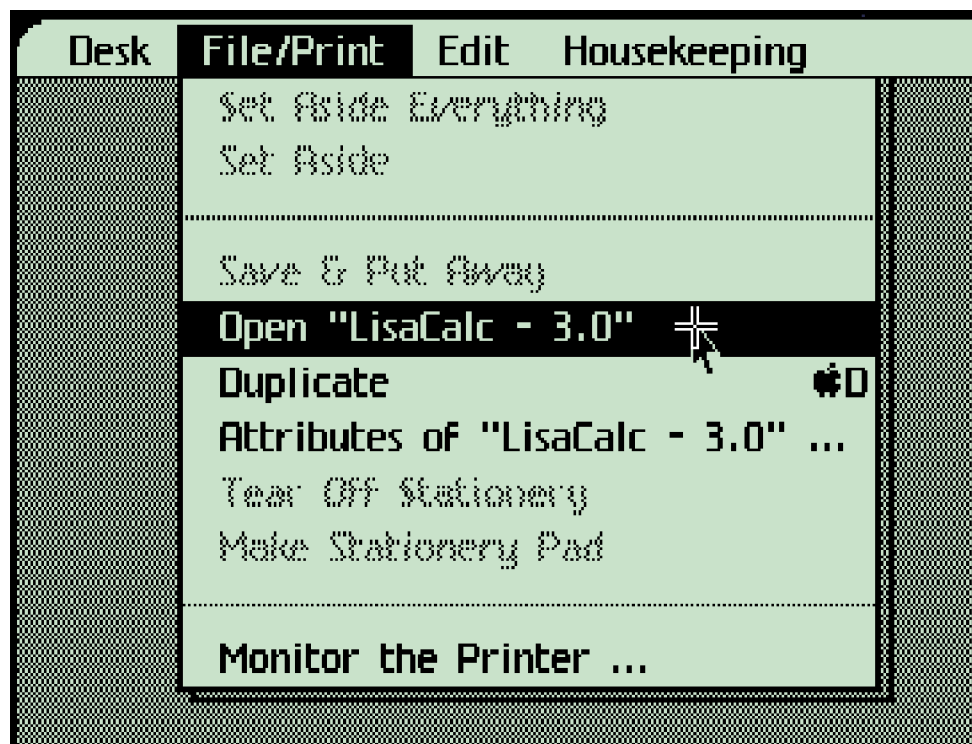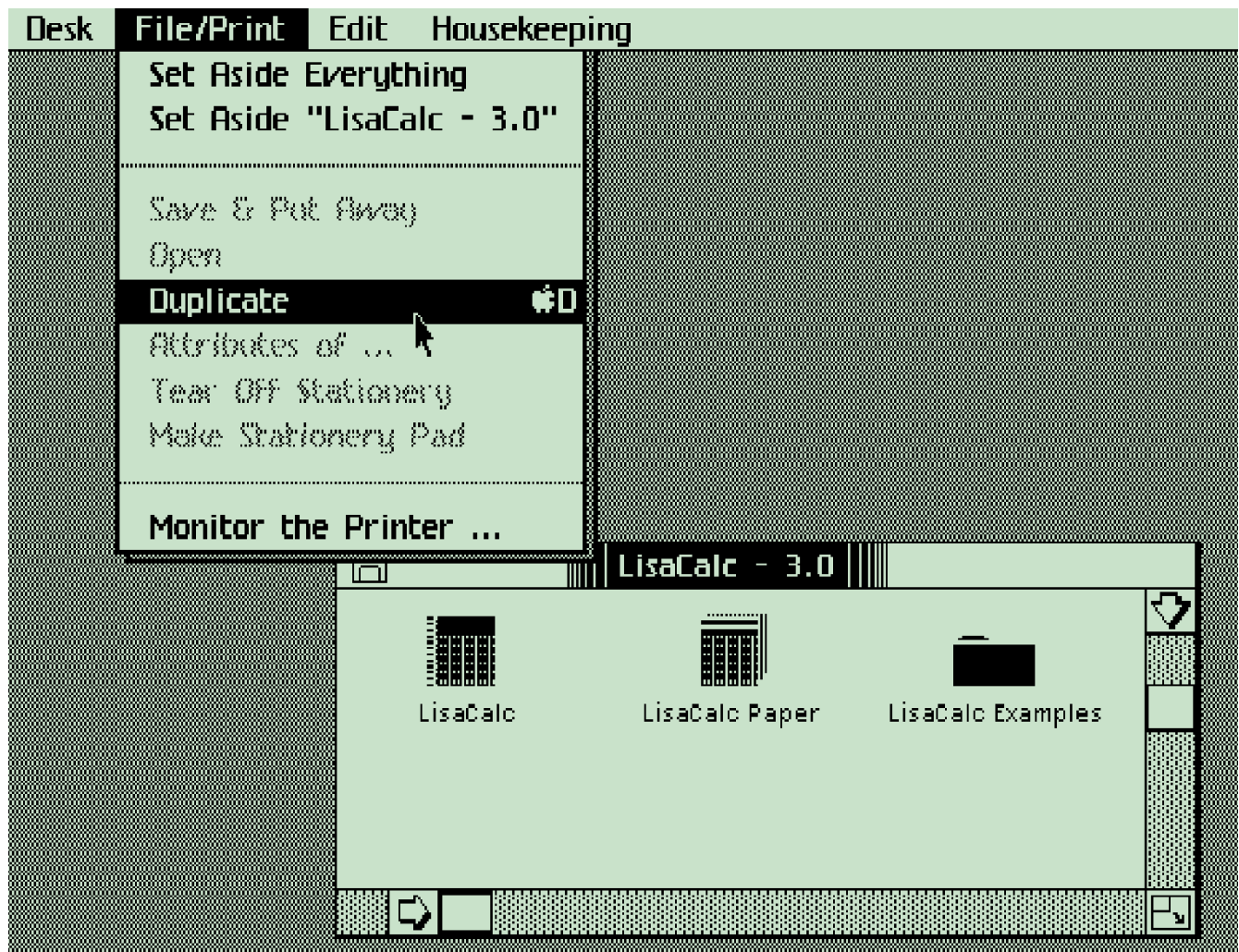

The disk will show up on the Lisa Office System desktop. Double click on it to open it, or use the **File/Print** menu **Open** option (inside the virtual Lisa)

With the Lisa Calc window open, pull down the Edit menu and select the "Select all Icons" item. (Alternatively, you could use the mouse to drag a square around the icons.)

