

LEARNING MADE EASY



7th Edition

Linux[®]

ALL-IN-ONE

for
dummies[®]
A Wiley Brand



Richard Blum

Has used Linux since the days when it
took 55 floppy disks to load it



Linux[®]

ALL-IN-ONE

7th Edition

by Richard Blum

for
dummies[®]
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Contents at a Glance

Introduction	1
Book 1: Getting Started with Linux	5
CHAPTER 1: Introducing Linux	7
CHAPTER 2: Installing Linux	21
CHAPTER 3: Living in a Virtual World	39
CHAPTER 4: Trying Out Linux	53
CHAPTER 5: Troubleshooting and Customizing Linux	63
Book 2: Linux Desktops	85
CHAPTER 1: The GNOME Desktop	87
CHAPTER 2: The KDE Plasma Desktop	93
CHAPTER 3: Other Popular Desktops	103
CHAPTER 4: Linux Desktop Applications	115
CHAPTER 5: The Linux File System	133
CHAPTER 6: Text Editors	155
Book 3: Networking	171
CHAPTER 1: Connecting to the Internet	173
CHAPTER 2: Setting Up a Local Area Network	185
CHAPTER 3: Going Wireless	199
CHAPTER 4: Managing the Network	207
Book 4: Administration	223
CHAPTER 1: Working with the Shell	225
CHAPTER 2: Introducing Basic System Administration	249
CHAPTER 3: Managing Users and Groups	287
CHAPTER 4: Managing File Systems	297
Book 5: Managing Linux Servers	311
CHAPTER 1: Hosting Internet Services	313
CHAPTER 2: Managing a Web Server	331
CHAPTER 3: Managing a Database Server	349
CHAPTER 4: Working with Samba and NFS	373
CHAPTER 5: Managing Mail Servers	385

Book 6: Security	401
CHAPTER 1: Introducing Linux Security	403
CHAPTER 2: Securing Linux	419
CHAPTER 3: Vulnerability Testing and Computer Security Audits	449
Book 7: Scripting	465
CHAPTER 1: Introductory Shell Scripting	467
CHAPTER 2: Advanced Shell Scripting	479
CHAPTER 3: Programming in Linux	487
Book 8: Linux Certification	513
CHAPTER 1: Studying for the Linux Professional Institute Exams	515
CHAPTER 2: Studying for the CompTIA Linux+ Exam	529
CHAPTER 3: Other Linux Certifications	535
Index	539

Table of Contents

INTRODUCTION	1
About This Book	1
Foolish Assumptions	2
Icons Used in This Book	3
Beyond the Book	4
Where to Go from Here	4
BOOK 1: GETTING STARTED WITH LINUX	5
CHAPTER 1: Introducing Linux	7
What Is Linux?	7
The Linux kernel	8
GNU utilities	11
Linux user interfaces	12
Linux Distributions: Why So Many?	16
Core Linux distributions	17
Specialized Linux distributions	18
CHAPTER 2: Installing Linux	21
Dual-Booting with Linux and Microsoft Windows	23
Installing a second hard drive	24
Partitioning an existing drive	24
Partitioning using Windows tools	25
Partitioning using Linux tools	26
Finally, Finally, Before You Get Started	27
Disabling the secure boot feature	27
Creating a boot disk	28
Installing Ubuntu	30
Your First Ubuntu Boot	36
CHAPTER 3: Living in a Virtual World	39
What Are Virtual Servers?	39
Installing VirtualBox	40
Creating a Linux Virtual Machine	42
Installing Linux on a Virtual Machine	45
Changing settings	45
Loading the operating system	47
Working with the sandbox	50

