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Author of *CompTIA Security+ Study Guide*

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Contents at a Glance

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Introduction

Linux is truly amazing when you consider how it originated and how it continues to evolve. From its modest beginning as the hobby of one person — Linus Torvalds of Finland — Linux has grown into a full-fledged operating system with features that rival those of any commercial Unix operating system. To top it off, Linux — with all its source code — is available free to anyone. All you have to do is download it from an Internet site or get it on CDs or a DVD for a nominal fee from one of many Linux CD vendors.

Linux certainly is an exception to the rule that "you get what you pay for." Even though Linux is free, it's no slouch when it comes to performance, features, and reliability. The robustness of Linux has to do with the way it is developed and updated. Developers around the world collaborate to add features. Incremental versions are continually downloaded by users and tested in a variety of system configurations. Linux revisions go through much more rigorous beta testing than any commercial software does.

Since the release of Linux kernel 1.0 on March 14, 1994, the number of Linux users around the world has grown exponentially. Many Linux distributions — combinations of the operating system with applications and installation tools — have been developed to simplify installation and use. Some Linux distributions are commercially sold and supported, while many continue to be freely available.

Linux, unlike many freely available software programs, comes with extensive online information on topics such as installing and configuring the operating system for a wide variety of PCs and peripherals. A small group of hard-core Linux users are expert enough to productively use Linux with the online documentation alone. A much larger number of users, however, move to Linux with some specific purpose in mind (such as setting up a web server or learning Linux). Also, many Linux users use their systems at home. For these new users, the online documentation is not easy to use and typically does not cover the specific uses of Linux that each user may have in mind.

If you're beginning to use Linux, what you need is a practical guide that not only gets you going with Linux installation and setup, but also shows you how to use Linux for a specific task. You may also want to try out different Linux distributions before settling on one.

About This Book

Linux All-in-One For Dummies gives you eight quick-reference guides in a single book. Taken together, these eight minibooks provide detailed information on installing, configuring, and using Linux, as well as pointers for passing the vendor-neutral certification exams available from the Linux Professional Institute (LPI) to authenticate your skills.

What you'll like most about this book is that you don't have to sequentially read the whole thing chapter by chapter — or even read through each section in a chapter. You can pretty much turn to the topic you want and quickly get the answer to your pressing questions about Linux, whether they're about using the LibreOffice.org word processor, setting up the Apache web server, or a wide range of topics.

Here are some of the things you can do with this book:

- Install and configure Linux using the information given in this book.
- Connect the Linux PC to the Internet through a DSL or cable modem.
- Add a wireless Ethernet to your existing network.
- Get tips, techniques, and shortcuts for specific uses of Linux, such as
  - Setting up and using Internet services
  - Setting up a Windows server using Samba
  - Using Linux commands
  - Using shell programming
  - Using the LibreOffice.org office suite and other applications that come with Linux
- Understand the basics of system and network security.
- Perform system administration tasks.

I use a simple notational style in this book. All listings, filenames, function names, variable names, and keywords are typeset in a `monospace` font for ease of reading. I *italicize* the first occurrences of new terms and concepts and then provide a definition right there. I show typed commands in **boldface.** The output of commands and any listing of files are shown in a `monospace` font.

Topics that correspond to the certification objectives are important after you've become comfortable enough with the operating system to consider taking the certification exams. As we discuss the material, Tips draw your attention to the key concepts and topics tested in the LX0-103 and LX0-104 exams (both of which you

must pass to become certified by the Linux Professional Institute). Note, though, that not all Tips indicate material that's on the exams; I also share other types of information in Tips.

If you are a novice to Linux, overlook the certification objective information as you read. Only after you become comfortable with the operating system, and are considering authenticating your skills by taking the LPI exams, should you revisit the book and look for this information.

Each minibook zeros in on a specific task area — such as using the Internet or running Internet servers — and then provides hands-on instructions on how to perform a series of related tasks. You can jump right to a section and read about a specific task. You don't have to read anything but the few paragraphs or the list of steps that relate to your question. Use the Table of Contents or the Index to locate the pages relevant to your question.

You can safely ignore text next to the Technical Stuff icons, as well as text in sidebars. However, if you're the kind of person who likes to know some of the hidden details of how Linux works, then, by all means, dig into the Technical Stuff icons and the sidebars.