This will highlight, the icons so that you can duplicate them to the virtual hard drive.

Desk **File/Print** Edit Housekeeping

Set Aside Everything
Set Aside "LisaCalc - 3.0"

Save & Put Away
Open
Duplicate   D
Attributes of ...
Tear Off Stationery
Make Stationery Pad

Monitor the Printer ...

LisaCalc - 3.0

LisaCalc   LisaCalc Paper   LisaCalc Examples

Do not drag the icons to the hard drive, as this will move them – that is erase them from the floppy once they're copied to the profile hard drive.
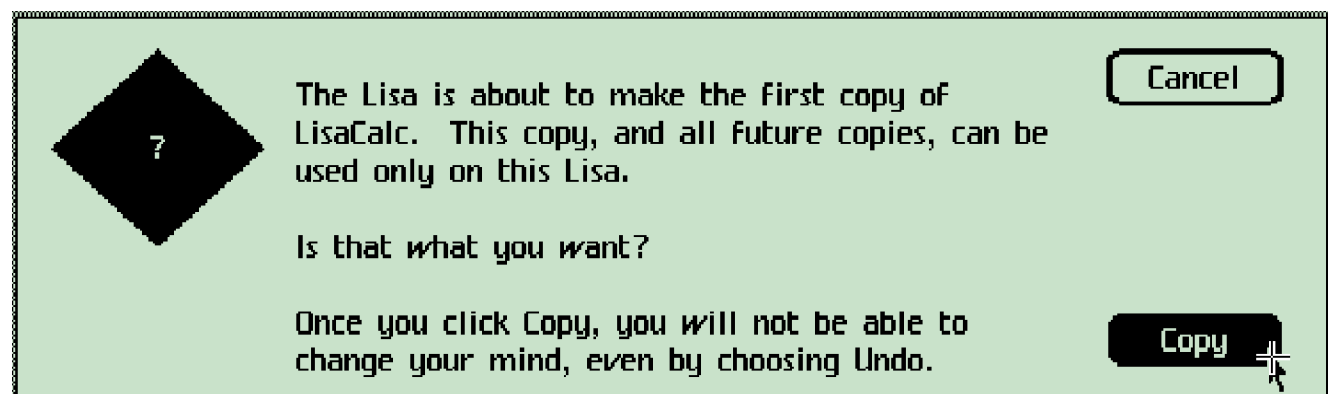
Instead, once the files are highlighted, pull down the **File/Print** menu and select the **Duplicate** item. The selected icons will form "blinking shadows" underneath them.
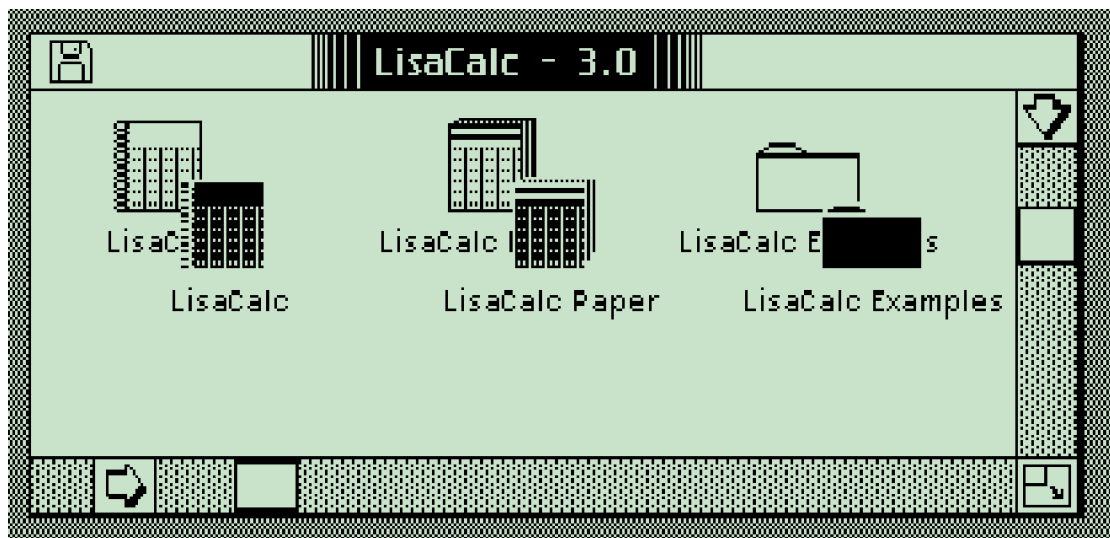
Drag these blinking "shadows" to the hard drive window or its icon, to start copying them.
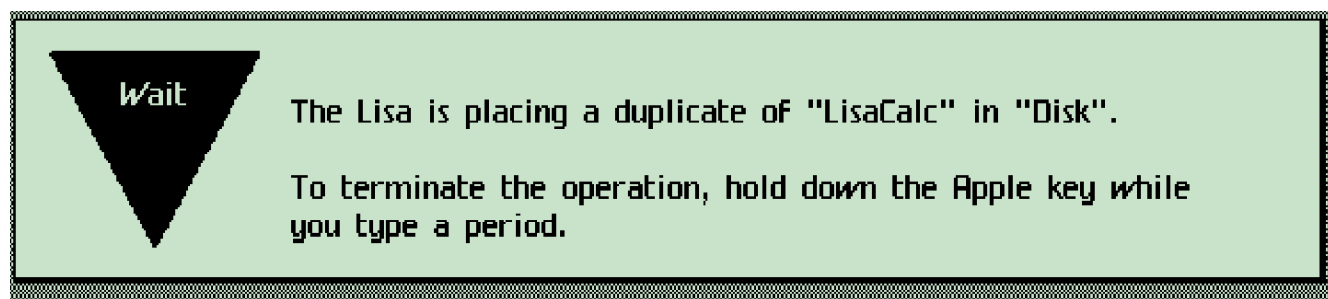
The Lisa desktop will now copy the files.

