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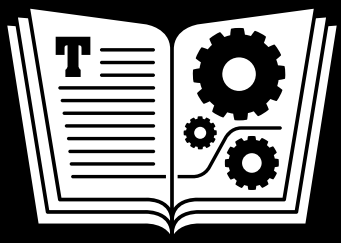

TAKE CONTROL OF

THE MAC COMMAND LINE WITH TERMINAL

by JOE KISSELL

$15

2ND EDITION

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Read Me First

Welcome to *Take Control of the Mac Command Line with Terminal, Second Edition,* version 2.1, published in January 2016 by TidBITS Publishing Inc. This book was written by Joe Kissell and edited by Geoff Duncan.

This book introduces you to Mac OS X's command line environment, teaching you how to use the Terminal utility to accomplish useful, interesting tasks that are either difficult or impossible to perform in the graphical interface. Most of the examples work with Mac OS X 10.6 Snow Leopard and later, although many also apply to earlier versions of Mac OS X. A few techniques require 10.9 Mavericks or later.

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Basics

To review background information that might help you understand this book better, such as finding System Preferences and working with files in the Finder, read Tonya Engst's free *Read Me First: A Take Control Crash Course*.

In addition, please be aware of the following special considerations:

- **Spurious hyphens!** When you view this ebook in EPUB or Mobipocket format, your ebook reader (such as iBooks or Kindle) may insert extra hyphens in the longer lines of text that are provided as examples of what to type on the command line. You can mitigate this problem by viewing the text in a single column, with a smaller font, and in a landscape position. In some cases, you can turn off autohyphenation to remove these spurious hyphens. For example, if you are reading in iBooks in iOS, you can go to the Settings app, select iBooks, and then turn off the Auto-hyphenation switch. However, with autohyphenation off, iBooks may now cut off some wider lines of command-line text.

  If you are reading this ebook to absorb the material conceptually, this won't be a problem, but if you want to type the commands on your Mac, consider downloading the PDF of this ebook onto your Mac, in order to read it there. As a bonus, you can copy the command-line text out of the PDF and paste it on the command line. Read Ebook Extras for help with downloading the PDF.

- **Entering commands:** I frequently tell you to "enter" a command in a Terminal window. This means you should type the command and then press Return or Enter. Typing a command without pressing Return or Enter afterward has no effect.

- **Getting commands into Terminal:** When you see commands that are to be entered into a Terminal window, you can type them manually. If you're reading this on a Mac, you can copy the command from the ebook and paste it into Terminal (which is handy, especially for longer and more complex commands).

Whichever method you use, keep these tips in mind:

- *When typing:* Every character counts, so watch carefully. The font that represents text you should type is *monospaced,* meaning every character has the same width. So, if it looks like there's a space between two characters, there is—and you should type it. Similarly, be sure to type all punctuation—such as hyphens and quotation marks—exactly as it appears in the book, even if it seems odd. If you type the wrong thing, the command probably won't work. (In the EPUB or Mobipocket version of this book, the font shown might not be monospaced. Also, be sure to *read the first item in this list,* to avoid entering unnecessary hyphens.)
- *When copying and pasting:* If you select a line of text to copy and paste into Terminal, be sure that your selection begins with the first character and ends with the last. If you accidentally leave out characters, the command probably won't work, and if you select too much (for example, extending your selection to the next line), you may see unexpected results, such as the command executing before you're ready.

What's New in Version 2.1

Version 2.1 is a minor update that does the following:

- Makes a few tiny updates to cover OS X 10.11 El Capitan
- Explains how the sudo command functions differently starting with El Capitan; see Perform Actions as the Root User
- Updates the number of packages available in Fink and Homebrew
- Adds a note about a key  icon that appears at password prompts; see Interactive Programs
- Updates the instructions to Flush Your DNS Cache in 10.10.4 Yosemite and later
- Mentions the removal of Secure Empty Trash in El Capitan, as well as how to clear the system and user "immutable" flags; see Delete Stubborn Items from the Trash

What Was New in the Second Edition

This revised and expanded second edition brought the book up to date with OS X 10.10 Yosemite (while maintaining compatibility all the way back to 10.6 Snow Leopard) and added material that's more advanced than what was in the first edition, enabling you to go further, do more in Terminal, and enhance your command-line skills.

The most significant changes included:

- Added new sidebars about Using a Mouse in Terminal (in the chapter Get to Know (and Customize) Terminal) and Finding Text in the Terminal Window (in the chapter Look Around)
- In the chapter Work with Files and Directories, added a new topic, Use Symbolic Links, and sidebars about Running Multiple Programs on One Line and Running Shell Scripts outside the Shell
- Included a fun tip about using emoji in your prompt, in Change Your Prompt
- Expanded the discussion of how to Open the Current Folder in Terminal to include the use of services in Mavericks and later
- In the Log In to Another Computer chapter, added a topic about how to Transfer Files with sftp or scp
- Renamed the chapter formerly called "Venture a Little Deeper" to Work with Permissions, which is more accurate and descriptive, and added a topic called Use the chmod Absolute Mode
- Added two new chapters for more-advanced readers: Learn Advanced Techniques, which covers piping and redirecting, grep, and adding logic to shell scripts; and Install New Software, which discusses Command Line Tools for Xcode, downloading and installing Unix software from scratch, and using package managers such as Homebrew and MacPorts
- In the Command-Line Recipes chapter, removed 6 recipes that no longer function in OS X and added 18 new ones (for a net gain of 12)
- Expanded several of the existing recipes with more details

Introduction

Back when I began using computers, in the early 1980s, user interfaces were pretty primitive. A computer usually came with only a keyboard for input—mice were a novelty that hadn't caught on yet. To get your computer to do something, you typed a command, waited for some result, and then typed another command. There simply was no concept of pointing and clicking to make things happen.