CHAPTER 4: Trying Out Linux	53
Starting Linux	53
Playing with the Shell	56
Starting the bash shell	56
Understanding shell commands	58
Trying a few Linux commands	58
Shutting Down	60
CHAPTER 5: Troubleshooting and Customizing Linux	63
Using Text Mode Installation	64
Lookin' for Trouble	64
Using the kernel ring buffer	65
Using log files	66
Using the journal	67
Resolving Other Installation Problems	68
Using KNOPPIX boot commands	68
Handling the fatal signal 11 error	71
Getting around the PC reboot problem	71
Using Linux kernel boot options	71
Setting Up Printers	74
Managing DVDs, CD-ROMs, and Flash Drives	76
Updating the Operating System	77
Updating Ubuntu	77
Updating openSUSE	78
Installing New Software	79
Adding applications	80
Adding packages	81
BOOK 2: LINUX DESKTOPS	85
CHAPTER 1: The GNOME Desktop	87
Looking at the History of GNOME	87
Breaking Down the GNOME Desktop	88
Menu, please!	88
The desktop	90
Exploring the Activities Overview	91
Customizing Your Ride	92
CHAPTER 2: The KDE Plasma Desktop	93
The KDE Plasma Desktop	93
The Application launcher	95
The panel	96
The desktop	96

Using Widgets	98
Adding widgets.	98
Getting more widgets	99
Plasma System Settings	99
Desktop Settings	100
CHAPTER 3: Other Popular Desktops	103
Spicing Things Up with Cinnamon	103
Reviewing the history of Cinnamon	104
Looking at the menu.	105
Changing settings	105
Adding more spice.	106
Working with MATE.	107
The history of MATE	107
Looking at the menu.	109
Changing desktop settings.	109
Applets	110
The Xfce Desktop Interface	111
The history of Xfce.	111
The Whisker menu	112
Changing Xfce settings	113
Applets	113
CHAPTER 4: Linux Desktop Applications	115
The LibreOffice Suite.	115
Browsing the Web with Firefox	117
Configuring Firefox	117
Communicating with Email	119
Evolving into email	120
Working with KMail	121
The amazing Thunderbird	123
Listening to Audio	124
Listening to downloaded music.	127
Viewing Movie Files	129
Creating and Modifying Graphics	130
CHAPTER 5: The Linux File System	133
Pieces of the Puzzle.	133
Touring the Linux File System	134
The root of the tree.	134
Where removable media lives	136
Managing Your File System without a Net (or Mouse).	136
Viewing information about files on the command line	136
Understanding file listing information	137

Comprehending file types	139
Navigating the file system in Linux	140
A Permissions Primer	141
Checking out the triplets	141
Beware of owners	143
Hanging out in groups	143
Clicking Your Way through the File System	144
Using files	145
Swimming with Dolphin	149
Don't forget Xfce!	151
Finding Things	152
CHAPTER 6: Text Editors	155
Viewing the Contents of a Text File	155
Editing Text Files with nano	156
Going with gedit	157
Editing Text in the KDE Plasma Desktop	158
Writing with KWrite	159
Meet Kate	160
Text Editing with ed and vi	161
Using ed	162
Using vi	165
BOOK 3: NETWORKING	171
CHAPTER 1: Connecting to the Internet	173
Understanding the Internet	174
Deciding How to Connect to the Internet	175
Connecting with DSL	176
How DSL works	176
DSL alphabet soup: ADSL, IDSL, SDSL	177
Typical DSL setup	179
Connecting with a Cable Modem	180
How a cable modem works	181
Typical cable modem setup	182
CHAPTER 2: Setting Up a Local Area Network	185
Understanding TCP/IP	185
IP addresses	187
Internet services and port numbers	189
Setting Up an Ethernet LAN	190
How Ethernet works	191
Ethernet cables	192
Configuring TCP/IP Networking	195
Connecting Your LAN to the Internet	196