Foolish Assumptions

I assume that you're familiar with a PC — you know how to turn it on and off and you've dabbled with Windows. (Considering that most new PCs come preloaded with Windows, this assumption is safe, right?) And I assume that you know how to use some Windows applications, such as Microsoft Office.

When installing Linux on your PC, you may want to retain your Windows installations. I assume that you don't mind shrinking the Windows partition to make room for Linux. For this procedure, you can invest in a good disk-partitioning tool or use one of the partitioning tools included with most Linux distributions.

I also assume that you're willing to accept the risk that when you try to install Linux, some things may not quite work. Problems can happen if you have some uncommon types of hardware. If you're afraid of ruining your system, try finding a slightly older, spare Pentium PC that you can sacrifice and then install Linux on that PC.

Linux All-in-One Desk Reference For Dummies has eight minibooks, each of which focuses on a small set of related topics. If you're looking for information on a specific topic, check the minibook names on the thumbtabs or consult the Table of Contents.

SIDEBARS

Sometimes I use sidebars to highlight interesting, but not critical, information. Sidebars explain concepts you may not have encountered before or give a little insight into a related topic. If you're in a hurry, you can safely skip the sidebars.

Icons Used in This Book

Following the time-honored tradition of the *All-in-One For Dummies* series, I use icons to help you quickly pinpoint useful information. The icons include the following:

The Distribution Specific icon points out information that applies to specific Linux distributions that this book covers: Debian, Fedora, Knoppix, SUSE, and Ubuntu.

The Remember icon marks a general, interesting fact — something that you want to know and remember as you work with Linux. You might even find interesting trivia worth bringing up at an evening dinner party.

When you see the Tip icon, you're about to read about something you can do to make your job easier. Long after you've finished with the first reading of this book, you can skim the book, looking for only the tips.

I use the Warning icon to highlight potential pitfalls. With this icon, I'm telling you: "Watch out! Whatever is being discussed could hurt your system." They say that those who are forewarned are forearmed, so I hope these entities will save you some frustration.

The Technical Stuff icon marks technical information that could be of interest to an advanced user (or those aspiring to be advanced users).

Beyond the Book

This book does not stop with the physical copy you hold in your hands. In addition to the content that is here, you'll find a Cheat Sheet worth looking at on the Dummies website. It includes quick tips for performing common tasks with Linux. You can find the Cheat Sheet at `www.dummies.com`.

Occasionally, we have updates to our technology books. If this book does have any technical updates, they'll be posted at www.dummies.com.

Where to Go from Here

It's time to get started on your Linux adventure. Turn to any chapter and let the fun begin. Use the Table of Contents and the Index to figure out where you want to go. Before you know it, you'll become an expert at Linux!

I hope you enjoy consulting this book as much as I enjoyed writing it!

1 Getting Started with Linux

Contents at a Glance

IN THIS CHAPTER

- Explaining Linux
- Looking at what Linux distributions typically include
- Discovering what Linux helps you manage
- Getting started with Linux

Chapter 1
Introducing Linux

By virtue of your holding this book in your hands, it's a safe bet that you've heard something about Linux. If you're wondering exactly what Linux is, whether it's worth serious consideration, and what it can help you do, this chapter is for you. Here, I provide a broad picture of Linux and tell you how you can start using it right away.

Although Linux can run on many hardware platforms, this book focuses on Linux for Intel Pentium-based processors (basically, any PC that can run any flavor of Windows).

What Is Linux?

You can think of a PC as being a combination of *hardware* — things you can touch, such as the system box, monitor, keyboard, and mouse. The system box contains the most important hardware of all: the *central processing unit* (CPU), the microchip that runs the *software* (any program that tells the computer how to do your bidding), which you can't actually touch. In a typical Pentium-based PC, the Pentium microprocessor is the CPU. Other important hardware in the system box includes the memory (RAM chips) and the hard drive.

The *operating system* is the program that has to interact with all the hardware and get it to play nice. The operating-system software manages all that hardware and

runs other software at your command. You, the user, provide those commands by choosing menus, clicking icons, or typing cryptic text. Linux is an operating system — as are Unix, macOS, Windows 10, and even older Windows versions. The Linux operating system is modeled after Unix; in its most basic, no-frills form, the Linux operating system also goes by *Linux kernel.*

The operating system gives a computer — any computer — its personality. You can run Windows on a PC, for example, and on that same PC, you can also install and run Linux. Then, depending on which operating system is installed and running at any particular time, the same PC can operate as a Windows system or as a Linux system.