Note that Lisa tools are serialized: the first time they are used, the Lisa's serial number is written on them to prevent them from being installed on any other Lisa. You should have backup disk images made if you are using original Lisa disks before continuing.

You'll be asked if this is what you want. Press **Copy** to allow the tool to be installed.   The Lisa will write its serial number to the tool and copy it to the profile hard drive. Note that next time you insert this floppy LisaEm will offer the option to deserialize the tool. :-)

Housekeeping

Eject Micro Diskette ⌘E

Pictorial View
Alphabetical View
Chronological View
Straighten up Icons

Repair "Disk"
Erase "Disk"

Empty "Wastebasket"

Once the copy completes, you can eject the LisaCalc disk by pulling down the **Housekeeping** menu and selecting the **Eject Micro Diskette** option. Repeat the installation process with the remaining Lisa tools (applications.)

▼ Wait

The Lisa is reconstructing "American Dictionary" on "Disk".
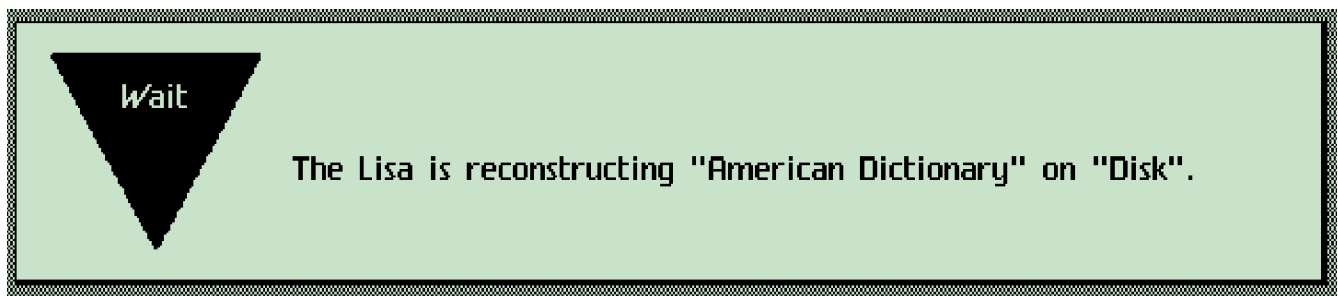
Note that LisaWrite's dictionary file is actually split across onto the second disk and lives on both disks. Don't try to copy it along with the other files, instead once LisaWrite and the examples are copied across, duplicate just the dictionary. You'll see this dialog box during the duplication.

```
┌─────────────────────────────────────────────────────────────────────┐
│                                                    ┌──────────┐       │
│         ▲                                          │  Cancel  │       │
│        ███         Please insert the next diskette into the micro     │
│       █████        diskette drive.                                    │
│      ███████                                       ┌──────────┐       │
│     █████████                                      │    OK   ↵│       │
│    Caution                                         └──────────┘       │
└─────────────────────────────────────────────────────────────────────┘
```

Once the first portion of the dictionary is copied, the diskette will eject, and you'll be prompted to insert the second diskette.

Once the copy is completed, you can eject the diskette.

NOTE: Be sure to press the **power** key before quitting the emulator so that you do not corrupt the file system on the virtual profile hard drive. You can do this by using the **Power** option under the **Key** menu, or if you have skins turned on, by clicking on the power button, which is located underneath the diskette drive, next to the keyboard jack. (Scroll the display downwards and to the right if your host machine's monitor cannot show the entire skin.)

Congratulations, you've successfully installed the Lisa Office System and Tools!

You can now party, like it's 1983. :-)

# Installing the
MacWorks XL
Environment

NOTE: The current version of LisaEm has bugs preventing the use of MacWorks! Presently, the 2007.01.28 Preview version of LisaEm is the only one that works with MacWorks!

MacWorks, MacWorks XL, MacWorks Plus aren't real emulators, but rather they are closer to a virtualization program that allow the Lisa to run early Mac OS software.

MacWorks consists of two diskettes. A boot diskette containing MacWorks itself, and a copy of the Macintosh Operating System.

The first thing to do if you've already installed the Lisa Office System is to save your preferences with a new name.   If you've already configured the Preferences for Lisa Office System, Save the current settings as "Lisa Office System.lisaem" so that you can return back to Lisa Office System later.