CHAPTER 3: Going Wireless	199
Understanding Wireless Ethernet Networks	199
Understanding infrastructure and ad hoc modes	201
Understanding wireless security	201
Setting Up Wireless Hardware	203
Configuring the Wireless Access Point	204
Configuring Wireless Networks	205
CHAPTER 4: Managing the Network	207
Configuring Network Features	207
Manually editing network configuration files	208
Using a graphical tool	210
Using a command-line tool	212
Basic Network Troubleshooting	216
Advanced Network Troubleshooting	218
BOOK 4: ADMINISTRATION	223
CHAPTER 1: Working with the Shell	225
Opening Terminal Windows and Virtual Consoles	225
Using the Bash Shell	228
Understanding the syntax of shell commands	228
Working with files	230
Combining shell commands	231
Controlling command input and output	231
Going wild with asterisks and question marks	233
Discovering and Using Linux Commands	235
Becoming root (superuser)	240
Managing processes	241
Working with date and time	242
Processing files	243
Writing Shell Scripts	246
CHAPTER 2: Introducing Basic System Administration	249
Taking Stock of System Administration Tasks	250
Becoming root	251
Using the su - command	251
Using the sudo command	252
Understanding How Linux Boots	252
Understanding the SysVinit method	253
Understanding the Systemd method	259
Monitoring System Performance	264
Using the top utility	264
Using the uptime command	266

Using the vmstat utility	267
Checking disk performance and disk usage	267
Viewing System Information with the /proc File System	270
Understanding Linux Devices	273
Device files	274
Persistent device naming with udev	275
Managing Loadable Driver Modules	276
Loading and unloading modules	276
Understanding the /etc/modprobe.d files	277
Scheduling Jobs in Linux	278
Scheduling one-time jobs	278
Scheduling recurring jobs	281
Introducing Some GUI System Administration Tools	284
CHAPTER 3: Managing Users and Groups	287
Adding User Accounts	288
Managing user accounts by using a GUI user manager	288
Managing user accounts by using commands	290
Managing Groups	291
Exploring the User Environment	292
Changing User and Group Ownership of Files	295
CHAPTER 4: Managing File Systems	297
Exploring the Linux File System	297
Understanding the file-system hierarchy	298
Mounting a device on the file system	299
Examining the /etc/fstab file	303
Sharing Files with NFS	304
Installing NFS	305
Exporting a file system with NFS	306
Mounting an NFS file system	307
Accessing a DOS or Windows File System	308
Mounting a DOS or Windows disk partition	308
Mounting an NTFS partition	309
BOOK 5: MANAGING LINUX SERVERS	311
CHAPTER 1: Hosting Internet Services	313
What Is a Linux Server?	313
Launching services	314
Listening for clients	316
Serving the Basics	318
Web services	319
Database services	320
Mail services	322

	Serving Local Networks	324
	File servers	325
	Print servers	326
	Network resource servers	326
CHAPTER 2:	Managing a Web Server	331
	Linux Web Servers	331
	Apache	331
	NGINX	333
	The Apache Web Server	333
	Installing an Apache server	333
	Configuring an Apache server	336
	The NGINX Server	344
	Installing NGINX	344
	Configuring NGINX	346
CHAPTER 3:	Managing a Database Server	349
	Using the MySQL/MariaDB Database	349
	Installing MariaDB	350
	Looking at the MariaDB command prompt	353
	Using the mysql commands	356
	Creating database objects	360
	Using the PostgreSQL Database	363
	Installing PostgreSQL	364
	Looking at the PostgreSQL command interface	366
	Creating PostgreSQL database objects	370
CHAPTER 4:	Working with Samba and NFS	373
	Sharing Files with NFS	373
	Installing NFS	374
	Exporting a file system with NFS	375
	Mounting an NFS file system	378
	Setting Up a Windows Server Using Samba	378
	Installing Samba	380
	Configuring Samba	382
	Trying out Samba	383
CHAPTER 5:	Managing Mail Servers	385
	Working with sendmail	385
	The sendmail configuration file	386
	Syntax of the sendmail.cf file	391
	Other sendmail files	393
	The .forward file	395
	The sendmail alias file	395