The primary job of an operating system is to load software (computer programs) from the hard drive (or other permanent storage) into the memory and get the CPU to run those programs. Everything you do with your computer is possible because of the operating system, so if the operating system somehow messes up, the entire system freezes. You may know how infuriating it can be when your favorite operating system — maybe even the one that came with your PC — suddenly calls it quits just as you were about to click the Send button after composing that long email to your friend. You try several things frantically, but nothing happens. Then it's time to press the Reset button (or pull the cord from the back of the machine if your computer's builders weren't wise enough to include a Reset button). Luckily, that sort of thing almost never happens with Linux; it has a reputation for being a very reliable operating system.


TECHNICAL STUFF

In technical mumbo jumbo, Linux is a *multiuser, multitasking operating system.* Those terms just mean that Linux enables multiple users to log in, and each of those users can run more than one program at the same time. Nearly all operating systems are multiuser and multitasking these days, but when Linux started in 1993, *multiuser* and *multitasking* were big selling points.

Linux distributions

A *Linux distribution* consists of the Linux *kernel* (the operating system) and a collection of applications together with an easy-to-use installation program.


TIP

Most people just say *Linux* to refer to a specific Linux distribution.

Many Linux distributions are available, and each includes the standard Linux operating system and the following major packages:

- **The X Window System:** It's the graphical user interface.
- **One or more graphical desktops:** Among the most popular are GNOME and KDE Plasma.

DOES LINUX REALLY RUN ON ANY COMPUTER?

TECHNICAL STUFF

Linux runs on many types of computer systems, and there are so many distributions that it does seem able to run on nearly any type of computer.

Linus Torvalds and other programmers developed Linux for the Intel 80x86 (and compatible) line of processors. This book covers Linux for Intel 80x86 and Pentium processors (known as the *IA32 architecture* processors, or *i386*, because they support the instruction set of the 80386 processor).

Nowadays, Linux is also available for systems based on other processors as well, and IBM has released its own version of Linux for its zSeries mainframes. Several popular Linux distributions, including Ubuntu and Fedora, can even be run on Sony's PlayStation video game system.

- **A selection of applications:** Linux programs come in the form of ready-to-run software, but the *source code* (the commands we humans use to tell the computer what to do) is included (or available), as is its documentation.

  Current Linux distributions include a huge selection of software — so much that some distributions usually require multiple DVD-ROMs for installation.

TIP

The development and maintenance of the Linux kernel, the software packages in a Linux distribution, and the Linux distributions themselves are organized as open-source projects. In a nutshell, *open-source* means access to the source code and the right to freely redistribute the software without any restrictions. The definition involves a lot more than this succinct note, however. To find out the details of what open-source means and the acceptable open-source licenses, you can visit the Open Source Initiative website at `https://opensource.org`.

Table 1-1 lists a few major Linux distributions and gives a brief description of each one. Note, however, that many more Linux distributions exist than the ones shown in Table 1-1. To find out more about Linux distributions, visit DistroWatch.com at `http://distrowatch.com`. At that website, you can read up on specific distributions, as well as find links for downloading or ordering DVDs for specific distributions.

As you can see from the brief descriptions in Table 1-1, some Linux distributions, such as Knoppix and MEPIS, are available in the form of Live media (USBs, CDs, or DVDs). A *Live* version includes a Linux kernel that you can boot and run directly from the USB, CD, or DVD without having to install it on your hard drive. Such Live distributions can be handy if you want to try a distribution before you decide whether to install it.

