BRIEF

Computer Concepts 2014

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BRIEF

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COURSE TECHNOLOGY
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New Perspectives on Computer Concepts, 2014, Brief

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Operating a Personal Computer
Working with Binary Numbers

CHAPTER 2
Benchmarking

CHAPTER 3
Installing and Uninstalling Software

CHAPTER 4
Managing Files
Backing Up Your Computer

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New Perspectives on Computer Concepts 2014

Preface

Connect the Concepts. We live in a digital world and we are constantly picking up bits and pieces of information about computers and other digital devices. But *understanding* digital devices in a way expected of a college graduate requires a framework of concepts that organizes information into hierarchies and relationships. It is, in a sense, **THE SOCIAL NETWORK OF LEARNING**.

New Perspectives on Computer Concepts 2014 is designed to help students connect the dots to visualize and internalize a framework for technology concepts that's applicable to academic research, career preparation, and today's digital lifestyles.

Ensure Success. Developed by digital textbook pioneers, NP2014 is a time-tested and fully interactive teaching and learning environment that supplies **TOOLS FOR SUCCESS**. The printed book, CourseMate Web site, interactive multimedia eBook, and assessment tools offer an engaging, multi-layered technology platform that supports diverse teaching and learning styles.

New for This Edition. What's the most effective study technique: Taking notes? Reviewing? According to researchers, students study most effectively by simply trying to recall the material they've read, seen, or heard. NP2014's new **TRY IT!** feature helps students recall key concepts as they read and later as they review. TRY IT! questions and activities on just about every page are interactive in digital versions of the textbook. Students using the printed textbook can find answers in the back of the book.

NP2014 is offered in several printed and digital formats. You can use the **PRINTED TEXTBOOK** alone or bundle it with one of the **MULTIMEDIA INTERACTIVE EBOOKS**. Or use the interactive eBooks by themselves. They contain page-for-page material from the printed textbook, plus videos, animated diagrams, software tours, computer-scored assessment, and results tracking.

PRINTED TEXTBOOK

- Orientation Chapter
- Section Concept Maps
- Learning Objectives
- Learning Objectives Checkpoints
- TRY IT!s
- Section QuickChecks
- Issues
- Information Tools
- Technology in Context
- Key Terms
- Interactive Summary
- Interactive Situation Questions
- Concept Maps

EBOOK CD

- Page-for-page equivalent to the printed textbook
- Videos and software tours
- Interactive TRY IT!s
- Computer-scored and tracked QuickChecks, Interactive Summaries, Situation Questions, and Concept Maps
- Practice Tests
- New Perspectives Labs with scored and tracked QuickChecks
- WebTrack results tracking
- Instructor annotations
- Chirps

COURSEMATE & EBOOK

- Page-for-page equivalent to the printed textbook
- Videos and software tours
- Interactive TRY IT!s
- Computer-scored and tracked Pre-Quizzes, Quickchecks, Interactive Summaries, Situation Questions, Concept Maps, and Chapter Quizzes
- Audio Overviews
- Audio Flashcards
- Games
- Track results with Engagement Tracker or WebTrack

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CREATE YOUR OWN LEARNING PLAN

It's easy! Use the NP2014 printed textbook, NP2014 Online CourseMate, or NP2014 eBook CD in **ANY WAY THAT'S RIGHT FOR YOU**. The Orientation helps you get acquainted with the extensive array of NP2014 technology at your command.

Your eBook CD Plan—Seven Easy Steps

1. Get started with the **EBOOK CD** and work on the Chapter opener **TRY IT! ACTIVITY** for a hands-on introduction to the chapter topics.
2. Read a chapter, answer the embedded **TRY IT!s**, and complete the **QUICKCHECKS**.
3. Use **CHIRPS** while you're reading to send questions to your instructor.
4. Work with **NEW PERSPECTIVES LABS** to apply your knowledge.
5. Complete **REVIEW ACTIVITIES** using your digital textbook.
6. Take **PRACTICE TESTS** to see if you're ready for the exam.
7. Transmit your results to your instructor on **WEBTRACK**.

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Your CourseMate Plan—Eight Steps Online

1. Log in to the NP2014 CourseMate to take the **PRE-QUIZ** and gauge what you already know.
2. Listen to an **AUDIO OVERVIEW** of chapter highlights.
3. Read a chapter in the online eBook and answer the embedded **TRY IT!s**.
4. Work with the **EBOOK ACTIVITIES AND PRACTICE TESTS** to assess your understanding. Your instructor can track your progress with WebTrack.
5. Have some fun reviewing with **ONLINE GAMES**.
6. Use **AUDIO AND TECHTERM FLASHCARDS** to review terminology from the chapter.
7. Check the **DETAILED LEARNING OBJECTIVES** to make sure you've mastered the material.
8. Take the **CHAPTER QUIZ** if your instructor is tracking results using Engagement Tracker.

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THE BOOK

NP2014 gives you the straight story on today's technology. The style has been carefully honed to be clear, concise, and visual.

Easy to read

Each chapter is divided into five **SECTIONS**, beginning with a **CONCEPT MAP** that provides a visual overview of concepts. **FAQS** answer commonly asked questions about technology and help you follow the flow of the presentation.

Keeps you on track

QUICKCHECKS at the end of each section give you a chance to find out if you understand the most important concepts. As you read the chapter, look for the answers to the questions posed as Learning Objectives, then try your hand at the **LEARNING OBJECTIVES CHECKPOINTS** at the end of each chapter to make sure you've retained the key points. Additional review activities include **TRY IT!s**, **KEY TERMS**, **INTERACTIVE CHAPTER SUMMARIES**, **INTERACTIVE SITUATION QUESTIONS**, and **CONCEPT MAPS**.

Helps you explore

The **ISSUE** section in each chapter highlights controversial aspects of technology. In the **TECHNOLOGY IN CONTEXT** section, you'll discover how technology plays a role in careers such as film-making, architecture, banking, and fashion design. The **INFORMATION TOOLS** section helps you brush up on digital research techniques and apps. Work with **ISSUE AND INFORMATION TOOLS TRY IT!s** to apply the concepts you learned as you explore technology controversies and sharpen your information literacy skills.

COMPUTERS AND DIGITAL BASICS 33

Control Unit

Add two numbers

ALU

Accumulator

Register 1

Register 2

RAM

TRY IT!

Execute the following set of commands using the ALU diagram at left.

Load Register 1 with 4.

Load Register 2 with 5.

Add the two registers.

Move the result to RAM.

1

What happens after an instruction is executed? When the computer completes an instruction, the control unit increments the instruction pointer to the memory address of the next instruction, and the instruction cycle begins again.

Do I need to know all this detailed stuff? What you should take away from the discussion about programming and instruction sets is the idea that computers and other digital devices accomplish a wide array of complex tasks by performing a very limited set of machine language instructions very fast.

These concepts about how processors work will help you understand the significance of microprocessor performance, such as speed and word size, which you'll learn about in the next chapter.

QuickCheck SECTION D

1. A(n) _____ converts all of the source code instructions into a new file containing _____ code.
2. A microprocessor is hard-wired to perform a set of activities called a(n) _____ set.
3. A machine language instruction has two parts: a(n) _____ code and an operand.
4. The ALU in your computer's microprocessor holds data in _____.
5. The microprocessor's control unit contains a(n) _____ pointer that holds the address of the instruction being executed.

CHECK ANSWERS

TRY IT! questions and activities embedded throughout the chapter keep learning interactive.

DIAGRAMS AND SCREENSHOTS on every page make it easy to visualize concepts.

FAQS break down concepts into manageable chunks of information.

QUICKCHECK questions throughout the chapter give you a chance to make sure you understand the main concepts.

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THE INTERACTIVE MULTIMEDIA EBOOK CD

The **NP2014 EBOOK CD** is a digital version of your textbook with multimedia and interactive activities designed to enhance your learning experience.

Works alone or with the printed book

Every page of the eBook CD **MIRRORS THE PRINTED TEXTBOOK**, so use the tool that's most convenient and that best suits your learning style.

Brings concepts to life

In the eBook CD, photos turn into **VIDEOS**. Illustrations become **ANIMATED DIAGRAMS**. Screenshots activate guided **SOFTWARE TOURS**, so you can see how applications and operating systems work even if they aren't installed on your computer.

Makes learning interactive

As you read each chapter, be sure to complete the computer-scored **TRY IT!s** and the **QUICKCHECKS** at the end of each section. When you complete a chapter, try the interactive, **COMPUTER-SCORED ACTIVITIES**. Take some **PRACTICE TESTS** to gauge how well you'll perform on exams.

You can master hundreds of computer concepts using the **NEW PERSPECTIVES LABS**. Use **WEBTRACK** to easily transmit your scores to your instructor. If you have questions as you're reading, use **CHIRPS** to send questions anonymously to your instructor.

The digital textbook is easy to use. It is packed with **MULTIMEDIA**, and offers plenty of **COMPUTER-SCORED ACTIVITIES**.

Interactive **NEW PERSPECTIVES LABS** give you hands-on experience with concepts and software.

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THE NP2014 ONLINE COURSEMATE WITH EBOOK

The NP2014 CourseMate is packed full of information and includes an interactive, multimedia eBook plus activities to accompany each chapter. Follow the directions in Section D of the Orientation chapter to sign up for an account and access the NP2014 CourseMate.

Lets you study anywhere

CourseMate includes an **ONLINE EBOOK**, so you can access your textbook from any computer that's connected to the Internet. eBook activities can be tracked by instructors using WebTrack.

Gives you options

Want to find out where to focus your study time? Start with a **PRE-QUIZ**. Looking for a fun way to review? Try an **ONLINE GAME** that packages chapter concepts into an entertaining quiz show or action game. When you're ready for some serious exam preparation, work with the **CHAPTER QUIZZES** to see how well you understand key concepts. Need some last-minute review? Load up your portable music player with a **CHAPTER OVERVIEW** and **AUDIO FLASHCARDS**.

Reinforces your understanding

DETAILED LEARNING OBJECTIVES help you determine if you've mastered all the requirements for completing a chapter.

Keeps track of your progress

CourseMate's **ENGAGEMENT TRACKER** records the time you spend on various activities, saves your scores, and shares them with your instructor. You can optionally send scores from the activities within the eBook to your instructor's WebTrack.

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Now you can listen to Audio Overviews and Flashcards on your computer or study while you are out and about by downloading them to your portable music player.

ONLINE EBOOK lets you access your textbook from any computer that's connected to the Internet.

Listen to chapter highlights or practice key terms with handy **AUDIO OVERVIEWS** and **AUDIO FLASHCARDS**.

Quizzes, games, and more provide many ways to explore and review.

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INSTRUCTOR RESOURCES

NP2014 resources provide instructors with a wide range of tools that enhance teaching and learning. These resources and more can be accessed from the NP2014 Instructor Companion Site. Log in by connecting to *www.cengagebrain.com*.

Instructor's Manual: Help is only a few keystrokes away

The NP2014 Instructor's Manual offers the following comprehensive instructional materials:

- Chapter table of contents
- Chapter Objectives
- FastPoll Clicker questions
- Bullet-point lecture notes for each chapter section
- Key terms
- Classroom activities and teaching tips, including how to effectively use and integrate CourseMate online content, interactive multimedia eBook content, and labs.

Tabbing Guide

If you've used previous editions of *New Perspectives on Computer Concepts*, you'll appreciate the Tabbing Guide that lets you see at a glance what's been updated for this edition. Use it to make revisions to your syllabus, as necessary.

Orientation scripts

We can help you introduce students to our technology. We've supplied complete orientation scripts for the NP2014 CD and Online CourseMate.

Solution Files

Your password-protected instructor resources provide answers to all the QuickChecks, Lab Assignments, Interactive Summaries, Interactive Situation Questions, Learning Objective CheckPoints, Concept Maps, Projects, Issue TRY IT!s, and Information Tools TRY IT!s.

Clicker Questions

Did your students read the assignment? Find out by using the FastPoll questions supplied with the Instructor's Manual and included in the NP2014 PowerPoint presentations. Each question is numbered so you can collect results using Chirps or a third-party course polling system. Even if you don't have polling technology, you can use FastPoll questions with a simple show of hands or as a quick paper-and-pencil quiz.

ANNOTATIONS! Instructors can create their own text, graphical, or video annotations that students will see as they read their digital textbook. Find out more about this innovative feature in the Technology Guide.

Course Presenter PowerPoints

Instructors can deliver engaging and visually impressive lectures for each chapter with the professionally designed Course Presenter PowerPoints available from the NP2014 Instructor Companion Site.

Technology Guide

Do you need to learn how to use WebTrack, the eBook CD, and the CourseMate interactive eBook? We now offer instructors a Technology Guide that provides step-by-step instructions for collecting WebTrack data, adding your own annotations to the digital textbook, exporting student scores, and much more.

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INSTRUCTIONAL TECHNOLOGY TOOLS

The NP team provides technology assets to help instructors optimize instruction, facilitate learning, and use their time effectively.

ExamView: Testbanks and powerful testing software

With ExamView, instructors can generate printed tests, create LAN-based tests, or test over the Internet. Examview testbanks cover the same material as Practice Tests and Test Yourself testbanks, but the questions are worded differently so the ExamView testbanks contain a unique collection of questions for graded tests and exams. The ExamView software is available from the NP2014 Instructor Companion Site.

WebTrack

Monitoring student progress is easy. With WebTrack's store-and-forward system, a student can transmit scores to an instructor, who can download them at any time. Newly downloaded scores are consolidated with previous scores and can be displayed, printed, or exported in a variety of report formats.

WebTrack setup is easy. We mean it! Simply download one file, start the app, and then create an ID and password. You don't even have to enter your students' names; your student list populates automatically as students submit results. You can link to WebTrack assets from the NP2014 Companion site.

WebTrackIII

WebTrackIII Instructor's Page

WEBTRACKIII is now available as a portable app that instructors can carry on a USB flash drive and use on their classroom, office, or home computer.

InfoWebLinks

Each chapter has a dedicated InfoWebLinks page containing significant post-publication updates. Be sure to check InfoWebLinks periodically at *www.infoweblinks.com/np2014*.

Chirps

Would you like to know the questions students have while reading their textbooks? Chirps let you find out! Similar to tweets, our Chirps feature allows students to send questions to instructors from within the eBook CD. Instructors can also use Chirps as an in-class polling system, or as an asynchronous polling tool for online students. To learn about this versatile new NP technology, refer to the Technology Guide.

Engagement Tracker

For courses that take advantage of the activities on the NP2014 Online CourseMate, the Engagement Tracker monitors student time on tasks and records scores that help instructors keep track of student progress.

SAM and MindTap Reader eBook

SAM (Skills Assessment Manager) is a robust assessment, training, and project-based system that enables students to be active participants in learning valuable Microsoft Office skills and technology concepts. The MindTap Reader version of New Perspectives on Computer Concepts 2014 works within the SAM environment for courses that combine concepts and Office skills. Let SAM be an integral part of your students' learning experience! Please visit www.cengage.com/samcentral.

SAM

MindTap™

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FROM THE AUTHORS

Many of today's students have substantially more practical experience with digital devices than their counterparts of 15 years ago, but even these students may lack a cohesive framework for their knowledge. Our Concept Map feature throughout the chapters is designed to help students organize technology-related facts, terms, and experiences. Our new TRY IT! activities are designed to keep students actively learning on every page.

The goal of *New Perspectives on Computer Concepts* is to bring every student up to speed with computer basics, and then go beyond basic computer literacy to provide students with technical and practical information that every college-educated person would be expected to know.

In producing the 2014 edition of this very popular textbook, we incorporated significant technology trends that affect computing and everyday life. Concerns for data security, personal privacy, and online safety, controversy over digital rights management, an explosion of interest in mobile apps and cloud computing, and the skyrocketing sales of Macs are just some of the trends that have been given expanded coverage in this edition of the book.

Whether you are an instructor or a student, we hope that you enjoy the learning experience provided by our text-based and technology-based materials.

ACKNOWLEDGEMENTS

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In addition, our thanks go to the New Perspectives Advisory Committee members and reviewers listed on the next page, who have made a tremendous contribution to New Perspectives. Thank you all!

June Parsons and Dan Oja

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ACADEMIC, TECHNICAL, AND STUDENT REVIEWERS

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Computer Concepts 2014

Parsons | Oja

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Apply Your Knowledge

The information in this chapter will give you the background to:

- Start your computer, use the keyboard, and operate the mouse
- Work with Windows or Mac OS
- Use word processing software
- Carry out research on the Web using a search engine and other resources such as Wikipedia
- Send e-mail
- Take effective steps to guard your privacy and safety online
- Access the NP2014 interactive eBook and online CourseMate for labs, quizzes, CourseCasts, and games
- Use eBook CD resources, such as pre-assessments, practice tests, labs, and interactive summaries

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TRY IT!

WHAT DO I NEED TO GET STARTED?

To complete the activities in Sections A, B, and C, you'll need access to a computer, Internet access, your e-mail address, and your instructor's e-mail address. To complete optional Sections D and E, you'll need access to the interactive eBook CD or CourseMate eBook.

To be sure you have what you need, use the following checklist. Check off the boxes for each item that you have.

☐ Access to a computer. If you're using your own computer, you might need a user ID and password to log in. Don't write your password down, but make sure you know what it is.

☐ Access to the Internet. You might need a user ID and password if you use your school's network to access the Internet. Check with your instructor or lab manager to learn how your school handles network access.

☐ An interactive, digital version of the textbook, such as the eBook CD or the CourseMate eBook. The eBook CD requires a CD or DVD drive. If your computer does not have this type of drive, check with your instructor. CourseMate eBook versions of your textbook require a browser. Your school network might provide access to the eBook CD or CourseMate eBook from lab computers.

☐ Your e-mail address. Your instructor should explain how you can obtain an e-mail address if you don't already have one. Write your e-mail address here:

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Getting Started

SECTION **A**

WHEN YOU USE the *New Perspectives on Computer Concepts* textbook, you will not only learn about computers; you'll also use computers as learning tools. Section A is designed to get computer novices quickly up to speed with computing basics, such as turning on computer equipment, working with Windows or Mac OS, using a mouse and computer keyboard, and accessing Help. Read through this section while at a computer so that you can do the TRY IT! activities.

COMPUTER EQUIPMENT

What do I need to know about my computer? Computers come in many packages, including small handheld smartphones, portable tablets and laptops, and stationary desktop models. A computer runs software applications (also called programs and apps) that help you accomplish a variety of tasks. Computer systems consist of several components.

What are the important components of my computer system? Your computer is housed in a case called a system unit that contains circuitry, including the microprocessor that is the "brain" of your computer and memory chips that temporarily store data. It also contains storage devices, such as a hard disk drive.

Your computer system includes basic hardware devices that allow you to enter information and commands, view work, and store information for later retrieval. Devices for entering information include a keyboard, mouse, touchpad, or touchscreen. A display device, sometimes called a monitor, allows you to view your work. A printer produces "hard copy" on paper. Speakers output music, movie soundtracks, and various sounds that help you pay attention to what happens on the screen.

Where are the important components of a desktop computer system? A desktop computer is designed for stationary use on a desk or table. Figure 1 shows the key components of a desktop computer system.

PC OR MAC?

In addition to being classified as desktops, laptops, tablets, and smartphones, personal computers can be classified by their operating systems.

Microsoft Windows is the world's most popular operating system for desktop and laptop computers. Windows computers are sometimes referred to as PCs.

OS X is the operating system used by desktop and laptop computers called Macs that are manufactured by Apple.

iOS is the operating system for iPhones, iPods, and iPads.

Android is the operating system for many non-Apple smartphones and tablets.

Microsoft Windows RT is the operating system for tablets in the Windows family.

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FIGURE 1

A desktop computer system includes several components that can be connected by cables or wirelessly.

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Where are the important components of a laptop computer system? Laptop computers (sometimes called notebook computers) are small, lightweight computers designed to be carried from place to place. The components of a laptop computer system, except the printer, are housed in a single unit, as shown in Figure 2.

FIGURE 2

A laptop computer includes a flat-panel screen, keyboard, speakers, and touchpad in the same unit that contains the microprocessor, memory, and storage devices. An external mouse is sometimes used instead of the touchpad.

How do I identify my computer's storage devices? Your computer contains a hard disk housed inside the system unit. It might also have a USB connector and some type of drive that works with CDs and DVDs. Figure 3 can help you identify your computer's storage devices and their uses.

DVD drive

DVD drives play CDs and DVDs. Most of today's DVD drives can write data on blank CDs and DVDs.

USB flash drive

A USB flash drive is about the size of a highlighter and plugs directly into the computer system unit.

External drive

External hard drives and DVD drives can be connected to a computer using a USB cable.

FIGURE 3

You should use the hard disk to store most of your data. To transport data, use a USB drive. For backups, use an external hard drive. Use an external DVD drive to run the eBook CD if your computer has no built-in drive to handle CDs and DVDs.

Do I have to log in? Most computers take a minute or two to power up, and you might be required to log in by entering a user ID and password. For security, you should use a password for all your digital devices.

Your computer is ready to use when it displays the Windows 8 Start screen, the Windows 7 desktop, or the Mac OS desktop (refer to the next two pages), and you can move the arrow-shaped pointer with your mouse.

Should I turn it off? After a period of inactivity, most computers are configured to enter a sleep mode that powers down the screen and other components. You can leave your computer in sleep mode if you plan to use it from time to time during the day.

If you're not planning to use your computer for a few days, you can initiate a shutdown sequence. When using a Windows computer, click the on-screen Start button, select Shut Down or Turn Off Computer, and follow the instructions on the screen. If there is no Start button, move the pointer to the lower-left corner of the screen. When the "charms" appear, select Settings, and then select the Power icon. To shut down a Mac, click the Apple icon in the upper-left corner of the screen and select Shut Down.

When using computers in a school lab, ask about the shutdown procedure. Your lab manager might want you to log out but leave the computer on.

TRY IT!

Turn your computer on

1. Locate the power switch for any devices connected to your computer and turn them on.

2. Locate the power switch for your computer and turn it on.

3. If a message asks for your user ID and/or password, type them in, and then press the **Enter** key on your computer's keyboard.

4. Wait for the desktop to appear.

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WINDOWS BASICS

What is Windows? Microsoft Windows is an example of a type of software called an operating system. The operating system controls all the basic tasks your computer performs, such as running application software, manipulating files on storage devices, and transferring data to and from printers, digital cameras, and other devices. The operating system also controls the user interface—the buttons, menus, and controls you see on the screen and how you use them.

What is the Windows Start screen? The Windows Start screen offers a quick way to access many computer tools, including apps, e-mail, and social sites (Figure 4).

FIGURE 4

Windows 8 is ready to use when it displays the Start screen. You can click any of the colored tiles to select tools and apps. To view a Windows desktop similar to the one in Figure 5, click the Desktop tile. Any time you want to get back to the Start screen, press the Windows key on your keyboard.

Windows key

What is the Windows desktop? Windows 7 and earlier versions have no Start screen. Instead, they start by displaying the Windows desktop shown in Figure 5.

FIGURE 5

Desktop icons can represent programs, documents, folders, or other electronic tools.
The **taskbar** is the area displayed at the bottom of the desktop.
The **Start button** displays the Start menu, which lists programs installed on your computer. Windows 8 has no Start button or Start menu.
The **Start menu** lists application and utility programs installed on your computer.
The **Notification area** displays the current time and the status of programs, devices, and Internet connections.

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MAC OS X BASICS

What is Mac OS? Mac OS is the operating system used on many of today's Macintosh computers. The most recent version of this operating system is Mac OS X, featured in Figure 6.

How similar are the Mac and Windows desktops? The Mac and Windows desktops have many similarities, such as the use of icons, menus, and rectangular on-screen windows. However, there are notable differences in the two desktops, such as the Mac desktop's dock, Apple icon, and fixed menu bar. If you switch between computers running Windows and Mac OS X, you should be aware of these differences.

What is the dock? The dock is a collection of icons that represent programs, files, and other activities. Usually the dock is located at the bottom of the screen, but it can be configured to appear on the left side or right side of the screen if that better suits the way you work. You can add icons to the dock for programs you use frequently so they are easily accessible.

What is the Apple icon? The Apple icon is the first icon on the menu bar located at the top of the Mac desktop. It is always visible, regardless of the program you're using. Clicking the Apple icon displays a menu that you can use to configure preferences for your computer display and devices. The Apple icon menu also includes options for logging out and shutting down your computer.

How does the fixed menu bar work? The Mac desktop contains a menu bar that remains at the top of the screen. The options on this menu bar change according to the program you are using. In contrast, the menus for Windows programs are incorporated into individual program windows; so if you have more than one window open, each program window displays a menu.

FIGURE 6

The Mac OS X desktop includes icons, a fixed menu bar, and a dock.
Desktop icons can represent devices, programs, documents, folders, or other electronic tools.
The **dock** displays icons for frequently used programs and files.
The **menu bar** contains the Apple icon and menu options for the active program.
The **Apple icon** is used to display a menu of options for setting preferences, moving the dock, logging in, and shutting down.

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MOUSE BASICS

What is a mouse? A mouse is a device used to manipulate items on the screen, such as the buttons and icons displayed on the Windows desktop. The mouse controls an on-screen pointer. The pointer is usually shaped like an arrow, but it can change to a different shape depending on the task you're doing. For example, when the computer is busy, the arrow shape turns into an hourglass or a circle, signifying that you should wait for the computer to finish its current task before attempting to start a new task.

PC-compatible mice have at least two buttons located on top of the mouse. Most mice also include a scroll wheel mounted between the left and right mouse buttons. Your mouse might include additional buttons on the top or sides (Figure 7).

How do I use a mouse? Hold the mouse in your right hand as shown in Figure 8. When you drag the mouse from left to right over your mousepad or desk, the arrow-shaped pointer on the screen moves from left to right. If you run out of room to move the mouse, simply pick it up and reposition it. The pointer does not move when the mouse is not in contact with a flat surface.

FIGURE 7

For basic mousing, you only need to use the mouse buttons; but the scroll wheel is also handy.

Spike Mafford/Photodisc/Getty Images

FIGURE 8

Rest the palm of your right hand on the mouse. Position your index finger over the left mouse button and your middle finger over the right mouse button.

There are several ways you can manipulate on-screen objects. Although you might not be able to manipulate every object in all possible ways, you'll soon learn which mouse actions are allowed for each type of control. The following list describes your repertoire of mouse actions.

Action	How to	Result
Click	Press the left mouse button once, and then immediately release it.	Select an object
Double-click	Press the left mouse button twice in rapid succession without moving the body of the mouse.	Activate an object
Right-click	Press the right mouse button once, and then immediately release it.	Display a shortcut menu
Drag	Hold the left mouse button down while you move the mouse.	Move an object

TRY IT!

Use your mouse

1. With your computer on and the desktop showing on the screen, move your mouse around on the desk and notice how mouse movements correspond to the movement of the arrow-shaped pointer.

2. Move the mouse to position the pointer on the User icon, Start button, or Apple icon.

3. Click the left mouse button to open the User menu, Start menu, or Apple menu.

4. Press the **Esc** key on your keyboard to close the Start menu.

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KEYBOARD BASICS

What are the important features of a computer keyboard? You use the computer keyboard to input commands, respond to prompts, and type the text of documents. An insertion point that looks like a flashing vertical bar indicates where the characters you type will appear. You can change the location of the insertion point by using the mouse or the arrow keys. Study Figure 9 for an overview of important computer keys and their functions.

FIGURE 9

Computer keyboards include special function keys.

A **Function** keys activate commands, such as Save, Help, and Print. The command associated with each key depends on the software you are using.

B The **Print Screen** key prints the contents of the screen or stores a copy of the screen in memory that you can print or manipulate with graphics software.

C The **Esc** (Escape) key cancels an operation.

D The **Windows** key on a PC displays the Windows 8 Start screen.

E The **Page Up** key displays the previous screen of information. The **Page Down** key displays the next screen of information.

F The **Backspace** key deletes one character to the left of the insertion point.

G The **Insert** key switches between insert mode and typeover mode.

H The **Home** key takes you to the beginning of a line or the beginning of a document, depending on the software you are using.

I The **Tab** key can move your current typing location to the next tab stop or the next text-entry box.

J The **Caps Lock** key capitalizes all the letters you type when it is engaged, but does not produce the top symbol on keys that contain two symbols. This key is a toggle key, which means that each time you press it, you switch between uppercase and lowercase modes.

K The **Shift** key capitalizes letters and produces the top symbol on keys that contain two symbols.

L You hold down the **Ctrl** key while pressing another key. On a Mac, the Command key, marked with an Apple or ⌘ symbol, works the same way. The result of Ctrl or Alt key combinations depends on the software you are using.

M You hold down the **Alt** key while you press another key.

N The **Enter** key is used to indicate that you have completed a command or want to move your typing position down to the next line.

O The **Delete** key deletes the character to the right of the insertion point.

P The **End** key takes you to the end of a line or the end of a document, depending on the software you are using.

Q The **right-click** key accomplishes the same task as right-clicking a mouse button, and usually opens a shortcut menu.

R The **arrow** keys move the insertion point.

S The **numeric keypad** produces numbers or moves the insertion point, depending on the status of the Num Lock key shown by indicator lights or a message on the screen.

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What's a keyboard shortcut? A keyboard shortcut allows you to use the keyboard rather than the mouse to select menu commands. If you see <Ctrl X>, Ctrl+X, [Ctrl X], Ctrl-X, or Ctrl X on the screen or in an instruction manual, it means to hold down the Ctrl key while you press X. For example, Ctrl-X is a keyboard shortcut that cuts out text or objects.

TERMINOLOGY NOTE

Mac keyboard shortcuts use the Command key ⌘ and the Option key ⌥ instead of the Ctrl or Alt keys.

What if I make a mistake? Everyone makes mistakes. The first rule is don't panic! Most mistakes are reversible. The following hints and tips should help you recover from mistakes.

What Happened	What to Do
Typed the wrong thing	Use the Backspace key to delete the last characters you typed.
Selected the wrong menu	Press the Esc key to close the menu.
Opened a window you didn't mean to	Click the X button in the upper corner of the window.
Computer has "hung up" and no longer responds to mouse clicks or typed commands	Hold down the Ctrl, Shift, and Esc keys, and then follow instructions to close the program.
Pressed the Enter key in the middle of a sentence	Press the Backspace key to paste the sentence back together.

WORKING WITH WINDOWS SOFTWARE

How do I start Windows applications? The Windows 8 Start screen includes tiles for many applications. Just click a tile to start the software of your choice. Or you can type the first few characters of the application's name and then select it from a list.

When using earlier versions of Windows, you can click the Start button to display the Start menu, which includes a list of recently accessed programs. Clicking the All Programs option displays a list of every program installed on your computer.

TRY IT!

Start Microsoft Paint

1. Use the Start screen or Start button.

Windows 8: From the Start screen, type **pa** and then select **Paint**.

Windows 7: Click the **Start** button to display the Start menu shown on the right.

Click **All Programs** to display a list of all software installed on your computer.

Click **Accessories**, and then click **Paint**.

2. Wait a few seconds for your computer to display the main screen for Microsoft Paint, shown below in Windows 7 (top) and Windows 8 (bottom). Leave Paint open for use with the next TRY IT!.

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How do I tell the software what I want to do? Word processing, photo editing, and other software designed for use on computers running the Windows operating system is referred to as Windows software. Most Windows software works in a fairly uniform way and uses a similar set of controls.

Each software application appears within a rectangular area called a window, which can include a title bar, a menu bar or ribbon, a workspace, and the various controls shown in Figure 10.

FIGURE 10

The **title bar** displays the title of the software, the name of the current data file, and the window sizing buttons.
The **Minimize button** shrinks the window to a button at the bottom of the screen.
The **Maximize button** stretches the window to fill the screen.
The **Close button** closes the window and exits the program.
A **ribbon**, **menu bar**, or **toolbar** displays the titles of menus and tools that you can click to select commands.
A **scroll bar** can be clicked or dragged to see any material that does not fit in the displayed window.
The **workspace** is the area in which your document or drawing is displayed.

If you're unfamiliar with Windows controls, take a few minutes to complete the steps in the TRY IT! box below.

TRY IT!

Use the toolbar or ribbon

1. As shown below, click the **Brushes** button on the Paint toolbar or ribbon.

2. Move the pointer to the workspace, hold down the left mouse button, and then drag the mouse to paint a shape.

3. Release the mouse button when the shape is complete.

Use the ribbon or menu bar

1. Click the arrow next to **Rotate**, and then click **Flip vertical**.

In old versions of Paint, click **Image**, click **Flip/Rotate**, click **Flip Vertical**, then click the **OK** button.

Your shape is now upside down.

Use the sizing buttons

1. Click the **Minimize** button.

2. The Paint window shrinks down to a button on the taskbar at the bottom of the screen.

3. Click the taskbar button to make the Paint window reappear.

4. Click the **Close** button to close the Paint program and remove its window from the screen. If you see a message asking if you want to save changes, click the Don't Save button.

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WORKING WITH MAC SOFTWARE

How do I start programs on the Mac? When using Mac OS X, you can click icons in the dock to easily start programs. For programs that are not in the dock, you can click the Finder icon and then click the Applications option. If you need to brush up on Mac controls, follow the instructions in the TRY IT! box below.

TRY IT!

Find out which programs are in the dock

1. Position the mouse pointer over each of the icons in the dock and wait for the program name to appear.

Use Finder to start a program

1. Click the **Finder** icon on the left side of the dock.

2. When the Finder window (similar to the one at right) appears, click the **Applications** option.

3. Double-click the **iCal** option to start the iCal calendar program and display the iCal window shown at right.

Use a menu and dialog box

1. Click **iCal** on the menu bar at the top of the screen.

2. Click **Preferences** to display a dialog box.

3. Click the button next to *Start week on* to change the day to Monday.

4. Click the **Close** button to close the Preferences dialog box.

Close a program

1. Click **iCal** on the menu bar.

2. Click **Quit iCal** to close the window and terminate the application.

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HELP

How can I get help using software? If you've had problems using software, you're not alone! Everyone has questions at one time or another. Most software offers several sources of help, such as the following:

- **Message boxes.** When using software, it is important to pay attention to any message boxes displayed on the screen. Make sure you carefully read the options they present. If the box doesn't seem to apply to what you want to do, click its Cancel button to close it. Otherwise, set the options the way you want them, and then click the OK button to continue.
- **User manual.** Whether you're a beginner or a power user, the manual that comes with software can be an excellent resource. User manuals can contain quick-start guides, tutorials, detailed descriptions of menu options, and tips for using features effectively. Many manuals are offered online along with tools you can use to browse through them or look for the answer to a specific question.
- **Google it.** If you encounter a software problem, open your browser and use a search engine like Google to enter your question. Be sure to specify the name of the application you are using, along with your computer's operating system.
- **Check YouTube.** Connect to YouTube and enter the name of your software. You might find useful videos showing how to use the coolest features.
- **Help menu.** The Help menu provides access to on-screen documentation, which can contain detailed instructions, tips, and FAQs. Answers to specific questions can be found by entering search terms, consulting the index, or browsing through a table of contents (Figure 11).

FIGURE 11
Clicking the Help button or the Help menu produces a list of help options, where you can enter search terms or browse through topics.

QuickCheck

SECTION A

1. The case that holds a computer's circuitry, memory, and storage devices is called a(n) _____ unit.
2. Instead of using the on/off switch to turn off a computer, you should instead use the Shut Down option. True or false? _____
3. On the Mac desktop, the _____ displays a row of program icons.
4. Ctrl-X is an example of a keyboard _____.
5. On a PC the _____ key can be used to delete the last character you typed.

CHECK ANSWERS

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Documents, Browsers, and E-mail

SECTION B

TO COMPLETE ASSIGNMENTS for your course, you should be able to work with documents, browsers, and e-mail. Section B walks you through the basics.

CREATING DOCUMENTS

How do I create and save a document? To create a document, simply type text in the workspace provided by word processing software such as Microsoft Word, OpenOffice Writer, LibreOffice Writer, or Apple iWork Pages. The flashing vertical insertion point (Figure 12) indicates your place in the document. Figure 13 explains how to save a document.

FIGURE 12

When typing text, you can use the following keys to move within a document and make revisions:

- **Backspace:** Delete the character to the left of the insertion point. On Macs, hold down the Fn key while pressing the Delete key.
- **Delete:** Delete the character to the right of the insertion point.
- **Enter:** End a paragraph and begin a new line.
- **Arrow keys:** Move the insertion point up, down, right, or left.

FIGURE 13

It is a good idea to save your document every few minutes, even if it is not finished. When you save a document, use the Save icon at the top of the screen. Your computer is probably configured to save documents on the hard disk in a library called Documents or a folder called My Documents. There is no need to change that until you gain more experience. File names can be several words long; just do not use the * / \ " ' : symbols in the file name.

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How do I print a document? To print a document, simply click the File tab, File menu, or Office button and then select Print. Your computer displays a window containing a series of print options. If you want to print a single copy of your document, these options should be correct, so you can click the Print or OK button to send your document to the printer.

Can I send a document to my instructor? You can e-mail a document by using the Send option accessed from the File tab, File menu, or Office button (Figure 14). To do so, you must know your instructor's e-mail address. Documents that you send along with e-mail messages are referred to as attachments. You'll learn more about e-mail later in the Orientation, but keep this option in mind because it is a handy way to submit assignments, such as projects and term papers.

How do I find my documents again in the future? If you want to revise a document sometime in the future, simply start your word processing software; click the File tab, File menu, or Office button; and then click Open. Your computer should display a list of documents stored in the Documents folder. Locate the one you want to revise and double-click it.

What should I do when I'm done? When you're ready to quit, you can close the document by clicking the Close option from the File tab, File menu, or Office button. When you want to close your word processing software, click the Close button (Windows) or click the program name on the menu bar and then select Quit (Mac).

FIGURE 14

To e-mail a document:

- In Word 2013, click the File tab, click Share, and then select Email (below).
- In Word 2010, click the File tab, select Save & Send, and then select Send as Attachment.
- In Word 2007, click the Office button, point to Send, and then select E-mail.
- In Word 2003, OpenOffice Writer, or LibreOffice Writer, click File, and then select Send or Send To.
- In iWork Pages, click the Share tab and then select the e-mail option.

TRY IT!

Create a document

1. Windows 8: Click the **Microsoft Word** or **LibreOffice** tile on the Start screen.

Windows 7: Click the **Start** button, and then click the **Microsoft Word** or **LibreOffice** option.

Mac: Click the **Finder** icon, select the **Applications** option, and then click to open iWork Pages or Microsoft Word.

2. Click the word processing workspace to position the insertion point in the upper-left corner.

3. Type a paragraph. Refer to Figure 12 for keys to use while typing and revising your work.

4. When the first paragraph is complete, press the **Enter** key to begin a new paragraph.

5. Type a second paragraph of text.

Save a document

1. Click the **Save** icon located near the top of the window.

2. Make sure the Documents library or folder is selected, as shown in Figure 13 on the previous page.

3. In the *File name* box, type a name for your document.

4. Click the **Save** button.

5. When the Save As dialog box closes, your document is saved.

Print a document, close it, and exit your word processing application

1. Click the **File** tab, **File** menu, or **Office** button, and then click **Print**.

2. Make sure the page range is set to **All**.

3. Make sure the number of copies is set to **1**.

4. Click the **Print** or **OK** button and wait a few seconds for the printer to produce your document.

5. Close the document by clicking the **File** tab, **File** menu, or **Office** button and then clicking **Close**. The workspace should become blank.

6. Exit your word processing software by clicking the **Close** button (Windows), or by clicking the program name on the menu bar and then selecting **Quit** (Mac).

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INTERNET AND WEB BASICS

What is the Internet? The Internet is the largest computer network in the world, carrying information from one continent to another in the blink of an eye (Figure 15). The computers connected to this network offer many types of resources, such as e-mail, instant messaging, social networking, popular music downloads, and online shopping.

FIGURE 15

The Internet communications network stretches around the globe.

Courtesy of Stephen G. Eick

What is the Web? Although some people use the terms *Internet* and *Web* interchangeably, the two are not the same. The Internet refers to a communications network that connects computers all around the globe. The Web—short for World Wide Web—is just one of the many resources available over this communications network.

The Web is a collection of linked and cross-referenced information available for public access. This information is accessible from Web sites located on millions of computers. The information is displayed as a series of screens called Web pages. You'll use the Web for general research and for specific activities designed to accompany this textbook. To use the Web, your computer must have access to the Internet.

How do I access the Internet? Most digital devices can be configured to connect to the Internet over telephone, cell phone, satellite, or cable television systems. Internet access can be obtained from school computer labs, local service providers such as your cable television company, and national Internet service providers such as AOL, AT&T, Comcast, Verizon, and EarthLink.

To expedite your orientation, it is assumed that your computer has Internet access. If it does not, consult your instructor, or ask an experienced computer user to help you get set up.

How do I know if my computer has Internet access? The easiest way to find out if your computer can access the Internet is to try it. You can quickly find out if you have Internet access by starting software called a browser that's designed to display Web pages.

Browser software called Internet Explorer is supplied with Microsoft Windows. Mac OS X includes a browser called Safari. Other browsers, such as Firefox and Chrome, are also available. Follow the steps in the TRY IT! box to start your browser.

TRY IT!

Start your browser

1. Click the icon for your browser. It is usually located on the Start screen, near the Start button, or on the dock.

2. Your computer should soon display the browser window.

If your computer displays a *Connect to* box, click the **Dial** button to establish a dial-up connection over your telephone line.

You'll need to cancel the browser command and consult an experienced computer user if:

- Your computer displays a "working off line" message.
- Your computer displays an Internet Connection Wizard box.

HOW TO USE A WEB BROWSER AND SEARCH ENGINE

How do I use a browser? A browser lets you enter a unique Web page address called a URL, such as *www.google.com*. You can also jump from one Web page to another by using links. Links are usually underlined; and when you position the arrow-shaped mouse pointer over a link, it changes to a hand shape.

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Although browsers offer many features, you can get along quite well using the basic controls shown in Figure 16.

Web site © MediaTechnics

FIGURE 16

Using a Browser

A full Web address might look like this:
http://www.mediatechnicscorp.com
It is not necessary to type the *http://*. So to access the MediaTechnics Corporation page shown here, you would type:
www.mediatechnicscorp.com
When typing a Web address, do not use any spaces, and copy uppercase and lowercase letters exactly.

How do I find specific information on the Web? If you're looking for information and don't know the Web site where it might be located, you can use a search engine to find it. Follow the steps in the TRY IT! box to "google it" by using the Google search engine.

TRY IT!

Use a search engine

1. Make sure the browser window is open.
2. Click the Address box and type:

3. Press the **Enter** key. Your browser displays the Web page for the Google search engine.
4. Click the blank search box and then type **national parks**.

5. Press the **Enter** key. Google displays a list of Web pages that relate to national parks.
6. Click the underlined **U.S. National Park Service** link. Your browser displays the Park Service's home page.
7. Leave your browser open for the next TRY IT!.

Search results © 2012 Google

Courtesy of the U.S. Park Service

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What are the best sources of information on the Web?

The best sources of information are easy to access, dependable, and preferably free. Sites such as Wikipedia, Answers.com, WhatIs.com, and HowStuffWorks are great sources for general information and researching topics for computer courses.

When you're looking for information on the Web, remember that virtually anyone can post anything. Consequently, some information you encounter might not be accurate.

To check the quality of information provided by a Web site, you can cross-check facts with other sites. Be sure to check when the material was posted or updated to determine if it is current. You might also consider the information source. Blogs, tweets, Facebook posts, and YouTube videos often express opinions rather than facts.

How does Wikipedia work? Wikipedia is an encyclopedia that is written and maintained by the people who use it. More than 23 million articles on a vast range of topics have been submitted and updated by users, many of them experts. Wikipedia information tends to be accurate because users are continually reading the articles and correcting inaccurate or biased information. However, some vandalism occurs and from time to time a few articles contain false or misleading information.

Most Wikipedia articles include a View history tab that tracks changes. Check the date of the last change to determine if the information is current. Articles also include a Discussion tab that can help you spot controversial aspects of the information. Use the TRY IT! below to see how Wikipedia works.

TRY IT!

Check out Wikipedia

1. In the Address bar of your browser, type **www.wikipedia.org** and then press the **Enter** key.

2. When the Wikipedia window appears, enter **cyberspace** in the search box and then press **Enter**.

3. Read a bit of the article to get an idea of its scope and detail. Do you detect any bias in the article?

4. Click the **View history** tab. Look at the last few updates. Does this article seem up to date?

5. Click the **Discussion** tab. What is the status of the article? Does it contain controversial statements? Can you envision how you might use Google or other Web resources to explore specific controversies?

6. Click the **Article** tab to return to the Cyberspace article.

7. You can leave your browser open for the next TRY IT!.

Courtesy of Wikipedia.org

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WORKING WITH E-MAIL

What is e-mail? E-mail is a form of communication that relies on computer networks, such as the Internet, to transmit messages from one computer to another. Like regular mail, e-mail messages are sent to a mailbox where they are kept until the recipient retrieves them. Messages might arrive at their destination within seconds, or might not arrive for a few hours. Once sent, e-mail messages cannot be recalled.

What do I need to use e-mail? To send and receive e-mail, you need an Internet connection, an e-mail account, and software that enables you to compose, read, and delete e-mail messages. An e-mail account consists of an e-mail address (Figure 17), a password, and a mailbox. You can usually obtain an e-mail account from your Internet service provider, your school, or a Webmail provider, such as Hotmail, Yahoo! Mail, or Gmail.

Webmail providers store your mail online. To access your mail, simply use your browser. In contrast, local mail, such as Microsoft Outlook, transfers mail to your computer and requires you to use special e-mail software instead of a browser.

How do I get a Webmail account? Registering for a Webmail account is easy and many online e-mail providers offer free basic service. Work with the TRY IT! below to see how.

FIGURE 17

E-mail Addresses

An e-mail address consists of a user ID followed by an @ symbol and the name of a computer that handles e-mail accounts. Ask your instructor for his or her e-mail address. It is likely similar to the following:

instructor@school.edu

When typing an e-mail address, use all lowercase letters and do not use any spaces.

TRY IT!

Get a Web-based e-mail account

1. In the Address bar of your browser, enter **www.gmail.com**.
2. When the Gmail window appears, click the button labeled **CREATE AN ACCOUNT**.
3. Follow the directions to enter your first name, last name, and username.
4. The login name you select is checked for uniqueness. If it is already in use, you'll have to try a different one.
5. When you've selected a valid username, continue down the page to create a password. Try not to use a name, a date, or any dictionary word as your password.
6. Continue down the page to complete the rest of the registration form.
7. Before finalizing your registration, review the information you've entered and jot down your login name and password.
8. Read the Terms of Service. If you agree, click the **Next step** button. That's it! You now have a Gmail account.

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Is Webmail better than local e-mail? Both Web-based and local e-mail have their advantages and disadvantages. Webmail accounts are definitely easier to set up and you can use them from any computer with an Internet connection. Webmail accounts are also ideal for "throw-away" accounts.

What is a throw-away e-mail account? Whether you use local mail or Webmail for your regular correspondence, you might consider creating one or two throw-away accounts for occasions when you have to give an e-mail address, but you don't want any continued correspondence from that source. Later in the chapter, you'll learn more about how e-mail scams and online marketing contribute to all the junk e-mail you receive. Your throw-away e-mail address can become the recipient for lots of those messages, and eventually you can simply delete the throw-away account and all the junk it contains.

How do I create and send an e-mail message? Many e-mail systems are available, and each uses slightly different software, making it impossible to cover all options in this short orientation. You might want to enlist the aid of an experienced computer user to help you get started. The steps in the TRY IT! box pertain to Gmail, but other e-mail packages work in a similar way.

E-MAIL PRIVACY

E-mail messages are not necessarily private; their contents might be seen during system maintenance or repair, and commercial e-mail archives are subject to search by government agencies.

Free Web-based mail is typically searched as you write it by digital bots that look for keywords, like *vacation* or *pet*, to display related advertising. If you want more privacy, consider private e-mail providers and local e-mail software.

TRY IT!

Create and send e-mail

1. If Gmail is not open, open your browser and type **www.gmail.com** in the address box. Log in to your Gmail account.

2. Click the **Compose** button to display a form like the one below.

3. Follow steps 4 through 6 as shown below.

7. When your message is complete, click the **SEND** button and Gmail sends the message.

8. You can continue to experiment with e-mail. When done, use the **Sign out** option under the link for your account (circled), then close your browser.

Note: With some local e-mail configurations, the Send button places the e-mail in an Outbox and you have to click the **Send/Receive** button on the toolbar to ship the message out from your computer.

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How do I get my e-mail? As with sending mail, the way you get mail depends on your e-mail system. In general, clicking the Send/Receive button collects your mail from the network and stores it in your Inbox. Your e-mail software displays a list of your messages. The new ones are usually highlighted or shown in bold type. You can click any message to open it, read it, and reply to it, as shown in Figure 18.

How do I log off? When working with a Webmail account, it is important to use the Log out or Sign out link before you close your browser. Taking this extra step makes your e-mail less vulnerable to hackers.

FIGURE 18

When e-mail software displays your Inbox, you can:

- Open a message and read it.
- Reply to a message.
- Delete unwanted messages (a good idea to minimize the size of your mailbox).
- Forward a message to someone else.

QuickCheck

SECTION B

1. Documents that you send along with e-mail messages are referred to as _____.
2. Popular _____ software includes Internet Explorer, Chrome, and Firefox.
3. When looking for information on the Web, you can use a(n) _____ engine to produce a list of links to Web pages that might contain the information you seek.
4. An e-mail _____ looks something like student@school.edu.
5. To access Webmail, you use a browser; but to access _____ e-mail, you use e-mail software such as Microsoft Outlook.

CHECK ANSWERS

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Security and Privacy

SECTION C

AS WITH MOST OTHER facets of modern life, the digital world has its share of troublemakers, scam artists, and identity thieves. Section C offers some tips on navigating through the sometimes rough neighborhoods of cyberspace, while keeping your data safe and your identity private.

SECURING YOUR DIGITAL DEVICES AND DATA

What's at risk if my computer or phone is stolen? The value of a stolen computer or phone is not so much in the hardware as in the data it contains. With stolen data such as your bank account numbers and PINs, a thief can wipe out your checking and savings accounts. With your credit card numbers, a thief can go on a spending spree. Even worse, a criminal can use stolen data to assume your identity, run up debts, get into legal difficulties, ruin your credit rating, and cause you no end of trouble.

How can I protect my data from theft? Never leave your devices unattended. If a thief steals your computer or phone, you can make it difficult to access your data by setting up a password. Until the password is entered, your data is off limits. Thieves will not be able to get beyond the login screen and should not be able to easily access your data.

Use security tools to protect your phone. Keep it locked while not in use and consider subscribing to a tracking service that allows you to use a Web site to find your phone, lock it, or erase it.

Many new computers are shipped with a standard administrator password that everyone knows. If you are the only person using your computer, you can use the administrator account for your day-to-day computing, but create a secure password (Figure 19) for this account as soon as you can.

Your computer might also include a preset guest account with a nonsecure password such as *guest*. You should disable this guest account or assign it a secure password.

FIGURE 19

To create a secure password:

- Use at least eight characters, mixing numbers with letters, as in *2by4lumber*.
- Do not use your name, the name of a family member, or your pet's name.
- Do not use a word that can be found in the dictionary.
- Do not forget your password!

TRY IT!

Check the accounts on your computer

1. Access user accounts.

Windows 8: From the Start screen, type **c** and then select **Control Panel**. Select **User Accounts** and then select **Manage another account**.

Windows 7: Click the **Start** button, and then select **Control Panel**. Select **User Accounts and Family Safety**, select **User Accounts**, and then select **Manage another account**. (You might be required to enter an administrator password.)

Mac: Click the **Apple** icon, select **System Preferences**, and then select **Accounts**.

2. Check the password protection on all accounts. If you are working on a school lab computer, do not make changes to the account settings. If you are using your own computer, click the Administrator account and make sure it has a secure password.

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AVOIDING VIRUSES

What's so bad about viruses? The term *virus* has a technical meaning, but is loosely used when referring to malicious programs that circulate on infected downloads, in e-mail attachments, and on the Internet. This malware, as it is sometimes called, can steal your data, destroy files, or create network traffic jams. It might display an irritating message to announce its presence, or it might surreptitiously spread itself to various files or mail itself out to everyone in your e-mail address book.

After a virus takes up residence in a computer or phone, it is often difficult to disinfect all your files. Rather than wait for a virus attack, you can take steps to keep your digital devices virus free.

How can I steer clear of malware? It helps to avoid risky behaviors, such as downloading pirated software, opening e-mail attachments from unknown senders, installing random social networking plug-ins, installing non-approved apps, and participating in illegal file sharing.

Antivirus software protects digital devices from malware (Figure 20). Because fewer viruses target Macs, OS X users who don't engage in risky online activities sometimes opt to work without antivirus software.

If you use antivirus software, configure it to run continuously whenever your computer is on. You should make sure your antivirus software is set to scan for viruses in incoming files and e-mail messages. At least once a week, your antivirus software should run a full system check to make sure every file on your computer is virus free.

As new viruses emerge, your antivirus software needs to update its virus definition file. It gets this update as a Web download. If you've selected the auto update option, your computer should automatically receive updates as they become available.

FIGURE 20

Popular Antivirus Software

- Windows Defender
- Norton AntiVirus
- McAfee AntiVirus Plus
- Kaspersky Anti-Virus
- F-Secure Anti-virus
- Panda Antivirus
- Trend Micro Antivirus+
- AVG AntiVirus FREE
- Avast! Free Antivirus

TRY IT!

Get familiar with your antivirus software

1. Look for antivirus software (refer to Figure 20 for a list). In Windows 7, click the **Start** button, and then select **All Programs**. In Windows 8, scroll through the tiles on the Start screen. On the Mac, use **Finder** to access the Applications folder.

Can't find any? If you are using your own computer and it doesn't seem to have antivirus software, you can connect to an antivirus supplier's Web site and download it.

2. Open your antivirus software. Each antivirus program has unique features.

3. Explore your antivirus software to find out if it offers options to:

- Scan incoming e-mail.
- Run continuously in the background—a feature sometimes called Auto Protect.
- Block malicious scripts.

4. Check the date of your last full system scan. If it was more than one week ago, you should check the settings that schedule antivirus scans.

5. Check the date when your computer last received virus definitions. If it was more than one week ago, you should make sure your antivirus software is configured to receive automatic live updates.

Windows Defender is included with Windows 8. You can access it from the Start screen by typing **w**.

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PREVENTING INTRUSIONS

Is the Internet risky? The Internet offers lots of cool stuff: music, movies, online shopping and banking, and much more. Most Internet offerings are legitimate, but some downloads contain viruses, and shady characters called hackers control programs that lurk about waiting to infiltrate your digital devices. If a hacker gains access to your phone or computer, he or she can view your files and steal personal information.

An infiltrated computer can be used as a launching platform for viruses and network-jamming attacks, or turned into a server for pornography and other unsavory material. Hackers have even found ways to turn thousands of infiltrated computers into "zombies," link them together, and carry out coordinated attacks to disrupt online access to Microsoft, Bank of America, and other Internet businesses.

How do hackers gain access? Intruders gain access by exploiting security flaws in your device's operating system, browser, and e-mail software. Companies such as Microsoft, Apple, and HTC constantly produce software updates to fix these flaws. As part of your overall security plan, you should download and install security updates as they become available.

Do I need a firewall? Firewall software and Internet security suites, such as those listed in Figure 21, provide a protective barrier between a computer and the Internet. If your computer is directly connected to the Internet, it should have active firewall software. If your computer connects to a local area network for Internet access, the network should have a device called a router to block infiltration attempts.

When a firewall is active, it watches for potentially disruptive incoming data called probes. When a probe is discovered, your firewall displays a warning and asks what to do. If the source looks legitimate, you can let it through; if not, you should block it (Figure 22).

Where do I get a firewall? Mac OS X and Windows include built-in firewalls. Third-party Internet security suites also include firewall modules.

FIGURE 21

Popular Firewall Software and Internet Security Suites

- Emsisoft Online Armor
- McAfee Internet Security
- ZoneAlarm Free Firewall
- Norton Internet Security
- Mac OS X Firewall
- Agnitum Outpost Firewall
- Windows Firewall
- Comodo Firewall
- Kaspersky Internet Security
- Trend Micro Internet Security

FIGURE 22

When your firewall software encounters new or unusual activity, it asks you what to do.

TRY IT!

Check your Windows computer's firewall

1. Access the **Control Panel** and then click the **Windows Firewall** link.

2. If the Windows firewall is not active, you should check to see if a third-party firewall is protecting your computer. To do so in Windows 7, click the **Start** button, select **All Programs**, and then look through the program list for firewalls such as those in Figure 21. In Windows 8, scroll through the tiles on the Start screen. If you find a firewall listed, start it and explore to see if it has been activated.

Check your Mac computer's firewall

1. Click the **Apple** icon, and then select **System Preferences**.

2. Click the **Security** icon, and then click the **Firewall** button.

3. If the firewall is off, click the **Start** button if you want to activate it.

4. If the Start button is grayed out, click the lock at the bottom of the page and then enter an administrator name and password.

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SAFE BROWSING

Are some Web sites dangerous? When you access Web sites, data is transferred to your device and displayed by your browser. Most of this data is harmless, but Web-based malware and spyware have the potential to search your device for passwords and credit card numbers, monitor your Web-browsing habits for marketing purposes, block your access to legitimate Web sites, or surreptitiously use your device as a staging area for illicit activities.

How can I block spyware? The first line of defense is to never click pop-up ads—especially those with dire warnings, such as the ad in Figure 23, about your computer being infected by a virus or spyware! To close an ad, right-click its button on the taskbar at the bottom of your screen, and then select the Close option from the menu that appears.

Most browsers can be configured to block spyware and pop-up ads. Your antivirus software might offer similar options.

FIGURE 23

Some pop-up ads contain fake warnings about viruses, spyware, and intrusion attempts.

What other steps can I take to browse the Web safely? Browsers include security features. You should take some time to become familiar with them. For example, Internet Explorer allows you to specify how you want it to deal with potentially dangerous ActiveX components, HTML scripts, spyware, and cookies. If you don't want to be bothered by these details, however, Internet Explorer offers several predefined configurations for Medium, Medium-High, and High security. Most Internet Explorer users set security and privacy options to Medium-High.

Your browser might also offer features such as private browsing, do not track, and delete browser history that can make your Web experience safer and more private.

TRY IT!

Check Internet security and privacy options

1. Start your browser and look for its security settings.

Internet Explorer: Click **Tools**, and then select **Internet Options**. Click the **Security** tab. Normally, your security setting should be Medium High. Click the **Privacy** tab. Your privacy setting should be Medium. If your version of IE offers a Pop-up Blocker, make sure its box contains a check mark so that it is activated.

Firefox: Click the **Firefox** tab or menu, select **Options** or **Preferences**, and then click **Content**. Make sure there is a check mark in the box for **Block pop-up windows**.

Safari: Click **Safari** on the menu bar. Make sure there is a check mark next to **Block Pop-Up Windows**.

Chrome: Click the **Chrome menu** icon, select **Settings**, and then click **Show advanced settings**. Click the **Content settings** button. Under Pop-ups, make sure that the **Do not allow** option is selected.

2. Use your browser's Help to find out if the following features are available:

Private browsing

Do not track

Delete browser history

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PROTECTING E-COMMERCE TRANSACTIONS

Is online shopping safe? Online shopping is generally safe. From time to time, shoppers encounter fake storefronts designed to look like legitimate merchants but that are actually set up to steal credit card information. You can avoid these fakes by making sure you enter correctly spelled URLs when connecting to your favorite shopping sites.

How safe is my credit card information when I'm shopping online? Online shopping has about the same level of risk as using your credit card for a telephone order or giving it to a server when you've finished eating in a restaurant.

That's not to say that credit cards are risk free. Credit cards are surprisingly vulnerable both online and off. Anyone who handles your card can copy the card number, jot down the expiration date, and try to make unauthorized charges. Thieves can break in to merchant computers that store order information. Thieves might even pick up your credit card information from discarded order forms. Despite these risks, we continue to use credit cards.

Many people are concerned about their credit card data getting intercepted as it travels over the Internet. As you wrap up an online purchase and submit your credit card information, it is transmitted from your computer to the merchant's computer. Software called a packet sniffer, designed for legitimately monitoring network traffic, can be used by unscrupulous hackers to intercept credit card numbers and other data traveling over the Internet.

How can I keep my credit card number confidential? When you submit credit card information, make sure the merchant provides a secure connection for transporting data. Normally, a secure connection is activated when you're in the final phases of checking out—as you enter your shipping and credit card information into a form and click a Submit button to send it.

A secure connection encrypts your data. Even if your credit card number is intercepted, it cannot be deciphered and used. To make sure you have a secure connection, look for the lock icon. The Address box should also display a URL that begins with *https://*.

TRY IT!

Identify a secure connection

1. Start your browser and connect to the site **bookstore.gpo.gov**.
2. Select any book and place it in your online shopping cart.
3. Click the **Go to Checkout** button to reach step 1 of the checkout process.
4. At the checkout screen, do you see any evidence that you're using a secure connection?
5. Close your browser so that you don't complete the transaction.

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AVOIDING E-MAIL SCAMS

What are e-mail scams? From time to time, you hear about con artists who have bilked innocent consumers out of their life savings. The Internet has its share of con artists, too, who run e-mail scams designed to collect money and confidential information from unsuspecting victims. E-mail scams are usually distributed in mass mailings called spam.

What do I need to know about spam? The Internet makes it easy and cheap to send out millions of e-mail solicitations. In the United States, the CAN-SPAM Act requires mass-mail messages to be labeled with a valid subject line. Recipients are supposed to be provided with a way to opt out of receiving future messages.

Legitimate merchants and organizations comply with the law when sending product announcements, newsletters, and other messages. Unscrupulous spammers ignore the law and try to disguise their solicitations as messages from your friends, chat room participants, or co-workers (Figure 24).

FIGURE 24

Some e-mail systems use spam filters to flag suspected spam by adding [SPAM] to the subject line. Spam filters are not perfect, however. Some spam is not flagged and occasionally legitimate mail is mistaken for spam.

Is spam dangerous? Some mass mailings contain legitimate information, including daily or weekly newsletters to which you've subscribed. Many mass mailings, however, advertise illegal products. Others are outright scams to get you to download a virus, divulge your bank account numbers, or send in money for products you'll never receive.

Beware of e-mail containing offers that seem just too good to be true. Messages about winning the sweepstakes or pleas for help to transfer money out of Nigeria (Figure 25) are scams to raid your bank account.

FIGURE 25

Many variations of this African money-transfer fraud—complete with deliberate grammatical errors—have circulated on the Internet for years. Victims who respond to these preposterous e-mails have found their bank accounts raided, their credit ratings destroyed, and their reputations ruined. According to the FBI, some victims have even been kidnapped!

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What's phishing? Phishing (pronounced "fishing") is a scam that arrives in your e-mailbox looking like official correspondence from a major company, such as Microsoft, PayPal, eBay, UPS, Yahoo!, or AOL. The e-mail message is actually from an illegitimate source and is designed to trick you into divulging confidential information or downloading a virus.

Links in the e-mail message often lead to a Web site that looks official, where you are asked to enter confidential information such as your credit card number, Social Security number, or bank account number.

The following are examples of phishing scams you should be aware of:

- A message from Microsoft with an attachment that supposedly contains a security update for Microsoft Windows. Downloading the attachment infects your computer with a virus.
- A message that appears to come from PayPal, complete with official-looking logos, that alerts you to a problem with your account. When you click the Billing Center link and enter your account information, it is transmitted to a hacker's computer.
- A message from UPS or the postal service informing you that a package cannot be delivered until you click a link to print or download a mailing label. Clicking the link installs malware on your computer.

How do I avoid e-mail scams? If your e-mail software provides spam filters, you can use them to block some unsolicited mail from your e-mailbox. Spam filters are far from perfect, however, so don't assume everything that gets through is legitimate. Use your judgment before opening any e-mail message or attachment.

Never reply to a message that you suspect to be fraudulent. If you have a question about its legitimacy, check whether it's on a list of known scams. Never click a link provided in an e-mail message to manage any account information. Instead, use your browser to go directly to the company's Web site and access your account as usual. Microsoft never sends updates as attachments. To obtain Microsoft updates, go to the Control Panel and click the Windows Update option.

TRY IT!

Arm yourself against e-mail scams

1. Start your browser and connect to the site **www.millersmiles.co.uk**. Browse through the list of recent phishing attacks.

2. Open your e-mail software and find out if it includes spam filters. You can usually find this information by clicking **Help** on the menu bar and then typing **spam filter** in the search box.

3. Explore how your e-mail software handles messages that might be spam. Can you create customized spam filters, or does your software have automatic filtering?

4. Spam filters sometimes catch legitimate mail and group it with junk mail. Check your Trash, Spam, or Junk folder. Does it contain any legitimate messages that were automatically labeled as spam and blocked from your Inbox?

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PROTECTING YOUR PRIVACY

How much information about me has been collected online? Information about you is stored in many places and has the potential to be consolidated by government agencies, private businesses, and criminals. Some databases are legitimate—those maintained by credit bureaus and medical insurance companies, for example. By law, you have the right to ask for a copy of these records and correct any errors you find. Many other databases, such as those maintained at e-commerce sites and those illegally acquired by hackers, are not accessible, and you have no way of checking the data they contain.

What's the problem with having my personal information in a few databases? The problem is that many companies share their databases with third parties. Your personal data might start in a single legitimate database, but that data can be sold to a continuous chain of third parties who use it to generate mass mailings that clog up your Inbox with marketing ploys, unwanted newsletters, and promotions for useless products.

Can I control who collects information about me? To some extent, you can limit your exposure to future data collection by supplying personal data only when absolutely necessary. When filling out online forms, consider whether you want to or need to provide your real name and address. Avoid providing merchants with your e-mail address even if you're promised a $5 coupon or preferred customer status. A small reward might not be worth the aggravation of an Inbox brimming with spam and e-mail scams. You should also be careful when using public computers (Figure 26).

Can I opt out? Some mass e-mailings give you a chance to opt out so that you don't receive future messages. Opting out is a controversial practice. On mailings from reputable businesses, clicking an opt-out link might very well discontinue unwanted e-mail messages. However, opting out does not necessarily remove your name from the database, which could be sold to a third party that disregards your opt-out request.

Scammers use opt-out links to look for "live" targets, perhaps in a database that contains lots of fake or outdated e-mail addresses. By clicking one of these opt-out links, you've played right into the hands of unscrupulous hackers—this action lets them know that your e-mail address is valid.