When I finally switched from DOS to the Mac (without ever going through a Windows phase, I should mention!), I was thrilled that I could do my work without having to memorize lists of commands, consult manuals constantly, or guess at how to accomplish something. Everything was right there on the screen, just a click away. It was simpler—not in the sense of being less powerful, but in the sense of requiring less effort to access the same amount of power. Like most everyone else, I fell instantly in love with graphical interfaces.

Fast forward a couple of decades, and I find myself faced with some mundane task, such as deleting a file that refuses to disappear from the Trash or changing an obscure system preference. After wasting time puzzling over how to accomplish my task—and perhaps doing some Web searches—I discover that Mac OS X's graphical interface does not, in fact, offer any built-in way to do what I want. So I have to hunt on the Internet for an application that seems to do what I want, download it, install it, and run it (and perhaps pay for it, too), all so that I can accomplish a task with my mouse that would have taken me 5 seconds in DOS 30 years ago.

That's not simple.

I'm a Mac user because I don't have time to waste. I don't want my computer to put barriers between me and my work. I want easier ways to do things instead of harder ways. Ironically, Mac OS X's beautiful graphical interface, with all its menus, icons, and buttons, doesn't always provide the easiest way to do something, and in some cases

it doesn't even provide a hard way. The cost of elegance and simplicity is sometimes a lack of flexibility.

Luckily, Mac OS X isn't restricted to the graphical realm of windows and icons. It has another whole interface that lets you accomplish many tasks that would otherwise be difficult, or even impossible. This other way of using Mac OS X looks strikingly like those DOS screens from the 1980s: it's a command-line interface, in which input is done with the keyboard, and the output is sent to the screen in plain text.

The usual way of getting to this alternative interface (though there are others) is to use a program called Terminal, located in the Utilities folder inside your Applications folder. It's a simple program that doesn't appear to do much at first glance—it displays a window with a little bit of text in it. But Terminal is in fact the gateway to vast power.

If you read TidBITS, Take Control books, Macworld, or any of the numerous other Mac publications, you've undoubtedly seen tips from time to time that begin, "Open Terminal and type in the following…". Many Mac users find that sort of thing intimidating. What do I click on? How do I find my way around? How do I stop something I've started? Without the visual cues of a graphical interface, lots of people get stuck staring at that blank window.

If you're one of those people, this book is for you. It's also for people who know a little bit about the command line but don't fully understand what they can do, how to get around, and how to stay out of trouble. By the time you're finished reading this book and trying out the examples I give, you should be comfortable interacting with your Mac by way of the command line, ready to confidently use Terminal whenever the need arises.

It's not scary. It's not hard. It's just different. And don't worry—I'll be with you every step of the way!

Much of this book is concerned with teaching you the skills and basic commands you must know in order to accomplish genuinely useful things later on. If you feel that it's a bit boring or irrelevant to learn how to list files or change directories, remember: it's all about the end

result. You learn the fundamentals of baking not because measuring flour or preheating an oven is intrinsically interesting, but because you need to know how to do those things in order to end up with cookies. And let me tell you, the cookies make it all worthwhile!

Speaking of food—my all-purpose metaphor—this book doesn't *only* provide information on individual ingredients and techniques. The last chapter is full of terrific, simple command-line recipes that put all this power to good use while giving you a taste of some advanced capabilities I don't explore in detail. Among other things, you'll learn:

- How to figure out what's preventing a disk from disconnecting (unmounting or ejecting)
- How to tell which applications are currently accessing the Internet
- How to rename lots of files at once, even if you're not running Yosemite or later
- How to change a number of hidden preferences
- How to understand and change file permissions
- How to automate command-line activities with scripts

Astute readers may note that some of these tasks can be accomplished with third-party utilities. That's true, but the command line is infinitely more flexible—and Terminal is free!

I should be clear, however, that this book won't turn you into a command-line expert. I would need thousands of pages to describe everything you can accomplish with the command line. Instead, my goal is to cover the basics and get you up to a moderate level of familiarity and competence. And, based on feedback from the first edition of this book, I've expanded the scope of this revised second edition to include a number of topics that are a bit more advanced.

Most of my examples work with any version of Mac OS X from 10.6 Snow Leopard on, although many also apply to earlier versions of Mac OS X. A few techniques require 10.9 Mavericks or later; I point out those out as we go along.

Mac OS X Command Line Quick Start

This book is mostly linear—the later sections tend to build on the earlier sections. For that reason, I strongly recommend starting from the beginning and working through the book in order (perhaps skimming lightly over any sections that explain already familiar concepts). You can use the items in the final chapter, Command-Line Recipes, at any time, but they'll make more sense if you understand all the basics presented earlier in the book.

Find your bearings:

- Learn about the command line and its terminology; see Understand Basic Command-Line Concepts.
- Become familiar with the most common tool for accessing the command line; see Get to Know (and Customize) Terminal.
- Navigate using the command line; see Look Around.

Learn basic skills:

- Create, delete, and modify files and directories; see Work with Files and Directories.
- Run or stop programs and scripts; see Work with Programs.
- Make your command-line environment work more efficiently; see Customize Your Profile.

Go beyond the Terminal window:

- Integrate the command line and Mac OS X's graphical interface; see Bring the Command Line into the Real World.
- Use the command line to control another Mac; see Log In to Another Computer.

Earn your propeller beanie:

- Learn about users, groups, permissions, and the infamous `sudo` command; see Work with Permissions.
- Learn Advanced Techniques such as piping and redirecting data, using the `grep` search tool, and adding logic to your shell scripts.
- Go beyond what's built into Mac OS X by downloading third-party command-line programs; see Install New Software.

Put your skills into practice:

- Do cool (and practical) stuff on the command line; see Command-Line Recipes.

Understand Basic Command-Line Concepts

In order to make sense of what you read about the command line, you should know a bit of background material. This chapter explains the ideas and terminology I use throughout the book, providing context for everything I discuss later in the book.