Next, save the preferences once more as "MacWorks.lisaem"   Next, go back to the Preferences dialog box, click on the ports tab and change the profile drive file name:
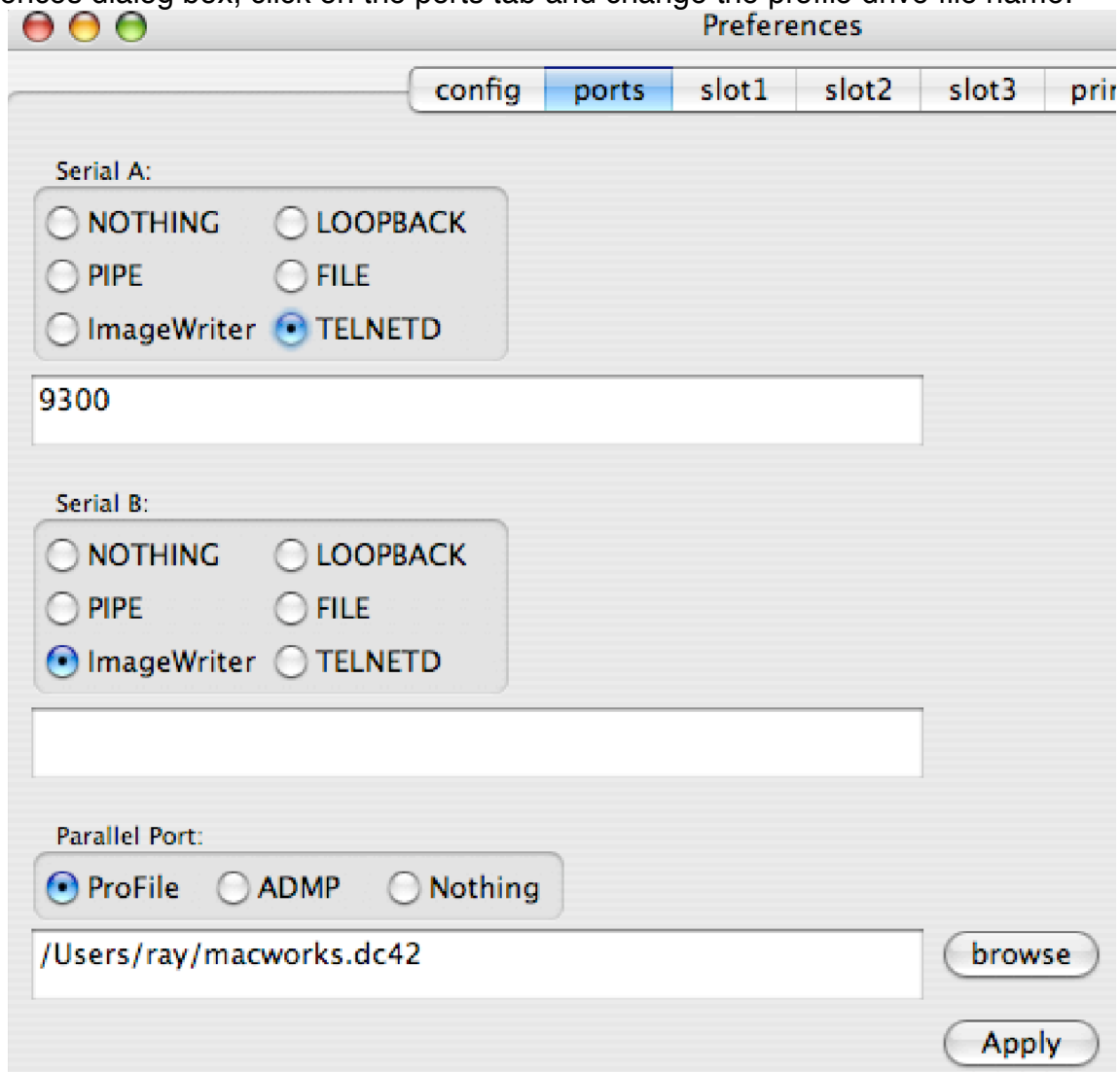
Once the name is changed, press **Apply**.   You're now ready to install MacWorks.

MacWorks is best viewed in the "Raw" display mode, since it will provide the square pixels needed by MacWorks. If you would like to experience the non-square pixels that the Lisa had without the screen modification kit, leave the Display setting to AntiAliased.

Once you power on the virtual Lisa, you will be prompted for the size of the profile drive you wish to create since this is a new drive. With MacWorks, you can chose any of the sizes presented.
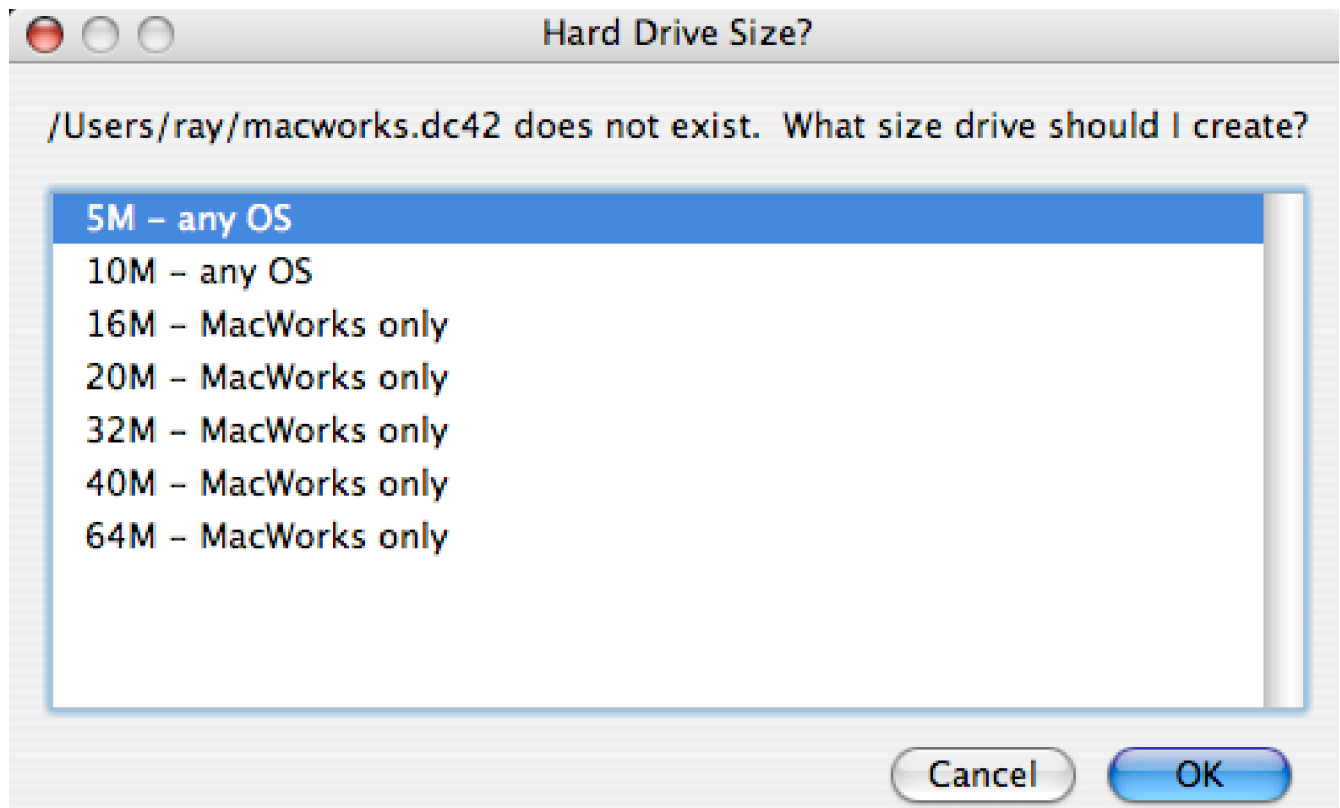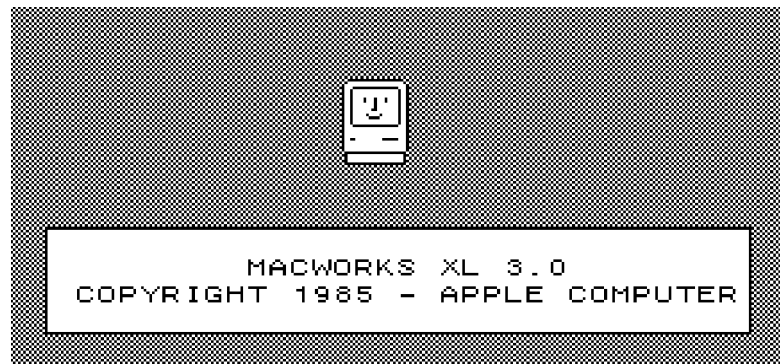