Working with Postfix	396
A Mail-Delivery Test	398
Using the mail command	399
The mail-delivery mechanism	400
BOOK 6: SECURITY	401
CHAPTER 1: Introducing Linux Security	403
Why Worry about Security?	404
Establishing a Security Framework	404
Determining business requirements for security	406
Performing risk analysis	406
Establishing a security policy	408
Implementing security solutions (mitigation)	409
Managing security	410
Securing Linux	410
Understanding the host-security issues	411
Understanding network-security issues	412
Delving Into Computer Security Terminology and Tools	413
Keeping Up with Security News and Updates	418
CHAPTER 2: Securing Linux	419
Securing Passwords	420
Shadow passwords	420
Pluggable authentication modules (PAMs)	421
Protecting Files and Directories	422
Viewing ownerships and permissions	423
Changing file ownerships	423
Changing file permissions	423
Setting default permission	424
Checking for set user ID permission	426
Encrypting and Signing Files with GnuPG	427
Understanding public key encryption	427
Understanding digital signatures	428
Using GPG	429
Monitoring System Security	433
Securing Internet Services	434
Turning off stand-alone services	434
Configuring the Internet super server	435
Configuring TCP wrapper security	436
Using Secure Shell for Remote Logins	437
Setting Up Simple Firewalls	439
Using NAT	442
Enabling packet filtering on your Linux system	443
Security Files to Be Aware Of	447

CHAPTER 3: Vulnerability Testing and Computer Security Audits	449
Understanding Security Audits	450
Nontechnical aspects of security audits	450
Technical aspects of security audits	451
Implementing a Security Test Methodology	452
Some common computer vulnerabilities	453
Host-security review	454
Network-security review	458
Vulnerability Testing Types	460
Exploring Security Testing Tools	461
BOOK 7: SCRIPTING	465
CHAPTER 1: Introductory Shell Scripting	467
Trying Out Simple Shell Scripts	468
Exploring the Basics of Shell Scripting	469
Storing stuff	470
Calling shell functions	471
Controlling the flow	471
Exploring bash's built-in commands	475
CHAPTER 2: Advanced Shell Scripting	479
Trying Out sed	479
Working with awk and sed	482
Step 1: Pull out the ISBN	483
Step 2: Calculate the 13th digit	484
Step 3: Add the 13th digit to the other 12	485
Step 4: Finish the process	485
Final Notes on Shell Scripting	486
CHAPTER 3: Programming in Linux	487
An Overview of Programming	488
Exploring the Software-Development Tools in Linux	489
GNU C and C++ compilers	490
The GNU make utility	493
The GNU debugger	502
Understanding the Implications of GNU Licenses	509
The GNU General Public License	510
The GNU Library General Public License	511

BOOK 8: LINUX CERTIFICATION	513
CHAPTER 1: Studying for the Linux Professional Institute Exams	515
Overview of LPI Certification Exams	515
Overview of the Linux Essentials Exam	516
Getting involved in the Linux community and finding a career in open source	517
Finding your way on a Linux system	518
The power of the command line	520
The Linux operating system	521
Security and file permissions	522
Overview of the Linux Professionals Exams	524
The LPIC-1 exams	524
The LPIC-2 exams	527
The LPIC-3 exams	528
CHAPTER 2: Studying for the CompTIA Linux+ Exam	529
Overview of the CompTIA Linux+ Exam	530
System Management	531
Security	532
Scripting, Containers, and Automation	533
Troubleshooting	533
CHAPTER 3: Other Linux Certifications	535
Vendor-Neutral Certifications	535
The Linux Foundation	535
The GIAC Certifications	536
Vendor-Specific Certifications	537
INDEX	539

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 a website or get it on a USB flash drive, CD, or 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.

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 CompTIA and 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.

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 I discuss the material, Tips draw your attention to the key concepts and topics tested in the CompTIA Linux+ or LPI LPIC-1 exams. 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, ignore 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 CompTIA or 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.

Within this book, you may note that some web addresses break across two lines of text. If you're reading this book in print and want to visit one of these web pages, simply key in the web address exactly as it's noted in the text, pretending as though the line break doesn't exist. If you're reading this as an e-book, you've got it easy — just click the web address to be taken directly to the web page.