What's Unix?

Unix is a computer operating system with roots going back to 1969. Back then, Unix referred to one specific operating system running on certain expensive minicomputers (which weren't "mini" at all; they were enormous!). Over time, quite a few companies, educational institutions, and other groups have developed their own variants of Unix—some were offshoots from the original version and others were built from scratch.

After many branches, splits, mergers, and parallel projects, there are now more than a dozen distinct families of Unix and Unix-like operating systems. Within each family, such as Linux (a Unix-like system), there may be many individual variants, or distributions.

Note: A Unix-like system is one that looks and acts like Unix, but doesn't adhere completely to a list of standards known as the Single UNIX Specification, or SUS. Mac OS X 10.5 Leopard or later running on an Intel-based Mac is a true Unix operating system. Earlier versions of Mac OS X, and any version running on PowerPC-based Macs, were technically Unix-like.

Mac OS X is a version of Unix that nicely illustrates this process of branching and merging. On the one hand, you had the classic Macintosh OS, which developed on its own path between 1984 and 2002. On the other hand, you had NeXTSTEP, an operating system based

on a variety of Unix called BSD (Berkeley Software Distribution). NeXT, the developer of NeXTSTEP, was the company that Steve Jobs founded after leaving Apple in 1985.

When Apple bought NeXT in 1996, it began building a new operating system that extended and enhanced NeXTSTEP while layering on capabilities (and some of the user interface) of the classic Mac OS. The result was Mac OS X: it's Unix underneath, but with a considerable amount of extra stuff that's not in other versions of Unix. If you took Mac OS X and stripped off the graphical interface, the Cocoa application programming interfaces (APIs), and all the built-in applications such as Mail and Safari, you'd get the Unix core of Mac OS X. This core has its own name: Darwin. When you work in the command-line environment, you'll encounter this term from time to time.

Darwin is itself a complete operating system, and though Apple doesn't sell computers that run only Darwin, it is available as open source so anyone with sufficient technical skill can download, compile, and run Darwin as an operating system on their own computer—for free.

What's a Command Line?

A command-line interface is a way of giving instructions to a computer and getting results back. You type a *command* (a word or other sequence of characters) and press Return or Enter. The computer then processes that command and displays the result (often in a list or other chunk of text). In most cases, all your input and output remains on the screen, scrolling up as more appears. But only one line—usually the last line of text in the window, and usually designated by a blinking cursor—is the actual *command line,* the one where commands appear when you type them.

Note: Although Darwin (which has only a command-line interface) is part of Mac OS X, it isn't quite correct to say that you're working in Darwin when you're using the Mac OS X command line. In fact, the command line gives you a way to interact with all of Mac OS X, only part of which is Darwin.

Get to Know (and Customize) Terminal

As I mentioned in What's Terminal?, the application you're most likely to use for accessing the command line in Mac OS X is Terminal. Since you'll be spending so much time in this application, a brief tour is in order. In addition, you may want to adjust a few settings, such as window size, color, and font, to whatever you find most comfortable and easy to read.

Learn the Basics of Terminal

The moment has arrived. Find the Terminal application (inside the folder `/Applications/Utilities`), double-click it, and take a Zen moment to contemplate the emptiness (**Figure 1**).

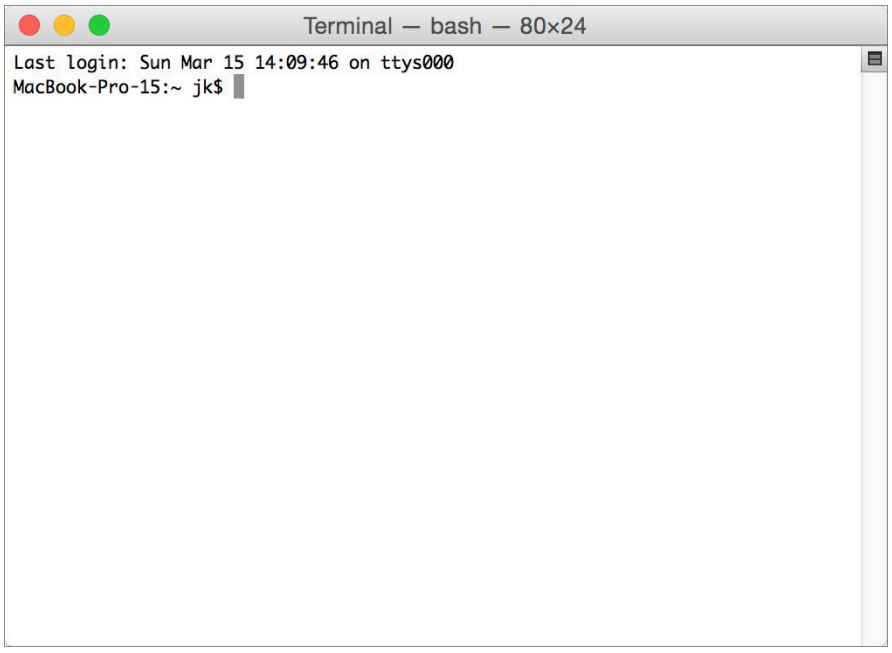

Figure 1: The Terminal window harks back to pre-graphical days.

To state the obvious, it's a (mostly) empty window. A Terminal window simply shows a command-line interface generated by a shell (in this case, the `bash` shell). As long as you're in this window, you can largely

forget about your mouse or trackpad: with a couple of notable exceptions (see the sidebar Using a Mouse in Terminal), everything you do here uses the keyboard only.

Of course, the window isn't *completely* empty. The first line lists, by default, the date and time of your last login. In this example, it's:

```
Last login: Sun Mar  15 14:09:46 on ttys000
```

That last part, `on ttys000`, is a bit of esoteric information that signifies the terminal interface with which you logged in the last time. It might say something different (such as `on console`) or nothing at all—for all practical purposes, you can safely ignore this line.