Once the Power On Self Test completes, you may see an error 84 because it is still a blank hard drive. Insert the disk image named "MacWorks XL"

In a few seconds, the display will clear, the floppy will be ejected and you'll see this:
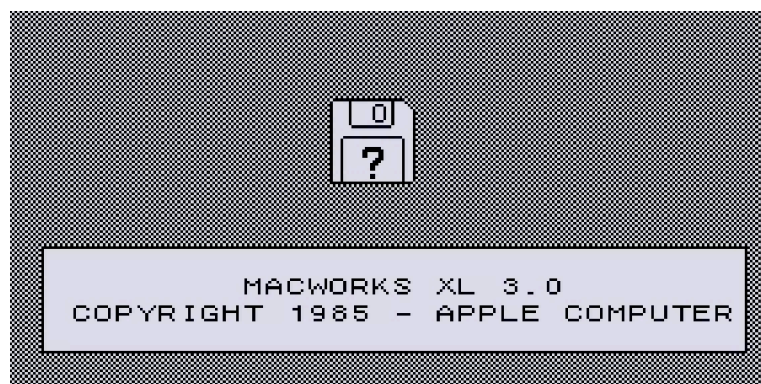
Insert the diskette image named "MacWorks System." This contains the Macintosh operating system.

```
                    MACWORKS XL 3.0
         COPYRIGHT 1985 - APPLE COMPUTER
```


Welcome to Macintosh.

```
                    MACWORKS XL 3.0
         COPYRIGHT 1985 - APPLE COMPUTER
```

You'll see the usual Happy Mac icon, followed by the MacWorks splash screen

MacWorks System Disk

352K in disk   48K available

Mover   Fonts   Hard Disk Install

Once it boots up, open up the MacWorks System Disk and run the application titled Hard Disk Install. Either double click on the icon, or use the **File** menu's **Open** item to launch it.

> This disk is unreadable, damaged or not
> a Macintosh disk: Do you want to erase
> it?
>
> [Erase]   [Cancel]

Since this is a fresh hard drive, HD Install will say its not readable. Click on the Erase button.
If you have Lisa Office System or Pascal Workshop installed, you'll be asked if you'd like to
share this disk instead.

> Initializing the hard disk. This will
> take about 1 minute(s) and 50
> seconds.
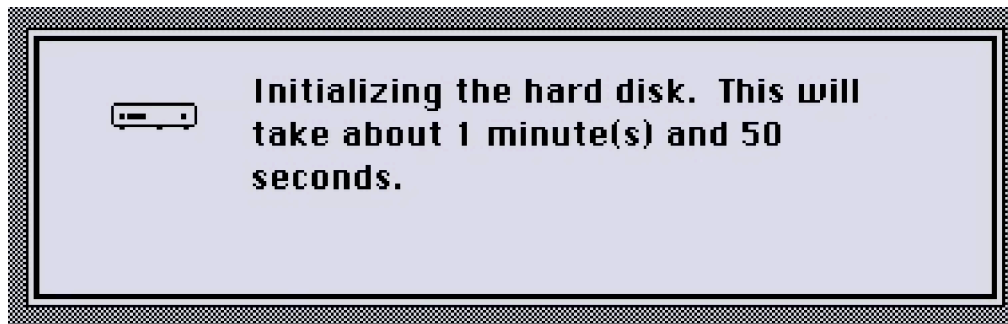
HD Install is now formatting the virtual Profile hard drive for MacWorks, by erasing all the
sectors on it, and installing the MFS file system.

> HardDisk Install will now copy an image of
> your MacWorks XL disk onto the hard disk.
> This is the first step in making a complete
> MacWorks XL hard disk.
>
> [OK]

When it is done erasing the disk, it will display the above dialog box. Press Ok to continue.