TABLE 1-1 Major Linux Distributions

Distribution	Description
Debian GNU/Linux	This noncommercial distribution started in 1993 and continues to be a popular distribution, with many volunteer developers around the world contributing to the project. Debian is a huge distribution that takes some time to install. After you install the base Debian system, you can install and upgrade Debian packages easily with a package installer called `apt-get` (where *apt* stands for the Advanced Packaging Tool). Debian is available free of charge from `https://www.debian.org`. Debian is the basis for several other recent distributions, including Knoppix, MEPIS, and Ubuntu. At this writing, the most recent release of Debian is Debian 9, code-named Stretch.
Fedora	This distribution, once known as Fedora Core, is the successor to Red Hat Linux, which is the Linux distribution from Red Hat. Fedora Core 1, released in November 2003, was the successor to Red Hat Linux 9. The alpha release of Fedora 27 occurred in 2017. Fedora is freely available and uses Red Hat Package Manager (RPM) format for its software packages. You can download Fedora at `https://getfedora.org`.
Gentoo Linux	This noncommercial, *source-based* (all software provided in source-code form) distribution first appeared in 2002. The installer provides some binary packages to get Linux going, but the idea is to compile all source packages on the user's computer. The requirement to install so much makes it time-consuming to build a full-fledged Gentoo system with the latest graphical desktops, multimedia, and development tools, because all the packages have to be downloaded and compiled. Gentoo Linux is freely available at `https://www.gentoo.org`.
Knoppix	This Live distribution is based on Debian and named after its developer, Klaus Knopper of Germany. Knoppix can be used as a recovery tool to fix problems with an installed Linux system because you can run Knoppix directly from a CD without having to install it on the hard drive. first (Although other distributions have this capability, Knoppix is ideally suited for the task.) Knoppix uses Debian package management. For information on downloading Knoppix free of charge, visit the Knoppix website at `www.knopper.net/knoppix/index-en.html`.
Linspire	This commercial distribution was first released in 2002 under the name LindowsOS. Linspire uses Debian package format and offers software downloads for a fee through what it calls the Click-N-Run web-based interface. Though you can still find it and download it from some locations, Linspire was acquired by Xandros in 2008 and has since been discontinued as a Linux distribution.
MEPIS Linux	This Debian-based Live distribution was first released in July 2003. It includes a graphical installer that can be launched from the Live distribution to install MEPIS on the hard drive. MEPIS has good hardware detection and comes with Java and multimedia software, which makes it popular. MEPIS uses Debian package format. You can download it from `www.mepis.org`.
Slackware Linux	This distribution is one of the oldest, first released in 1992. Slackware uses compressed `tar` files for its packages and provides a text-based installer with limited automatic detection of hardware. You do all software configurations by editing text files. Slackware is freely available from `www.slackware.com`.

Distribution	Description
SUSE Linux	This commercial distribution switched to a community development project called openSUSE in August 2005. SUSE Linux Open Source Software (OSS) is now freely available, and retail SUSE Linux is based on the open-source version. SUSE comes with the YaST installation and configuration tool, which is one of the best administration tools available. SUSE Linux uses RPM packages. The openSUSE project provides the ISO image files from various mirror sites. Visit `https://www.opensuse.org` for more information.
Ubuntu Linux	This Debian-based, noncommercial Linux distribution has become very popular since its initial release in 2004. Ubuntu is available as both an install distribution and a Live distribution. Because it's Debian-based, you can install the basic desktop system from the install media and then use the `apt-get` tool to install other packages and keep the system up to date. You can download Ubuntu free of charge from `https://www.ubuntu.com/download`.

Many Linux distributions are commercial products that you can buy online or in computer stores and bookstores. If you've heard about open-source and the *GNU* (which stands for GNU's Not Unix) license, you may think that no one can sell Linux for profit. Luckily for companies that sell Linux distributions, the GNU license — also called the GNU General Public License (GPL) — does allow commercial, for-profit distribution (but requires that the software be distributed in source-code form) and stipulates that anyone may copy and distribute the software in source-code form to anyone else. Several Linux distributions are available free of charge under the GPL, which means that you can download as many copies of the OS as you like.

Making sense of version numbers


TIP

The Linux kernel — and each Linux distribution — has its own version number. Additional software programs (such as GNOME and KDE Plasma desktops) that come with the Linux distribution have their own version numbers as well. The version numbers for the Linux kernel and the Linux distributions are unrelated, but each has particular significance. Version numbers are in the form of three integers separated by periods — *major.minor.patch,* where *major* and *minor* are numbers denoting the major and minor version numbers, and *patch* is another number representing the patch level (for example 4.15.7).


TIP

You can find out about the latest version of the Linux kernel online at `https://www.kernel.org`.

Each version of a Linux distribution includes specific versions of the Linux kernel and other major components, such as GNOME, KDE, and various applications.

The developers of active Linux distributions usually release new versions of their distribution on a regular basis — about every six to nine months. Ubuntu 17.10, for example, was released in October 2017; the next version was scheduled for release in April 2018. Typically, each new major version of a Linux distribution provides significant new features.