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 PC that you can sacrifice and then install Linux on that PC. Alternatively, you can install a virtual server software package such as Oracle's VirtualBox and install Linux as a virtual machine inside your Windows desktop.

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 thumb tabs or consult the Table of Contents.

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:



REMEMBER

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.



TIP

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.



WARNING

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.



TECHNICAL
STUFF

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

In addition to the book you have in your hands, you can access some helpful extra content online. Check out the free Cheat Sheet by going to www.dummies.com and entering **Linux All-in-One For Dummies** in the Search box. You'll find common Linux commands and where to go for more help with Linux.

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

CHAPTER 1: Introducing Linux	7
What Is Linux?	7
Linux Distributions: Why So Many?	16
CHAPTER 2: Installing Linux	21
Dual-Booting with Linux and Microsoft Windows	23
Finally, Finally, Before You Get Started.	27
Installing Ubuntu	30
Your First Ubuntu Boot.	36
CHAPTER 3: Living in a Virtual World	39
What Are Virtual Servers?	39
Installing VirtualBox	40
Creating a Linux Virtual Machine	42
Installing Linux on a Virtual Machine	45
CHAPTER 4: Trying Out Linux	53
Starting Linux	53
Playing with the Shell	56
Shutting Down	60
CHAPTER 5: Troubleshooting and Customizing Linux	63
Using Text Mode Installation	64
Lookin' for Trouble	64
Resolving Other Installation Problems	68
Setting Up Printers	74
Managing DVDs, CD-ROMs, and Flash Drives	76
Updating the Operating System	77
Installing New Software	79

Chapter 1

Introducing Linux

The Linux operating system has become one of the most widely used operating systems, popular among researchers, application developers, and hobbyists alike. These days, the Linux operating system can be found in an amazing range of computer environments, from mobile phones to satellites.

This chapter examines just what the Linux operating system is and why there are so many different Linux distributions available to choose from. With this information, you can select the right Linux distribution for your environment.

What Is Linux?

If you've never worked with Linux before, you may be confused as to why there are so many different versions of it available. You've most likely come across terms such as *distribution*, *LiveDVD*, and *GNU* when looking at Linux packages, and you may have been confused. This section takes some of the mystery out of the Linux system for you.

Although people usually refer to the Linux operating system as just "Linux," in reality there are quite a few parts that make up a complete Linux system. The four main parts of a Linux system are

- »» The Linux kernel
- »» The GNU utilities
- »» The user interface
- »» Application software

Each of these four parts has a specific job in the Linux system. Although each of the parts by itself isn't very useful, put together, they create what people refer to as "Linux." Figure 1-1 shows the basic diagram of how these parts fit together to create the overall Linux system.

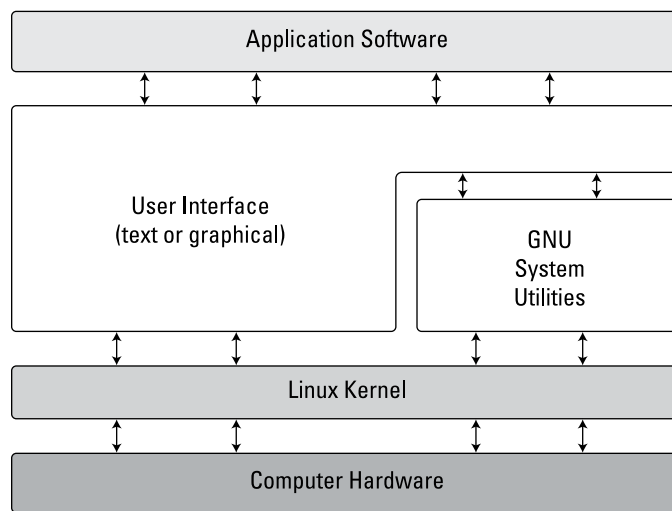


FIGURE 1-1:
The Linux system.

The following sections describe these four parts in detail and give you an overview of how they work together to create a complete Linux system.