The second line is the actual command line (the line on which you type commands):

```
MacBook-Pro-15:~ jk$ ■
```

The rectangular box at the end (which may instead appear as a vertical line or an underscore, any of which may or may not blink) is the *cursor* (not to be confused with the *pointer*, which reflects mouse movement). Everything before the cursor is known as the *prompt*, which is to say it's prompting you to type something.

The first part of the prompt, `MacBook-Pro-15`, is the name of my Mac (by default, spaces are replaced with hyphens, and punctuation, if any, usually disappears). The colon (`:`) is simply a visual separator. Next is the tilde (`~`), which signifies that I'm currently in my home directory (which, for me, is `/Users/jk`). The `jk` is the short username of the account under which I'm logged in. And finally, the `$` signifies that I'm logged in as an ordinary (non-root) user. (I say more about the `$` in the sidebar The $, #, and Other Strange Things on My Command Line, ahead.) If your short username is cindy and your computer's name, as shown in System Preferences > Sharing, is Cindy's Groovy iMac, your command line may look something like this:

```
Cindys-Groovy-iMac:~ cindy$ ■
```

All these things are customizable; see Customize Your Profile.

Look Around

In this chapter, I help you find your way around your Mac from the command line and, at the same time, teach you some of the most common navigational commands and conventions.

For right now, you're going to look, but not touch—that is, nothing you do here can change any files or cause any damage, as long as you follow my instructions.

Discover Where You Are

Ready to start learning some commands? Here we go. Open a Terminal window and enter this:

```
pwd
```

> **Note:** As a reminder, to enter something on the command line, type it and press Return or Enter afterward.

The `pwd` command stands for "print working directory," and it gives you the complete path to the directory you're currently using. If you haven't done anything else since opening a Terminal window, that's your home directory, so you'll see something like this:

```
/Users/jk
```

That's not exciting, but it's extremely important. As you navigate through the file system, it's easy to get lost, and ordinarily your prompt only tells you the name of your current directory, not where it's located on your disk. When you're deep in the file system, being able to tell exactly where you are can be a huge help.

See What's Here

If you were in the Finder, you'd know exactly what's in the current folder just by looking. Not so on the command line; you must ask explicitly. To get a list, you use the "list" command:

```
ls
```

What you get by default is a list along the lines of the following:

```
Desktop         Downloads       Movies          Pictures
Documents       Library         Music           Public
```

Items are listed alphabetically, top to bottom and then left to right. But as you can see, this doesn't tell you whether these items are files or directories, how large they are, or anything else about them. So most people prefer the more-helpful long format by adding the -l flag:

```
ls -l
```

This produces a result something like:

```
drwxr-xr-x   18 jk    admin    612 Feb 12 09:42 Desktop
drwxr--r--@ 108 jk    admin   3672 Feb  9 14:35 Documents
drwx------   15 jk    admin    510 Feb 12 11:17 Downloads
drwx------   94 jk    admin   3196 Feb 11 22:40 Library
drwx------   13 jk    admin    442 Dec 30 15:34 Movies
drwxr--r--   15 jk    admin    510 Aug 27 15:02 Music
drwxr--r--   14 jk    admin    476 Jan 26 19:40 Pictures
drwxr-xr-x    7 jk    admin    238 Jan 22 23:13 Public
```

Reading from right to left, notice that each line ends with the item's name. To the left of the name is a date and time showing when that item was most recently modified. To the left of the date is another number showing the item's size in bytes. See the sidebar on the next page, Making Output (More) Human-Readable, to find out how to turn that number into a nicer format. (In the case of a directory, the number shown by `ls -l` doesn't tell you the total size of the directory's

Work with Files and Directories

Much of what you'll need to do on the command line involves working with files in some way—creating, deleting, copying, renaming, and moving them. This chapter covers the essentials of interacting with files and directories.

Create a File

I want to mention a curious command called `touch` that serves two interesting functions:

- When applied to a nonexistent file, `touch` creates an empty file.
- When applied to an existing file or folder, `touch` updates its modification date to the current date and time, marking it as modified.

Try entering the following command:

```
touch file1
```

Now use `ls -l` to list the contents of your current directory. You'll see `file1` in the list. This file that you've just created is completely empty. It doesn't have an extension, or a type, or any contents. It's just a marker, though you could use a text editor, for example, to add to it.

Why would you do this? There are occasionally situations in which a program behaves differently based solely on the existence of a file with a certain name in a certain place. What's in the file doesn't matter—just that it's there. Using `touch` is the quickest way to create such a file.

But for the purposes of this book, the reason to know about `touch` is so you can create files for your own experiments. Since you're creating the files, you can rename, move, copy, and delete them without worrying about causing damage. So try creating a few files right now with `touch`.

Note: Remember, if you want to create a file with a space in the name, put it in quotation marks (`touch "my file"`) or escape the space character (`touch my\ file`).

As for the other use of `touch`—marking a file as modified—you might do this if, for example, the program that saved it failed to update its modification date for some reason and you want to make sure your backup software notices the new version. You use exactly the same syntax, supplying the name of the existing file:

```
touch file1
```

When applied to an existing file, `touch` doesn't affect its contents at all, only its modification date.

Create a Directory

To create a directory (which, of course, appears in the Finder as a folder), use the `mkdir` (make directory) command. To make a directory called `apples`, you'd enter the following:

```
mkdir apples
```

That's it! Other than the fact that you can create a new directory in some other location than your current one (for example, you could enter `mkdir ~/Documents/apples`), and the fact that spaces, apostrophes, or quotation marks in directory names must be escaped (see Spaces in Paths), there's nothing else you need to know about `mkdir` at this point.