DISTRIBUTION SPECIFIC

Debian always has at least three releases at any time:

- **Stable:** Most users prefer this type of release because it's the latest officially released distribution.
- **Unstable:** The developers are working on this release.
- **Testing:** The release contains packages that have gone through some testing but aren't ready for inclusion in the stable release.

Linux Standard Base (LSB)

Linux has become important enough that it has a standard called the Linux Standard Base (LSB). *LSB* is a set of binary standards that should help reduce variations among the Linux distributions and promote portability of applications. The idea behind LSB is to provide an application binary interface so that software applications can run on any Linux (or other Unix) systems that conform to the LSB standard. The LSB specification references POSIX (Portable Operating System Interface) standards as well as many other standards, such as the C and C++ programming language standards, the X Window System version 11 release 6 (X11R6), and the Filesystem Hierarchy Standard (FHS). LSB version 1.2 (commonly referred to as *LSB 1.2*) was released on June 28, 2002. LSB 2.0 was released on August 30, 2004, and LSB 4.0 was released on November 11, 2008. Version 4.1 followed on February 16, 2011, essentially removing Java; version 5.0, the most recent version, was released June 2, 2015.

The LSB specification is organized into two parts: a common specification that remains the same across all types of processors and a set of hardware-specific specifications, one for each type of processor architecture. LSB 1.2, for example, has architecture-specific specifications for Intel 32-bit (IA32) and PowerPC 32-bit (PPC32) processors. LSB 1.3 adds a specification for the Intel 64-bit (IA64) architecture and IBM zSeries 31-bit (S/390) and 64-bit (S390X) processors, in addition to the ones for IA32 and PPC32. LSB 2.0 added a specification for the AMD 64-bit (AMD64 or X86_64) processors. LSB 4.0, which is the current specification, supports seven processor architectures: IA32, IA64, PPC32, PPC64 (64-bit PowerPC), S390, S390X, and X86_64.

An LSB certification program exists. Several Linux distributions are certified to be LSB-compliant, IA32 runtime environments. To discover more about LSB, visit `https://wiki.linuxfoundation.org/lsb/start`.

Contents of a Linux Distribution

A Linux distribution comes with the Linux kernel and a lot more software. These software packages include everything from graphical desktops to Internet servers to programming tools for creating new software. In this section, I briefly describe some major software packages that are bundled with typical Linux distributions. Without this bundled software, Linux wouldn't be as popular as it is today.

GNU software

At the heart of a Linux distribution is a collection of software that came from the GNU Project (see the nearby sidebar). You get to know these GNU utilities only if you use your Linux system through a *text terminal:* basic command-line interface that doesn't use onscreen visuals but instead shows a prompt at which you type your commands. (Alternatively, you could use a graphical window that mimics a text terminal and still use GNU utilities.) The GNU software is a basic part of any Linux distribution.

WHAT IS THE GNU PROJECT?

GNU is a recursive acronym that stands for GNU's Not Unix. Richard Stallman launched the GNU Project in 1984 to develop a complete Unix-like operating system. The GNU Project developed nearly everything needed for a complete operating system except the operating-system kernel.

All GNU software was distributed under the GNU General Public License (GPL). GPL essentially requires the software to be distributed in source-code form and stipulates that any user may copy, modify, and distribute the software to anyone else in source-code form. Users may have to pay for their individual copies of GNU software, however.

The Free Software Foundation is a tax-exempt charity that raises funds for work on the GNU Project. To find out more about the GNU Project, visit its home page at `www.gnu.org`. The home page is also where you can find information about how to contact the Free Software Foundation and how to help the GNU Project.

As a Linux user, you may not realize the extent to which all Linux distributions rely on GNU software. Nearly all the tasks you perform in a Linux system involve one or more GNU software packages. The GNOME graphical user interface (GUI) and the command interpreter (that is, the `bash` shell), for example, are both GNU software programs. By the way, the *shell* is the command-interpreter application that accepts the commands you type and then runs programs in response to those commands. If you rebuild the kernel or develop software, you do so with the GNU C and C++ *compiler* (which is part of the GNU software that accompanies Linux). If you edit text files with the `ed` or `emacs` editor, again, you're using a GNU software package. The list goes on and on.

Table 1-2 lists some well-known GNU software packages that come with most Linux distributions. Depending on your interests, you may never need to use many of these packages, but knowing what they are in case you ever do need them is a good idea.