Most experts recommend that you never use opt-out links, but instead go to the sender's Web site and try to opt out from there. If you are tempted to use an opt-out link directly from an e-mail message, carefully examine the link's URL to make sure you'll connect to a legitimate Web site.

FIGURE 26

Using public computers poses security risks from people looking over your shoulder, spyware that collects your keystrokes, and the footprint you leave behind in cookies and temporary Internet pages.

AP Photo/Darren Hauck

To minimize risks when using public computers:

- Be sure to log out from all sites and close all browser windows before quitting.
- Delete cookies and browser history.
- Avoid using public computers for financial transactions such as filing your taxes.
- Reboot the computer before you quit.
- If you're using your own portable apps from a USB drive, make sure your computer is running antivirus software.

TRY IT!

Check your privacy

1. Start your browser and go googling by connecting to **www.google.com**. Enter your name in the Search box. What turns up?

2. Connect to **www.peoplefinders.com**. Enter your name and state of residence. Click the **Search** button. Notice all the information that's offered.

3. Connect to **www.ciadata.com** and scroll down the page to view the kind of information anyone can obtain about you for less than $100.

4. Read about your rights to view credit reports at the Federal Trade Commission site:
www.ftc.gov/bcp/menus/consumer/credit/rights.shtm

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SAFE SOCIAL NETWORKING

What's the risk at sites like Twitter, Facebook, and LinkedIn? A prolific Twitter user with 650 followers had a nasty surprise one morning. She discovered that private messages she'd sent to specific friends were showing up on her public feed for everyone to see. Although this is an extreme example of how things can go wrong on social networking sites, embarrassing incidents are all too frequent.

The more information you reveal at social networking sites, the more you increase your susceptibility to identity theft, stalking, and other embarrassing moments, such as when a prospective employer happens to see those not-so-flattering photos of you on your spring break.

How do I stay safe and keep my stuff private when using social networking sites? The first rule of social networking safety is never share your Social Security number, phone number, or home address. Unfortunately, everyone has access to Web-based tools for finding addresses and phone numbers, so withholding that information provides only a thin security blanket.

Most social networking sites depend on references and friends-of-friends links to establish a trusted circle of contacts. *Trusted* is the key word here. When using social networking sites, make sure you understand what information is being shared with friends, what information is available to strangers on the site, and what data is available publicly to search engines.

Be careful about revealing personal information at social networking sites, blogs, chat rooms, and Twitter. Many online participants are not who they appear to be. Some people are just having fun with fantasy identities, but others are trying to con people by telling hard luck stories and faking illnesses. Resist the temptation to meet face to face with people you've met online without taking precautions, such as taking along a group of friends.

And what about the site itself? Social networking sites, like any online business, are always looking for ways to make a profit. Every participant is a valuable commodity in a database that can be used for marketing and research. Before you become a member, read the site's privacy policy to see how your personal data could be used. Remember, however, that privacy policies can change, especially if a site goes out of business and sells its assets.

You should also find out if you can remove your data from a site. Although most sites allow you to deactivate your information, some sites never actually remove your personal information from their databases, leaving it open to misuse in the future.

TRY IT!

Check your social networking sites

1. Log in to any social networking site you use.

2. Locate the site's privacy policy and read it. Are you comfortable with the ways in which the site protects your personal information?

3. If you are not familiar with the site's options for designating who can view your personal data, find out how you can limit its public exposure.

4. Find out if you can delete your data from the site.

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ONLINE PRIVACY AND SAFETY GUIDELINES

What should I do? Online safety and online privacy are important aspects of computer use today. The average consumer must remain constantly vigilant to detect if his or her personal data has been misused or has fallen into the wrong hands.

Cyberthreats are becoming more troubling. Who would imagine that the webcam at the top of your laptop computer screen could be remotely controlled by hackers to capture video of you without your knowledge?

If you recognize that anything on the Web or in e-mail messages is not necessarily private, you've got the right outlook. You can use the guidelines in Figure 27 to keep track of your personal data and stay safe online.

FIGURE 27

Online Privacy and Safety Guidelines

- Use a password to protect your data in case your computer is stolen.
- Don't leave your digital devices unattended in public places.
- Run antivirus software and keep it updated.
- Install software service packs and security patches as they become available, but make sure they are legitimate.
- Install and activate firewall software, especially if your computer is directly connected to the Internet by an ISDN, DSL, satellite, or cable connection.
- Do not publish or post personal information, such as your physical address, passwords, Social Security number, phone number, or account numbers, on your Web site, in your online resume, in your blog, or in other online documents.
- Be wary of contacts you make in public chat rooms and social networking sites.
- Don't click pop-up ads.
- Install and activate antispyware and ad-blocking software.
- Do not reply to spam.
- Ignore e-mail offers that seem too good to be true.
- Establish a throw-away e-mail account and use it when you have to provide your e-mail address to marketers and other entities whom you don't want to regularly correspond with.
- Make sure you control who has access to the data you post at social networking sites.
- Do not submit data to a social networking site until you've read its privacy policy and have made sure that you can remove your data when you no longer want to participate.
- Avoid using opt-out links in mass mailings unless you are certain the sender is legitimate.
- When using public computers, avoid financial transactions if possible. Make sure you log out from password-protected sites. Delete cookies and Internet history. Reboot the computer at the end of your session.
- Regard e-mail messages as postcards that can be read by anyone, so be careful what you write!
- Cover the webcam on your computer with a sticky note when it is not in use.
- Use the private browsing feature offered by your browser when you don't want to store a record of sites you've visited.
- Activate your browser's Do Not Track feature if you don't want Web sites to collect information about your visit.

QuickCheck

SECTION C

1. Internet security suites usually include antivirus and antispyware tools. True or false? _____
2. _____ software can block intrusion attempts such as hacker probes.
3. Most Web browsers include settings for blocking pop-up ads. True or false? _____
4. E-mail scams are usually distributed in mass mailings called _____.
5. Using opt-out links is the most secure and dependable way to reduce the amount of spam you receive. True or false? _____

CHECK ANSWERS

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NP2014 Online CourseMate

SECTION D

THE INTERNET offers access to information that's useful to just about everyone, and New Perspectives students are no exception. When you purchase access to the New Perspectives 2014 Online CourseMate, you'll find targeted learning materials to help you understand key concepts and prepare for exams.

COURSEMATE RESOURCES

What's on CourseMate? The New Perspectives 2014 CourseMate includes a digital version of your textbook loaded with videos, software tours, and activities. The CourseMate menu includes even more goodies such as quizzes, games, and audio files that you can download to your iPod or other portable device. Figure 28 highlights the features you'll find on the NP2014 CourseMate.

Web site © Cengage Learning

FIGURE 28

NP2014 CourseMate Features

eBook
The NP2014 interactive, multimedia eBook gives you access to your textbook from any computer connected to the Internet.

Detailed Objectives
Access an expanded version of the Learning Objectives that are included at the beginning of each chapter.

Pre-Quiz
Before starting a chapter, take the pre-quiz to find out how to best focus your study time.

TechTerm Flashcards
Make sure you understand all of the technical terms presented in the chapter.

Audio Overview
Listen to a five-minute audio presentation of chapter highlights on your computer or download the files to your MP3 player to study on the go.

Audio Flashcards
Interact with downloadable audio flashcards to review key terms.

Projects
Get ideas for term papers, group projects, and assignments.

Quizzes
Check your understanding and ability to apply concepts.

Student Edition Labs
Get hands-on practice with key topics presented in a chapter.

Games
Have some fun while refreshing your memory about key concepts that might appear on the exam.

Glossary
Get a quick overview of all the key terms presented in each chapter.

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COURSEMATE ACCESS

How do I access the NP2014 CourseMate? CourseMate is hosted on the CengageBrain Web site, *www.cengagebrain.com*. The first time you connect to CengageBrain, sign up for an account. When you have completed the short registration process, you can search for materials by logging in (Figure 29).

FIGURE 29

Open your browser to connect to CengageBrain.

How do I add NP2014 to my dashboard? After you've logged in to CengageBrain, enter the ISBN for your book. If you have an access code, enter it, too.

There are several digital and print options for the NP2014 textbook, as well as bundles that include both print and digital versions. Make your selection carefully. Complete the purchase process, as necessary, and the NP2014 CourseMate will appear on your CengageBrain dashboard (Figure 30).

FIGURE 30

The Home page of your CengageBrain dashboard displays the course materials you've selected.

TRY IT!

Get started with CourseMate

1. Start your browser and connect to *www.cengagebrain.com*.

2. If you are accessing CengageBrain for the first time, click the **Sign Up** link and follow the instructions to create your account.

3. Once you've created a CengageBrain account, you can log in by entering your user name and password, and then clicking the **Log In** button.

4. Add the NP2014 title that's used in your course. Choose carefully to make sure you get the correct edition, version, and electronic format.

5. Open the NP2014 CourseMate.

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COURSEMATE ACTIVITIES

How do I use CourseMate? The NP2014 CourseMate includes two major assets: an interactive, multimedia textbook and a set of activities designed to help you review chapter material, prepare for tests, and extend your understanding of various topics. Let's take a look at the activities first because you might want to use some of them even before you begin reading a chapter.

CourseMate activities are displayed in a list on the left side of the screen, as shown in Figure 31.

FIGURE 31

CourseMate offers activities you can use before and after reading a chapter.

Where do I start? Consider the following tips for using CourseMate activities as an effective study tool:

- Before beginning a chapter, try the Pre-Quiz activity to find out where to focus your study time.
- The Audio Overview presents a high-level introduction to chapter highlights. Use it as an orientation or as a quick refresher before an exam.
- If you like a challenge, use the online games as a review activity; you'll get high scores if you understand the chapter material.
- Quizzes are a great way to make sure that you understand and can apply key concepts presented in a chapter.
- For last-minute review, load up your iPod with the Audio Flashcards. You can listen to them for a quick refresher on your way to the test!

Can I submit scores from CourseMate activities to my instructor? Your results from various CourseMate activities are automatically recorded for your instructor using the Engagement Tracker.

TROUBLE?

If your computer has trouble properly displaying CourseMate or your online eBook, try using a different browser.

Google Chrome seems to be the browser that offers the most consistent browsing experience for PCs and Macs. You can download Chrome for free from *www.google.com/chrome*.

TRY IT!

Explore CourseMate

1. Select **Chapter 1** and then try some CourseMate activities.
2. Be sure to check out the Audio Overview, Flashcards, and Games.

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ONLINE INTERACTIVE EBOOK

What is the NP2014 interactive eBook? The digital version of NP2014 uses an advanced eBook technology that's chock full of activities designed to help readers focus on important concepts and remember them when it is time to take a test.

Each page of the eBook looks exactly like the printed book, so students and instructors are literally all on the same page for assignments and discussions.

How do I access the NP2014 interactive eBook? You can access the eBook from the list on the left side of the CourseMate screen. Select the Chapter eBook option. The NP2014 eBook opens in a new tab or new browser window, depending on how your browser is configured (Figure 32).

CengageBrain screen CourseMate screen eBook screen

FIGURE 32

Remain aware of the windows and tabs that hold the CourseMate and eBook so that you don't mistakenly close one or the other during a session.

How do I navigate through the interactive eBook? You can turn pages using the arrows at the top and bottom of each page. Use the Contents link at the top of each page to jump to the first page of the chapter. Use the links on the first page to jump to any section of a chapter or to end-of-chapter activities.

How do I work with videos and software tours? You can click the Video button to open a video window or software tour. Then use the control buttons to play, pause, or stop playback (Figure 33).

FIGURE 1-47

Password managers help you keep track of all your passwords. If you've never used a password manager and want to see how one works, start the guided tour for this figure in your interactive eBook.

FIGURE 33

Most videos play within the page, whereas software tours play in a separate window. Look for the playback controls on the left side of the video or software tour window.

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Are my eBook activities tracked? Quizzes and Practice tests in the NP2014 eBook are computer scored. You have the option of saving your results and sending them to your instructor.

The first time you start a quiz or practice test, you'll see a message box like the one in Figure 34. If you want to send your scores, fill in the box. If you do not want to send your scores, click the *Do not track results for this session* check box.

FIGURE 34

The data entered for tracking and sending your scores remains in effect for an entire session until you close the eBook. If you change your mind about tracking, simply close the eBook and then open it again.

QuickCheck

SECTION D

1. To access the NP2014 CourseMate, you need a user name and password. True or false? _____
2. The _____ Tracker automatically records your scores for quiz activities listed on the CourseMate main screen.
3. Audio Flashcards can be loaded on an iPod. True or false? _____
4. The Audio _____ is a five-minute audio presentation of chapter highlights.
5. The interactive eBook opens in a new _____ or window of your browser.

CHECK ANSWERS

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Interactive eBook CD

SECTION E

IF YOU CAN'T DEPEND ON your Internet connection, you might consider the interactive, digital version of your textbook that is available on CD. This section describes its features.

EBOOK CD BASICS

How do I start the eBook CD? To start the eBook CD on any Windows computer, follow the instructions in the TRY IT! box below.

What if I have a Mac? If you have a Mac that runs Parallels or Boot Camp, that means you have access to the Windows operating system on your Mac. Boot up your Mac in Windows mode and then use the eBook CD just as you would on a Windows computer.

If your Mac runs only OS X, you can still access the digital textbook by performing a simple conversion process. For instructions on how to convert the eBook CD for your Mac, connect to *www.infoweblinks.com/np2014* and look for the MacPac link.

What if my computer has no CD drive? You can use an external CD drive or install the eBook CD on a local drive. Refer to the NP2014 technical support link at *www.infoweblinks.com/np2014*.

QUESTIONS?

Additional FAQs about the eBook CD are posted at *www.infoweblinks.com* under the Technical Support link. You'll find information on topics such as what to do if the CD doesn't start, and how to use the eBook CD in a computer without a CD drive.

TRY IT!

Start the eBook CD

1. Insert the eBook CD into your computer's CD or DVD drive, label side up.

2. Wait a few seconds until the eBook CD has loaded.

3. When the main Computer Concepts screen appears, proceed to step 4.

- If an Autoplay box appears, select *Run eBook CD.exe*.
- If the CD does not start automatically, click the Start button, click Computer, and then double-click the CD or DVD drive icon.

The eBook CD allows you to save your scores for QuickChecks, practice tests, and other activities. But for this session, you do not need to track this data.

4. Click the **File** menu, and then select **Change Tracking Options**.

5. To disable tracking for now, make sure the box next to *Save Tracking data* is empty. If the box contains a check mark, click the box to empty it.

6. Click the **OK** button to close the Tracking Options dialog box.

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How do I navigate through the book? The eBook CD menu and toolbar near the top of the screen contain tools you can use for navigation. The Next and Back buttons turn one page at a time. To get to the first page of any chapter, you can select it from the Contents menu.

The eBook CD pages mirror the pages in the printed book. So if you want to take the QuickCheck that's on page 21 of your printed textbook, for example, you can use the Go to Page option on the toolbar to jump right to it.

What are the other menu and navigation options? The menu bar includes a Web Links menu that opens your browser and connects to InfoWebLinks. The menu bar also includes a Help menu where you can access instructions and troubleshooting FAQs. The Glossary button provides access to definitions for key terms. An Annotation button appears when your instructor has posted comments or lecture notes. If your instructor has not posted annotations, the button will not appear.

How do I exit the eBook CD? When you have completed a session and want to close the eBook CD, you can click the button in the upper-right corner of the title bar (Windows). On Mac OS X, you can click *NP2014 eBook CD* on the menu bar and select Quit. Figure 35 helps you locate the Close button and eBook CD navigation tools.

TERMINOLOGY NOTE

The eBook CD requires Adobe Flash Player for displaying labs. The Flash Player is installed on most computers. If the eBook CD cannot find your Flash Player when it starts, you'll be directed to go online to download and install it.

FIGURE 35

Key Features of the eBook CD Menu Bar and Toolbar

TRY IT!

Open a chapter and navigate the eBook CD

1. Click **Contents** on the menu bar. The Contents menu appears.
2. Click **Chapter 2**.
3. When Chapter 2 appears, click the **Next** button twice until you see page 56.
4. Click the **Back** button twice to go back to the first page of Chapter 2.
5. Click the white box on the right side of *Go to Page*. Type **89**, and then click the **Go to Page** button.
6. Click the **Go to Page** button. Now you should be back at the first page of Chapter 2.
7. Scroll down the page until you can see the Chapter Contents listing. As shown at right, you can use this list to quickly jump to Sections A, B, C, D, or E; Issues; Technology in Context; NP Labs; and Review Activities.
8. Click **Section D** to jump to Section D.

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MULTIMEDIA AND COMPUTER-SCORED ACTIVITIES

What kinds of multimedia are included in the eBook CD? Figures in your book marked with the icon morph into multimedia tours, animations, and videos. A tour takes you on a guided software tour—even if you don't have the software installed on your computer! Animations and videos visually expand on the concepts presented in the text.

How do I access software tours and other multimedia? To access multimedia elements, simply click the icon while using the eBook CD.

Which activities are computer scored? Figure 36 lists the eBook CD activities that are computer scored. You can use these activities to gauge how well you remember and understand the material you read in the textbook.

Suppose you're reading Chapter 2. Work with the TRY IT! below to see how multimedia and computer-scored activities work.

FIGURE 36

eBook CD Computer-scored Activities

- Interactive Summary
- Interactive Situation Questions
- Interactive Practice Tests
- Concept Map
- QuickChecks
- Lab QuickChecks

Orientation

TRY IT!

Explore multimedia and computer-scored activities

1. Use the **Go to Page** control to jump to page 79.

2. On page 79, Figure 2-27 contains an icon. Click any line of the figure caption to launch the video.

3. When you want to stop the video, click any blank area of the eBook CD page. To restart the video, click the icon again.

4. Now, try a computer-scored QuickCheck. Use the **Go to Page** control to get to page 87 and scroll down the page until you can see the entire set of QuickCheck questions.

5. Click the answer box for question 1, and then type your answer. Most answers are a single word. Upper- and lowercase have no effect on the correctness of your answer.

6. Press the **Tab** key to jump to question 2, and then type your answer. Don't worry if you don't know the answer; you haven't actually read Chapter 2 yet. Just make a guess for now.

7. When you have answered all the questions, click the CHECK ANSWERS icon. The computer indicates whether your answer is correct or incorrect.

8. Continue to click **OK** to check the rest of your answers.

9. When you've reviewed all your answers, the computer presents a score summary. Click **OK** to close the dialog box.

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NEW PERSPECTIVES LABS

What about labs? Your eBook CD includes New Perspectives Labs that give you hands-on experience applying concepts and using software discussed in each chapter. Labs in the eBook CD are divided into topics, and each topic ends with a QuickCheck so that you can make sure you understand key concepts.

In addition to lab QuickChecks, each New Perspectives Lab also includes a set of assignments located on the Lab page of each chapter. Your instructor might require you to complete these assignments. You can submit them on paper, as an e-mail message, or as a document in your Blackboard drop box according to your instructor's directions.

How do I launch a lab? First, navigate to the lab page using the New Perspectives Labs option from the Chapter Contents list, or type in the corresponding page number from the printed book. Click the lab's icon to start it, as explained in the TRY IT! below.

TRY IT!

Open a lab

1. Click **Contents** on the eBook CD menu bar and select **Chapter 1**.

2. Scroll down to the Chapter Contents list and click **New Perspectives Labs**.

3. When the New Perspectives Labs page appears, click **OPERATING A PERSONAL COMPUTER**.

4. The lab window opens. Click the button to view objectives for Topic 1.

5. Click the button again to view page 1 of the lab. Read the information on the page, and then continue through the lab, making sure to follow any numbered instructions.

6. After page 8, you will encounter the first QuickCheck question. Click the correct answer, and then click the **Check Answer** button. After you find out if your answer was correct, click the button to continue to the next question. Complete all the QuickCheck questions for Topic 1.

7. For this TRY IT!, you don't have to complete the entire lab. When you are ready to quit, click the button.

8. Click the button again. Your Lab QuickCheck results are displayed.

9. Click the **OK** button to return to the eBook CD.

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TRACKING YOUR SCORES

Can I save scores from QuickChecks, labs, and other activities? To save your scores, you have to create a Tracking file. The file can be located on a rewritable CD, your computer's hard disk, a USB flash drive, or a network drive where you have permission to store files.

How do I make a Tracking file? The Tracking Options dialog box lets you create a Tracking file and designate where you want to store it. Work with the TRY IT! below to create a Tracking file.

TRY IT!

Create a Tracking file

1. Make sure your eBook CD is open.

2. Click **File** on the eBook CD menu bar, and then click **Change Tracking Options**.

3. When the Tracking Options dialog box appears, click the **Create** button.

4. When the Create Tracking File dialog box appears, enter the requested data (see illustration at right), and then click **Continue**. The Save As (Windows) or Save (Mac) dialog box appears.

5. Use the dialog box to specify the location and name for your Tracking file. (See the illustration at right for Windows or the illustration below for Macs.)

6. After selecting a name and location for your Tracking file, click the **Save** button.

7. Back at the Tracking Options dialog box, make sure there is a check mark in the box labeled *Save Tracking data*, and then click the **OK** button. Now your Tracking file is ready to receive your scores.

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How do I get scores into my Tracking file? Whenever the *Save Tracking data* box is checked, all scored activities are automatically saved in your Tracking file. In the previous TRY IT!, you activated tracking; so until you go back into Tracking Options and remove the check mark from *Save Tracking data*, your scores will be saved.

What happens if I do an activity twice? While tracking is active, all your scores are saved. If you do an activity twice, both scores are saved. Your scores are dated, so you and your instructor can determine which scores are the most recent.

Can I review my scores? You can see all your scores in a Tracking Report.

Can I delete or change my scores? No. Your Tracking data is encrypted and cannot be changed.

Work with the TRY IT! below to see how easy it is to save scores and view your Tracking Report.

TRY IT!

Complete a Practice Test

To start tracking your scores, you can complete a Practice Test.

1. Click the **Practice Test** button located on the eBook CD toolbar.

2. The first question of a ten-question Practice Test appears. Answer the question, and then click the **Next** button.

3. Answer the remaining questions, and then click the **Check Answers** button.

4. When you see your score summary, click the **OK** button. You can then step through each of your answers or view a study guide.

5. Click the **Study Guide** button. A browser window opens to display each Practice Test question, your answers, and the corresponding page numbers in your textbook.

6. Close the Study Guide by clicking the button on your browser window (Windows), or by clicking the browser name in the Mac menu bar and then selecting **Quit** (Mac).

7. Click the **Close** button on the Practice Test window to close it and save your scores.

View the contents of your Tracking file

1. Click **File** on the eBook CD menu bar.

2. Click **View Tracking Report**. Your computer opens your browser and displays a summary score for the Practice Test you completed. The list of summary scores grows as you save additional Practice Tests, QuickChecks, Interactive Summaries, Interactive Situation Questions, and Lab QuickChecks.

3. To close the Tracking Report, close the browser window (Windows) or the TextEdit window (Mac).

Thursday, February 15 9:11:13 AM

New Perspectives on Computer Concepts

Name: Sam Jones
Student ID: 123456789
Class Section: CSC 101A
Tracking file: Documents\tracking-123456789.tk3

Correct: 8
Points Possible: 10
Score: 80.00%

#	Question	Your Answer	Scored As	Review Page
1	The _____ conversion process allows photos, sounds, and other media to travel over the Internet as ASCII text e-mail attachments.	MIME	Correct	34
2	A URL never contains a(n) _____.	B	Correct	26
3	Personal computer systems typically include the following devices EXCEPT _____.	A	Incorrect	10
	Personal computers are available as desktop computers, tablet computers, or			

Sunday, August 24 7:16:33 PM

Tracking Report

New Perspectives on Computer Concepts

Name: Sam Jones
Student ID: 123456789
Class Section: CSC 101A
Tracking file: Macintosh HD:Users Sam:Documents:tracking-123456789.tk3

#	Activity	Date	Time	Points Earned	Points Possible	Score
1	NP2014 Chapter 01 Practice Test	8/24	7:16 PM	8	10	80.00%

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How do I submit scores from my Tracking file? You can use the Submit Tracking Data option on the File menu to send your scores to your instructor. The files are sent over an Internet service called WebTrack.

Are the scores erased from my Tracking file when they are sent? No. Your scores remain in your file—a copy is sent to your instructor. If your instructor's computer malfunctions and loses your data, you can resubmit your Tracking file. It is a good idea to back up your Tracking file using the Back Up Tracking File option on the File menu.

What are chirps? A chirp is a short message, similar to a Twitter-style tweet. You can use chirps to send queries to your instructor. Your instructor might also use chirps as a classroom polling system. Chirps work through WebTrack.

TRY IT!

Send your Tracking data and send a chirp

1. Click **File** on the eBook CD menu bar, and then click **Submit Tracking Data**.

2. Make sure your instructor's WebTrack address is correctly displayed in the Tracking Data Destination dialog box, and then click **Continue**.

3. Your computer opens a browser window, makes an Internet connection, and contacts the WebTrack server.

4. When the WebTrack screen appears, make sure the information displayed is correct, and then click the **Submit** button.

5. When you see a message that confirms your data has been submitted, you can close the browser window.

6. To send a chirp, click the **Chirp** button on the eBook CD toolbar.

7. When the Chirps panel appears, enter your message in the box labeled *Your message*.

8. Click the **Send** button.

9. Close your eBook CD.

QuickCheck

SECTION E

1. Figures in the book marked with an & sign morph into multimedia software tours, animations, and videos. True or false? _____
2. When you use the NP2014 eBook CD, a(n) _____ button appears if your instructor has posted comments or lecture notes.
3. To save your scores, you have to create a(n) _____ file.
4. New Perspectives _____ are divided into topics and each topic ends with a QuickCheck.
5. WebTrack provides a way to submit scores to your instructor. True or false? _____

CHECK ANSWERS

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Computer Concepts 2014

Parsons | Oja

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1 Computers and Digital Basics

Chapter Contents

SECTION A: ALL THINGS DIGITAL
The Digital Revolution
Data Processing
Personal Computing
Network Computing
Cloud Computing
Digital Society

SECTION B: DIGITAL DEVICES
Computer Basics
Computer Types and Uses
Microcontrollers

SECTION C: DIGITAL DATA REPRESENTATION
Data Representation Basics
Representing Numbers, Text, Images, and Sound
Quantifying Bits and Bytes
Circuits and Chips

SECTION D: DIGITAL PROCESSING
Programs and Instruction Sets
Processor Logic

SECTION E: PASSWORD SECURITY
Authentication Protocols
Password Hacks
Secure Passwords

ISSUE: WHAT IS THE VALUE OF INFORMATION?

INFORMATION TOOLS: FINDING THE RIGHT STUFF

TECHNOLOGY IN CONTEXT: MARKETING

NEW PERSPECTIVES LABS

REVIEW ACTIVITIES

INFOWEBLINKS

You'll find updates for chapter material by connecting to the **NP2014 Chapter 1** InfoWebLink.

CLICK TO CONNECT
www.infoweblinks.com/np2014/ch01

Learning Objectives

After reading this chapter, you will be able to answer the following questions by completing the outcomes-based Learning Objectives Checkpoints on page 53.

1. What are the four phases of the digital revolution?
2. What is convergence and how does it apply to the digital revolution?
3. How does digital technology affect society?
4. How do computers work with input, output, processing, storage, and stored programs?
5. What's the difference between an operating system and application software?
6. How do personal computers differ from servers, mainframes, and supercomputers?
7. Are portable media players and mobile phones classified as computers?
8. Why are microcontrollers the computers no one sees?
9. Aren't data and information the same thing?
10. What's the difference between analog and digital?
11. How do digital devices use 1s and 0s to work with numbers, text, images, and sound?
12. Why is there so much jargon pertaining to bits and bytes?
13. What hardware components manipulate the bits that represent data?
14. Why do computers need programs?
15. How do a microprocessor's ALU and control unit work?
16. How do hackers steal passwords?
17. How can I create secure passwords?

Apply Your Knowledge

The information in this chapter will give you the background to:

- Inventory the digital devices you own
- Put digital technology in the context of history, pop culture, and the global economy
- Read computer ads with an understanding of technical terminology
- Select secure passwords for protecting your computer and Internet logins
- Use a password manager to keep track of all your passwords
- Use digital devices with an awareness of how they might infringe on your privacy

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TRY IT!

WHAT'S MY DIGITAL PROFILE?

The average American consumer owns more than 24 digital devices. Before you begin Chapter 1, take an inventory of your digital equipment to find the brands, models, and serial numbers. Tuck this information in a safe place. It can come in handy when you need to call technical support, arrange for repair services, or report missing equipment.

1. Fill in the following table for any digital equipment you own, rent, lease, or use.

	BRAND	MODEL	SERIAL NUMBER
COMPUTER			
KEYBOARD			
MOUSE			
MONITOR			
PRINTER			
DIGITAL CAMERA			
DIGITAL MUSIC PLAYER			
INTERNET OR NETWORK DEVICE			
MOBILE PHONE			
GAME CONSOLE			
OTHER (LIST)			

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All Things Digital

SECTION **A**

WE LIVE IN THE INFORMATION AGE: a period in history when information is easy to access and affects many aspects of everyday life, from the economy to politics and social relationships. The importance of information is not new. It has always been a powerful tool. Scrolls treasured by monks during the Middle Ages, scientific knowledge collected during the Renaissance, and intelligence data collected during the Cold War were all critical in shaping world events. The Information Age is unique because of its underlying technology based on digital electronics. Section A offers an overview of the digital revolution that ushered in the Information Age.

TERMINOLOGY NOTE

The word *digital* comes from the root *digit*. In Latin, the word *digitus* means finger or toe. The modern use of the term *digital* is probably derived from the idea of counting on your fingers.

THE DIGITAL REVOLUTION

What is the digital revolution? The **digital revolution** is an ongoing process of social, political, and economic change brought about by digital technology, such as computers and the Internet.

Like the agricultural and industrial revolutions, the digital revolution offers advantages, but requires adaptations. Digital innovations challenge the status quo and require societies to make adjustments to traditions, lifestyles, and legislation.

The technology driving the digital revolution is based on digital electronics and the idea that electrical signals can represent data, such as numbers, words, pictures, and music. Without digital electronics, computers would be huge machines, priced far beyond the reach of individuals; your favorite form of entertainment would probably be foosball, and you'd be listening to bulky vacuum tube radios instead of carrying sleek iPods (Figure 1-1).

FIGURE 1-1

From Victrolas to stereos, and from boomboxes to iPods, music is only one aspect of life that's been affected by technology.

Velora/Shutterstock.com, Steve Bower/Shutterstock.com, Ivan Bondarenko/Shutterstock.com, © MediaTechnics

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What is the significance of digitization? **Digitization** is the process of converting text, numbers, sound, photos, and video into data that can be processed by digital devices. The significant advantage of digitization is that things as diverse as books, movies, songs, conversations, documents, and photos can all be distilled down to a common set of signals that do not require separate devices.

Before digitization, a phone conversation required a telephone handset and dedicated phone lines. Viewing photos required a slide projector and screen. Reading required a paper book. Viewing movies required a film projector. Once digitized, however, conversations, photos, books, and movies can all be managed by a single device or transmitted over a single set of communication lines.

You can pull a photo down from a Web site, store it on your computer's hard disk, make a copy of it on a flash drive, send it to a friend as an e-mail attachment, add it to a report, print it, combine it with other photos to make a slide show, burn the slide show to a CD, and watch the slide show on your home theater system.

You can use a digitized photo in so many ways. In contrast, if you just have a photo print, you can make a copy of it with a photo copier, send it by snail mail, or frame it, but not much else. Digitization creates versatility.

The digital revolution has evolved through four phases, beginning with big, expensive, standalone computers, and progressing to today's digital world in which small, inexpensive digital devices are everywhere (Figure 1-2).

TRY IT!

According to Figure 1-2, AOL and CompuServe were popular when:

- ❍ data processing was the main digital technology
- ❍ most people had dial-up Internet access and used desktop computers
- ❍ smartphones and tablets were introduced
- ❍ people stopped using cloud computing

1

FIGURE 1-2

As the digital revolution progressed, technology changed, as did the way we use it.

Expired	Tired	Uninspired	Desired
Data processing	Personal computing	Network computing	Cloud computing
Big corporate and government computers	Desktop computers	Laptop computers	Smartphones and tablets
Custom applications	Standalone applications	Monolithic software suites	Handheld apps and cloud-based apps
CB radios	Dial-up Internet access	Cable and satellite Internet access	4G and Wi-Fi Internet access
ARPANET	AOL and CompuServe	The Web and virtual worlds	Social media
Arcade games	2-D action games	3-D multiplayer games	Touchscreen micro-games

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DATA PROCESSING

When did the digital revolution begin? Some historians mark the 1980s as the beginning of the digital revolution, but engineers built the first digital computers during World War II for breaking codes and calculating missile trajectories. In the 1950s, computers were marketed for business applications, such as payroll and inventory management.

What was computing like back then? In this first phase of the digital revolution, computers were huge, complex, and expensive devices. They existed in limited numbers, primarily housed in big corporations and government agencies. Computers were operated by trained technicians. Each computer installation required specialized software. The idea that computers might be used by ordinary people in their homes was only a glimmer of an idea in the minds of science fiction writers.

Back then, processing components for computers were housed in closet-sized cabinets that did not usually include a keyboard or display device. Computers were accessed using the keyboard and display screen of a terminal. Terminals had little processing capability of their own, so they were simply used to enter data and view results produced by software that ran on the main computer.

During the antiestablishment era of the 1960s, the digital revolution was beginning to transform organizations, but ordinary people had little direct contact with computers. As with many new technologies, computers were initially viewed with suspicion by consumers, who were uncomfortable with the idea of giant machine "brains." Computers seemed remote. They were housed out of sight in special facilities and were inaccessible to ordinary people. Computers also seemed impersonal. Instead of names, computers used Social Security numbers to uniquely identify people (Figure 1-3).

FIGURE 1-3

In the 1950s and 1960s, data used by government and business computers was coded onto punched cards that contained the warning "Do not fold, tear, or mutilate this card." Similar slogans were used by protesters who were concerned that computers would have a dehumanizing effect on society.

Throughout the first phase of the digital revolution, businesses adopted computers with increasing enthusiasm as benefits for cutting costs and managing mountains of data became apparent. Computers and data processing became crucial tools for effective business operations.

What is data processing? **Data processing** is based on an input-processing-output cycle. Data goes into a computer, it is processed, and then it is output. For example, a batch of employee time cards are entered into a payroll computer system; the payroll data is processed to calculate take-home pay, deductions, and taxes; paychecks are output (Figure 1-4).

FIGURE 1-4

Data processing is the computing model for the first phase of the digital revolution. The concept of large computers performing tasks based on the input-processing-output cycle represents the primary way computers were used from the 1940s through the 1970s. Data processing installations still exist today, but other technologies emerged, making computing available to a more diverse group of users. See an example of data processing.

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PERSONAL COMPUTING

When did digital devices become available to consumers? Digital devices were first available to consumers in the 1970s when handheld calculators and digital watches hit store shelves. The first personal computers made their debut in 1976, but sales got off to a slow start. Without compelling software applications, personal computers, such as the Apple II, seemed to offer little for their $2,400 price.

As the variety of software increased, however, consumer interest grew. In 1982, *TIME* magazine's Man of the Year award went to the computer, an indication that these digital machines had finally gained a measure of popular acceptance.

What is personal computing? The model for the second phase of the digital revolution, **personal computing** is characterized by small, standalone computers powered by local software. **Local software** refers to any software that is installed on a computer's hard drive.

During this phase of the digital revolution, computers were not connected to networks, so they were essentially self-contained units that allowed users to interact only with installed software. On the business front, large computers continued to run payroll, inventory, and financial software. Some managers used personal computers and spreadsheet software to crunch numbers for business planning.

If you owned a computer back in the second phase of the digital revolution, it was probably a small standalone machine with a display device that looked like an old-fashioned television (Figure 1-5).

Courtesy of Blake Patterson

FIGURE 1-5

The most popular uses for personal computers were word processing and gaming; sound systems and graphics capabilities were primitive. The Internet wasn't open to public use, so computing was not a social experience.

How long was the second phase of the digital revolution? In 1982, computers had gained recognition in *TIME* magazine, but fewer than 10% of U.S. households had a computer. Working on a standalone computer wasn't for everyone.

People without an interest in typing up corporate reports or school papers, crunching numbers for accounting, or playing computer games weren't tempted to become active soldiers in the digital revolution. Social scientists even worried that people would become increasingly isolated as they focused on computer activities rather than social ones. Computer ownership increased at a gradual pace until the mid-1990s, and then it suddenly accelerated into the third phase of the digital revolution.

TRY IT!

During the second phase of the digital revolution, which one of the following was making news headlines?

- ❍ A new band called The Beatles
- ❍ The first space flights
- ❍ President Bill Clinton
- ❍ Apple II computers

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NETWORK COMPUTING

What caused the sudden upswing in computer ownership during the 1990s? The third phase of the digital revolution materialized as computers became networked and when the Internet was opened to public use. A **computer network** is a group of computers linked together to share data and resources.

Network technology existed before the Internet became popular, but those networks were mainly deployed to connect computers within a school or business. Networks were complicated to set up and unreliable. As the third phase of the digital revolution unfolded, network technology became consumer-friendly, allowing homeowners to connect multiple computers, exchange files, and, most importantly, share an Internet connection.

The **Internet** is a global computer network originally developed as a military project, and was then handed over to the National Science Foundation for research and academic use. When restrictions on commercial use of the Internet were lifted in 1995, companies such as AOL and CompuServe became popular services for access to e-mail and the World Wide Web. Internet access was a major factor contributing to the upswing in computer ownership during the 1990s.

What about the Web? When historians look back on the digital revolution, they are certain to identify the Web as a major transformative influence. The **Web** (short for *World Wide Web*) is a collection of linked documents, graphics, and sounds that can be accessed over the Internet.

A key aspect of the Web is that it adds content and substance to the Internet. Without the Web, the Internet would be like a library without any books or a railroad without any trains. Online storefrons, auction sites, news, sports, travel reservations, and music downloads made the Web a compelling digital technology for just about everyone.

So what was computing like? During the period from 1995–2010, computing was characterized by the Web, e-mail, multiplayer games, music downloads, and enormous software applications, such as Microsoft Office, Norton's Internet Security Suite, and Corel Digital Studio (Figure 1-6).

TRY IT!

The Web and the Internet are not the same. Why?

- ❍ The Internet is a communications network; but the Web consists of content that is distributed by the Internet
- ❍ The Internet consists of sites like Twitter and Facebook, whereas the Web links devices like iPods and computers

FIGURE 1-6

Computers were the primary devices for accessing the Internet prior to 2010, but applications, media, and data remained on the local hard disk.

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CLOUD COMPUTING

Is the Web dead? A 2010 *Wired* magazine cover announced "The Web is Dead." That pronouncement was premature, but Facebook, Twitter, and Google Apps have sent computing in new directions. Local applications are being eclipsed by cloud computing, which characterizes the fourth phase of the digital revolution.

What is cloud computing? **Cloud computing** provides access to information, applications, communications, and storage over the Internet. Before cloud computing, most computers ran software based locally. For example, to use a word processor, you might fire up the latest edition of Microsoft Word, which you'd installed on your computer's hard disk. Prior to the cloud, you stored data locally, too. E-mail, documents, photos, and music all resided on your computer's hard disk or flash drive.

With cloud computing, all that changes. You can use your browser to access word processing applications that run from the Internet, instead of software that you have installed on your local hard disk. You can use online applications to manage your e-mail, create floor plans, produce presentations, and carry out a host of other activities. You can store your data in the cloud, too, making it available no matter what computer you're using as long as it has an Internet connection.

The cloud gets its name from diagrams like the one in Figure 1-7, which shows Internet-based applications, storage, and other services outlined by a cloud-like shape designed to help you visualize the idea that cloud services are "out there" somewhere on the Internet.

FIGURE 1-7

The "cloud" represents Internet-based services, such as applications and social media, that are available from computers and handheld digital devices.

What is convergence? The expansion of cloud computing is due in part to **convergence**, a process by which several technologies with distinct functionalities evolve to form a single product. Your computer plays movies. Your cell phone has a camera. Your clock has a radio. Your watch functions as a compass. You can store data on your iPod touch. All these are examples of technological convergence.

Convergence worked its magic on cell phones, computers, portable media players, digital cameras, GPSs, watches, and ebook readers. Now you get features from all of them by purchasing a single digital device. Whether you purchase a full-size computer, a sophisticated mobile phone, or even a game console, you generally have access to software, music, photos, ebooks, movies, communications, and the Web (Figure 1-8).

Convergence is important to the digital revolution because it created sophisticated mobile devices whose owners demand access to the same services available from full-size computers on their desks.

Your smartphone isn't usually in range of the cable modem in your house, so it needs a different way to access the Internet. Your iPad is too small for a huge hard disk, so it needs an alternative place to store data and applications. Touchscreen devices are not great for typing tasks, so cloud-based apps can be specially designed to suit the use of gestures, rather than the use of a mouse and keyboard. You can see how these mobile devices require a solution such as cloud computing to provide a full spectrum of digital services.

FIGURE 1-8

Smartphones such as the iPhone and Droid offer a huge selection of applications and Internet access.

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What role do social media play? The fourth phase of the digital revolution turned the worry of social isolation on its head; instead of computers decreasing human interaction, social media encourage interpersonal communications and relationships. **Social media** are cloud-based applications designed for social interaction and consumer-generated content. They include social networking services, wikis, blogging services, photo sharing services, and microblogging sites (Figure 1-9).

FIGURE 1-9

Social media include many popular services.

Myspace, Facebook, and Twitter became some of the first popular social networking services. Myspace lost steam in 2008, but Facebook and Twitter marched ahead by attracting millions of users. Many factors influenced the popularity of these sites, but one important factor is their ease of use. As cloud-based services, there is no software to install and there are no updates to worry about. Getting started is as simple as registering your name and creating a password.

How is today's computing different from the past? Using computers during the fourth phase of the digital revolution, you're likely to have a mobile device that accesses the Internet using a cell phone service provider.

The touchscreen on your mobile device gives you access to apps that play music, show movies, report news and sports scores, help you find the nearest Starbucks, and all kinds of other fun stuff. You occasionally use Google or Wikipedia to access information; and when you need to produce a document, you head over to Google to access its cloud-based word processor. You spend lots of time maintaining your profiles on social networking services and interacting with friends through cloud-based social media.

TRY IT!

Which social media site has more users: Facebook or Twitter? Do a Google search and find out.

❍ Facebook

❍ Twitter

DIGITAL SOCIETY

How does digital technology affect freedom and democracy? Freedom of speech is the cornerstone of democracy. It can be defined as being able to speak freely without censorship or fear of reprisal. The concept is not limited to speaking, but includes all forms of expression, such as writing, art, and symbolic actions. The more inclusive term *freedom of expression* is sometimes used instead of *freedom of speech*.

Freedom of speech is not an absolute. Most societies prohibit or repress some types of expression, such as hate speech, libel, pornography, and flag burning. Although freedom of expression is guaranteed under the U.S. Constitution, the European Convention on Human Rights, and the Universal Declaration of Human Rights, these documents recognize the necessity for some restrictions, which might vary from one society to the next.

Incidents ranging from the controversy over teaching evolution in schools to the Arab world's fury over cartoons of Mohammed illustrate that societies

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draw the freedom of speech line in different places. The types of expression that are allowed or prohibited in a particular country are, in many respects, a reflection of its culture.

Digital technologies and communications networks make it easy to cross cultural and geographic boundaries. News, television shows, music, and art from all over the globe are accessible on the Internet. The Internet has the potential to expand freedom of speech by offering every person on the planet a forum for personal expression using personal Web sites, blogs, chat groups, social media, and collaborative wikis. Anonymous Internet sites such as Freenet and **anonymizer tools** that cloak a person's identity even make it possible to exercise freedom of speech in situations where reprisals might repress it.

Internet information that seems innocuous in some cultures is not acceptable in others. Governments, parents, and organizations sometimes find it necessary to censor the Internet by limiting access and filtering content.

Despite attempts to censor and filter speech on the Internet, it seems clear that digital technology opens the door to freedom of expression in unprecedented ways. Limitations on Internet speech are likely to change, too, as technology evolves and as societies come to grips with the balance between freedom and responsibility.

TRY IT!

Which country has the most Draconian Internet censorship? Search the Web to find out.

- ❍ United States
- ❍ Russia
- ❍ Iran
- ❍ Greece

Has digital technology changed the way we view privacy? Citizens of free societies have an expectation of privacy, which in the words of Supreme Court Justices Warren and Brandeis is "the right to be let alone." Digital technology use has exerted substantial pressure to diminish privacy by making it possible to easily collect and distribute data about individuals without their knowledge or consent.

Privacy also encompasses confidentiality—the expectation that personal information will not be collected or divulged without permission. Internet marketers have a whole bag of tricks for surreptitiously getting personal information, and hackers are adept at breaking into sensitive databases to obtain confidential information (Figure 1-10).

FIGURE 1-10

Is your location private information? Many applications and social media sites want to know your location. Do you want to reveal it? If not, turn location off.

Surveillance is viewed by many people as an invasion of privacy. Tracking technologies embedded in cars, clothing, passports, and devices such as cell phones make it much too easy to track people without their knowledge.

In the United States, the expectation of privacy is derived from Fourth Amendment protections against unreasonable searches and seizures. The Fourth Amendment was formulated long before the digital revolution. Today's lawmakers struggle to strike the right balance between privacy and competing principles, such as free speech or free trade, but the Internet and other digital technologies are slowly being used to chip away at the wall that protects our private lives.

Some individuals dismiss the erosion of privacy saying, "I have nothing to hide, so I don't care." Many other people don't want stores, hackers, and curious onlookers to have access to data about what they buy, read, and watch; who they call; where they travel; and what they say.

Social media, however, encourage participants to reveal personal details online, and that information is being captured, aggregated, reposted, and distributed publicly. Privacy advocates fear that these digital technologies are fundamentally changing our expectation of what is private and what is not.

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How does digital technology affect intellectual property? **Intellectual property** refers to the ownership of certain types of information, ideas, or representations. It includes patented, trademarked, and copyrighted material, such as music, photos, software, books, and films. In the past, such works were difficult and expensive to copy.

Digital technology has made it easy to produce copies with no loss in quality from the original. Pirating—illegal copying and distribution of copyrighted material—is simple and inexpensive. It has caused significant revenue loss for software publishers, recording studios, and film producers. The fight against piracy takes many forms, from passing strict anti-piracy laws; to scrambling, encryption, and digital rights management schemes that physically prevent copying; to anti-piracy videos (Figure 1-11).

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FIGURE 1-11

Most moviegoers have seen the rock-video style "Don't Copy" trailer. Consumer education is one front in the war against piracy. You can view this video from your interactive eBook.

Digital technology adds complexity to intellectual property issues. For example, artists used to think nothing of cutting out various photos from magazines and pasting them together to form a collage. It is even easier to download digital images from the Web and paste them into reports, add them to Web pages, and incorporate them into works of art. Without permission, however, such digital cut and paste is not allowed.

Some films contain scenes that parents would rather their children not see. Even some scenes from family-oriented Harry Potter films might be too intense for young viewers. So, why not simply edit them out digitally to make a new DVD that even preschoolers can watch? Such modifications are not allowed under current U.S. law, even for private viewing.

In the U.S., it is legal to make a backup copy of software CDs or DVDs that you own. However, if a software CD is copy protected to prevent you from making a copy, it is against the law to break the copy protection. So, legally you have a right to a backup, but you don't have the right to circumvent the copy protection to legally create one!

Bucking protectionist trends are **open source** projects that promote copying, free distribution, peer review, and user modification. Linux is an open-source computer operating system that can be modified and freely distributed. Open source application software includes the popular LibreOffice suite, Firefox Web browser, and Thunderbird e-mail.

Digital technology makes it possible to copy and modify films, music, software, and other data, but a tricky balancing act is required to allow consumers flexibility to use data while protecting the income stream to artists, performers, and publishers.

TRY IT!

The United Nations declared that Internet access is a human right, along with food and clean water. Visit the Internet World Stats site to find out what percent of the world's population has Internet access.

- ❍ 10-25%
- ❍ 25-50%
- ❍ 50-75%
- ❍ 75-100%

What effect does digital technology have on the economy? Digital technology is an important factor in global and national economies, in addition to affecting the economic status of individuals. **Globalization** can be defined as the worldwide economic interdependence of countries that occurs as cross-border commerce increases and as money flows more freely among countries.

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In a global economy, consumers gain access to a wide variety of products, including technology products manufactured in locations scattered all over the globe.

Global communications technology offers opportunities for teleworkers in distant countries. Customer service lines for U.S.-based companies, such as IBM, Dell, and Hewlett-Packard, are often staffed by offshore technicians who earn far more than they could if working for a company that is based in their home country.

Globalization, fueled by digital technology, has controversial aspects, however. Worker advocates object to the use of cheap offshore labor that displaces onshore employees.

Some individuals are affected by the **digital divide**, a term that refers to the gap between people who have access to technology and those who do not. Digital have-nots may face economic barriers. They cannot afford computers, cell phones, and Internet access, or they are located in an economically depressed region where electricity is not available to run digital devices, where Internet access is slow, or where cell phone service is unavailable (Figure 1-12).

Globalization is an ongoing process that will have far-reaching effects on people in countries with developed technologies and those with emerging economies. Digital technology will be called upon to open additional economic opportunities without disrupting the lifestyles of currently prosperous nations.

So what's the point? Learning about digital technology is not just about circuits and electronics, nor is it only about digital gadgets, such as computers and portable music players. Digital technology permeates the very core of modern life. Understanding how this technology works and thinking about its potential can help you comprehend many issues related to privacy, security, freedom of speech, and intellectual property. It will help you become a better consumer and give you insights into local and world events.

As you continue to read this textbook, don't lose sight of the big picture. On one level, in this course you might be simply learning about how to use a computer and software. On a more profound level, however, you are accumulating knowledge about how digital technology applies to broader cultural and legal issues that are certain to affect your life far into the future.

FIGURE 1-12

The digital divide is narrowing as the prices of digital devices fall, and as inexpensive handheld devices acquire more features.

AP Photo/Pavel Rahman

1

QuickCheck

SECTION A

1. Data _____ was the computing technology behind the first phase of the digital revolution.
2. _____ software refers to any software that is installed on a computer's hard drive.
3. A computer _____ is a group of computers linked together to share data and resources.
4. The process of converting text, numbers, sound, photos, or video into data that can be processed by a computer is called _____ .
5. _____ computing provides access to information, applications, communications, and storage over the Internet.

CHECK ANSWERS

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Digital Devices

SECTION **B**

WHETHER YOU REALIZE IT or not, you already know a lot about the devices produced by the digital revolution. You've picked up information from commercials and news articles, from books and movies, from friends and coworkers—even from using a variety of digital devices and trying to figure out why they don't always work! Section B provides an overview that's designed to help you start organizing what you know about digital devices, beginning with computers.

COMPUTER BASICS

What is a computer? The word *computer* has been part of the English language since 1646; but if you look in a dictionary printed before 1940, you might be surprised to find a computer defined as a person who performs calculations! Prior to 1940, machines designed to perform calculations were usually referred to as calculators and tabulators, not computers. The modern definition and use of the term *computer* emerged in the 1940s, when the first electronic computing devices were developed.

Most people can formulate a mental picture of a computer, but computers do so many things and come in such a variety of shapes and sizes that it might seem difficult to distill their common characteristics into an all-purpose definition. At its core, a **computer** is a multipurpose device that accepts input, processes data, stores data, and produces output, all according to a series of stored instructions (Figure 1-13).

FIGURE 1-13

A computer can be defined by its ability to accept input, process data, store data, and produce output, all according to a set of instructions from a computer program.

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What is input? Computer **input** is whatever is typed, submitted, or transmitted to a computer system. Input can be supplied by a person, by the environment, or by another computer. Examples of the kinds of input that computers can accept include words and symbols in a document, numbers for a calculation, pictures, temperatures from a thermostat, audio signals from a microphone, and instructions from a computer program. An input device, such as a keyboard or mouse, gathers data and transforms it into a series of electronic signals for the computer to store and manipulate.

What is output? **Output** is the result produced by a computer. Some examples of computer output include reports, documents, music, graphs, and pictures. Output devices display, print, or transmit the results of processing.

What does *process data* mean? Technically speaking, **data** refers to the symbols that represent facts, objects, and ideas. Computers manipulate data in many ways, and this manipulation is called **processing**. Some of the ways that a computer can process data include performing calculations, modifying documents and pictures, keeping track of your score in a fast-action game, drawing graphs, and sorting lists of words or numbers (Figure 1-14).

FIGURE 1-14

An unsorted list is input into the computer, where it is processed in the CPU and output as a sorted list.

In a computer, most processing takes place in a component called the **central processing unit** or **CPU**. The CPU of most modern computers is a **microprocessor**, which is an electronic component that can be programmed to perform tasks based on data it receives. You'll learn more about microprocessors later in the chapter. For now, visualize a microprocessor as the little black box that's the brain of a digital device.

How do computers store data? A computer stores data so that it will be available for processing. Most computers have more than one place to put data, depending on how the data is being used. **Memory** is an area of a computer that temporarily holds data waiting to be processed, stored, or output. **Storage** is the area where data can be left on a permanent basis when it is not immediately needed for processing.

Data is typically stored in files. A computer file, usually referred to simply as a **file**, is a named collection of data that exists on a storage medium, such as a hard disk, CD, DVD, or flash drive. A file can contain data for a term paper, Web page, e-mail message, or music video. Some files also contain instructions that tell the computer how to perform various tasks.

What's so significant about a computer's ability to store instructions? The series of instructions that tells a computer how to carry out processing tasks is referred to as a **computer program**, or simply a program. These programs form the **software** that sets up a computer to do a specific task. When a computer "runs" software, it performs the instructions to carry out a task.

Take a moment to think about the way you use a simple handheld calculator to balance your checkbook each month. You're forced to do the calculations in stages. Although you can store data from one stage and use it in the next stage, you cannot store the sequence of formulas—the program—required to balance your checkbook. Every month, therefore, you have to

TRY IT!

Suppose you see an iPad advertised with a 64-GB capacity. Does that specification refer to memory or storage?

❍ memory

❍ storage

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perform a similar set of calculations. The process would be much simpler if your calculator remembered the sequence of calculations and just asked you for this month's checkbook entries.

The idea of a **stored program** means that a series of instructions for a computing task can be loaded into a computer's memory. These instructions can easily be replaced by a different set of instructions when it is time for the computer to perform another task. This ability to switch programs makes computers multipurpose machines.

The stored program concept allows you to use your computer for one task, such as word processing, and then easily switch to a different type of computing task, such as editing a photo or sending an e-mail message. It is the single most important characteristic that distinguishes a computer from other simpler and less versatile digital devices, such as watches, calculators, and pocket-sized electronic dictionaries.

TRY IT!

Do you know the difference between the apps you use and your computer's operating system? Which of the following are operating systems?

- ❍ Microsoft Windows
- ❍ Microsoft Word
- ❍ Apple iOS
- ❍ Mac OS X
- ❍ iWork
- ❍ iTunes

What kinds of software do computers run? Computers run two main types of software: application software and system software. A computer can be applied to many tasks, such as writing, number crunching, video editing, and online shopping. **Application software** is a set of computer programs that helps a person carry out a task. Word processing software, for example, helps people create, edit, and print documents. Personal finance software helps people keep track of their money and investments. Video editing software helps people create home movies and professional films. Software applications are sometimes referred to as **apps**, especially in the context of handheld devices.

Whereas application software is designed to help a person carry out a task, the primary purpose of **system software** is to help the computer system monitor itself in order to function efficiently. An example of system software is a computer **operating system** (OS), which is essentially the master controller for all the activities that take place within a computer. Although an operating system does not directly help people perform application-specific tasks, such as word processing, people do interact with the operating system for certain operational and storage tasks, such as starting programs and locating data files.

COMPUTER TYPES AND USES

Are computers categorized in any way? At one time it was possible to define three distinct categories of computers. Mainframes were housed in large, closet-sized metal frames. Minicomputers were smaller, less expensive, and less powerful computers that were able, nevertheless, to support multiple users and run business software. Microcomputers were clearly differentiated from computers in other categories because they were dedicated to a single user and their CPUs consisted of a single microprocessor chip.

Today, microprocessors are no longer a distinction between computer categories because just about every computer uses one or more microprocessors as its CPU. The term *minicomputer* has fallen into disuse, and the terms *microcomputer* and *mainframe* are used with less and less frequency.

Computers are versatile machines, but some computers are better suited than others for certain tasks. Categorizing computers is a way of grouping them according to criteria such as usage, cost, size, and capability. Experts don't necessarily agree on the categories or the devices placed in each category, but commonly used computer categories include personal computers, servers, mainframes, and supercomputers.

TERMINOLOGY NOTE

The term *personal computer* is sometimes abbreviated as *PC*. However, *PC* can also refer to a specific type of personal computer that descended from the original IBM PC and runs Windows software.

In this book, *PC* refers to IBM PC descendants. It is not used as an abbreviation for *personal computer*.

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What is a personal computer? A **personal computer** is a microprocessor-based computing device designed to meet the computing needs of an individual. It commonly includes a keyboard and screen, and provides access to a wide variety of local and cloud-based applications.

Personal computers are available as desktop or portable models, and in a variety of shapes, sizes, and colors. You'll learn more about the wide variety of personal computers in the Hardware chapter. For now, simply remember that computers like those pictured in Figure 1-15 are classified as personal computers.

FIGURE 1-15

Personal computer designs run the gamut from drab gray boxes to colorful curvy cases.

Are handheld devices computers? Handheld digital devices include familiar gadgets such as iPhones, iPads, iPods, Garmin GPSs, Droids, and Kindles. These devices incorporate many computer characteristics. They accept input, produce output, process data, and include storage capabilities. Handheld devices vary in their programmability and their versatility.

Handheld devices can be divided into two broad categories: those that allow users to install software applications (apps) and those that do not. Handheld devices that allow you to install applications can be classified as personal computers; devices that are not programmable cannot.

iPads and Droid phones, for example, offer access to a wide range of apps that include games, ebook readers, maps, comics, recipes, and news, which are tasks also performed by personal computers that sit on a desk or table (Figure 1-16).

FIGURE 1-16

Tablet computers, high-end mobile phones, and similar handheld devices allow you to install your choice of application software.

Is an Xbox a computer? A **videogame console**, such as Nintendo's Wii, Sony's PlayStation, or Microsoft's Xbox, is a computer, but would not generally be referred to as a personal computer because of its history as a dedicated game device. Videogame consoles originated as simple digital devices that connected to a television and provided only a pair of joysticks for input.

Today's videogame consoles contain microprocessors that are equivalent to any found in a fast personal computer, and they are equipped to produce graphics that rival those on dedicated technical and scientific computers. Add-ons such as keyboards, DVD players, and Internet access make it possible to use a videogame console for activities similar to those for which you'd use a personal computer. Despite these features, videogame consoles like the one in Figure 1-17 fill a specialized niche and are not considered a replacement for a personal computer.

FIGURE 1-17

A videogame console includes circuitry similar to a personal computer's, but its input and output devices are optimized for gaming.

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What is a workstation? The term **workstation** has two meanings. It can simply refer to an ordinary personal computer that is connected to a network. A second meaning refers to powerful desktop computers used for high-performance tasks, such as medical imaging and computer-aided design, that require a lot of processing speed. Workstations, such as the one pictured in Figure 1-18, typically cost a bit more than an average personal computer.

© 2011 Hewlett-Packard Development Company, LP

FIGURE 1-18

A workstation resembles a desktop computer, but typically features more processing power and storage capacity.

What makes a computer a server? In the computer industry, the term *server* has several meanings. It can refer to computer hardware, to a specific type of software, or to a combination of hardware and software. In any case, the purpose of a **server** is to serve computers on a network (such as the Internet or a home network) by supplying them with data.

Any software or digital device, such as a computer, that requests data from a server is referred to as a **client**. For example, on the Internet, a server might respond to a client's request for a Web page. Servers also handle the steady stream of e-mail that travels among clients from all over the Internet. A server might also allow clients within a home, school, or business network to share files or access a centralized printer.

Client computers can download and upload files from servers. The term **download** refers to the process of copying a file from a server to your own client computer. For example, you can say "I had to download the file before I could install it." The term can also refer to the file that you download, as in "I had to delete the download because it was infected with a virus."

Upload refers to the process of copying files from your client computer to a server. As with the term *download*, *upload* can also refer to the file you have uploaded.

Remarkably, just about any personal computer, workstation, mainframe, or supercomputer can be configured to perform the work of a server. That fact should emphasize the concept that a server does not require a specific type of hardware. Nonetheless, computer manufacturers such as IBM, SGI, HP, and Dell offer devices called servers (Figure 1-19) that are especially suited for storing and distributing data on a network.

TRY IT!

How would you classify the computer in this diagram?

- ❍ A server
- ❍ A client
- ❍ Both

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© John Kershaw/Alamy

FIGURE 1-19

Some servers look like personal computer tower units, whereas others are housed in industrial-looking cases.

Server prices vary, depending on configuration, but tend to be more similar to workstation prices than personal computer prices. Despite impressive performance on server-related tasks, these machines do not offer features such as sound cards, DVD players, and other fun accessories, so they are not a suitable alternative to a personal computer.

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What's so special about a mainframe computer? A **mainframe computer** (or simply a mainframe) is a large and expensive computer capable of simultaneously processing data for hundreds or thousands of users. Mainframes are generally used by businesses or governments to provide centralized storage, processing, and management for large amounts of data. Mainframes remain the computer of choice in situations where reliability, data security, and centralized control are necessary.

The price of a mainframe computer typically starts at $100,000 and can easily exceed $1 million. Its main processing circuitry is housed in a closet-sized cabinet (Figure 1-20); but after large components are added for storage and output, a mainframe computer system can fill a good-sized room.

Courtesy of International Business Machines Corporation. Unauthorized use not permitted.

FIGURE 1-20

This IBM z9 mainframe computer weighs 2,807 pounds and is about 6.5 feet tall.

How powerful is a supercomputer? A computer falls into the **supercomputer** category if it is, at the time of construction, one of the fastest computers in the world (Figure 1-21).

Because of their speed, supercomputers can tackle complex tasks and compute-intensive problems that just would not be practical for other computers. A **compute-intensive** problem is one that requires massive amounts of data to be processed using complex mathematical calculations. Molecular calculations, atmospheric models, and climate research are all examples of projects that require massive numbers of data points to be manipulated, processed, and analyzed.

Common uses for supercomputers include breaking codes, modeling worldwide weather systems, and simulating nuclear explosions. One impressive simulation, which was designed to run on a supercomputer, tracked the movement of thousands of dust particles as they were tossed about by a tornado.

At one time, supercomputer designers focused on building specialized, very fast, and very large CPUs. Today, most supercomputer CPUs are constructed from thousands of microprocessors. Of the 500 fastest supercomputers in the world, the majority use microprocessor technology.

Lawrence Livermore National Laboratory

FIGURE 1-21

In 2012, IBM's Blue Gene/Q became the fastest supercomputer in the world. With a speed of 16.32 petaflops, the number of calculations this computer can perform in one hour would require 300 years if every person on Earth used a handheld calculator.

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MICROCONTROLLERS

What is a microcontroller? Have you ever wondered how a guided missile reaches its target or how your refrigerator knows when to initiate a defrost cycle? What controls your microwave oven, digital video recorder, washing machine, and watch? Many common appliances and machines are controlled by embedded microcontrollers. A **microcontroller** is a special-purpose microprocessor that is built into the machine it controls. A microcontroller, such as the one in Figure 1-22, is sometimes called a computer-on-a-chip or an embedded computer because it includes many of the elements common to computers.

© mbed

FIGURE 1-22

A microcontroller is a self-contained chip that can be embedded in an appliance, vehicle, or other device.

How does a microcontroller work? Consider the microcontroller in a Sub-Zero refrigerator. It accepts user input for desired temperatures in the refrigerator and freezer compartments. It stores these desired temperatures in memory. Temperature sensors collect additional input of the actual temperatures. The microcontroller processes the input data by comparing the actual temperature to the desired temperature. As output, the microcontroller sends signals to activate the cooling motor as necessary. It also generates a digital readout of the refrigerator and freezer temperatures.

Is a microcontroller really a computer? Recall that a computer is defined as a multipurpose device that accepts input, produces output, stores data, and processes it according to a stored program. A microcontroller seems to fit the input, processing, output, and storage criteria that define computers. Some microcontrollers can even be reprogrammed to perform different tasks.

Technically, a microcontroller could be classified as a computer. Despite this technicality, however, microcontrollers tend to be referred to as processors rather than as computers because in practice they are used for dedicated applications, not as multipurpose devices.

TRY IT!

Which one of the following would you most likely use to add and use apps such as games and weather tracking?

- ❍ A microcontroller
- ❍ Any handheld digital device
- ❍ A handheld computer

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Why are microcontrollers significant? Microcontrollers can be embedded in all sorts of everyday devices, enabling machines to perform sophisticated tasks that require awareness and feedback from the environment (Figure 1-23).

FIGURE 1-23

A microcontroller is usually mounted on a circuit board and then installed in a machine or an appliance using wires to carry input and output signals.

TRY IT!

Where's the microcontroller in this figure? Click it to see if you're right.

When combined with wireless networks, devices with embedded processors can relay information to Web sites, cell phones, and a variety of data collection devices. Machines and appliances with embedded processors tend to be smarter about their use of resources—such as electricity and water—which makes them environmentally friendly.

Perhaps the most significant effect of microcontrollers is that they are an almost invisible technology, one that doesn't require much adaptation or learning on the part of the people who interact with microcontrolled devices. However, because microcontrollers remain mostly out of sight and out of mind, it is easy for their use to creep into areas that could be detrimental to quality of life, privacy, and freedom.

The GPS chip in your cell phone, for example, can be useful if you're lost and need 911 assistance, but it could potentially be used by marketers, law enforcement, and others who want to track your location without your consent.

QuickCheck

SECTION B

1. A computer is a digital device that processes data according to a series of _____ instructions called a program or software.
2. Computer data is temporarily stored in _____, but is usually transferred to _____ where it can be left on a more permanent basis.
3. _____ computers are available in desktop and portable models.
4. A digital device, such as a computer, is called a(n) _____ when it requests data from a server.
5. A(n) _____ is a special-purpose microprocessor that is built into the machine it controls.

CHECK ANSWERS

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Digital Data Representation

SECTION C

COMPUTERS AND OTHER DIGITAL DEVICES work with all sorts of "stuff," including text, numbers, music, images, speech, and video. The amazing aspect of digital technology is that it distills all these different elements down to simple pulses of electricity and stores them as 0s and 1s. Understanding the data representation concepts presented in Section C will help you grasp the essence of the digital world and get a handle on all the jargon pertaining to bits, bytes, megahertz, and gigabytes.