Copy a File or Directory

To duplicate a file (in the same location or another location), use the `cp` (copy) command. It takes two arguments: the first is the file you want to copy, and the second is the destination for the copy. For example, if you're in your home directory (`~`) and want to make a copy of the file `file1` and put it in the `Documents` directory, you can do it like this:

```
cp file1 Documents
```

Work with Programs

Every command that you use on the command line, including merely listing files, involves running a program. (So, in fact, you've been using programs throughout this book!) However, some aspects of using programs on the command line aren't entirely obvious or straightforward. In this chapter, I explain some of the different types of programs you may encounter and how to run them (and stop them).

I also show you how to edit files on the command line, and I talk about *shell scripts,* a special kind of program you can create to automate a sequence of tasks.

Learn Command-Line Program Basics

If you've been reading this book in order, you already know many basics of running programs on the command line. Each time you enter a command such as `ls` or `cp` or `pwd`, you're running a program—and we saw how to change program options and supply additional parameters with arguments and flags earlier (in What Are Commands, Arguments, and Flags?). However, I think you should know a few other important facts about running programs.

Command-line programs come in a few varieties, which for the sake of convenience I'll lump together in three broad categories. (These are my own terms, by the way; other people may categorize them differently.) You'll have an easier time using the command line if you're aware of the differences.

Basic Programs

Most command-line programs you use simply do their thing and then quit automatically. Enter `ls`, for instance, and you instantly get a list of files, after which point `ls` is no longer running. Some of these single-shot programs produce visible output (`date`, `ls`, `pwd`, etc.); some normally provide no feedback at all unless they encounter an error

(cp, mv, rm, etc.). But the point is: they run only as long as is needed to complete their task, without requiring any interaction with you other than the original command (with any flags and arguments).

Interactive Programs

A second type of program asks you for an ongoing series of new commands, and in some cases doesn't quit until you tell it to. For example, the command-line program used to change your password is passwd. If you enter passwd, you see something like the following:

```
Changing password for jk.

Old password:
```

You type your old password and press Return, and then the program gives you another prompt:

```
New password:
```

Type in a new password and you get yet another prompt:

```
Retype new password:
```

Reenter your new password, as long as it matches the first one, the program changes your password and exits without any further output.

> **Note:** This procedure really does change the password for your user account, which applies everywhere on your Mac (not just on the command line).

Programs of this sort include ssh, which lets you Log In to Another Computer, and ftp, which lets you transfer files between computers, among many others. If you're running an interactive program, want to quit it, and can't find an obvious way to do so, try pressing Control-C (see Stop a Program for more possibilities).

> **Note:** Starting in 10.11 El Capitan, whenever you use a command that prompts you for a password, such as passwd or sudo, a key icon appears after the password prompt to remind you that whatever you type will not be shown on screen.

Customize Your Profile

Now that you know the basics of the command line and Terminal, you may find some activities are a bit more complicated than they should be, or feel that you'd like to personalize the way your shell works to suit your needs. One way to exercise more control over the command-line environment is to customize your profile, a special file the bash shell reads every time it runs. In this chapter, I explain how the profile works and how you can use it to save typing, customize your prompt, and more.

How Profiles Work

A profile is a file your shell reads every time you start a new session that can contain a variety of preferences for how you want the shell to look and behave. Among other things, your profile can customize your PATH variable (see How Your PATH Works), add shortcuts to commands you want to run in a special way, and include instructions for personalizing your prompt. I cover just a few basics here.

What you should understand, though, is that for complicated historical reasons, you may have more than one profile (perhaps as many as four or five!), and certain rules govern which one is used when.

When you start a new shell session, `bash` first reads in the system-wide default profile settings, located at `/etc/profile`. Next, it checks if you have a personal profile. It first looks for a file called `~/.bash_profile`, and if it finds one, it uses that. Otherwise, it moves on to look for `~/.bash_login` and, finally, `~/.profile`. Of these last three files, it loads only the first one it finds, so if you have a `.bash_profile` file, the others, if present, are ignored.

Note: You may also read about a file called `.bashrc`, which `bash` reads in only under certain unusual conditions that you're unlikely to encounter when using Terminal on Mac OS X.

Because `.bash_profile` is the first user-specific profile to be checked, that's the one I suggest you use.

> **Note:** Customizations you make in `.bash_profile` (or any other profile file mentioned here) apply only in a shell session; they aren't used by shell scripts (see Create Your Own Shell Script). As a result, when writing a script, you should always spell out complete paths and assume default values for all variables.

Edit .bash_profile

To edit `.bash_profile` in `nano`, simply enter the following:

```
nano ~/.bash_profile
```

If the file already exists, `nano` opens it for editing; if not, it prompts you to create the file when you save or quit the program.

This file is a simple text file, and unlike shell scripts, it doesn't use a shebang. Just add one or more lines to specify the changes that you want (as described on the following pages). When you're finished editing `.bash_profile`, save it (Control-O) and close it (Control-X). Ordinarily, the changes take effect with the next shell session (window or tab) you open. To load the modified profile immediately, enter `source .bash_profile`.

Create Aliases

In the Finder, an alias is a small file that serves as a pointer to another file (for something comparable to Finder aliases on the command line, refer to Use Symbolic Links). In the command-line environment, however, the word *alias* means a shortcut in which one command substitutes for another.

For example, suppose you're used to command-line conventions from DOS and Windows, in which you enter `dir` (directory) to list your files. If you want to use that same command in Mac OS X, you can make an

Bring the Command Line into the Real World

So far in this book I've largely ignored Mac OS X's graphical interface, treating the command-line environment as a separate world. In fact, because the command-line interface and the graphical interface share the same set of files and many of the same programs, they can interact in numerous ways.

In this chapter, I discuss how your shell and the Finder can share information and complement each others' strengths—giving you the best of both worlds.

Get the Path of a File or Folder

Suppose you want to perform some command from the command line on a file or folder you can see in the Finder, but you don't know the exact path of that folder—or even if you do, you don't want to type the whole thing. You're in luck: there's a quick and easy way to get the path of an item from the Finder into a Terminal window.