GUIs and applications

Face it — typing cryptic Linux commands on a terminal is boring. For average users, using the system through a *graphical user interface* (GUI, pronounced "GOO-ee") — one that gives you icons to click and windows to open — is much easier. This case is where the X Window System, or *X*, comes to the rescue.

X is kind of like Microsoft Windows, but the underlying details of how X works are different from those of Windows. X provides the basic features of displaying windows onscreen, but unlike Microsoft Windows, it doesn't come with any specific look or feel for graphical applications. That look and feel come from GUIs such as GNOME and KDE's Plasma, which use the X Window System.

Most Linux distributions come with the X Window System in the form of XFree86 or X.Org X11, which are implementations of the X Window System for 80x86 systems. XFree86 and X.Org X11 work with a wide variety of video cards available for today's PCs.

Until early 2004, XFree86 from the XFree86 Project (`www.xfree86.org`) was the most commonly used X Window System implementation for x86 systems. Around version 4.4, however, some changes in the XFree86 licensing terms caused concerns for many Linux and Unix vendors, who felt that the licensing terms were no longer compatible with the GNU GPL. In January 2004, several vendors formed the X.Org Foundation (`www.x.org`) to promote continued development of an open-source X Window System and graphical desktop. The first release of X.Org X11 uses the same code that was used by XFree86 4.4, up until the time when the XFree86 license changes precipitated the creation of the X.Org Foundation.

TABLE 1-2 Well-Known GNU Software Packages

Software Package	Description
autoconf	Generates shell scripts that automatically configure source-code packages
automake	Generates Makefile.in files for use with autoconf
bash	The default shell (command interpreter) in Linux
bc	An interactive calculator with arbitrary-precision numbers
Binutils	A package that includes several utilities for working with binary files: ar, as, gasp, gprof, ld, nm, objcopy, objdump, ranlib, readelf, size, strings, and strip
Coreutils	A package that combines three individual packages called Fileutils, Shellutils, and Textutils and that implements utilities such as chgrp, chmod, chown, cp, dd, df, dir, dircolors, du, install, ln, ls, mkdir, mkfifo, mknod, mv, rm, rmdir, sync, touch, vdir, basename, chroot, date, dirname, echo, env, expr, factor, false, groups, hostname, id, logname, nice, nohup, pathchk, printenv, printf, pwd, seq, sleep, stty, su, tee, test, true, tty, uname, uptime, users, who, whoami, yes, cut, join, nl, split, tail, and wc
cpio	Copies file archives to and from disk or to another part of the file system
diff	Compares files, showing line-by-line changes in several formats
ed	A line-oriented text editor
emacs	An extensible, customizable, full-screen text editor and computing environment
Findutils	A package that includes the find, locate, and xargs utilities
finger	A utility program designed to enable users on the Internet to get information about one another
gawk	The GNU Project's implementation of the awk programming language
gcc	Compilers for C, C++, Objective-C, and other languages
gdb	Source-level debugger for C, C++, and FORTRAN
gdbm	A replacement for the traditional dbm and ndbm database libraries
gettext	A set of utilities that enables software maintainers to *internationalize* (make the software work with different languages such as English, French, and Spanish) a software package's user messages
ghostscript	An interpreter for the PostScript and Portable Document Format (PDF) languages
ghostview	An X Window System application that makes ghostscript accessible from the GUI, enabling users to view PostScript or PDF files in a window

(continued)

TABLE 1-2 *(continued)*

Software Package	Description
The GIMP	The GNU Image Manipulation Program, an Adobe Photoshop–like image-processing program
GNOME	A GUI for a wide variety of tasks that a Linux user may perform
GNUchess	A chess game
GNU C Library	For use with all Linux programs
Gnumeric	A graphical spreadsheet (similar to Microsoft Excel) that works in GNOME
`grep` package	Includes the `grep`, `egrep`, and `fgrep` commands, which are used to find lines that match a specified text pattern
`groff`	A document formatting system similar to `troff`
`gtk+`	A GUI toolkit for the X Window System (used to develop GNOME applications)
`gzip`	A GNU utility for compressing and decompressing files
`indent`	Formats C source code by indenting it in one of several styles
`less`	A page-by-page display program similar to `more` but with additional capabilities
`libpng`	A library for image files in Portable Network Graphics (PNG) format
`m4`	An implementation of the traditional Unix macro processor
`make`	A utility that determines which files of a large software package need to be recompiled and issues the commands to recompile them
`ncurses`	A package for displaying and updating text on text-only terminals
`patch`	A GNU version of Larry Wall's program to take the output of `diff` and apply those differences to an original file to generate the modified version
`rcs`	Revision Control System, used for version control and management of source files in software projects
`sed`	A stream-oriented version of the `ed` text editor
Sharutils	A package that includes `shar` (used to make shell archives out of many files) and `unshar` (to unpack these shell archives)
`tar`	A tape-archiving program that includes *multivolume support* — the capability to archive *sparse files* (files with big chunks of data that are all zeros), handle compression and decompression, and create remote archives — and other special features for incremental and full backups
`texinfo`	A set of utilities that generates printed manuals, plain ASCII text, and online hypertext documentation (called `info`), and enables users to view and read online `info` documents
`time`	A utility that reports the user, system, and actual time that a process uses