DATA REPRESENTATION BASICS

What is data? As you learned earlier in the chapter, *data* refers to the symbols that represent people, events, things, and ideas. Data can be a name, a number, the colors in a photograph, or the notes in a musical composition.

Is there a difference between data and information? In everyday conversation, people use the terms *data* and *information* interchangeably. Nevertheless, some technology professionals make a distinction between the two terms. They define data as the symbols that represent people, events, things, and ideas. Data becomes information when it is presented in a format that people can understand and use. As a general rule, remember that (technically speaking) data is used by machines, such as computers; information is used by humans.

What is data representation? **Data representation** refers to the form in which data is stored, processed, and transmitted. For example, devices such as smartphones, iPods, and computers store numbers, text, music, photos, and videos in formats that can be handled by electronic circuitry. Those formats are data representations. Data can be represented using digital or analog methods.

What's the difference between analog and digital? For a simple illustration of the difference between analog and digital, consider the way you can control the lights in a room using a traditional light switch or a dimmer switch (Figure 1-24).

A traditional light switch has two discrete states: on and off. There are no in-between states, so this type of light switch is digital. A dimmer switch, on the other hand, has a rotating dial that controls a continuous range of brightness. It is, therefore, analog.

Digital data is text, numbers, graphics, sound, and video that have been converted into discrete digits such as 0s and 1s. In contrast, **analog data** is represented using an infinite scale of values.

TERMINOLOGY NOTE

The word *data* can be correctly treated either as a plural noun or as an abstract mass noun, so phrases such as "The data are being processed" and "The data is being processed" are both correct usage. In this textbook, the word *data* is paired with singular verbs and modifiers.

FIGURE 1-24

A computer is a digital device, more like a standard light switch than a dimmer switch.

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How does digital data work? Imagine that you want to send a message by flashing a light. Your light switch offers two states: on and off. You can use sequences of ons and offs to represent various letters of the alphabet. To write down the representation for each letter, you can use 0s and 1s. The 0s represent the off state of your light switch; the 1s indicate the on state. For example, the sequence *on on off off* would be written as 1100, and you might decide that sequence represents the letter *A*.

Digital devices are electronic and so you can envision data flowing within these devices as pulses of light. In reality, digital signals are represented by two different voltages, such as +5 volts and +.2 volts. They can also be represented by two different tones as they flow over a phone line. Digital data can also take the form of light and dark spots etched onto the surface of a CD or the positive and negative orientation of magnetic particles on the surface of a hard disk.

The 0s and 1s used to represent digital data are referred to as binary digits. It is from this term that we get the word *bit*—*bi*nary digi*t*. A **bit** is a 0 or 1 used in the digital representation of data.

REPRESENTING NUMBERS, TEXT, IMAGES, AND SOUND

How do digital devices represent numbers? **Numeric data** consists of numbers that can be used in arithmetic operations. For example, your annual income is numeric data, as is your age. Digital devices represent numeric data using the binary number system, also called base 2.

The **binary number system** has only two digits: 0 and 1. No numeral like 2 exists in this system, so the number two is represented in binary as 10 (pronounced "one zero"). You'll understand why if you think about what happens when you're counting from 1 to 10 in the familiar decimal system. After you reach 9, you run out of digits. For ten, you have to use the digits 10—zero is a placeholder and the 1 indicates one group of tens.

In binary, you just run out of digits sooner—right after you count to 1. To get to the next number, you have to use the 0 as a placeholder and the 1 indicates one group of twos. In binary, then, you count 0 (zero), 1 (one), 10 (one zero), instead of counting 0, 1, 2 in decimal. If you need to brush up on binary numbers, refer to Figure 1-25 and to the lab at the end of the chapter.

Decimal (Base 10)	Binary (Base 2)
0	0
1	1
2	10
3	11
4	100
5	101
6	110
7	111
8	1000
9	1001
10	1010
11	1011
1000	1111101000

FIGURE 1-25

The decimal system uses ten symbols to represent numbers: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. The binary number system uses only two symbols: 0 and 1.

TRY IT!

The table shows the binary equivalent of numbers 1 through 11. What is the binary for the number 12?

- ❍ 10111
- ❍ 1100
- ❍ 10000
- ❍ 1111

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The important point to understand is that the binary number system allows digital devices to represent virtually any number simply by using 0s and 1s. Digital devices can then perform calculations using these numbers.

How do digital devices represent words and letters?

Character data is composed of letters, symbols, and numerals that are not used in arithmetic operations. Examples of character data include your name, address, and hair color. Just as Morse code uses dashes and dots to represent the letters of the alphabet, a digital computer uses a series of bits to represent letters, characters, and numerals.

Digital devices employ several types of codes to represent character data, including ASCII, EBCDIC, and Unicode. **ASCII** (American Standard Code for Information Interchange, pronounced "ASK ee") requires only seven bits for each character. For example, the ASCII code for an uppercase *A* is 1000001. ASCII provides codes for 128 characters, including uppercase letters, lowercase letters, punctuation symbols, and numerals.

EBCDIC (Extended Binary-Coded Decimal Interchange Code, pronounced "EB seh dick") is an 8-bit code used only by older, mainframe computers.

Extended ASCII is a superset of ASCII that uses eight bits to represent each character. For example, Extended ASCII represents the uppercase letter *A* as 01000001. Using eight bits instead of seven bits allows Extended ASCII to provide codes for 256 characters. The additional Extended ASCII characters include boxes and other graphical symbols. Figure 1-26 lists the Extended ASCII character set.

TRY IT!

Write out **Hi!** in Extended ASCII code. (Hint: Use an uppercase *H*, but a lowercase *i*.)

H _____

i _____

! _____

FIGURE 1-26

The Extended ASCII code uses eight 1s and 0s to represent letters, symbols, and numerals. The first 32 ASCII characters are not shown in the table because they represent special control sequences that cannot be printed. The two blank entries are space characters.

	00100000	>	00111110	\	01011100	z	01111010	ÿ	10011000	╢	10110110	╘	11010100	≥	11110010
!	00100001	?	00111111	]	01011101	{	01111011	Ö	10011001	╥	10110111	╒	11010101	≤	11110011
"	00100010	@	01000000	^	01011110	|	01111100	Ü	10011010	╕	10111000	╓	11010110	⌠	11110100
#	00100011	A	01000001	_	01011111	}	01111101	¢	10011011	╣	10111001	╫	11010111	⌡	11110101
$	00100100	B	01000010	`	01100000	~	01111110	£	10011100	║	10111010	╪	11011000	÷	11110110
%	00100101	C	01000011	a	01100001	⌂	01111111	¥	10011101	╗	10111011	┘	11011001	≈	11110111
&	00100110	D	01000100	b	01100010	Ç	10000000	₧	10011110	╝	10111100	┌	11011010	°	11111000
'	00100111	E	01000101	c	01100011	ü	10000001	ƒ	10011111	╜	10111101	█	11011011	∙	11111001
(	00101000	F	01000110	d	01100100	é	10000010	á	10100000	╛	10111110	▄	11011100	·	11111010
)	00101001	G	01000111	e	01100101	â	10000011	í	10100001	┐	10111111	▌	11011101	√	11111011
*	00101010	H	01001000	f	01100110	ä	10000100	ó	10100010	└	11000000	▐	11011110	ⁿ	11111100
+	00101011	I	01001001	g	01100111	à	10000101	ú	10100011	┴	11000001	▀	11011111	²	11111101
,	00101100	J	01001010	h	01101000	å	10000110	ñ	10100100	┬	11000010	α	11100000	■	11111110
-	00101101	K	01001011	i	01101001	ç	10000111	Ñ	10100101	├	11000011	β	11100001		11111111
.	00101110	L	01001100	j	01101010	ê	10001000	ª	10100110	─	11000100	Γ	11100010		
/	00101111	M	01001101	k	01101011	ë	10001001	º	10100111	┼	11000101	π	11100011		
0	00110000	N	01001110	l	01101100	è	10001010	¿	10101000	╞	11000110	Σ	11100100		
1	00110001	O	01001111	m	01101101	ï	10001011	⌐	10101001	╟	11000111	σ	11100101		
2	00110010	P	01010000	n	01101110	î	10001100	¬	10101010	╚	11001000	µ	11100110		
3	00110011	Q	01010001	o	01101111	ì	10001101	½	10101011	╔	11001001	τ	11100111		
4	00110100	R	01010010	p	01110000	Ä	10001110	¼	10101100	╩	11001010	Φ	11101000		
5	00110101	S	01010011	q	01110001	Å	10001111	¡	10101101	╦	11001011	Θ	11101001		
6	00110110	T	01010100	r	01110010	É	10010000	«	10101110	╠	11001100	Ω	11101010		
7	00110111	U	01010101	s	01110011	æ	10010001	»	10101111	═	11001101	δ	11101011		
8	00111000	V	01010110	t	01110100	Æ	10010010	░	10110000	╬	11001110	∞	11101100		
9	00111001	W	01010111	u	01110101	ô	10010011	▒	10110001	╧	11001111	ø	11101101		
:	00111010	X	01011000	v	01110110	ö	10010100	▓	10110010	╨	11010000	∈	11101110		
;	00111011	Y	01011001	w	01110111	ò	10010101	│	10110011	╤	11010001	∩	11101111		
<	00111100	Z	01011010	x	01111000	û	10010110	┤	10110100	╥	11010010	≡	11110000		
=	00111101	[	01011011	y	01111001	ù	10010111	╡	10110101	╙	11010011	±	11110001		

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Unicode (pronounced "YOU ni code") uses sixteen bits and provides codes for 65,000 characters—a real bonus for representing the alphabets of multiple languages. For example, Unicode represents an uppercase *A* in the Russian Cyrillic alphabet as 0000010000010000.

Why do ASCII and Extended ASCII provide codes for 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9? While glancing at the table of ASCII codes in Figure 1-26, you might have wondered why the table contains codes for 0, 1, 2, 3, and so on. Aren't these numbers represented by the binary number system? A computer uses Extended ASCII character codes for 0, 1, 2, 3 , etc. to represent numerals that are not used for calculations.

TRY IT!

Social Security numbers and the numerals in a street address are considered character data. If your address is 10 B St, how would you complete the Extended ASCII code?

1	0		B		S	T
			01000010	00100000		

How can bits be used to store images? Images, such as photos, pictures, line art, and graphs, are not small, discrete objects like numbers or the letters of the alphabet. Images have to be digitized in order for digital devices to work with them.

Images can be digitized by treating them as a series of colored dots. Each dot is assigned a binary number according to its color. For example, a green dot might be represented by 0010 and a red dot by 1100, as shown in Figure 1-27. A digital image is simply a list of color numbers for all the dots it contains.

How can bits be used to store sound? Sound, such as music and speech, is characterized by the properties of a sound wave. You can create a comparable wave by etching it onto a vinyl platter—essentially how records were made in the days of jukeboxes and record players. You can also represent that sound wave digitally by sampling it at various points, and then converting those points into digital numbers. The more samples you take, the closer your points come to approximating the full wave pattern. This process of sampling, illustrated in Figure 1-28, is how digital recordings are made.

FIGURE 1-27

An image can be digitized by assigning a binary number to each dot.

FIGURE 1-28

A sound wave can be sampled at fraction-of-a-second time intervals. Each sample is recorded as a binary number and stored.

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QUANTIFYING BITS AND BYTES

How can I tell the difference between bits and bytes?

The ads for digital devices often include lots of abbreviations relating to bits and bytes. A few key concepts can help you understand what these abbreviations mean. Even though the word *bit* is an abbreviation for *binary digit*, it can be further abbreviated, usually as a lowercase *b*.

On older digital devices, bits were handled in groups, and terminology from that era is still used. A group of eight bits is called a **byte** and is usually abbreviated as an uppercase *B*.

Transmission speeds are usually expressed in bits, whereas storage space is typically expressed in bytes. For example, a cable Internet connection might transfer data from the Internet to your computer at 8 mega*bits* per second. In an iPod ad, you might notice that it can store up to 60 giga*bytes* of music and video.

TERMINOLOGY NOTE

What's a kibibyte? Some computer scientists have proposed alternative terminology to dispel the ambiguity in terms such as *mega* that can mean 1,000 or 1,024. They suggest the following prefixes:

Kibi = 1,024

Mebi = 1,048,576

Gibi = 1,073,741,824

What do the prefixes *kilo-*, *mega-*, *giga-*, and *tera-* mean?

When reading about digital devices, you'll frequently encounter references such as 50 kilobits per second, 1.44 megabytes, 2.8 gigahertz, and 2 terabytes. *Kilo*, *mega*, *giga*, *tera*, and similar terms are used to quantify digital data as shown in Figure 1-29.

Bit	One binary digit	Gigabit	2^{30} bits
Byte	8 bits	Gigabyte	2^{30} bytes
Kilobit	1,024 or 2^{10} bits	Terabyte	2^{40} bytes
Kilobyte	1,024 or 2^{10} bytes	Petabyte	2^{50} bytes
Megabit	1,048,576 or 2^{20} bits	Exabyte	2^{60} bytes
Megabyte	1,048,576 or 2^{20} bytes		

FIGURE 1-29
Quantifying Digital Data

In common usage, *kilo*, abbreviated as K, means a thousand. For example, $50K means $50,000. In the context of computers, however, 50K means 51,200. Why the difference? In the decimal number system we use on a daily basis, the number 1,000 is 10 to the third power, or 10^3. For digital devices where base 2 is the norm, a kilo is precisely 1,024, or 2^{10}. A **kilobit** (abbreviated Kb or Kbit) is 1,024 bits. A **kilobyte** (abbreviated KB or Kbyte) is 1,024 bytes. Kilobytes are often used when referring to the size of small computer files.

The prefix *mega* means a million, or in the context of bits and bytes, precisely 1,048,576 (the equivalent of 2^{20}). A **megabit** (Mb or Mbit) is 1,048,576 bits. A **megabyte** (MB or MByte) is 1,048,576 bytes. Megabytes are often used when referring to the size of medium to large computer files.

In technology lingo, the prefix *giga* refers to a billion, or precisely 1,073,741,824. As you might expect, a **gigabit** (Gb or Gbit) is approximately 1 billion bits. A **gigabyte** (GB or GByte) is 1 billion bytes. Gigabytes are commonly used to refer to storage capacity.

Computers—especially mainframes and supercomputers—sometimes work with huge amounts of data, and so terms such as *tera* (trillion), *peta* (thousand trillion), and *exa* (quintillion) are also handy.

TRY IT!

Fill in the correct abbreviation (B, MB, KB, or GB):

My iPhone has 8 [ ] of storage space.

I uploaded a high-resolution 8- [ ] graphic.

You can download my resume; the file is only 8 [ ] .

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CIRCUITS AND CHIPS

How do digital devices store and transport all those bits? Because most digital devices are electronic, bits take the form of electrical pulses that can travel over circuits in much the same way that electricity flows over a wire when you turn on a light switch. All the circuits, chips, and mechanical components that form a digital device are designed to work with bits.

At the simplest level, you can envision bits as two states of an electric circuit; the state used for a 1 bit would be on and the state for a 0 bit would be off. In practice, the 1 bit might be represented by an elevated voltage, such as +5 volts, whereas a 0 bit is represented by a low voltage, such as 0.2.

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Kozhadub Sergei/Shutterstock.com

TRY IT!

Suppose for a moment that you are a microprocessor and you get the set of signals shown at left. What letter are you processing?

- ❍ Q
- ❍ a
- ❍ j
- ❍ S

What's inside? If it weren't for the miniaturization made possible by digital electronic technology, computers, cell phones, and portable media players would be huge and contain a complex jumble of wires and other electronic gizmos. Instead, today's digital devices contain relatively few parts—just a few wires, some microchips, and one or more circuit boards.

What's a computer chip? The terms *computer chip*, *microchip*, and *chip* originated as technical jargon for integrated circuit. An **integrated circuit** (IC), such as the one pictured in Figure 1-30, is a super-thin slice of semiconducting material packed with microscopic circuit elements, such as wires, transistors, capacitors, logic gates, and resistors.

Semiconducting materials (or semiconductors), such as silicon and germanium, are substances with properties between those of a conductor (like copper) and an insulator (like wood). To fabricate a chip, the conductive properties of selective parts of the semiconducting material can be enhanced to essentially create miniature electronic pathways and components, such as transistors.

© 2011 Intel-Vintage A

FIGURE 1-30

The first computer chips contained fewer than 100 miniaturized components, such as diodes and transistors. The chips used as the CPUs for today's computers and cutting-edge graphics cards contain billions of transistors.

Integrated circuits are packaged in protective carriers that vary in shape and size. Figure 1-31 illustrates some chip carriers, including small rectangular DIPs (dual in-line packages) with caterpillar-like legs protruding from a black, rectangular body; and pin-cushion-like PGAs (pin-grid arrays).

A DIP has two rows of pins that connect the IC circuitry to a circuit board.

A PGA is a square chip package with pins arranged in concentric squares, typically used for microprocessors.

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FIGURE 1-31

Integrated circuits can be used for microprocessors, memory, and support circuitry. They are housed within a ceramic carrier. These carriers exist in several configurations, or chip packages, such as DIPs and PGAs.

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How do chips fit together? The electronic components of most digital devices are mounted on a circuit board called a system board, motherboard, or main board. The **system board** houses all essential chips and provides connecting circuitry between them. Figure 1-32 illustrates circuit boards for two digital devices. Although one device is a full-size computer and the other is an iPhone, they both have chips for processing, memory, input, and output.

FIGURE 1-32

The electronic components of computers and handheld devices have many similar elements, including microchips and circuit boards. Circuit boards are usually green, whereas microchips are usually black.

iPhone circuit board (enlarged)

QuickCheck

SECTION C

1. Data _____ refers to the format in which data is stored, processed, and transferred.
2. Digital devices often use the _____ number system to represent numeric data.
3. Most computers use Unicode or Extended _____ code to represent character data. (Hint: Use the acronym.)
4. KB is the abbreviation for _____ .
5. Integrated circuits are fabricated from _____ materials that have properties of a conductor and an insulator.

CHECK ANSWERS

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Digital Processing

SECTION D

COMPUTERS AND OTHER DIGITAL DEVICES process data, but how do they know what to do with it? The instructions you issue aren't 0s and 1s that a digital device can work with. So what goes on inside the box? Section D explains the programs that make digital devices tick. You'll discover that although digital devices appear to perform very complex tasks, under the hood they are really performing some very simple operations, but doing them at lightning speed.

PROGRAMS AND INSTRUCTION SETS

How do digital devices process data? Computers and dedicated handheld devices all work with digital data under the control of a computer program. Let's take a closer look at programs to see how they are created and how digital devices work with them.

Who creates programs? Computer programmers create programs that control digital devices. These programs are usually written in a high-level **programming language**, such as C, BASIC, COBOL, or Java.

Programming languages use a limited set of command words such as *Print*, *If*, *Write*, *Display*, and *Get* to form sentence-like statements designed as step-by-step directives for the processor chip. An important characteristic of most programming languages is that they can be written with simple tools, such as a word processor, and they can be understood by programmers. A simple program to select a song on your iPod might contain the statements shown in Figure 1-33.

Program:

```
Display Playlist
Get Song
Play Song
```

The human-readable version of a program, like the one above, created in a high-level language by a programmer is called **source code**. However, just as a digital device can't work directly with text, sounds, or images until they have been digitized, source code has to be converted into a digital format before the processor can use it.

TRY IT!

Was the first computer programmer a man or a woman? There is controversy surrounding the answer to this question. Check online to find the name of the person who is often cited as the first computer programmer.

- ❍ Bill Gates
- ❍ Ada Lovelace
- ❍ Grace Hopper
- ❍ Charles Fortran

FIGURE 1-33

The program for an iPod displays a list of songs that the user can choose to play. A program works behind the scenes to display the list, get your selection, process it, and play the song.

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How does source code get converted? The procedure for translating source code into 0s and 1s can be accomplished by a compiler or an interpreter. A **compiler** converts all the statements in a program in a single batch, and the resulting collection of instructions, called **object code**, is placed in a new file (Figure 1-34). Most of the program files distributed as software contain object code that is ready for the processor to execute.

FIGURE 1-34

A compiler converts statements written in a high-level programming language into object code that the processor can execute. Watch a compiler in action.

As an alternative to a compiler, an **interpreter** converts and executes one statement at a time while the program is running. After a statement is executed, the interpreter converts and executes the next statement, and so on (Figure 1-35).

FIGURE 1-35

An interpreter converts high-level statements one at a time as the program is running. Watch an interpreter in action.

Compilers and interpreters don't simply convert the characters from source code into 0s and 1s. For example, in the first line of the iPod program, Display Playlist, a compiler would not simply convert the *D* into its ASCII equivalent. No, computers are a little trickier than that.

What does the conversion process produce? A microprocessor is hard-wired to perform a limited set of activities, such as addition, subtraction, counting, and comparisons. This collection of preprogrammed activities is called an **instruction set**. Instruction sets are not designed to carry out any specific task, such as word processing or playing music. Instead, an instruction set is designed to be general purpose so that programmers can use it in creative ways for the wide variety of tasks performed by all kinds of digital devices.

Each instruction has a corresponding sequence of 0s and 1s. For example, 00000100 might correspond to *Add*. The list of codes for a microprocessor's instruction set, called **machine language**, can be directly executed by the processor's circuitry. A set of machine language instructions for a program is called **machine code**.

TRY IT!

Suppose a programmer wants to distribute the object code for an iPhone app. After creating the program as source code, the programmer needs to use a(n):

- ❍ interpreter
- ❍ compiler
- ❍ COBOL
- ❍ ASCII code

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A machine language instruction has two parts: the op code and the operands. An **op code**, which is short for *operation code*, is a command word for an operation such as add, compare, or jump. The **operand** for an instruction specifies the data, or the address of the data, for the operation. In the following instruction, the op code means add and the operand is 1, so the instruction means add 1.

TRY IT!

Label the operand and the op code.

A single high-level instruction very often converts into multiple machine language instructions. Figure 1-36 illustrates the number of machine language instructions that correspond to a simple high-level program.

```
#include <stdio.h>
int main ()
{
int i;

for (i=1; i<=100; i=i+1)
  printf("%d\t",i);
return(0);
}
```

```
00100111101111011111111111100000
10101111101111110000000000010100
10101111101001000000000000100000
10101111101001010000000000100100
10101111101000000000000000011000
10101111101000000000000000011100
10001111101011100000000000011100
10001111101111000000000000011000
00000001110011100000000000011001
00100101110010000000000000000001
00101001000000010000000001100101
10101111101010000000000000011100
00000000000000000111100000010010
00000011000011111100100000100001
00010100001000001111111111110111
10101111101110010000000000011000
00111100000001000001000000000000
10001111101001010000000000011000
00001100000100000000000011101100
00100100100001000000010000110000
```

FIGURE 1-36

The source code program in the left column prints numbers from 1 to 100. This source code is converted to machine language instructions shown in the right column that the computer can directly process.

To summarize what you should now know about programs and instruction sets, a programmer creates human-readable source code using a programming language. A compiler or an interpreter converts source code into machine code. Machine code instructions are a series of 0s and 1s that correspond to a processor's instruction set.

PROCESSOR LOGIC

What happens inside a computer chip? A microprocessor contains miles of microscopic circuitry and millions of miniature components divided into different kinds of operational units, such as the ALU and the control unit.

The **ALU** (arithmetic logic unit) is the part of the microprocessor that performs arithmetic operations, such as addition and subtraction. It also performs logical operations, such as comparing two numbers to see if they are the same. The ALU uses **registers** to hold data that is being processed, just as you use a mixing bowl to hold the ingredients for a batch of cookies.

The microprocessor's **control unit** fetches each instruction, just as you get each ingredient out of a cupboard or the refrigerator. Data is loaded into the ALU's registers, just as you add all the ingredients to the mixing bowl. Finally, the control unit gives the ALU the green light to begin processing, just as you flip the switch on your electric mixer to begin blending the cookie ingredients. Figure 1-37 illustrates a microprocessor control unit and an ALU preparing to add 2 + 3.

FIGURE 1-37

The control unit fetches the ADD instruction, then loads data into the ALU's registers where it is processed.

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What happens when a computer executes an instruction?

The term **instruction cycle** refers to the process in which a computer executes a single instruction. Some parts of the instruction cycle are performed by the microprocessor's control unit; other parts of the cycle are performed by the ALU. The steps in this cycle are summarized in Figure 1-38.

FIGURE 1-38

The instruction cycle includes four activities.

What role does the control unit play?

The instructions that a computer is supposed to process for a particular program are held in memory. When the program begins, the memory address of the first instruction is placed in a part of the microprocessor's control unit called an instruction pointer.

The control unit can then fetch the instruction by copying data from that address into its instruction register. From there, the control unit can interpret the instruction, gather the specified data, or tell the ALU to begin processing. Figure 1-39 helps you visualize the control unit's role in processing an instruction.

FIGURE 1-39

The control unit's instruction pointer indicates M1, a location in memory. The control unit fetches the "Add two numbers" instruction from M1. This instruction is then sent to the ALU. The instruction pointer then changes to M2. The processor fetches the instruction located in M2, moves it to a register, and executes it. See how it works.

When does the ALU swing into action?

The ALU is responsible for performing arithmetic and logical operations. It uses registers to hold data ready to be processed. When it gets the go-ahead signal from the control unit, the ALU processes the data and places the result in an accumulator. From the accumulator, the data can be sent to memory or used for further processing. The TRY IT! on the next page helps you visualize what happens in the ALU as the computer processes data.

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TRY IT!

Execute the following set of commands using the ALU diagram at left.

Load Register 1 with 4.

Load Register 2 with 5.

Add the two registers.

Move the result to RAM.

What happens after an instruction is executed? When the computer completes an instruction, the control unit increments the instruction pointer to the memory address of the next instruction, and the instruction cycle begins again.

Do I need to know all this detailed stuff? What you should take away from the discussion about programming and instruction sets is the idea that computers and other digital devices accomplish a wide array of complex tasks by performing a very limited set of machine language instructions very fast.

These concepts about how processors work will help you understand the significance of microprocessor performance, such as speed and word size, which you'll learn about in the next chapter.

QuickCheck

SECTION D

1. A(n) _____ converts all of the source code instructions into a new file containing _____ code.
2. A microprocessor is hard-wired to perform a set of activities called a(n) _____ set.
3. A machine language instruction has two parts: a(n) _____ code and an operand.
4. The ALU in your computer's microprocessor holds data in _____ .
5. The microprocessor's control unit contains a(n) _____ pointer that holds the address of the instruction being executed.

CHECK ANSWERS

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Password Security

SECTION E

USER IDS, passwords, and personal identification numbers (PINs) are a fact of everyday life in the information age. They are required for activities such as using ATMs and debit cards, logging in to Windows, accessing wireless networks, making an iTunes purchase, instant messaging, reading e-mail, and file sharing. Many Web sites encourage you to sign up for membership by choosing a user ID and password. Section E provides information about selecting secure passwords and managing the mountain of passwords you collect and tend to forget.

AUTHENTICATION PROTOCOLS

What is an authentication protocol? Security experts use the term **authentication protocol** to refer to any method that confirms a person's identity using something the person knows, something the person possesses, or something the person is. For example, a person might know a password or PIN. A person might possess an ATM card or a credit card. A person can also be identified by **biometrics**, such as a fingerprint, facial features (photo), or a retinal pattern (Figure 1-40).

Authentication protocols that use more than one means of identification are more secure than others. Two-factor authentication, which verifies identity using two independent elements of confirmation such as an ATM card and a PIN, is more secure than single-factor authentication, such as a password. Computer-related security is primarily based on passwords associated with user IDs. The level of protection offered by single-factor authentication depends on good password selection and management on the part of users.

What is a user ID? A **user ID** is a series of characters—letters and possibly numbers or special symbols—that becomes a person's unique identifier, similar to a Social Security number. It is also referred to as a user name, login, screen name, online nickname, or handle. User IDs are public. Because they are not secret, they do not offer any level of security.

The rules for creating a user ID are not consistent throughout all applications, so it is important to read instructions carefully before finalizing your user ID. For example, spaces might not be allowed in a user ID. Hence, the underline in brunhilde_jefferson is used instead of a space. There might be a length limitation, so Ms. Jefferson might have to choose a short user ID, such as bjeffe. It is becoming common to use your e-mail address as a user ID; it is unique and easy to remember.

FIGURE 1-40

Biometric authentication protocols include retinal scans that identify unique patterns of blood vessels in the eye.

© Brand X Pictures/Alamy

TRY IT!

When you use a debit card, you have to enter your PIN. This is an example of:

- ❍ single-factor authentication
- ❍ single user ID
- ❍ two-factor authentication
- ❍ password security

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Some computers that host password-protected resources don't differentiate between uppercase and lowercase letters, and would consider the user IDs B_Jefferson and b_jefferson to be the same. Other computers are **case sensitive** and differentiate between uppercase and lowercase. On such computers, if Ms. Jefferson selected Brun_Jeff as her user ID, she would not be able to gain access by typing brun_jeff.

What is a password? A **password** is a series of characters that verifies a user ID and guarantees that you are the person you claim to be. Although you might be assigned a password, more commonly you are asked to provide your own. In some situations, you might be given a temporary password and then be asked to change it as soon as you successfully log in for the first time. Passwords and user IDs are created on a registration or enrollment screen similar to the one in Figure 1-41.

FIGURE 1-41

When you create an account, you are usually required to enter a user ID and password. Then you are required to confirm the password to make sure you typed it correctly.

What if I forget my password? Login screens for many applications provide a "forgot my password" link. Clicking this link checks your identity using your answer to a personal question. If your identity checks out, your password is e-mailed to you. A personal question provides an alternative authentication protocol to ensure that you are not a hacker pretending to be a legitimate user who has lost a password.

Personal questions and answers are usually set up at the same time you create an account. After selecting a password, you are required to choose a question that you must answer before your forgotten password is e-mailed to you. This question might be something like: *What is your mother's maiden name?*, *What is your favorite color?*, or *Where were you born?* You should be careful about the question you choose because public information like your mother's maiden name or the town of your birth can be researched by any hacker.

What is the difference between a password and a PIN? Both passwords and PINs are classified as *something-the-user-knows* authentication methods. In practice, PINs tend to be a short sequence of numbers that can be entered using a numeric keypad, whereas passwords tend to be longer sequences of letters, numbers, and special characters that require a full qwerty keyboard for entry. PINs are commonly used with two-factor authentication protocols, whereas passwords are used in conjunction with single-factor authentication protocols.

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For example, ATMs require a bank card (something you possess) and a PIN (something you know). In contrast, passwords are associated with single-factor authentication used for networks, Web sites, and other situations in which the hardware for dealing with ID cards is not available.

PASSWORD HACKS

How serious is password theft? To a hacker, obtaining the password for a specific user ID can be even more rewarding than a burglar figuring out the combination to a house safe. Once hackers get into a user account, a wealth of personal information can be at their fingertips. This information could be anything from juicy e-mail gossip to Social Security numbers, credit card numbers, bank account numbers, health data, and other private details. When someone gains unauthorized access to your personal data and uses it illegally, it is called **identity theft**. Victims of this increasingly common crime often don't realize what has happened until it's too late.

TERMINOLOGY NOTE

Hacker can refer to a skilled programmer or to a person who manipulates computers with malicious intent. The terms *black hat* and *cracker* are also used to refer to a malicious or criminal hacker.

Armed with your password and other personal data, a cybercriminal can rack up bills using your credit card, apply for a mortgage using your financial data, create fake accounts in your name, send embarrassing e-mail messages, or wreak havoc on your bank account. Once a thief breaks into an online account, he or she can also change your password and you will no longer be able to log in. Password theft is serious and pervasive, so it is important to understand how hackers get passwords and how you can protect yours.

How can hackers get my password? Hackers employ a whole range of ways to steal passwords. Some primitive means include shoulder surfing, which is looking over your shoulder as you type in your password, and dumpster diving, which is going through your trash.

Password thieves can easily find your password if you write it down on a yellow sticky note hidden under your keyboard or in plain sight on top of your monitor. If a hacker doesn't have physical access to your work area but your computer is connected to a network, your password can be discovered by a hacker using a remote computer and software tools that systematically guess your password, intercept it, or trick you into revealing it.

A **dictionary attack** helps hackers guess your password by stepping through a dictionary containing thousands of the most commonly used passwords. Password dictionaries can be found on black hat sites and packaged with password-cracking software, such as John the Ripper. Unfortunately, dictionary attacks are often enough to break a password because many users choose passwords that are easy to remember and likely to be in the most commonly used list (Figure 1-42).

FIGURE 1-42

Some of the most commonly used passwords are included in the dictionaries packaged with password-cracking software. These passwords (listed in order of popularity) should not be used.

12345	internet	jordan	alex	newyork	jonathan
abc123	service	michael	apple	soccer	love
password	canada	michelle	avalon	thomas	marina
computer	hello	mindy	brandy	wizard	master
123456	ranger	patrick	chelsea	Monday	missy
tigger	shadow	123abc	coffee	asdfgh	monday
1234	baseball	andrew	dave	bandit	monkey
a1b2c3	donald	bear	falcon	batman	natasha
qwerty	harley	calvin	freedom	boris	ncc1701
123	hockey	changeme	gandalf	dorothy	newpass
xxx	letmein	diamond	golf	eeyore	pamela
money	maggie	matthew	green	fishing	pepper
test	mike	miller	helpme	football	piglet
carmen	mustang	ou812	linda	george	poohbear
mickey	snoopy	tiger	magic	happy	pookie
secret	buster	trustno1	merlin	iloveyou	rabbit
summer	dragon	12345678	molson	jennifer	rachel

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The **brute force attack** also uses password-cracking software, but its range is much more extensive than the dictionary attack. Because it exhausts all possible combinations of letters to decrypt a password, a brute force attack can run for days to crack some passwords.

If hackers can't guess a password, they can use another technique called **sniffing**, which intercepts information sent out over computer networks. Sniffing software is used legitimately by network administrators to record network traffic for monitoring and maintenance purposes. The same software can also be used for illicit activities. If your user ID and password travel over a network as unencrypted text, they can easily fall into the hands of a password thief.

An even more sophisticated approach to password theft is **phishing**, in which a hacker poses as a legitimate representative of an official organization such as your ISP, your bank, or an online payment service in order to persuade you to disclose highly confidential information. Mostly through e-mail or instant messaging, a fake customer representative or administrator asks you to visit a Web page to confirm billing information or verify your account by providing your password, credit card number, or Social Security number.

If you examine phishing messages more closely, you might realize that the Web sites referred to are fake. However, seasoned hackers try to make the URLs look as close as possible to the official Web sites they claim to represent (Figure 1-43).

TRY IT!

How fast can you guess the password for this account?

Log in

User name:

Mickey@gmail.com

Password:

FIGURE 1-43

A fake Web site can look very similar to the real thing, but this fraudulent site originates in Korea. Do you notice that the URL is www.paypvl.com.kr instead of the legitimate *www.paypal.com*? You should avoid clicking links in e-mail messages that attempt to get you to confirm or renew account data.

As users became better at identifying phishing messages, password thieves resorted to the use of keyloggers. Short for *keystroke logging*, a **keylogger** is software that secretly records a user's keystrokes and sends the information to a hacker. A keylogger is a form of malicious code called a Trojan horse, or Trojan. Trojans are computer programs that seem to perform one function while actually doing something else. They can be embedded in e-mail attachments, software downloads, and even files. Trojans are discussed in more detail in the security section of the Software chapter.

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SECURE PASSWORDS

How do I create a secure password? With password theft becoming more and more widespread, security experts recommend using a strong, secure password for financial transactions such as those that involve PayPal, iTunes, or bank accounts. A strong, secure password is one that is easy to remember but difficult to crack. Figure 1-44 offers guidelines for selecting secure passwords and avoiding ones that are easily crackable.

FIGURE 1-44

Tips for Creating Secure Passwords

- Use passwords that are at least eight characters in length. The longer the password, the tougher it is to crack.
- Use a combination of letters, numbers, and special characters such as $, #, if permitted.
- Use uppercase and lowercase letters if the hosting computer is case sensitive.
- Use a passphrase based on several words or the first letters of a verse from a favorite poem or song. For example, the words from the nursery rhyme "Jack and Jill went up the hill" can be converted to jjwuth. You can then insert special characters and numbers, and add some uppercase letters to create a password that still makes sense to you personally, such as J&J w^th!ll. This type of password appears random to anyone else but you.

- Do not use a password based on public information such as your phone number, Social Security number, driver's license number, or birthday. Hackers can easily find this information, and other personal facts such as names of your spouse, children, or pets.
- Avoid passwords that contain your entire user ID or part of it. A user ID of bjeffe coupled with a password of bjeffe123 is an easy target for password thieves.
- Steer clear of words that can be found in the dictionary, including foreign words. Dictionary attacks can utilize foreign language dictionaries. Even common words spelled backwards, such as drowssap instead of password, are not tricky enough to fool password-cracking software.

How do I protect my password? Once you have selected a strong password, you must take steps to keep it safe. Do not share your password with anyone. Avoid writing down a password. If possible, memorize it. If you must write down a password, do not leave it in an obvious place such as under your keyboard or mouse pad. Recording passwords in an unencrypted file stored on your computer is risky, too, especially if you have more than one password. A hacker who gains access to that file can use the passwords to access all your accounts.

If you think one of your passwords has been compromised, change it immediately. Even if you have no evidence of password tampering, security experts recommend that you change passwords periodically, say every six months. When you change your passwords, do not just make a slight variation to your current one. For example, do not change just4Me1 to just4Me2. You should not reuse your old passwords either, so it's best to keep a password history list.

TRY IT!

Which password for Dave Meyers is most secure?

- ❍ DaveBMeyers
- ❍ Dave12345
- ❍ Gilgamesh
- ❍ Ih2gtg8pw
- ❍ HomeGilgamesh

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Aside from good password maintenance habits, computer maintenance is also essential. Make sure that your entire computer is protected by security software, which is explained in the Software chapter.

How do I deal with all my passwords and user IDs? You can accumulate many passwords and user IDs—for logging in to Windows, accessing online banking, using e-mail, shopping online, downloading music, and getting into your Facebook account. The more passwords and user IDs you have, the more difficult they become to remember.

How many times have you had to click the "I forgot my password" link when you logged in to an online account? Your passwords provide the most protection if they are unique, but accessing even 25 different Web sites that require 25 different user IDs and 25 corresponding passwords requires quite a memory. To add to the confusion, you must also regularly change passwords to your critical accounts!

Instead of using 25 different user IDs and passwords, you need some way to reduce the number of things you have to memorize. First, strive to select a unique user ID that you can use for more than one site. Remember that people with your name who selected user IDs before you might have already taken the obvious user IDs. For example, when John Smith selects a user ID, you can bet that other people have already used johnsmith, jsmith, and john_smith. To keep his user ID unique, John might instead select jsl2wm (the first letters in "John Smith loves 2 watch movies").

Next, you can maintain two or three tiers of passwords—the top level for high security, the second level for medium security, and the third level for low security. If you do not have too many accounts, you can opt for just two tiers—for high and low security. You can then select two passwords. Use the high-security password for accessing critical data, such as online banking, for managing an online stock portfolio, or for your account at an online bookstore that stores a copy of your billing and credit card information.

Use your low-security password in situations where you don't really care if your security is compromised. Some places on the Internet want you to establish an account with a user ID and password just to add your name to a mailing list. At other sites, your user ID and password provide access to information, but none of your critical personal or financial data is stored there. It is not necessary to change your low-security password very often. Figure 1-45 provides more information about tiered passwords.

FIGURE 1-45

Tiered passwords reduce the number of user IDs and passwords that you have to remember; however, the disadvantage is that a hacker who discovers one of your passwords will be able to use it to access many of your accounts.

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Can my computer help me to remember passwords? Your computer's operating system, Web browser, or other software might include a password manager to help you keep track of user IDs and passwords. A **password manager** (sometimes called a keychain) stores user IDs with their corresponding passwords and automatically fills in login forms. For example, when you register at a Web site while using a browser such as Internet Explorer, the browser stores your new ID and password in an encrypted file on your computer's hard disk. The next time you visit the Web site, your ID and password are automatically filled in on the login screen (Figure 1-46).

The drawback to password managers that are built into browsers, operating systems, or other software is that if you switch to different software or to a different computer, you will not have access to the stored passwords. For example, if you usually work with the Safari browser on your MacBook Air, it stores your passwords; but if you use a public computer in a coffee shop, your passwords are not accessible from that machine.

Standalone password manager software offers a more inclusive approach to creating and retrieving passwords.

What is password manager software? A standalone password manager is a software application that feeds passwords into login forms regardless of the software you're using. As with built-in password managers, a standalone password manager stores user IDs and passwords in an encrypted file. You can access this file using a master password. This type of password manager can be moved from one computer to another, for example, if you purchase a new computer.

A standalone password manager can also generate secure "nonsense passwords." You don't have to worry if the passwords are difficult to remember because the password manager software can keep track of them (Figure 1-47).

FIGURE 1-46

Checking the *Remember me* box saves your user ID and password for the next time you log in, but you have to be using the same browser.

FIGURE 1-47

Password managers help you keep track of all your passwords. If you've never used a password manager and want to see how one works, start the guided tour for this figure in your interactive eBook.

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In addition to generating and tracking your passwords, most password manager software provides other features, such as password strength meters and form fillers.

A password strength meter indicates whether your passwords are secure enough—a feature that is useful if you've created your own passwords, rather than using your password manager to generate them.

Form fillers automatically enter data into online Web forms such as those that request billing data when you order at an online shopping site. Many form fillers also match a Web form's URL against a set of valid URLs that you have provided in order to avoid sending data to a fake Web site that you have been lured to visit by a phishing message. When entering passwords, form fillers are not collecting your password from the keyboard; therefore, a hacker's keylogger cannot secretly record keystrokes.

There are several free, shareware, or open source password managers, such as KeePass, RoboForm, DataVault, and Kaspersky Password Manager. Some password manager software is portable, which means that it does not have to be installed on a computer before it is used. Instead, you can carry it around on a USB flash drive so that your passwords are available wherever you use a computer, such as in your school lab, at the library, or at work. When you remove the flash drive, your portable password manager leaves no traces of passwords behind (Figure 1-48).

For extra protection against intruders who might search your computer for passwords, a flash drive that contains a password manager can be unplugged when you are not accessing password-protected sites. You can also remove the flash drive from your computer when you're out so that your nosy roommate can't snoop through your computer files.

Should I store passwords in the cloud? New password management techniques are being developed, but some offer their own set of potential security problems. For example, Web-based password managers can be attractive targets for password thieves. By breaking into a single site, a password thief could harvest thousands of passwords. As new password management technologies appear, make sure you evaluate them carefully before trusting them with your valuable data.

FIGURE 1-48

Some password managers are portable so that you can carry them with you on a USB flash drive.

TRY IT!

Smartphone access can be controlled by a password. Would you recommend a password manager to your friend with an iPhone?

- ❍ No. The phone's password is all my friend will need
- ❍ Yes, especially if my friend wants to access Facebook or other subscription sites from the phone

QuickCheck

SECTION E

1. An authentication _____ is any method that confirms a person's identity using something the person knows, something the person possesses, or something the person is.
2. On a(n) _____ -sensitive server, the user ID BJP is different from bjp.
3. A(n) _____ attack can guess your password if you are using common passwords or everyday words.
4. A(n) _____ scam looks like a request from your bank or an online payment service, but is actually a hacker who wants you to disclose your user ID and password.
5. Most browsers include a built-in password _____ that remembers the user IDs and passwords you use when logging in to Web sites or online e-mail.

CHECK ANSWERS

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Issue: What Is the Value of Information?

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THE GUERILLA Open Access Manifesto begins, "Information is power. But like all power, there are those who want to keep it for themselves. The world's entire scientific and cultural heritage, published over centuries in books and journals, is increasingly being digitized and locked up by a handful of private corporations."

Written by Aaron Swartz, the manifesto makes a case for free access to information, particularly scientific information that has the potential to benefit society. To publicize his views, Swartz took action, allegedly downloading nearly 5 million articles, editorials, reviews, and other material from the prestigious JSTOR academic database. He was arrested on felony charges.

Shortly after the Swartz story broke, another open access advocate, Gregg Maxwell, uploaded more than 18,000 articles from Philosophical Transactions of the Royal Society to a file sharing site. The articles, all dated prior to 1923 and previously available by subscription, became accessible to the general public for free.

In explaining his actions, Maxwell wrote, "The liberal dissemination of knowledge is essential to scientific inquiry. More than in any other area, the application of restrictive copyright is inappropriate for academic works: there is no sticky question of how to pay authors or reviewers, as the publishers are already not paying them. And unlike 'mere' works of entertainment, liberal access to scientific work impacts the well-being of all mankind. Our continued survival may even depend on it."

Certainly there are expenses associated with operating academic databases such as JSTOR, but the researchers who write academic articles are typically not paid for their contributions. Money to support their research often comes from public funding collected from taxpayers. Yet academic databases often charge access fees to read full-text articles.

Schools and libraries often pay a per-year fee that provides students and faculty with free access to academic publications, but members of the general public trying to access such information from their home or work computers hit a paywall that becomes a barrier to access. Open access advocates want information to be freely available, and technologies of the Information Age seem on the way to making that a reality.

Information purveyors such as JSTOR and *The New York Times* argue that free data is unsustainable. Gathering, storing, and distributing information entail costs that need to be passed on to consumers. Information has value that consumers should be willing to pay for.

A U.S. Department of the Navy report suggests that information has value whether or not it is free; however, the value of information increases when it is easy to access, organized, current, and reliable.

On the surface, information available from the Web might seem free, but there are hidden costs such as intrusive advertising, surreptitious tracking, and personal data collection that erode privacy.

> *Information from the Web might seem free, but there are hidden costs...*

Public release of massive numbers of documents onto the Internet is becoming more common as open access advocates take action. Sometimes information, such as Sarah Palin's e-mails and FBI files on the Roswell UFO incident, can be obtained through the Freedom of Information Act (FOIA) and other legitimate channels.

When legitimate routes fail, documents and databases are sometimes released through backdoor channels. Climategate and WikiLeaks are notorious examples of leaked data.

Open access is a complex concept that requires intelligent compromise among the interests of individuals, businesses, and government agencies. Individuals want to retain their privacy, businesses want to retain their income stream, and governments want to maintain security. Yet, all parties would like as much information as possible in order to make informed decisions and take constructive action.

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TRY IT! Explore the value of information, paywalls, and data leaks by working on the following activities.

1. Despite the widespread belief that digital information should be free, the popularity of iTunes and ebook readers, such as the Kindle, demonstrate that consumers are willing to pay for some digital content accessed from the Internet. Make a list of digital content that you currently pay for.

2. A paywall blocks access to documents, news articles, and other content until the consumer pays an access or registration fee. Notable publications such as *The New York Times* and *The Wall Street Journal* have instituted paywalls with varying degrees of success. Use a search engine to answer two questions about paywalls:

   a. What is the reason that premium newspapers and magazines believe that paywalls are necessary?

   b. How successful are paywalls based on the number of consumers who actually pay for access to content in online newspapers and magazines?

3. Paywalls are not the only barrier that blocks access to information. Individuals, corporations, and governments hold personal, proprietary, and classified information that is not available for public access. That information sometimes goes public. Explore some of the most notorious data leaks by filling in the following table.

LEAK	CONTENTS	DATE	NUMBER OF DOCUMENTS
CRU CLIMATE DATA			
U.S. DIPLOMATIC CABLES			
WAR DIARY: AFGHANISTAN WAR LOGS			
WAR DIARY: IRAQ WAR LOGS			

4. Many countries have legislation similar to the United States Freedom of Information Act, which provides a legitimate channel for requesting the release of proprietary and classified information. Declassified data is posted on Web sites for public access. The FBI maintains a fascinating site called The Vault, where you can read dossiers about Marilyn Monroe, Malcolm X, and the Roswell UFO incident.

   Head over to The Vault (*vault.fbi.gov*), browse through the documents for a topic that interests you, and record the most surprising piece of information you find.

INFOWEBLINKS

You can check the **NP2014 Chapter 1** InfoWebLink for updates to these activities.

CLICK TO CONNECT
www.infoweblinks.com/NP2014/ch01

ISSUE

What Do You Think?

1. From what you have learned, do you think that academic research articles should be available for free?
2. Do you agree with magazine and news companies that quality content requires a paywall?
3. Do you support efforts to make information accessible through back channels such as WikiLeaks?

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Information Tools: Finding the Right Stuff

Mark Graves /Shutterstock.com

You're looking for information. Where you start depends on how you plan to use the information. The sources you need for a class research paper often differ from information sources for personal use.

Information sources can be roughly divided into two categories: those that serve academic audiences and those that serve consumers.

Find these sources using Google Scholar and academic databases/ directories such as DOAJ

Scholarly and academic sources

- Written by experts
- Intended for academic or professional readers
- Peer-reviewed by other experts before publication
- Contain original research, theoretical analysis, or best practices
- Carefully documented by footnotes or endnotes
- Published by academic publishers, professional associations, or university presses
- Include academic books, academic journals, papers, conference proceedings, dissertations, textbooks, and monographs in printed or digital format

Use these sources for class papers, theses, essays, and dissertations

Find these sources using Google Web, Google News, and product Web sites

Consumer-level sources

- Written by reporters, bloggers, or practitioners
- Intended for the general public
- Usually reviewed by an editor before publication
- Sometimes open to public comment after publication

- Printed or displayed in color with included photos
- Often published in for-profit publications that include advertising
- Include trade books, magazines, encyclopedias, press releases, trade journals, blogs, news sites, and online forums

Use these sources for product information, troubleshooting, news, and topic overviews

HELP!

Can't access what you need for a research project? Here are some common problems encountered by students, and solutions that help you find the resources you need for a paper that earns you an A.

PROBLEM: Web search engines, such as Google, sometimes miss many of the articles most relevant for a college-level research project because articles are often locked behind paywalls or firewalls that don't allow search engine access. **SOLUTION:** Go directly to a journal's Web site and search there.

PROBLEM: Many scholarly journals display only abstracts to the general public; viewing the full text of articles requires a subscription or download fee. **SOLUTION:** Use your library's online database to locate articles that are included in the physical collection. You might have to go to the library to read the articles or ask for the full article from inter-library loan.

PROBLEM: Access to academic search engines and databases, such as LexisNexis, requires subscriptions. **SOLUTION:** Your school might provide registered students with free access to journal databases if you log in from a computer on the school network or from within the library.

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TRY IT! Research about computers and technology relies on information from a broad base of sources. Let's explore these sources by comparing what they offer. Some searches will produce information suitable for academic projects, such as term papers, while other searches tend to produce information suitable for personal use, such as figuring out if someone is hacking into your home network.

To record the results of this comparison, write down (or screen capture) one example that you get from each source, and then describe an academic project or personal use for which that information would be suitable. As an example, suppose that you search for "cloud computing" using Google Scholar and one of the results is

> **Introduction to parallel algorithms and architectures**
> T Leighton - sce.uhcl.edu
> ... Catalog Description: This course covers parallel computations using popular interconnection networks such as arrays, trees, hypercubes, and permutation networks such as the star and the pancake networks, as well as grid and **cloud computing**. ...
> Cited by 2996 - Related articles - View as HTML - Library Search - All 5 versions

This information is academic and could be suitable as one of the sources for a term paper about cloud computing for a computer science course. Okay, now see what you can do with the rest.

1. Check Wikipedia for general information about "cloud computing" and then look at the list of references.
2. Search for academic and trade books about cloud computing at Amazon Books.
3. Search for conference proceedings about cloud computing at the ACM Digital Library.
4. Search an open access database such as DOAJ (see sidebar) for a recent paper about cloud computing.
5. Search an academic database (see sidebar) for an abstract about cloud computing.
6. Search Science.gov for a full text article about cloud computing.
7. Search an online computer magazine, such as *Wired*, for a recent article about cloud computing.
8. Use a search engine, such as Google or Bing, to locate a recent press release about cloud computing.
9. Search Amazon Electronics for cloud computing products and customer reviews.
10. Search a technology news site (see sidebar) for the latest industry news about cloud computing.

Computer and Technology Academic Databases

- Odysci Academic Search
- DOAJ (Directory of Open Access Journals)
- Science.gov
- TDG Scholar
- Microsoft Academic Search
- IEEE Xplore
- CiteSeerX
- ACM (Association for Computing Machinery) Digital Library

Computer and Technology News Sites

- Huffington Post Tech
- Engadget
- TechCrunch
- Ars Technica
- Google News Technology
- WSJ All Things Digital
- CNET News
- Tom's Hardware

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Technology in Context: Marketing

Darren Hubley/Shutterstock.com

WALKING OUT THE GATE of ancient Pompeii, you might have come across an eye-catching sign extolling the virtues of a popular tavern in the next town. The sign was a clever bit of marketing designed to target thirsty travelers and drum up business. Throughout the centuries, handbills, newspaper ads, television commercials, radio spots, and mass mail campaigns were all important tools of the marketing industry. Now, computers have opened new vistas for communicating with consumers.

The American Marketing Association defines marketing as an organizational function and a set of processes for creating, communicating, and delivering value to customers and for managing customer relationships in ways that benefit the organization and its stakeholders. A person-in-the-street definition might simply be that marketing is an attempt to sell products.

Computers first played a role in marketing as a research tool for quickly crunching numbers from consumer surveys and sales figures. Statistics derived from that data helped companies focus development efforts on the most promising products and market them effectively. Marketing research data made one fact very clear: Even the most effective advertising cannot convince everyone to buy a particular product. A costly prime-time television ad, for example, might be seen by millions of viewers, but many of them have no interest in the advertised product. To better target potential buyers, marketers turned to direct marketing.

Image Courtesy of The Advertising Archives

Direct marketing attempts to establish a one-to-one relationship with prospective customers rather than waiting for them to learn about a product from general, impersonal forms of advertising, such as billboards, radio spots, television commercials, and newspaper ads. The first direct marketing techniques included personalized letters, catalogs, and telemarketing. Customer names, addresses, and phone numbers were mined from computer databases maintained by mailing list brokers. Lists could be tailored in rudimentary ways to fit target markets. Selling snow tires? Get a list of consumers in northern states. Looking for Peace Corps volunteers? Get a list of college students.

"Dear Carmen Smith, you might already have won…" Just about everyone in America has received a personalized sweepstakes mailing. Initially, personalized names were crudely inserted using dot matrix printers, but today high-speed laser printers dash off thousands of personalized letters per hour and use graphics capabilities to affix signatures that appear to have been hand-signed in ink.

Telemarketing is a technique for telephone solicitation. Computerized autodialers make it possible for telemarketers to work efficiently. An autodialer is a device that can dial telephone numbers stored in a list. It can also generate and dial telephone numbers using a random or sequential number generator.

A smart autodialer, called a predictive dialer, increases a telemarketer's efficiency even more by automatically calling several numbers at the same time and only passing a call to the marketer when a person answers.

If you've picked up the telephone only to hear silence or a disconnect, it was likely an autodialer that connected to more than one person at the same time and dropped your call. Predictive dialers eliminate telemarketing time that would be otherwise wasted with busy signals, answering machines, and so on.

The Internet opened up dramatic new horizons in direct marketing by providing an inexpensive conduit for collecting information about potential customers and distributing targeted direct marketing. According to author Jim Sterne, "The Internet and the World

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Wide Web have become the most important new communication media since television, and ones that are fundamentally reshaping contemporary understanding of sales and marketing." Today, a vast amount of information flows over the Internet and marketers are trying to harness that information to most efficiently communicate their messages to prospective customers.

E-commerce Web sites offer a global distribution channel for small entrepreneurs as well as multinational corporations. Consumers can locate e-commerce sites using a search engine. Some search engines allow paid advertising to appear on their sites. Clever marketers use search engine optimization techniques to get their Web sites to the top of search engine lists.

Another way to drive traffic to an e-commerce site is banner advertising that clutters up Web pages with inviting tag lines for free products. Clicking the ad connects consumers to the site. The cost of placing a banner ad depends on the click-through rate—the number of consumers who click an ad. Sophisticated banner ad software displays the banner ad across an entire network and monitors click-through rates. Not only does this software keep track of clickthroughs for billing purposes, it can automatically adjust the sites that carry each ad to maximize click-through rates.

Internet marketing is often associated with the tidal wave of spam that's currently crashing into everyone's Inbox. These mass spam e-mails, however bothersome, are a very crude form of direct marketing. Typically, spammers use unscrubbed mailing lists containing many expired, blocked, and invalid e-mail addresses. This hit-or-miss strategy is cheap. Ten million e-mail addresses can be rented for as low as $100 and server bandwidth provided by e-mail brokers costs about $300 per million messages sent.

Marketing professionals regard massive e-mail spamming with some degree of scorn because most lists don't narrow the focus to the most promising customers. Worse yet, consumers react by installing spam filters. Some spammers try to evade spam filters. More than one Web site offers marketers a free service that analyzes mass e-mail solicitations using a spam filter simulator. If the solicitation can't get through the filter, the service offers suggestions on what to change so the message slips through.

Ads - Why these ads?
These ads are based on the e-mail message you are currently viewing.

Modeling - Models Wanted
Make your dreams come true Join Free. Upload audition photos NOW!
modeliscious.com/modeling

Sailing Charters
Island and pirate adventures await you in the beautiful Caribbean.
carribeamcharterspriates.com

Visit St. Thomas
Sun and sand chase the winter chill away. Save up to 50% on hotels and tours.
sttvisitorstours.com/specials

Sailing Charters
Island and pirate adventures await you in the beautiful Caribbean.
carribeamcharterspriates.com

Fix Your Credit Score
Use this simple trick and your score will jump. Banks hate it, you'll love it. Guaranteed.
giturcreditbacknow.com

Debit Cards 4 All
Low-fee debit cards. No credit check. Personal service.
dbitcrdsrus.com

In contrast to gratuitous spammers, marketing professionals have learned that opt-in mailing lists have much higher success rates. Consumers who have asked for information more often appreciate receiving it and act on it. Opt-in consumers are also more willing to divulge information that develops an accurate profile of their lifestyle so marketers can offer them the most appropriate products.

When given a choice, however, consumers tend to opt out, and marketers responded by surreptitiously collecting data from free apps, Web sites, Facebook pages, and the content of Web-based e-mail messages. Privacy advocates attacked this practice, and savvy consumers have found tools and techniques to minimize the amount of personal data that is harvested behind the scenes.

Most consumers would agree that the marketing industry needs professionals who are socially responsible. In describing the qualifications for marketing professionals, the Bureau of Labor Statistics states the obvious when it says, "Computer skills are vital because marketing, product promotion, and advertising on the Internet are increasingly common."

In preparing for a marketing career, a knowledge of computers, the Web, and the Internet are important. Equally important is preparation in statistical analysis, psychology, and ethics, along with coursework that covers legal and regulatory aspects of the technology-driven marketing industry.

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New Perspectives Labs

To access the New Perspectives Labs for Chapter 1, open the NP2014 interactive eBook and then click the icon next to the lab title.

OPERATING A PERSONAL COMPUTER

IN THIS LAB YOU'LL LEARN:

- How to start a Windows computer
- What to do when a computer is in sleep mode
- How to deactivate a screensaver
- How to select a different screensaver
- How to use the Alt, Ctrl, Esc, Num Lock, Caps Lock, Windows, Fn, Backspace, Delete, and arrow keys
- The difference between forward and backward slashes
- How to start and exit a program
- How to close a program that is not responding
- When to use the reset button
- How to shut down Windows

LAB ASSIGNMENTS

1. Start the interactive part of the lab. Make sure you've enabled Tracking if you want to save your QuickCheck results. Perform each lab step as directed, and answer all the lab QuickCheck questions. When you exit the lab, your answers are automatically graded and your results are displayed.
2. Make a note of the brand and location of the computer you're using to complete these lab assignments.
3. Use the Start button to access your computer's Control Panel folder. Describe the status of your computer's power saver settings.
4. Preview the available screensavers on the computer you use most frequently. Select the screensaver you like the best and describe it in a few sentences.
5. What is the purpose of an Fn key? Does your computer keyboard include an Fn key? Explain why or why not.
6. In your own words, describe what happens when you (a) click the Close button; (b) hold down the Ctrl, Alt, and Del keys; (c) press the reset button; and (d) select the Shut Down option.

WORKING WITH BINARY NUMBERS

IN THIS LAB YOU'LL LEARN:

- The difference between the binary number system and the decimal number system
- How to count in binary
- How to convert decimal numbers into binary numbers
- How to convert binary numbers into decimal numbers
- How to use the Windows Calculator to convert numbers
- How to work with powers of two

LAB ASSIGNMENTS

1. Start the interactive part of the lab. Make sure you've enabled Tracking if you want to save your QuickCheck results. Perform each lab step as directed, and answer all the lab QuickCheck questions. When you exit the lab, your answers are automatically graded and your results are displayed.
2. Using paper and pencil, manually convert the following decimal numbers into binary numbers. Your instructor might ask you to show the process that you used for each conversion.

a. 100	b. 1,000	c. 256
d. 27	e. 48	f. 112
g. 96	h. 1,024	

3. Using paper and pencil, manually convert the following binary numbers into decimal numbers. Your instructor might ask you to show the process that you used for each conversion.

a. 100	b. 101	c. 1100
d. 10101	e. 1111	f. 10000
g. 1111000	h. 110110	

4. Describe what is wrong with the following sequence:

   10 100 110 1000 1001 1100 1110 10000

5. What is the decimal equivalent of 2^0? 2^1? 2^8?

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Key Terms

Make sure you understand all the boldfaced key terms presented in this chapter. With the NP2014 interactive eBook, you can use this list of terms as an interactive study activity. First, try to define a term in your own words, and then click the term to compare your definition with the definition presented in the chapter.

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Interactive Summary

To review important concepts from this chapter, fill in the blanks to best complete each sentence. When using the NP2014 interactive eBook, click the Check Answers buttons to automatically score your answers.

SECTION A: The _____ revolution is an ongoing process of social, political, and economic change brought about by technologies such as computers and networks. The _____ is a global computer network originally developed as a military project, adapted for research and academic use, and then for commercial use. _____, a form of electronic communication, was an application for the masses and finally a reason to buy a computer and join the digital revolution. Another aspect of the digital revolution is _____, a process by which several technologies with distinct functionalities evolve to form a single product. Technology has the potential to spread ideas, such as freedom and democracy, but it might have a chilling effect on _____, or "the right to be left alone." It might also affect intellectual _____ because digital technology has made it easy to produce copies with no loss in quality from the original. Technology-driven _____ has an effect on the economy, as consumers gain access to products and services from countries other than their own. Activists worry about the digital _____ that separates people who have access to technology and those who do not.

CHECK ANSWERS

SECTION B: A(n) _____ is a multipurpose device that accepts input, processes data, stores data, and produces output according to a series of stored instructions. The data a computer is getting ready to process is temporarily held in _____. This data is then processed in the central processing _____. The series of instructions that tells a computer how to carry out processing tasks is referred to as a computer _____, which forms the _____ that sets up a computer to do a specific task. Data is typically stored in a(n) _____, which is a named collection of data that exists on a storage medium, such as a hard disk, CD, DVD, Blu-ray disc, or USB flash drive. The idea of a(n) _____ program means that a series of instructions for a computing task can be loaded into a computer's memory. _____ software is a set of computer programs that helps a person carry out a task. _____ software helps the computer system monitor itself in order to function efficiently. For example, a computer _____ system (OS) is essentially the master controller for all the activities that take place within a computer. Computers can be grouped into categories. A(n) _____ computer is a type of microcomputer designed to meet the needs of an individual. The term _____ can refer to an ordinary personal computer that is connected to a network or to a powerful desktop computer designed for high-performance tasks. A(n) _____ is, at the time of its construction, one of the fastest computers in the world. A(n) _____ computer is large, expensive, and capable of simultaneously processing data for hundreds or thousands of users. Small, portable digital devices that allow you to install apps can be classified as _____ computers. A(n) _____ is a special-purpose microprocessor that can control a device, such as a refrigerator or microwave oven.

CHECK ANSWERS

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SECTION C: _____ data is processed, stored, and transmitted as a series of 1s and 0s. Each 1 or 0 is called a(n) _____. A series of eight 0s and 1s, called a(n) _____, represents one character—a letter, number, or punctuation mark. Data becomes _____ when it is presented in a format that people can understand and use. _____ data consists of numbers that might be used in arithmetic operations. It can be represented digitally using the _____ number system. _____ data is composed of letters, symbols, and numerals that are not used in arithmetic operations. Computers represent this type of data using _____, EBCDIC, or Unicode. Data is quantified using terms such as _____ or kibibyte (1024 bytes), and prefixes, such as _____ or mebi (1,048,576), and giga or _____ (1,073,741,824). The bits that represent data travel as electronic pulses through _____ circuits, sometimes called computer chips. These chips are made from _____ materials and are housed in chip carriers that can be plugged into the _____ board of a digital device.

CHECK ANSWERS

SECTION D: Software is usually written in high-level languages, such as C, BASIC, COBOL, and Java. The human-readable version of a program, created in a high-level language by a programmer, is called _____ code. A(n) _____ or an interpreter converts this high-level code into _____ code. A microprocessor is hard-wired to perform a limited set of activities, such as addition, subtraction, counting, and comparisons. This collection of preprogrammed activities is called a(n) _____ set. Each instruction begins with a(n) _____ code, which is a command word for an operation such as add, subtract, compare, or jump. Most instructions also include a(n) _____ that specifies the data, or the address of the data, for the operation. The processor's ALU uses _____ to hold data that is being processed. The processor's _____ unit fetches each instruction, sends data to the registers, and then signals the ALU to begin processing.

CHECK ANSWERS

SECTION E: Passwords and user IDs are the most common authentication _____. Password theft has become a serious security problem that has led to many cases of _____ theft, when unauthorized individuals gain access to personal data. Hackers guess, discover, and steal passwords using a variety of techniques. A(n) _____ attack tries passwords from a list of commonly used passwords. A(n) _____ force attack tries every possible combination of letters and numbers. _____ intercepts information sent out over computer networks. _____ uses fraudulent Web sites or e-mail messages to fool unsuspecting readers into entering passwords and other personal information. A(n) _____ is software that secretly records a user's keystrokes and sends them to a hacker. To keep passwords safe, you should consider using tiered passwords or standalone password _____ software that generates secure passwords and keeps track of which password corresponds to each site you access.

CHECK ANSWERS

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Interactive Situation Questions

Apply what you've learned to some typical computing situations. When using the NP2014 interactive eBook, you can type your answers, and then use the Check Answers button to automatically score your responses.

1. Suppose that you walk into an office and see the devices pictured to the right. You would probably assume that they are the screen, keyboard, and mouse for a(n) _____ computer, workstation, or server.

