

*Demystifying the  
Geekier Side of Mac OS X*

**4th Edition**  
**Now Covers Leopard**



Mac OS X

*for* Unix Geeks

O'REILLY®

*Brian Jepson,  
Ernest E. Rothman  
& Rich Rosen*

## Mac OS X for Unix Geeks



If you're a developer or system administrator lured to Mac OS X because of its Unix roots, you'll quickly discover that performing Unix tasks on a Mac is different from what you're accustomed to. *Mac OS X for Unix Geeks*, Fourth Edition, serves as a bridge between Apple's Darwin OS and more traditional Unix systems. This clear, concise guide gives you a tour of Mac OS X's Unix shell in both Leopard and Tiger, and helps you find the facilities that replace or correspond to standard Unix utilities.

Learn how to perform common Unix tasks in Mac OS X, such as using Directory Services instead of the standard Unix `/etc/passwd` and `/etc/group`, and discover how to compile code, link to libraries, and port Unix software using either Leopard or Tiger. This book will help you:

- Navigate the Terminal and understand how it differs from an `xterm`
- Use Open Directory (LDAP) and NetInfo as well as Directory Services
- Compile your code with GCC 4
- Use Fink and MacPorts to install free and open source software
- Search through metadata with Spotlight's command-line utilities
- Use virtualization to run Linux on your Mac

*Mac OS X for Unix Geeks* is the ideal survival guide for taming the Unix side of Leopard and Tiger. If you're a Unix geek with an interest in Mac OS X, you'll find this book invaluable.

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“Mac OS X for Unix Geeks is an excellent resource for anyone with an interest in tapping into the power behind OS X, from geeks to firmly established command-line pros.”

—Chris Seibold,  
author of *Big Book  
of Apple Hacks*  
(O'Reilly)

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FOURTH EDITION

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# Mac OS X for Unix Geeks

*Brian Jepson, Ernest E. Rothman,  
and Rich Rosen*

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## **Mac OS X for Unix Geeks, Fourth Edition**

by Brian Jepson, Ernest E. Rothman, and Rich Rosen

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# Preface

Once upon a time, Unix came with only a few standard utilities. If you were lucky, it included a C compiler. When setting up a new Unix system, you'd have to crawl the Net looking for important software: Perl, *gcc*, *bison*, *flex*, *less*, Emacs, and other utilities and languages. That was a lot of software to download through a 28.8-Kbps modem. These days, Unix distributions come with many more features, and more and more users are gaining access to a wide-open pipe.

Free Linux distributions pack most of the GNU tools onto a CD-ROM, and now commercial Unix systems are catching up. Solaris comes with a companion CD of free software including a big selection of GNU utilities, and just about every flavor of Unix (including Mac OS X) now includes Perl. Mac OS X also comes with many tools, most of which are open source and complement the tools associated with Unix.

This book serves as a bridge for Unix developers and system administrators who've been lured to Mac OS X because of its Unix roots. When you first launch the Terminal application, you'll find yourself at home in a Unix shell. However, Apple's credo is "Think Different," and you'll soon find yourself doing things a little differently. Some of the standard Unix utilities you've grown accustomed to may not be there, */etc/passwd* and */etc/group* have been supplanted with something called Directory Services, and when it comes to developing applications, you'll find that things like library linking and compiling have a few new twists to them.

Despite all the beauty of Mac OS X's Aqua interface, you'll find that some things are different on the Unix side. But rest assured, the changes are easy to deal with if you know what to do. This book is your survival guide for taming the Unix side of Mac OS X.

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## Audience for This Book

This book is aimed at Unix developers—a category that includes programmers who have switched to Linux from a non-Unix platform—as well as web developers who spend most of their time in `~/public_html` over an `ssh` connection, and experienced Unix hackers. In catering to such a broad audience, we've chosen to include some material that advanced users might consider basic. However, this choice makes the book accessible to all Unix programmers who've switched to Mac OS X as their operating system of choice, whether they have been using Unix for 1 year or 10. If you are coming to Mac OS X with no Unix background, we suggest that you start with *Learning Unix for Mac OS X Tiger* by Dave Taylor (O'Reilly) to get up to speed with the basics.

## Organization of This Book

This book is divided into four parts. Part I helps you map your current Unix knowledge to the world of Mac OS X. Part II discusses compiling and linking applications. Part III takes you into the world of Fink and covers packaging. Part IV discusses using Mac OS X as a server and provides some basic system management information. Appendix A provides useful reference information. Here's a brief overview of what's in the book.

### Part I, Getting Around

This part of the book orients you to Mac OS X's unique way of expressing its Unix personality.