As for the GUI, Linux distributions include one or two powerful GUI desktops: *KDE* (K Desktop Environment) and *GNOME* (GNU Object Model Environment). If both GNOME and KDE are installed on a PC, you can choose which desktop you want to use as the default or switch between the two. KDE and GNOME provide desktops similar to those of Microsoft Windows and the macOS. GNOME also comes with the Nautilus graphical shell, which makes finding files, running applications, and configuring your Linux system easy. With GNOME or KDE, you can begin using your Linux workstation without having to know cryptic Linux commands. If you ever need to use those commands directly, however, all you have to do is open a terminal window and type the commands at the prompt.

Linux also comes with many graphical applications. One of the most noteworthy programs is *the GIMP* (GNU Image Manipulation Program), a program for working with photos and other images. The GIMP's capabilities are on a par with those of Adobe Photoshop.

Although Linux used to lack in providing common productivity software such as word processing, spreadsheet, and database applications, this situation has changed. Linux now has no shortage of Linux office applications that are compatible with Microsoft Office and other productivity suites.

Networks

Linux comes with everything you need to use the system on networks to exchange data with other systems. On networks, computers that exchange data must follow well-defined rules, or *protocols.* A *network protocol* is a method that the sender and receiver agree on for exchanging data across a network. Such a protocol is similar to the rules you might follow when you're having a polite conversation with someone at a party. You typically start by saying hello, exchanging names, and then taking turns talking. That's about the same way network protocols work. The two computers use the same protocol to send bits and bytes back and forth across the network.

One of the best-known (and most popular) network protocols is Transmission Control Protocol/Internet Protocol (TCP/IP). TCP/IP is the protocol of choice on the Internet — the "network of networks" that spans the globe. Linux supports the TCP/IP protocol and any network applications that use TCP/IP.

Internet servers

Some popular network applications are designed to deliver information from one system to another. When you send electronic mail (email) or visit websites

by using a web browser, you use these network applications (also called *Internet services*). Here are some common Internet services:

- **Electronic mail** (email), which you use to send messages to any other person on the Internet by using addresses such as joe@someplace.com
- **World Wide Web** (or, simply, the web), which you browse by using a web browser
- **File transfer utilities,** which you can use to upload and download files
- **Remote login, which** you use to connect to and work with another computer (the remote computer) on the Internet, assuming that you have the username and password required to access that remote computer

Any Linux PC can offer these Internet services. To do so, the PC must be connected to the Internet, and it must run special server software called *Internet servers.* Each server uses a specific protocol for transferring information. Here are some common Internet servers that you find in Linux:

- `sendmail` is a mail server for exchanging email messages between systems by using SMTP (Simple Mail Transfer Protocol).
- Apache `httpd` is the web server for sending documents from one system to another by using HTTP (Hypertext Transfer Protocol).
- `vsftpd` is the server for transferring files between computers on the Internet by using FTP (File Transfer Protocol).
- `in.telnetd` allows a user on one system to log in to another system on the Internet by using the Telnet protocol.
- `sshd` allows a user on one system to log in securely to another system on the Internet by using the SSH (Secure Shell) protocol.

Software development

Linux is particularly well suited to software development. Straight out the box, it's chock-full of software-development tools, such as the compiler and libraries of code needed to build programs. If you happen to know Unix and the C programming language, you'll feel right at home programming in Linux.

As far as the development environment goes, Linux has the same basic tools (such as an editor, a compiler, and a debugger) that you might use on other Unix workstations, such as those from IBM, Sun Microsystems, and HP.