2. You receive an e-mail message asking you to join a circle of friends. You assume that the message was generated in conjunction with an online _____ network, such as Facebook, and if you become a member, you will be able to socialize online.

3. You're planning a trip to Finland, but when you access the hotel site, the prices are listed in euros. To find the price in U.S. dollars, you access a currency converter from your mobile phone. That's an example of _____ computing, representative of the fourth phase of the digital revolution.

4. You're visiting an antique shop and notice a collection of old-fashioned radios. They actually feature a dial for tuning in different radio stations. You immediately recognize this as a(n) _____ device because it deals with an infinite scale of values, rather than discrete values.

5. While attending a meeting at work, you hear one of the executives wondering if "unit code" would be helpful. After a moment of puzzlement, you realize that the executive really meant _____, and that it would allow your company software to be translated into the Cyrillic alphabet used by the Russian language.

6. You have a storage device that offers 2 GB of storage space. It is currently empty. Your friend wants to give you a large digital photo that's 16 MB. Will it fit on your storage device? ____

7. Your bank is giving customers the choice of using a four-digit PIN or a password that can contain up to ten letters and numbers. The _____ is more secure, so that's what you decide to use.

8. You need to select a password for your online PayPal account. Which of the following passwords would be the LEAST secure: jeff683, hddtmrutc, gargantuan, fanhotshot, bb#ii22jeffry, or high348? _____

CHECK ANSWERS

Interactive Practice Tests

Practice tests that consist of ten multiple-choice, true/false, and fill-in-the-blank questions are available in your NP2014 interactive eBook. Test questions are selected at random from a large test bank, so each time you take a test, you'll receive a different set of questions. Your tests are scored immediately, and you can print study guides that help you find the correct answers for any questions that you missed.

CLICK TO START

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Learning Objectives Checkpoints

Learning Objectives Checkpoints are designed to help you assess whether you have achieved the major learning objectives for this chapter. You can use paper and pencil or word processing software to complete most of the activities.

1

1. List the four phases of the digital revolution.
2. Define the term *convergence* and provide examples of at least five devices that are converging.
3. Describe at least two social, political, and economic effects of the digital revolution.
4. Draw a diagram to explain how a computer makes use of input, processing, storage, memory, output, and stored programs.
5. Describe the difference between system software, an operating system, application software, and a computer program.
6. List, briefly describe, and rank (in terms of computing capacity) the characteristics of each computer category described in Section B of this chapter.
7. List three handheld devices that would be classified as personal computers and three that would not be.
8. Define the term *microcontroller* and provide three examples of devices in which microcontrollers are found.
9. Explain the technical difference between data and information.
10. Provide three examples of digital devices and three examples of analog devices.
11. List the ASCII representation for *B* and the binary representation for 18; draw a stepped waveform showing a digital sound; and draw a diagram showing how color is represented in a graphic.
12. List and define all the chapter terms, such as *bit*, *byte*, and *kibibyte*, that pertain to quantifying data.
13. Use the terms *integrated circuits*, *microprocessor*, and *system board* in a meaningful sentence.
14. Describe how compilers and interpreters work with high-level programming languages, source code, and object code.
15. Make a storyboard showing how a microprocessor's ALU would add the numbers 2 and 8.
16. Explain how hackers use dictionary and brute force attacks.
17. Provide examples of five secure passwords and five passwords that might be easy to crack.

Study Tip: Make sure you can use your own words to correctly answer each of the purple focus questions that appear throughout the chapter.

Concept Map

Fill in the blanks to show that you understand the relationships between programming concepts presented in the chapter.

CHECK ANSWERS

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2 Computer Hardware

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REVIEW ACTIVITIES

INFOWEBLINKS

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CLICK TO CONNECT
www.infoweblinks.com/NP2014/ch02

Learning Objectives

After reading this chapter, you will be able to answer the following questions by completing the outcomes-based Learning Objectives Checkpoints on page 117.

1. What are the components of a typical personal computer system?
2. What is a computer form factor?
3. Is a home computer more or less desirable than a game console or small business computer?
4. What's the best way to select a computer?
5. Are PCs and Macs compatible?
6. Is it a good idea to upgrade an old computer?
7. How does a microprocessor work?
8. Why are some computers faster than others?
9. Why does a computer need memory?
10. What is the best type of storage for my data?
11. What factors affect a computer's screen display?
12. Are ink jet printers better than laser printers?
13. What's the best way to add devices to a computer system?
14. How can I protect my computer system from theft and damage?
15. Are there guidelines for troubleshooting hardware and software problems?

Apply Your Knowledge

The information in this chapter will give you the background to:

- Identify all the components of a typical personal computer system
- Purchase a new computer based on features, performance, and price
- Upgrade your current computer
- Change your computer's boot settings in EEPROM
- Select a microprocessor based on performance specifications
- Select storage devices for your computer
- Change the resolution of your monitor
- Install peripheral devices
- Perform basic maintenance on your computer and troubleshoot hardware problems

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TRY IT!

HOW POWERFUL IS MY COMPUTER?

As you read Chapter 2, you'll learn that some computers are more powerful than others because they can store more data and process data faster. To find out how your home, work, or lab computer stacks up, you'll need to know a few of its specifications. Check your computer's specifications by starting your computer and then doing the following:

1. Access your computer's system information.
   Windows 7: Click the **Start** button, then click **Control Panel**. Follow links to System where you can view basic information about your computer.
   Windows 8: From the Start screen, type **Control** and then click **Control Panel**. Follow links to System where you can view basic information about your computer.
   MAC OS X: Click the **Apple** icon on the menu bar located at the top of the desktop. Select **About this Mac**.
2. Record information about your computer similar to the information provided for the sample computer in the table at right.
3. Next, find the list of devices that are attached to your computer.
   Windows 7 and 8: Click the link or icon for **Device Manager**.
   Mac OS X: Click the **More Info** button.
4. Make a note of five devices connected to your computer. When you're done, close the window that lists your devices.
5. If you have a PC, click the **Windows Experience Index**. Make a note of your computer's base score and subscores.

	SAMPLE COMPUTER	YOUR COMPUTER
COMPUTER MANUFACTURER	DELL	
COMPUTER MODEL	INSPIRON 17	
PROCESSOR MANUFACTURER	INTEL	
PROCESSOR TYPE	CORE I7	
PROCESSOR SPEED	3.1 GHZ	
OPERATING SYSTEM	WINDOWS 7	
RAM CAPACITY	8 GB	
WINDOWS EXPERIENCE INDEX	5.4	

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Personal Computer Basics

SECTION **A**

WHETHER YOU ARE SHOPPING for a new computer, using your trusty laptop, or troubleshooting a system glitch, it is useful to have some background about computer system components and how they work. Section A begins with a framework for understanding the vast number of options available for putting together a personal computer system, and then wraps up with some tips on interpreting the jargon in computer ads and negotiating the digital marketplace.

DESKTOP COMPUTER SYSTEMS

What are the components of a typical desktop computer system? A **desktop computer** fits on a desk and runs on power from an electrical wall outlet. The main component of a typical desktop computer is a system unit that houses the processor, memory, storage devices, display circuitry, and sound circuitry.

In addition, most desktop systems include peripheral devices. The term **peripheral device** designates input, output, and storage equipment that might be added to a computer system to enhance its functionality. Popular peripheral devices include printers, digital cameras, scanners, game controllers, and speakers (Figure 2-1).

FIGURE 2-1

A personal computer system includes the system unit and a variety of storage, input, and output devices. The components of a typical desktop system are shown here. To compare the components of desktops with portable computers, watch the video for this figure in your interactive eBook.

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A typical desktop computer system includes several components. Many of these components can also be found in portable computers.

- **System unit.** The **system unit** is the case that holds the computer's main circuit boards, microprocessor, memory, power supply, and storage devices. Depending on the computer design, the system unit might also include other built-in devices, such as a keyboard and speakers.
- **Keyboard.** Most desktop computer systems are equipped with a keyboard as the primary input device.
- **Mouse.** A mouse is an input device designed to manipulate on-screen graphical objects and controls.
- **Hard disk drive.** A hard disk drive is the main storage device on many computer systems. It is usually mounted inside the computer's system unit and can store billions of characters of data. Some portable computers use a solid state drive as an alternative for main storage.
- **Optical drive.** An optical drive is a storage device that works with CDs, DVDs, Blu-ray discs, or some combination of these storage media. Optical drives are handy for playing audio CDs, DVD movies, and Blu-ray movies. They can also be used to store computer data on writable CDs, DVDs, and Blu-ray discs.
- **Removable storage.** In the past, personal computers included a low-capacity storage device called a floppy disk drive that accepted removable storage disks. Today, floppy disks have been replaced by solid state storage options, such as USB flash drives and memory cards (Figure 2-2).

© MediaTechnics

FIGURE 2-2

Computers provide sockets called ports for solid state storage such as these SD cards and USB flash drives.

- **Sound system.** The sound system for a personal computer can output digital music, digitally recorded speech, and a variety of sound effects called system sounds designed to draw your attention to various messages and events. To produce sounds, a computer uses a circuit board called a sound card, which is housed in the system unit. A computer's sound card sends signals to speakers, which can be external devices or built into the system unit.
- **Display system.** A personal computer display system consists of two parts. Circuitry, called a graphics card, converts raw digital data into images that can be shown on a display device. Display devices, often called computer screens or monitors, present visual output, such as documents, photos, and videos. Display devices are usually integrated with the system unit of portable computers, but exist as standalone devices for computers that spend most of their time on a desk.
- **Network and Internet access.** Many personal computer systems include built-in circuitry for wired or wireless connections to a computer network. Networking circuitry is useful for constructing a home network or connecting to public networks in coffee shops and airports.
- **Printer.** A computer printer is an output device that produces computer-generated text or graphical images on paper.

TERMINOLOGY NOTE

The word *peripheral* is a relatively old part of computer jargon that dates back to the days of mainframes when the CPU was housed in a giant box and all input, output, and storage devices were housed separately. Technically speaking, a peripheral is any device that is not part of the CPU.

In the world of personal computers, however, the use of the term *peripheral* varies and it is often used to refer to any components that are not housed inside the system unit. Many personal computer owners do not think of a hard disk drive as a peripheral device, but technically it is one.

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What is the significance of different computer designs?

The industrial design principle that "form follows function" applies to computers. If you need a computer that's functional for mobile applications, you would not consider hauling around a large, heavy unit designed to remain on a desk. Instead, you would look for a computer "form" that suits your mobile "function."

In the computer industry, the term form factor refers to the size and dimensions of a component, such as a system board or system unit. Personal computers are available in all sorts of form factors; some are small and some are large; some are designed to remain on a desk, whereas others are designed to be portable.

What are the options for desktop computer form factors?

A desktop computer's keyboard, mouse, and display screen are typically separate components that are connected to the main unit by cables or wireless technology. A desktop computer's system unit can be housed in a vertical case, a horizontal case, or the display device (Figure 2-3).

FIGURE 2-3

Desktop computer form factors include horizontal, tower, and all-in-one units.

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A tower unit can be placed on the desk or on the floor.

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A horizontal unit is often placed under the monitor

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The circuitry for this desktop all-in-one model is integrated into the case that holds the screen.

Most horizontal units are placed under the display device to save desk space. A vertical system unit can be placed on a desk, on the floor, or in a cubbyhole beneath the desk. The case for a vertical system unit is often referred to as a tower.

A **tower case** provides plenty of space for gamers and "modders" who want to enhance their machines by adding storage devices, lighted power cables, or accelerated graphics cards. Tower units are also the form factor of choice for computer owners who might want to upgrade components in the future because it is easy to get inside the case and swap out parts.

Some manufacturers eliminate the separate system unit by incorporating computer circuitry in the back of a flat-panel screen. Dubbed an **all-in-one computer**, this form factor is handy, but has limited space for expansion.

The first personal computers were desktop models, and this style remains popular for offices, schools, and homes. Because their components can be manufactured economically, desktop computers generally provide the most computing power for your dollar. The price of an entry-level desktop computer starts at US$300 or a bit less. Desktops with average performance cost $500–$700 and a souped up desktop equipped for gaming can cost over $3,000.

TRY IT!

Visit the Dell Web site. What is the price of the least expensive desktop computer?

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PORTABLE COMPUTERS

How do portable computers differ from desktops? A **portable computer** is a small, lightweight personal computer with input, output, storage, and processing components integrated into a single unit that runs on power supplied by an electrical outlet or a battery.

Portable computers are ideal for mobile uses because they are easy to carry and can be used outdoors, in airports, and in classrooms without the need for a nearby electrical outlet. Portable computer form factors include clamshell styles and slate styles (Figure 2-4).

Clamshell units are hinged with a screen on top and a keyboard below. The advantage of this form factor is that the screen is protected when the unit is closed.

Slate units have a screen, but no physical keyboard. The screen accepts touch input. These units are lighter and smaller than their clamshell counterparts.

FIGURE 2-4

Portable computers can have a clamshell or slate form factor.

What is a laptop computer? A **laptop computer** (also referred to as a notebook computer) is a small, lightweight portable computer that opens like a clamshell to reveal a screen and keyboard. Laptop computers tend to cost a bit more than desktop computers with similar computing power and storage capacity.

Laptops are popular with students because they don't take up too much space in crowded dorm rooms and they are fairly easy to carry around campus. On average, a laptop computer weighs about five pounds. The price of an entry-level laptop computer starts around $400. Consumers often spend between $700 and $1,000, however, to get the features and performance they want. A fully loaded laptop computer with widescreen display can cost more than $2,000 (Figure 2-5).

TRY IT!

Check the Web for information on the MacBook Air and Dell Ultrabook. What do these computers have in common?

FIGURE 2-5

A laptop computer is small and lightweight, giving it the advantage of portability. It can be plugged into an electrical outlet, or it can run on battery power.

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What types of computers are available in the slate form factor? Three types of computers are available in the slate form factor: enhanced media players, smartphones, and tablets. These computers are sometimes referred to as "mobile devices" because they are so easy to carry and they can access the Internet using wireless connections.

What is an enhanced media player? An **enhanced media player** is a handheld device designed for playing music and videos. These devices offer a camera, access to the Internet, and a variety of apps. Enhanced media players do not ordinarily include mobile phone capabilities.

Media players are great for listening to music and watching videos on the go. They're handy entertainment devices for traveling because you can use them without worrying that you're depleting the battery in your mobile phone. Enhanced media players feature a 3.5" screen, with overall dimensions about the size of an index card (Figure 2-6).

FIGURE 2-6

Enhanced media players, such as this iPod Touch, can be as small as a set of car keys, and range in price from $150–$400, depending on storage capacity.

What is a smartphone? A **smartphone** is an enhanced mobile phone that also functions as a portable media player and has the capability to access the Internet. Smartphones, such as Apple's iPhone and Motorola's Droid, are similar in size and appearance to enhanced media players, but generally cost a bit more and require a mobile service contract for voice calls.

TRY IT!

In what ways do tablet computers differ from enhanced media players?

- ❍ Size
- ❍ Touchscreen
- ❍ Slate form factor
- ❍ Mobile phone service

What is a tablet computer? A **tablet computer** is a handheld computer that is essentially a large version of an enhanced media player. First popularized by the Apple iPad, tablets are also offered by other companies, including Samsung and Motorola. Tablet prices range upward from $250 depending on brand and features.

Tablets are smaller than most laptop computers and weigh considerably less, in part because they have no keyboard, trackpad, or DVD drive. A virtual keyboard, displayed on the screen, can be supplemented by an auxiliary keyboard. A trackpad and mouse are not necessary; the touchscreen handles most input and provides output (Figure 2-7).

Tablets can generally access the Internet using Wi-Fi networks or cellular data service. Many people use a tablet as a second computer; one that's handy for a quick Web search. In the business world, tablets are used by insurance adjusters who do most of their work at the scene of accidents and natural disasters, real estate agents who need access to data while out with clients, and health care workers who are moving quickly from one patient to the next.

FIGURE 2-7

Tablet computer prices start at $250 and can exceed $1,200, depending on storage capacity. Most tablets feature a 10" touchscreen and weigh about one pound.

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BUYING A COMPUTER

How do I get started? The process of buying your own computer system is not cut and dried. Some experts advocate assessing your computing needs first, whereas other experts suggest researching features and prices. The trick is to do your homework for the entire system before jumping into a purchase of any one component. Remember that you will be purchasing peripherals, software, and accessories in addition to a computer. To prepare for a computer purchase, you should complete the following activities:

- Browse through computer magazines and online computer stores to get a general idea of features and prices.
- Decide on a budget and stick to it.
- Make a list of the ways you plan to use your computer.
- Select a platform.
- Decide on a form factor.
- Select peripherals, software, and accessories.

Where can I find product information? You can start by looking at ads in current computer magazines, such as *Wired*, *PCWorld*, and *Macworld*. You might visit computer stores online or in a nearby mall to get a general idea of prices and features.

How can I make sense of all the jargon in computer ads? Computer ads are loaded with jargon and acronyms, such as RAM, ROM, GHz, GB, and USB. You're sure to spot lots of this computer lingo in ads like the one in Figure 2-8.

When you complete this chapter, you should be able to sort out the terminology used in a typical computer ad. For terms you encounter that are not covered in this textbook, you can google the term or refer to online dictionaries and encyclopedias, such as Webopedia, Whatis.com, or Wikipedia.

What can I expect to pay for a new computer? The price tag for a smartphone is $200–$500, whereas tablet computer prices range from $200–$1,200. Desktop and laptop computers usually cost a bit more, with price points roughly grouped into three categories: above $1,200, $500–$1,200, and under $500.

A desktop or laptop computer priced higher than $1,200 is the computer equivalent of a luxury automobile. Computers in this price range contain one or more fast processors, a generous amount of RAM, and a copious amount of disk space. These computers contain state-of-the-art components and should not have to be replaced as quickly as less expensive computers. Computer game enthusiasts and anyone planning to work extensively with video editing, graphics, and desktop publishing are likely to require a high-end computer.

Desktops and laptops that retail for between $500 and $1,200 might be considered the four-door sedans of the computer marketplace because a majority of buyers select computers in this price range. These popular computers lack the flashy specifications of their state-of-the-art cousins, but provide ample computing power to meet the needs of an average user.

FIGURE 2-8

A typical computer ad provides specifications and lots of computer jargon.

- Intel Core i7-2630M processor 2.0 GHz 1066 MHz FSB
- 6 MB L2 cache
- 6 GB DDR3-800 MHz dual channel SDRAM
- 750 GB SATA HD (7200 rpm)
- 8x CD/DVD burner (Dual Layer DVD+/-R)
- 15.6" High Def (720p) LCD display screen
- 1 GB NVIDIA GeForce graphics card
- Harman/Kardon speakers
- Integrated 1.3 megapixel webcam
- 4 USB ports
- 1 IEEE 1394 port
- HDMI graphics ports
- 5-in-1 media card reader
- Wireless networking 802.11 g/n
- 1 GB Ethernet
- Windows 8 64-bit operating system
- Home/small business software bundle
- 1-year limited warranty

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In the computer industry, the equivalent of a compact car is a sub-$500 computer. The technology in these computers is usually a year or two old and you can expect reduced processor speed, memory capacity, and drive capacity. Nevertheless, budget computers feature many of the same components that owners coveted in their state-of-the-art computers a few years back. You might have to replace a budget computer sooner than a more expensive computer, but it should be serviceable for typical applications.

Why is it important to figure out how I'm going to use my new computer? Although it is impossible to predict all the ways you might use your new machine in the future, you can make a list of the ways you plan to immediately use your computer and that list can help you think about the features you'll need.

Some computer-based activities require more processing or storage capacity than others. Therefore, if you have some ideas about your computer usage, you're more likely to buy the right computer and not have to purchase expensive upgrades for it later. Figure 2-9 offers some guidelines to help you evaluate how your plan for using a computer might affect your purchase decision.

TRY IT!

The majority of desktop and laptop buyers spend how much on a computer?

- ❍ $100–$250
- ❍ $250–$500
- ❍ $500–$1,200
- ❍ $800–$1,500

FIGURE 2-9

Consider these factors to narrow down the mind-boggling number of choices offered to computer shoppers.

Usage Plan	Purchase Recommendation
You plan to use your computer for popular activities such as e-mail and Facebook, browsing the Web, playing a few games, managing your finances, downloading digital music, and writing school papers.	A mid-priced computer with standard features might meet your needs.
You're on a budget.	A budget-priced computer will handle the same applications as a mid-priced computer, but some tasks might run more slowly.
You plan to work on accounting and budgeting for a small business.	Consider one of the business systems offered by a local or an online computer vendor.
You spend lots of time playing computer games.	Buy a computer with the fastest processor and graphics card you can afford.
You plan to work extensively with video editing or desktop publishing.	Select a computer system with a fast processor, lots of hard disk capacity, and a graphics card loaded with memory.
Someone who will use the computer has special needs.	Consider purchasing appropriate adaptive equipment, such as a voice synthesizer or one-handed keyboard.
You plan to use specialized peripheral devices.	Make sure the computer you purchase can accommodate the devices you plan to use.
Your work at home overlaps your work at school or on the job.	Shop for a computer that's compatible with the computers you use at school or work.
You want to work with specific software, such as a game or graphics tool.	Make sure you select a computer that meets the specifications listed on the software box or Web site.
You're buying a new computer to replace an old one.	If you have a big investment in software, you should select a new computer that's compatible with the old one.
You want a 3-D display for games and movies.	Make sure the monitor is rated for 3-D display.
You need a computer that is easy to transport.	Consider a tablet computer or small laptop computer.

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How important is compatibility? Suppose that you want to do some assignments at home using the same software provided by your school lab. Maybe you want to transport data back and forth between your job and home. Or, perhaps your children want to use a computer at home that is similar to those they use at school.

Computers that operate in essentially the same way and use the same software are said to be **compatible**. They can also be described as having the same "platform." To assess whether two computers are compatible, check their operating systems. Computers with the same operating systems can typically use the same software and peripheral devices.

Currently, there are three popular platforms for desktop and laptop computers: PC, Mac, and Linux.

- The **PC platform** is based on the original IBM PC. The great-grandchildren of the IBM PC are on computer store shelves today—a huge selection of personal computer brands and models manufactured by companies such as Lenovo, Hewlett-Packard, Dell, Toshiba, and Sony. The Windows operating system was designed specifically for these personal computers and, therefore, the PC platform is sometimes called the Windows platform.
- The **Mac platform** is based on a proprietary design for a personal computer called the Macintosh (or Mac), manufactured almost exclusively by Apple Inc. The Mac lineup includes the iMac, MacBook Air, MacBook Pro, and Mac mini, all running the Mac OS operating system.
- The **Linux platform** uses a standard PC or Mac to run the Linux operating system. A variety of software is available for this platform, though it tends to be more specialized but not as polished as software for Windows and Mac operating systems.

At one time, the PC, Mac, and Linux platforms were not compatible because of hardware and operating system differences. Application software designed for Macs did not work on other platforms and vice versa.

The compatibility situation has changed because most Mac computers now use the same microprocessor as PCs. If you have a Mac computer with an Intel processor (sometimes called an Intel Mac), you can install Windows on it and run Windows software. You can also configure it to run Linux software.

The ability to run Windows offers Mac owners access to software from the PC and Mac platforms, and makes it possible to use the Mac OS to run one application, then switch to Windows to run another application. This capability can come in handy, for example, if a parent who uses Windows software is sharing a computer with an elementary-school student who is working with Macs at school.

Are there compatibility issues with handheld computers? As with full-size computers, the world of handheld computers includes several non-compatible platforms that affect your selection of apps.

When purchasing apps, you are limited to those designed for your device. Android apps do not work on iPhones, iPods, or iPads. Windows Phone apps run on many Nokia phones, but not on iPhones, Droids, or BlackBerry devices. Handheld computer platforms are summarized in Figure 2-10 on the next page.

TERMINOLOGY NOTE

Computers that are compatible with the PC platform are usually referred to simply as PCs. Computers in the Mac platform are referred to as Macs.

TRY IT!

If you want to run Mac and Windows software, what can you do?

- ❍ Buy a Mac and install Windows on it
- ❍ Buy a PC and install Mac OS on it
- ❍ Buy an iPad and access Windows on the Internet
- ❍ Forget it; it can't be done

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Platform	Source	Devices
iOS	Apple	iPhone, iPad, iPod Touch
Android	Google	Droid, ATRIX, HKC, HTC phones Samsung Galaxy, Acer ICONIA, Motorola XOOM, Toshiba Excite tablets
Windows Phone	Microsoft	Nokia smartphones
Windows 8 RT	Microsoft	Windows tablet computers
BlackBerry OS	Research In Motion	BlackBerry smartphones

FIGURE 2-10
Handheld Computer Platforms

What about software? Most computers are sold with a preinstalled operating system and a Web browser. Some computers are bundled with application software that you can use to create documents, crunch numbers, and produce presentations. Check the software offerings carefully; they might include applications that you can use for free only for a few months. To continue using the software beyond the trial period, however, you have to pay for it. Such software is "included" but not "free." Buyer beware.

If you're purchasing a computer to do a task that requires specialized software, you should factor its price into the cost of your computer system. Check the specifications listed on the software box to make sure your new computer has enough memory and processing speed to run it.

TRY IT!

Which platform supports the widest variety of handheld devices?

- ❍ iOS
- ❍ Android
- ❍ Windows 8 RT
- ❍ BlackBerry OS

HOME, GAME, AND SMALL BUSINESS SYSTEMS

What's the significance of designations, such as home, small business, or game systems? When studying computer ads and browsing vendor Web sites, you're likely to see some computer systems designated as home systems, whereas others are designated as game systems or small business systems. These designations are created by computer vendors to help consumers sort through the sometimes mind-boggling variety of configuration options.

What differentiates a home computer from other types? The idea of a home computer system probably developed because Microsoft offered Home and Professional versions of the Windows operating system. Windows Home version targeted less sophisticated users and originally was not meant to be used extensively for networking.

Today, the term **home computer system** encompasses a vast array of desktop and laptop computer configurations designed to accommodate consumers who use computers for personal tasks. These systems also work for dual-use environments where a computer might be needed for general computing activities and also for home office tasks.

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The prices and features of home computer systems vary. Basic, inexpensive home systems offer adequate, but not super-charged, support for most computer applications, including Web browsing, e-mail, working with photos, downloading music, and working with general productivity applications, such as word processing. Software applications run at an acceptable speed, but graphics and games might be a bit slow.

A basic home computer system can also function for home office tasks with the addition of accounting software or other business applications.

Upscale home computer systems include cutting-edge computers, large-screen displays, 3-D Blu-ray players, and entertainment components to stream music throughout the house and display movies in a home theater (Figure 2-11).

FIGURE 2-11

Many high-end home computers are configured to function as the command center for watching movies and listening to music.

Volodymyr Vasylkiv/Shutterstock.com

Movies, games, and music come to life with cutting-edge 3-D graphics and mind-blowing audio. Experience amazing visuals and incredible sound.

- 3-D Blu-ray at home or on the go
- 2nd generation Intel Core processors
- Razor-sharp graphics
- High-fidelity JBL speakers and Waves MaxxAudio
- Hi-def webcam

Maximum Entertainment Experience.

What's so great about a gaming computer? Some of the most cutting-edge computers are designed for gaming. Not only do these machines feature the fastest processors, they are also stuffed with memory, include state-of-the-art sound capabilities, and feature multiple graphics processors.

Although some manufacturers produce gaming laptop computers, most serious gamers tend to select desktop models because they are easier to customize and offer a little more power per dollar. The technophile features of a gaming computer come with a steep price premium. Game systems start at $1,000 and quickly climb past the $3,000 price point (Figure 2-12).

FIGURE 2-12

Game systems are high-powered and expensive.

Courtesy of Dell, Inc.

Aurora: Alienware Built. Gamer Approved.

The new Alienware Aurora: Overwhelm the enemy with overclocked power and expandability with the most upgradable desktop in its class.

Factory-overclocked, liquid-cooled processors
Ultraperformance dual graphics and optional high-definition (HD) 3-D gaming
Chassis designed for easy and optional thermal control

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What are the characteristics of small business computers?

Computers marketed for small business applications tend to be middle-of-the-line models pared down to essentials. A medium-speed processor, moderate amount of RAM, and sensible disk capacity are adequate for basic business applications, such as word processing, spreadsheet analysis, accounting, and e-mail. Easy networking options allow small business computers to connect with other computers in an office environment.

Tower and all-in-one units are popular for in-office use, whereas laptop computers are a practical solution for employees who are on the go.

With price tags under $1,000, small business computers like those advertised in Figure 2-13 remain cost-effective because they are not loaded with memory, fancy graphics cards, or audio systems, which are typical on home computers. Small business computers might not include a CD or DVD drive and often do not include speakers.

FIGURE 2-13

Small business owners want a cost-effective solution without bells and whistles.

mmaxer/Shutterstock.com

BusinessClass 400 Desktop.

Reliable, Expandable Solution for Small Businesses

From its scalable design to its versatility, the latest MTC BusinessClass computers can be configured to meet all your business requirements. Whether your business is migrating to the cloud or staying anchored to the ground, the BusinessClass 400 provides a strong foundation for a wide range of business applications.

- Scalable design: Just the right size for the modern office, with choices of network options
- Business dedicated: No extraneous software, no demoware—just the basic operating system, which allows your tech team to easily install your business desktop
- Affordable: Put your investment where you need it: in processing power, storage, and connectivity
- Backed by solid MTC service and warranty

QuickCheck

SECTION A

1. A computer _____ unit houses the main circuit board, microprocessor, storage devices, and network card.
2. Personal computers are available in a variety of _____ factors, such as tower units and all-in-one units.
3. The iPad is an example of a computer with a(n) _____ form factor.
4. Small _____ computers are middle-of-the-line models that are not loaded with memory, fancy graphics cards, or audio systems.
5. Desktop and laptop computer _____ include PC, Mac, and Linux.

CHECK ANSWERS

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Microprocessors and Memory

SECTION **B**

A TYPICAL COMPUTER AD contains a long list of specifications that begin with microprocessor speed and memory capacity (Figure 2-14). Section B explains how microprocessors and memory affect computer performance and price.

FIGURE 2-14

Most computer ads specify the amount and type of RAM.

- Intel Core i7 processor 3.4 GHz 1600 MHz FSB
- 8 MB L3 cache
- 4 GB DDR3-1800 MHz dual channel SDRAM
- 2 TB SATA HD (7200 rpm)
- 16X max. DVD+/-R/RW SuperMulti drive

MICROPROCESSOR BASICS

What exactly is a microprocessor? As you learned in Chapter 1, a microprocessor (sometimes simply referred to as a processor) is an integrated circuit designed to process instructions. It is the most important, and usually the most expensive, component of a computer.

What does it look like? Looking inside a computer, you can easily identify the microprocessor because it is the largest chip on the system board, although it might be hidden under a cooling fan. Most of today's microprocessors are housed in a pin grid array chip package, as shown in Figure 2-15.

What makes one microprocessor perform better than another? A microprocessor's performance is affected by several factors, including clock speed, bus speed, word size, cache size, instruction set, number of cores, and processing techniques.

What do MHz and GHz have to do with computer performance? A specification, such as 3.4 GHz, that you see in a computer ad indicates the speed of the **microprocessor clock**—a timing device that sets the pace for executing instructions. Most computer ads specify the speed of a microprocessor in gigahertz. **Gigahertz** (GHz) means a billion cycles per second.

A cycle is the smallest unit of time in a microprocessor's universe. Every action a processor performs is measured by these cycles. It is important, however, to understand that the clock speed is not equal to the number of instructions a processor can execute in one second. In many computers, some instructions occur within one cycle, but other instructions might require multiple cycles. Some processors can even execute several instructions in a single clock cycle.

FIGURE 2-15

Although a microprocessor is sometimes mistakenly referred to as a computer on a chip, it can be more accurately described as a CPU on a chip because it contains—on a single chip—circuitry that performs essentially the same tasks as the central processing unit of a classic mainframe computer.

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A specification such as 2.13 GHz means that the microprocessor's clock operates at a speed of 2.13 billion cycles per second. If you are curious about the speed of the processor in your computer, Figure 2-16 can help you find it.

You might expect a computer with a 2.13 GHz processor to perform slower than a computer with a 3.4 GHz processor. This is not necessarily the case. Clock speed comparisons are only valid when comparing processors within the same chip family. As you might expect, a 1.87 GHz i7 processor is faster than a 1.6 GHz i7 processor.

Suppose, however, that you're shopping for a laptop computer and you have the option of an Intel i7 1.6 GHz processor or an i5 2.4 GHz processor. You might be surprised that the i7 1.6 GHz processor is faster than the i5 2.4 GHz processor. Why? Because factors other than clock speed contribute to the overall performance of a microprocessor. In multi-core processors, the number of cores affects performance.

FIGURE 2-16

You can discover your computer processor's specs using operating system utilities or third-party software, such as HWiNFO64. If you are using a Mac, click the Apple icon and then select About This Mac. When using Windows, link to the Control Panel to access System Information.

Software © 2012 Apple Inc. All rights reserved.

What's a multi-core processor? A microprocessor that contains circuitry for more than one processing unit is called a **multi-core processor**. More cores usually produce faster performance. The 2.4 GHz i5 processor has two cores, giving it the equivalent of 4.8 GHz performance (2.4 x 2). The 1.6 GHz i7 processor has four cores, giving it the equivalent of 6.4 GHz performance (1.6 x 4).

What is FSB? FSB stands for **front side bus**, a term that refers to the circuitry that transports data to and from the microprocessor. A fast front side bus moves data quickly and allows the processor to work at full capacity. FSB speed (technically its frequency) is measured in megahertz. **Megahertz** means one million cycles per second. Today's computers have FSB speeds ranging from 1000 MHz to 1800 MHz. Higher numbers indicate faster FSB speeds.

TERMINOLOGY NOTE

Other terms for *front side bus* include *system bus* and *memory bus*.

How does the cache size affect performance? **CPU cache** (pronounced "cash") is special high-speed memory that allows a microprocessor to access data more rapidly than from memory located elsewhere on the system board. A large cache can increase computer performance.

CPU cache is structured into several levels. Level 1 cache (L1) is the fastest, whereas Level 2 (L2) and Level 3 (L3) are slightly slower, but still faster than accessing main memory or disk storage. Cache capacity is usually measured in megabytes.

TRY IT!

Is bigger always better? Which one of the following will NOT increase computer performance?

- ❍ Higher GHz clock speed
- ❍ More cycles per instruction
- ❍ Higher MHz front side bus speed
- ❍ More cores

What impact does word size have on performance? **Word size** refers to the number of bits that a microprocessor can manipulate at one time. Word size is based on the size of registers in the ALU and the capacity of circuits that lead to those registers. A **64-bit processor**, for example, has 64-bit registers and processes 64 bits at a time.

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A large word size gives processors the ability to handle more data during each processing cycle—a factor that leads to increased computer performance. Today's personal computers typically contain 32-bit or 64-bit processors.

How does an instruction set affect performance? As chip designers developed various instruction sets for microprocessors, they added increasingly complex instructions, each requiring several clock cycles for execution. A microprocessor with such an instruction set uses **CISC** (complex instruction set computer) technology. A microprocessor with a limited set of simple instructions uses **RISC** (reduced instruction set computer) technology.

A RISC processor performs most instructions faster than a CISC processor. It might, however, require more of these simple instructions to complete a task than a CISC processor requires for the same task.

Most processors in today's desktop and laptop computers use CISC technology. Many processors used in handheld devices, such as iPods, Droids, and BlackBerrys, are ARM (advanced RISC Machine) processors.

Can a microprocessor execute more than one instruction at a time? Some processors execute instructions "serially"—that is, one instruction at a time. With **serial processing**, the processor must complete all steps in the instruction cycle before it begins to execute the next instruction. However, using a technology called **pipelining**, a processor can begin executing an instruction before it completes the previous instruction. Many of today's microprocessors also perform **parallel processing**, in which multiple instructions are executed at the same time. Pipelining and parallel processing, illustrated in Figure 2-17, enhance processor performance.

FIGURE 2-17

Microprocessor designers have developed techniques for serial processing, pipelining, and parallel processing.

In serial processing, one instruction is processed at a time.

In pipelining, an instruction can begin to be processed before the previous instruction's processing is complete.

In parallel processing, multiple instructions can be processed at the same time.

To get a clearer picture of serial, pipelining, and parallel processing technology, consider an analogy in which computer instructions are pizzas. Serial processing executes only one instruction at a time, just like a pizzeria with one oven that holds only one pizza.

Pipelining is similar to a pizza conveyor belt. A pizza (instruction) starts moving along the conveyor belt into the oven; but before it reaches the end, another pizza starts moving along the belt.

Parallel processing is similar to a pizzeria with a large oven. Just as this oven can bake more than one pizza at a time, a parallel processor can execute more than one instruction at a time.

TRY IT!

Which processing method is slowest?

- ❍ Serial processing
- ❍ Pipelining
- ❍ Parallel processing

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With so many factors to consider, how can I compare microprocessor performance? Various testing laboratories run a series of tests to gauge the overall speed of a microprocessor. The results of these tests—called **benchmarks**—can then be compared to the results for other microprocessors. The results of benchmark tests are usually available on the Web and published in computer magazine articles.

Windows 7 and 8 offer a set of benchmarks called the Windows Experience Index that scores a computer's overall performance, and the performance of components such as its processor, memory, graphics, and storage system (Figure 2-18).

FIGURE 2-18

To access the Windows Experience Index, search for it in the Control Panel.

What do the Windows Experience Index scores mean? Windows determines the performance subscores for five computer components: processor speed, memory transfer speed, ability to display graphics for the Aero desktop, 3-D animated graphics performance, and disk drive data transfer rate. Scores range from a low of 1.0 to a high score of 7.9.

The base score is determined by the lowest subscore because the component with the worst performance sets the limit on overall performance. Computers with a base score lower than 3.0 might be fine for basic applications, but base scores above 6.0 are desirable for computers used for multiplayer and 3-D games, teleconferencing, and HDTV playback.

TRY IT!

In Figure 2-18, click the component that has the lowest subscore.

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TODAY'S MICROPROCESSORS

Which companies produce most of today's popular microprocessors? Intel is the world's largest chipmaker and supplies a sizeable percentage of the microprocessors that power computers of all types. In 1971, Intel introduced the world's first microprocessor—the 4004. Intel's 8088 processor powered the original IBM PC. Since the debut of the IBM PC in 1985, Intel has introduced numerous microprocessors that have been used by most major computer manufacturers.

AMD (Advanced Micro Devices) is Intel's chief rival in the PC chip market. AMD's Phenom processors are direct competitors to Intel's Core 2 Quad line; AMD's Athlon X2 processors compete directly with Intel's Core 2 Duo processors (Figure 2-19). AMD processors are less expensive than comparable Intel models and have a slight performance advantage according to some benchmarks.

ARM processors are designed and licensed by ARM Holdings, a British technology company founded by Acorn Computers, Apple Inc., and VLSI Technology. Its RISC processors are manufactured by companies that include Apple, NVIDIA, Samsung, and Nintendo. ARM processors are used in many mobile phones and other handheld devices, such as the Apple iPad.

Which microprocessor is best? The microprocessor that's best for you depends on your budget and the type of work and play you plan to do. The microprocessors marketed with the current crop of desktop and laptop computers can handle most business, educational, and entertainment applications. You'll want to consider the fastest processor offerings if you engage in processing-hungry activities, such as 3-D animated computer games, desktop publishing, multitrack sound recording, or video editing.

Can I replace my computer's microprocessor with a faster one? It is technically possible to upgrade the microprocessor in a desktop computer, but computer owners rarely do so. The price of the latest, greatest microprocessor can often get you more than halfway to buying an entirely new computer system.

Technical factors also discourage microprocessor upgrades. A microprocessor operates at full efficiency only if all components in the computer can handle the faster speeds. In many cases, installing a new processor in an old computer can be like attaching a huge outboard engine to a canoe. In both cases, too much power can lead to disaster.

What is overclocking? **Overclocking** is a technique for increasing the speed of a computer component, such as a processor, graphics card, system board, or memory. When successful, overclocking can increase the processing power of a slow component to match that of a faster, more expensive component. Overclocking is popular with gamers who want to squeeze every bit of processing speed out of their computers.

Why doesn't everyone overclock? Overclocking is very risky. Additional electrical power pumped into a component increases heat output. Overclocked components can overheat and even catch fire. To maintain safe operating temperatures, an overclocked computer might require a supplemental cooling system.

FIGURE 2-19

Today's Popular Server, Desktop, and Mobile Microprocessor Families

Processor	Application
INTEL	
Core i7 and i5	Desktops and Laptops
Pentium	Desktops
Celeron	Desktops and Laptops
Xeon	Servers and Workstations
Itanium	Servers
Atom	Tablets and Handhelds
AMD	
Phenom	Desktops
Athlon	Desktops and Laptops
Sempron	Desktops and Laptops
Turion	Laptops
Opteron	Servers and Workstations
Fusion	Tablets
ARM	
ARM7	Analog Phones
ARM9	Digital Phones
Cortex-A	Handhelds
Apple A5X	iPad 2

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RANDOM ACCESS MEMORY

What is RAM? **RAM** (random access memory) is a temporary holding area for data, application program instructions, and the operating system. In a personal computer, RAM is usually several chips or small circuit boards that plug into the system board within the computer's system unit. A computer's RAM capacity is invariably included in the list of specifications in personal computer ads (Figure 2-20).

The amount of RAM in a computer can affect the overall price of a computer system. To understand how much RAM your computer needs and to understand computer ad terminology, it is handy to have a little background on how RAM works and what it does.

FIGURE 2-20

A computer ad typically specifies the amount and type of RAM.

- Intel Core i7 processor 3.4 GHz 1600 MHz FSB
- 8 MB L3 cache
- 4 GB DDR3-1800 MHz dual channel SDRAM
- 2 TB SATA HD (7200 rpm)
- 16X max. DVD+/-R/RW SuperMulti drive

Why is RAM so important? RAM is the "waiting room" for the computer's processor. It holds raw data waiting to be processed as well as the program instructions for processing that data. In addition, RAM holds the results of processing until they can be stored more permanently on a hard disk, CD, or flash drive.

In addition to data and application software instructions, RAM also holds operating system instructions that control the basic functions of a computer system. These instructions are loaded into RAM every time you start your computer, and they remain there until you turn off your computer.

TERMINOLOGY NOTE

RAM is classified as memory, whereas a computer's hard disk or solid state drive is classified as storage. Don't confuse the two. Memory is temporary; storage is more permanent. Computers typically have much less memory than storage capacity.

How does RAM work? In RAM, microscopic electronic parts called **capacitors** hold the bits that represent data. You can visualize the capacitors as microscopic lights that can be turned on or off. A charged capacitor is "turned on" and represents a "1" bit. A discharged capacitor is "turned off" and represents a "0" bit. Each bank of capacitors holds eight bits—one byte of data. A RAM address on each bank helps the computer locate data, as needed, for processing (Figure 2-21).

FIGURE 2-21

Each RAM location has an address and uses eight capacitors to hold the eight bits that represent a byte. Your interactive eBook shows you how RAM works with bits that represent data.

In some respects, RAM is similar to a chalkboard. You can use a chalkboard to write mathematical formulas, erase them, and then write an outline for a report. In a similar way, RAM can hold numbers and formulas when you balance your checkbook, and then can hold the outline of your English essay when you use word processing software. RAM contents can be changed just by changing the charge of the capacitors.

Unlike disk storage, most RAM is **volatile**, which means it requires electrical power to hold data. If the computer is turned off, if the battery runs out of juice, or if a desktop computer is accidentally unplugged or experiences a power failure, all data stored in RAM instantly and permanently disappears. This type of RAM is technically classified as **dynamic RAM** (DRAM) but it is commonly referred to simply as RAM.

TRY IT!

Which statement is true?

- ❍ Computers usually have more memory than storage
- ❍ RAM is a data holding area between the processor and disk storage
- ❍ Volatile RAM holds data even when the computer is turned off

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How much RAM does my computer need? RAM capacity is expressed in gigabytes. Today's personal computers typically feature 2–8 GB of RAM. For good basic performance, a computer running Windows should have at least 1 GB of RAM. Games, desktop publishing, graphics, and video applications tend to run more smoothly with at least 2 GB of RAM.

The amount of RAM your computer needs depends on the software you use. RAM requirements are routinely specified on the outside of a software package (Figure 2-22).

FIGURE 2-22

Minimum RAM requirements are usually displayed on the package of a software product.

Minimum System Requirements:

- Windows 7 or 8
- 1 GB of RAM
- 450 MB hard drive space
- CD drive for installation
- Mouse
- Internet connection (optional)
- Printer (optional)
- Scanner or digital camera

Can my computer run out of memory? Suppose that you want to work with several programs and large graphics at the same time. Will your computer eventually run out of memory? The answer is "probably not." Today's personal computer operating systems are quite adept at allocating RAM space to multiple programs.

If a program exceeds its allocated space, the operating system uses an area of the hard disk, called **virtual memory**, to store parts of programs or data files until they are needed. By selectively exchanging the data in RAM with the data in virtual memory, your computer effectively gains almost unlimited memory capacity.

Too much dependence on virtual memory can slow down your computer's performance, however, because getting data from a mechanical device, such as a hard disk drive, is much slower than getting data from an electronic device, such as RAM. To minimize virtual memory use, load up your computer with as much RAM as possible.

How do I add RAM? First, check how much RAM is currently installed, and then check the maximum RAM limit to make sure RAM can be added. Check your computer documentation or the manufacturer's Web site for information on the type and speed of RAM required.

Most of today's personal computers use SDRAM (synchronous dynamic RAM), which is fast and relatively inexpensive. SDRAM (shown in Figure 2-23) is further classified as DDR, DDR2, or DDR3. Make sure that you purchase the right type.

Oleksiy Mark/Shutterstock.com

FIGURE 2-23

SDRAM is the most popular type of RAM in today's computers. It is sold as a small circuit board. When adding memory to a computer, follow the manufacturer's instructions carefully.

What about RAM for handheld computers? Handheld computers commonly have about 512 MB–1 GB of RAM, which is far less than the amount in desktop or laptop computers. Handheld apps are simpler than the applications designed for more powerful devices, so they require less memory. Apps run within the standard memory limits, so there is no need to add RAM to handheld devices.

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ROM AND EEPROM

What is ROM? **ROM** (read-only memory) is a type of memory circuitry that is housed in a single integrated circuit—usually a fairly large, caterpillar-like DIP package—which is plugged into the system board.

Whereas RAM is temporary and volatile, ROM is permanent and non-volatile. The contents of ROM are "hard-wired" in the circuitry and remain in place even when the computer power is turned off.

Early ROM technologies were not modifiable; updating ROM meant physically replacing the chip. Newer EEPROM technologies now offer more versatility.

What is EEPROM? **EEPROM** (electrically erasable programmable read-only memory) is a type of ROM that is non-volatile but user-modifiable. EEPROM technology has replaced non-modifiable ROMs on most modern computers. Today, the term *ROM* is used when referring to either ROMs or EEPROMs.

TERMINOLOGY NOTE

A ROM or EEPROM chip along with its instructions is commonly referred to as firmware; a sort of melding of hardware and software.

What does a computer store in ROM? ROM contains a small set of instructions and data called the **bootstrap loader**. In a PC, the contents of ROM are sometimes referred to as the **BIOS** (basic input/output system).

The bootstrap loader's instructions tell the computer how to access the hard disk, find the operating system, and load it into RAM. After the operating system is loaded, the computer can understand your input, display output, run software, and access data files.

The bootstrap loader requires some basic information about storage, memory, and display configurations. That data is stored in ROM along with the bootstrap loader instructions.

Why isn't the bootstrap loader stored in RAM? RAM requires power to hold data. When your computer is off, RAM is empty. When you turn on your computer, RAM is still empty and doesn't contain any instructions for the microprocessor to execute. ROM, on the other hand, holds data even when the power is off. So when you press the power button, your computer can immediately access the instructions in ROM and proceed with the startup routine.

How do I change the contents of ROM? In rare cases, the bootstrap loader instructions must be changed in ROM. This process is called "flashing" and it is performed by running a program supplied by your computer manufacturer. Be sure to carefully follow instructions for this procedure. If the flash fails, your computer will not start until you get the ROM chip replaced.

TRY IT!

When a computer is turned on, what happens first?

- ❍ The microprocessor gets the operating system from the hard disk
- ❍ ROM is cleared to make space for the operating system
- ❍ The bootstrap loader is copied into RAM and then executed by the microprocessor

If you change basic hardware—for example, by adding RAM or changing your hard drive—the bootstrap loader data must be updated. Unlike an update to the bootstrap loader instructions, the configuration data stored in ROM can usually be changed without the perilous flashing procedure.

Some operating systems recognize hardware changes and automatically update the configuration data stored in ROM. Alternatively, you can use a setup utility to manually change the data in ROM as shown in Figure 2-24 on the next page.

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BIOS software © Phoenix Technologies

FIGURE 2-24

On a PC, you can access the BIOS setup utility by holding down the F1 key as your computer boots. But be careful! If you make a mistake with these settings, your computer might not be able to start.

2

If you mistakenly enter the setup program, follow the on-screen instructions to exit and proceed with the boot process. The Esc (Escape) key allows you to exit the setup program without making any changes to the configuration settings.

What information about memory performance is most important? Even though ROM has important roles in the operation of a personal computer, RAM capacity really makes a difference you can notice. With lots of RAM, you'll find that documents scroll faster, games respond more quickly, and many graphics operations take less time than with a computer that has a skimpy RAM capacity.

Most ads specify RAM capacity, speed, and type. Now when you see the specification "2 GB Dual Channel DDR2 SDRAM (max. 4 GB)" in a computer ad, you'll know that the computer's RAM capacity is 2 gigabytes (enough to run Windows 8) and that it uses dual-channel, double data rate SDRAM. You'll also have important information about the maximum amount of RAM that can be installed in the computer—4 GB, which is more than enough for the typical computer owner who does a bit of word processing, surfs the Web, and plays computer games.

QuickCheck

SECTION B

1. A personal computer with an Intel Core i7 microprocessor is likely to operate at a speed of 3.4 _____. (Hint: Use the abbreviation.)
2. A(n) _____ side bus is circuitry that transports data to and from the processor.
3. 4004, 8088, Athlon, and Pentium are all types of _____.
4. *DDR2*, *virtual*, and *volatile* are terms that apply to _____. (Hint: Use the acronym.)
5. The instructions for loading the operating system into RAM when a computer is first turned on are stored in _____. (Hint: Use the acronym.)

CHECK ANSWERS

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Storage Devices

SECTION C

COMPUTER MANUFACTURERS commonly try to entice consumers by configuring computers with a variety of storage devices, such as a hard disk drive, solid-state card readers, and some sort of CD or DVD drive. What's the point of having so many storage devices? As it turns out, none of today's storage technologies is perfect.

In this section, you'll find guidelines that can make you a smart storage technology buyer and owner. The storage technologies you'll learn about are now used in a variety of devices—from digital cameras to player pianos—so an understanding of storage technology can be useful even outside the boundaries of personal computing.

STORAGE BASICS

What are the basic components of a data storage system? A data storage system has two main components: a storage medium and a storage device. A **storage medium** (*storage media* is the plural) is the disk, tape, CD, DVD, paper, or other substance that contains data. A **storage device** is the mechanical apparatus that records and retrieves data from a storage medium. Storage devices include hard disk drives, CD drives, DVD drives, Blu-ray drives, and flash drives. The term *storage technology* refers to a storage device and the media it uses.

How does a storage device interact with other computer components? You can think of your computer's storage devices as having a direct pipeline to RAM. Data gets copied from a storage device into RAM, where it waits to be processed. After data is processed, it is held temporarily in RAM, but it is usually copied to a storage medium for more permanent safekeeping.

As you know, a computer's processor works with data that has been coded into bits that can be represented by 1s and 0s. When data is stored, these 1s and 0s must be converted into some kind of signal or mark that's fairly permanent, but can be changed when necessary.

Obviously, the data is not literally written as "1" or "0." Instead, the 1s and 0s must be transformed into something that can remain on the surface of a storage medium. Exactly how this transformation happens depends on the storage technology. For example, hard disks store data in a different way than CDs. Three types of storage technologies are commonly used for personal computers: magnetic, optical, and solid state.

TERMINOLOGY NOTE

The process of storing data is often referred to as writing data or saving a file because the storage device writes the data on the storage medium to save it for later use.

The process of retrieving data is often referred to as reading data, loading data, or opening a file.

TRY IT!

Data stored on a hard disk:

- ❍ has a direct pipeline to the microprocessor
- ❍ goes to RAM before it is transferred to the processor
- ❍ can be remotely processed without leaving the storage device

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Which storage technology is best? Each storage technology has its advantages and disadvantages. If one storage system was perfect, we wouldn't need so many storage devices connected to our computers! To compare storage devices, it is useful to apply the criteria of versatility, durability, speed, and capacity.

How can one storage technology be more versatile than another? The hard disk drive sealed inside a computer's system unit is not very versatile; it can access data only from its fixed disk platters. More versatile devices can access data from several different media. For example, a DVD drive is versatile because it can access computer DVDs, DVD movies, audio CDs, computer CDs, and CD-Rs.

What makes a storage technology durable? Most storage technologies are susceptible to damage from mishandling or environmental factors, such as heat and moisture. Some technologies are more susceptible than others to damage that could cause data loss. CDs and DVDs tend to be more durable than hard disks, for example.

What factors affect storage speed? Quick access to data is important, so fast storage devices are preferred over slower devices. **Access time** is the average time it takes a computer to locate data on the storage medium and read it. Access time for a personal computer storage device, such as a disk drive, is measured in milliseconds (thousandths of a second). One millisecond (ms) is one-thousandth of a second. Lower numbers indicate faster access times. For example, a drive with a 6 ms access time is faster than a drive with an access time of 11 ms.

TRY IT!

Most computer storage devices locate and retrieve data by:

- ❍ random access
- ❍ sequential access

Access time is best for random-access devices. **Random access** (also called direct access) is the ability of a device to "jump" directly to the requested data. Hard disk, CD, DVD, Blu-ray, and solid state drives are random-access devices, as are the memory cards used in digital cameras. Old-fashioned tape drives, on the other hand, used slower **sequential access** by reading through the data from the beginning of the tape. The advantage of random access becomes clear when you consider how much faster and easier it is to locate a song on a CD (random access) than on a cassette tape (sequential access).

Data transfer rate is the amount of data a storage device can move per second from the storage medium to the computer. Higher numbers indicate faster transfer rates. For example, a hard disk drive with a 57 MBps (megabytes per second) data transfer rate is faster than one with a 50 MBps transfer rate.

What's important about storage capacity? In today's computing environment, higher capacity is almost always preferred. Storage capacity is the maximum amount of data that can be stored on a storage medium, and it is measured in bytes; usually in gigabytes (GB) or terabytes (TB).

Storage capacity is directly related to **storage density**, the amount of data that can be stored in a given area of a storage medium, such as the surface of a disk. The higher the storage density, the more data is stored. Storage density can be increased by making the particles representing bits smaller, by layering them, packing them closer together, or standing them vertically (Figure 2-25).

FIGURE 2-25

Vertical storage produces higher storage capacities than horizontal storage.

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With horizontal storage, particles are arranged end to end, and use of the disk surface is not optimized.

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With vertical storage, particles stand on end so that many more can be packed on the disk surface.

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MAGNETIC STORAGE TECHNOLOGY

What is magnetic storage technology? **Magnetic storage** stores data by magnetizing microscopic particles on a disk or tape surface. The particles retain their magnetic orientation until that orientation is changed, thereby making disks fairly permanent but modifiable storage media.

Data stored magnetically can be easily changed or deleted simply by changing the magnetic orientation of the appropriate particles on the disk surface. This feature of magnetic storage provides lots of flexibility for editing data and reusing areas of a storage medium containing unneeded data.

How does a hard disk drive work? As the main storage device on most computers, a **hard disk drive** contains one or more platters and their associated read-write heads. A **hard disk platter** is a flat, rigid disk made of aluminum or glass and coated with magnetic iron oxide particles.

More platters mean more data storage capacity. The platters rotate as a unit on a spindle, making thousands of rotations per minute. Hard disk platters are typically 3.5" in diameter, with storage capacities ranging from 40 GB to 2 TB.

Each platter has a read-write head that hovers just a few microinches above the surface. A **read-write head** mechanism in the disk drive magnetizes particles to write data, and senses the particles' polarities to read data. Figure 2-26 shows how a computer stores data on magnetic media.

TERMINOLOGY NOTE

You might hear the term *fixed disk* used to refer to hard disks. You often see the terms *hard disk* and *hard disk drive* used interchangeably, although technically *hard disk* refers to the platters sealed inside the hard disk drive.

FIGURE 2-26

Before data is stored, particles on the surface of the disk are scattered in random patterns. The disk drive's read-write head magnetizes the particles, and orients them in a positive (north) or negative (south) direction to represent 0 and 1 bits, respectively.

Why are hard disk drives so popular? Hard disk technology is the preferred type of main storage for most personal computers for three reasons. First, it provides lots of storage capacity. Second, it provides fast access to files. Third, a hard disk is economical. The cost of storing 1 gigabyte of data is about five cents.

What's the downside of hard disk storage? Hard disks are not as durable as many other storage technologies. Data stored on magnetic media can be unintentionally altered by magnetic fields, dust, mold, smoke particles, heat, and mechanical problems with a storage device. Over time, magnetic media gradually lose their magnetic charge, resulting in lost data. Some experts estimate that the reliable life span of data stored on magnetic media is about three years. They recommend that you refresh your data every two years by recopying it.

TRY IT!

Check online. What's the average price for a 2 TB hard drive?

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The read-write heads in a hard disk hover a microscopic distance above the disk surface. If a read-write head runs into a dust particle or some other contaminant on the disk, it might cause a **head crash**, which damages some of the data on the disk (Figure 2-27).

© MediaTechnics

FIGURE 2-27

Hard disk platters and read-write heads are sealed inside the drive case or cartridge to screen out dust and other contaminants. The video for this figure in your interactive eBook shows how a hard drive works and what happens when a hard disk crashes.

To help prevent contaminants from contacting the platters and causing head crashes, a hard disk is sealed in its case. A head crash can be triggered by jarring the hard disk while it is in use. Although hard disks have become considerably more rugged in recent years, you should handle and transport them with care. You should also make backup copies of the data stored on your hard disk in case of a head crash.

What should I know about selecting a hard disk drive?

Computer ads commonly specify the capacity, access time, and speed of a hard disk drive. So "2 TB 8 ms 7200 RPM HD" means a hard disk drive with 2 terabyte capacity, access time of 8 milliseconds, and speed of 7,200 revolutions per minute. Ads rarely specify the amount of data that a hard drive can transfer, but the average data transfer rate is about 57,000 KBps (also expressed as 57 MBps or MB/s).

Hard disk access times of 6 to 11 ms are not uncommon, whereas a CD takes about 500 ms to spin up to speed and find data. Hard disk drive speed is sometimes measured in revolutions per minute (rpm). The faster a drive spins, the more rapidly it can position the read-write head over specific data. For example, a 7,200 rpm drive is able to access data faster than a 5,400 rpm drive.

Computer ads use acronyms such as ATA, EIDE, SCSI, and DMA to describe the type of circuitry used to transfer data between the hard disk and other components on the computer's system board. Some are slightly faster than others, but for most buyers this specification is not a significant factor.

TERMINOLOGY NOTE

Data transfer rates can be specified in bits or bytes, so read the specifications carefully.

50 Mbps or Mb/s means 50 mega*bits* per second.

50 MBps or MB/s means 50 mega*bytes* per second.

Also stay alert for the difference between kilo (K) and mega (M), remembering that mega is 1,000 times more than kilo.

TRY IT!

If you see an ad for a computer with a 6 ms hard drive, you can assume that 6 ms refers to:

- ❍ the drive's access time
- ❍ the drive's capacity
- ❍ the drive's rotational speed
- ❍ the drive's data transfer rate

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Can I use a second hard disk drive to increase storage space? You can increase the storage capacity of your desktop or laptop computer by adding a second hard disk drive, which can also provide a backup for your primary drive. Hard disk drives are available as internal or external units. Internal drives are inexpensive and can be easily installed in a desktop computer's system unit. External drives are slightly more expensive and connect to a desktop or laptop computer using a cable (Figure 2-28).

© MediaTechnics

FIGURE 2-28

External hard drives offer a low-cost way to beef up the storage capacity of a personal computer.

Do computers still store data on tapes? Next time you watch a movie from the 1950s or 1960s that shows a computer, look for the big reels of tape used as storage devices. Tape storage, once used to store mainframe data and also used for personal computer backups, is too slow for modern computing.

What is floppy disk technology? At one time, just about every personal computer included a floppy disk drive (Figure 2-29) that stored data on **floppy disks** (also called floppies or diskettes). This storage technology is no longer used because a floppy disk's 1.44 MB capacity is not sufficient for today's media-intensive applications.

Many MP3 music files and photos are too large to fit on a floppy. In the past, floppy disks were extensively used to distribute software. CDs and DVDs offer more capacity for distributing the huge files for today's software applications. Web downloads offer more convenience.

© MediaTechnics

FIGURE 2-29

A standard floppy disk drive reads and writes data on a 3.5" floppy disk.

TRY IT!

Which device does NOT use magnetic storage technology?

- ❍ Hard disk
- ❍ Floppy disk
- ❍ USB flash drive
- ❍ Tape drive

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OPTICAL STORAGE TECHNOLOGY

How do CD, DVD, and Blu-ray technologies differ? Today, most desktop and laptop computers come equipped with one or more drives designed to work with CD, DVD, and Blu-ray technologies.

- **CD** (compact disc) technology was originally designed to hold 74 minutes of recorded music. The original CD standard was adapted for computer storage with capacity for 650 MB of data. Later improvements in CD standards increased the capacity to 80 minutes of music or 700 MB of data.
- **DVD** (digital video disc or digital versatile disc) is a variation of CD technology that was originally designed as an alternative to VCRs, but was quickly adopted by the computer industry to store data. The initial DVD standard offered 4.7 GB (4,700 MB) of data storage; that's about seven times as much capacity as a CD. Subsequent improvements in DVD technology offer even more storage capacity. A double layer DVD has two recordable layers on the same side and can store 8.5 GB of data.
- **Blu-ray** is a high-capacity storage technology with a 25 GB capacity per layer. The name *Blu-ray* is derived from the blue-violet colored laser used to read data stored on Blu-ray discs. DVD technology uses a red laser; CD technology uses a near infrared laser.

How do CD, DVD, and Blu-ray drives work? CD, DVD, and Blu-ray technologies are classified as **optical storage**, which stores data as microscopic light and dark spots on the disc surface. The dark spots, shown in Figure 2-30, are called **pits**. The lighter, non-pitted surface areas of the disc are called **lands**.

Optical drives contain a spindle that rotates the disc over a laser lens. The laser directs a beam of light toward the underside of the disc. The dark pits and light lands on the disc surface reflect the light differently. As the lens reads the disc, these differences are translated into the 0s and 1s that represent data (Figure 2-31).

FIGURE 2-30

As seen through an electron microscope, the pits on an optical storage disc look like small craters. Each pit is less than 1 micron (one-millionth of a meter) in diameter—1,500 pits lined up side by side are about as wide as the head of a pin.

Courtesy of IBM

© Media Technics

FIGURE 2-31

CD, DVD, and Blu-ray drives use a laser to read data from the underside of a disc.

TRY IT!

How does the capacity of a Blu-ray disc compare to a standard DVD?

- ❍ It has about half the capacity
- ❍ It has double the capacity
- ❍ It has about five times the capacity

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How durable are optical drives? The surface of an optical disc is coated with clear plastic, making the disc quite durable and less susceptible to environmental damage than data recorded on magnetic media. An optical disc, such as a CD, is not disrupted by humidity, fingerprints, dust, magnets, or spilled soft drinks. Scratches on the disc surface can interfere with data transfer, but a good buffing with toothpaste can erase the scratch without damaging the underlying data. An optical disc's useful life is estimated to be more than 30 years. Figure 2-32 illustrates the layers of an optical disc.

FIGURE 2-32

CDs, DVDs, and Blu-ray discs are constructed with one or more layers of recording surface sandwiched between protective plastic.

How fast are CD, DVD, and Blu-ray drives? In the past, optical drives were used to store computer data, such as software and document files. Today, the trend is to use optical storage primarily for watching movies on your computer screen.

The CD and Blu-ray drives built into today's computers are fast enough to stream video and audio data for movies.

Most optical drives permit you to also store computer data on blank CDs, DVDs, and BDs using recordable or rewritable technologies.

What's the significance of ROM, R, and RW? Optical technologies are grouped into three categories: read-only, recordable, and rewritable.

- **Read-only technology** (ROM) stores data permanently on a disc, which cannot be subsequently added to or changed. Read-only discs, such as CD-ROMs, CDDAs, DVD-Video, and DVD-ROMs, are mass produced and used to distribute software, music, and movies.
- **Recordable technology** (R) uses a laser to change the color in a dye layer sandwiched beneath the clear plastic disc surface. The laser creates dark spots in the dye that are read as pits. The change in the dye is permanent, so data cannot be changed once it has been recorded.
- **Rewritable technology** (RW) uses phase change technology to alter a crystal structure on the disc surface. Altering the crystal structure creates patterns of light and dark spots similar to the pits and lands on a CD. The crystal structure can be changed from light to dark and back again many times, making it possible to record and modify data much like on a hard disk. The term *rerecordable* (RE) is sometimes used instead of *rewritable*.

TERMINOLOGY NOTE

The letter *D* in acronyms for optical media such as CDs and DVDs formally means *disc*. In common usage, however, you will often see it spelled *disk*.

TRY IT!

Which optical technology performs most similarly to a hard disk drive?

- ❍ RAM
- ❍ ROM
- ❍ R
- ❍ RW

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What are my choices for CD, DVD, and Blu-ray media?

Several CD and DVD formats are currently popular for use in personal computers. Figure 2-33 summarizes available optical media formats.