#### *Chapter 1, Inside the Terminal*

This chapter provides you with an overview of the Terminal application, including a discussion of the differences between the Terminal and the standard Unix `xterm`.

#### *Chapter 2, Searching and Metadata*

This chapter introduces Spotlight, a subsystem for searching your Mac. In this chapter, you'll learn how to access this powerful metadata store from the command line.

#### *Chapter 3, Files and Filesystems*

Here you'll learn about the layout of the Mac OS X filesystem, with descriptions of key directories and files.

#### *Chapter 4, Startup*

This chapter describes the Mac OS X boot process, from when the Apple icon first appears on your display to when the system is up and running.

*Chapter 5, Directory Services*

This chapter gets you started with Mac OS X's powerful Directory Services system, which replaces or complements the standard Unix flat files in the */etc* directory.

*Chapter 6, Printing*

This chapter explains how to set up a printer under Mac OS X and shows you around CUPS, the open source printing engine under Mac OS X's hood.

*Chapter 7, The X Window System and VNC*

In this chapter, you'll learn how to install and work with the X Window System and how to use both built-in Mac OS X and third-party tools for establishing VNC connections between Mac OS X and other Unix systems.

*Chapter 8, Third-Party Tools and Applications*

This chapter introduces some third-party applications that put a new spin on Unix features, such as SSH/SFTP frontends, T<sub>E</sub>X applications, the statistical package R, and multimedia-related applications.

*Chapter 9, Dual-Boot and Beyond*

Mac OS X isn't the only operating system you can run on your Mac. In this chapter, you'll learn how you can run many operating systems on your Mac, perhaps even two or three at a time.

## **Part II, Building Applications**

Although Apple's C compiler is based on the GNU Compiler Collection (GCC), there are important differences between compiling and linking on Mac OS X and on other platforms. This part of the book describes these differences.

*Chapter 10, Compiling Source Code*

This chapter describes the peculiarities of the Apple C compiler, including using macros that are specific to Mac OS X, working with precompiled headers, and configuring a source tree for Mac OS X.

*Chapter 11, Libraries, Headers, and Frameworks*

Here we discuss building libraries, linking, and miscellaneous porting issues you may encounter with Mac OS X.

## **Part III, Working with Packages**

There are several packaging options for software that you compile, as well as for software you obtain from third parties. This part of the book covers software packaging on Mac OS X.

### *Chapter 12, Fink*

In this chapter you'll learn all about Fink, a package management system and porting effort that brings many open source applications to Mac OS X.

### *Chapter 13, MacPorts*

MacPorts offers another way to install lots of open source software on your Mac. You'll learn all about it in this chapter.

### *Chapter 14, Creating and Distributing Installable Software*

This chapter describes the native package formats used by Mac OS X, as well as packaging options you can use to distribute applications.

## **Part IV, Serving and System Management**

This part of the book talks about using Mac OS X as a server and discusses system administration.

### *Chapter 15, Using Mac OS X As a Server*

In this chapter, you'll learn about setting up your Macintosh to act as a server, selectively letting traffic in (even through a Small Office/Home Office firewall such as the one found in the AirPort base station), setting up Postfix, and setting up and configuring MySQL and PostgreSQL.

### *Chapter 16, System Management Tools*

This chapter describes commands for monitoring system status and configuring the operating system.

### *Chapter 17, Other Programming Languages: Perl, Python, Ruby, and Java*

This chapter describes the versions of Perl, Python, Ruby, and Java that ship with Mac OS X, as well as optional modules that can make your experience much richer.

## **Appendix**

The appendix includes reference information that will be useful to newcomers.

### *Appendix A*

If you are totally new to Mac OS X, this appendix will get you up to speed with the basics of its user interface. It also introduces terminology that we use throughout the book.

## **Xcode Tools**

This book assumes that you have installed the Xcode tools, which include the latest version of Apple's port of *gcc*. If you bought a boxed version of Mac OS X Tiger or Leopard, you can find the installer for Xcode in the *Xcode* folder on

the same DVD that you used to install Mac OS X. Boxed versions of earlier releases of Mac OS X included Xcode on a separate CD-ROM. If you'd like to be absolutely sure that you have the latest versions of the tools, they are available to Apple Developer Connection (ADC) members at <http://connect.apple.com>.

## Where to Go for More Information

Although this book will get you started with the Unix underpinnings of Mac OS X, there are many online resources that can help you get a better understanding of Unix for Mac OS X:

### *Apple's Open Source mailing lists page*

This page leads to all the Apple-hosted Darwin mailing lists and includes links to list archives.