> **Please insert your MacWorks XL disk for installation on the hard disk.**
>
> [Cancel]
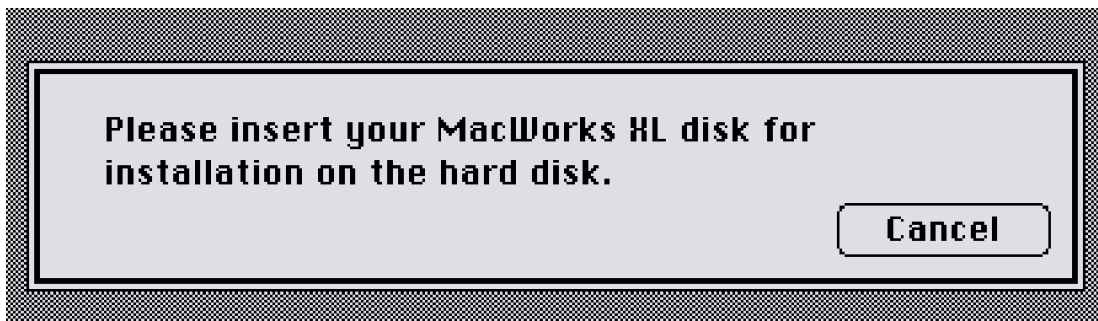
Next, Insert the MacWorks XL diskette when prompted.

> **Reading from the MacWorks XL disk . . .**

> **Transferring the MacWorks XL disk image to the hard disk . . .**

HD Install is now copying the MacWorks software to your profile hard drive.

> **Please insert the disk:**
>
> **MacWorks System Disk**
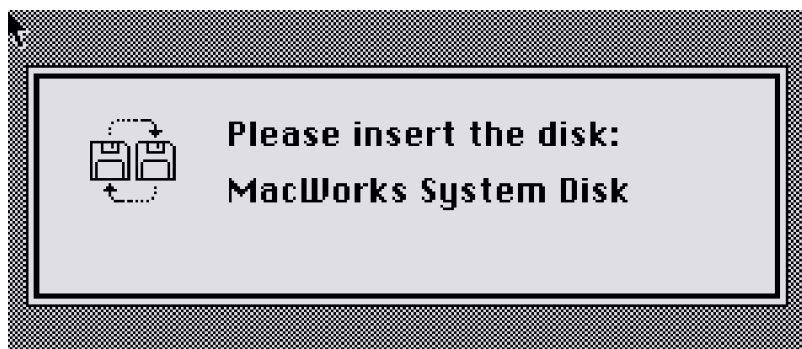
After the copy completes, the MacWorks XL disk will be ejected, and you'll then be prompted to re-insert the System diskette.

Please name this disk:

Hard Disk

OK

Next, name your profile hard drive. This is the name that will show up on the Desktop.

Hard Disk installation has been completed successfully. Before running an application program from the hard disk, copy the System Folder to the hard disk.

OK

IMPORTANT: The install is complete, but you must copy the system folder to the hard drive, otherwise attempting to boot from it will cause a Sad Mac error!

0F0064

System Folder   Parallel Printer Install

Hard Disk
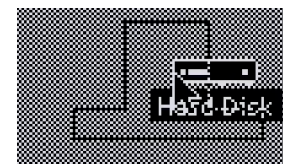
Use the mouse to drag System folder icon to the Profile hard drive. This will copy the System Folder to the hard drive, preventing the Sad Mac error!

The Finder is now copying the System Folder to the Profile hard drive.

Once it's done copying, you can use the **Special** menu item **Shutdown** to power off your virtual Lisa.

Whenever you want to boot up MacWorks, you'll still need to first boot from the MacWorks XL boot floppy, however, once loaded it will see that the ProFile has MacWorks installed and it will boot Mac OS from it from that point.
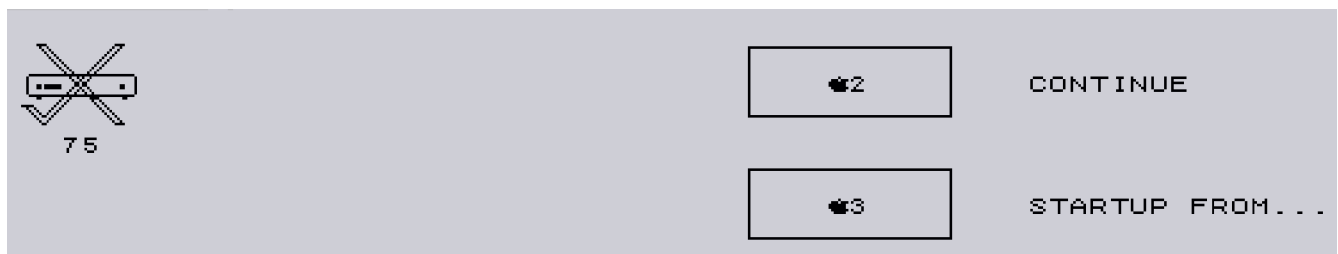
If you attempt to boot from the Profile directly, you'll get error #75.

Congratulations, MacWorks is now installed.

Managing Multiple LisaEm Preferences files

Managing multiple preferences files

The emulator allows you to manage multiple preferences files, each one representing a separate virtual Lisa. You can have a Lisa with the Lisa Office System, another with MacWorks, another with the Lisa Pascal Workshop and so on.

You should save the current preferences with a descriptive name indicating what was installed on the Lisa. i.e. "Lisa Office System.lisaem", "Lisa Pascal Workshop.lisaem", or "MacWorks XL 3.0.lisaem"

Then, when, you are ready to create a new virtual Lisa, save the preferences with a new name indicating the new configuration, and then change that configuration using the Preferences menu item.