FIGURE 2-33
Optical Storage Media

CDDA	(compact disc digital audio)	The format for commercial music CDs. Music is recorded on audio CDs by the manufacturer, but can't be changed by the consumer. Commonly known as audio CDs.
DVD-Video	(digital versatile disc video)	The format for commercial DVDs that contain feature-length films.
CD-ROM	(compact disc read-only)	The original optical format for computer data. Data is stamped on the disc at the time it is manufactured. Data cannot be added, changed, or deleted from these discs.
DVD-ROM	(digital versatile disc read-only)	Contains data stamped onto the disc surface at the time of manufacture. Like CD-ROMs, the data on DVD-ROMs is permanent, so you cannot add or change data.
CD-R	(compact disc recordable)	Stores data using recordable technology. The data on a CD-R cannot be erased or modified once you record it. However, most CD-R drives allow you to record your data in multiple sessions. For example, you can store two files on a CD-R disc today, and add data for a few more files to the disc at a later time.
DVD+R DVD-R	(digital versatile disc recordable)	Stores data using recordable technology similar to a CD-R, but with DVD storage capacity.
CD-RW	(compact disc rewritable)	Stores data using rewritable technology. Stored data can be recorded and erased multiple times, making it a very flexible storage option.
DVD+RW DVD-RW	(Digital versatile disc rewritable)	Stores data using rewritable technology similar to CD-RW, but with DVD storage capacity.
BD-ROM	(Blu-ray disc read-only memory)	Used to store commercial movies.
BD-R	(Blu-ray disc recordable)	Stores data using recordable technology; can be written to once.
BD-RE	(Blu-ray disc rerecordable)	Stores data using rewritable technology so data can be recorded and erased multiple times.

Are rewritable CD, DVD, or Blu-ray drives an acceptable replacement for a hard disk? A rewritable CD, DVD, or Blu-ray drive is a fine addition to a computer system, but is not a good replacement for a hard disk drive. Unfortunately, the process of accessing, saving, and modifying data on a rewritable disc is relatively slow compared to the speed of hard disk access.

Can I use a single drive to work with any CD, DVD, or Blu-ray media? Most CD drives can read CD-ROM, CD-R, and CD-RW discs, but cannot read DVDs or BDs. Most DVD drives can read CD and DVD formats. Storing computer data and creating music CDs require a recordable or rewritable device.

TRY IT!

In the table above, click the row that contains the technology used to play movies from an optical drive on your computer.

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SOLID STATE STORAGE TECHNOLOGY

What is solid state storage? **Solid state storage** (sometimes called flash memory) is a technology that stores data in erasable, rewritable circuitry, rather than on spinning disks or streaming tape. It is widely used in portable consumer devices, such as digital cameras, portable media players, iPads, and cell phones. It is also used as an alternative for hard disk storage in some laptop computers.

Some solid state storage is removable and provides fairly fast access to data. It is an ideal solution for storing data on mobile devices and transporting data from one device to another.

How does solid state storage work? Solid state storage contains a gridwork of circuitry. Each cell in the grid contains two transistors that act as gates to hold the 1s and 0s that represent data (Figure 2-34).

archidea/Shutterstock.com

FIGURE 2-34

When the gates are closed by a process called Fowler-Nordheim tunneling, the cell has a value that represents a "0" bit. When the gates are open, current can flow and the cell has a value that represents a "1" bit.

Very little power is required to open or close the gates, which makes solid state storage ideal for battery-operated devices, such as digital cameras and media players. Once the data is stored, it is **non-volatile**—the chip retains the data without the need for an external power source.

Solid state storage provides fast access to data because it includes no moving parts. This storage technology is very durable—it is virtually impervious to vibration, magnetic fields, or extreme temperature fluctuations. On the downside, the capacity of solid state storage does not currently match that of hard disks. The cost per megabyte of solid state storage is slightly higher than for magnetic or optical storage.

TRY IT!

Both solid state storage and RAM store data in integrated circuits. What is the main difference between the circuits used for RAM and for solid state storage?

- ❍ RAM is volatile
- ❍ Solid state storage is more temporary
- ❍ RAM is more easily removable
- ❍ Solid state storage has less capacity

What are my options for solid state storage? Several types of solid state storage are available to today's consumers: memory cards, solid state drives, and USB flash drives.

When should I use memory cards? A **memory card** is a flat, solid state storage medium commonly used to transfer files from digital cameras and media players to computers. The term *memory card* might lead you to believe that it is similar to random access memory (RAM), but these cards are non-volatile, so they retain data even when they are disconnected from computers and other devices.

The formats for memory cards include CompactFlash, MultiMedia, Secure Digital (SD), xD-Picture Cards, and SmartMedia. A **card reader** is a device that reads and writes data on solid state storage. Sometimes referred to as 5-in-1, 7-in-1, or all-in-one card readers, these combination devices work with multiple types of solid state storage formats (Figure 2-35).

FIGURE 2-35

Most personal computers are equipped with a card reader for transferring data to and from solid state memory cards.

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Because digital photography is so popular, many laptop and desktop computers have a built-in card reader to make it simple to transfer photos from your camera to your computer. Moving data in the other direction, a computer can download MP3 or iTunes music files and store them on a solid state memory card. That card can be removed from the computer and inserted into a portable media player, so you can listen to your favorite tunes while you're on the go.

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Do I need a solid state drive? A **solid state drive** (SSD) is a package of flash memory that can be used as a substitute for a hard disk drive. Some solid state drives are about the same size as a microprocessor chip, whereas others are about the size of a small hard disk drive (Figure 2-36).

SSDs are widely used as the main storage device in handheld devices, such as iPhones and iPads. Some laptop computers also include an SSD instead of a hard disk drive.

When shopping for a laptop computer, you might have the choice of a hard disk drive or an SSD. An SSD is an attractive option for customers who use computers in rugged conditions. Currently, solid state drives are not a popular option for adding storage capacity to existing computers.

FIGURE 2-36

Like hard disk drives, SSDs offer fast data transfer rates and are fixed in place. Although they use the same technology as USB flash drives, SSDs cannot be easily removed from a computer.

What is the best use for USB flash drives? A **USB flash drive** is a portable storage device that plugs directly into a computer's system unit using a built-in connector.

Also called thumb drives, pen drives, jump drives, keychain drives, or UFDs, USB flash drives are about the size of a highlighter pen and so durable that you can literally carry them on your key ring. USB flash drives have capacities ranging from 16 MB to 256 GB.

USB flash drive data transfer speeds average 10–35 MBps (10,000–35,000 KBps). At these speeds, flash drives are slower than hard disk drives, so you might notice a bit of hesitation, especially when working with large files.

Files stored on a USB flash drive can be opened, edited, deleted, and run just as though those files were stored on magnetic or optical media. You might say that USB flash drives are the new floppy disks because not only can you access files as if they were stored on disks, but you can carry them from one computer to another and you can run software from them, too.

A USB flash drive is used for storing data files and programs that you want to use on various computers; for example, on your home computer and at work or in a school lab. When a USB flash drive is inserted, your computer automatically detects it. Macs display a flash drive icon on the desktop. Windows detects the flash drive and displays the AutoPlay window shown in Figure 2-37 so that you can quickly access files.

FIGURE 2-37

To view the files and programs stored on a USB flash drive, insert it into the computer. Windows displays the AutoPlay window that you can use to quickly view the files stored on the USB device.

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STORAGE WRAP-UP

Can I add storage to my computer? You can increase storage capacity in a desktop or laptop computer by adding hard drives, and you can add storage flexibility by installing additional types of storage devices.

External storage devices, such as external hard disk drives, CD drives, DVD drives, and USB flash drives, simply plug into connectors built into your computer's system unit. They can be easily detached when you want to move your computer or if your external drive contains a backup that you want to store away from your computer.

Before you disconnect any storage device, make sure you understand the manufacturer's instructions for doing so. On PCs, you usually have to use the Safely Remove Hardware icon on the Windows taskbar. Macs usually provide an eject icon next to the drive listing.

As an alternative to an external drive, you can install storage devices inside a desktop or laptop system unit case in "parking spaces" called **drive bays**. An external drive bay provides access from outside the system unit—a necessity for a storage device with removable media, such as floppy disks, CDs, and DVDs.

Internal drive bays are located deep inside the system unit and are designed for hard disk drives, which don't use removable storage media. Most desktop computers include several internal and external bays. Laptop computers may include a drive bay for a CD/DVD drive (Figure 2-38).

TRY IT!

Which one of the following can be installed in an internal drive bay?

- ❍ Solid state drive
- ❍ CD drive
- ❍ USB flash drive
- ❍ Blu-ray player

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FIGURE 2-38

Some laptop computers provide bays for one hard disk drive and one CD or DVD drive.

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Most desktop computers have several drive bays: some accessible from outside the case, and others—designed for hard disk drives—without any external access. Empty drive bays are often hidden from view with a face plate.

Watch the video for this figure to find out how to install internal and external drives.

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What are the relative advantages and disadvantages of each type of computer storage device? Earlier in the chapter, you read that no storage technology is perfect. While hard disk drives offer fast and inexpensive access, they are not the most durable technology. CD and DVD technology is durable, but slow, and flash drive storage is expensive when compared per gigabyte to other storage media. The table in Figure 2-39 summarizes the relative advantages and disadvantages of each storage technology covered in this section.

FIGURE 2-39
Storage Technology Comparison

Storage Type	Cost of Device	Capacity	Data Transfer Rate	Technology	Removable
USB Flash Drive	$$	2–256 GB	Medium	Solid state	Yes
CD-RW	$	700 MB	Slow	Optical	Yes
DVD+RW	$	8.5 GB	Slow	Optical	Yes
Blu-ray	$$$$	50 GB	Slow	Optical	Yes
Floppy Disk	$	1.44 MB	Glacial	Magnetic	Yes
Hard Drive (Internal)	$$$	80 GB–2 TB	Fast	Magnetic	No
Hard Drive (External)	$$$	80 GB–2 TB	Fast	Magnetic	Yes
Solid State Drive (Internal)	$$$	32 GB–256 GB	Fast	Solid state	No

2

QuickCheck

SECTION C

1. Access _____ is typically faster for random-access devices than for sequential-access devices.
2. A magnetic storage device uses a read-_____ head to magnetize particles that represent data.
3. A hard disk drive that is rated at a speed of 7200 _____ will give you faster access to your data than a drive rated at 5400. (Hint: Use the acronym.)
4. CD-R technology allows you to write data on a disc, and then change that data. True or false? _____
5. A(n) _____ uses the same storage technology as a USB flash drive, but is not designed to be removable. (Hint: Use the acronym.)

CHECK ANSWERS

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Input and Output Devices

SECTION **D**

THIS SECTION provides an overview of the most popular input and output devices for personal computers. After a survey of input devices, display devices, and printers, you'll take a look at the computer's expansion bus so that you'll be able to select, install, and use all kinds of peripherals.

BASIC INPUT DEVICES

What devices can I use to get data into a computer? Most computer systems include a keyboard and pointing device, such as a mouse, for basic data input. Touch-sensitive screens offer an additional input option. Other input devices, such as scanners, digital cameras, and graphics tablets, are handy for working with graphical input. Microphones and electronic instruments provide input capabilities for sound and music.

TRY IT!

Desktop and laptop computers have QWERTY keyboards. Check your tablet or smartphone. Is its on-screen keyboard layout QWERTY or ABCD?

What's special about a computer keyboard's design? The design of most computer keyboards is based on the typewriter's qwerty layout, which was engineered to keep the typewriter's mechanical keys from jamming. In addition to a basic typing keypad, desktop and laptop computer keyboards include a collection of keys such as Alt, Ctrl, and Print Screen, designed for computer-specific tasks.

Most desktop computer keyboards include a calculator-style numeric keypad, plus an editing keypad with keys such as End, Home, and Page Up, to efficiently move the screen-based insertion point. You can even find tiny keyboards on handheld devices—entering text and numbers is an important part of most computing tasks.

What does a pointing device do? A **pointing device** allows you to manipulate an on-screen pointer and other screen-based graphical controls. The most popular external pointing devices for personal computers include mice and game controllers. External pointing devices, such as the mouse in Figure 2-40, can be connected to the computer with a cable or with a wireless connection.

FIGURE 2-40

An optical mouse uses an onboard chip to track a light beam as it bounces off a surface, such as a desk, clipboard, or mouse pad.

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Which pointing device should I choose? Most desktop computer systems include a **mouse** as the primary pointing device. Many computer owners also add a mouse to their laptop computers.

Game controllers come in many styles, such as joysticks, steering wheels, and wands. Game controllers also serve as adaptive devices for people with physical disabilities who cannot use a keyboard or mouse.

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When do I need a trackpad? A **trackpad** (or touchpad) is a touch-sensitive surface on which you can slide your fingers to move the on-screen pointer. Trackpads also include buttons that serve the same function as mouse buttons. Trackpads are located just beneath the keyboard of most laptop computers so that it is not necessary to carry a mouse as an extra component.

The act of moving your fingers on the surface of a trackpad is called a gesture. On a standard trackpad, sliding a single finger moves the pointer. With a multi-touch trackpad, additional gestures are possible (Figure 2-41).

FIGURE 2-41

Touchpad Gestures

Zoom in: Move two fingers apart to zoom in and enlarge photos or documents.

Zoom out: Move two fingers closer to each other to reduce the size of images or documents.

Horizontal scrolling: Move two fingers to the right or left.

Vertical scrolling: Move two fingers up or down.

Rotate: Turn two fingers on the trackpad to rotate an image.

Tap: Tapping the trackpad performs the same function as clicking a mouse button.

Two-finger tap: Tapping the trackpad with two fingers generates a right-click.

Swipe: Move three fingers horizontally to step through a series of photos, album covers, or windows.

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How does a touchscreen work? Tablet computers, handheld devices, retail store self-checkouts, and information kiosks collect input from a **touchscreen**, which overlays a display screen. The most commonly used touchscreen technology is a transparent panel coated with a thin layer of electrically conductive material that senses a change in the electrical current when touched. This "resistive" technology is fairly durable. It is not susceptible to dust or water, but it can be damaged by sharp objects. Processing technology can interpret a single touch or more complex input such as handwriting.

The coordinates for a touch event are processed in essentially the same way as a mouse click. For example, if you touch your iPad screen at the location of a button labeled Calendar, the area you touch generates coordinates and sends them to the processor. The processor compares the coordinates to the image displayed on the screen to find out what is at the coordinates, and then responds—in this case, by opening your appointment calendar. A popular use for touchscreens is to display a **virtual keyboard** on the screen of a handheld device, as shown in Figure 2-42.

FIGURE 2-42

A virtual keyboard can be displayed on a touchscreen to collect typed input.

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DISPLAY DEVICES

What are my options for display devices? A computer display device that simply displays text and images is classified as an output device. Touch-sensitive screens, however, can be classified as both input and output devices because they accept input and display output.

Standalone display devices, sometimes called monitors, are popular for desktop computers. Display devices for laptops, tablets, and handheld devices are built into the system units. Two technologies are commonly used for computer display devices: LCD and LED.

LCD (liquid crystal display) technology produces an image by filtering light through a layer of liquid crystal cells (Figure 2-43). The advantages of LCD screens include display clarity, low radiation emission, portability, and compactness. The source of the light that filters through the LCD is referred to as backlighting. In a standard LCD screen, the source of this light is a series of cold cathode fluorescent lamps (CCFLs), which are not environmentally friendly. Gradually, CCFL backlighting is being replaced by **LED** (light-emitting diode) technology.

FIGURE 2-43

An LCD screen is composed of a grid arrayed with liquid crystal cells.

Andrey Burmakin/Shutterstock.com

What factors affect image quality? Image quality is a factor of screen size, dot pitch, width of viewing angle, response rate, resolution, and color depth. Screen size is the measurement in inches from one corner of the screen diagonally across to the opposite corner. Screen sizes range from 3" on smartphones to 60" or more for home entertainment systems.

Dot pitch (dp) is a measure of image clarity. A smaller dot pitch means a crisper image. Technically, dot pitch is the distance in millimeters between like-colored **pixels**—the small dots of light that form an image. A dot pitch between .26 and .23 is typical for today's display devices. Dot pitch can also be expressed as dots per inch, with higher numbers indicating better image quality.

A display device's **viewing angle width** indicates how far to the side you can still clearly see the screen image. With a wide viewing angle of 170 degrees or more, you can view the screen from various positions without compromising image quality.

Response rate is the time it takes for one pixel to change from black to white then back to black. Display devices with fast response rates display a crisp image with minimal blurring or "ghosting" of moving objects. Response rate is measured in milliseconds (ms). For gaming systems, a response rate of 5 ms or less is desirable.

The number of colors a monitor can display is referred to as **color depth** or bit depth. Most PC display devices have the capability to display millions of colors. When set at 24-bit color depth (sometimes called True Color), your PC can display more than 16 million colors—and produce what are considered photographic-quality images.

DVARG/Shutterstock.com

TRY IT!

The colors above show what happens when you blend red, green, and blue. Which combination of liquid crystal cells creates a yellow pixel?

- ❍ Blue and red
- ❍ Red and green
- ❍ Green and blue
- ❍ Red, green, and blue

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What should I know about screen resolution? The number of horizontal and vertical pixels that a device displays on the screen is referred to as **screen resolution**. Standard resolutions are optimized for a 4:3 aspect ratio in which the width is slightly larger than the height. Widescreen displays with 16:9 aspect ratios carry a W designation. Common screen resolutions are listed in Figure 2-44.

HDTV (high-definition TV) broadcast systems use resolutions of 1280 x 720 (720p) or 1920 x 1080 (1080p). For HDTV compatibility and viewing movies, your computer display should be compatible with one of these formats.

Should I set my computer on its highest resolution? At higher resolutions, text and other objects appear smaller, but the computer can display a larger work area, such as an entire page of a document. At lower resolutions, text appears larger, but the work area is smaller. Enlarged text sometimes looks blurry because a letter that required one row of dots might now require additional dots to fill it in. Most displays have a recommended resolution at which images are clearest and text is crispest.

The two screens in Figure 2-45 help you compare a display set at 1280 x 800 resolution with a display set at 800 x 600 resolution.

FIGURE 2-44

Common Screen Resolutions

VGA	640 x 480
SVGA	800 x 600
XGA	1024 x 768
SXGA	1280 x 1024
UXGA	1600 x 1200
WUXGA	1920 x 1200
WQXGA	2560 x 1600

FIGURE 2-45

The screen on the left shows 1280 x 800 resolution. Notice the size of text and other screen-based objects. The screen on the right shows 800 x 600 resolution. Text and other objects appear larger on the low-resolution screen, but you see a smaller portion of the screen desktop.

What are the components of a typical computer display system? In addition to a display device, such as a monitor, a computer display system also requires graphics circuitry that generates the signals for displaying an image on the screen. One type of graphics circuitry, referred to as **integrated graphics**, is built into a computer's system board. A second option, called **dedicated graphics**, is graphics circuitry mounted on a small circuit board called a **graphics card** (or video card) like the one in Figure 2-46.

A graphics card contains a **graphics processing unit** (GPU) and special video memory, which stores screen images as they are processed but before they are displayed. Lots of video memory is the key to lightning-fast screen updating for fast action games, 3-D modeling, and graphics-intensive desktop publishing. In addition to video memory, most graphics cards contain special graphics accelerator technology to further boost performance.

FIGURE 2-46

A graphics card is a small circuit board that plugs into the system board.

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PRINTERS

What printer technologies are available for personal computers? Printers are one of the most popular output devices available for personal computers. Today's best-selling printers use ink jet or laser technology in multifunction devices that can also serve as scanners, copiers, and fax machines.

How does an ink jet printer work? An **ink jet printer** has a nozzle-like print head that sprays ink onto paper to form characters and graphics. The print head in a color ink jet printer consists of a series of nozzles, each with its own ink cartridge. Most ink jet printers use CMYK color, which requires only cyan (blue), magenta (pink), yellow, and black inks to create a printout that appears to have thousands of colors. Alternatively, some printers use six or eight ink colors to print midtone shades that create slightly more realistic photographic images.

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FIGURE 2-47

Ink jet printers spray ink from a series of ink cartridges.

Ink jet printers, such as the one in Figure 2-47, outsell all other types of printers because they are inexpensive and produce both color and black-and-white printouts. They work well for most home and small business applications. Small, portable ink jet printers meet the needs of many mobile computer owners.

Ink jet technology also powers many photo printers, which are optimized to print high-quality images produced by digital cameras and scanners.

TRY IT!

Digital devices use various color models. Whereas display devices use the RGB model, printers use what color model?

How do laser printers compare to ink jet printers? A **laser printer** uses the same technology as a photocopier to paint dots of light on a light-sensitive drum. Electrostatically charged ink is applied to the drum and then transferred to paper. A laser printer prints faster than an ink jet printer, but laser technology is more complex than ink jet technology, which accounts for the higher price of laser printers.

A basic laser printer like the one in Figure 2-48 produces only black-and-white printouts. Color laser printers are available, but are somewhat more costly than basic black-and-white models. Laser printers are often the choice for business printers, particularly for applications that produce a high volume of printed material.

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FIGURE 2-48

Laser printers electrostatically collect toner on a drum, then the toner is transferred onto paper. Find out more about laser printers by watching the video for this figure in your interactive eBook.

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What is a dot matrix printer? When PCs first appeared in the late 1970s, dot matrix printers were the technology of choice, and they are still available today. A **dot matrix printer** produces characters and graphics by using a grid of fine wires. As the print head noisily clatters across the paper, the wires strike a ribbon and paper in a pattern prescribed by your PC (Figure 2-49).

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FIGURE 2-49
Unlike laser and ink jet technologies, a dot matrix printer actually strikes the paper and, therefore, can print multipart carbon forms.

Dot matrix printers can print text and graphics—some even print in color using a multicolored ribbon. Today, dot matrix printers are used primarily for "back-office" applications that demand low operating cost and dependability, but not high print quality.

What features should I look for in a printer? Printers differ in resolution, print speed, duty cycle, operating costs, duplex capability, memory, and networkability.

- **Resolution.** The quality or sharpness of printed images and text depends on the printer's resolution—the density of the gridwork of dots that create an image. Printer resolution is measured by the number of dots printed per linear inch, abbreviated as dpi. At normal reading distance, a resolution of about 900 dpi appears solid to the human eye, but a close examination reveals a dot pattern. If you want magazine-quality printouts, 900 dpi is sufficient resolution. If you are aiming for resolution similar to expensive coffee-table books, look for printer resolution of 2,400 dpi or higher.
- **Print speed.** Printer speeds are measured either by pages per minute (ppm) or characters per second (cps). Color printouts typically take longer than black-and-white printouts. Pages that contain mostly text tend to print more rapidly than pages that contain graphics. Typical speeds for personal computer printers range between 6 and 30 pages of text per minute. A full-page 8.5 x 11 photo can take about a minute to print.
- **Duty cycle.** In addition to printer speed, a printer's **duty cycle** determines how many pages a printer is able to churn out. Printer duty cycle is usually measured in pages per month. For example, a personal laser printer has a duty cycle of about 3,000 pages per month (ppm)—that means roughly 100 pages per day. You wouldn't want to use it to produce 5,000 campaign brochures for next Monday, but you would find it quite suitable for printing ten copies of a five-page outline for a meeting tomorrow.
- **Operating costs.** The initial cost of a printer is only one of the expenses associated with printed output. Ink jet printers require frequent replacements or refills for relatively expensive ink cartridges. Laser printers require toner cartridge refills or replacements. Dot matrix printers require replacement ribbons. When shopping for a printer, you can check online resources to determine how often you'll need to replace printer supplies and how much they are likely to cost.

TRY IT!

Which type of printer is slower, but less expensive to operate?

❍ Laser printer

❍ Ink jet printer

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- **Duplex capability.** A **duplex printer** can print on both sides of the paper. This environmentally friendly option saves paper but can slow down the print process, especially on ink jet printers that pause to let the ink dry before printing the second side.
- **Memory.** A computer sends data for a printout to the printer along with a set of instructions on how to print that data. **Printer Command Language** (PCL) is the most widely used language for communication between computers and printers, but **PostScript** is an alternative printer language that many publishing professionals prefer. Data that arrives at a printer along with its printer language instructions requires memory. Laser printers do not start printing until all the data for a page is received. You can add memory to most laser printers if necessary for your print jobs.
- **Networkability.** A network-enabled printer can connect directly to a computer network, rather than to a single computer. The network connection can be wired or wireless. The advantage of a network-ready printer is that it can be placed in a location convenient for all the network users. Network-enabled printers are essential for printing from handheld devices that can't be connected to a printer by cable. For example, to print from an iPad or iPhone, you can use an AirPrint compatible printer that's part of your home Wi-Fi network.

Should I refill or recycle? Ink and toner cartridges are expensive and you can save some money by refilling them yourself or taking them to an ink refilling station at a local office store. Remanufactured and discount printer supplies are available online, too. Before you try one of these options, read the instructions and warranty for your printer. Inexpensive printer supplies don't always get stellar ratings from consumers. If cartridge and toner refills are not available, find out how to responsibly recycle them (Figure 2-50).

FIGURE 2-50

When you replace printer components, check to see if the manufacturer has a recycle program.

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INSTALLING PERIPHERAL DEVICES

How does a computer move data to and from peripheral devices? When you install a peripheral device, you are basically creating a connection for data to flow between the device and the computer. Within a computer, data travels from one component to another over circuits called a **data bus**.

One part of the data bus, referred to as the local bus or internal bus, runs between RAM and the microprocessor. The segment of the data bus to which peripheral devices connect is called the **expansion bus** or external bus. As data moves along the expansion bus, it can travel through expansion slots, expansion cards, ports, and cables (Figure 2-51).

FIGURE 2-51

The expansion bus connects the computer system board to peripheral devices.

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What's an expansion slot? An **expansion slot** is a long, narrow socket on the system board into which you can plug an expansion card. An **expansion card** is a small circuit board that gives a computer the capability to control a storage device, an input device, or an output device. Expansion cards are also called expansion boards, controller cards, or adapters.

Expansion slots can be used for installing high-end graphics cards in desktop computers configured for gaming, desktop publishing, and graphics applications. Figure 2-52 shows how to plug an expansion card into an expansion slot.

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FIGURE 2-52

An expansion card simply slides into an expansion slot. Before you install an expansion card, be sure to unplug the computer and ground yourself—that's technical jargon for releasing static electricity by using a special grounding wristband or by touching both hands to a metal object. Your interactive eBook explains how to install expansion cards in a desktop computer.

What is an expansion port? An **expansion port** is any connector that passes data into and out of a computer or peripheral device. It is similar to an electrical outlet because you can plug things in to make a connection.

Expansion ports are usually incorporated in the system board. Computer system units are designed with openings that make these ports accessible from outside the case.

As shown in Figure 2-53, the built-in ports supplied with today's desktop and laptop computers usually include graphics ports for connecting display devices, an Ethernet port for connecting to a wired network, eSATA and FireWire ports for high-speed external data storage, audio ports for microphone and speakers, and USB ports for connecting a mouse, keyboard, printer, and other peripheral devices.

FIGURE 2-53

When this system board is installed in a computer, the expansion ports will be accessible from outside the system unit.

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Is it difficult to install a new peripheral device? At one time, installing computer peripherals required a screwdriver and extensive knowledge of ports, slots, boards, and various electronic gizmos. Today, most peripheral devices connect to an external **USB** (universal serial bus) port, located on the front, sides, or back of the computer system unit (Figure 2-54).

Many kinds of peripheral devices—including mice, scanners, and joysticks—are available with USB connections. Transmitters for wireless devices, such as wireless mice, also plug into USB slots. Several types of storage devices, such as USB flash drives and external hard disk drives, use USB connections, too.

What if I run out of USB ports? You can easily add USB ports to your computer by using an inexpensive **USB hub**, which contains several auxiliary USB ports. The hub plugs into one of your computer's USB ports and you can then insert multiple USB devices into the ports supplied by the hub.

Self-powered USB hubs require power from an external power supply, such as a wall outlet. Bus-powered USB hubs (sometimes called unpowered hubs) draw their power from the computer. A bus-powered USB hub can be used for low-power devices, such as card readers and mice. A self-powered USB hub is required if the hub is used for connecting scanners, printers, and some external hard drives. Figure 2-55 illustrates how a USB hub can be used to connect several devices to a single USB port on a computer.

FIGURE 2-54

A USB connector is shaped like a flat rectangle. Make sure you know which side of the plug is up; the top is usually labeled with the USB logo.

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FIGURE 2-55

This self-powered USB hub connects two USB flash drives, an external hard drive, and a printer to a single USB port that is connected to a computer.

When do I use other kinds of ports? **FireWire** ports (also called IEEE 1394 ports) are used for external storage devices and for transferring data from digital video cameras to a computer. **eSATA** is a high-speed port used for connecting external storage devices. **Thunderbolt** is a very high-speed port for connecting display or storage devices.

VGA (Video Graphics Array), **DVI** (Digital Visual Interface), and **HDMI** (High-Definition Multimedia Interface) ports are designed for audiovisual devices. They are primarily used for connecting a monitor to a desktop computer, and for connecting an external monitor to a laptop computer. Figure 2-56 illustrates ports that can be used for connecting display devices.

FIGURE 2-56

A variety of ports are available for connecting an external monitor to a desktop or laptop computer.

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What is hot-plugging? When you connect or disconnect a peripheral device while the computer is operating, you are **hot-plugging**, a practice that's allowed with USB and FireWire devices. Before you unplug a device, such as a USB flash drive, however, your computer might require notification. In Windows, you can give notification using the Safely Remove Hardware icon in the notification area of the taskbar. With a Mac, hold down the Control key, click the device icon, and then select Eject.

Windows

Macs

TRY IT!

Click the icons on the Windows and Mac toolbars to find out which ones remove a USB flash drive from your computer.

Why do some peripheral devices include a CD? Some devices require software to establish communication with your computer. The directions supplied with your peripheral device include instructions on how to install the software. Typically, you use the installation CD one time to get everything set up, and then you can put the CD away in a safe place. You'll learn more about this software, called a device driver, in the next chapter.

Long-time computer techies probably remember the days when installing a peripheral device meant messing around with little electronic components called dip switches and a host of complex software settings called IRQs.

Fortunately, USB, FireWire, and Thunderbolt ports can autodetect a newly connected device and attempt to establish the settings necessary for sending data between it and the computer (Figure 2-57).

Autodetect, sometimes called "plug and play," works quite well for most popular peripheral devices. If your computer does not recognize a newly connected device or is unable to correctly exchange data with it, check the manufacturer's Web site for a device driver update, or call the manufacturer's technical support department.

Windows 8 displays a progress bar during the autodetect process.

FIGURE 2-57

After your computer detects a newly connected device, it might take a few seconds to set up communication.

QuickCheck

SECTION D

1. On a multi-touch trackpad, you can use various _____ to move the pointer, zoom, and scroll.
2. A widescreen computer display has a 16:9 _____ ratio.
3. One type of graphics circuitry, referred to as _____ graphics, is built into a computer's system board.
4. Most ink jet printers use _____ color that requires four ink colors. (Hint: Use the acronym.)
5. A(n) _____ port provides one of the fastest, simplest ways to connect peripheral devices. (Hint: Use the acronym.)

CHECK ANSWERS

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Hardware Security

SECTION E

THE INFORMATION that computers contain and process has become practically priceless to every PC owner. Just about everyone depends on a computer for information and communication. A stolen computer, even if it's low-priced, can be a huge loss if it holds valuable financial data or months of research. A broken PC can easily cost hundreds of dollars to repair, especially if the data is damaged and needs to be recovered. For trouble-free computer use, it is important to secure and regularly maintain your computer equipment, just as you would your home and car.

ANTI-THEFT DEVICES

What can I do to prevent my computer from being stolen? Computers are prime targets for thieves. Many security breaches have been traced to stolen computers. The portability of laptop and tablet computers makes them particularly easy for a thief to grab, just as a wallet or a handbag would be. Figure 2-58 contains important tips for protecting your portable computer from theft.

- Never leave your portable computer unattended, especially when you are at a coffee shop, the library, or the airport.
- If you have to leave your portable computer in your car, never leave it in plain view. Lock it up in the trunk or cover it up.
- Carry your portable computer in an inconspicuous carrying case.
- Record your portable computer's make, model, and serial number and store them away from the computer. Many recovered computers cannot be returned to their owners because this tracking information is not supplied to police.
- Consider securing your portable computer with an anti-theft device.

FIGURE 2-58

Tips for Preventing Computer Theft

How do computer anti-theft devices work? Several computer anti-theft devices are available. Most can be used for both desktop and laptop computers.

The Kensington Security Slot is a security mechanism that's factory-installed on many personal computers. It is a small, reinforced oblong hole into which you can insert a special lock that can be attached to a cable. The cable can be fastened to a desk to prevent theft as shown in Figure 2-59.

FIGURE 2-59

The Kensington Security Slot is an industry standard way to secure a computer to a desk.

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If my computer is stolen, can authorities recover it? Your chances of recovering a stolen computer improve if you have taken some steps in advance, such as recording the computer's serial number, affixing a tracking label, or installing tracking software.

STOP (Security Tracking of Office Property) plates leave an indelible tattoo on your computer equipment, which contains a unique ID number registered in the international STOP database.

Tracking and recovery software, such as CyberAngel and LoJack for Laptops, secretly sends a message as soon as a thief uses a stolen computer to log on to the Internet. This message contains the computer's exact location and is directed to a tracking or monitoring center.

Apple's Find My iPhone system can be used to track missing iPhones, iPods, and iPads (Figure 2-60).

Software © 2012 Apple Inc. All rights reserved

FIGURE 2-60
Find My iPhone can locate a missing phone and remotely lock it or delete its contents.

SURGE PROTECTION AND BATTERY BACKUP

What is a power surge? To ensure that your computer stays in good running condition, it is essential to protect it from power surges. A **power surge** is a sudden increase in electrical energy affecting the current that flows to electrical outlets. Power surges often occur before or after power failures, which also put your computer and data at risk.

Computers and peripheral devices require stable current and are particularly sensitive to sudden bursts of electrical energy. A powerful surge can ruin computer circuitry. Smaller surges can slowly damage your computer's circuit boards and other electrical components. Over time, even small, repeated power surges can shorten your PC's life.

Power surges originate from a number of sources: downed power lines, power grid switching by the electric company, faulty wiring, and large appliances like refrigerators and air conditioners powering on and off. Lightning causes extremely large power surges and consequently poses a real threat to your computer equipment.

How can I protect my computer from power surges? You can protect your computer equipment from power surges by plugging it into a surge strip instead of directly into a wall outlet. For added protection during thunderstorms, shut down your computer, turn off all your peripheral devices, and unplug the surge strip and all computer-related cables from wall outlets, including the cable for your modem.

TRY IT!

You're recharging your iPad. Which is safest?

- ❍ Plug the charger into a wall outlet
- ❍ Plug the charger into a surge strip

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What is a surge strip and how does one work? A **surge strip** (also called a surge suppressor or surge protector) is a device that contains electrical outlets protected by circuitry that blocks surges. Some surge strips also have sockets for modem connections that prevent surges from traveling down telephone or cable lines and into your computer.

A surge strip like the one in Figure 2-61 monitors the electrical current that passes from an outlet to all the devices plugged into the strip. When it detects a surge, it redirects the extra current to a grounded circuit.

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FIGURE 2-61

Surge strips should be connected directly to a wall outlet. Plugging one surge strip into another surge strip reduces their effectiveness.

A big power surge can burn out a surge strip while it tries to protect your equipment. Some surge strips have an indicator light that warns you if the surge strip is no longer functioning properly. Check the manufacturer's documentation to determine if you should discard the depleted strip, reset it, or install a new fuse.

What is a UPS? A **UPS** (uninterruptible power supply) is a device that not only provides surge protection, but also furnishes desktop computers and network devices with battery backup power during a power outage.

If your desktop computer is connected to a UPS when a power outage occurs, the battery backup allows you to save what you're doing and properly shut down your computer. Depending on your system's configuration, a UPS with a high-performance battery might give you enough backup power to keep your computer up and running for several hours, allowing you to continue to work during the entire power outage.

TRY IT!

A UPS is NOT particularly useful for which of the following devices?

- ❍ A desktop computer
- ❍ A laptop computer
- ❍ The router for your home network
- ❍ Your Internet modem

Portable computers run on battery power and so the data you're working on is not immediately affected by a power outage. However, if you want to access your local area network or Internet connection, you might consider plugging your network devices and Internet modem into a UPS so that they continue to operate during an outage.

As shown in Figure 2-62, most UPSs have two types of sockets: one type offers battery backup plus surge protection, and the other offers only surge protection. The surge-only sockets are for printers, which use so much power that they can quickly drain the battery. At the Web site for American Power Conversion, you'll find tips for choosing a UPS based on your system's configuration and the amount of run time you want during a power outage.

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FIGURE 2-62

An uninterruptible power supply (UPS) not only protects electronic equipment from power surges, it also provides battery power during power outages.

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BASIC MAINTENANCE

Can I prevent hardware problems? Computer component failures can be caused by manufacturing defects and other circumstances beyond your control. You can, however, undertake some preventive maintenance to extend the life of your computer equipment, just as regular tune-ups lengthen the life of your car.

Preventive maintenance can save you more than the cost of repairs; you also save the time you would've lost while tracking down problems and arranging for repairs. Regularly cleaning your computer components and peripheral devices helps to keep them in good condition.

How do I clean the keyboard? Always shut down your computer before you clean your keyboard so that you don't inadvertently type in commands that you don't want your system to execute. Also, disconnect the keyboard and remember where the connection is located. Flip the keyboard over and shake it gently to get rid of debris that became lodged between the keys. A can of compressed air is also effective for removing debris. A vacuum cleaner can suck away the keys on your keyboard, so be very careful if you use one to clean your keyboard.

You can use cotton swabs just slightly moistened with a mild cleaning fluid to clean the sides of keys. Wipe the tops of the keys with a soft cloth, again slightly dampened with a mild cleaning solution. Allow your keyboard to dry before you reconnect it. Keep drinks away from your computer to avoid spilling liquids onto the keyboard. Figure 2-63 provides more information on cleaning your computer keyboard.

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FIGURE 2-63

Carefully use a cotton swab and a can of compressed air or a vacuum cleaner to remove dust and debris from your keyboard. Sticky liquids are difficult to remove. That can of pop? Keep it away from your keyboard. Watch the video in your interactive eBook to see how to safely clean your computer keyboard.

How do I get dust and fingerprints off my computer screen? Dust and fingerprint smudges can easily accumulate on display screens and make them quite difficult to read. You should clean screens, especially touchscreens, on a regular basis. It's always best to turn off your display device before you clean because a blank screen will reveal all the smudges, dust, and dirt.

Follow the manufacturer's instructions for cleaning your display screens, using the recommended cleaning product. Spray the cleaner on a lint-free, soft cloth, but never directly on the screen. Don't scrub. The membrane covering many screens is delicate and can be easily damaged.

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Should I be concerned about my computer's operating temperature? High-performance processors, hard drives, graphics cards, and several other computer components generate a lot of heat. Overheating can shorten the lifespan of internal components and chips.

Most desktop computers have a fan mounted on the power supply that runs continuously to maintain the proper temperature inside of the system unit. Additional cooling fans might also be used to cool the microprocessor or graphics card. Laptop computers also have cooling fans, but the fans come on only after the processor reaches a certain temperature (Figure 2-64).

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FIGURE 2-64

Fans that cool your computer vent outside the case. Keep the area around your computer clear for good air circulation.

It is important to be aware of the ventilation around your computer system and ensure that the fans are able to draw air from the room and blow it across the internal components. If your desktop's system unit is in an enclosed space, such as a cabinet, you might need to cut out a hole at the back to give your PC some room to "breathe."

Dust particles, dirt, and pet hair can collect on and around a computer's cooling fans and impede their performance. You should regularly use a can of compressed air or a vacuum cleaner hose to clean out debris from the vents and fans.

Exercise extreme caution when cleaning inside your computer's system case. First, make sure that you've turned off the computer and all connected devices. Do not touch the system board, and be sure not to knock any cables loose.

You should also be aware of the temperature in the room in which your computer resides. Several vendors sell cooling mats containing fans that can be placed under your laptop computer (Figure 2-65).

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FIGURE 2-65

If your laptop computer case usually feels warm, consider placing it on a chill mat containing fans that can lower the computer's temperature and potentially increase its lifespan.

Are there any other components that need TLC? To avoid read or write errors, you want your optical drives to function properly. Retailers provide cleaning kits for many types of storage devices and media. Also examine your CDs and DVDs for scratches and fingerprints. Clean them with a soft cloth slightly dampened with water. If the smudges don't come off, a little isopropyl alcohol might help.

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What is a good computer maintenance routine? Aside from cleaning your computer equipment on a regular basis, you should do the preventive maintenance tasks listed in Figure 2-66. You'll learn how to do these tasks in later chapters.

- Back up your files regularly, particularly those that are most important to you. You might want to perform daily backups of critical data and monthly backups of all your files. You should also test your backup procedures periodically.
- Run utilities that ensure peak performance for your hard disk drive. In Windows, these utilities include Disk Cleanup and Disk Defragmenter. It's best to do this maintenance on a weekly basis.
- Delete your browser's history and cache files on a monthly basis in order to free up space for your temporary files. The free space results in faster downloads from the Internet.
- Apply the latest operating system, driver, and security updates.
- Scan your computer for viruses and spyware once a week.
- Keep antivirus and spyware definitions updated.

FIGURE 2-66

Tips for Regular Computer Maintenance

TROUBLESHOOTING AND REPAIR

How can I tell if something is wrong with my computer? There are several telltale signs that your computer is in trouble. The most obvious one is failure to power up. A loud beep at startup time can also indicate a problem. If your computer's screen remains blank or error messages appear, you might have a hardware problem (Figure 2-67).

FIGURE 2-67

Windows 8 displays this Recovery message when it detects a hardware problem during startup.

Hardware problems can also show up as unexpected restarts at random intervals, or as a peripheral device that stops working. Some problems are intermittent and might seem to be resolved only to come back when they are least convenient to deal with.

What is the blue screen of death? Many seasoned Windows users have encountered the **blue screen of death** (also called BSoD) that suddenly replaces the usual graphical screen display with an enigmatic error message written in white text against a blue background. The blue screen of death indicates that the operating system has encountered an error from which it cannot recover, and the computer no longer accepts any commands.

Hardware problems can quickly escalate and some can eventually make your computer non-functional or make your data impossible to access. Any computer problem that prevents you from working as usual should be taken seriously. A little time spent troubleshooting can save you lots of annoyance down the road.

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How do I troubleshoot a hardware problem? You might be able to solve many hardware problems by simply following the basic guidelines for troubleshooting listed in Figure 2-68.

- Stay calm and don't jump to any conclusions until you've thought everything through.
- Write down all error messages and any other information that goes with them.
- Make sure all components are plugged in and that there are no loose cables. For example, if your display device's cable is loose, the indicator light will be off and your screen will be blank.
- If you can, try to duplicate the problem by going through the same steps that led you to it.
- Look for troubleshooting and repair tips in your user's manual, on your vendor's Web site, or even through a search engine. If you search the Internet by typing in the error message number or keywords in the error message, you might discover that at least one person has already found a solution to your problem.
- Run your antispyware and antivirus software. Lurking viruses, worms, Trojan horses, and spyware (discussed in the next chapter) can cause strange and unexplainable occurrences in your computer system. For example, spyware can cause your computer to keep displaying a pop-up ad no matter how you try to close it.
- Restarting your computer can clear up many minor operational problems. Windows always requires a reboot when it displays the blue screen of death. However, a more serious problem underlying the BSoD will not be resolved with a reboot. To reboot a PC, hold down the Ctrl, Alt, and Del keys at the same time. When the next screen appears, select the Shut Down button.

FIGURE 2-68

Troubleshooting Tips

TRY IT!

What is one of the simplest steps to take if your computer seems to have an operational problem?

- ❍ Access the BSoD
- ❍ Activate its safe mode
- ❍ Restart your computer
- ❍ Plug it into a surge strip

Troubleshooting and diagnostic tools can help you find the source of a problem and fix it. For example, Windows offers interactive troubleshooting tools formatted as a series of simple questions, answers, and recommendations (Figure 2-69). You might have to borrow a computer to run these tools if your computer is totally out of commission.

FIGURE 2-69

To access Windows troubleshooters, go to the Control Panel.

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What is safe mode? Whether you use a PC or a Mac, your computer probably has a special **safe mode** designed for professional troubleshooting. On Macs this mode is referred to as Safe Boot, whereas Windows calls it Safe Mode. When operating in these modes, your computer uses a limited version of the operating system that allows you to use your mouse, screen, and keyboard, but no other peripheral devices. Safe Mode and Safe Boot can be used to track down and uninstall programs or hardware that might be causing operational problems (Figure 2-70).

FIGURE 2-70

When your computer is in a "safe" mode, it can be used for troubleshooting, but not normal computing.

Windows Safe Mode

Mac Safe Boot Mode

What if I can't solve the problem myself? If you are unable to fix a hardware problem yourself, you might have to call the technical support center for the device or component that is malfunctioning. You can also consider asking for help from a knowledgeable person or from computer repair professionals like the Geek Squad.

When seeking outside technical help, make sure you've checked your warranty, and know the purchase date, serial number, brand, model, and operating system. You should also have a written copy of error messages and a description of the steps that led to the problem.

Once the problem is resolved, write down the solution. You never know when you might need it again!

QuickCheck

SECTION E

1. A power _____ is a sudden increase or spike in electrical energy, affecting the current that flows to electrical outlets.
2. A(n) _____ can provide power to keep your desktop computer, network, and Internet connection operational during a power outage. (Hint: Use the acronym.)
3. If your computer's built-in fans don't provide an adequate level of cooling, you can place it on a chill mat. True or false? _____
4. When using Windows, you can troubleshoot hardware problems by logging in to the BSoD. True or false? _____
5. _____ Mode is a stripped-down version of Windows that is designed for troubleshooting.

CHECK ANSWERS

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Issue: Where Does All the Ewaste Go?

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IN THE WEST AFRICAN nation of Ghana, smoldering piles of discarded computers and monitors ring a mucky river, polluted beyond recovery. Teenage boys play soccer in a toxic haze. When their break is over, they get back to work smashing monitors, ripping out the innards, and tossing the plastic cases into a smoking pyre of oozing plastic.

In Guiyu, China, thousands of women huddle over primitive stoves "cooking" circuit boards to retrieve trace amounts of gold. Toxic fumes from the cooking process cloud the air; a toddler showing symptoms of lead poisoning plays listlessly with the carcasses of discarded mice and cell phones.

It is called ewaste, e-garbage, or technotrash—all the unwanted and outdated computers, monitors, printers, cell phones, disk drives, disks, CDs, and DVDs. According to the Environmental Protection Agency (EPA), 3 million tons of it is discarded every year. In the United States alone, almost eight printer cartridges are discarded every second, and millions of CDs and DVDs end up in landfills every year.

Some illegal ewaste originates in legitimate recycling centers...

Computers and other electronic gear contain toxic substances such as lead, cadmium, and mercury. When discarded equipment is buried in landfills, these substances can leach into groundwater and streams. When burned, electronic components can emit toxic dioxin.

Ewaste is a global problem. As countries struggle to deal with discarded electronic components, an alarming amount of ewaste is shipped to developing countries where villagers, working for pennies a day, are exposed to toxic chemicals as they attempt to reclaim resalable metals from discarded equipment. Throughout the emerging world, ugly ewaste dumps defile the landscape and have yet unknown health effects.

Where does all this ewaste originate? Every country generates ewaste, but the bulk of it comes from prosperous, technology-forward countries such as the United States, Great Britain, Germany, Japan, France, and China. Despite laws that ban ewaste transhipping, loopholes allow discarded but working electronics to be shipped as "donations." Tons of donations arrive every day in port cities, such as Hong Kong, where they follow a shadowy route to unregulated workshops and dump sites.

Some illegal ewaste originates in legitimate recycling centers, where consumers assume electronic components will be handled in environmentally friendly ways. Many recycling centers do not process materials on site. Instead, they ship the ewaste to third parties. Without careful monitoring, that ewaste can be diverted to offshore locations where it piles up, waiting to be disassembled by backstreet laborers ungoverned by environmental protection regulations.

Developed countries have strict environmental regulations designed to prevent toxic substances from polluting air, land, and water. Proper disposal is expensive, however. In countries with high labor costs and stringent environmental regulations, the value of compounds retrieved from ewaste does not cover the cost of extraction.

The high cost of properly processing ewaste makes gray market options attractive. Ewaste can be handled more cost-effectively in emerging countries where environmental regulations are ignored, wages are pitiful, and workers are not covered by health and safety laws.

So, who is responsible for ewaste sweatshops and pollution? Is it consumers in developed countries who deposit unwanted gear at recycling stations that don't carry out the recycling process in-house, or is it the recycling firms that ship ewaste to third parties? Is it the firms that ship ewaste to emerging countries or the governments that can't close the loopholes on ewaste transhipping?

Perhaps the responsibility lies with emerging countries that are unable to control ewaste sweatshops and ignore the resulting environmental and human casualties.

Wherever the blame lies, consumers who are aware of the problem can become more responsible in the way they dispose of unwanted gear to keep it out of landfills at home and offshore.

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TRY IT! Explore the ewaste issue. Watch a video of the Ghana crisis and explore the steps you can take to minimize the number of electronic components that end their life in landfills and toxic waste dumps.

1. A group of graduate journalism students from the University of British Columbia investigated the illicit ewaste industry. Their story is presented in a Frontline World report located at *www.pbs.org/frontlineworld/stories/ghana804/video/video_index.html*. Watch the video. Where do the researchers drop off the ewaste and where does it end up?
2. Many computers, mobile phones, and other electronic components pile up in landfills because their owners are unaware of potential environmental hazards and simply toss them in the garbage. Use Web sites such as Earth911.com, or search for "recycling computers" and add your city name as in "recycling computers Chicago." Where is the nearest drop-off location for old laptop computers? Would you be charged a fee, and if so, how much?
3. Before donating or discarding a computer, you should erase all the data it contains. Simply deleting files is not sufficient to prevent data from being recovered. Connect to *www.pcworld.com* and search for "erase hard drive." Locate the how-to video and watch it. What are three ways you can securely prevent access to the data on a hard disk?
4. Consumers can select "green" products and purchase equipment from environment-friendly manufacturers. Check out Greenpeace's Green Ranking. What is the ranking for the company that manufactured your computer?
5. You might wonder if the computer you are currently using is environmentally friendly. The Green Electronics Council rates specific computer models as bronze, silver, or gold. Connect to the EPEAT site (*www.epeat.net*), click Search the Registry, and then drill down to find your computer. What is the rating for your computer brand and model?

	epeat BRONZE	epeat SILVER	epeat GOLD	Total
Desktops	1	83	132	216
Displays	0	352	308	660
Integrated Desktop Computers	0	51	27	78
Notebooks	50	635	1018	1703
Thin Clients	0	21	4	25
Workstation Desktops	0	0	20	20
Workstation Notebooks	0	2	7	9
Totals	51	1144	1516	2711

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INFOWEBLINKS

You can check the **NP2014 Chapter 2** InfoWebLink for updates to these activities.

CLICK TO CONNECT
www.infoweblinks.com/NP2014/ch02

What Do You Think?

ISSUE

1. Have you ever thrown away an old computer or other electronic device?
2. Do you research products before you purchase them to find out if they are environmentally friendly throughout their life cycle?
3. Would it be fair for consumers to pay a recycling tax on electronic equipment that they purchase?

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Information Tools: Making the Cut

© MediaTechnics

Searching Bing, Google Scholar, or academic databases produces mountains of links. How do you select and save the most relevant bits of information? The first step is to decide which information is relevant enough to make the cut. To decide, ask yourself the following three questions:

1. IS IT RELEVANT? Read the search engine synopsis carefully. With Google and other search engines, the synopsis shows your search terms in the context of the article. Academic databases display a standard synopsis. Don't waste your time linking to articles that are not relevant to your research topic.

> **The zen of overclocking**
> B Colwell - Computer, 2004 - ieeexplore.ieee.org
> Every once in a while, some- thing comes along in the computer industry that really surprises me. The first time this happened was in the early 1980s, when the first personal computing stores showed up in shop- ping malls. The second time was when I took the first Internet browser ...
> Cited by 13 - Related articles - All 4 versions

2. WHAT'S THE MAIN IDEA? Link to articles that seem relevant and skim them to pick up the main idea. Academic databases typically connect you to an abstract that provides a short summary. You can get an overview of an article's key terms using Web apps such as Wordle to create a word cloud.

may
cooling
overclocked
components
video
overclocking
component
heat
performance
clock
system
voltage
card
rate
computer
firmware
used
cards
edit
hardware
increase
usually
often
also
new
devices
operating
example
stability
higher
overclockers
overclocking
tests
cause
processor
memory
Radeon
without
testing
even
general
CPU
boxed
JSS
result
systems
chip
software
benchmarks
bios
cases
fans
increases
problem
sometimes
overclock
pipeline
pipelines
thermal
bus
failure
failures
errors
default
functional
original
data
edit mode
release
product
one
processors
motherboards
manufacturers
devices
using
settings
warranty
less
different
boxed
beyond
cpu
ingore
temperature
manufacturer
bios
bottleneck
problem
sometimes
overclocking
overclock
pipeline
pipelines
thermal
overclockers
overclocking
tests
cause
processor
memory
without
testing
even
general
cpu
bus
failure
failures
errors
default
functional
original
data
edit mode
release
product
one
processors
motherboards
manufacturers
devices
using
settings
warranty
less
different
boxed
beyond
cpu
ingore
temperature
manufacturer
bios
bottleneck
problem
sometimes

TRY IT! As you find information that is relevant to your research topic, you need a way to record it and keep track of it. Note-taking tools help you record important ideas; the trick is to keep your notes in good order. Many students use word processors to take notes. Bookmarking tools offer another option. Here's a chance to explore these tools and make a word cloud.

Many scholars record their notes in a word processing document. This method offers flexibility for copying snippets of text as well as entering summary notes.

1. Use your favorite word processing software to create a blank document called Project [Your Name] Chapter 2, then complete the rest of the steps.

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2. Use an academic database to search for a journal article about ewaste. Read the conclusion, highlight the most important idea, and copy it to your Project document using quotation marks to show that it is original material. Capture the Web address (URL) in your Project document. Add a phrase in your own words that summarizes the main idea.
3. Find three pieces of information that support the idea you selected in step 2. This information can be found in the journal article or another source. Copy the passages into your Project document (don't forget the quotation marks) along with the corresponding URLs.
4. Use a search engine, such as Google or Bing, to locate a magazine article about ewaste. Read the article, highlight the paragraph containing the most important idea, copy it to your Project document, and put it in quotation marks. Also capture the URL.
5. Search for ewaste in Wikipedia. Highlight one of the main ideas. Copy the text, add quotation marks, and capture the URL in your Project document.

A bookmarking tool helps you collect and recall key pieces of information by storing the source URL and important snippets that you highlight. Dedicated bookmarking apps offer tools that automate the process of collecting information and URLs from online sources. Many bookmarking services are Web apps, so your data remains in the cloud and is accessible to you from any computer connected to the Internet.

6. Register for a free account on a bookmarking service such as WebNotes or Diigo. Use that tool to capture the same information as you collected in steps 2–5. Don't forget to add your own tags that summarize each idea. Export your bookmarks if the tool offers a way to do so, then import the bookmarks into your Project document. If you can't export and import, then instead take a screenshot of your bookmarks and paste it into your Project document.

Web site © Diigo Inc 2011

7. Search Wikipedia for the article about ewaste. Copy the entire article, then go to *www.wordle.com* and paste the text to create a word cloud. Take a screenshot of your word cloud and paste it into your Project document.

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Technology in Context: Military

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IN THE BOOK ENGINES OF THE MIND, Joel Shurkin writes, "If necessity is the mother of invention, then war can be said to be its grandmother." The military, an early pioneer in computer and communication technologies, continues to be the driving force behind technologies that have revolutionized everyday life.

During World War II, the U.S. military initiated a classified research program, called Project PX, to develop an electronic device to calculate artillery firing tables; by hand, each table required weeks of grueling calculations.

Project PX produced ENIAC (Electronic Numerical Integrator And Computer), one of the first general-purpose electronic computers. When ENIAC was completed in 1946, the war was over, but ENIAC's versatile architecture could be used for other calculations, such as designing hydrogen bombs, predicting weather, and engineering wind tunnels. ENIAC's technology evolved into the computers used today.

After Project PX, the military continued to support computer research. Like most large corporations, the military used mainframe computers to maintain personnel, inventory, supply, and facilities records. This data was distributed to terminals at other locations through rudimentary networks.

Because all data communication flowed through the mainframe, a single point of failure for the entire system was a possible risk. A malfunction or an enemy "hit" could disrupt command and control, sending the military into chaos. Therefore, the armed forces created the Advanced Research Projects Agency (ARPA) to design a distributed communications system that could continue operating without a centralized computer.

The result was ARPANET, which paved the way for the data communications system we know today as the Internet. ARPANET was activated in 1967, but the .mil domain that designates U.S. military Web sites was not implemented until 1984.

The U.S. Department of Defense (DoD) currently maintains several data communications networks, including SIPRNet, a classified (secret-level) network, and NIPRNet, which provides unclassified services. The DoD's public Web site provides official information about defense policies, organizations, budgets, and operations.

Computers and communications technology have also become an integral part of high-tech military operations. U.S. Apache helicopters, for example, are equipped with computer-based Target Acquisition Designation Sights, laser range finder/designators, and Pilot Night Vision Sensors.

The U.S. Army's BCT Modernization project includes high-tech vehicles, sensors, and equipment, coordinated by a network of computers, software, and radios. According to United States Army General George W. Casey Jr., "The network links Soldiers on the battlefield with space-based and aerial sensors, robots, and command posts. This provides the situational awareness necessary to apply lethal and non-lethal force with the precision demanded by the security environment."

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BCT, which stands for Brigade Combat Team, includes "software-defined" radios that are less vulnerable to cyberthreats than conventional radios. Soldiers can use these radios to communicate voice and data.

A small handheld device with a touch-sensitive screen allows soldiers to control unmanned robots and drones. A solar backpack supplements the battery-powered device. BCT equipment also includes wearable devices, such as helmet-mounted displays and communications devices.

The military has conducted research in computer simulations that are similar to civilian computer games. "Live" military training is dangerous—weapons are deadly and equipment costs millions of dollars. With computer simulations, however, troops can train in a true-to-life environment without physical harm or equipment damage.

Photo Courtesy of U.S. Army

Flying an F-16 fighter, for example, costs thousands of dollars an hour, but flying an F-16 simulator costs only a few hundred dollars per hour. The military uses simulators to teach Air Force pilots to fly fighter jets, Navy submarine officers to navigate in harbors, and Marine infantry squads to handle urban combat. Military trainers agree that widespread use of computer games helps prepare troops to adapt quickly to simulations.

A 24-year-old preflight student at Pensacola Naval Air Station modified the Microsoft Flight Simulator game to re-create a T-34C Turbo Mentor plane's controls. After logging 50 hours on the simulator, the student performed so well on a real plane that the Navy used his simulation to train other pilots.

Today, a growing cadre of computer and communications specialists is needed to create and maintain increasingly complex military systems such as the Defense Department's Distributed Common Ground System (DCGS) for sharing surveillance imagery and intelligence.

Armies once depended primarily on their infantry divisions, but today's high-tech armies also depend on database designers, computer programmers, and network specialists. Even previously low-tech military jobs, such as mechanics and dietitians, require some computer expertise. Happily, new recruits are finding military computer systems easy to learn, based on their knowledge of civilian technologies, such as the Internet and computer games.

Although most citizens recognize that an adequate national defense is necessary, the cost of defense-related equipment, personnel, and cutting-edge research remains controversial. In a 1961 speech, President Dwight Eisenhower warned "We must guard against the acquisition of unwarranted influence, whether sought or unsought, by the military-industrial complex."

Some socially motivated citizens and pacifists tried to withhold tax dollars from the military-industrial complex that Eisenhower cautioned against. In retrospect, however, military funding contributed to many technologies we depend on today.

For example, detractors tried to convince the government that Project PX was doomed to failure; but without ENIAC research, computers might not exist today. Skeptics saw no future for the fruits of ARPANET research; but it led to the Internet, which has changed our lives significantly.

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New Perspectives Labs

To access the New Perspectives Lab for Chapter 2, open the NP2014 interactive eBook and then click the icon next to the lab title.

BENCHMARKING

IN THIS LAB YOU'LL LEARN:

- Which computer performance factors can be measured by benchmark tests
- How to run a test that identifies a computer's processor type, RAM capacity, and graphics card type
- How to run benchmarking software that analyzes a computer's processor speed and graphics processing speed
- How to interpret the results of a benchmark test
- How to compare results from benchmark tests that were performed on different system configurations
- When benchmark tests might not provide accurate information on computer performance

LAB ASSIGNMENTS

1. Start the interactive part of the lab. Make sure you've enabled Tracking if you want to save your QuickCheck results. Perform each lab step as directed, and answer all the lab QuickCheck questions. When you exit the lab, your answers are automatically graded and your results are displayed.
2. Use the System Information utility to analyze the computer you typically use. If you are using a Windows 7 or 8 computer, also check the results of the Windows Experience Index. Provide the results of the analysis along with a brief description of the computer you tested and its location (at home, at work, in a computer lab, and so on).

Processor Benchmarks

Processor	Quake III Arena	PCMark
"Supernova EE"	548	5198
"Pulsar FX"	551	5020

3. Based on the Processor Benchmarks table above, which fictional processor appears to be faster at graphics processing? Which processor appears to be better at overall processing tasks?
4. Explain why you might perform a benchmark test on your own computer, but get different results from those stated in a computer magazine, which tested the same computer with the same benchmark test.
5. Use a search engine on the Web to find benchmark ratings for one of Intel's Core processors and one of AMD's Athlon 64 processors. Are the benchmarks different? What would account for the benchmark results?

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Key Terms

Make sure you understand all the boldfaced key terms presented in this chapter. With the NP2014 interactive eBook, you can use this list of terms as an interactive study activity. First, try to define a term in your own words, and then click the term to compare your definition with the definition presented in the chapter.

64-bit processor, 68
Access time, 77
All-in-one computer, 58
Benchmarks, 70
BIOS, 74
Blue screen of death, 103
Blu-ray, 81
Bootstrap loader, 74
Capacitors, 72
Card reader, 84
CD, 81
CISC, 69
Color depth, 90
Compatible, 63
CPU cache, 68
Data bus, 94
Data transfer rate, 77
Dedicated graphics, 91
Desktop computer, 56
Dot matrix printer, 93
Dot pitch, 90
Drive bays, 86
Duplex printer, 94
Duty cycle, 93
DVD, 81
DVI, 96
Dynamic RAM, 72
EEPROM, 74
Enhanced media player, 60
eSATA, 96
Expansion bus, 94
Expansion card, 95
Expansion port, 95
Expansion slot, 95
FireWire, 96
Floppy disks, 80
Form factor, 58
Front side bus, 68
Game controllers, 88
Gigahertz, 67
Graphics card, 91
Graphics processing unit, 91
Hard disk drive, 78
Hard disk platter, 78
HDMI, 96
Head crash, 79
Home computer system, 64
Hot-plugging, 97
Ink jet printer, 92
Integrated graphics, 91
Lands, 81
Laptop computer, 59
Laser printer, 92
LCD, 90
LED, 90
Linux platform, 63
Mac platform, 63
Magnetic storage, 78
Megahertz, 68
Memory card, 84
Microprocessor clock, 67
Mouse, 88
Multi-core processor, 68
Non-volatile, 84
Optical storage, 81
Overclocking, 71
Parallel processing, 69
PC platform, 63
Peripheral device, 56
Pipelining, 69
Pits, 81
Pixels, 90
Pointing device, 88
Portable computer, 59
PostScript, 94
Power surge, 99
Printer Command Language, 94
RAM, 72
Random access, 77
Read-only technology, 82
Read-write head, 78
Recordable technology, 82
Response rate, 90
Rewritable technology, 82
RISC, 69
ROM, 74
Safe mode, 105
Screen resolution, 91
Sequential access, 77
Serial processing, 69
Smartphone, 60
Solid state drive, 85
Solid state storage, 84
Storage density, 77
Storage device, 76
Storage medium, 76
Surge strip, 100
System unit, 57
Tablet computer, 60
Thunderbolt, 96
Touchscreen, 89
Tower case, 58
Trackpad, 89
UPS, 100
USB, 96
USB flash drive, 85
USB hub, 96
VGA, 96
Viewing angle width, 90
Virtual keyboard, 89
Virtual memory, 73
Volatile, 72
Word size, 68

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Interactive Summary

To review important concepts from this chapter, fill in the blanks to best complete each sentence. When using the NP2014 interactive eBook, click the Check Answers buttons to automatically score your answers.

SECTION A: The core of a personal computer system includes the computer system _____, display device, keyboard, and mouse. Personal computers come in several varieties of _____ factors. A(n) _____ computer fits on a desk, runs on power from an electrical wall outlet, and can be housed in a horizontal case or vertical _____ case. A(n) _____ computer is a small, lightweight personal computer designed to run on battery power. Three categories of these computers include tablet computers, smartphones, and _____ computers, which have the screen, keyboard, storage, and processing components integrated into a single clamshell-style system unit. At one time, Macs and PCs were not compatible, but today's Macs can run Windows because they use the same _____ as PCs. The apps you can install on a slate-style handheld tablet or smartphone depend on its _____; for example, if it is an Android or iOS device. Personal computers are sometimes designated as home, small business, or game systems to help consumers select the computer that's right for their needs. Consumers can sometimes save money by installing upgrades after purchase; however, replacing a(n) _____ is difficult and not recommended.

CHECK ANSWERS

SECTION B: The microprocessor and memory are two of the most important components in a computer. The microprocessor is a(n) _____ circuit, which is designed to process data based on a set of instructions. Microprocessor performance can be measured by the speed of the microprocessor _____. A specification such as 3.33 GHz means that the microprocessor operates at a speed of 3.33 _____ cycles per second. Other factors affecting overall processing speed include word size, cache size, instruction set complexity, parallel processing, and pipelining. Most personal computers only contain one main microprocessor, but today's multi- _____ processors contain the circuitry for multiple microprocessors.

Computers contain various kinds of memory. Random _____ memory is a special holding area for data, program instructions, and the _____ system. It stores data on a temporary basis until the processor makes a data request. RAM is different from disk storage because it is _____, which means that it can hold data only when the computer power is turned on. Computers also contain read- _____ memory, which is a type of non-volatile memory that provides a set of "hard-wired" instructions that a computer uses to boot up. A type of user-modifiable ROM, called by its acronym _____, is used to store the bootstrap loader instructions and data in most modern computers.

CHECK ANSWERS

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SECTION C: Today's personal computers use a variety of storage technologies. _____ storage technologies, such as hard disks, store data as magnetized particles. A hard disk drive provides multiple _____ for data storage that are sealed inside the drive case to prevent airborne contaminants from interfering with the read-write heads. Hard disks are less durable than many other types of storage, so it is important to make a copy of the data they contain. _____ storage technologies store data as a series of _____ and lands on the surface of CDs, DVDs, or BDs. Storage technologies, such as CD-_____, are often used for distributing software, but you cannot alter the disc's contents. _____ technology allows you to write data on a CD, DVD, or BD, but you cannot delete or change that data. Rerecordable or _____ technology allows you to write and erase data on a CD, DVD, or BD. _____ state storage technologies, such as USB flash drives, store data by activating electrons in a microscopic grid of circuitry.