TIP

If you work by day on one of these Unix workstations, you can use a Linux PC in the evening at home to duplicate that development environment at a fraction of the cost. Then you can either complete work projects at home or devote your time to software that you write for fun and to share on the Internet.

STUFF PROGRAMMERS WANT TO KNOW ABOUT LINUX

These features make Linux a productive software-development environment:

- **GNU C compiler (`gcc`):** Compiles ANSI-standard C programs.
- **GNU C++ compiler (`g++`):** Supports ANSI-standard C++ features.
- **GNU compiler for Java (`gcj`):** Compiles programs written in the Java programming language.
- **GNU `make` utility:** Enables you to compile and link large programs.
- **GNU debugger (`gdb`):** Enables you to step through your program to find problems and determine where and how a program failed. (The failed program's memory image is saved in the `core` file; `gdb` can examine this file.)
- **GNU profiling utility (`gprof`):** Enables you to determine the degree to which a piece of software uses your computer's processor time.
- **Subversion, Concurrent Versions System (CVS), and Revision Control System (RCS):** Maintain version information and controls access to the source files so that two programmers don't inadvertently modify the same source file at the same time.
- **GNU `emacs` editor:** Prepares source files and even launches a compile-link process to build the program.
- **Perl:** Enables you to write scripts to accomplish a specific task, tying together many smaller programs with Linux commands.
- **Tool Command Language and its graphical toolkit (`Tcl/Tk`):** Enable you to build graphical applications rapidly.
- **Python:** Enables you to write code in an interpreted programming language comparable to Perl and Tcl. (The Fedora Core installation program, called `anaconda`, is written in Python, for example.)
- **Dynamically linked, shared libraries:** Allow your actual program files to be much smaller because all the library code that several programs may need is shared, with only one copy loaded in the system's memory.

Online documentation

As you become more adept at using Linux, you may want to look up information quickly — without having to turn the pages of (ahem) this great book, for example. Luckily, Linux comes with enough online information to jog your memory in those situations when you vaguely recall a command's name but can't remember the syntax you're supposed to type.

If you use Linux commands, you can view the manual page — commonly referred to as the *man page* — for a command by using the `man` command. (You do have to remember that command to access online help.)

You can also get help from the GUI desktops. Both GNOME and KDE desktops come with help viewers to view online help information. Most distributions include a help option on the desktop menu or a help icon on the desktop that you can use to get online help. Then you can browse the help information by clicking the links in the initial help window. Figure 1-1 shows a typical help window from Ubuntu's desktop.

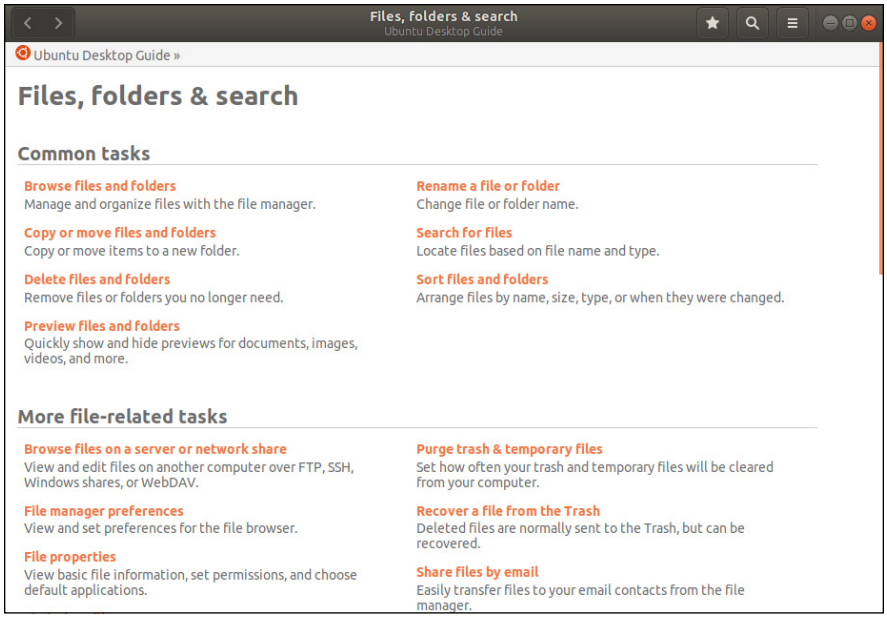

FIGURE 1-1: Online help is available from the GUI desktop.