The Linux kernel

The core of the Linux system is the *kernel*. The kernel controls all the hardware and software on the computer system, allocating hardware when necessary and executing software when required.

If you've been following the Linux world at all, no doubt you've heard the name Linus Torvalds. Linus is the person responsible for creating the first Linux kernel software while he was a student at the University of Helsinki. He intended it to be a copy of the Unix system, at the time a popular operating system used at many universities.

After developing the Linux kernel, Linus released it to the Internet community and solicited suggestions for improving it. This simple process started a revolution in the world of computer operating systems. Soon Linus was receiving suggestions from students as well as professional programmers from around the world.

Allowing anyone to change programming code in the kernel would result in complete chaos. To simplify things, Linus acted as a central point for all improvement suggestions. It was ultimately Linus's decision whether to incorporate suggested code in the kernel. This same concept is still in place with the Linux kernel code, except that instead of just Linus controlling the kernel code, a team of developers has taken on the task.

The kernel is primarily responsible for four main functions:

- » System memory management
- » Software program management
- » Hardware management
- » File system management

The following sections explore the first three functions in more detail. File system management in Linux can be somewhat complicated; Book 2, Chapter 5 dives into that topic.

System memory management

One of the primary functions of the operating system kernel is memory management. Memory management is the ability to control how programs and utilities run within the memory restrictions of the system. Not only does the kernel manage the physical memory available on the system, but it can also create and manage *virtual memory* (memory that doesn't actually exist but is created on the hard drive and treated as real memory).

It does this by using space on the hard disk called the *swap space*. The kernel swaps the contents of virtual memory locations back and forth from the swap space to the actual physical memory. This allows the system to think there is more memory available than what physically exists, as shown in Figure 1-2.

The memory locations are grouped into blocks called *pages*. The kernel locates each page of memory either in the physical memory or the swap space. The kernel then maintains a table of the memory pages that indicates which pages are in physical memory and which pages are swapped out to disk.

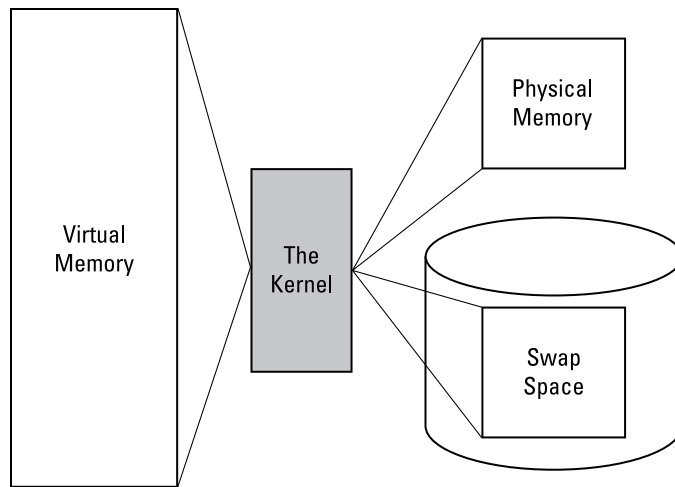


FIGURE 1-2:
The Linux system
memory map.

The kernel keeps track of which memory pages are in use and automatically copies memory pages that have not been accessed for a period of time to the swap space area (called *swapping out*) — even if other memory is available. When a program wants to access a memory page that has been swapped out, the kernel must make room for it in physical memory by swapping out a different memory page and swapping in the required page from the swap space. Obviously, this process takes time and can slow down a running process. The process of swapping out memory pages for running applications continues for as long as the Linux system is running.

Software program management

With the Linux operating system, a running program is called a *process*. A process can run in the foreground, displaying output on a display, or it can run in the background, doing work behind the scenes. The kernel controls how the Linux system manages all the processes running on the system.

The kernel creates the first process, called the *init process*, to start all other processes on the system. When the kernel starts, it loads the *init process* into virtual memory. As the kernel starts each additional process, it gives it a unique area in virtual memory to store the data and code that the process uses.