CHECK ANSWERS

SECTION D: Most computer systems include a keyboard and some type of _____ device, such as a mouse, for basic data _____. For output, most computers include a display device. _____ technology produces an image by filtering light through a layer of liquid crystal cells. Image quality for a display device is a factor of resolution, screen size, dot _____, viewing angle width, response _____, and color _____. A typical computer display system consists of the display device and a(n) _____ card. For printed output, most personal computer owners select _____ jet printers, although _____ printers are a popular option when low operating costs and high duty cycle are important. A(n) _____ matrix printer is sometimes used for back-office applications and printing multipart forms. Installing a peripheral device is not difficult when you remember that it uses the _____ bus to make a connection between the computer and peripheral device. Many of today's peripherals connect to a(n) _____ port. If the right type of port is not built into your computer, you might have to add a(n) _____ card.

CHECK ANSWERS

SECTION E: For trouble-free computer use, it is important to secure and regularly _____ your computer equipment. Anti-theft devices include computer locks and tie-down brackets. Computers can be protected from power _____ by connecting to a surge strip. A(n) _____ power supply can also protect against surges, plus it can supply backup power in case of a power outage. Keeping your computer's _____ vents free of dust can help to keep its temperature within operational levels. You can also clean dust off the screen and shake dirt out of the keyboard. Problems such as the blue screen of _____ require troubleshooting. Windows offers interactive troubleshooting tools formatted as a series of simple questions, answers, and recommendations. Booting into _____ mode can also be a helpful step in the troubleshooting process.

CHECK ANSWERS

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Interactive Situation Questions

Apply what you've learned to some typical computing situations. When using the NP2014 interactive eBook, you can type your answers, and then use the Check Answers button to automatically score your responses.

1. Suppose you're reading a computer magazine and you come across the ad pictured to the right. By looking at the specs, you can tell that the microprocessor was manufactured by which company? _____

2. The capacity of the hard disk drive in the ad is _____ GB and the memory capacity is _____ GB.

3. The computer in the ad appears to have a(n) _____ controller card for the hard disk drive.

4. You are thinking about upgrading the microprocessor in your four-year-old computer, which has a 2.6 GHz Core i3 microprocessor and 512 MB of RAM. Would it be worthwhile to spend $500 to install an Intel Core 7 processor? Yes or no? _____

5. You're in the process of booting up your computer and suddenly the screen contains an assortment of settings for date and time, hard disk drive, and memory capacity. From what you've learned in this chapter, you surmise that these settings are stored in _____ , and that they are best left unmodified.

6. You're looking for a portable storage device that you can use to transport a few files between your home computer and your school computer lab. The school lab computers have no floppy disk drives, but do have USB ports. You should be able to transport your files using a USB _____ drive.

SUP-R GAME DESKTOP
MODEL EEXL

- Intel® Core™ i7
- 6 GB Tri-Channel DDR3
- 500 GB SATA-II (7200 rpm)
- 16x CD/DVD burner
- 21.5" HD widescreen monitor
- NVIDIA® GeForce™
- Creative Sound Blaster® X-Fi Titanium
- Altec Lansing speakers
- Gigabit Ethernet port
- 3-year limited warranty
- Windows 8

$949

7. You're frustrated about using the keys on your cell phone to enter long e-mail addresses, so you decide to get a new smartphone with a touchscreen that displays a(n) _____ keyboard.

8. Suppose that you want to purchase a new monitor. A(n) _____ screen offers a more environmentally friendly choice than a(n) _____ screen.

9. Suppose that you volunteer to produce a large quantity of black-and-white leaflets for a charity organization. It is fortunate that you have access to a(n) _____ printer with a high duty cycle and low operating costs.

CHECK ANSWERS

Interactive Practice Tests

Practice tests that consist of ten multiple-choice, true/false, and fill-in-the-blank questions are available in the NP2014 interactive eBook. Test questions are selected at random from a large test bank, so each time you take a test, you'll receive a different set of questions. Your tests are scored immediately, and you can print study guides that help you find the correct answers for any questions that you missed.

CLICK TO START

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Learning Objectives Checkpoints

Learning Objectives Checkpoints are designed to help you assess whether you have achieved the major learning objectives for this chapter. You can use paper and pencil or word processing software to complete most of the activities.

1. Draw a sketch of your computer system and label at least six of its components. Make a table with three columns, labeled Input, Output, and Storage/Memory. Skim through the chapter and for each device you encounter, place it in one or more of the columns as appropriate.
2. Draw a set of quick sketches that show each of the following form factors: desktop tower, desktop horizontal, all-in-one, clamshell, slate. List the advantages of each form factor.
3. Create a short consumer brochure that lists five characteristics that would help consumers choose among a home, game, or small business computer system.
4. List important factors to consider when shopping for a new computer. Describe the three price points for personal computers and indicate which price point best fits your computing needs.
5. Explain how Intel Macs are changing the old idea that PCs and Macs are not compatible.
6. List at least six computer upgrades and rank each as easy, moderate, or difficult for computer owners to perform.
7. Refer to Section D of Chapter 1 and create a sequence of sketches that shows what happens in a microprocessor's ALU and control unit when an instruction is processed.
8. List and describe the factors that affect microprocessor performance. Name three popular microprocessors, and list some of the models in each family.
9. List four types of memory and briefly describe how each one works.
10. Describe the advantages and disadvantages of magnetic storage, optical storage, and solid state storage using criteria such as versatility, durability, capacity, access time, and transfer rate.
11. Summarize what you know about how a graphics card can affect a display device's resolution.
12. Compare and contrast the technologies and applications for ink jet, laser, and dot matrix printers.
13. Create your own diagram to illustrate how the data bus connects RAM, the microprocessor, and peripheral devices. Explain the hardware compatibility considerations, device drivers, and procedures involved in installing a peripheral device.
14. List ways you can protect your computer system hardware from theft and damage.
15. Think about the last time you had a problem with computer hardware or software. Would any of the steps in Figure 2-68 have helped you solve the problem faster? If not, what guidelines would you add to the list in the figure?

Study Tip: Make sure you can use your own words to correctly answer each of the purple focus questions that appear throughout the chapter.

Concept Map

Fill in the blanks to show the hierarchy of system unit components.

CHECK ANSWERS

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3 Software

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INFOWEBLINKS

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CLICK TO CONNECT
www.infoweblinks.com/NP2014/ch03

Learning Objectives

After reading this chapter, you will be able to answer the following questions by completing the outcomes-based Learning Objectives Checkpoints on page 181.

1. What are the most popular types of application software?
2. What basic utilities are included with Windows and Mac operating systems?
3. How do iPhones provide adaptive utilities for people who can't see the screen?
4. Why is it important to know where to locate the version numbers for device drivers?
5. How can word processing software help improve your writing?
6. How does spreadsheet software work?
7. How is the data in a database stored and accessed?
8. What are key features of presentation software?
9. What is the difference between Web apps and mobile apps?
10. What kinds of files are included in local applications software?
11. Is installing downloaded software different from installing software from a distribution CD?
12. What are software patches and service packs?
13. How do I uninstall software on Windows and Macs?
14. What is a EULA?
15. What are the differences between proprietary software, commercial software, shareware, open source software, freeware, and public domain software?
16. What's malware?
17. How does antivirus software work?

Apply Your Knowledge

The information in this chapter will give you the background to:

- Find and update device drivers for printers and other devices
- Use word processing software
- Use a spreadsheet
- Use Web apps
- Install mobile apps
- Download and install local software
- Work with portable application software
- Find open source software
- Read a EULA so that you know how to use software legally
- Uninstall software
- Install and use antivirus software

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TRY IT!

IS MY SOFTWARE UP TO DATE?

The average American consumer owns more than 24 digital devices. Before you begin Chapter 1, take an inventory of your digital equipment to find the brands, models, and serial numbers. Tuck this information in a safe place. It can come in handy when you need to call technical support, arrange for repair services, or report missing equipment.

1. Find the list of installed software.
   Windows 7: Click the **Start** button. Click the **All Programs** option to display a list of installed software. Point to items in the list that have a ▸ symbol to see a sublist of software programs.
   Windows 8: Make sure you are viewing the Start screen. Use the horizontal scroll bar, if necessary, to view the application tiles on the right side of the screen.
   Mac: Click the **Finder** icon and then click **Applications** from the list on the left side of the Finder window.
   Tablet or smartphone: Swipe the screen to scroll through pages of icons that represent apps.
2. As you look through the list of installed software, jot down the names of any that you're not familiar with. When you read the chapter, you might find out what they do.
3. Open any one of your applications.
4. Find the current version of the application.
   Windows 7 and 8: Click the **Help** menu, then click **About**. For Microsoft Office 2010, click **File**, then click **Help**; for Office 2013, click **File**, then click **Account**.
   Mac: Click the program name from the menu bar at the top of the screen, then select About.
   Tablet or smartphone: Press the **Home** button to display the main screen. Touch the **Settings** icon. On some devices you might have to select Apps or Apps Manager. Select an app from the list.
   Version numbers are displayed in a format like 1.4.5 or 7.0. Version information might also include a service pack number like SP2. You'll learn the significance of version numbers and service packs when you read the chapter.
5. Check the version numbers for other software that is installed on your computer. Do some programs provide more information than others in the About window?

Desktop and laptop applications display version numbers in a window accessed through Help.

Tablets and smartphones provide access to version numbers through Settings.

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Software Basics

SECTION **A**

SOFTWARE determines the tasks a digital device can help you accomplish. Some software helps you create documents, while other software helps you block viruses or fine-tune computer performance. Section A helps you categorize application software, utilities, and device drivers.

SOFTWARE CATEGORIES

What is software? As you learned in Chapter 1, the instructions that tell a computer how to carry out a task are referred to as a computer program. These programs form the software that prepares a computer to do a specific task, such as document production, photo editing, virus protection, file management, or Web browsing.

How is software categorized? The two main categories are system software and application software. Operating systems, which are covered in the next chapter, are classified as system software. Device drivers, utilities, and programming languages are also system software. Application software categories include music, graphics, mapping, finance, and entertainment.

Application software is designed to help people accomplish real-world tasks, whereas system software is designed for computer-centric tasks. For example, you would use application software to edit a photo, write a term paper, or play a game, but you would use system software to diagnose a problem with your hard disk drive or Internet connection. Let's take a look at some of the applications you might have on your digital devices.

TERMINOLOGY NOTE

The term *software* was once used for all non-hardware components of a computer. In this context, *software* referred to computer programs and to the data the programs used. It could also refer to any data that existed in digital format, such as documents or photos. Using today's terminology, however, the documents and photos you create are usually referred to as data files rather than as software.

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MUSIC SOFTWARE

What are the basic capabilities of music software?

Music software offers many ways to work with music, sound effects, and narration from your desktop, laptop, or handheld computer. The most popular music software capabilities are listed in Figure 3-1.

- Download music and other sound files
- Play music and sound files
- Create playlists
- Transfer music to handheld devices
- Convert audio CDs into digital music
- Record music and narrations
- Edit volume, speed, and quality of digital recordings
- Crop and mix recordings
- Stream radio music to your computer
- Identify songs playing on the radio
- Voice training

FIGURE 3-1

Music software may offer some, but not all, of these features. For example, some music software offers extensive playback features, but no way to make recordings. You might have to use more than one music software product to complete a project.

What's the most popular music software?

The premier music software, iTunes, can be used by anyone who wants to listen to digital music (Figure 3-2).

Software © 2012 Apple Inc. All rights reserved

FIGURE 3-2

iTunes helps you collect digital music and arrange it into playlists; you can also use it to pull music from audio CDs and convert it into a format supported by your portable media player.

If you want tools that allow you to record, edit, and mix digital audio, you can turn to **audio editing software**, also called recording or mixing software. Your operating system might supply audio editing software, such as Windows Sound Recorder, or you can download software, such as the ProStudio app or open source Audacity (Figure 3-3).

FIGURE 3-3

Audio editing software provides controls much like those on a DVD player. Menus offer additional digital editing features, such as speed control, volume adjustments, clipping, and mixing.

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VIDEO SOFTWARE

What do I need to work with video on my digital devices? The most popular video software plays movies on your computer or hand-held device. As with digital music, the source of videos is usually an online store such as iTunes or Netflix, or a video sharing site such as YouTube. Another popular video application is video editing software.

What can video editing software do? **Video editing software** provides a set of tools for creating video productions from raw footage. Professional versions are used by video production studios, whereas simpler, consumer-level software is designed for the casual user.

The popularity of video editing can be attributed to consumer-level video editing software, such as Windows Movie Maker and Apple iMovie, included with many new computers. Consumer-level video editing software provides a set of tools for video production tasks, such as these:

- Transfer footage from camera to computer hard disk
- Split video into smaller clips
- Rearrange clips
- Add still photos
- Add transitions between clips
- Add soundtracks
- Add titles and captions
- Add special effects
- Alter colors
- Zoom in and out
- Export in formats for e-mail, Web pages, or desktop viewing

Despite an impressive array of features, video editing software is relatively easy to use, as explained in Figure 3-4.

FIGURE 3-4

Video editing software helps you import a series of video clips from a camera or other video source, arrange the clips in the order of your choice, add transitions between clips, and add an audio track.

Can it produce discs for DVD players? After producing a video that plays on your computer, you might want to transfer it to a DVD that you can use in a standard DVD or Blu-ray player connected to a television or projector. **DVD authoring software** offers tools for creating DVDs with Hollywood-style menus. You can obtain this software as a standalone product or in a collection of video editing tools.

TRY IT!

Check the Web. What software would you use to create your own DVDs?

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GRAPHICS SOFTWARE

What kind of software do I need to work with drawings, photos, and other pictures? In computer lingo, the term **graphics** refers to any picture, drawing, sketch, photograph, image, or icon that appears on your computer screen. **Graphics software** is designed to help you create, manipulate, and print graphics.

Some graphics software products specialize in a particular type of graphic, while others allow you to work with multiple graphics formats. If you are really interested in working with graphics, you will undoubtedly end up using more than one graphics software product.

The graphics captured by digital cameras and smartphones can be best edited using paint or photo editing software (Figure 3-5). To create graphics from scratch, you can use drawing software, 3-D graphics software, or CAD software.

Paint software (sometimes called a raster graphics editor) provides a set of electronic pens, brushes, and paints for painting images on the screen. A simple program called Microsoft Paint is included with Windows. More sophisticated paint software products are also available. Many graphic artists, Web page designers, and illustrators use paint software as their primary computer-based graphics tool.

Photo editing software, such as Adobe Photoshop, includes features specially designed to fix poor-quality photos by modifying contrast and brightness, cropping out unwanted objects, and removing red eye. Photos can also be edited using paint software, but photo editing software commonly offers tools and wizards that simplify common photo editing tasks.

Drawing software provides a set of lines, shapes, and colors that can be assembled into diagrams, corporate logos, and schematics. The drawings created with tools such as Adobe Illustrator, CorelDRAW, and Autodesk SketchBook tend to have a flat cartoon-like quality, but they are very easy to modify and look good at just about any size. Figure 3-6 illustrates a typical set of tools provided by drawing software.

FIGURE 3-5

Use paint or photo editing software for working with images from digital cameras, smartphones, or scanners.

Phase4Photography/Shutterstock.com

TRY IT!

Suppose that you want to create a logo for your local softball team. What kind of graphics software would give you the most flexibility for using the final design on uniforms, Web sites, and printed materials?

- ❍ Paint software
- ❍ Photo editing software
- ❍ Drawing software

Software courtesy of Apache Software Foundation

FIGURE 3-6

Drawing software provides tools for creating and manipulating graphics.

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3-D graphics software provides a set of tools for creating wireframes that represent three-dimensional objects. A wireframe acts much like the framework for a pop-up tent. Just as you would construct the framework for the tent and then cover it with a nylon tent cover, 3-D graphics software can cover a wireframe object with surface texture and color to create a graphic of a 3-D object (Figure 3-7).

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FIGURE 3-7

3-D graphics software provides tools for creating a wireframe that represents a 3-D object. Some 3-D software specializes in engineering-style graphics, while other 3-D software specializes in figures.

CAD software (computer-aided design software) is a special type of 3-D graphics software designed for architects and engineers who use computers to create blueprints and product specifications. AutoCAD is one of the best-selling professional CAD products. TurboCAD is a low-cost favorite. Scaled-down versions of professional CAD software provide simplified tools for homeowners who want to redesign their kitchens, examine new landscaping options, or experiment with floor plans (Figure 3-8).

Courtesy of MIDASoft Inc.

FIGURE 3-8

CAD software is used extensively for architectural, engineering, and mechanical drawings.

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MAPPING AND LOCATION-BASED SOFTWARE

What are mapping applications? A **mapping application** displays satellite, aerial, or street maps used to locate places and get directions between two addresses. Google Maps is one of the most extensive mapping applications, and its core technology is the basis for many other mapping and location-based products (Figure 3-9).

Software © 2012 Google, Software © 2012 Apple Inc. All rights reserved

FIGURE 3-9

With Google Maps, you can view a street map, satellite image, or street view.

What is location-based software? **Location-based software** is able to access your current location and use it to show you the closest shops, restaurants, and theaters, as well as information about each location. Want to find the nearest ATM? Need turn-by-turn directions to the airport? Want to hook up with friends who are nearby? Would you like some user reviews about the Mexican restaurant you just spotted? There are location-based apps designed to answer those questions and more (Figure 3-10).

Location-based software is available for desktop, laptop, and handheld computers. Mobile devices can pinpoint your location using the built-in GPS (Global Positioning System) or by triangulating your distance from nearby cell towers. Desktop and laptop computers can determine your location based on your Internet service provider and nearby private computer networks.

Is it safe? When devices record your location, there is the possibility of abuse. Stay alert for devices and software applications that track your location. In some cases, you can turn tracking off temporarily or permanently. In other cases, tracking may not be under your control; you'll have to decide whether the service you receive from the device or software is worth relinquishing your privacy.

FIGURE 3-10

Yelp uses the GPS signal built into your mobile phone to pinpoint your position and offer suggestions for nearby restaurants, banks, museums, and other attractions.

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BUSINESS AND "NUMBER CRUNCHING" SOFTWARE

Do businesses use specialized software? *Business software* is a broad term that includes vertical and horizontal market software.

What is vertical market software? **Vertical market software** is designed to automate specialized tasks in a specific market or business. Examples include hospital patient management and billing software, construction industry job estimating software, and student record management. Today, almost every business has access to some type of specialized vertical market software designed to automate, streamline, or computerize key business activities.

What is horizontal market software? **Horizontal market software** is generic software that just about any kind of business can use. For example, many small and medium-size businesses use QuickBooks to keep track of income and expenses, pay bills, and track inventory.

Payroll software is another example of horizontal market software. Almost every business has employees and must maintain payroll records. No matter what type of business uses it, payroll software must collect similar data and make similar calculations to produce payroll checks and W-2 forms.

Accounting software and project management software are additional examples of horizontal market software. **Accounting software** helps a business keep track of the money flowing into and out of various accounts. **Project management software** is an important tool for planning large projects, scheduling project tasks, and tracking project costs.

How about other "number crunching" software? Businesses use a variety of "number crunching" software applications for planning and analysis. Spreadsheets, featured in Section B, are an important tool that can be used to create numeric models by simply entering values, labels, and formulas.

Statistical software is designed for analyzing large sets of data to discover relationships and patterns. Products such as IBM SPSS Statistics and StatSoft STATISTICA are helpful tools for summarizing survey results, test scores, sales data, experiment results, or population data. Most statistical software includes graphing capability so that you can display and explore your data visually.

Mathematical modeling software provides tools for solving a wide range of math, science, and engineering problems. Students, teachers, mathematicians, and engineers, in particular, appreciate how products such as Mathcad and Mathematica help them recognize patterns that can be difficult to identify in columns of numbers (Figure 3-11).

TRY IT!

Retail businesses use point-of-sale software systems to keep track of transactions at checkout registers. This software would be classified as:

- ❍ vertical market software
- ❍ horizontal market software
- ❍ project management software
- ❍ CAD software

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Courtesy of Wolfram Research

FIGURE 3-11

Mathematical modeling software helps you visualize complex formulas. Here the points from a sphere are graphed onto a plane to demonstrate the principles behind the Astronomical Clock of Prague.

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DESKTOP PUBLISHING SOFTWARE

What is desktop publishing software? **Desktop publishing software** (DTP software) takes word processing to the next level by providing professional tools for producing typeset-quality documents.

DTP software is available in consumer-level and professional-level versions. Adobe InDesign is the choice of professional layout artists, with Scribus and QuarkXPress as alternatives. Microsoft Publisher is an example of a consumer-level option.

How does DTP software differ from word processing software? The main difference is that word processing software is document-based, whereas DTP software is frame based. When you use word processing software, each page is basically one box into which you enter text and paste images. When the box becomes full, your software adds another page and the text flows onto it.

DTP software allows you to create a page using multiple frames; some frames can hold text, while other frames can hold titles, graphics, and tables. To achieve a pleasing layout, you can move, resize, and overlap frames. You can also link frames so that text flows seamlessly from one frame to another on the same page or over to a different page. Because this software maximizes the flexibility for placing elements on a page, it is sometimes referred to as page layout software.

Do I need DTP software? Today's word processing software provides an adequate feature set for the document production needs of most individuals.

DTP software is usually used in a production environment for publishing paperback and hardcover books. In a typical production environment, an author uses word processing software to create a document, edit it, and check spelling. The electronic version of the document then goes to a desktop publishing technician who imports the document into desktop publishing software, where the text can be formatted into columns and linked to flow from one page to another (Figure 3-12).

3

TRY IT!

How many frames are used in the layout of the Launching page shown in Figure 3-12?

- ❍ 1
- ❍ 3
- ❍ 5
- ❍ 7

Software © 2012 Adobe Systems Incorporated. All rights reserved

FIGURE 3-12

DTP frames give you exact control over the position of text and graphical elements on a page. Want to see how desktop publishing software works? Start the tour for this figure in your interactive eBook.

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PERSONAL FINANCE SOFTWARE

What software is available for managing my money?

Money management software offers a variety of tools for tracking cash flow and investments. In this software category, **personal finance software**, such as Intuit Quicken, is designed to keep track of income, expenses, assets, and liabilities using a simple checkbook-like user interface. Options for handhelds include Checkbook HD and PocketMoney.

Personal finance software also automates routine tasks, such as budgeting, investing, check writing, and bill paying. Many personal financial software products provide direct links to online banking services, so you can use them to check account balances, transfer funds, and pay bills.

Personal finance software produces reports and graphs that show you where your money goes. For example, you can analyze various aspects of your cash flow, such as how much you spent on entertainment last month and how that compares to previous months (Figure 3-13).

Software © 2012 Intuit, Inc. All rights reserved

FIGURE 3-13

Personal finance software offers lots of tools to help you get a handle on the money that comes in and goes out.

Tax preparation software is a specialized type of personal finance software designed to help you gather your annual income and expense data, identify deductions, and calculate tax payments. Popular products, such as Intuit TurboTax, even accept data directly from personal finance software to eliminate hours of tedious data entry.

When using tax preparation software, make sure you have the current version and updates. Tax laws are constantly changing; you don't want to miss out on any changes that let you keep more of the money you earn. Before submitting your return, proofread it to make sure the numbers make sense.

Your tax preparation software includes a feature that files your return electronically. That option not only eliminates paper forms and the late night trip to the post office on April 15, but it speeds up your refund, too.

TRY IT!

Check the IRS Web site for information on e-file. What is the name of the software that individuals can use to file their U.S. tax returns online?

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UTILITY SOFTWARE

What is utility software? A type of system software called **utility software** is designed to help you monitor and configure settings for your digital gear, its operating system, or application software.

Like all system software, utilities focus on computer-centric tasks such as blocking viruses or diagnosing hard disk errors, rather than real-world tasks such as document production or accounting.

A set of basic utilities is included with your device's operating system. Your iPhone utilities are accessed from the Settings icon. With a Mac, click the Apple icon and select System Preferences (Figure 3-14):

Software © 2012 Apple Inc. All rights reserved

FIGURE 3-14

Mac utilities are listed in the System Preferences window.

In Windows, all the utilities supplied by Microsoft can be accessed from the Control Panel. To open the Control Panel from the Start screen, type "Control" and then click the Control Panel option (Figure 3-15).

FIGURE 3-15

Windows utilities are listed in the Control Panel. To easily find a utility, set the view to Large icons.

TRY IT!

The following are bundled with the Windows operating system, but which one would NOT be considered a utility?

- ❍ Disk Defragmenter
- ❍ Paint
- ❍ Sync Center
- ❍ Power Options

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What are must-have utilities? Third-party software companies offer additional products that extend and improve upon those supplied by the operating system. You can download these products from the Web or from an app store. A PDF reader, such as Adobe Reader, is an essential utility that displays documents stored in standard PDF files. **PDF** (Portable Document Format) is a standard format for exchanging files, so most people will assume that your computer has PDF capability (Figure 3-16).

Software © 2012 Adobe Systems Incorporated. All rights reserved

FIGURE 3-16

Documents from expensive DTP software and other applications can be output in PDF format. You don't have to own the DTP software to view these documents; you can simply open them using a PDF reader.

How about adaptive utilities? Computers offer opportunities for individuals with physical challenges. **Adaptive utilities** alter a device's user interface to create an accessible environment by providing closed captions, text-to-speech, speech-to-text, or large screen text. These capabilities are usually included with operating system utilities.

Individuals who cannot read the screen have the biggest challenge when it comes to computers. Screen readers that narrate the text displayed on a computer screen offer only rudimentary accessibility. Imagine the jumble of text, advertising, and sidebars displayed on a typical Web page; making sense out of a narrated version of that chaos is not easy.

Touchscreen capabilities, combined with screen readers, are a next step toward better accessibility. For example, the iPhone includes an accessibility feature for people who can't see the screen (Figure 3-17).

FIGURE 3-17

The iPhone Accessibility screen includes a VoiceOver option that speaks a description of anything you touch on the screen.

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What else? Another popular category of utility software is **system utilities** that can track down and fix disk errors, repair corrupted files, and give your device a performance-enhancing tune-up.

System utilities for handheld computers include apps such as System Activity Monitor, which displays memory usage, available storage space, CPU usage, Wi-Fi and cellular addresses, and battery level. Similar utilities for desktops and laptops include TuneUp Utilities, System Mechanic, and Advanced System Optimizer.

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DEVICE DRIVERS

What is a device driver? A **device driver** is software that helps a peripheral device establish communication with a computer. This type of system software is used by printers, monitors, graphics cards, sound cards, network cards, modems, storage devices, mice, and scanners. Once installed, a device driver automatically starts when it is needed. Device drivers usually run in the background, without opening a window on the screen.

Suppose you connect a new printer to your computer. You might also have to install a printer driver or select a preinstalled driver. After the device driver is installed, it runs in the background to send data to the printer whenever you initiate a print job. The printer driver signals you only if it runs into a problem, such as if the printer is not connected or it runs out of paper.

On a Mac, you can click the Apple icon, select About this Mac, and then select More info to look at a list of devices connected to your computer. By selecting a device, you can view information about it, including the driver version number. Check the manufacturer's Web site to find out if your version is current.

On a PC, if you need to update a device driver or change its settings, you can usually view driver information by accessing the Control Panel and selecting System (or System and Security). Then use the Device Manager option to view a list of your computer system hardware and corresponding device drivers, as shown in Figure 3-18.

FIGURE 3-18

The Windows Device Manager offers access to device drivers. You can check if they are working and change settings. You can also check the device driver's version number and compare it with the most recent version posted online.

TRY IT!

System software includes all of the following EXCEPT:

- device drivers
- adaptive utilities
- system utilities
- DTP software

QuickCheck

SECTION A

1. The category of software that is designed for computer-centric tasks is _____ software.
2. _____ software helps you carry out tasks such as creating documents, editing graphics, and locating nearby restaurants.
3. _____ market software is designed to automate specialized business tasks, such as hospital billing.
4. System _____ software can help you track down and fix disk errors, repair corrupted files, and improve device performance.
5. A(n) _____ driver is designed to help a peripheral device establish communication with a computer.

CHECK ANSWERS

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Office Suites

SECTION **B**

OFFICE SUITES, such as Microsoft Office and Google Docs, are popular with individual computer owners and in business environments. They are sometimes referred to as **productivity software** because they offer features that really help get work done. Section B highlights productivity software applications in office suites.

OFFICE SUITE BASICS

What is an office suite? An **office suite** is a collection of programs that typically include word processing, spreadsheet, presentation, and database modules. Suites may also include e-mail and contact managers, calendars, project management, and drawing modules.

In the context of office suites, the term **module** refers to a component, such as a word processing module. Modules can be run as individual programs, but all of the modules in an office suite have a standard set of controls, making it easy to transfer your expertise on one module to the others.

What are the most popular office suites? Popular office suites include Google Docs, iWork, LibreOffice, Microsoft Office, Microsoft Office 365, and Zoho Office Suite (Figure 3-19).

FIGURE 3-19

Popular office suites contain a similar set of modules.

Name	Modules	Platform
Google Docs	Word processing, spreadsheet, presentation	Online (Free)
iWork	Word processing, spreadsheet, presentation	Mac ($$)
LibreOffice	Word processing, spreadsheet, presentation, database, drawing	Windows, Mac, Linux (Free)
Microsoft Office	Word processing, spreadsheet, presentation, database, mail/calendar	Windows, Mac, Linux ($$)
Microsoft Office 365	Word processing, spreadsheet, presentation	Online (Free)
Zoho Office Suite	Word processing, spreadsheet, presentation, calendar, and more	Online (Free)

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WORD PROCESSING

How can my computer help me with my writing? Whether you are writing a ten-page paper, generating software documentation, designing a brochure for your new startup company, or writing a dissertation, you will probably use the word processing module of an office suite.

Word processing software has replaced typewriters for producing many types of documents, including reports, letters, memos, papers, and book manuscripts. Word processing packages, such as Microsoft Word, iWork Pages, and LibreOffice Writer, give you the ability to create, spell-check, edit, and format a document on the screen before you commit it to paper.

A typical word processor window displays a work area, called a workspace, that represents a blank piece of paper. The window also includes controls for viewing and formatting the document (Figure 3-20).

FIGURE 3-20

No matter which word processor you use, it includes elements similar to those shown in this Microsoft Word example.

How does word processing software help me turn my ideas into sentences and paragraphs? Word processing software makes it easy to let your ideas flow because it automatically handles many tasks that might otherwise distract you. For example, you don't need to worry about fitting words within the margins. A feature called **word wrap** determines how your text flows from line to line by automatically moving words down to the next line as you reach the right margin.

Imagine that the sentences in your document are ribbons of text; word wrap bends the ribbons. Changing the margin size just means bending the ribbon in different places. Even after you type an entire document, adjusting the size of your right, left, top, and bottom margins is simple.

Can word processing software help me break bad writing habits? You can use the **Search and Replace** feature to hunt down mistakes that you habitually make in your writing. For example, if you tend to overuse the word *typically*, you can use Search and Replace to find each occurrence of *typically*, and then decide whether you should substitute a different word, such as *usually* or *ordinarily*.

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Can word processing software improve my writing?

Because word processing software tends to focus on the writing process, it offers several features that can improve the quality of your writing.

Your word processing software is likely to include a **thesaurus**, which can help you find a synonym for a word so that you can make your writing more varied and interesting. A **grammar checker** reads through your document and points out potential grammatical trouble spots, such as incomplete sentences, run-on sentences, and verbs that don't agree with nouns.

Your word processing software might also be able to analyze the reading level of your document using a standard **readability formula**, such as the Flesch-Kincaid reading level. You can use this analysis to find out if your writing matches your target audience, based on sentence length and vocabulary.

Most word processing software includes a **spelling checker** that marks misspelled words in a document. You can easily correct a misspelled word as you type, or you can run the spelling checker when you finish entering all the text. Some software even has autocorrecting capability as you type that automatically changes a typo, such as *teh*, to the correct spelling (*the*).

Although your software's spelling checker helps you correct misspellings, it cannot guarantee an error-free document. A spelling checker works by comparing each word from your document to a list of correctly spelled words stored in a data file called a **spelling dictionary**. If the word from your document is in the dictionary, the spelling checker considers the word correctly spelled. If the word is not in the dictionary, the word is counted as misspelled.

Spelling checkers can't tell if you misuse a word, such as if you use the phrase *pear of shoes* instead of *pair of shoes*. Also, spelling checkers flag many proper nouns and scientific, medical, and technical words because they are not included in the spelling checker's dictionary. Make sure you proofread, even after using a spelling checker (Figure 3-21).

TRY IT!

You can depend on your word processor's spelling checker to:

- ❍ flag words that are not in its dictionary
- ❍ catch all your misspellings
- ❍ identify words that you misuse
- ❍ correct grammar errors

FIGURE 3-21

Word processing software can check your spelling and grammar. ▶ Refer to your interactive eBook for an overview of using your word processor's thesaurus, spelling checker, grammar checker, and readability statistics.

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How do I get my documents to look good? The term **document formatting** refers to the way that all the elements of a document—text, pictures, titles, and page numbers—are arranged on the page.

The final format of your document depends on how and where you intend to use it. A school paper, for example, simply needs to be printed in standard paragraph format—perhaps double spaced and with numbered pages. A brochure, newsletter, or corporate report, on the other hand, might require more ambitious formatting, such as columns, headers, and graphics.

The look of your final document depends on several formatting factors, such as page layout, paragraph style, and font.

- **Page layout** refers to the physical position of each element on a page. In addition to paragraphs of text, these elements might include margins, page numbers, **header** text that you specify to automatically appear in the top margin of every page, and **footer** text that you specify to automatically appear in the bottom margin of every page.
- **Paragraph style** includes the alignment of text within the margins and the space between each line of text. The spacing between lines of text is called **leading** (pronounced "LED ding"). Most documents are single spaced or double spaced, but you can adjust line spacing in 1 pt. increments. **Paragraph alignment** refers to the horizontal position of text—whether it is aligned at the left margin, aligned at the right margin, or **fully justified** so that the text is aligned evenly on both the right and left margins (Figure 3-22).
- A **font** is a set of letters that share a unified design. Font size is measured as **point size**, abbreviated pt. One point is about 1/72 of an inch.

Instead of individually selecting font and paragraph style elements, word processing software allows you to select a **style** that lets you apply several font and paragraph characteristics with a single click (Figure 3-23).

FIGURE 3-22

Your document looks more formal if it is fully justified than if it has an uneven, ragged-right margin.

The study in question produced results that appear consistent with the findings from earlier research, with the exception of Miller and Candlewood's classic experiment with digital and genetic markers.

Fully justified text

Once upon a time, very long ago, a motley crew of pirates sailed into a sheltered Caribbean harbor ringed with jagged rocks and scrubby vegetation.

Left-aligned text

FIGURE 3-23

In this document, headings were formatted by selecting a style with a single click instead of individually selecting a font color, font size, and font style. Now if the Heading style is changed to green, for example, all the headings will automatically change from black to green. Your interactive eBook walks you through the process of defining and using styles.

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SPREADSHEETS

What is a spreadsheet? A **spreadsheet** uses rows and columns of numbers to create a model or representation of a real situation. For example, your bank statement is a type of spreadsheet because it is a numerical representation of cash flowing into and out of your bank account.

Spreadsheet software, such as Microsoft Excel, iWork Numbers, Google Docs Spreadsheets, or LibreOffice Calc, provides tools to create electronic spreadsheets. It is similar to a smart piece of paper that automatically adds up columns of numbers written on it.

You can make other calculations, too, based on simple equations that you create or more complex, built-in formulas. As an added bonus, spreadsheet software can turn your data into colorful graphs. It also includes special data-handling features that allow you to sort data, search for data that meets specific criteria, and print reports.

Spreadsheet software was initially popular with accountants who dealt with paper-based spreadsheets, but found the electronic version far easier to use and less prone to errors than manual calculations. Other people soon discovered the benefits of spreadsheets for projects that require repetitive calculations, such as budgeting, computing grades, tracking investments, calculating loan payments, and estimating project costs.

Because it is so easy to experiment with different numbers, spreadsheet software is particularly useful for **what-if analysis**. You can use what-if analyses to answer questions such as "What if I get an A on my next two economics exams? But what if I get only Bs?" or "What if I invest $100 a month in my retirement plan? But what if I invest $200 a month?"

TRY IT!

Is the worksheet in Figure 3-24 an example of a what-if analysis?

❍ Yes

❍ No

What does a computerized spreadsheet look like? You use spreadsheet software to create an on-screen **worksheet**. A worksheet is based on a grid of columns and rows. Each **cell** in the grid can contain a value, label, or formula. A **value** is a number that you want to use in a calculation. A **label** is any text used to describe data (Figure 3-24).

FIGURE 3-24

In a worksheet, each column is lettered and each row is numbered. The intersection of a column and a row is called a cell. Each cell has a unique cell reference, or address, derived from its column and row location. For example, A1 is the cell reference for the upper-left cell in a worksheet because it is in column A and row 1. You can designate the active cell by clicking it. Once a cell is active, you can enter data into it.

Click for an overview of spreadsheet software.

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Are there formatting options? You can format the labels and values on a worksheet in much the same way as you would format text in a word processing document. You can change fonts and font size, select a font color, and select font styles, such as bold, italics, and underline.

How does spreadsheet software work? The values contained in a cell can be manipulated by formulas placed in other cells. A **formula** works behind the scenes to tell the computer how to use the contents of cells in calculations. You can enter a simple formula in a cell to add, subtract, multiply, or divide numbers. More complex formulas can be designed to perform just about any calculation you can imagine. Figure 3-25 illustrates how a formula might be used in a simple spreadsheet to calculate savings.

FIGURE 3-25

When a cell contains a formula, it displays the result of the formula rather than the formula itself. To view and edit the formula, you use the Formula bar. You can think of the formula as working behind the scenes to perform calculations and then to display the result. Why is it important to use a formula such as =B4-B5 instead of a formula with the actual numbers? To find out, start the tour for this figure in your interactive eBook.

A formula, such as =D4-D5+((D8/B2)*110), can contain **cell references** (like D4 and D5), numbers (like 110), and **mathematical operators**, such as the multiplication symbol (*), the division symbol (/), the addition symbol, and the subtraction symbol. Parts of a formula can be enclosed in parentheses to indicate the order in which the mathematical operations should be performed. The operation in the innermost set of parentheses—in this case, (D8/B2)—should be performed first.

You can enter a formula from scratch by typing it into a cell, or you can use a built-in preset formula called a **function**, provided by the spreadsheet software. To use a function, you simply select one from a list, as shown in Figure 3-26, and then indicate the cell references of any values you want to include in the calculation.

FIGURE 3-26

Functions are special formulas provided by spreadsheet software.

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What happens when I modify a worksheet? When you change the contents of any cell in a worksheet, all the formulas are recalculated. This **automatic recalculation** feature ensures that the results in every cell are accurate for the information currently entered in the worksheet.

Your worksheet is also automatically updated to reflect any rows or columns that you add, delete, or copy within the worksheet. Unless you specify otherwise, a cell reference is a **relative reference**—that is, a reference that can change from B4 to B3, for example, if row 3 is deleted and all the data moves up one row.

If you don't want a cell reference to change, you can use an absolute reference. An **absolute reference** never changes when you insert rows, or copy or move formulas. Understanding when to use absolute references is one of the key aspects of developing spreadsheet design expertise. Figure 3-27 and its associated tour provide additional information about relative and absolute references.

FIGURE 3-27

As shown in the examples, a relative reference within a formula can change when you change the sequence of a worksheet's rows and columns. An absolute reference is anchored so that it always refers to a specific cell. For some dynamic examples of absolute and relative references, watch the tour for this figure in your digital textbook.

How will I know which formulas and functions to use when I create a worksheet? To create an effective and accurate worksheet, you must understand the calculations and formulas that are involved. If, for example, you want to create a worksheet that calculates your final grade in a course, you need to know the grading scale and understand how your instructor plans to weight each assignment and test.

Most spreadsheet software includes a few templates or wizards for predesigned worksheets, such as invoices, income-expense reports, balance sheets, and loan payment schedules. Additional templates are available on the Web. These templates are designed by professionals and contain all the necessary labels and formulas. To use a template, you simply plug in the values for your calculation.

TRY IT!

In Figure 3-27, the formula in cell B5 is =B3-B4. Are B3 and B4 relative references or absolute references?

❍ Relative

❍ Absolute

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DATABASES

What is a database? The term *database* has evolved from a specialized technical term into a part of our everyday vocabulary. In the context of modern usage, a **database** is simply a collection of data that is stored on one or more computers.

A database can contain any sort of data, such as a university's student records, a library's card catalog, a store's inventory, an individual's address book, or a utility company's customers. Databases can be stored on personal computers, network servers, Web servers, mainframes, and even handheld computers.

What is database software? **Database software** helps you enter, find, organize, update, and report information stored in a database. Microsoft Access, FileMaker Pro, and LibreOffice Base are three examples of popular database software for personal computers. Oracle and MySQL are popular server database software packages.

TERMINOLOGY NOTE

Database software is also referred to as database management software (DBMS).

How does a database store data? Database software stores data as a series of records, which are composed of fields that hold data. A **record** holds data for a single entity—a person, place, thing, or event. A **field** holds one item of data relevant to a record. You can envision a record as a Rolodex card or an index card. A series of records is often presented as a table arranged in rows and columns (Figure 3-28).

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FIGURE 3-28

A single database record is similar to a Rolodex card or an index card. A series of records is usually depicted in table format.

A series of records in table format

Song Title	Performer	Composer	Album	Date	Label	Length
Take It Back	Norah Jones	Jones	Little Broken Hearts	05/01/2012	Blue Note	4:05
Even Though	Norah Jones	Jones and Harris	The Fall	11/17/2009	Blue Note	3:52
Summertime	Janis Joplin	Gershwin	Cheap Thrills	08/12/1968	Columbia	4:00
Summertime	Sarah Vaughan	Gershwin	Compact Jazz	06/22/1987	PolyGram	4:34

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Can a database hold different kinds of records? Some database software provides tools to work with more than one collection of records, as long as the records are somehow related to each other.

For example, suppose MTV maintains a database pertaining to jazz music. One series of database records might contain data about jazz songs. It could contain fields such as song title, performer, and length. Another series of records might contain biographical data about jazz performers, including the performer's name, birth date, and hometown. It might even include a field for the performer's photo.

These two sets of records can be related by the name of the performing artist, as shown in Figure 3-29.

TRY IT!

Figure 3-28 shows a table of jazz performers and a table of jazz songs. How many databases do these tables represent?

- ❍ 1
- ❍ 2
- ❍ 4
- ❍ 8

JAZZ PERFORMERS Performer	Birth Date	Hometown
Ella Fitzgerald	04/25/1917	Newport News, VA
Norah Jones	03/30/1979	New York, NY
Billie Holiday	04/07/1915	Baltimore, MD
Lena Horne	06/30/1917	Brooklyn, NY

JAZZ SONGS Song Title	Performer	Composer	Album	Date	Label	Length
Take It Back	Norah Jones	Jones	Little Broken Hearts	05/01/2012	Blue Note	4:05
Even Though	Norah Jones	Jones and Harris	The Fall	11/17/2009	Blue Note	3:52
Summertime	Janis Joplin	Gershwin	Cheap Thrills	08/12/1968	Columbia	4:00
Summertime	Sarah Vaughan	Gershwin	Compact Jazz	06/22/1987	PolyGram	4:34

FIGURE 3-29

The two sets of records are related by the Performer field. The relationship allows you to select Norah Jones from the Jazz Performers table and locate two of her songs in the Jazz Songs table.

How do I create a database? Database software provides the tools you need to define fields for a series of records. Figure 3-30 shows a simple form you might use to specify the fields for a database.

FIGURE 3-30

Database software provides tools for specifying fields for a series of records. Your interactive eBook shows you how to use database software to create a handy household database.

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When can I enter data? After you've defined fields for a series of records, you can enter the data for each record. Your database software provides a simple-to-use data entry form that allows you to easily fill in the data for each field.

Instead of typing data into a database, you can also import data from a commercial database, such as a customer mailing list. You can even download databases from the Web, and then import the data into fields you have defined with your database software.

How do I locate specific data? Many databases contain hundreds or thousands of records. If you want to find a particular record or a group of records, scrolling through every record would take a very long time. Instead, you can enter a **query** that describes the information you want to find. Queries can take several forms:

- A **query language**, such as SQL (Structured Query Language), provides a set of commands for locating and manipulating data. To locate all performances of *Summertime* before 1990 from a Jazz Songs database, you might enter a query such as:

  Select * from JazzSongs where SongTitle = 'Summertime' and Date < '1990'

- A **natural language query** is a question stated in a language such as English, rather than an esoteric query language.

  Who performed Summertime before 1990?

- A **keyword search**, popular with search engines such as Google, is simply a collection of words relevant to your search:

  Summertime song performer <1990

- A **query by example** (QBE) simply requires you to fill out a form with the type of data you want to locate. Figure 3-31 illustrates a query by example for *Summertime* performances before 1990.

How can I use database search results? Your database software can help you print reports, export data to other programs (such as to a spreadsheet where you can graph the data), convert the data to other formats (such as HTML so that you can post the data on the Web), and transmit data to other computers.

TRY IT!

What kind of query do most people use when searching for data on the Web?

- ❍ A query language
- ❍ A natural language query
- ❍ A keyword search
- ❍ A query by example

© MediaTechnics

FIGURE 3-31

When you query by example, your database software displays a blank form on the screen, and you enter examples of the data that you want to find.

Whether you print, import, copy, save, or transmit the data you find in databases, it is your responsibility to use it appropriately. Never introduce inaccurate information into a database.

Respect copyrights, giving credit to the person or organization that compiled the data. You should also respect the privacy of the people who are the subject of the data. Unless you have permission to do so, do not divulge names, Social Security numbers, or other identifying information that might compromise someone's privacy.

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PRESENTATIONS

What is presentation software? **Presentation software** supplies the tools for combining text, photos, clip art, graphs, animations, and sound into a series of electronic slides that can be shown on a computer screen or projector (Figure 3-32).

Popular presentation software products include Microsoft PowerPoint, iWork Keynote, LibreOffice Impress, and Google Docs Presentations.

What are the best features of presentation software? Presentation software highlights include:

- Bulleted lists to summarize the points in your presentation
- Graphics to make your presentation visually interesting
- Transitions between slides to keep your audience's attention
- Speaker notes to help you remember what to say
- Themes and templates to give your slides a professional appearance
- Conversion routines to package presentations as PDF files and YouTube videos

FIGURE 3-32

A computer-based presentation consists of a series of slides created with presentation software. Click to find out how to use presentation software.

QuickCheck

SECTION B

1. Word processing applications offer _____ style options including margins, leading, and alignment.
2. _____ software is useful for performing "what-if" analyses.
3. When entering formulas, you can use relative references and _____ references.
4. When using database software, you can search for data by entering a keyword or natural language _____.
5. Each database record is composed of many _____.

CHECK ANSWERS

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Installing Software and Upgrades

SECTION C

IT'S SURPRISING HOW QUICKLY your collection of software can grow as you discover new applications for school, work, and play. You can use some software without installing it, but other software has to be installed before you can use it. **Software installation** is the process of placing a program into a computer so that it can be run or executed. As you read Section C, you'll find out how to access and install software on desktops and laptops, as well as handheld computers. You'll also learn how to eliminate software you no longer need.

WEB APPS

What are Web apps? A **Web application** (or Web app) is software that is accessed with a Web browser. Instead of running locally, much of the program code for the software runs on a remote computer connected to the Internet or other computer network.

Web apps are examples of cloud computing. You might be familiar with some frequently used Web apps, such as Hotmail, Google Docs, and Turnitin, but there are thousands more.

Many Web apps are associated with consumer sites, such as the Color Visualizer at the Sherwin-Williams Web site that uses a photo of your house to help you select paint colors. Other Web apps, such as the XE Universal Currency Converter, have dedicated sites.

Remote computer Local computer Web browser

Software © 2012 Google Inc.

TRY IT!

In this diagram, which component runs a Web app?

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Do I have to install Web apps? Most Web apps require no installation at all on your local computer or handheld device. Your device must, however, have a Web browser and an Internet connection.

To access a Web app, simply go to its Web site. You might have to register before your first use, and then log in using your registered user name and password for subsequent visits (Figure 3-33).

Software © 2012 Google Inc.

FIGURE 3-33

Web apps, such as Google Docs, can be used for collaborative work. The document can be edited online by any of the people listed as collaborators. Take a quick tour of Google Docs.

What are the advantages and disadvantages of Web apps? Web apps are truly handy, but consider their advantages and disadvantages before entrusting them with your work:

- You can access Web apps from any device that has a browser and an Internet connection, including full-size computers, smartphones, tablet computers, and enhanced media players.
- Your data is usually stored on the app's Web site, so you can access data even when you are away from your main computer.
- Web apps are always up to date; you don't have to install updates because the latest version is the one posted at the Web site where you access the app.
- Web apps don't require local storage space, so you don't have to worry about them accumulating on your hard disk or SSD.
- Web apps tend to have fewer features than applications that require installation.
- If the site hosting the app shuts down, you will not be able to access the application or your data.
- Your data might be more vulnerable to exposure or loss because it is out of your control; make local backups, if possible.

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MOBILE APPS

What are mobile apps? A **mobile app** is designed for a handheld device, such as a smartphone, tablet computer, or enhanced media player. They are generally small, focused applications sold through an online app store. Many apps are free or cost less than US$5.00. There are lots of them, and they are fun (Figure 3-34)!

Software © 1996–2012, Amazon.com, Inc.

Software © 2012 YouTube, LLC

© iStockphoto.com/alxpin

FIGURE 3-34

Mobile apps range from simple utilities that turn the device into a flashlight, to more sophisticated apps for entertainment and learning.

How do mobile apps differ from Web apps? Most handheld devices can use both Web apps and mobile apps. The difference between the two is that Web apps run on a remote computer, whereas mobile apps run from the handheld device, so they have to be downloaded and installed. Games and entertainment seem to dominate mobile apps, whereas shopping and social apps dominate the Web apps category.

How do I install mobile apps? The first step is to head over to the app store for your device. iPhone, iPad, and iPod Touch owners can find apps for their devices at the online Apple App Store; Droid owners can go to the Android Market. Most handheld devices have an icon that takes you directly to the app store for your device's platform.

At the app store, select an app and pay for it, if necessary. Touching the Download button retrieves the file and installs it automatically. The installation process places the app's program file on the storage device and creates an icon that you can use to launch the app (Figure 3-35).

What is jailbreaking? iPads, iPhones, and iPods are only allowed to download apps from the official iTunes App Store. Apps are available from other sources, but using them requires an unauthorized change to the device's software called a **jailbreak**.

Software that helps you jailbreak a device is available from several Web sites. After downloading and installing the jailbreak software, your device will be able to install apps from a variety of sources other than the iTunes App Store.

The jailbreak lasts until you accept a software update from Apple. Updates wipe out the jailbreak software, forcing you to reinstall it.

Can I jailbreak an Android device? Android phones are not limited to a single app store, so there is no need to jailbreak them to access more apps. There are various ways to make unauthorized modifications to any mobile device to overcome limitations imposed by mobile service providers. The process is called **rooting**, but most consumers have no need to root their mobile devices.

FIGURE 3-35

Once an app is downloaded, an icon automatically appears on the start screen. You can start the app by touching the icon. Some apps require an Internet connection to run.

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LOCAL APPLICATIONS

How do local applications work? Local applications are installed on a computer's hard disk. When you install a local application, all of its files are placed in the appropriate folders on your computer's hard disk, and then your computer performs any software or hardware configurations necessary to make sure the program is ready to run.

What's included in a typical software package? The main component of a software package is an **executable file** designed to be started by users or automatically launched by the operating system.

On PCs, these programs are sometimes referred to as EXE files (pronounced "E-X-E") because of the .exe file extension appended to the program name. For example, the main executable file for Microsoft Word would be called Word.exe.

For Macs, the executable program usually has an .app file extension. Microsoft Word running on a Mac would be called Word.app.

Are there additional files? Many Mac applications consist of a single application file. Other Mac applications require more than one file.

Most applications for PCs consist of multiple files. Additional files contain support modules called "application extensions," data files, and text files as shown in Figure 3-36.

Are all the software files installed in the same folder? Most executable files and data files for new software are placed in the folder you specify. Some support programs for the software, however, might be stored in other folders. The location for these files is determined by the software installation routine.

The process of installing software on PCs often sprinkles files in various folders, including the System folder, where they can be shared with other programs. This technique complicates the process of locating all the files associated with an application that you want to delete because they are not all in one place. You'll learn more about this topic later in the chapter.

FIGURE 3-36

Blender is an example of software installed on a PC that requires executable, support, and data files.

TRY IT!

In Figure 3-36, how many executable files were installed for the Blender software?

- ❍ 1
- ❍ 2
- ❍ 3
- ❍ 22

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How do I install software on a Mac? Mac software is easy to install. Downloads are ordinarily supplied as .dmg files, commonly referred to as "disk images." When you download software from the Apple App Store, the software's .dmg file is installed automatically, just like installing apps for your mobile device.

Software downloaded from other sources often requires a manual step or two. You might have to open the .dmg file from the Downloads folder and then drag it to your Applications folder as shown in Figure 3-37.

Software © 2012 Apple Inc. All rights reserved

FIGURE 3-37

If a Mac download doesn't automatically install, you can manually drag the program icon to the Applications folder. Use your interactive eBook to see how it works.

How do I access Mac software after it is installed? On a Mac, you can access most software from the Launchpad at the bottom of the screen. Clicking an icon tells the computer to start the .app executable file. You can drag an icon from the Launchpad to the Dock if you use it frequently (Figure 3-38).

Software © 2012 Apple Inc. All rights reserved

FIGURE 3-38

After an application is installed, you can start it from the Launchpad.

TRY IT!

Mac users should be able to identify executable and disk image files. On a Mac, software downloads are usually packaged as:

- .app files
- .exe files
- .dmg files
- .dwl files

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What about installing software on PCs? Software for PCs contains a **setup program** that guides you through the installation process. The setup program makes installation easy because it handles a variety of behind-the-scenes technical details. During the installation process, the setup program usually performs the following activities:

- Copies application files from distribution media (CDs or DVDs) or downloads files to specified folders on the hard disk
- Reconstitutes files that have been distributed in compressed format
- Analyzes the computer's resources, such as processor speed, RAM capacity, and hard disk capacity, to verify that they meet or exceed the minimum system requirements
- Analyzes hardware components and peripheral devices to select appropriate device drivers
- Looks for any system files and players, such as Internet Explorer or Windows Media Player, that are required to run the program but are not supplied on the distribution media or download
- Updates necessary system files, such as the Windows Registry and the Windows 7 Start menu, with information about the new software
- Places an icon for the new software on the Windows desktop or the Windows 8 Start screen (Figure 3-39)

TERMINOLOGY NOTE

The Windows Registry is a database that keeps track of your computer's peripheral devices, software, preferences, and settings. You'll learn more about the Registry in the operating system chapter. The important concept to understand is that when you install software on a computer with the Windows operating system, information about the software is recorded in the Registry.

FIGURE 3-39

In Windows 7 (top), installed programs can be accessed from the Start menu or desktop icons. With Windows 8 (below), programs are displayed in tiles on the Start screen. Use your interactive eBook to take a tour of ways to start programs from Windows 7 and from the Start screen in Windows 8.

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How do I install PC applications from CDs and DVDs?

The process of installing a local application from distribution CDs or DVDs is very straightforward. You insert the CD or DVD and close the tray. A setup program should autostart and then guide you through the process of selecting the hard disk location for the program files and acknowledging the license agreement. Figure 3-40 shows what to expect when you use a setup program to install local applications from CDs or DVDs.

FIGURE 3-40

Installing from Distribution Media

1 Insert the first distribution CD or DVD. The setup program should start automatically. If it does not, look for a file called *Setup.exe* and then run it.

© MediaTechnics

2 Read the license agreement, if one is presented on the screen. By agreeing to the terms of the license, you can proceed with the installation.

3 Select the installation option that best meets your needs. If you select a full installation, the setup program copies all files and data from the distribution medium to the hard disk of your computer system. A full installation gives you access to all features of the software.

If you select a custom installation, the setup program displays a list of software features for your selection. After you select the features you want, the setup program copies only the selected program and data files to your hard disk. A custom installation can save space on your hard disk.

4 Follow the prompts provided by the setup program to specify a folder to hold the new software program. You can use the default folder specified by the setup program or a folder of your own choosing. You can also create a new folder during the setup process.

5 If the software includes multiple distribution CDs, insert each one in the specified drive when the setup program prompts you to do so.

6 When the setup is complete, start the program you just installed to make sure it works.

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How do I install downloaded Windows software? The installation process is slightly different for Windows software that you download. Usually all the files needed for the new software are **zipped** to consolidate them into one large file, which is compressed to decrease its size and reduce the download time. As part of the installation process, this downloaded file must be reconstituted, or **unzipped**, into the original collection of files.

It is a good idea to store original unzipped files for downloaded software on a CD or in a hard disk folder that you back up periodically. If your computer's hard drive malfunctions, you can use these files to reconstitute your software without having to download all of it again. Figure 3-41 maps out the process of downloading and installing local apps.

FIGURE 3-41
Installing Downloaded Software

1 At the distribution Web site, locate any information pertaining to installing the software. Read it. You might also want to print it.

2 Click the download link.

3 If you are downloading from a trusted site and have antivirus software running, click the Run button in the File Download dialog box.

4 Wait for the download to finish. Usually, the setup program included in the download starts automatically.

5 Use the setup program to specify a folder to hold the new software program. You can use the default folder specified by the setup program or a folder of your own choosing. You can also create a new folder during the setup process.

6 Wait for the setup program to uncompress the downloaded file and install the software in the selected directory. During this process, respond to the license agreement and other prompts. When the installation is complete, test the software to make sure it works.

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PORTABLE SOFTWARE

What is portable software? **Portable software** is designed to run from removable storage, such as a CD or USB flash drive. Program files are not installed on the hard disk, no configuration data is stored on the hard disk, and no entries need to be made in the Windows Registry. When the device containing the portable software is removed from the computer, no trace of it is left there.

The CD version of this textbook is an example of portable software. To use it, you simply insert the CD containing the program files. Other examples of portable applications include LibreOffice Portable, Thunderbird (e-mail), Firefox (browser), and FileZilla (upload and download), which are designed to run from USB flash drives.

How do I install portable software? Portable software is so simple to install that it is sometimes referred to as install-free software. Installation is simply a matter of getting program files to the media on which they are supposed to run. For example, suppose that you want to run LibreOffice Portable from a USB flash drive. You can download the LibreOffice Portable zip file and then simply unzip it so that the files end up on the USB flash drive (Figure 3-42).

Software © 2004–2012 Rare Ideas, LLC

Download the program files to your flash drive.

FIGURE 3-42

Portable software is designed so that you can simply copy files to a hard disk or flash drive and run the program without additional installation. Find out how to work with portable software from your USB flash drive.

TRY IT!

The key aspect of using portable software with a PC is:

- ❍ it runs from the hard disk
- ❍ it uses an easy setup program for installation
- ❍ it runs from the cloud
- ❍ it does not require an entry in the Windows Registry

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SOFTWARE UPGRADES AND UPDATES

What are updates, patches, and service packs? Periodically, software publishers replace older versions of a software product with a new version that's sometimes referred to as a **software upgrade**. To keep these upgrades straight, each one carries a version or revision number. For example, version 1.0 might be replaced by a newer version, such as version 2.0. Upgrading to a new version usually involves a fee, but it is usually less costly than purchasing the new version off the shelf.

A **software update** (sometimes called a software patch) is a small section of program code that replaces part of the software you currently have installed. The term **service pack**, which usually applies to operating system updates, is a set of updates. Updates and service packs are designed to correct problems and address security vulnerabilities. Software updates and service packs are usually free. They are typically numbered using decimal places; for example, an update might change version 2.0 to version 2.01.

How do I get updates? Many software applications allow you to set your preferences for how you would like to receive notifications and updates. You can periodically check for updates at the publisher's Web site, or use the software's Automatic Update option that downloads and installs updates without user intervention. The advantage of Automatic Update is convenience. The disadvantage is that changes can be made to your computer without your knowledge.

Most popular software can be configured to check the Web to see if an update is available and gives you the option of downloading and installing it (Figure 3-43).

FIGURE 3-43

If you prefer not to have software updates automatically installed, look for an option or preference that lets you choose which updates to install and decide when to install them. Work with the tour to find out how to manually launch updates.

When should I update or upgrade my software? It is always a good idea to install updates and service packs when they become available. The revised code they contain often addresses security vulnerabilities, and the sooner you patch up those holes, the better.

Version upgrades are a slightly different story. Many savvy computer owners wait to upgrade for a few weeks or months after new software versions become available. The reason they wait is to find out how other users like the new version. If Internet chatter indicates some major flaws, it can be prudent to wait until the publisher is able to address them with patches.

How do I install an upgrade? A new version upgrade usually installs in a similar way as you installed the original version: by activating a setup program, displaying a license agreement, and adding updated entries to your computer's Start menu. To combat piracy, many software publishers require users to enter a validation code to complete an upgrade.

TRY IT!

A service pack is most similar to:

- ❍ a software upgrade
- ❍ a software update
- ❍ a portable app
- ❍ a Web app

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UNINSTALLING SOFTWARE

How do I know what software is installed on my computer? Mac users can find a list of installed software by opening the Applications folder from the Dock. When working with a PC, there are several places you can look to see what software is installed. The All Programs menu lists most installed applications. A few applications might not appear on this list if they were installed in a non-standard way.

How do I get rid of software? The Windows operating system includes an **uninstall routine**, which deletes the software's files from various folders on your computer's hard disk. The uninstall routine helps you decide what to do with shared files that are used by more than one program. As a rule, you should leave the shared files in place.

The uninstall routine also removes references to the program from the desktop and from operating system files, such as the file system and the Windows Registry (Figure 3-44).

FIGURE 3-44

To make sure all files are properly deleted, always use the Uninstall utility when removing software from a PC. Make sure you know how to uninstall software by watching the tour for this figure in your interactive eBook.

What about uninstalling Mac software? Most Mac users simply use Finder to locate the program's .app file and move it to the trash. This process can leave some support files on the hard disk, however. Some Mac programs include a more thorough uninstall routine, which is usually listed in the Utilities folder.

QuickCheck

SECTION C

1. Most _____ applications require no installation and are accessed through a browser.
2. On a PC, a(n) _____ program guides you through the installation process.
3. Usually the files for downloaded software are _____ into one compressed file.
4. _____ software can be copied to a flash drive and run without additional installation.
5. A(n) _____ pack is a set of patches that correct problems and address security vulnerabilities.

CHECK ANSWERS

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Buying Software

SECTION D

SAVVY SOFTWARE SHOPPERS have a good sense of what to buy and where to find it. Section C offers some shopping tips for expanding the software accessible from your handheld or full-size computer. The section ends with a discussion of software copyrights—important information that will help you understand the difference between legal and illegal software use.

CONSUMER BASICS

What are the most essential applications and utilities to have on a handheld device? Most smartphones and other handheld computers include a basic set of apps including a calendar, clock, calculator, notepad, and browser, as well as e-mail. Your device might also supply social networking, photo, video, music, and game apps (Figure 3-45).

What about a full-size computer? In addition to an operating system, your desktop or laptop computer should have browser software, an e-mail client, word processing software, a security suite, a graphics viewer, and software that lets you burn files onto CDs and DVDs.

You will probably also want compression software that lets you shrink big graphics files before e-mailing them, graphics software for editing photos, and some type of diagnostic software for troubleshooting hardware and software problems. For entertainment, you might want music software, as well as a few computer games.

FIGURE 3-45

Just about every digital device includes a set of preinstalled applications.

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Should I use the apps and utilities that come with the operating system? Most operating systems include a handful of small applications and a good variety of useful utility software. You'll want to thoroughly explore what your operating system has to offer before you spend money on third-party software. Figure 3-46 contains a list of the most frequently used apps and utilities offered by the Microsoft Windows operating system.

Software	Function
Internet Explorer	Browse the Web
File Explorer	Keep track of files and folders; shrink file size
WordPad	Perform basic word processing
Notepad	Perform basic text editing
Calculator	Add, subtract, and calculate basic functions
Paint	Edit bitmap images, such as photos
Sound Recorder	Digitize music and voice input from a microphone
Windows Media Player	Play music and videos
File History	Make backups of hard disk files
Disk Defragmenter	Arrange data on hard disk for optimal efficiency
Windows Defender	Protect your computer from viruses and spyware
Windows Firewall	Block intrusion attempts
Magnifier and Narrator	Improve accessibility
Windows Photo Viewer	View digital photos

FIGURE 3-46

The Windows 8 operating system includes many useful applications and utilities. You can evaluate these offerings before considering whether to supplement them with third-party versions.

How do I know if an application will work on my device? If you're like the majority of digital device owners, you want more applications and utilities than those supplied out of the box. You can choose from any applications that are compatible with your device.

Most Web apps work on any device with a compatible browser. Mobile, local, and portable apps specify device requirements, such as model number, memory capacity, and storage space. **System requirements** specify the operating system and minimum hardware capacities necessary for a software product to work correctly (Figure 3-47).

FIGURE 3-47

System requirements can be found on the software box or on the download site.

System Requirements

Operating Systems: Windows 8/7/Vista/XP
Processor: Intel Pentium or Core or equivalent
Memory: 1 GB or more
Hard Disk Space: 50 MB for installation
Screen Resolution: 1024 x 768 or better
Internet Connection

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SOFTWARE COPYRIGHTS AND LICENSES

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A **copyright** is a form of legal protection that grants the author of an original work an exclusive right to copy, distribute, sell, and modify that work. Purchasers do not have this right except under the following special circumstances described by copyright laws:

- The purchaser has the right to copy software from distribution media or a Web site to a computer's hard disk in order to install it.
- The purchaser can make an extra, or backup, copy of the software in case the original copy becomes erased or damaged, unless the process of making the backup requires the purchaser to defeat a copy protection mechanism designed to prohibit copying.
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Can I tell if software is pirated? Software pirates are getting more and more aggressive, and pirated software is not always easy to identify. Some unsuspecting consumers have inadvertently obtained pirated software, even when paying full price from a reputable source. Widespread pirating of Microsoft products has led to preventive measures such as Certificates of Authenticity and expensive-to-duplicate holographic images on CD labels.