<http://developer.apple.com/darwin/mail.html>

### *The Darwin project*

Darwin is a complete Unix operating system for x86 and PowerPC processors. Mac OS X is based on the Darwin project. Spend some time at the project's web page to peek as deep under Mac OS X's hood as is possible.

<http://www.opensource.apple.com/darwinsource/>

### *Fink*

Fink is a collection of open source Unix software that has been ported to Mac OS X. It is based on the Debian package management system and includes utilities to easily mix precompiled binaries and software built from source. Fink also includes complete GNOME and KDE desktop distributions.

<http://fink.sourceforge.net>

### *MacPorts*

MacPorts (formerly known as DarwinPorts), a project of OpenDarwin, is an open source community-based project that provides a unified porting system for Darwin, Mac OS X, FreeBSD, and Linux. At the time of this writing, it includes thousands of ports, including the GNOME desktop system. The MacPorts project is hosted by Apple, Inc.

<http://www.macports.org>

### *MacOSXHints*

MacOSXHints presents a collection of reader-contributed tips, along with commentaries from people who have tried the tips. It includes an extensive array of Unix tips.

*<http://www.macosxhints.com>*

#### *Stepwise*

Before Mac OS X, Stepwise was the definitive destination for OpenStep and WebObjects programmers. Now Stepwise provides news, articles, and tutorials for Cocoa and WebObjects programmers.

*<http://www.stepwise.com>*

#### *VersionTracker*

VersionTracker keeps track of software releases for Mac OS X and other operating systems.

*<http://www.versiontracker.com>*

#### *MacUpdate*

MacUpdate also tracks software releases for Mac OS X.

*<http://www.macupdate.com>*

#### *FreshMeat's Mac OS X section*

FreshMeat catalogs and tracks the project history of thousands of applications (mostly open source).

*<http://osx.freshmeat.net>*

## Conventions Used in This Book

The following typographical conventions are used in this book:

#### *Italic*

Used to indicate new terms, URLs, filenames, file extensions, directories, commands and options, modules, and Unix utilities. For example, a path in the filesystem will appear in the text as */Applications/Utilities*.

#### **Constant width**

Used to show functions, variables, keys, attributes, the contents of files, or the output from commands.

#### **Constant width bold**

Used in examples to show commands or other text that should be typed literally by the user.

#### *Constant width italic*

Used in examples and commands to show text that should be replaced with user-supplied values, and to highlight comments in command output.

#### *Menus/Navigation*

Menus and their options are referred to in the text as File→Open, Edit→Copy, etc. Arrows are also used to signify a navigation path when



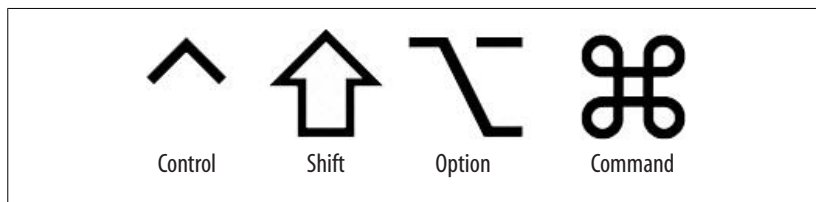


Figure P-1. These symbols, which appear in Mac OS X's menus, are used for issuing keyboard shortcuts so you can quickly work with an application without having to use the mouse

using window options; for example, System Preferences→Accounts→*username*→Password means that you should launch System Preferences, click the icon for the Accounts preference panel, select the appropriate username, and then click on the Password pane within that panel.

#### Pathnames

Pathnames are used to show the location of a file or application in the filesystem. Directories (or *folders* for Mac and Windows users) are separated by a forward slash. For example, if you're told to "...launch the Terminal application (*/Applications/Utilities*)," it means you can find the Terminal application in the *Utilities* subfolder of the *Applications* folder.

#### \$, #

The dollar sign (\$) is used in some examples to show the user prompt for the *bash* shell; the hash mark (#) is the prompt for the *root* user.

#### Menu symbols

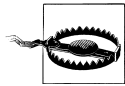
When looking at the menus for any application, you will see some symbols associated with keyboard shortcuts for particular commands. For example, to open a document in Microsoft Word, you could go to the File menu and select Open (File→Open), or you could issue the keyboard shortcut ⌘-O.

Figure P-1 shows the symbols used in the various menus to denote a keyboard shortcut.

Rarely will you see the Control symbol used as a menu command option; it's more often used in association with mouse-clicks to emulate a right-click on a two-button mouse or for working with the *bash* shell.