Click Apply in the Preferences window to save your settings. You may then start installing the new environment

When you wish to switch configurations, use the **File** menu **Open Preferences** item to load a new preferences file. The settings will take effect when you power on the virtual Lisa.

If you are switching between preference files, you should only do so while the virtual Lisa is powered off.

In future versions, you will be able to double click on the preferences file to automatically load them at start up. (If you're running on Linux, or windows you can pass the preferences file name on the command line to LisaEm when launching, and it will open them for you.)

The idea here is that you can store the LisaEm preferences in either a folder, or on your desktop, then double click on whichever virtual Lisa you wish to work with.

The LisaEm Menus

The File Menu:
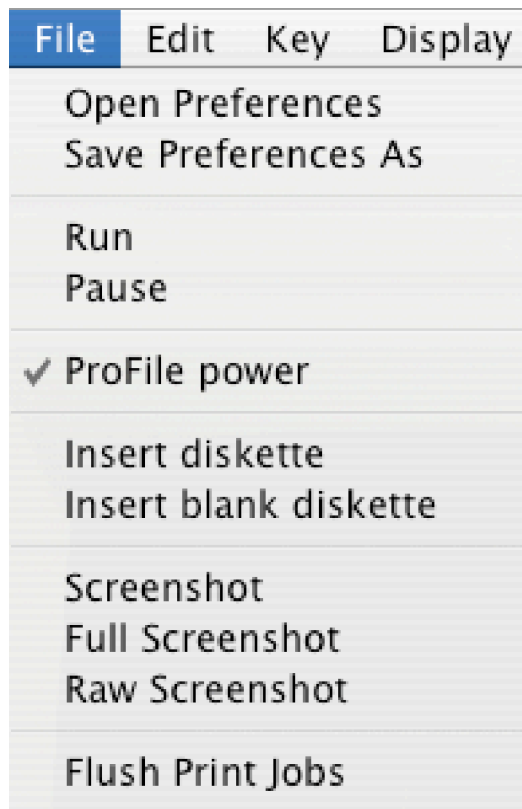
Open Preferences: Opens a preferences file

Save Preferences As: Saves the current preferences to a new file.

Preferences: Brings up the Preferences dialog. (Under LisaEm menu on OS X)

Run: Equivalent to the **Key** menu **Power** item. Used to turn the virtual Lisa on or off.

Pause: Pauses emulation

Profile Power: Allows you to temporarily disconnect all profile drives during the POST. Useful for booting off the Lisa Office System 1 diskette so you can repair the ProFile.

Insert diskette: Inserts a disk copy 4.2 or DART diskette image into the Lisa's floppy drive. DART images will be converted to Disk Copy 4.2 format, so the media that the DART image resides on must be writeable.

Insert blank diskette: Creates a blank Disk Copy 4.2 image, and then inserts it into the Lisa.

Screenshot: Save a screenshot of the display. Only the screen portion is saved. If you're using the AntiAliased or AntiAliased with gray replacement modes, you'll get exactly what the screen shows.

Full Screenshot: Same as screenshot, but will also include skins if they are turned on.
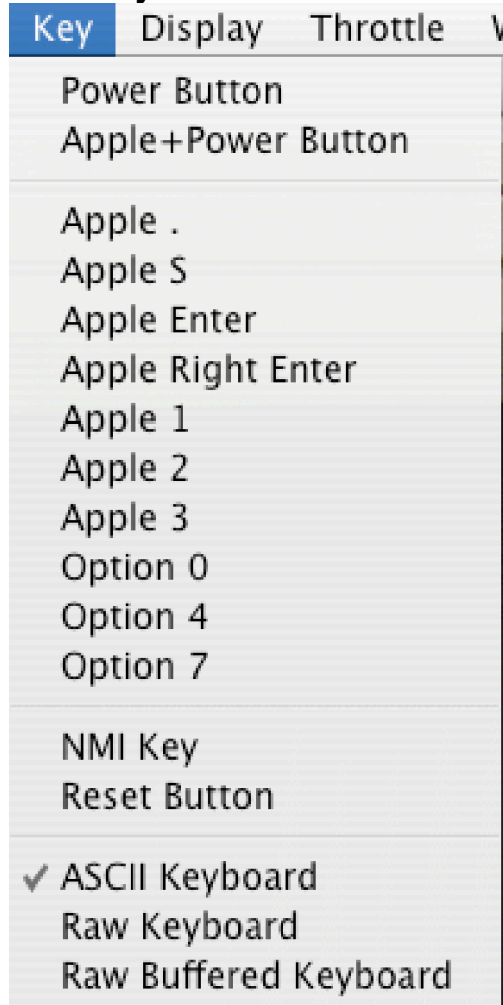
Raw Screenshot: This will take a raw screenshot, without the square pixel correction (same as in the raw display mode.)

The Edit Menu:

Edit Key

Paste

Paste: Paste the clipboard text into the emulator's keyboard.

The Key Menu:

Key Display Throttle V

Power Button
Apple+Power Button

Apple .
Apple S
Apple Enter
Apple Right Enter
Apple 1
Apple 2
Apple 3
Option 0
Option 4
Option 7

NMI Key
Reset Button

✓ ASCII Keyboard
Raw Keyboard
Raw Buffered Keyboard

Power Button: Pushes the power key. Equivalent to the **File** Menu **Run** command, or clicking on the skin's power button.

Apple {key}: Sends the Apple-key combination.

NMI Key: Sends a Non Maskable Interrupt key. This is used to enter LisaBug.

ASCII Keyboard: Does keystroke translation in ASCII between the host and the Lisa. Use this for normal operations.

Raw Keyboard: Directly maps keystrokes from the host computer to the Lisa.

Raw Buffered Keyboard: same as above, but, buffer keystrokes to prevent unwanted repeats when the CPU throttle is set to higher than 5MHz.