If you suspect that software is pirated, it is best not to buy it or install it. If you have questions about a product's authenticity, you can contact the Software & Information Industry Association (SIIA) or the legitimate software publisher. According to the SIIA, the following characteristics can help you spot pirated software:

- Software sold at Web sites for prices well below retail
- Software sold in a clear CD-ROM jewel case with no accompanying documentation, license, registration card, or Certificate of Authenticity
- Software marked as an "Academic" product, but not purchased through an authorized dealer
- Software marked as "OEM" or "For Distribution Only With New PC Hardware"
- Software marked "NFR" (not for resale)
- Software CD-ROMs with handwritten labels
- Backup discs that you receive from a computer retailer containing handwritten labels
- Poor graphics and coloring of labels, disc jackets, or documentation
- Multiple programs from many different publishers on a single CD-ROM (commonly referred to as compilation CDs)
- Software loaded on your PC by a computer retailer, with no manuals; when you request the original manual, the dealer responds by telling you to purchase a third-party book (e.g., *Photoshop for Dummies*)
- Photocopied manuals

TRY IT!

Suppose you download a free app for your smartphone and the main screen contains no copyright notice. What should you assume?

- ❍ The software is copyrighted
- ❍ The software is pirated
- ❍ The software has a virus
- ❍ The software is defective

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What is a software license? In addition to copyright protection, computer software is often protected by the terms of a software license. A **software license**, or license agreement, is a legal contract that defines the ways in which you may use a computer program.

Software licenses can impose additional restrictions on software use, or they can offer additional rights to consumers. For example, most software is distributed under a **single-user license** that limits use to one person at a time. However, some software publishers offer volume licenses for multiple users to schools, organizations, and businesses.

A **site license** is generally priced at a flat rate and allows software to be used on all computers at a specific location. A **multiple-user license** is priced per copy and allows the allocated number of copies to be used simultaneously.

Where is the license? For personal computer software, you can find the license on the outside of the package, on a separate card inside the package, on the CD packaging, in one of the program files, or at the software publisher's Web site.

Most legal contracts require signatures before the terms of the contract take effect. This requirement becomes unwieldy with software—imagine having to sign a license agreement and return it before you can use new software. To circumvent the signature requirement, software publishers use two techniques to validate a software license: shrink-wrap licenses and EULAs.

What is a shrink-wrap license? When you purchase boxed computer software, the distribution media are usually sealed in an envelope, a plastic box, or shrink wrapping. A **shrink-wrap license** goes into effect as soon as you open the packaging.

What is a EULA? A **EULA** (end-user license agreement) is displayed on the screen when you first install software. After reading the software license on the screen, you can indicate that you accept the terms of the license by clicking a designated button—usually labeled OK, I agree, or I accept. If you do not accept the terms, the software does not load and you will not be able to use it (Figure 3-48).

TRY IT!

Your school's computer lab has high-end architecture software that can be accessed from any lab computer, but a maximum of only five students can use it at any given time. What kind of license does it have?

- ❍ A single-user license
- ❍ A site license
- ❍ A multiple-user license
- ❍ A pirated license

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FIGURE 3-48

When you agree to the terms of an on-screen license agreement, you are essentially signing a contract to abide by the terms stated in the agreement.

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TRY IT!

Read the EULA and answer the following questions:

- ❍ Am I buying the software or licensing it?
- ❍ When does the license go into effect?
- ❍ Under what circumstances can I make copies?
- ❍ Can I loan the software?
- ❍ Can I sell the software?
- ❍ Does the software publisher provide a warranty?

Are all software licenses similar? From a legal perspective, there are two categories of software: public domain and proprietary. **Public domain software** is not protected by copyright because the copyright has expired, or the author has placed the program in the public domain, making it available without restriction. Public domain software may be freely copied, distributed, and even resold. The primary restriction on public domain software is that you are not allowed to apply for a copyright on it.

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How about free apps? Some commercial software is free. The next time you download a free app for your tablet or smartphone, take a look at the license agreement. Your use of the app is usually restricted to the device on which it was downloaded.

What is demoware? Some commercial software is available as a trial version, sometimes called demoware. **Demoware** is distributed for free and often comes preinstalled on new computers, but it is limited in some way until you pay for it.

Demoware publishers can use a variety of techniques to limit the software. It might remain functional for a set number of days before expiring and requiring payment. It might run for a limited amount of time—for example, 60 minutes—each time you launch it. Demoware could be configured so that you can run it for only a limited number of times. Or, key features, such as printing, might be disabled.

Demoware publishers usually take steps to prevent users from uninstalling and reinstalling the demo to circumvent time limitations. Users who want to unlock the full version of a demo can do so by following links to the software publisher's Web site and using a credit card to purchase a registration code. The software can then be restarted and used without further interruption after the registration code is entered.

Is shareware the same as demoware? The characteristics of shareware sound very similar to those of demoware. **Shareware** is copyrighted software marketed under a try-before-you-buy policy. It typically includes a license that permits you to use the software for a trial period. To use it beyond the trial period, you are supposed to pay a registration fee. Unlike feature- or time-limited demoware, shareware is supposed to be fully-functioning software.

Shareware was conceived as a low-cost marketing and distribution channel for independent programmers. A shareware license usually encourages you to make copies of the software and distribute them to others. Copying—considered a bad thing by commercial software publishers—can work to the advantage of shareware authors, but only if users pay for the product. Unfortunately, many shareware authors collect only a fraction of the money they deserve for their programming efforts.

Today, many shareware authors use demoware techniques to limit their programs until payment is received. The term *shareware* is used today to refer to programs distributed by independent programmers, whereas *demoware* tends to be used when referring to trial versions of software from big software firms, such as Microsoft, Adobe Systems, and Symantec.

TRY IT!

What is the main difference between shareware and demoware?

- ❍ Shareware is distributed by independent programmers
- ❍ Shareware is not copyrighted
- ❍ Shareware is free
- ❍ Shareware is distributed through app stores

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What is open source software? **Open source software** makes uncompiled program instructions—the source code—available to programmers who want to modify and improve the software. Open source software may be sold or distributed free of charge in compiled form, but it must, in every case, also include the source code.

Linux is an example of open source software, as are programs such as Blender and FileZilla. LibreOffice—a full-featured productivity suite—is another popular example of open source software. You can search for open source applications at the *sourceforge.net* Web site (Figure 3-49).

Despite the lack of restrictions on distribution and use, open source software is copyrighted and is not in the public domain. Many open source characteristics also apply to free software (not to be confused with freeware, which you are not supposed to modify or resell). Both open source and free software can be copied an unlimited number of times, distributed for free, sold, and modified.

The philosophies behind open source and free software are slightly different, but their licenses are really quite similar. Two of the most common open source and free software licenses are BSD and GPL. The **BSD license** originated as the Berkeley Software Distribution license for a UNIX-like operating system. The license is simple and short (Figure 3-50).

The **GPL** (General Public License) was developed for a free operating system called GNU. The GPL is slightly more restrictive than the BSD license because it requires derivative works to be licensed. That means if you get a really cool computer game that's licensed under a GPL and you modify the game to create a new level, you have to distribute your modification under the GPL. You cannot legally market your modification under a commercial software license. There are currently three versions of the GPL. Their differences are of interest primarily to software developers.

FIGURE 3-49

Open source and free software applications are plentiful. Click to find out how to participate in open source software development projects and download free open source software.

open source™

© 2006 by the Open Source Initiative

Software	Function
LibreOffice	Productivity
Thunderbird	E-mail
Firefox	Browser
GIMP	Graphics editing
Gallery	Photo viewer
Blender	3-D modeling and game design
Audacity	Sound editing and effects
7-Zip	Compression
FileZilla	FTP download

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FIGURE 3-50

The BSD license for open source software is short and easy to understand.

TRY IT!

The first clause of the BSD license permits what?

- ❍ Breaking copy protection
- ❍ Distribution of the source code
- ❍ Pirating
- ❍ Modifying the copyright

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What about freeware? **Freeware** is copyrighted software that—as you might expect—is available for free. It is fully functional and requires no payment for its use. A freeware license permits you to use the software, copy it, and give it away, but does not permit you to alter it or sell it. Many utility programs, most device drivers, and some games are available as freeware.

What if my software requires activation? **Product activation** is a means of protecting software from illegal copying by requiring users to enter a product key or activation code before the software can be used. Activation is usually part of the software installation process, but it can also occur when demoware times out. Failure to enter a valid code prohibits the program from launching. The information you enter is either checked against a database or used to create a hash value.

Checking an activation code against a database makes sure that the code you've entered has not been used before. If the code is a duplicate, the license for that copy of the software is being used by someone else and you will have to call customer service to straighten out the problem.

A **hash value** is a unique number derived from encoding one or more data sets, such as names, serial numbers, and validation codes. Product validation can create a hash value based on your validation code and your computer's internal serial number, effectively tying the software to use on one specific computer.

Validation codes are very important. You should keep a list of them in a safe place, along with other configuration information for your computer system.

Should a software license affect my purchase decision? Before purchasing software, make sure the license allows you to use the software the way you want to. If you plan to install the software on more than one computer or introduce modifications, make sure the license allows you to do so.

Some commercial software, such as security software, requires annual renewal. If you don't want to pay the fee every year, you might consider freeware or open source security software instead. Informed consumers tend to make better buying decisions. Just remember that many software programs exist and you can usually find alternatives with similar features offered under various licensing terms.

TRY IT!

The free apps you download from your mobile phone are:

- ❍ classified as freeware
- ❍ activated with a hash value
- ❍ designed to self-destruct if copied
- ❍ licensed as commercial software

3

QuickCheck

SECTION D

1. Before purchasing software, you should check the _____ requirements.
2. _____ law allows you to make an extra, or backup, copy of software as long as you do not defeat any copy protection mechanisms.
3. _____ licenses include site licenses and multiple-user licenses.
4. _____ that expires after a set period of time is often factory-installed on new computers.
5. LibreOffice, Firefox, and Linux are examples of _____ source software that can be legally modified and redistributed.

CHECK ANSWERS

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Security Software

SECTION E

THE DAYS WHEN VIRUSES were the greatest threat to computers are long gone. Today, a virus is just one of many categories of malicious software, or malware, that can wreak havoc on computer systems, networks, and even handheld devices. Section E explains how you can use security software to combat malicious software that threatens your computer.

SECURITY SOFTWARE BASICS

What is security software? **Security software** is designed to protect computers from various forms of destructive software and unauthorized intrusions. Security software can be classified into various types: antivirus, antispyware, anti-spam, and firewalls. Each type focuses on a specific security threat.

What devices are at risk? Windows computers have the highest risk of unwanted intrusions or contracting a virus, but any device that receives e-mail, accesses the Web, and runs apps is potentially vulnerable.

Apple computers and handheld devices are not targeted as often as Windows and Android devices, but the incidence of attacks is growing across all platforms. Jailbreaking or rooting a phone increases its vulnerability (Figure 3-51).

What are malware threats? The terms **malicious software** and **malware** refer to any computer program designed to surreptitiously enter a computer, gain unauthorized access to data, or disrupt normal processing operations. Malware includes viruses, worms, Trojans, bots, and spyware.

Malware is created and unleashed by individuals referred to as hackers, crackers, black hats, or cybercriminals. Some malware is released as a prank. Other malware is created to distribute political messages or to disrupt operations at specific companies.

In an increasing number of cases, malware is unleashed for monetary gain. Malware designed for identity theft or extortion has become a very real threat to individuals and corporations.

FIGURE 3-51

This smartphone's security was breached, letting a hacker surreptitiously record conversations.

Android is a trademark of Google Inc. © 2012 Google

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What is a virus? A **computer virus** is a set of program instructions that attaches itself to a file, reproduces itself, and spreads to other files. A common misconception is that viruses spread themselves from one computer to another. They don't. Viruses can replicate themselves only on the host computer.

A key characteristic of viruses is their ability to lurk in a computer for days or months, quietly replicating themselves. While this replication takes place, you might not even know that your computer has contracted a virus; therefore, it is easy to inadvertently spread infected files to other people's computers.

In addition to replicating itself, a virus usually delivers a payload, which can be as harmless as displaying an annoying message or as devastating as trashing the data on your computer's storage device. It can corrupt files, destroy data, or otherwise disrupt computer operations. A trigger event, such as a specific date, can unleash some viruses. Viruses that deliver their payloads on a specific date are sometimes referred to as time bombs. Viruses that deliver their payloads in response to some other system event are referred to as logic bombs.

Viruses spread when people exchange infected files on disks and CDs, as e-mail attachments, and on file sharing networks, social networking sites, and download sites.

What is a worm? A **computer worm** is a self-replicating program designed to carry out some unauthorized activity on a victim's computer. Worms can spread themselves from one computer to another without any assistance from victims.

Worms can enter a computer through security holes in browsers and operating systems, as e-mail attachments, and by victims clicking on infected pop-up ads or links contained in e-mails. For example, a mass-mailing worm called Ackantta is hidden in an attachment to an e-mail message that's a fake Twitter invitation. Clicking the attachment activates the worm.

A **mass-mailing worm** spreads by sending itself to every address in the address book of an infected computer. Your friends receive these messages and, thinking that they are from a trusted source, open the infected attachment, spreading the worm to their computers and on to their friends.

Although e-mail is currently the primary vehicle used to spread worms, hackers have also devised ways to spread worms over file sharing networks, instant messaging links, and mobile phones.

What is a Trojan horse? A **Trojan horse** (sometimes simply called a Trojan) is a computer program that seems to perform one function while actually doing something else. Unlike a worm, a Trojan is not designed to spread itself to other computers. Also differing from viruses and worms, most Trojans are not designed to replicate themselves. Trojans are standalone programs that masquerade as useful utilities or applications, which victims download and install unaware of their destructive nature.

Trojans are notorious for stealing passwords using a keylogger that records keystrokes as you log in to your computer and various online accounts. Another type of Trojan called a **Remote Access Trojan** (RAT) has backdoor capabilities that allow remote hackers to transmit files to victims' computers, search for data, run programs, and use a victim's computer as a relay station for breaking into other computers.

TERMINOLOGY NOTE

A spoofed address is one that is misleading or incorrect. In the case of e-mail, it is not the actual address of the person or computer that sent the e-mail message. Spoofed addresses make it difficult or impossible to trace mail back to the sender.

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What is a bot? Any software that can automate a task or autonomously execute a task when commanded to do so is called an intelligent agent. Because an intelligent agent behaves somewhat like a robot, it is often called a **bot**.

Good bots perform a variety of helpful tasks such as scanning the Web to assemble data for search engines like Google. Some bots offer online help, while others monitor online discussions for prohibited behavior and language. Bad bots, on the other hand, are controlled by hackers and designed for unauthorized or destructive tasks. They can be spread by worms or Trojans. Most bad bots are able to initiate communications with a central server on the Internet to receive instructions. A computer under the control of a bad bot is sometimes referred to as a **zombie** because it carries out instructions from a malicious leader.

Like a spider in its web, the person who controls many bot-infested computers can link them together into a network called a **botnet**. Experts have discovered botnets encompassing more than 1 million computers. Botmasters who control botnets use the combined computing power of their zombie legions for many types of nefarious tasks such as breaking into encrypted data, carrying out denial-of-service attacks against other computers, and sending out massive amounts of spam.

TRY IT!

Use a search engine such as Google to find the name of the world's largest botnet. How many computers did it infect?

TERMINOLOGY NOTE

A denial-of-service attack is designed to generate a lot of activity on a network by flooding its servers with useless traffic—enough traffic to overwhelm the server's processing capability and essentially bring all communications and services to a halt.

What is spyware? **Spyware** is a type of program that secretly gathers personal information without the victim's knowledge, usually for advertising and other commercial purposes. Once it is installed, spyware starts monitoring Web-surfing and purchasing behavior, and sends a summary back to one or more third parties. Just like Trojans, spyware can monitor keystrokes and relay passwords and credit card information to cybercriminals.

Spyware can get into a computer using exploits similar to those of Trojans. It can piggyback on seemingly legitimate freeware or shareware downloads. You can also inadvertently allow spyware into your computer by clicking innocuous but infected pop-up ads or surfing through seemingly valid and secure Web sites that have been compromised by hackers.

What does malware do? Once viruses, worms, bots, Trojans, and spyware enter your computer, they can carry out a variety of unauthorized activities, such as those listed in Figure 3-52.

FIGURE 3-52

Malware Activities

- Display irritating messages and pop-up ads
- Delete or modify your data
- Encrypt your data and demand ransom for the encryption key
- Upload or download unwanted files
- Log your keystrokes to steal your passwords and credit card numbers
- Propagate malware and spam to everyone in your e-mail address book or your instant messaging buddy list
- Disable your antivirus and firewall software
- Block access to specific Web sites and redirect your browser to infected Web sites
- Cause response time on your system to deteriorate
- Allow hackers to remotely access data on your computer
- Allow hackers to take remote control of your machine and turn it into a zombie
- Link your computer to others in a botnet that can send millions of spam e-mails or wage denial-of-service attacks against Web sites
- Cause network traffic jams

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How do I know if my computer is infected? Watch out for the symptoms of an infected computer listed in Figure 3-53.

FIGURE 3-53
Symptoms of Infection

- Irritating messages or sounds
- Frequent pop-up ads, at times with pornographic content
- The sudden appearance of a new Internet toolbar on your browser's home page
- An addition to your Internet favorites list that you didn't put there
- Prolonged system startup
- Slower than usual response to mouse clicks and keyboard strokes
- Browser or application crashes
- Missing files
- Your computer's security software becomes disabled and cannot be restarted
- Periodic network activity when you are not actively browsing or sending e-mail
- Your computer reboots itself frequently

Michael D Brown/Shutterstock.com

Some malware does a good job of cloaking itself, so victims are unaware of its presence. Cloaking techniques are great defense mechanisms because when victims aren't aware of malware, they won't take steps to eradicate it. Many victims whose computers were part of massive botnets never knew their computers were compromised.

Some hackers cloak their work using rootkits. The term **rootkit** refers to software tools used to conceal malware and backdoors that have been installed on a victim's computer. Rootkits can hide bots, keyloggers, spyware, worms, and viruses. With a rootkit in place, hackers can continue to exploit a victim's computer with little risk of discovery. Rootkits are usually distributed by Trojans.

How do I avoid security threats? The Orientation section at the beginning of this book listed some techniques for safe computing. That list is worth repeating (Figure 3-54).

FIGURE 3-54
Avoiding Security Threats

- Install and activate security software on any digital device that is at risk.
- Keep software patches and operating system service packs up to date.
- Do not open suspicious e-mail attachments.
- Obtain software only from reliable sources; and before running it, use security software to scan for malware.
- Do not click pop-up ads—to make an ad go away, right-click the ad's taskbar button and select the Close option.
- Avoid unsavory Web sites.
- Disable the option *Hide extensions for known file types in Windows* so you can avoid opening files with more than one extension, such as a file called *game.exe.zip*.

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What's a virus hoax? Some virus threats are very real, but you're also likely to get e-mail messages about so-called viruses that don't really exist. A **virus hoax** usually arrives as an e-mail message containing dire warnings about a supposedly new virus on the loose. When you receive an e-mail message about a virus or any other type of malware, don't panic. It could be a hoax.

You can check one of the many hoaxbuster or antivirus software Web sites to determine whether you've received a hoax or a real threat. The Web sites also provide security or virus alerts, which list all of the most recent legitimate malware threats. If the virus is a real threat, the Web site can provide information to determine whether your computer has been infected. You can also find instructions for eradicating the virus. If the virus threat is a hoax, by no means should you forward the e-mail message to others.

What if my computer gets infected? If you suspect that your computer might be infected by a virus or other malware, you should immediately use security software to scan your computer and eradicate any suspicious program code.

SECURITY SUITES

What is a security suite? A **security suite** integrates several security modules to protect against the most common types of malware, unauthorized access, and spam. Security suites might include additional features such as Wi-Fi detection that warns of possible intrusions into your wireless network, and parental controls for monitoring and controlling children's Internet usage. A security suite, like the one in Figure 3-55, typically includes antivirus, firewall, and antispyware modules.

Software © 1995–2012 Symantec Corporation

FIGURE 3-55

The Norton 360 security suite includes modules for scanning viruses, detecting spyware, and activating a firewall against unauthorized intrusions. Take a tour of these modules by using your interactive eBook.

What are the advantages and disadvantages of a security suite? A security suite costs less than purchasing standalone security modules. In addition, a single interface for accessing all of the security suite's features is much less complex than having to learn how to configure and run several different products.

When installing a security suite, you might be required to uninstall or disable all other antivirus, antispyware, and firewall software on your computer. Most security suites cannot run concurrently with standalone security products, and overlapping security coverage from two similar products can cause glitches. Therefore, one disadvantage of security suites is that you become dependent on your security package's vendor, which becomes the sole protector of your computer from malicious code.

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Where can I purchase a security suite? The most popular security suites include Norton 360, McAfee Internet Security Suite, avast!, and Trend Micro Titanium Maximum Security. They can be purchased in most office, electronics, and computer stores, or downloaded from the Web.

It is also worth looking into your Internet service provider's free security offerings. For example, Comcast provides its customers with Norton security products, all accessible through Comcast's Security Web page.

A security suite is often preinstalled on new desktop and laptop computers. However, the suite is usually demoware, so you have the option of purchasing it after the trial period, normally 60 days. Commonly, there is also an annual subscription fee for continued use and regular updates. When you renew your subscription, you might have an option to upgrade to a newer version for an extra $10–$20. There are also open source and freeware versions of security software, which do not require annual subscription fees.

ANTIVIRUS MODULES

What is antivirus software? **Antivirus software** is a type of utility software that looks for and eradicates viruses, Trojan horses, worms, and bots. Some antivirus software also scans for spyware, although several security software publishers offer spyware detection as a separate module. Antivirus software is included in security suites or available as a standalone module. Antivirus software is available for all types of computers and data storage devices, including handhelds, personal computers, USB flash drives, servers, PCs, and Macs (Figure 3-56).

Software © 1988–2012 AVAST Software a.s.

FIGURE 3-56

Free antivirus software is available, so computer owners have no excuse for leaving their computers unprotected.

TRY IT!

What is the name of the antivirus software installed on the computer you usually use? (Hint: On a PC, look in the Programs folder; on a Mac, look in the Utilities folder; on a handheld device, look in Settings.)

How does antivirus software work? Modern antivirus software attempts to identify malware by searching your computer's files and memory for virus signatures. A **virus signature** is a section of program code, such as a unique series of instructions, that can be used to identify a known malicious program, much as a fingerprint is used to identify an individual.

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Antivirus software scans for virus signatures in programs, data files, incoming and outgoing e-mail and attachments, and inbound instant message attachments. Antivirus software can also watch for unusual activity such as a large number of e-mail messages being sent out from your computer by a mass-mailing worm or bot.

Most antivirus programs can also scan for virus signatures in zip files, which is important when downloading zipped software and receiving zipped e-mail attachments.

How do I activate and deactivate my antivirus software? Installation and activation procedures vary for each virus protection product. However, once you have installed your antivirus software, the best and safest practice is to keep it running full time in the background so that it checks every e-mail message as it arrives and scans all files the moment you access them. The scanning process requires only a short amount of time, which creates a slight delay in downloading e-mail and opening files.

When installing some application or utility software, you might be instructed to deactivate your antivirus software. You can usually right-click the icon on your computer's taskbar that corresponds to your antivirus software and then select the exit or disable option. Do not forget to reactivate your antivirus software as soon as the installation is completed.

How should I configure my antivirus software? For the most extensive protection from malware, you should look for and enable the following features of your antivirus software:

- Start scanning when the computer boots.
- Scan all programs when they are launched and document files when they are opened.
- Scan other types of files, such as graphics, if you engage in some risky computing behaviors and are not concerned with the extra time required to open files as they are scanned.
- Scan incoming mail and attachments.
- Scan incoming instant message attachments.
- Scan outgoing e-mail for worm activity such as mass-mailing worms.
- Scan zipped (compressed) files.
- Scan for spyware, sometimes called pups (potentially unwanted programs).
- Scan all files on the computer's hard disk at least once a week.

How do I keep my antivirus software up to date? Two aspects of your antivirus software periodically need to be updated. First, the antivirus program itself might need a patch or an update to fix bugs or improve features. Second, the list of virus signatures must be updated to keep up with the latest malware developments.

Virus signatures and other information that antivirus software uses to identify and eradicate malware are stored in one or more files usually referred to as **virus definitions** (or a virus database). Antivirus program updates and revised virus definitions are packaged into a file that can be manually or automatically downloaded. If your antivirus software is part of a security suite, the update might also include patches for other security software modules, such as the spyware module or firewall.

Most antivirus products are preconfigured to regularly check for updates, download them, and install them without user intervention. If you would rather control the download and installation process yourself, you can configure your antivirus software to alert you when updates are ready. In any case, you should manually check for updates periodically just in case the auto-update function has become disabled.

TRY IT!

When were the virus definitions for your antivirus software last updated?

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How often should I run a system scan? Most experts recommend that you configure your antivirus software to periodically scan all the files on your computer. With the proliferation of malware attacks, it's best to schedule a weekly system scan. Because a full system scan can significantly slow down your computer, schedule the scan for a time when you are not usually using your computer, but it is turned on.

You can also run a manual scan of your entire computer or of specific files. For example, suppose you download a program and you want to make sure it is virus-free before you install and run it. Depending on your antivirus software, you might be able to simply right-click the file name to start the scan (Figure 3-57). Otherwise, open your antivirus software and select the manual scan option.

FIGURE 3-57

Before installing and running a downloaded file, you can scan it by right-clicking the file name and selecting the Scan option.

What does *quarantine* mean? If, during the scanning process, your virus protection software identifies a virus, worm, Trojan horse, or bot in a file or an attachment, it can try to remove the infection, put the file into quarantine, or simply delete the file.

In the context of antivirus software, a **quarantined file** contains code that is suspected of being part of a virus. For your protection, most antivirus software encrypts the file's contents and isolates it in a quarantine folder, so it can't be inadvertently opened or accessed by a hacker. If the infected file ends up on a quarantine list, your antivirus software might give you the option of trying to disinfect the file or deleting it.

How dependable is antivirus software? Today's antivirus software is quite dependable, but not infallible. A fast-spreading worm can reach your computer before a virus definition update arrives, some spyware can slip through the net, and cloaking software can hide some viral exploits.

Despite occasional misses, however, antivirus software and other security software modules are constantly weeding out malware that would otherwise infect your computer. It is essential to use security software, but also important to take additional precautions, such as making regular backups of your data.

TRY IT!

Has your antivirus software quarantined any files? (Hint: Open your antivirus software and check the History tab.)

_____

QuickCheck

SECTION E

1. A computer _____ can lurk in a computer for days or months, quietly replicating itself.
2. A mass-mailing _____ spreads to other computers by sending itself to all the addresses stored in the local e-mail client.
3. A group of zombie computers controlled by a hacker is called a(n) _____.
4. A virus _____ is a unique section of malicious code that can be identified by antivirus software.
5. A(n) _____ file is suspected of containing a virus, so your antivirus software usually encrypts the file and stores it in a special folder.

CHECK ANSWERS

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Issue: How Serious Is Software Piracy?

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SOFTWARE IS EASY TO STEAL. You don't have to walk out of a Best Buy store with a box of expensive software under your shirt. You can simply copy the software from your friend's computer. It seems so simple that it couldn't be illegal. But it is.

Piracy takes many forms. End-user piracy includes friends loaning distribution discs to each other and installing software on more computers than the license allows. Although it is perfectly legal to lend a physical object, such as a sweater, to a friend, it is not legal to lend digital copies of software and music. Unlike a sweater that can be worn by only one person at a time, copies of digital things can be simultaneously used by many people.

Software counterfeiting is the large-scale illegal duplication of software distribution media, and sometimes even its packaging. According to Microsoft, many software counterfeiting groups are linked to organized crime and money-laundering schemes that fund a diverse collection of illegal activities, such as smuggling, gambling, extortion, and prostitution. Counterfeit software is sold in retail stores and through online auctions—often the packaging looks so authentic that buyers have no idea they have purchased illegal goods.

Internet piracy uses the Web as a way to illegally distribute unauthorized software. In Net jargon, the terms *appz* and *warez* (pronounced as "wares" or "war EZ") refer to pirated software. Some warez have even been modified to eliminate serial numbers, registration requirements, expiration dates, or other forms of copy protection. Web sites, file sharing networks, and auction sites sell or distribute hundreds of thousands of pirated software products.

In many countries, including the United States, software pirates are subject to civil lawsuits for monetary damages and criminal prosecution, which can result in jail time and stiff fines. Nonetheless, software piracy continues to have an enormous impact. According to a Business Software Alliance (BSA) and IDC Piracy Study, $130 billion of software was legitimately purchased worldwide, but software worth a whopping $53 billion was pirated.

Is software piracy really damaging? Who cares if you use a program without paying for it? According to industry experts, software piracy has a negative effect on the economy. Software production makes a major contribution to the United States economy, employing more than 250,000 people and accounting for billions of dollars in corporate revenue. It fuels economic development in countries such as India and China. A BSA economic impact study concluded that lowering global piracy by 10 percentage points over a four-year period would add more than 500,000 jobs and $141 billion in worldwide economic growth.

Web sites, file sharing networks, and auction sites sell or distribute hundreds of thousands of pirated software products.

Decreases in software revenues can have a direct effect on consumers, too. When software publishers are forced to cut corners, they tend to reduce customer service and technical support. As a result, you, the consumer, get put on hold when you call for technical support, find fewer free technical support sites, and encounter customer support personnel who are only moderately knowledgeable about their products. The bottom line—software piracy negatively affects customer service.

As an alternative to cutting support costs, some software publishers might build the cost of software piracy into the price of the software. The unfortunate result is that those who legitimately license and purchase software pay an inflated price.

Courtesy of Software & Information Industry Association

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TRY IT! What is the extent of piracy and is there any way to stop it? Explore the issue by completing the TRY IT! activities. Your instructor can specify how to submit your findings.

1. Analysts fear that the Internet is a major factor in piracy growth. As Internet access becomes more widely available, piracy is likely to increase, rather than decrease. Access to high-speed Internet connections makes it much easier to quickly download large software files. To find out if piracy is increasing, connect to *www.bsa.org* and look at the most recent Global Piracy Study, and then answer the following questions:

   a. What time period does the study cover?

   b. Did software piracy increase or decrease during this time period, and if so, by how much?

   c. Which regions had the highest and lowest piracy rates?

   d. Which countries had the three highest piracy rates, and what percentage of software is pirated in these countries?

2. As a justification of high piracy rates, some observers point out that people in many countries simply might not be able to afford software priced for the U.S. market. Find the current retail price for Microsoft Office in the United States. Next, find the average annual income for Bangladesh. Divide the price by the average annual income to calculate the percentage of a Bangladeshi's income that would be required to purchase Microsoft Office. What percentage of a Bangladeshi's income would he or she have to pay to get Microsoft Office at full retail U.S. price?

3. The incidence of piracy seems to be higher among small businesses and individual users than corporations and government agencies. According to one study, two-thirds of college and university students see nothing unethical about swapping or downloading digital copyrighted software, music, and movie files without paying for them, and more than half of the people surveyed for the study believe it is acceptable to do so in the workplace. Perhaps education is part of the solution; more publicity about the cost of piracy might encourage people to stop using illegal software. Search YouTube for "software piracy" or "anti-piracy ads," and then complete the following:

   a. List the titles and links for three of the ads that you consider most effective.

   b. List the title and link for an anti-piracy video that college students would consider "lame."

4. The software industry wants you to report piracy. Do a Web search for "report piracy" and list five sites where you can report individuals or businesses that use or distribute illegal copies of software.

INFOWEBLINKS

You can check the **NP2014 Chapter 3** InfoWebLink for updates to these activities.

CLICK TO CONNECT
www.infoweblinks.com/NP2014/ch03

What Do You Think?

ISSUE

1. Do you believe that software piracy is a serious issue?
2. Do you know of any instances of software piracy?
3. Do you think that most software pirates understand that they are doing something illegal?
4. Should software publishers try to adjust software pricing for local markets?

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Information Tools: Organizing Your Writing

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You can organize a research paper, a report, or an essay simply by rearranging entries you made in the document containing your research notes. Your bookmarking application might include a feature to arrange your bookmarks and accompanying notes. These tools can be clumsy, however, if your notes are extensive. Dealing with hundreds of notes, you might have trouble seeing the big picture.

Organization tools help you visualize relationships between important pieces of information and supporting detail. They also help you determine the order in which you'll present concepts when you begin to write. Tools that writers find useful include outlines, concept maps, and SmartArt shapes.

OUTLINES. Most word processors include an outline feature that you can use to devise the basic structure of a research paper. You can rearrange outline points using your word processor's Move function. Pay attention to make sure the outline numbering adjusts correctly.

Microsoft Word offers an Outline view in which you can collapse or expand outline levels. This feature is useful for long outlines. For example, suppose you want to organize main ideas; you can collapse the detail so that supporting points are not displayed. Dedicated outline apps, such as OmniOutliner and ThinkBook, offer similar features.

CONCEPT MAPS. If you like to work with concepts visually, check out concept mapping software, such as SimTech MindMapper, Tufts' VUE, and SmartDraw, or Web apps, such as Cacoo and bubbl.us.

Concept maps use bubbles to represent ideas. Lines connect the bubbles to show related concepts. You can customize your concept maps to show a sequence by mapping from left to right.

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SMARTART SHAPES. You can use Microsoft Excel's SmartArt shapes to organize the structure for a research paper. Just looking through the SmartArt options can give you ideas about the overall structure and the structure of subsections.

Excel's SmartArt Tools feature contains a variety of pre-designed diagrams that you can use to visualize how the pieces of your report fit together. You can enter text directly on the shapes, or in the outline box located on the left side of the screen.

3

TRY IT! Suppose you are working with a team to improve the organization of a Wikipedia article on gray wolves. To begin this project, copy the entire Wikipedia article on gray wolves into a new document named Wolf Project [Your Name] Chapter 3.

1. Use outline view and make each of the headings an outline level.
2. Add or modify headings and move material so that the article is organized into the sections listed in the sidebar.
3. Enter the headings as nodes in a concept map created with the diagramming tool of your choice. Add three subpoints to each node.
4. Use an Excel SmartArt diagram to show how you visualize the points made in the "Relation with humans" section.

New Organization for Gray Wolves Article

Naming and etymology
Range and habitat
Physical characteristics
Behavior
Conservation efforts
Relation with humans

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Technology in Context: Journalism

IN THE ANCIENT WORLD, news spread by word of mouth, relayed by bards and merchants who traveled from town to town—in essence, they were the first reporters to broadcast the news. The news business is all about gathering and disseminating information quickly. Technology has played a major role in news reporting's evolution from its bardic roots to modern 24-hour news networks and Web sites.

Johann Gutenberg's printing press (ca. 1450), the first technological breakthrough in the news business, made it feasible to publish news as printed notices tacked to walls in the town square. As paper became more economical, resourceful entrepreneurs sold broadsheets to people eager for news, and the concept of a newspaper was born. The first regularly published newspapers appeared in Germany and Holland in 1609, and the first English newspaper, the *Weekly News*, was published in 1622.

But the news spread slowly. In the early 1800s, it took four weeks for newspapers in New York to receive reports from London. With the advent of the telegraph in 1844, however, reporters from far-flung regions could wire stories to their newspapers for publication the next day. The first radio reporters in the 1920s offered live broadcasts of sports events, church services, and variety shows. Before the 1950s, black-and-white newsreels shown in movie theaters provided the only visual imagery of news events, but television gave viewers news images on a nightly basis.

Technology has benefited print journalism, too. For decades, typesetters transferred reporters' handwritten stories into neatly set columns of type. Today, reporters use computers and word processing software to tap out their stories and run a preliminary check of spelling and grammar.

Stories are submitted by computer network to editors, who also use word processing software to edit stories to fit time and space constraints. The typesetting process has been replaced by desktop publishing software and computer to plate (CTP) technology. Digital pages produced with desktop publishing software are sent to a raster image processor (RIP), which converts the pages into dots that form words and images. After a page has been RIPed, a platesetter uses lasers to etch the dots onto a physical plate, which is then mounted on the printing press to produce printed pages. CTP is much faster and more flexible than typesetting, so publishers can make last-minute changes to accommodate late-breaking stories.

Personal computers have also added a new dimension to the news-gathering process. Reporters were once limited to personal interviews, observation, and fact gathering at libraries, but can now make extensive use of Internet resources and e-mail. Web sites and online databases provide background information on all sorts of topics. Other resources include newsgroups and chat rooms, where reporters can monitor public opinion on current events and identify potential sources.

© Erik S. Lesser/The New York Times/Redux Pictures

Most major networks maintain interactive Web sites that offer online polls and bulletin boards designed to collect viewers' opinions. Although online poll respondents are not a representative sample of the population, they can help news organizations gauge viewer opinions and determine whether news coverage is comprehensive and effective.

Blogs and Web sites can be a source of news, in addition to reporting it. An online newspaper called *The Huffington Post* is a frequently cited source of stories reported on cable news networks. And even CNN now reports on news stories that originate on blogs such as *Slashdot*.

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E-mail has changed the way reporters communicate with colleagues and sources. It's often the only practical method for contacting people in remote locations or distant time zones, and it's useful with reluctant sources, who feel more comfortable providing information under the cloak of anonymous Hotmail or Yahoo! accounts. Vetting e-mail sources—verifying credentials such as name, location, and occupation—can be difficult, however, so reporters tend not to rely on these sources without substantial corroboration.

For broadcast journalism, digital communications play a major role in today's live-on-the-scene television reporting. Most news organizations maintain remote production vans, sometimes called satellite news gathering (SNG) trucks, that travel to the site of breaking news, raise their antennas, and begin to broadcast. These complete mobile production facilities include camera control units, audio and video recording equipment, and satellite or microwave transmitters.

On-the-scene reporting no longer requires a truck full of equipment, however. Audiovisual editing units and video cameras have gone digital, making them easier to use and sized to fit in a suitcase. A new breed of backpack journalists carry digital video cameras, notebook computers, and mobile phones.

Backpack journalists can transfer video footage to their notebook computers and then edit the footage with consumer-level video editing software. The resulting video files are compressed and sent to newsroom technicians, who decompress the videos and then broadcast them—all in a matter of seconds.

One drawback of backpack journalists' use of digital cameras and compression is that the video quality usually isn't as crisp as images filmed with studio cameras. News organizations with high standards were once hesitant to use this lower quality video, but have found that viewers would rather see a low-quality image now than a high-quality image later. To many viewers, a few rough edges just make the footage seem more compelling—more like you are there.

A memorable tour de force in SNG was the brainchild of David Bloom, an NBC reporter embedded with the U.S. Army 3rd Infantry Division during Operation Iraqi Freedom. He helped modify an M-88 tank recovery vehicle into a high-tech, armored SNG vehicle. The $500,000 Bloommobile featured a gyrostabilized camera that could produce jiggle-free video as the tank blasted over sand dunes at 50 mph. Tragically, Bloom died while covering the conflict; but viewers vividly remember his exhilarating reports as the Bloommobile raced down desert roads, trundled along with Army supply convoys, and narrowly escaped enemy fire.

Video-enabled mobile phones ushered in another era of news gathering. Citizen journalists who are on the spot during news-making events simply point, shoot, and e-mail footage to media Web sites, such as CNN.com and FOXNews.com. During the tragic 2008 terrorist attacks in Mumbai, eyewitness accounts and updates flooded over social networking sites such as Facebook and Twitter. The first images of the attacks spread through social networking sites minutes before they appeared on mainstream news channels.

Computers, the Internet, and communications technology make it possible to instantly broadcast live reports across the globe, but live reporting is not without controversy. Reporters and amateur journalists who arrive at the scene of a disaster with microphones, cameras, or cell phones in hand have little time for reflection, vetting, and cross-checking, so grievous errors, libelous images, or distasteful video footage sometimes find their way into news reports.

Jeff Gralnick, former executive producer for ABC News, remarks, "In the old days, we had time to think before we spoke. We had time to write, time to research and time to say, 'Hey, wait a minute.' Now we don't even have the time to say, 'Hey, wait a nanosecond.' Just because we can say it or do it, should we?" Technology has given journalists a powerful arsenal of tools for gathering and reporting the news, but has also increased their accountability for accurate, socially responsible reporting.

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New Perspectives Labs

To access the New Perspectives Lab for Chapter 3, open the NP2014 interactive eBook and then click the icon next to the lab title.

INSTALLING AND UNINSTALLING SOFTWARE

IN THIS LAB YOU'LL LEARN:

- How to use a setup program to install Windows application software from a distribution CD
- The difference between typical, compact, and custom installation options
- How to specify a folder for a new software installation
- How to install downloaded software
- How to install an upgrade
- How to uninstall a Windows application
- What happens, in addition to deleting files, when you uninstall a software application
- How to locate the program that will uninstall a software application
- Why you might not want to delete all of the files associated with an application

LAB ASSIGNMENTS

1. Start the interactive part of the lab. Make sure you've enabled Tracking if you want to save your QuickCheck results. Perform each lab step as directed, and answer all the lab QuickCheck questions. When you exit the lab, your answers are automatically graded and your results are displayed.
2. Browse the Web and locate a software application that you might like to download. Use information supplied by the Web site to answer the following questions:
   a. What is the name of the program and the URL of the download site?
   b. What is the size of the download file?
   c. According to the instructions, does the download file appear to require manual installation, or does it automatically install itself when the download is complete?
3. On the computer you regularly use, look through the list of installed programs. List the names of any programs that include their own uninstall routines.
4. (Windows only) On the computer you regularly use, open the Control Panel and then select the Uninstall a Program option. List the first ten programs shown.

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Key Terms

Make sure you understand all the boldfaced key terms presented in this chapter. With the NP2014 interactive eBook, you can use this list of terms as an interactive study activity. First, try to define a term in your own words, and then click the term to compare your definition with the definition presented in the chapter.

Absolute reference, 138
Adaptive utilities, 130
Automatic recalculation, 138
Bot, 164
Botnet, 164
BSD license, 160
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Software upgrade, 152
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Style, 135
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Virus definitions, 168
Virus hoax, 166
Virus signature, 167
Web application, 143
What-if analysis, 136
Word wrap, 133
Worksheet, 136
Zipped, 150
Zombie, 164
*See page 180 for a list of key software applications.

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Interactive Summary

To review important concepts from this chapter, fill in the blanks to best complete each sentence. When using the NP2014 interactive eBook, click the Check Answers buttons to automatically score your answers.

SECTION A: Computer software can be grouped into two main categories. _____ software is designed for computer-centric tasks, whereas _____ software is designed to help people accomplish real-world tasks. These two main categories can be further divided into subcategories. Popular software categories include music, video, and graphics. Mapping and _____ -based software on desktop and mobile computing devices helps consumers find the nearest ATM or turn-by-turn directions to the airport. For businesses, _____ market software is designed to automate specialized tasks in a specific market or business. _____ market software is generic software that can be used by just about any kind of business. _____ software is designed to help you monitor and configure settings for your computer system equipment, the operating system, or application software. A(n) _____ reader is an essential utility that displays documents in a standard format for exchanging files. _____ utilities alter a device's user interface to create an accessible environment for people who cannot see the screen or have other barriers to access. Device _____ are a type of system software that helps a computer establish communication with peripheral devices.

CHECK ANSWERS

SECTION B: Office suites are sometimes referred to as _____ software because they offer features that really help get work done. Word _____ software assists you with composing, editing, designing, printing, and electronically publishing documents. When you want to change margins, headers, and footers, you can use _____ layout tools. To change the spacing between lines or the alignment of text, you can use tools to adjust _____ style. _____ software is similar to a smart piece of paper that automatically adds up the columns of numbers you write on it. You can use it to make other calculations, too, based on simple equations that you write or more complex, built-in formulas. Because it is so easy to experiment with different numbers, this type of software is particularly useful for _____ analyses. _____ software helps you store, find, organize, update, and report information stored in one or more tables. Data is stored in _____ , which form records. When two sets of records are _____ , database software allows you to access data from both tables at the same time. A(n) _____ language such as SQL describes the information you want to find in a set of records. _____ software supplies tools for creating a series of electronic slides that can be shown on a computer screen or projector.

CHECK ANSWERS

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SECTION C: The process of _____ software places a program into a computer so that it can be executed or run. _____ apps are examples of cloud computing and are accessed from a browser. _____ apps are installed on a local handheld device by downloading from an app store. Some Apple devices have to use a designated app store unless they are _____ by an unauthorized change to the device's software. Most local applications include a(n) _____ program that guides you through the installation process. The main program is stored in a(n) _____ file that might call additional programs as necessary. For downloaded software, the first step in the installation process is usually to _____ the distribution file that was compressed to conserve space and reduce download time. In contrast to local applications, _____ software is designed to run from removable storage, such as a CD or USB flash drive. On PCs, these apps require no entries in the Windows Registry. Software publishers regularly update their software to add new features, fix bugs, and update its security. A software _____ is a small section of program code that replaces part of the software you currently have installed. The term *service* _____, which usually applies to operating system updates, is a set of patches that correct problems and address security vulnerabilities. To remove software from a Windows PC, it is important to use a(n) _____ routine, rather than simply deleting program files.

CHECK ANSWERS

SECTION D: Most new computers include an operating system, essential utilities, and some basic application software. When shopping for additional utilities and apps, check the system _____ to make sure your device has the correct operating system and necessary hardware capacity. Software is protected by _____, and illegal copying or distribution is sometimes referred to as software _____. _____ software, such as commercial software, is protected by copyright that grants to its author an exclusive right to copy, distribute, sell, and modify that work. Public _____ software is not protected by copyright. A software _____ can extend or limit the rights granted by copyright. Demoware and _____ are distributed free of charge, but require payment for continued use. Freeware is copyrighted software that can be used for free, but cannot be altered or resold. _____ source software is distributed with its source code, and can be modified, sold, and redistributed.

CHECK ANSWERS

SECTION E: Security software can be classified into various types: antivirus, antispyware, anti-spam, and firewalls. Each type focuses on a specific security threat. A computer _____ is a set of program instructions that attaches itself to a file, reproduces itself, and spreads to other files. A computer _____ is a self-replicating program designed to carry out some unauthorized activity on a victim's computer. In the context of computing, a Trojan _____ is a computer program that seems to perform one function while actually doing something else. For example, it might steal passwords using a type of program called a _____ that records keystrokes. A Remote Access Trojan sets up _____ capabilities that allow remote hackers to access files on victims' computers. _____ programs can turn computers into zombies and link them together into _____. _____ is a type of program that secretly gathers personal information without the victim's knowledge, usually for advertising and other commercial purposes. To combat malware, it is important to use _____ software that looks for virus signatures. Most computer owners obtain this software as one module in a security _____.

CHECK ANSWERS

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Software Key Terms

3-D graphics software, 124
Accounting software, 126
Antivirus software, 167
Audio editing software, 121
CAD software, 124
Database software, 139
Desktop publishing software, 127
Drawing software, 123
DVD authoring software, 122
Graphics software, 123
Horizontal market software, 126
Location-based software, 125
Mathematical modeling software, 126
Money management software, 128
Music software, 121
Paint software, 123
Payroll software, 126
Personal finance software, 128
Photo editing software, 123
Presentation software, 142
Project management software, 126
Security software, 162
Spreadsheet software, 136
Statistical software, 126
Tax preparation software, 128
Vertical market software, 126
Video editing software, 122
Word processing software, 133

Interactive Situation Questions

Apply what you've learned to some typical computing situations. When using the NP2014 interactive eBook, you can type your answers, and then use the Check Answers button to automatically score your responses.

1. You're using an app on your iPhone to find the nearest bike repair shop. This _____ -based app works because it can triangulate your whereabouts based on the built-in GPS or your distance from nearby cell towers.
2. Suppose that you've been hired to organize a professional skateboard competition. When you consider how you'll need to use computers, you realize that you must collect information on each competitor and keep track of every competitive event. With at least two types of related records, you'll probably need to use _____ software.
3. Imagine that you just purchased a new software package. You insert the distribution CD, but nothing happens. No problem—you can manually run the _____ program, which will start the install routine.
4. Your friend has an iPod Touch that's loaded with all kinds of applications; but every time there's a software update, your friend grumbles about "redoing stuff." You guess that your friend's iPod is _____ .
5. You download an open source software program from the Web. You assume that the download includes the uncompiled _____ code for the program as well as the _____ version.
6. You're in the process of receiving some e-mail messages when your antivirus software displays an alert. You assume that it has discovered a virus _____ in an attachment for one of the e-mail messages. The message also states that the file has been _____ ; that is, moved to an area where it cannot cause more harm.

CHECK ANSWERS

Interactive Practice Tests

Practice tests that consist of ten multiple-choice, true/false, and fill-in-the-blank questions are available in the NP2014 interactive eBook. Test questions are selected at random from a large test bank, so each time you take a test, you'll receive a different set of questions. Your tests are scored immediately, and you can print study guides that help you find the correct answers for any questions that you missed.

CLICK TO START

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Learning Objectives Checkpoints

Learning Objectives Checkpoints are designed to help you assess whether you have achieved the major learning objectives for this chapter. You can use paper and pencil or word processing software to complete most of the activities.

1. List seven categories of application software.
2. List at least ten functions performed by utilities included with Windows and Mac operating systems.
3. Provide an example of an adaptive utility on the iPhone.
4. Explain why you might want to locate the version number for a device driver.
5. Describe three ways that word processing software can help improve your writing.
6. Draw a sketch of a simple worksheet and label the following: columns, rows, cell, active cell, values, labels, formulas, and Formula bar. Explain the difference between an absolute reference and a relative reference, giving an example of each.
7. Describe four ways to query a database.
8. List at least six key features of presentation software.
9. Describe the difference between Web apps and mobile apps.
10. List and describe the two main types of files included in a local software installation.
11. Write a set of step-by-step instructions for installing software from a distribution CD, and another set of instructions for installing downloaded software.
12. Explain the purpose of a software patch and describe how it differs from a service pack.
13. Describe the difference between uninstalling software on Macs and on Windows.
14. Find a EULA for an application installed on your computer and use it to answer each of the questions posed in the TRY IT! on page 158.
15. Explain the differences between proprietary software, commercial software, shareware, open source software, freeware, and public domain software.
16. Create a table that summarizes the differences between various types of malware based on their method of distribution and exploits.
17. Draw a storyboard to illustrate how antivirus software works.

Study Tip: Make sure you can use your own words to correctly answer each of the purple focus questions that appear throughout the chapter.

Concept Map

Fill in the blanks to show the hierarchy of software described in this chapter.

CHECK ANSWERS

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4

Operating Systems and File Management

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Learning Objectives

After reading this chapter, you will be able to answer the following questions by completing the outcomes-based Learning Objectives Checkpoints on page 243.

1. What are system resources?
2. How do multitasking, multithreading, and multiprocessing work?
3. What is a memory leak?
4. What happens during the boot process?
5. When do users interact with the operating system?
6. How do GUIs differ from command line interfaces?
7. Which operating systems are typically used on personal computers, on servers, and on handheld devices?
8. What is a virtual machine?
9. Do operating systems put limits on the names that can be used for files?
10. What is a file specification or path?
11. What is a native file format?
12. Are there guidelines for managing files so that they are easy to locate and back up?
13. What happens behind the scenes when a computer stores a file?
14. What is the best backup device?
15. How do synchronization and backup software differ?
16. How do restore points, bare-metal restore, disk imaging, virtual machines, boot disks, and recovery disks relate to backup?
17. Is it possible to back up data on handheld devices?

Apply Your Knowledge

The information in this chapter will give you the background to:

- Find out which processes are running on your computer
- Use operating systems, such as Windows, Mac OS, iOS, Android, and Linux
- Maintain an efficient organization of files
- Identify file name extensions
- Convert files from one format to another
- Open, save, rename, move, copy, and delete files
- Burn a CD, DVD, or BD
- Shred computer files so they cannot be read
- Back up important data
- Get up and running after a hard disk failure

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TRY IT!

IS MY COMPUTER'S HARD DISK GETTING FULL?

Your computer's hard disk stores a high percentage of the programs you use and the data files you create. You might wonder if your hard disk is getting full. To find out, follow the steps below.

Windows 7:

1. Start your computer and make sure you can see the Windows desktop.
2. Click the **Start** button, and then select Computer.
3. Right-click your **(C:)** drive to display a pop-up menu.
4. Click **Properties**. A Local Disk Properties dialog box should appear containing statistics about your computer's hard disk.
5. For the properties indicated by red underlines in the figure at right, jot down the statistics for used space, free space, and capacity. Then sketch in the slices of the pie chart for your computer.
6. Also, use the blank provided to jot down the file system used by your computer. You'll learn the significance of your computer's file system when you read the chapter.

Windows 8:

1. From the Start screen, click the **Desktop** tile.
2. Click the **File Explorer** folder at the bottom of the screen.
3. Follow instructions 3–6 for Windows 7.

Mac:

1. Click the **Finder** icon, located on the dock at the bottom of the screen.
2. Right-click the **Macintosh HD** link. (If your mouse has only one button, hold down the **Ctrl** key and click it.)
3. Select **Get Info** from the pop-up menu.
4. For the properties indicated by red underlines in the figure at right, jot down the statistics for capacity, available space, and used space in GB and bytes.
5. Also, jot down the file system shown on the Format line. You'll learn the significance of the file system when you read the chapter.

Finder icon

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Operating System Basics

SECTION **A**

AN OPERATING SYSTEM is an integral part of virtually every computer system. It fundamentally affects how you can use your computer. Can you run two programs at the same time? Can you connect your computer to a network? Does your computer run dependably? Does it have a touchscreen? To answer questions like these, it is helpful to have a clear idea about what an operating system is and what it does. Section A provides an overview of operating system basics.

OPERATING SYSTEM TASKS

What is an operating system? An operating system (abbreviated OS) is a type of system software that acts as the master controller for all activities that take place within a computer system. It is one of the factors that determines your computer's compatibility and platform.

Most computers are sold with a preinstalled operating system, such as Microsoft Windows or Mac OS (Figure 4-1). A third operating system called Linux is customarily used for high-end workstations and servers, but can also be installed on personal computers. Tablet computers and smartphones use operating systems such as Windows RT, iOS, and Android.

FIGURE 4-1

Windows (left) is preinstalled on IBM-compatible computers manufactured by companies such as Dell and Hewlett-Packard. Mac OS (middle) is preinstalled on Apple Macintosh computers. Linux (right) is an open source operating system that's available as a free download.

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What does an operating system do? Your computer's operating system provides an environment for running software and controlling peripheral devices.

The operating system, application software, and device drivers are organized similar to the chain of command in an army. You issue a command using application software. Application software tells the operating system what to do. The operating system tells the device drivers, the device drivers tell the hardware, and the hardware actually does the work. Figure 4-2 illustrates this chain of command for printing a document or photo.

FIGURE 4-2

A command to print a document is relayed through various levels of software, including the operating system, until it reaches the printer.

The operating system interacts with application software, device drivers, and hardware to manage a computer's resources. In the context of a computer system, the term **resource** refers to any component that is required to perform work.

The processor is a computer's main resource. RAM (random access memory), storage space, and peripheral devices are also resources. While you interact with application software, your computer's operating system is busy behind the scenes with resource management tasks such as those listed in Figure 4-3.

	Manage processor resources to handle simultaneous input, output, and processing tasks
	Manage memory by allocating space for all the programs and data that are in use during a computing session
	Keep track of storage resources so that files and programs can be found and manipulated
	Ensure that input and output proceed in an orderly manner by communicating with peripheral devices
	Establish basic elements of the user interface such as the appearance of the desktop, menus, and toolbars

FIGURE 4-3

Operating System Tasks

TRY IT!

Click the resource in Figure 4-3 that stores data on a temporary basis.

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How do operating systems manage processor resources?

Every cycle of a computer's microprocessor is a resource for accomplishing tasks. Many activities—called processes—compete for the attention of your computer's microprocessor. Commands are arriving from programs you're using, while input is arriving from the keyboard, mouse, and other devices. At the same time, data is being sent to the display device or printer, and Web pages could be arriving from your Internet connection.

To manage all these competing processes, your computer's operating system must ensure that each process receives its share of microprocessor cycles. You can check the processes that are being executed by the microprocessor if you suspect that a program did not close properly or that malware is working behind the scenes (Figure 4-4).

FIGURE 4-4

The Windows operating system displays a list of processes when you hold down the Ctrl, Shift, and Esc keys. On the Mac, look for the Activity Monitor in the Utilities folder listed under Applications. Most processes are legitimate programs that run in the background to carry out tasks for the operating system, device drivers, and applications. Occasionally a bot or worm launches rogue processes. If you want to know if a process is legitimate, you can google it. Use your interactive eBook to find out how to access information about the processes on your computer.

How do operating systems handle so many processes?

During a typical computing session, your computer might run an average of 50 processes. Ideally, the operating system should be able to help the microprocessor switch seamlessly from one process to another. Depending on the capabilities of the operating system and computer hardware, processes can be managed by multitasking, multithreading, and multiprocessing.

Multitasking provides process and memory management services that allow two or more tasks, jobs, or programs to run simultaneously. Most of today's popular operating systems offer multitasking services.

Within a single program, **multithreading** allows multiple parts, or threads, to run simultaneously. For example, one thread for a spreadsheet program might be waiting for input from the user while other threads perform a long calculation in the background. Multithreading can speed up performance on single- or multiple-processor computers.

Many new computers include multi-core processors or multiple processors. An operating system's **multiprocessing** capability supports a division of labor among all the processing units.

TRY IT!

When an operating system allocates tasks to various cores of a microprocessor, it is called:

- ❍ multitasking
- ❍ multithreading
- ❍ multiprocessing

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How does an operating system manage memory? A microprocessor works with data and executes instructions stored in RAM—one of your computer's most important resources. When you want to run more than one program at a time, the operating system has to allocate specific areas of memory for each program, as shown in Figure 4-5.

Sometimes an application requests memory but never releases it—a condition called a **memory leak**. Memory "leaks" away into this application's reserved area, eventually preventing other programs from accessing enough memory to function properly. Those programs can crash, and the operating system might display error messages, such as "General Protection Fault" or "Program Not Responding." Your computer can sometimes recover from a memory leak if you access Task Manager (PCs) or Activity Monitor (Macs) to close the corrupted program.

How does the OS keep track of storage resources? Behind the scenes, an operating system acts as a filing clerk that stores and retrieves files from your computer's hard drive and other storage devices. It remembers the names and locations of all your files and keeps track of empty spaces where new files can be stored. Later in the chapter, you'll explore file storage in more depth and learn how the operating system affects the way you create, name, save, and retrieve files.

Why does the operating system get involved with peripheral devices? Every device connected to a computer is regarded as an input or output resource. Your computer's operating system communicates with device driver software so that data can travel smoothly between the computer and peripheral resources. If a peripheral device or driver is not performing correctly, the operating system makes a decision about what to do—usually it displays an on-screen message to warn you of the problem.

Your computer's operating system ensures that input and output proceed in an orderly manner, using **buffers** to collect and hold data while the computer is busy with other tasks. By using a keyboard buffer, for example, your computer never misses one of your keystrokes, regardless of how fast you type or what else is happening in your computer at the same time.

Are different operating systems needed for different computing tasks? One operating system might be better suited to some computing tasks than others. To provide clues to their strengths and weaknesses, operating systems are informally categorized and characterized using one or more of the following terms:

A **single-user operating system** deals with one set of input devices—those that can be controlled by one user at a time. Operating systems for tablet computers and smartphones fit into this category. DOS is an example of a single-user operating system designed for desktop computers.

A **multiuser operating system** allows a single, centralized computer to deal with simultaneous input, output, and processing requests from many users. One of its most difficult responsibilities is to schedule all the processing requests that a centralized computer must perform.

A **server operating system** provides tools for managing distributed networks, e-mail servers, and Web hosting sites. Mac OS X Server, Windows Server 2012, and Linux are examples of server operating systems. Server operating systems typically route data and programs to each user's local computer where the actual processing takes place. They might also provide multiuser capabilities.

FIGURE 4-5

The operating system allocates a specific area of RAM for each program that is open and running. The operating system is itself a program, so it requires RAM space, too.

TERMINOLOGY NOTE

The term *buffer* is technical jargon for a region of memory that holds data waiting to be transferred from one device to another.

TRY IT!

Is Windows 8 a multiuser operating system?

❍ Yes

❍ No

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A **desktop operating system** is designed for a desktop or laptop personal computer. The computer you use at home, at school, or at work is most likely configured with a desktop operating system, such as Microsoft Windows or Mac OS. These operating systems are designed to accommodate one user at a time, but also provide networking capability. Today's desktop operating systems invariably provide multitasking capabilities so that users can run more than one application at a time.

A **mobile operating system** is designed for devices such as smartphones and tablet computers. Mobile OSs support touchscreens, but tend to limit multitasking and user access to local storage devices.

Operating systems for handheld and desktop devices provide many similar services, such as scheduling processor resources, managing memory, loading programs, managing input and output, and establishing the user interface. But because handheld devices tend to be used for less sophisticated tasks, their operating systems are somewhat simpler and significantly smaller.

TERMINOLOGY NOTE

Some operating system vendors characterize their products as home or professional versions. The home version usually has fewer network management tools than the professional version.

THE BOOT PROCESS

Where is the operating system stored? In some digital devices, such as handheld media players, ebook readers, and games, the entire operating system is small enough to be stored in ROM. For most other computers, the operating system program is quite large, so most of it is stored on a hard disk.

During the boot process, the operating system kernel is loaded into RAM. The **kernel** provides essential operating system services, such as memory management and file access. The kernel stays in RAM all the time your computer is on. Other parts of the operating system, such as customization utilities, are loaded into RAM as they are needed.

TERMINOLOGY NOTE

The term *boot* comes from the word *bootstrap*, which is a small loop on the back of a boot. Just as you can pull on a big boot using a small bootstrap, your computer boots up by first loading a small program into memory, and then it uses that small program to load a large operating system.

What is the boot process? The sequence of events that occurs between the time that you turn on a computer and the time that it is ready for you to issue commands is referred to as the **boot process**, or booting your computer.

Your computer's small **bootstrap program** is built into special ROM circuitry housed in the computer's system unit. When you turn on a computer, the ROM circuitry receives power and begins the boot process by executing the bootstrap program. Six major events happen during the boot process:

1. **Power up.** When you turn on the power switch, the power light is illuminated, and power is distributed to the computer circuitry.
2. **Start boot program.** The microprocessor begins to execute the bootstrap program that is stored in ROM.
3. **Power-on self-test.** The computer performs diagnostic tests of several crucial system components.
4. **Identify peripheral devices.** The computer identifies any peripheral devices that are connected and checks their settings.
5. **Load operating system.** If necessary, the operating system is copied from the hard disk to RAM.
6. **Check configuration and customization.** The microprocessor reads configuration data and executes any customized startup routines specified by the user.

TRY IT!

During the boot process on a desktop computer, what part of the operating system is loaded into RAM?

- ❍ Bootstrap loader
- ❍ Kernel
- ❍ ROM
- ❍ Desktop

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Why doesn't a computer simply leave the operating system in memory? Most of a computer's memory is volatile DRAM, which cannot hold any data when the power is off. Although a copy of the operating system is housed in RAM while the computer is in operation, this copy is erased as soon as the power is turned off.

In addition to RAM, computers have non-volatile memory circuitry, such as ROM, which can store data even when the power is off. Typically, ROM is not large enough to store an entire operating system.

Given the volatility of RAM and the insufficient size of ROM, computer designers decided to store the operating system on a computer's hard disk or solid state drive. During the boot process, a copy of the operating system is transferred into RAM, where it can be accessed quickly whenever the computer needs to carry out an input, output, or storage operation (Figure 4-6).

FIGURE 4-6

The bootstrap program copies the operating system into RAM, where it can be directly accessed by the processor to carry out input, output, or storage operations.

How do I know when the operating system is loaded? The operating system is loaded and the boot process is complete when the computer is ready to accept your commands. Usually, the computer displays an operating system prompt or a main screen. For example, Windows 8 displays the Start screen when the boot process is complete; Mac OS X displays the desktop and dock.

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USER INTERFACES

Do I ever interact directly with the OS? Although its main purpose is to control what happens behind the scenes, you can interact with the operating system to launch programs, manage files, configure your computer equipment, and customize your work environment.

The programs you use to accomplish these tasks are called utilities, but the general way you interact with an operating system and application software is referred to as the user interface.

What is a user interface? A **user interface** can be defined as the combination of hardware and software that helps people and computers communicate with each other. A personal computer's user interface includes a display device, mouse, and keyboard that allow you to view and manipulate your computing environment. It also includes software elements, such as icons, menus, and toolbar buttons.

How does the operating system affect the user interface? The operating system's user interface defines the so-called look and feel of compatible software. For example, application software that runs under Mac OS uses a standard set of menus, buttons, and toolbars based on the operating system's user interface. Originally, computers had a **command-line interface** that required users to type memorized commands to run programs and accomplish tasks.

Command-line user interfaces can be accessed from most operating systems, including Windows and Mac OS. Experienced users and system administrators sometimes prefer to use a command-line interface for troubleshooting and system maintenance. Figure 4-7 illustrates the use of a command-line interface.

FIGURE 4-7

A command-line user interface requires users to type commands. Here the prompt C:\MYDATA> means the computer is looking at the MYDATA folder of drive C. The user has tried to start a program called Paint, but that program does not exist in the current folder, so the computer has produced the error message "Bad command or file name."

What kind of UIs do modern computers have? Most computers today feature a graphical user interface, abbreviated as GUI and pronounced as "gooey" or "gee you eye." A **graphical user interface** provides a way to select menu options and manipulate graphical objects displayed on the screen using a mouse or gesture.

GUIs were originally conceived at the prestigious Xerox PARC research facility. In 1984, Apple turned the idea into a commercial success with the launch of its popular Macintosh computer, which featured a GUI operating system and applications. Graphical user interfaces didn't really catch on in the PC market until the 1992 release of Windows 3.1.

TRY IT!

How long have computers had GUIs?

- ❍ About 5 years
- ❍ About 10 years
- ❍ About 20 years
- ❍ More than 25 years

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What are the basic control elements of a GUI? GUIs are based on graphical objects that can be manipulated using a touchscreen, mouse, or other input device. Each graphical object represents a computer task, command, or real-world object.

Desktops and windows. A **desktop** is a visual work area that covers the entire screen and remains in the background throughout a computing session. A desktop includes a **taskbar** or **dock** for launching applications, which are displayed in rectangular **application windows** on the desktop. These application windows can be resized and repositioned so you can simultaneously work on multiple projects (Figure 4-8).

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FIGURE 4-8

This Mac desktop stretches over the entire screen and displays windows, icons, and a dock for launching applications.

Start screens. A **Start screen**, popular on handheld devices, appears at the end of the boot process and whenever it is invoked by the user, commonly by pressing the Home button. Start screens display icons or tiles for apps, so that you can select the one you want to use (Figure 4-9).

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FIGURE 4-9

This Start screen is displayed when the iPad starts, and any time the user presses the Home button.