This icon signifies a tip, suggestion, or general note.



This icon indicates a warning or caution.

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## Acknowledgments from the Previous Editions

This book builds on the first edition of *Mac OS X for Unix Geeks*, for which we had help from a number of folks. Thanks to:

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## PART I

---

# Getting Around

This part of the book orients you to Mac OS X's unique way of expressing its Unix personality. You'll start out with a quick overview of the Terminal application—Mac OS X's Unix interface—and then go on to learn more about Spotlight and searching, the filesystem, startup processes, and more. You'll also see how to run Linux on your Mac, as well as how to run Mac OS X on x86 PCs.

Chapters in this part of the book include:

- Chapter 1, *Inside the Terminal*
- Chapter 2, *Searching and Metadata*
- Chapter 3, *Files and Filesystems*
- Chapter 4, *Startup*
- Chapter 5, *Directory Services*
- Chapter 6, *Printing*
- Chapter 7, *The X Window System and VNC*
- Chapter 8, *Third-Party Tools and Applications*
- Chapter 9, *Dual-Boot and Beyond*



# Inside the Terminal

The first order of business when exploring a new flavor of Unix is to find the command prompt. In Mac OS X, you won't find the command prompt in the Dock or on a Finder menu. Instead, you'll need to use the Terminal application, located in `/Applications/Utilities`. Inside the Terminal, Unix users will find a familiar command-line environment. In this chapter we'll describe the Terminal's capabilities, comparing them to the corresponding functionality of X11 terminal emulators such as *xterm* when appropriate. We'll also highlight key features of some alternatives to the Terminal. The chapter concludes with a synopsis of the *open* command, which you can use to launch native Mac OS X applications from the Terminal, and a quick look at a freeware application that allows you to open a Terminal window from a Finder window.

## Mac OS X Shells

Mac OS X comes with the Bourne Again SHell (*bash*) as the default user shell and also includes the TENEX C shell (*tcsh*), the Korn shell (*ksh*), and the Z shell (*zsh*). *bash*, *ksh*, and *zsh* are compatible with *sh*, the original Bourne shell. When *tcsh* is invoked through the *cs* link, it behaves much like *cs*. Similarly, `/bin/sh` is a hard link to *bash*, which also reverts to traditional behavior when invoked through this link (see the *bash* manpage for more information).

The version of *bash* that ships with Mac OS X is, according to its manpage, a conformant implementation of the Shell and Utilities portion of the IEEE POSIX Standard 1003.1 specification. Invoking *bash* with the `--posix` command-line option changes the default behavior of *bash* to comply with the POSIX 1003.1 standard in cases where the default behavior differs from this standard.



Apple promotes Mac OS X 10.5.x Leopard as an Open Brand UNIX 03 registered product, conforming to the SUSv3 and POSIX 1003.1 specifications for the C API, Shell Utilities, and Threads.

If you install additional shells, you should add them to the `/etc/shells` file. To change the Terminal's default shell, see "Customizing the Terminal" later in this chapter. To change a user's default shell (used for both the Terminal and remote console logins), see "Modifying a user" in Chapter 5.

## The Terminal and `xterm` Compared

There are several differences between Mac OS X's Terminal application and the `xterm` and `xterm`-like applications common to Unix systems running the X Window System:

- You cannot customize the characteristics of the Terminal with command-line switches such as `-fn`, `-fg`, and `-bg`. Instead, you must use the Terminal Inspector or the Terminal Preferences.
- Unlike `xterm`, in which each window corresponds to a separate process, a single master process controls the Terminal. However, each shell session is run as a separate child process of the Terminal. You can force a separate instance of some applications, including Terminal, by using the `open` command with the `-n` and `-a` switches, as described later in this chapter.
- A selection made in the Terminal is not automatically put into the clipboard. You use `⌘-C` to copy and `⌘-V` to paste. Even before you press `⌘-C`, the selected text is contained in a location called the *pasteboard*. One similarity between the Terminal and `xterm` is that selected text can be pasted in the same window with the middle button of a three-button mouse (or with `Shift-⌘-V`). If you want to paste selected text into another window, you must drag and drop it with the mouse or use copy and paste. The operations described in "The Services Menu," later in this chapter, also use the pasteboard.
- The value of `$TERM` is `xterm-color` when running under Terminal (it's set to `xterm` under `xterm` by default).
- Pressing Page Up or Page Down scrolls the Terminal window, rather than letting the running program handle it. Use Shift-Page Up or Shift-Page Down if you want a character-mode program to receive those keystrokes.



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