To get the path of an item in the Finder, do the following:

1. In a Terminal window, type the command you want to use, *followed by a space*. The space is essential!
2. Drag the file or folder from the Finder into the Terminal window.

As soon as you release the mouse button, Terminal copies the path of the file or folder you dragged onto the command line. It even escapes spaces and single quotation marks with backslashes for you automatically! You can then press Return to run the command.

For example, suppose you want to use the `ls -l@` command to list the contents of a folder with their extended attributes (a type of *metadata,*

or extra information about files and folders in addition to their actual contents), which you can't see in the Finder. You could type this:

```
ls -l@
```

(Don't forget the space after the `@`!) Then drag a folder into the Terminal window, as shown in **Figure 6**.

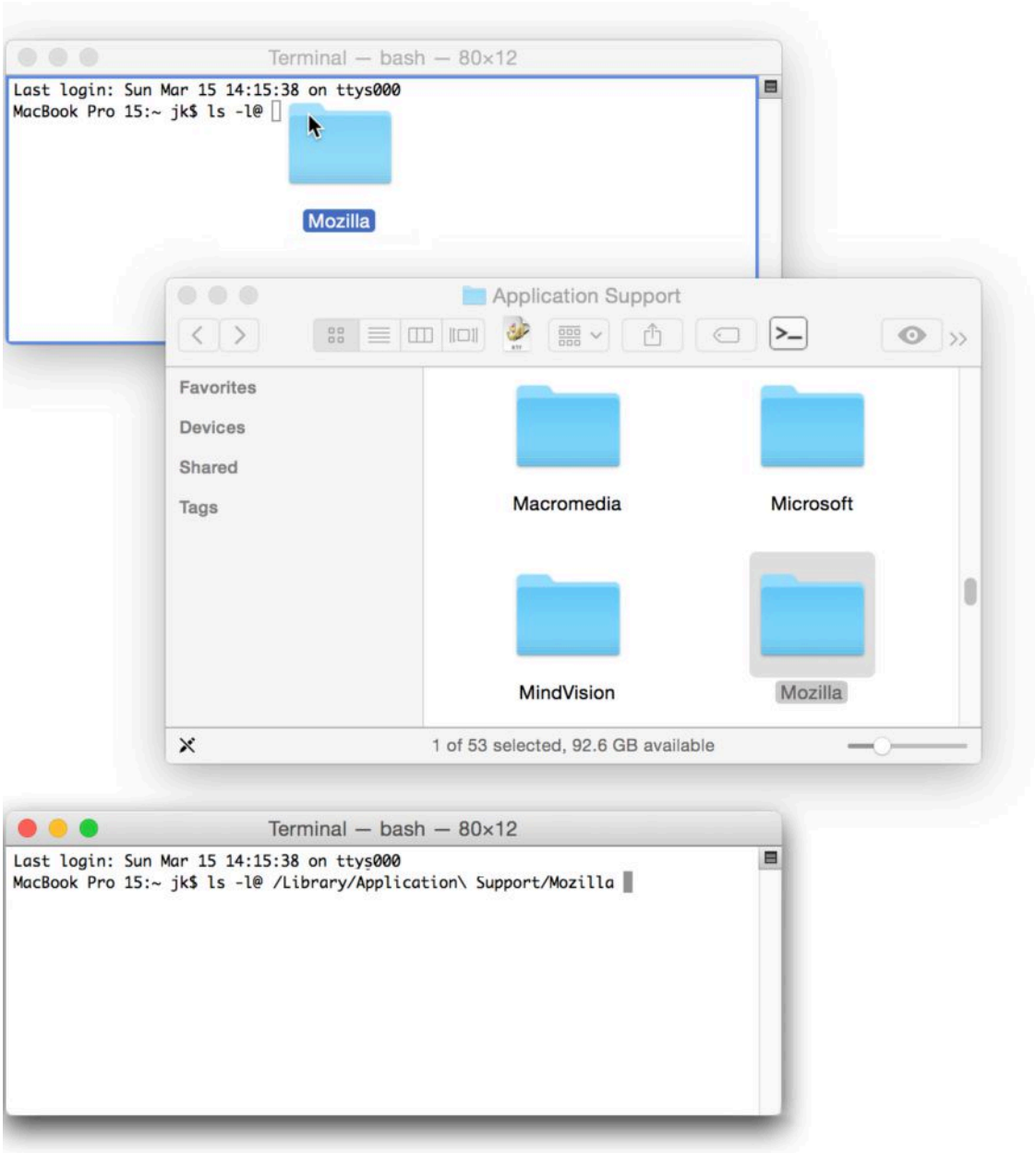

Figure 6: Drag a file or folder into the Terminal window (top); when you release the mouse button, you get that item's full path (bottom).

Log In to Another Computer

Every time you connect to another Mac to share files or other system resources, you are, in a way, logging in to that other Mac. However, in this chapter, I describe a particular way of logging in to a remote computer—doing so using SSH (secure shell), which gives you access to the other computer's command-line interface from within your own Mac's command-line interface. Logging in via SSH lets you interact with another computer in the same way you interact with your current Mac from inside a Terminal window.

You can connect to almost any Mac, Unix, or Unix-like computer (and some Windows computers) using SSH, provided the other computer has SSH enabled. (To enable incoming SSH access on a Mac, check the Remote Login box in System Preferences > Sharing.)

If you log in to another Mac, everything should look quite familiar, whereas other operating systems may follow different conventions. For the purposes of this chapter, I assume that the remote computer is at least running a Unix-like system so that most of the things you've learned in this book still apply.