A few different types of *init process* implementations are available in Linux, but these days, the two most popular are

- » **SysVinit:** The SysVinit initialization method was the original method used by Linux and was based on the Unix System V initialization method. Though it is not used by many Linux distributions these days, you still may find it around in older Linux distributions.

- » **systemd:** The systemd initialization method was created in 2010 and has become the most popular initialization and process management system used by Linux distributions.

The SysVinit initialization method primarily utilizes scripts to start and stop applications as needed, while the systemd initialization method uses configuration files. Book 4, Chapter 2 explores how each of these initialization methods works and how you can configure them to customize which applications your Linux system starts automatically.

Hardware management

Still another of the kernel's responsibilities is hardware management. Any device that the Linux system must communicate with needs driver code inserted inside the kernel code. The driver code in the kernel allows the kernel to pass data back and forth to the device, acting as a middleman between applications and the hardware. There are two methods used for inserting device driver code in the Linux kernel:

- » Drivers compiled in the kernel
- » Driver modules added to the kernel during runtime

Originally, the only way to insert device driver code was to recompile the kernel and restart the system. Each time you added a new device to the system, you had to recompile the kernel code and restart. This process became even more inefficient as Linux kernels supported more hardware and as removable storage devices (such as USB sticks) became more popular. Fortunately, Linux developers devised a better method to insert driver code into the running kernel.

Programmers developed the concept of *kernel modules* to allow the insertion of device driver code into a running kernel without having to recompile the kernel. Also, a kernel module could be removed from the kernel when the system had finished using the device. This greatly simplified and expanded using hardware with Linux.

Book 4, Chapter 2 also dives into driver modules and how to use them in your Linux system.

GNU utilities

Besides having a kernel to control memory, software, and hardware devices, a computer operating system needs utilities to perform standard functions, such

as handling files and programs. Although Linus created the Linux system kernel, he had no system utilities to run on it. Fortunately for him, at the same time he was working, a group of people were working together on the Internet trying to develop a standard set of computer system utilities that mimicked the popular Unix operating system.

The GNU Project (GNU stands for GNU's Not Unix — a recursive acronym) developed a complete set of Unix utilities but had no kernel system to run them on. These utilities were developed under a software philosophy called open-source software (OSS).

The concept of OSS allows programmers to develop software and then release it to the world with no licensing fees attached. Anyone can use the software, modify it, or incorporate it into their own system without having to pay a license fee. Uniting Linus's Linux kernel with the GNU operating system utilities created a complete, functional, free operating system.

Although the bundling of the Linux kernel and GNU utilities is often just called Linux, you'll see some Linux purists on the Internet refer to it as the GNU/Linux system to give credit to the GNU Project for its contributions to the cause.

The GNU Project was mainly designed for Unix system administrators to have a Unixlike environment available. This focus resulted in the project porting many common Unix system commandline utilities. The core bundle of utilities supplied for Linux systems is called the `coreutils` package.

The GNU `coreutils` package consists of three parts:

- » Utilities for handling files
- » Utilities for manipulating text
- » Utilities for managing processes

Each of these three main groups of utilities contains several utility programs that are invaluable to the Linux system administrator and programmer.

Linux user interfaces

Having a world-class operating system that can manage your computer hardware and software is great, but you need some way to communicate with it. With the popularity of Microsoft Windows, desktop computer users expect some type of graphical display to interact with their system. This spurred more development in the OSS community, and the Linux graphical desktops emerged.

Linux is famous for being able to do things in more than one way, and no place is this more relevant than in graphical desktops. There are a plethora of graphical desktops you can choose from in Linux. The following sections describe a few of the more popular ones.

The X Window system

There are two basic elements that control your video environment: the video card in your workstation and your monitor. To display fancy graphics on your computer, the Linux software needs to know how to talk to both of them.

The X Window software is a lowlevel program that works directly with the video card and monitor in the workstation and controls how Linux applications can present fancy windows and graphics on your computer.