The Display Menu:
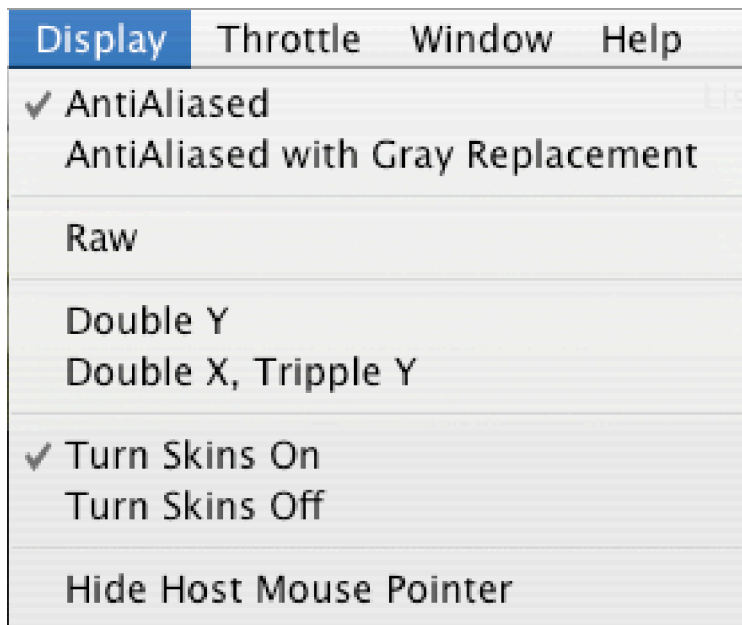
Anti Aliased: This is the normal mode you should use with the Lisa Office System. This corrects the square pixel issues and uses anti-aliasing to fix most artifacts.

Anti Aliased with Gray Replacement: As above, but attempts to replace the 50% desktop gray patterns with an actual gray color. The side effect is that some text will become fuzzy.

Raw: Uncorrected square pixel display. Will show an incorrect aspect ratio. This is the right mode to use with MacWorks.

Double Y: Same as Raw mode, only will double the vertical size.

Doube X, Tripple Y: This mode is for giant displays. It corrects the square pixel problem by stretching the display.

Note: Using the 3A ROM with LisaEm will also disable the raw, anti-aliased, anti-aliased with gray replacement display modes.
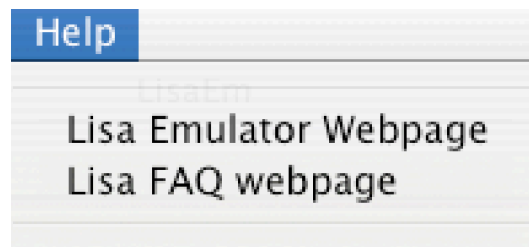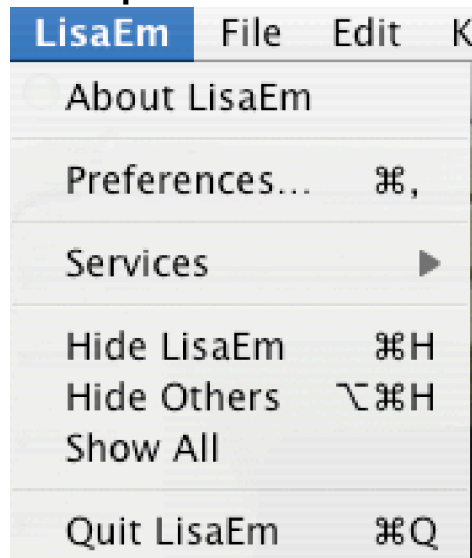
Turn Skins On/Off: Turns on the Lisa Skins. Skins On is the default, however, it should not be used with systems that are low on memory, nor with small displays.

The Throttle Menu:

This sets the throttle speed attempting to limit the emulator's CPU usage. Normaly at 5Mhz.

The Help Menu:

The help menu provides links to the LisaEm project webpage. Future versions will include a help browser.

On OS X, the LisaEm menu contains the **About LisaEm** item which tells you what version of LisaEm you're running. On other operating systems, this option is under the Help menu.

Contact and Support Information

Contact and Support Information:

http://lisaem.sunder.net This is the project's official web site. Please visit this site every two weeks, or every month to see if updated versions of the emulator are available.

http://lisafaq.sunder.net The Lisa Frequently Asked Questions site provides information about the Lisa computer. It is not specific to the emulator.

mailto://lisaem-bugs@sunder.net Please send bug reports to this address.
mailto://lisaem@sunder.net Please send questions about the emulator here.

The Lisa List Google Group:
http://groups.google.com/group/lisalist

The LisaList mailing list is run on GoogleGroups. This is not affiliated with the emulator project, however it is a forum for Lisa enthusiasts.

Credits

Credits:

My thanks go out to the following people:

David T. Craig for the wealth of Lisa information which he allowed me to scan in, for the many contacts with Lisa developers and faithfully listening to status reports over the ages.

James MacPhail for all of the hardware help with the Lisa and many suggestions as to what and how to test, for helping me with the logic analyzer, for the 68000 help, for the schematics help, for helping me repair my dead Lisa, for the help with the ProFile protocol, and many other things I could fill a book with.

Brian Foley for beta testing, profiling, and debugging help with OS X, and fixing nasty display bugs in wxWidgets on OS X, working on the new UI, providing an SVN server.

James Ponder for his wonderful Generator project, one of the better Sega Genesis emulators out there, whose CPU core is the very heart of the LisaEm project.

Adam Firester for providing the many years of bandwidth for the project website.

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The wxWidgets project, I wish I made use of a lot earlier, who have made my life a lot easier,

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Gilles Fetis for being the third person to use my dc42 routines, even though he is using ancient versions of them for his competing emulator.

To all of the folks who have wished for a Lisa emulator, whose requests and encouragement over the years pushed me to complete this project.

Most importantly, to all of the people at Apple, who worked on the Lisa over the years, and remember it fondly.

Thank you!