Start an SSH Session

The easiest way to start an SSH session from Terminal is to begin in an existing shell session. Then follow these steps:

1. Enter the following, substituting your username on the remote computer for `username`, and the remote computer's IP address or domain name for `remote-address`:

   ```
   ssh username@remote-address
   ```

2. If this is the first time you're connecting to this particular remote computer, you will see a message something like the following:

   ```
   The authenticity of host 'macbook-pro.local (fe80::20c:74ee:ed-
   b2:61ae%en0)' can't be established.

   RSA key fingerprint is d0:15:73:75:04:9a:c3:2d:5b:b1:f8:c0:7d:
   83:52:ef.

   Are you sure you want to continue connecting (yes/no)?
   ```

   After reading the sidebar "SSH Security Considerations," just ahead, assuming you're still comfortable connecting, type `yes` and press Return.

3. Text similar to the following appears on screen:

   ```
   Warning: Permanently added 'macbook-pro.local.,
   fe80::20c:74ee:edb2:61ae%en0' (RSA) to the list of known hosts.
   ```

   And following that is a password prompt. Type your password for the remote computer and press Return.

> **Note:** As you type your password, no text appears—not even bullet or asterisk characters. That's normal.

Assuming the remote computer accepts your password, it presents you with a new command prompt, often (but not always) accompanied by a brief welcome message.

Work with Permissions

Everything you do on your Mac, and especially on the command line, is governed by *permissions*—which user(s) can do which things with which items, under which circumstances. In this chapter, I introduce you to file permissions, along with the closely related notions of owners and groups. I also explain how to temporarily assume the power of the root user using the `sudo` command.

Understand Permission Basics

As you may recall from See What's Here, when you list files in the long format (`ls -l`), you can see the permissions, owner, and group of each file and directory. Every file in Mac OS X has all these attributes, and you should understand how they work because they influence what you can and can't do with each item.

Note: This section covers only the basics of permissions. To learn the full details, I heartily recommend reading Brian Tanaka's *Take Control of Permissions in Snow Leopard* (which also applies to newer versions of Mac OS X).

Before I get into how to read or change permissions, I want to describe the basic options. Put simply, permissions consist of three possible activities (reading, writing, and executing), performed by any of three types of user (the file's owner, the file's group, and everyone else). Three types of permission multiplied by three types of user equals nine items, each of which can be specified individually for any file or folder.

Read, Write, and Execute

Someone with permission to *read* a file can open it and see what's inside it. Someone with *write* permission can modify an item or delete it. *Execute* permission, for a file, means it can be run (that is, it can behave as a program or script); for a directory, execute permission means someone can list its contents.

On the command line, read permission is abbreviated with an `r`, write permission is abbreviated with a `w`, and execute permission is abbreviated with an `x`.

User, Group, and Everyone Else

Every file and folder specifies read, write, and execute permissions for the following types of user:

- **User:** In terms of file permissions, the term *user* means the owner of a file or directory. (The user may be a person, like you, or it may be a system process, such as `_screensaver`, which is exactly what it looks like.)
- **Group:** Each file and directory also has an associated group—one or more users for whom a set of permissions can be specified. That group could have just one member (you, for example), or many. Mac OS X includes several built-in groups, such as `admin` (all users with administrator access), `staff` (all standard users without administrative access), and `wheel` (which normally contains only the root user—see Perform Actions as the Root User). You can also create your own groups.
- **Others:** Every user who is neither the owner nor in the file's group is lumped into the "others" category.

Reading Permissions, Owner, and Group

To illustrate how this all works, suppose you find the following two items in a certain directory by entering `ls -l` (list in long format):

```
drwxr--r--   15 jk    admin    510 Aug 27 15:02 fruits

-rw-r--r--   2  root  wheel   1024 Sep 02 11:34 lemon
```

For the purposes of this section, we care about just three of the items on each line (apart from the item's name, at the end). The initial group of characters (like `drwxr--r--`) constitutes the permissions, and the two names in the middle (like `jk admin`) are the user and group, respectively. For now, you can ignore all the other information.

Learn Advanced Techniques

Now that you know the basics of working with the command line, I want to show you a few techniques that build on your knowledge and enable you to perform more advanced tasks.

First I tell you how to Pipe and Redirect Data—two powerful (and related) techniques you can apply to many different commands in order to combine them in useful ways and do more with your data. Next, you'll Get a Grip on grep, a tool that helps you locate files containing specified patterns of characters. Finally, I explain the basics of how you can Add Logic to Shell Scripts, making them much more useful than simple sequences of commands.

As you can imagine, these are but a few of many advanced techniques for using the command line, but I've found them to be consistently helpful, and I hope you will too.

Pipe and Redirect Data

Most of the time when you enter commands on the command line, the output—a list of files, the date, the contents of a log, or whatever—is shown directly on the screen. But that isn't always what you want.

For example, maybe the output of some command is a list of hundreds or thousands of files, but that's more information than you need; you want to filter the list to show only files that meet certain criteria. Or, maybe having that list in a Terminal window isn't useful to you, but if it were in a BBEdit document, it would be. In cases like these, you can use either of two commands to take a command's output and do something other than display it on the screen.

Pipe (|)

The pipe operator, which is the `|` symbol that you get when you type Shift-\, sends the output of a command to another *program*. To use it, you type the first command, then a space, the `|` character, another space, and the name of the second program. Like so:

```
program | other-program
```

We saw the pipe earlier, in Ps, and there are also a few instances of this in Command-Line Recipes, but let me give you some further examples to illustrate how this works and what you might do with it.

If I used the `ls /Library/Preferences` command to show me everything in my `/Library/Preferences` folder, that would be a pretty long list. But suppose I remembered that most of the items in that folder started with `com.apple` and I wanted to see just the last, say, ten items because that would filter out most of the Apple stuff. And then I remember that the Tail command does exactly that. Ordinarily, `tail` expects you to give it a *file* as an argument. But instead, I could give it a file *listing* as an argument, using the pipe operator, like so:

```
ls /Library/Preferences | tail
```

And that does what I expect—it shows just the last ten items from that directory. If I wanted to show the last 15, I could instead enter:

```
ls /Library/Preferences | tail -n 15
```

Most flags and arguments work as usual with piped commands. The exception, of course, is that commands expecting a file as an argument normally put the file *after* the command, but when you use a pipe, the order is reversed.