Linux isn't the only operating system that uses X Window; there are versions written for many different operating systems. In the Linux world, there are a few different software packages that can implement it, but there are two that are most commonly used:

- » **X.org:** Based on the original Unix X Window System version 11 (often called X11), it's the older of the two packages.
- » **Wayland:** More Linux distributions are migrating to the Wayland software, a newer X Window package that is touted to be more secure and easier to maintain.

When you first install a Linux distribution, it attempts to detect your video card and monitor and then creates an X Window configuration file that contains the required information. During installation, you may notice a time when the installation program scans your monitor for supported video modes. Sometimes this causes your monitor to go blank for a few seconds. Because there are lots of different types of video cards and monitors out there, this process can take a little while to complete.

The core X Window software produces a graphical display environment but nothing else. Although this is fine for running individual applications, it isn't too useful for day-to-day computer use. There is no desktop environment allowing users to manipulate files or launch programs. To do that, you need a desktop environment on top of the X Window system software.

The KDE Plasma desktop

The K Desktop Environment (KDE) was first released in 1996 as an open-source project to produce a graphical desktop similar to the Microsoft Windows

environment. The KDE desktop incorporates all the features you're probably familiar with if you're a Windows user. Figure 1-3 shows the current version, called KDE Plasma, running in the openSUSE Linux distribution.

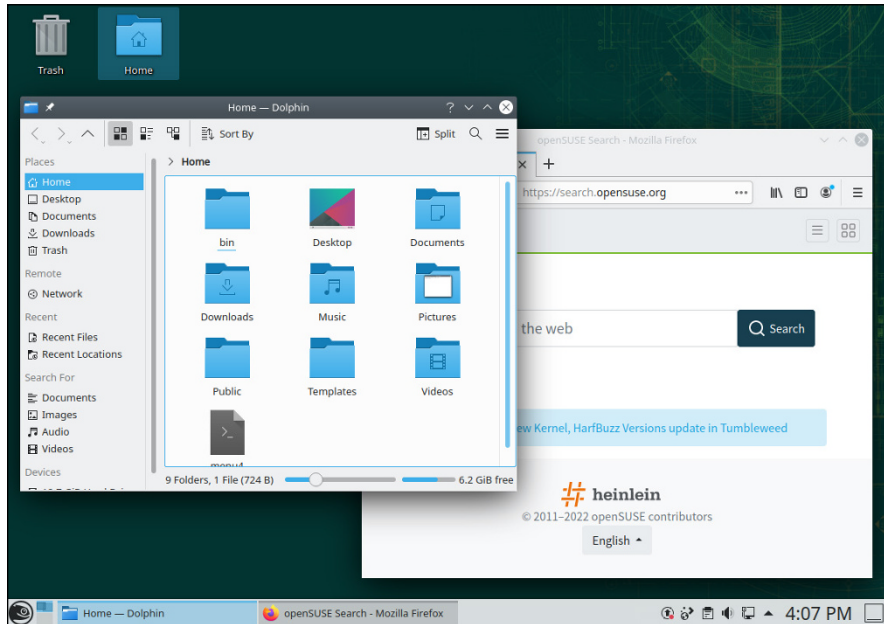


FIGURE 1-3: The KDE Plasma desktop in openSUSE.

The KDE project also maintains lots of common desktop applications that run in KDE Plasma. Book 2, Chapter 2 explores all the features of the KDE Plasma desktop environment.

The GNOME desktop

The GNU Network Object Model Environment (GNOME) is another popular Linux desktop environment. First released in 1999, GNOME has become the default desktop environment for many Linux distributions (the most popular being Red Hat Enterprise Linux).

The GNOME desktop underwent a radical change with version 3, released in 2011. It departed from the standard look and feel of most desktops that use standard menu bars and task bars, and instead made the interface more menu-driven so it would be user-friendly across multiple platforms, such as tablets and mobile phones. This change led to controversy, spawning many new desktops that kept the GNOME 2 look. Figure 1-4 shows the standard GNOME 3 desktop used in the Ubuntu Linux distribution.