How about another example? If I used the `locate` command to find all the files containing *Apple* in the name—again, an awkwardly large number—they'd all scroll by at a dizzying speed. If instead I wanted to be able to page through them one screenful at a time—hey, just like you can do with `less` (see View a Text File)—I can just pipe the output of `locate` into `less`, like so:

```
locate Apple | less
```

Install New Software

With just the software Mac OS X includes (and perhaps a few shell scripts you write on your own or find on the Web), you can do a tremendous number of useful activities on the command line. But sooner or later you're likely to encounter a task that requires a command-line program you don't already have, which means you'll need to find and install it yourself. (Admittedly, this is not for everyone, and if the next few paragraphs give you a headache, skip ahead to Command-Line Recipes and forget I ever mentioned installing your own software!)

Fortunately, the vast majority of command-line software created for Unix and Unix-like operating systems (such as the various Linux distributions) can run on your Mac too! (Refer back to What's Unix? for the differences between "Unix" and "Unix-like.") Tens of thousands of command-line programs are at your disposal! Just a handful of examples:

- **alpine:** An email client
- **FLAC:** An audio format converter
- **lynx:** A command-line Web browser (yes, really)
- **pdftohtml:** A program that converts—you'll never guess!—PDFs to HTML format
- **postgresql:** A relational database manager
- **wget:** A tool for downloading files from the Web

Except… on the command line, it's almost never as simple as downloading an application and running it. Because each Unix and Unix-like operating system is a bit different, in most cases, a given program must be *compiled* for the specific platform in question—that is, the raw source code (in a language such as C) has to be run through a program called a *compiler* to produce a *binary* file that will run on the target

system. (In fact, compiling can be vastly more complex than this description suggests, but that's the basic idea.)

So, if you have an interest in adding third-party command-line software to your Mac, you'll first need the tools that are required to compile and install them. You can get them easily (read Use Command Line Tools for Xcode, next), and in the process gain a bunch of extra programs that may be useful to you on their own.

Next, you have a choice:

- If you're a glutton for punishment (or want to see how things work), you can Install Unix Software from Scratch. (do it at least once, just for the experience.)
- If you'd like to make life easier for yourself, however, you can often use a special program called a *package manager* to do the heavy lifting of finding, downloading, and (if necessary) compiling the software you want (see Use a Package Manager). Package managers are way faster and more convenient than compiling software from scratch, although not every program you may want to install is available in that form.

Use Command Line Tools for Xcode

Let's start with something simple: a free software package from Apple called Command Line Tools for Xcode. This collection includes nearly 100 new command-line programs, mostly intended to perform functions useful to developers but not needed by the typical Mac user. However, since you now know your way around the command line, you're not a typical Mac user! And in order to install new command-line software, you'll almost certainly need tools such as `make` (to build a set of binary files from their source files), which in turn relies on a compiler such as `gcc`.

Command-Line Recipes

You've learned about the raw ingredients and the tools you need to put them together. Now it's time for some tasty recipes that put your knowledge to good use! In this chapter, I present a selection of short, easy-to-use commands and customizations you can perform in the bash shell. Many use features, functions, and programs I haven't yet mentioned, and although I describe essentially how they work, I don't go into detail about every new item included in the recipes. Just add these herbs and spices as directed, and enjoy the results!

Misplaced hyphens! Your ebook reader may insert extra hyphens into longer lines of command-line text shown in this ebook. Please see the first item under Basics, earlier, for more information about how to avoid extra hyphens.

Change Defaults

Most Mac OS X applications, from the Finder to Mail to iTunes, store their settings in specially formatted property list, or .plist, files. Surprisingly, applications often have hidden preferences that don't show up in their user interfaces—but if you put just the right thing in the preference file, you can change an application's behavior in interesting ways, or even turn on entirely new features.

One way to edit preference files is to open them in a text editor, or in Apple's Xcode development environment (which is available as a free download from the Mac App Store). But another, often easier way, is to use a command called `defaults` which can directly add, modify, or remove a preference from a .plist file. The recipes in this first set all use the defaults command.

Before using these commands to alter an application's defaults, quit the application if possible (obviously that's not an option with the Finder or the Dock, but the recipes that involve those apps include directions to force-quit and relaunch them).

Tip: Various Web sites list hundreds of additional settings you can change—for example, at defaults-write.com and dotfiles.

Expand Save Dialogs by Default

Ordinarily when you use an application's Save or Export command, the Save dialog that appears gives you only a simple pop-up menu from which to select a location for a file; you have to click the triangle  button to expand it so it shows your entire computer. To make all Save dialogs appear in their expanded state by default, enter this:

```
defaults write -g NSNavPanelExpandedStateForSaveMode -bool TRUE
```

(To reverse this setting, repeat the command, changing `TRUE` to `FALSE`.)

Show Hidden Files in the Finder

By default, the Finder keeps some files and folders hidden—those whose names begin with a period and many of the Unix files and directories at the root level of your disk.

That's usually good, because it prevents you from changing things that could cause your computer to break, but if you want to see all your files and folders, enter this:

```
defaults write com.apple.finder AppleShowAllFiles TRUE; killall
Finder
```

(To reverse this setting, repeat the command, changing `TRUE` to `FALSE`.)

Prevent Dock Icons from Bouncing

When an application wants to get your attention, its Dock icon usually bounces. If you find this distracting and want to turn off the bouncing, enter the following:

```
defaults write com.apple.dock no-bouncing -bool TRUE; killall Dock
```

(To reverse this setting, repeat the command, changing `TRUE` to `FALSE`.)

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Shameless Plug

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