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Icons. An **icon** is a small picture that represents a program, file, or hardware device. Some icons are designed as **tiles**, which can display information feeds of live data (Figure 4-10).

FIGURE 4-10
Icons (left) and Tiles (right)

Buttons, toolbars, and taskbars. A **button** is a graphic—usually rectangular in shape—that can be clicked to make a selection. Buttons can be arranged in a **toolbar** or displayed on a taskbar (Figure 4-11).

FIGURE 4-11
Buttons can be arranged on a taskbar (top) or on a toolbar (bottom).

Menus and ribbons. A **menu** displays a list of commands or options on a **menu bar**. Each line of the menu is referred to as a menu option or a menu item. Menus were developed in response to the difficulties many people experienced trying to remember command words and syntax for command-line user interfaces. Menus are popular because you simply choose the command you want from a list. Also, because all the commands on the list are valid, it is not possible to invoke invalid commands that generate errors (Figure 4-12).

FIGURE 4-12
Clicking a command word on the menu bar displays a list of menu options.

A **ribbon** is an alternative type of menu that is arranged as rows of tools on a succession of tabs. Microsoft pioneered the ribbon interface element, which was incorporated in the last several editions of Microsoft Office (Figure 4-13).

FIGURE 4-13
Each tab on the ribbon contains a series of command options.

You might wonder how a menu can present all the commands you might want to use. Obviously, there are many possibilities for combining command words so there could be hundreds of menu options. Two methods are generally used to present a reasonably sized list of options: submenus and dialog boxes.

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A **submenu** is an additional set of commands that the computer displays after you make a selection from the main menu. Sometimes a submenu displays another submenu, providing even more command choices (Figure 4-14).

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FIGURE 4-14

Menu options with a ▶ symbol lead to submenus.

Some menu and ribbon options lead to a dialog box. A **dialog box** displays the options associated with a command. You fill in the dialog box to indicate specifically how you want the command carried out. Dialog boxes, like the one shown in Figure 4-15, appear when you click a dialog box launcher or when you click a menu item that ends with the three dots of an ellipsis.

How similar are the user interfaces for Windows, Mac OS, and Linux? All of the popular desktop operating systems use graphical user interfaces that are more similar than they are different. Regardless of whether you use Windows, Mac OS, or Linux, you'll encounter a fairly standard set of on-screen controls. They might differ in their visual design, but it is easy to determine how to use them. In the next section of the chapter, you'll learn more about the similarities and differences in today's popular operating systems.

FIGURE 4-15

A dialog box contains controls to specify settings for a task.

QuickCheck

SECTION A

1. An operating system manages a computer's _____, such as RAM, storage, and peripherals.
2. Most personal computer operating systems have _____ capabilities so that they can simultaneously run two or more tasks, jobs, or programs.
3. The core part of an operating system is called its _____.
4. During the _____ process, a program stored in ROM tells the hard disk to load the operating system into RAM.
5. Most computers today have _____ user interfaces.

CHECK ANSWERS

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Today's Operating Systems

SECTION **B**

CONSUMERS HAVE A CHOICE of computer operating systems. What makes these operating systems different? What are their strengths and weaknesses? Section B offers an operating system overview designed to give you a basic familiarity with their features.

MICROSOFT WINDOWS

What's the best-selling operating system? **Microsoft Windows** is installed on more than 80% of the world's personal computers. It features a Start screen with colorful tiles that can be used to launch applications, connect to Internet-based sites and services, or access a multitasking desktop environment (Figure 4-16).

FIGURE 4-16

Microsoft Windows is the world's most popular operating system. The Start screen is displayed on startup. Clicking a tile launches an application. To redisplay the Start screen, press the Windows key on the keyboard or the Start button on a Windows smartphone or tablet. Tour the Windows desktop and find out how to set up live tiles.

What do I need to know about the evolution of Windows? From its inception, the Windows operating system was designed to run on Intel or Intel-compatible microprocessors. The first PCs used a command-line operating system called **DOS** (Disk Operating System).

To create Microsoft Windows, developers used the DOS kernel, but added a point-and-click graphical user interface. Since its introduction in 1985, Windows has evolved through several versions, listed in Figure 4-17 on the next page.

TRY IT!

Before Windows, PCs used a command-line user interface called _____ .

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Why "Windows"? The Windows operating system got its name from the rectangular work areas on the screen-based desktop. Each window can display a different document or program, which provides a visual model of the operating system's multitasking capabilities (Figure 4-18).

FIGURE 4-18 The Windows desktop can display multiple application windows.

Through many editions, the Windows user interface was characterized by a colorful Start button in the lower-left corner of the screen (Figure 4-19). Clicking the Start button produced a menu for quickly accessing programs, files, and settings. The Start button was replaced by the Start screen with the release of Windows 8.

FIGURE 4-19 Legacy versions of Windows featured a Start button and Start menu.

FIGURE 4-17

Windows Timeline

2012	**Windows 8** Replaced the Start button with a Start screen.
2009	**Windows 7** Featured 64-bit support, enhanced desktop and taskbar features, and touchscreen capabilities.
2007	**Windows Vista** Featured 64-bit support, enhanced security, and more flexible file management.
2001	**Windows XP** Featured an updated user interface, used the Windows 2000 32-bit kernel, and supported FAT32 and NTFS file systems.
2000	**Windows Me** The last Windows version to use the original Windows kernel that accesses DOS.
2000	**Windows 2000** Billed as a "multipurpose network OS for businesses of all sizes" and featured enhanced Web services.
1998	**Windows 98** Increased stability was a big feature of this Windows version, which also included the Internet Explorer browser.
1995	**Windows 95** Featured a revised user interface. Supported 32-bit processors, dial-up networking, and long file names.
1993	**Windows NT** Provided management and security tools for network servers and the NTFS file system.
1992	**Windows for Workgroups** Provided peer-to-peer networking, e-mail, group scheduling, and file and printer sharing.
1992	**Windows 3.1** Introduced program icons and the file folder metaphor.
1990	**Windows 3.0** Introduced graphical controls.
1987	**Windows 2.0** Introduced overlapping windows and expanded memory access.
1985	**Windows 1.0** Divided the screen into rectangular windows that allowed users to work with several programs at the same time.

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Does Windows 8 run on tablets and phones, too? Microsoft offers several editions of Windows 8 designed for desktop and laptop computers. In addition to basic Windows 8, consumers can purchase Windows 8 Pro and Windows 8 Enterprise editions, designed for power users and businesses. Windows 8 Pro also runs on a select group of Intel-based tablet computers, offering the complete Windows 8 experience and access to the vast array of Windows software.

Windows RT is designed as a mobile operating system for tablet devices with ARM processors (Figure 4-20). It does not include a full-featured desktop and will not run Windows desktop applications. Like other mobile operating systems, Windows RT limits software to apps obtained through an authorized online store.

Windows Phone 8 is designed for smartphones. It features a Start screen and live tiles similar to Windows RT.

© MediaTechnics

FIGURE 4-20

Microsoft offers several versions of Windows designed for different computing tasks and equipment.

What are the strengths of Windows? The number and variety of programs that run on Windows are unmatched by any other operating system. For the best selection of software, especially for games and business software, Windows is the operating system of choice.

The Windows user community is also a strength. Comprehensive tutorials and troubleshooting guides can be found online and on the shelves of most bookstores. Microsoft's official site, *www.microsoft.com*, includes thousands of pages of easily searchable information.

With the largest user base of any platform, Windows computer owners can select from a vast array of peripheral devices. Many of the fastest graphics cards and the coolest joysticks are offered exclusively for the Windows platform.

What are Windows' weaknesses? Windows has been criticized for two major weaknesses: reliability and security. The reliability of an operating system is usually gauged by the length of time it operates without glitches. Windows tends to become unstable with more frequency than other operating systems.

Slow system response, programs that stop working, and error messages can be symptoms of a Windows malfunction. Rebooting usually clears the error condition and returns a computer to normal functionality, but the time wasted shutting down and waiting for a reboot adds unnecessary frustration to the computing experience.

Of the major desktop operating systems, Windows has the reputation for being the most vulnerable to viruses, worms, and other attacks. One reason for Windows' vulnerability is because its huge user base makes it the biggest target for hackers. Although Microsoft is diligent in its efforts to patch security holes, its programmers are often one step behind the hackers; and while users wait for patches, their computers are vulnerable.

TRY IT!

Which edition of Windows 8 is installed on ARM tablets?

- ❍ Windows RT
- ❍ Windows Pro
- ❍ Windows Server 2012
- ❍ Windows Enterprise

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MAC OS

What's unique about Mac OS? **Mac OS** stands for Macintosh Operating System and it is the operating system designed for Apple's Macintosh line of computer systems. As a desktop operating system, Mac OS features a GUI with beautifully designed icons and multiple rectangular work areas to reflect multitasking capabilities.

Unique features of the Mac desktop include the Apple icon, the Dock, and an application menu bar fixed at the top of the screen. Figure 4-21 illustrates some basic features of the Mac desktop.

FIGURE 4-21

You can tell when you're using Mac OS by the Apple logo that appears on the menu bar. Tour the Mac OS desktop and compare it to the Windows desktop.

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What do I need to know about the evolution of Mac OS? Like Windows, Mac OS has been through a number of revisions. The original Classic Mac OS was introduced in 1984 and designed for a line of Macintosh computers based on the Motorola 68000 microprocessor.

In 2001, Classic Mac OS was rewritten to run on Macintosh computers containing PowerPC microprocessors produced by IBM. The new Mac OS was called Mac OS X (the X can be pronounced as either "ten" or the letter "X"). Mac OS X was much more sophisticated than its predecessor, with better memory management and multitasking capabilities.

In 2006, Macintosh hardware changed significantly with the switch from PowerPC to Intel processors. Mac OS X was again rewritten. The first version of Mac OS X to support the Intel architecture was Mac OS X version 10.4.4, sometimes referred to as Tiger. In 2012, Apple released Mac OS X 10.8 (Mountain Lion). A timeline of Mac OS development is detailed in Figure 4-22.

FIGURE 4-22

Mac OS X Timeline

2012	**Mac OS X 10.8 (Mountain Lion)** Offered support for storing files in iCloud, an Internet-based cloud storage and computing service.
2011	**Mac OS X 10.7 (Lion)** Integrated iPad-style gestures and App Store.
2009	**Mac OS X 10.6 (Snow Leopard)** Enhanced version to increase efficiency and reliability.
2007	**Mac OS X 10.5 (Leopard)** Supported both Intel and PowerPC processors; full support for 64-bit applications.
2006	**Mac OS X 10.4.4 (Tiger Intel)** First OS for Intel Macs.
2001	**Mac OS X 10.1 - 10.4 (Cheetah)** Desktop editions for PowerPC; new kernel based on UNIX-like, open source code.

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What are the strengths of Mac OS? Mac OS X has a reputation for being an easy-to-use, reliable, and secure operating system. Back when PC owners were struggling with an inscrutable command-line operating system, Macintosh owners were breezing along with a point-and-click GUI. According to industry observers, Macintosh developers have always been in the lead when it comes to intuitive user interface design.

The operating system kernel of Mac OS X is based on UNIX and includes industrial-strength memory protection features that contribute to a low incidence of errors and glitches. Mac OS X inherited a strong security foundation from UNIX that tends to limit the number of security holes and the damage that can be done by hackers who manage to slip in.

Another factor that contributes to the security of computers running Mac OS is that fewer viruses are designed to target Macs because the user base is much smaller than the Windows user base.

Regardless of the relative security of computers running Mac OS X, Macintosh owners should practice safe computing by applying software and OS patches as they become available, activating wireless network encryption, not opening suspicious e-mail attachments, and not clicking links embedded in e-mail messages.

In addition to reliability and security, Mac OS X offers dual boot options and a good virtual machine platform.

What is dual boot? Mac OS X on an Intel Mac offers the ability to run Windows and Windows application software in addition to software designed for the Macintosh. Software called Boot Camp is a **dual boot** utility that can switch between Mac OS X and Windows. When booting, you can select either Mac OS X or Windows (Figure 4-23). To change operating systems, you have to reboot.

FIGURE 4-23

On a Macintosh computer with Boot Camp, you can boot into Mac OS X or into Windows. See how it works!

What is a virtual machine? Mac OS X is also a good platform for **virtual machine** (VM) technologies that allow you to use one computer to simulate the hardware and software of another. Each virtual machine has its own simulated processor (or core processor), RAM, video card, input and output ports, and operating system. Each machine can run most software that's compatible with the virtual OS platform.

TRY IT!

Dual boot or _____ machine technology can be used to run two different operating systems on a single computer.

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Popular virtual machine software such as VMware and Parallels Desktop can run on most computers with Intel microprocessors, including Intel Macs, PCs, and generic Linux computers. The computer boots into its native OS such as Mac OS, but users can create a virtual machine running guest operating systems, such as Windows. The virtual machine's desktop appears in a window on the host desktop (Figure 4-24).

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FIGURE 4-24

On a Mac with virtual Windows and Linux, switching from one operating system to another is as simple as selecting a window. When switched to the Windows work area, you can run games, business software, and other applications designed for the Windows OS. By clicking the Linux work area, you could run Linux applications from its vast collection of open source software. After returning to the Mac OS X desktop, you could run your collection of high-end graphics and multimedia iLife software designed exclusively for the Macintosh.

What are the weaknesses of Mac OS? The weaknesses of Mac OS include a somewhat limited selection of software and its use of resource forks. A decent collection of software is available for computers that run Mac OS, although the selection is not as vast as the Windows collection. Many of the most prolific software publishers produce one version of their software for Windows and another, similar version for Mac OS.

Macintosh computer owners might find that many popular software titles are not available for Mac OS X. The selection of games, for example, is much sparser than for Windows, although it should be noted that the selection of graphics software for Mac OS X is as good as or better than the selection available for Windows.

What is a resource fork? In most operating systems, a file is a single unit that contains data or program code. Files maintained by the Macintosh operating system, however, can have two parts, called forks. The **data fork** is similar to files in other operating systems. It contains data, such as the text for a document, the graphics for a photo, or the commands for a program. The **resource fork** is a companion file that stores information about the data in the data fork, such as the file type and the application that created it.

Although resource forks have advantages on their native Macintosh platform, they can be a nuisance when files are transferred to other platforms. When you copy a file from a Mac to a Windows computer, for example, you end up with two files: one for the data fork and one for the resource fork. The resource fork begins with a period and can usually be ignored or deleted from the Windows directory.

TRY IT!

OS X files have data and resource _____ .

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iOS

What is iOS? Because Mac OS X was designed for desktop and laptop computers, Apple developed **iOS** as an operating system for the Apple iPhone, which launched in 2007. iOS was subsequently used for the iPod Touch and iPad. All iOS devices use ARM-based microprocessors.

Is iOS related to Mac OS X? iOS is derived from the Mac OS X code, and shares its UNIX roots. The appearance of iOS has similarities to Mac OS X. Both operating systems feature icons that look three-dimensional.

How does iOS work? iOS displays a home screen containing application icons. At the bottom of the screen, a dock holds icons for frequently used apps. Touching an app launches it. Pressing the physical Home button located on the device returns the user to the home screen (Figure 4-25).

FIGURE 4-25

iPhones, iPod Touches, and iPads use the iOS operating system.

See how it works!

Apps can be grouped into folders to save space on the Home screen. Touching and holding an app icon produces "Jiggle mode" in which icons vibrate to indicate they are in a modifiable state. From Jiggle mode, icons can be deleted or dragged on top of each other to put them into a folder.

iOS was the first operating system to offer routines to manage touchscreen gesture inputs, such as using your fingers to "squeeze" an on-screen graphic into a smaller size.

As a mobile operating system, iOS provides connectivity options, such as 3G and 4G cell phone connections, as well as local networking. Though all iOS devices have Wi-Fi and Bluetooth capability, only iPhones and some iPads have cellular capabilities.

What are the limitations of iOS? iOS limits your selection of apps to those provided by the online Apple App store, unless you jailbreak the phone. Jailbreaking also overcomes other limitations, such as access to the file system. Unlike full desktop operating systems, iOS does not include a file manager. The only way to access a data file is through the app that was used to create it.

You won't find a desktop with application windows on an iOS device. Each app fills the entire screen. Background processes, such as music, voice calls, and notifications, provide very limited multitasking.

TRY IT!

Which device does NOT use iOS?

- ❍ iPhone
- ❍ MacBook Air
- ❍ iPad
- ❍ iPod Touch

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ANDROID

What is Android? **Android** is a mobile operating system that is a popular platform for tablet computers, smartphones, and ebook readers. Android was developed by a consortium of technology companies and unveiled in 2007. It is an open source operating system under the project leadership of Google. As with other popular mobile operating systems, Android is designed for ARM processors.

How does Android work? Android displays a home screen containing icons that represent software applications. Touching an icon launches the app.

Unlike iOS and Windows RT devices, Android devices have a screen-based home button, rather than a physical button. Touching the on-screen home button recalls the home screen (Figure 4-26).

FIGURE 4-26

All the Android controls can be accessed from the screen.

What's unique about Android? In addition to touchscreen input, the Android OS supports voice input for Google searching, voice dialing, navigation, and other applications.

The Android OS contains basic network and routing routines that allow Android devices to become Wi-Fi hotspots. For example, activating the Network utility on an Android-based smartphone transforms the phone into a router, and the phone's data connection can be used by a nearby desktop, laptop, or tablet computer to access the Internet.

Android gives you access to the file system and provides a utility that lets you view the files stored internally or on external SD cards. A third-party file manager utility is required to manipulate files.

TRY IT!

Where can you find the Home button on an Android device?

- ❍ On the Start menu
- ❍ On the system unit
- ❍ Next to the Apple icon
- ❍ At the bottom of the screen

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UNIX AND LINUX

Are UNIX and Linux the same? The **UNIX** operating system was developed in 1969 at AT&T's Bell Labs. It gained a good reputation for its dependability in multiuser environments, and many versions of it became available for mainframes and microcomputers.

In 1991, a young Finnish student named Linus Torvalds developed the **Linux** (pronounced "LIH nucks") operating system. Linux was inspired by and loosely based on a UNIX derivative called MINIX, created by Andrew Tanenbaum. Linux is frequently used as an operating system for servers. It is not as popular for desktop applications as Windows or Mac OS.

What are the strengths of Linux? Linux is rather unique because it is distributed along with its source code under the terms of a GPL (General Public License), which allows everyone to make copies for their own use, to give to others, or to sell. This licensing policy has encouraged programmers to develop Linux utilities, software, and enhancements. Linux is primarily distributed over the Web.

Linux shares several technical features with UNIX, such as multitasking and multiuser capabilities. It is also secure and reliable. Android OS, iOS, and Mac OS are based on UNIX and Linux kernels.

What are the weaknesses of Linux? Linux requires more tinkering than the Windows and Mac desktop operating systems. The comparatively limited number of programs that run under Linux also discourages many nontechnical users. A constantly growing collection of high-quality open source software is becoming available for the Linux platform, but many of these applications are targeted toward business and technical users.

How do I get Linux? A **Linux distribution** is a download that contains the Linux kernel, system utilities, graphical user interface, applications, and an installation routine. Beginner-friendly Linux distributions include Fedora, Mint, Debian, openSUSE, and Ubuntu (Figure 4-27).

TRY IT!

What is significant about UNIX?

- ❍ It is the most dependable mobile operating system
- ❍ It is the basis for Linux, Android, iOS, and Mac OS
- ❍ It is part of the PC platform
- ❍ It is the newest operating system

FIGURE 4-27

Linux users can choose from several graphical interfaces. Pictured here is the popular Ubuntu graphical desktop. With your interactive eBook, you can tour Linux and compare it to using Windows and Mac OS.

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BLACKBERRY OS

What's BlackBerry OS? **BlackBerry OS** is a proprietary operating system produced by RIM, the Canadian company that developed the BlackBerry smartphone. A key feature of BlackBerry OS is its ability to work with corporate e-mail software systems produced by Microsoft and IBM.

What's unique about BlackBerry OS? RIM pioneered the idea of **push technology** in which notifications are automatically sent to a device. For example, rather than collect e-mail using a Get Mail button, push technology automatically sends new messages to your device and notifies you when they arrive (Figure 4-28).

FIGURE 4-28

BlackBerry devices are known for push technology.

BlackBerry devices can be integrated into a wireless platform designed for corporate-wide secure exchange of encrypted e-mail, calendars, and text messages. The exchange is handled by the BlackBerry Enterprise Server, a software package that can be deployed by independent corporations.

RIM also offers direct Internet connections, which don't require a third-party carrier, such as AT&T or Verizon. As with the enterprise platform, data is encrypted before being sent over secure connections. The significance of encrypted data is that it cannot be intercepted by corporate spies or government censors. In recent years, RIM has been challenged by several governments to establish censorship mechanisms that pierce through the veil of encryption.

QuickCheck

SECTION B

1. Microsoft Windows featured the first graphical user interface. True or false? _____
2. A resource _____ is a companion file created by Mac OS to store information about a file and its data.
3. VMware and Parallels Desktop are examples of _____ machine technology that can be used to run Windows software on a Mac.
4. The operating system for iPads, iPod Touches, and iPhones is called _____ .
5. Tablets and smartphones with the _____ operating system have a screen-based home button, rather than a physical button.

CHECK ANSWERS

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File Basics

SECTION C

COMPUTER FILES IN DIGITAL format offer a compact and convenient way to store documents, photos, videos, and music. Computer files have several characteristics, such as a name, format, location, size, and date. To make effective use of computer files, you'll need a good understanding of these file basics, and that is the focus of Section C.

FILE NAMES AND EXTENSIONS

What is a computer file? As you learned in Chapter 1, a computer file—or simply a file—is defined as a named collection of data that exists on a storage medium, such as a hard disk, CD, DVD, or USB flash drive. A file can contain a group of records, a document, a photo, music, a video, an e-mail message, or a computer program.

What are the rules for naming files? Every file has a name and might also have a file extension. When you save a file, you must provide a valid file name that adheres to specific rules, referred to as **file-naming conventions**. Each operating system has a unique set of file-naming conventions. Figure 4-29 lists file-naming conventions for the current versions of Windows and Mac OS.

Is there a maximum length for file names? Current versions of Windows and Mac OS support file names up to 255 characters long. In practice, some of the 255 characters are used for the file's drive letter, folder designation, and extension, so the name you assign to a file should be much shorter. A file name limitation of 255 characters gives you the flexibility to use descriptive file names, such as *Household Budget 2014*, so that you can easily identify what a file contains.

What is a file extension? A **file extension** (sometimes referred to as a file name extension) is an optional file identifier that is separated from the main file name by a period, as in *Paint.exe*. File extensions provide clues to a file's contents. For example .exe files (Windows) and .app files (Mac OS) contain computer programs.

Why are certain characters not allowed in a file name? If an operating system attaches special significance to a symbol, you might not be able to use it in a file name. For example, Windows uses the colon (:) character to separate the device letter from a file name or folder, as in

FIGURE 4-29

Windows File-naming Conventions

Case sensitive	No
Maximum length of file name	File name, path, and extension cannot exceed 255 characters
Spaces allowed	Yes
Numbers allowed	Yes
Characters not allowed	* \ : < > | " / ?
File names not allowed	Aux, Com1, Com2, Com3, Com4, Con, Lpt1, Lpt2, Lpt3, Prn, Nul

Macintosh File-naming Conventions

Case sensitive	No
Maximum length of file name	File name, path, and extension cannot exceed 255 characters
Spaces allowed	Yes
Numbers allowed	Yes
Characters not allowed	: (the colon)

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C:Music. A file name that contains a colon, such as *Report:2014*, is not valid because the operating system would become confused about how to interpret the colon. When you use Windows applications, avoid using the symbols : * \ < > | " / and ? in file names.

TRY IT!

Which file name would NOT be allowed under Windows or Mac OS?

- ❍ Budget: Jan-Mar
- ❍ MacBook Air
- ❍ Navy Aux 504
- ❍ Paint.exe

What are reserved words? Some operating systems also contain a list of **reserved words** that are used as commands or special identifiers. You cannot use these words alone as a file name. You can, however, use these words as part of a longer file name. For example, under Windows, the file name *Nul* would not be valid, but you could name a file something like *Nul Committee Notes.docx* or *Null Set.exe*.

What else should I know about creating file names? Some operating systems are case sensitive, but not those you regularly work with on personal computers. Feel free to use uppercase and lowercase letters in file names that you create on PCs and Macs.

You can also use spaces in file names. That's a different rule than for e-mail addresses, where spaces are not allowed. You've probably noticed that people often use underscores or periods instead of spaces in e-mail addresses such as Madi_Jones@msu.edu. That convention is not necessary in file names, so a file name such as *Letter to Madi Jones* is valid.

FILE DIRECTORIES AND FOLDERS

How do I designate a file's location? To designate a file's location, you must first specify the device where the file is stored. As shown in Figure 4-30, you can store files on a hard drive, removable storage, a network computer, or cloud-based storage.

FIGURE 4-30

Files can be stored on local devices, on a network, or in the cloud. Before storing files on a network, you might need permission. To store files using a cloud-based service, such as Microsoft's SkyDrive, you'll have to sign up for an account.

What does C: mean? When working with Windows, each local storage device is identified by a device letter. The main hard disk drive is referred to as drive C. A device letter is usually followed by a colon, so C: is typically the designation for a hard disk drive. See if you can spot it in the figure above. Removable storage devices are assigned drive letters when they are inserted.

Macs do not use drive letters. Every storage device has a name. The main hard disk is called Macintosh HD, for example.

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What is a disk partition? A **disk partition** is a section of a hard disk drive that is treated as a separate storage unit. Most computers are configured with a single hard disk partition that contains the operating system, programs, and data. However, it is possible to create more than one hard disk partition. For example, a PC owner might set up one partition for operating system files and another partition for programs and data. This arrangement sometimes can speed up the process of disinfecting a computer that has been attacked by malicious software.

Partitions can be assigned drive letters. In the example above, the operating system files would be stored in partition C. The program and data file partition would probably be designated as drive D. Partitions are not the same thing as folders. Partitions are more permanent, and a special utility is required to create, modify, or delete them.

TERMINOLOGY NOTE

Drive letter assignments are based on conventions that date back to the first PCs. The original IBM PCs shipped with a single floppy disk drive and it was designated drive A. An enhanced PC later shipped with two floppy disk drives, designated A and B. When hard disk drives were eventually added to PC systems, they were designated drive C.

Do I have to remember where I put each file? Every storage device has a **directory** containing a list of its files. The main directory is referred to as the **root directory**. On a PC, the root directory is identified by the device letter followed by a backslash. For example, the root directory of the hard disk would be C:\. A root directory can be subdivided into smaller lists. Each list is called a **subdirectory**.

What is a folder? When you use Windows, Mac OS, or a Linux graphical file manager, each subdirectory is depicted as a **folder**. Folders help you envision your files as if they were stored in a filing cabinet. Each folder can hold related items; for example, a set of documents, sound clips, financial data, or photos for a school project. Windows provides a folder called My Documents that you might use to hold reports, letters, and so on. You can also create and name folders to meet your needs, such as a folder called QuickBooks to hold your personal finance data.

TRY IT!

Look at the directory listing for your computer's hard disk. How many folders does the root directory contain?

Folders can be created within other folders. You might, for example, create a Jazz folder within your Music folder to hold a collection of jazz tracks, and another folder named Reggae to hold your reggae music collection.

A folder name is separated from a drive letter and other folder names by a special symbol. In Microsoft Windows, this symbol is the backslash (\). For example, the folder for your reggae music (within the Music folder on drive C) would be written as C:\Music\Reggae. Other operating systems use a forward slash (/) to separate folders.

A computer file's location is defined by a **file specification** (sometimes called a **path**), which on a PC includes the drive letter, folder(s), file name, and extension. Suppose that you have stored an MP3 file called *Marley One Love* in the Reggae folder on your hard disk. Its file specification is shown in Figure 4-31.

FIGURE 4-31

A file specification provides the name and location of a file.

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FILE FORMATS

What is a file format? The term **file format** refers to the organization and layout of data that is stored in a file. As you might expect, music files are stored differently than text files or graphics files; but even within a single category of data, there are many file formats. For example, graphics data can be stored in file formats such as BMP, GIF, JPEG, or PNG.

The format of a file usually includes a header, data, and possibly an end-of-file marker. A **file header** is a section of data at the beginning of a file that contains information about a file, such as the date it was created, the date it was last updated, its size, and its file type.

The remaining contents of a file depend on whether it contains text, graphics, audio, or multimedia data. A text file, for example, might contain sentences and paragraphs interspersed with codes for centering, boldfacing, and margin settings. A graphics file might contain color data for each pixel, followed by a description of the color palette. Figure 4-32 illustrates the format for a Windows bitmap (BMP) file and contrasts it with the format of a GIF file.

TRY IT!

What happens to the contents of a file if you change its file name extension?

- ❍ Nothing happens
- ❍ The contents are erased
- ❍ The contents are converted into a format that corresponds to the extension
- ❍ The extension is added to the file header

4

FIGURE 4-32

Although BMP and GIF file formats contain graphics, the file layouts differ.

Is a file extension the same as a file format? No. Although a file extension is a good indicator of a file's format, it does not really define the format. You could use the Rename command to change a QuickTime movie called *Balloons.mov* to *Balloons.docx*. Despite the .docx extension, the file is still in QuickTime format because the data elements in the file are arranged in a specific configuration unique to QuickTime.

What should I know about file formats? Each software application works with specific file formats. When you use the Open dialog box, most applications automatically comb through your files to display a list of files that are stored in file formats they can use.

Some operating systems also do a fairly good job of shielding users from the intricacies of file formats. For example, Windows uses a file association list to link file formats with corresponding application software so that when you double-click a file name, your computer automatically opens a software application that works with the correct file format.

With all this help from the operating system and your application software, it might seem that knowing about file formats is unimportant. However, understanding file formats is useful for accomplishing tasks such as those listed in Figure 4-33.

FIGURE 4-33

Understanding file formats helps you perform the following tasks:

- Figure out the correct format for e-mail attachments that you send to friends or colleagues.
- Find the right player software for music and media files that you download from the Web.
- Discover how to work with a file that doesn't seem to open.
- Convert files from one format to another.

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Which file formats am I most likely to encounter? A Windows software program consists of at least one executable file with an .exe file extension. It might also include a number of support programs with extensions such as .dll, .vbx, and .ocx. Configuration and startup files usually have .bat, .sys, .ini, and .bin extensions. In addition, you'll find files with .hlp and .tmp extensions. Files with .hlp extensions hold the information for a program's Help utility.

Files with .tmp extensions are temporary files. When you open a data file with software applications, such as word processors, spreadsheets, and graphics tools, your operating system makes a copy of the original file and stores this copy on disk as a temporary file. It is this temporary file that you work with as you view and revise a file.

To the uninitiated, the file extensions associated with programs and the operating system might seem odd. Nevertheless, executable and support files—even so-called temporary files—are crucial for the correct operation of your computer system. You should not manually delete them. The table in Figure 4-34 lists file extensions associated with the Windows operating system and executable files.

TRY IT!

Suppose your friend sends you a file with an .ods extension. You can probably open it with what?

- ❍ Graphics software
- ❍ LibreOffice
- ❍ Microsoft Publisher
- ❍ iTunes

FIGURE 4-34

Executable File Extensions

Type of File	Description	Extension
Batch file	A sequence of operating system commands executed automatically when the computer boots	.bat
Configuration file	Information about programs the computer uses to allocate the resources necessary to run them	.cfg .sys .mif .bin .ini
Help	The information displayed by on-screen Help	.hlp
Temporary file	A sort of scratch pad that contains data while a file is open, but is discarded when you close the file	.tmp
Support program	Program instructions executed along with the main .exe file for a program	.ocx .vbx .vbs .dll
Program	The main executable files for a computer program	.exe .com .app (Mac OS)

The list of data file formats is long, but becoming familiar with the most popular formats (shown in Figure 4-35) and the type of data they contain is useful, whether you are using a PC or Mac.

FIGURE 4-35

Data File Extensions

Type of File	Extensions
Text	.txt .dat .rtf .docx (Microsoft Word) .doc (Microsoft Word 2003) .odt (OpenDocument text) .wpd (WordPerfect) .pages (iWork)
Sound	.wav .mid .mp3 .m4p .aac
Graphics	.bmp .tif .wmf .gif .jpg .png .eps .ai (Adobe Illustrator)
Animation/video	.flc .swf .avi .mpg .mp4 .mov (QuickTime) .wmv (Windows Media Player)
Web page	.htm .html .asp .vrml .php
Spreadsheet	.xlsx (Microsoft Excel) .xls (Microsoft Excel 2003) .ods (OpenDocument spreadsheet) .numbers (iWork)
Database	.accdb (Microsoft Access) .odb (OpenDocument database)
Miscellaneous	.pdf (Adobe Acrobat) .pptx (Microsoft PowerPoint) .qxp (QuarkXPress) .odp (OpenDocument presentations) .zip (WinZip) .pub (Microsoft Publisher)

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How do I know which files a program will open? A software application can open files that exist in its **native file format**, plus several additional file formats. For example, Microsoft Word opens files in its native DOCX (.docx) format, plus files in formats such as HTML (.htm or .html), Text (.txt), and Rich Text Format (.rtf).

Within the Windows environment, you can discover which formats a particular software program can open by looking at the list of file types in the Open dialog box, as shown in Figure 4-36.

FIGURE 4-36

An application's Open dialog box usually displays a list of file formats the program can open. You can also look for an Import option on the File menu.

Why can't I open some files? Suppose you receive an e-mail attachment called *Cool.tif*. "Aha!," you say to yourself, "My Photoshop software ought to open that file." You try—several times—but all you get is an error message. When a file doesn't open, one of three things probably went wrong:

- The file might have been damaged—a techie would call it corrupted—by a transmission or disk error. Although you might be able to use file recovery software to repair the damage, it is usually easier to obtain an undamaged copy of the file from its original source.
- Someone might have inadvertently changed the file extension. While renaming the Cool file, perhaps the original .bmp extension was changed to .tif. If you have a little time, you can change the file extension and try to open the file. If a file contains a graphic, chances are that it should have the extension for one of the popular graphics formats, such as .bmp, .gif, .jpg, .tif, or .png. Otherwise, you should contact the source of the file to get accurate information about its real format.
- Some file formats exist in several variations, and your software might not have the capability to open a particular variation of the format. You might be able to open the file if you use different application software. For example, Photoshop might not be able to open a particular file with a .tif file extension, but Corel PaintShop Pro might open it.

TRY IT!

Check your word processing software. If a friend sends you a file in .doc format, can you open it? _____

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What if all my software fails to open a particular file format? Although a computer might be able to discover a file's format, it might not necessarily know how to work with it. Just as you might be able to identify a helicopter, you can't necessarily fly it without some instructions. Your computer also requires a set of instructions to use most file formats. These instructions are provided by software. To use a particular file format, you must make sure your computer has the corresponding software.

Many files downloaded from the Web require special player or reader software. For example, PDF files require software called Adobe Reader, Flash video files require the Adobe Flash Player, and OGG music files require a player such as Winamp. Suppose you download a file with an .ogg extension and none of your current software works with this file format (Figure 4-37).

FIGURE 4-37

A download from the music group Epoq is in OGG format. To play the file, you'll need software that works with the OGG file format.

Typically, you can follow a link from the Web page that supplied your file download to find a site from which you can download the necessary player or reader software. When such a link is not provided, you can google the file type or extension. Several Web sites provide lists of file formats and corresponding software. By looking up a file extension in one of these lists, you can find out what application software you'll need to download and install.

TRY IT!

Check your computer. Do you have software that reads PDF files? _____

How do I know what kinds of file formats I can send to other people? Unless you know what application software is installed on your friends' computers, you won't know for certain whether they can open a particular file you've sent. There's a good chance, however, that your friends can open files saved in common document formats such as Microsoft Word's DOCX or Adobe Reader's PDF format; graphics formats such as PNG, TIFF, or JPEG; and music formats such as MP3 and WAV. You should check with the recipient before sending files in less common, proprietary formats, such as Adobe Illustrator's AI format and QuarkXPress's QXP format.

Is it possible to convert a file from one format to another? Perhaps you created a Word document on your PC, but you need to convert it into a format that's usable by your colleague who is using LibreOffice Writer. Or suppose you want to convert a Word document into HTML format so that you can post it on the Web. You might also want to convert a BMP graphic into JPEG format so that you can include it on a Web page.

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The easiest way to convert a file from one format to another is to find application software that works with both file formats. Open the file using that software, and then use the Export option, or the Save As dialog box, to select a new file format, assign the file a new name, and save it (Figure 4-38).

FIGURE 4-38

An easy way to convert a file from one format to another is to open it with an application that supports both file formats, and then use the Save As dialog box to select an alternative file format. Discover the native file formats for Adobe Reader and Windows Paint. Your interactive eBook also shows you how to adjust the Windows setting for showing or hiding file extensions.

Will a converted document be identical to the original?

Many file formats convert easily to another format, and the resulting file is virtually indistinguishable from the original. Some conversions, however, do not retain all the characteristics of the original file. When you convert a DOCX file into HTML format, for example, the HTML page does not contain any of the headers, footers, superscripts, page numbers, special characters, or page breaks that existed in the original DOCX file.

When you need a conversion routine for an obscure file format, or if you need to make conversions between many different file formats, consider specialized conversion software, available through commercial or shareware outlets.

QuickCheck

SECTION C

1. .bmp, .docx, .exe, and .mov are examples of file _____ .
2. When using Windows, you cannot use a(n) _____ word, such as Aux, as a file name.
3. A disk _____ is a section of a hard disk drive that is treated as a separate storage unit.
4. A software application automatically stores files in its _____ file format unless you specify otherwise.
5. When you convert a DOCX file into HTML format, the resulting file is virtually indistinguishable from the original. True or false? _____

CHECK ANSWERS

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File Management

SECTION D

FILE MANAGEMENT ENCOMPASSES any procedure that helps you organize your computer-based files so that you can find and use them more efficiently. Depending on your computer's operating system, you can organize and manipulate files from within an application program or by using a special file management utility provided by the operating system. Section D offers an overview of application-based and operating system–based file management.

APPLICATION-BASED FILE MANAGEMENT

How does a software application help me manage files? Applications generally provide a way to open files and save them in a specific folder on a designated storage device. Some applications also allow you to delete and rename files.

What should I know about saving files? Saving files is easy. Simply use the Save option provided by your application, specify a location for the file, and give it a name. Some applications allow you to add a **file tag** that describes the file's contents (Figure 4-39).

FIGURE 4-39

Some PC applications, such as Microsoft Word, let you enter file tags when you save a file. Learn more about the Save As dialog box and sort out the differences between it and the Save option.

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What's the difference between the Save option and the Save As option? The Save As option allows you to select a name and storage device for a file, whereas the Save option simply saves the latest version of a file under its current name and at its current location.

A potentially confusing situation occurs when you try to use the Save option for a file that doesn't yet have a name. Because you can't save a file without a name, your application displays the Save As dialog box, even though you selected the Save option. So when do you use Save and when do you use Save As? Consider the alternatives in Figure 4-40.

Save or Save As When saving a file for the first time, you can use Save or Save As.

Save When you've revised a file and want to save just the newly revised file with the same name and on the same storage device, use Save.

Save as When you've revised a file and want to save the original version in addition to the newly revised version, use Save As, give the file a different name, and/or select a different storage location.

FIGURE 4-40

Save vs. Save As in Windows

Can I create a new folder while saving a file? Your computer's operating system supplies a ready-made set of folders for storing documents, music, videos, and downloads. You might want to better organize the files in these folders by creating subfolders.

When saving a file, if you don't see a suitable folder for it, create a new folder as shown in Figure 4-41.

FIGURE 4-41

When you create a new folder, pay attention to the hierarchy of devices and folders to be sure the new folder is created where you expect it to be.

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How about saving files on Macs? The latest versions of Mac OS have no Save As command. Figure 4-42 details how to use the Save, Duplicate, and Rename commands to accomplish file saving tasks.

FIGURE 4-42

Command Options for Saving Files Under Mac OS

Save Use this option when saving a file for the first time or after you've revised a file and want to save the revisions.

Duplicate Use this option when you want to save a copy of a file, such as when you've revised a document but want to keep the original version in addition to the revised version.

Rename Use this option along with the Duplicate option to give your revised version a different name than the original.

Can I add tags to Mac files? File tags are a type of **metadata** that describes the contents of a file. The term **metadata** essentially means "data about data." File tags are metadata that describe the data contained in a file.

You can use tags to specify keywords for a file that will later help you search for it; for example, if you can't remember the file name. Tags can also be used to annotate the file with information you want to remember, such as the status of a document that is in process, or the camera setting you used to create a particularly stunning photo.

Whereas Windows applications let you add tags as you save a file, Mac applications are tagged after they've been created using the Spotlight Comments field of the Get Info dialog box. Figure 4-43 explains how.

FIGURE 4-43

Use Get Info to add tags to Mac files.

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FILE MANAGEMENT METAPHORS

How does the operating system help me manage files? Although most application software gives you access to commands you can use to open, save, and rename files, you might want to work with groups of files or perform other file operations that are inconvenient within the Open or Save dialog boxes.

For these other tasks, you can use a **file management utility**, such as the Windows File Explorer or the Mac OS X Finder.

How can a file management utility help me visualize my computer's file storage? File management utilities often use some sort of storage metaphor to help you visualize and mentally organize the files on your disks and other storage devices. These metaphors are also called **logical storage models** because they are supposed to help you form a mental (logical) picture of the way in which your files are stored.

What storage metaphors are typically used for personal computers? After hearing so much about files and folders, you might have guessed that the filing cabinet is a popular metaphor for computer storage. In this metaphor, each storage device corresponds to one of the drawers in a filing cabinet. The drawers hold folders and the folders hold files.

Another storage metaphor is based on a hierarchical diagram that is sometimes referred to as a tree structure. In this metaphor, a tree represents a storage device.

The trunk of the tree corresponds to the root directory. The branches of the tree represent folders. These branches can split into small branches representing folders within folders. The leaves at the end of a branch represent the files in a particular folder (Figure 4-44).

The tree structure metaphor offers a useful mental image of the way in which files and folders are organized. It is not, however, particularly practical as a user interface. For practicality, storage metaphors are translated into more mundane screen displays. Figure 4-45 shows how Microsoft programmers combined the filing cabinet metaphor to depict a tree structure in the Windows file management utility.

FIGURE 4-44

You can visualize the directory of a disk as a tree on its side. The trunk corresponds to the root directory, the branches to folders, and the leaves to files.

FIGURE 4-45

File Explorer borrows folders from the filing cabinet metaphor and places them in a hierarchical structure similar to a tree on its side.

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FILE EXPLORER

How do I use a file management utility? As an example of a file management utility, take a closer look at **File Explorer**, a utility program bundled with the Windows operating system and designed to help you organize and manipulate the files stored on your computer.

The File Explorer window is divided into several window panes. The pane on the left side of the window lists each of the storage devices connected to your computer, plus several important system objects, such as Desktop and Computer.

An icon for a storage device or other system object can be expanded by clicking its corresponding ▷ symbol. Expanding an icon displays the next level of the storage hierarchy—usually a collection of folders.

A device icon or folder can be opened by clicking directly on the icon rather than on the ▷ symbol. Once an icon is opened, its contents appear in the pane on the right side of the File Explorer window. Figure 4-46 illustrates how to manipulate the directory display.

TERMINOLOGY NOTE

File Explorer is referred to as Windows Explorer in Windows 7 and earlier versions of Microsoft Windows.

FIGURE 4-46

File Explorer makes it easy to drill down through the levels of the directory hierarchy to locate a folder or file.

Learn how to navigate through the hierarchy of folders by watching the tour for this figure in your interactive eBook.

What can I do with the folders and files that are listed in File Explorer? In addition to locating files and folders, File Explorer helps you manipulate files and folders in the following ways:

- **Rename.** You might want to change the name of a file or folder to better describe its contents.
- **Copy.** You can copy a file from one device to another—for example, from a USB drive to the hard disk drive. You can also make a copy of a document so that you can revise the copy and leave the original intact.
- **Move.** You can move a file from one folder to another or from one storage device to another. When you move a file, it is erased from its original location, so make sure you remember the new location of the file. You can also move an entire folder and its contents from one storage device to another storage device, or move it to a different folder.
- **Delete.** You can delete a file when you no longer need it. You can also delete a folder. Be careful when you delete a folder because most file management utilities also delete all the files within a folder.

TRY IT!

In Figure 4-46, what is the status of the Favorites folder?

- ❍ Expanded
- ❍ Collapsed
- ❍ Deleted
- ❍ Restored

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Can I work with more than one file or folder at a time? To work with a group of files or folders, you must first select them. You can accomplish this task in several ways. You can hold down the Ctrl key (Command key on the Mac) as you click each item. This method works well if you are selecting files or folders that are not listed consecutively.

As an alternative, you can hold down the Shift key while you click the first item and the last item you want to select. By using the Shift key method, you select the two items that you clicked and all the items in between. After a group of items is selected, you can use the same copy, move, or delete procedure that you would use for a single item.

What are personal folders? Windows offers a set of preconfigured personal folders, such as My Documents and My Music, for storing your personal data files. Windows also supplies preconfigured Public folders, such as Public Documents and Public Pictures, that can be used to store files you want to share with other network users (Figure 4-47).

What is a library? In addition to folders, Windows 7 and 8 offer libraries that are handy for organizing and accessing the files you use for projects. A **library** is similar to a folder only in the sense that it can be used to group similar files; however, a library doesn't actually store files. Instead, it contains a set of links to files that are stored on various devices and in various folders.

Macs also have a Library folder, but its purpose is quite different from the Windows Library folder. The Mac Library folder is used for system files and should not be used for your data files.

To understand how you might use libraries in Windows, think about a collection of music files. Some files might be stored on your hard disk in the My Music folder. You might be using other music files for the soundtrack of a movie project stored in a folder called Soundtracks that is stored along with the video footage. Your Music library can contain links to the music files in both folders so that you can access them all from the same list (Figure 4-48).

FIGURE 4-47

Windows supplies a set of preconfigured personal folders and a corresponding set of Public folders.

FIGURE 4-48

A library is not a "real" location; it is more like an index in a book because it points to the location of a file.

Find out how to use libraries to organize files for your projects.

TERMINOLOGY NOTE

In Windows, libraries and personal folders have similar names, which can be confusing. Personal folders are labeled with "My" as in My Documents. The name of the corresponding library is simply Documents.

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FILE MANAGEMENT TIPS

A file management utility provides tools and procedures to help you keep track of your program and data files, but these tools are most useful when you have a logical plan for organizing your files and when you follow some basic file management guidelines. Consider the following tips for managing files on your own computer. When working with files on lab computers, follow the guidelines from your instructor or lab manager.

- **Use descriptive names.** Give your files and folders descriptive names, and avoid using cryptic abbreviations.
- **Maintain file extensions.** When renaming a file, keep the original file extension so that it can be opened with the correct application software.
- **Group similar files.** Separate files into folders based on subject matter. For example, store your creative writing assignments in one folder and your MP3 music files in another folder.
- **Organize your folders from the top down.** When devising a hierarchy of folders, consider how you want to access files and back them up. For example, it is easy to specify one folder and its subfolders for a backup. If your important data is scattered in a variety of folders, however, making backups is more time consuming.
- **Consider using default folders.** You should use personal folders, such as My Documents and My Music, as your main data folders. Add subfolders to these personal folders as necessary to organize your files.
- **Use Public folders for files you want to share.** Use the Public folders for files that you want to share with other network users.
- **Do not mix data files and program files.** Do not store data files in the folders that hold your software—on Windows systems, most software is stored in subfolders of the Program Files folder; on Macs, in the Applications folder.
- **Don't store files in the root directory.** Although it is acceptable to create folders in the root directory, it is not a good practice to store programs or data files in the root directory of your computer's hard disk.
- **Access files from the hard disk.** For best performance, copy files from USB drives or CDs to your computer's hard disk before accessing them.
- **Follow copyright rules.** When copying files, make sure you adhere to copyright and license restrictions.
- **Delete or archive files you no longer need.** Deleting unneeded files and folders helps keep your list of files from growing to an unmanageable size.
- **Be aware of storage locations.** When you save files, be sure to specify the correct storage device and folder.
- **Back up!** Back up your folders regularly.

PHYSICAL FILE STORAGE

Is data stored in specific places on a disk? So far, you've seen how an operating system such as Windows can help you visualize computer storage as files and folders. This logical storage model, however, has little to do with what actually happens on your disk. The structure of files and folders you see in File Explorer is called a logical model because it is supposed to help you create a mental picture. A **physical storage model** describes what actually happens on the disks and in the circuits. As you will see, the physical model is quite different from the logical model.

TRY IT!

Check the root directory of your computer. Does it contain any data files? _____

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Before a computer can store a file on a disk, CD, DVD, or BD, the storage medium must be formatted. The **formatting** process creates the equivalent of electronic storage bins by dividing a disk into **tracks** and then further dividing each track into **sectors**.

Tracks and sectors are numbered to provide addresses for each data storage bin. The numbering scheme depends on the storage device and the operating system. On hard disks, tracks are arranged as concentric circles; on CDs, DVDs, and BDs, one or more tracks spiral out from the center of the disk (Figure 4-49).

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FIGURE 4-49

A process called formatting prepares the surface of a disk to hold data in storage areas called sectors.

How does a disk get formatted? Today, most hard disks are preformatted at the factory. CDs, DVDs, and BDs are formatted by the utilities that you use when you copy data files to them. Before you write data to a CD, DVD, or BD, you usually have the option of formatting it for mastering or for packet writing (Figure 4-50).

- **Disc mastering** is the process of creating a CD, DVD, or BD by selecting all the files and then copying them in a single session. The process can take some time—especially when burning a full DVD or BD. Mastered discs are compatible with the largest number of computer optical drives and standalone players. Mastering also works well if you want to burn several copies of a disc.
- **Packet writing** is a recording technology that lets you record in multiple sessions. For example, you can copy a few files to a CD during one session, and then at a later date record additional files to the same CD. In Windows terminology, CDs, DVDs, and BDs formatted for packet writing are referred to as Live File System discs.

Packet writing is faster and more flexible than mastering, but discs created with packet writing might not work on all computers. A process called closing helps make the discs more compatible; but once a disc is closed, no more data can be added to it.

FIGURE 4-50

CDs and DVDs can be created using mastering or packet-writing techniques. Mastering creates discs that can be used more reliably on a wide variety of computers and standalone players. Packet writing is more flexible for discs that you plan to use only on your own computer.

How does the operating system keep track of a file's location? The operating system uses a **file system** to keep track of the names and locations of files that reside on a storage medium, such as a hard disk. Different operating systems use different file systems. For example, Mac OS X uses the Macintosh Hierarchical File System Plus (HFS+). Ext3fs (Third Extended File System) is the native file system for Linux. Microsoft Windows 8, 7, NT, 2000, XP, and Vista use a file system called NTFS (New Technology File System).

To speed up the process of storing and retrieving data, a disk drive usually works with a group of sectors called a **cluster** or a block. The number of sectors that form a cluster varies, depending on the capacity of the disk and the way the operating system works with files. A file system's primary task is to maintain a list of clusters and keep track of which are empty and which hold data. This information is stored in a special index file. If your computer uses NTFS, the index file is called the Master File Table (MFT).

TRY IT!

Which formatting option should you use to burn a DVD that can be used in the largest number of computers?

- ❍ Disc mastering
- ❍ Packet writing
- ❍ Live File system
- ❍ iTunes

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Each of your disks contains its own index file so that information about its contents is always available when the disk is in use. Unfortunately, storing this crucial file on disk also presents a risk because if the index file is damaged by a hard disk head crash or corrupted by a virus, you'll generally lose access to all the data stored on the disk. Index files become damaged all too frequently, so it is important to back up your data.

When you save a file, your PC's operating system looks at the index file to see which clusters are empty. It selects one of these empty clusters, records the file data there, and then revises the index file to include the new file name and its location.

A file that does not fit into a single cluster spills over into the next contiguous (meaning adjacent) cluster, unless that cluster already contains data. When contiguous clusters are not available, the operating system stores parts of a file in noncontiguous (nonadjacent) clusters. Figure 4-51 helps you visualize how an index file, such as the MFT, keeps track of file names and locations.

Master File Table

File	Cluster	Comment
MFT	**1**	Reserved for MFT files
DISK USE	**2**	Part of MFT that contains a list of empty sectors
Bio.txt	**3, 4**	Bio.txt file stored in clusters 3 and 4
Jordan.wks	**7, 8, 10**	Jordan.wks file stored noncontiguously in clusters 7, 8, and 10
Pick.bmp	**9**	Pick.bmp file stored in cluster 9

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FIGURE 4-51

Each colored cluster on the disk contains part of a file. *Bio.txt* is stored in contiguous clusters. *Jordan.wks* is stored in noncontiguous clusters. A computer locates and displays the *Jordan.wks* file by looking for its name in the Master File Table.

When you want to retrieve a file, the operating system looks through the index for the file name and its location. It moves the disk drive's read-write head to the first cluster that contains the file data. Using additional data from the index file, the operating system can move the read-write heads to each of the clusters containing the remaining parts of the file.

What happens when a file is deleted? When you click a file's icon and then select the Delete option, you might have visions of the read-write head somehow scrubbing out the clusters that contain data. That doesn't happen. Instead, the operating system simply changes the status of the file's clusters to "empty" and removes the file name from the index file. The file name no longer appears in a directory listing, but the file's data remains in the clusters until a new file is stored there.

You might think that this data is as good as erased, but it is possible to purchase utilities that recover a lot of this supposedly deleted data. Law enforcement agents, for example, use these utilities to gather evidence from deleted files on the computer disks of suspected criminals.

To delete data from a disk in such a way that no one can ever read it, you can use special **file shredder software** that overwrites supposedly empty sectors with random 1s and 0s. This software is handy if you plan to donate your computer to a charitable organization and you want to make sure your personal data no longer remains on the hard disk.

TRY IT!

In Figure 4-51, the Bio.txt file is stored in contiguous _____ .

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Can deleted files be undeleted? The Windows Recycle Bin and similar utilities in other operating systems are designed to protect you from accidentally deleting hard disk files you actually need. Instead of marking a file's clusters as available, the operating system moves the file to the Recycle Bin folder. The deleted file still takes up space on the disk, but does not appear in the usual directory listing.

Files in the Recycle Bin folder can be undeleted so that they again appear in the regular directory. The Recycle Bin can be emptied to permanently delete any files it contains.

How does a disk become fragmented? As a computer writes files on a disk, parts of files tend to become scattered all over the disk. These **fragmented files** are stored in noncontiguous clusters. Drive performance generally declines as the read-write heads move back and forth to locate the clusters containing the parts of a file. To regain peak performance, you can use a **defragmentation utility**, such as Windows Disk Defragmenter, to rearrange the files on a disk so that they are stored in contiguous clusters (Figure 4-52).

FIGURE 4-52

Defragmenting a disk helps your computer operate more efficiently. Consider using a defragmentation utility at least once a month to keep your computer running in top form. Your interactive eBook shows you how to defragment your computer's hard disk and how to find out how much space is available for storing files.

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On the fragmented disk (left), the purple, orange, and blue files are stored in noncontiguous clusters.

When the disk is defragmented (right), the sectors of data for each file are moved to contiguous clusters.

QuickCheck

SECTION D

1. Suppose you open a file and edit it, and then want to save it with a different name. You can use the Save option from the File menu. True or false? _____
2. _____ file storage models, such as a filing cabinet or tree metaphor, help you visualize the organization of your computer files.
3. Windows 8 offers a preconfigured Documents _____ that's designed to hold links to document files stored in various folders.
4. A hard disk stores data in concentric circles called _____, which are divided into wedge-shaped _____.
5. The acronyms NTFS, HFS+, and MFT pertain to _____ file storage models.

CHECK ANSWERS

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Backup Security

SECTION E

COMPUTER EXPERTS UNIVERSALLY recommend that you back up your data. It sounds pretty basic, right? Unfortunately, this advice tells you what to do, not how to do it. It fails to address some key questions, such as: Do I need special backup equipment and software? How often should I make a backup? How many of my files should I back up? What should I do with the backups? In this section, you'll find the answers to your questions about backing up data that's stored on personal and handheld computers.

BACKUP BASICS

Why do I need to make backups? Have you ever mistakenly copied an old version of a document over a new version? Has your computer's hard disk drive gone on the fritz? Did a virus wipe out your files? Did your smartphone fail? These kinds of data disasters are not rare; they can happen to everyone.

You can't always prevent data disasters, so you should have a **backup** that stores the files needed to recover data that's been wiped out by operator error, viruses, or hardware failures. Backups allow you to **restore** data from a backup to the original storage location or to a replacement device.

How often should I back up my data? Your backup schedule depends on how much data you can afford to lose. If you're working on an important project, you might want to back up the project files several times a day. Under normal use, however, most people schedule a once-a-week backup. If you work with a To Do list, use it to remind yourself when to make a backup or verify that your automated backup has been completed.

How can I be sure that my backup works? You should test your backup by trying to restore one file. Restore the test file to a different drive or folder to avoid overwriting the original file.

TRY IT!

Check the Web. According to Microsoft, about what percentage of computer owners actually make backups of their data?

- ❍ Less than 10%
- ❍ About 25%
- ❍ About 50%
- ❍ More than 50%

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Where should I store my backups? You can choose to store backups on local devices such as an external hard disk or a USB flash drive, or you might consider storing your backup on a server in a local network or on an Internet-based server (Figure 4-53).

FIGURE 4-53

The device that holds your backups depends on what you want to back up.

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What's better: online backups or local backups? There are advantages and disadvantages for each. Local storage is the traditional route. Your backups are under your control, but they are vulnerable to theft and damage.

If your backups are local, keep them in a safe place. Don't leave them on your computer desk because a fire or flood that damages your computer could also wipe out your backups. In addition, a thief who steals your computer might also scoop up nearby equipment and media. Storing your backups at a different location is the best idea. If off-site storage isn't practical, at least move them to a room apart from your computer.

Web sites that offer storage space for backups are called **online backup services**. The cost of these services usually depends on the amount of storage space that's allocated to you.

Before depending on remote backups, however, be aware that the speed for backing up and restoring your data is only as fast as your Internet connection. Also, remote data is more prone to snooping by employees, hackers, and overzealous government agents; you might want to encrypt your remote backup data, but make sure you don't lose your encryption key or your backup data will be useless.

You should also be aware that a backup service might close down without giving much notice to its users. Use an additional backup location for your really important files.

TERMINOLOGY NOTE

Online backup services are also referred to as remote backup services or managed backup services.

TRY IT!

You'll have the most flexible access to your backup data but the least control over it when you put your backup:

- ❍ on your local hard drive
- ❍ on an external hard drive
- ❍ on a flash drive
- ❍ on a managed backup service

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FILE COPIES

What's the easiest way to back up important files? The most important files on your computer contain the documents, images, and other data that you've created. These files are unique and might be difficult to reproduce. An easy way to back up your data is simply by copying selected files to a USB flash drive, to an external hard disk, or to cloud-based storage. To copy important files manually, you can use the Copy and Paste commands supplied by your computer's file management software.

Which data files should I back up? If your strategy is to back up important data files, the procedure can be simplified if you've stored all these files in one folder and its subfolders. For example, Windows users might store their data files in the preconfigured folders for their user accounts.

Folders such as My Documents, My Music, and My Pictures are all stored as subfolders of your user folder. With your data files organized under the umbrella of a single folder, you are less likely to omit an important file when you make backups.

Some applications, such as financial software, create files and update them without your direct intervention. If you have the option during setup, make sure these files are stored in one of your personal folders. Otherwise, you must discover the location of the files and make sure they are backed up with the rest of your data.

In addition to data files you create, a few other types of data files might be important to you. Consider making backups of the files listed in Figure 4-54.

FIGURE 4-54

Back up these files in addition to your documents, graphics, and music files.

- E-mail folders. If you're using local e-mail software, your e-mail folder contains all the messages you've sent and received, but not deleted. Check the Help menu on your e-mail program to discover the location of these files.
- E-mail address book. Your e-mail address book might be stored separately from your e-mail messages. To find the file on a Windows computer, search for "Contacts."
- Favorite URLs. If you're attached to the URLs you've collected in your Favorites or Bookmarks list, you might want to back up the file that contains this list. To find the file, search your hard disk for "Favorites" or "Bookmarks." As an alternative method, check your browser for an option that exports your favorite URLs.
- Internet connection information. Your ISP's phone number and IP address, your user ID, and your password are often stored in an encrypted file somewhere in the Windows\System folder. Your ISP can usually help you find this file.
- Downloads. If you paid to download software, you might want to back it up so that you don't have to pay for it again. Downloaded software usually arrives in the form of a compressed .zip file. For backup purposes, the .zip file should be all you need.
- Validation codes and other configuration information. If you keep a running list of validation or activation codes that correspond to your software, then it is important to copy this information in case your hard disk crashes and you have to reinstall your software.

How do I restore files from my data file backups? Restoring from a data file backup is easy. You simply copy files from your backup to your hard disk.

Are file backups sufficient protection against data disasters? Your computer system contains programs and configuration settings in addition to your data files. Your computer setup is unique and you can't capture it by simply backing up your data files. If you want to be able to restore your computer to its current state, you need to back up all of its files using synchronization software, backup software, imaging software, or virtual machine technology.

TRY IT!

Check your computer. Do you have files for downloaded software in your Downloads folder?

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SYNCHRONIZATION

What is synchronization? **Synchronization** compares the content of files on two devices and makes them the same. It can be used for backup because it dynamically maintains a parallel set of files on your computer's hard disk and your backup device.

How does synchronization software work? A program called Time Machine supplied with Mac OS X is a good example of synchronization software. It works by first making a backup of every file from the computer's primary storage device. Every hour, Time Machine checks the files on your computer's primary storage device and synchronizes any files that have been changed. This procedure ensures that your backup is never more than an hour old.

The number of backups you can retain—days', weeks', or months' worth—depends on the capacity of your storage device, the size of your data files, and the frequency at which you make changes. For best results, use an external hard disk drive that's at least the same capacity as your computer's internal hard disk. Time Machine and similar synchronization software can store backups on network file servers and on Internet-based storage services.

Can I restore individual files from these backups? Yes. Time Machine displays a window for each hour's backup. You can go back in time to any hour or day, select a file, and restore it to your computer's primary storage device.

What about restoring the entire computer? Suppose your computer's hard disk fails and you have to replace it. Once you've installed a new, blank hard disk, you can insert the Mac OS setup CD and select the Time Machine option to restore the operating system, programs, preferences, and data files that existed at the time of the last Time Machine backup. Figure 4-55 explains the elements of Time Machine's interface.

Software © 2012 Apple Inc. All rights reserved

FIGURE 4-55

Time Machine saves hourly backups for the past 24 hours, daily backups for the past month, and weekly backups for data older than a month. When the backup device runs out of space, Time Machine deletes the oldest weekly backup.

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WINDOWS BACKUP

Does Windows include backup software? Windows 8 includes a synchronization utility called File History. It is designed to back up the files stored in your Libraries, Desktop, Favorites, and Contacts folders. Once you activate File History, it checks hourly for files that have changed and copies those files to the backup device. Figure 4-56 explains how to activate File History.

FIGURE 4-56

Microsoft Windows 8 includes the File History utility to back up important files. Discover how to activate it.

How much of my computer is backed up? A **full system backup** includes a copy of every file stored on your computer's hard drive. In addition to data files, a full system backup includes copies of all installed programs, settings, and the operating system. File History is not a full system backup. If your hard drive crashes, the files stored by File History are not sufficient to configure a new drive. To restore your hard drive, you'll need to use a boot disk, a recovery disk, and copies of your application software.

What is a boot disk? A **boot disk** is a removable storage medium containing the operating system files needed to boot your computer without accessing the hard disk. CDs, DVDs, and even USB flash drives can be used as boot disks. With current versions of Windows, the Windows installation CD is configured as a boot disk and can be used if your computer does not boot normally. When you insert the installation CD, you'll have the option of repairing Windows or reinstalling it. Try the repair option first.

What is a recovery disk? A **recovery disk** (sometimes referred to as a recovery CD) is a bootable CD, DVD, or other media that contains a complete copy of your computer's hard disk as it existed when the computer was new. It contains the operating system, device drivers, utilities, and even software that was bundled with your computer.

You can use a recovery disk to return your computer to its factory default state. However, a recovery disk will not restore your data files, any software that you installed, or any configuration settings you've made since you unwrapped your computer from its shipping box.

TERMINOLOGY NOTE

The contents and capabilities of recovery disks vary. Some are designed to restore your computer to its like-new state and wipe out all your data. Others attempt to restore user settings, programs, and data. Before you depend on a recovery disk, make sure you know what it contains and how to use it in case of a system failure.

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Where can I get a recovery disk? The installation instructions for new computers explain how to make a recovery disk, usually by copying files stored in a **recovery partition** on the computer's hard disk. Be sure to create your recovery disks right away and then store them in a safe place.

Recovery partitions are convenient for restoring a corrupted device driver or software module because you can simply copy or reinstall the file from the recovery partition to the main partition. The files in the recovery partition are not accessible, however, if your computer's hard disk fails. Therefore, don't be misled into thinking that a recovery partition can help you restore your computer after a hard disk failure.

What about backing up the Windows Registry? The **Windows Registry**, or Registry as it is usually called, is an important group of files used by the Windows operating system to store configuration information about all the devices and software installed on a computer system. If the Registry becomes damaged, your computer might not be able to boot up, launch programs, or communicate with peripheral devices. It is a good idea to have an extra copy of the Registry in case the original file is damaged.

As simple as it sounds, backing up the Registry can be a problem because the Registry is always open while your computer is on. Some software that you might use for backups cannot copy open files. If you use such software, it might never back up the Registry. To get periodic copies of your computer's Registry settings, you can create restore points.

What is a restore point? A **restore point** is a snapshot of your computer settings. Restore points are essentially backups of the Windows Registry. If a hard disk problem causes system instability, you might be able to roll back to a restore point when your computer was operational.

Restore points are set automatically when you install new software. You can manually set restore points, too. For example, you might want to set a restore point before updating a program, setting up a network, or installing new hardware (Figure 4-57).

TRY IT!

Suppose your PC's hard drive crashes and you have to replace it. What is the first thing you'll need in order to restore a new hard drive to working status?

- ❍ The File History backup
- ❍ A boot disk
- ❍ A restore point
- ❍ Time Machine

4

FIGURE 4-57

Restore points can be set by accessing the Control Panel and then searching for "Restore Point." Use this figure in your interactive eBook to learn how to work with restore points.

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BACKUP SOFTWARE

Are there third-party backup utilities? Yes. Windows users, especially those in a small business or corporate environment, can select from a variety of third-party options for backup that create full system backups and disk images.

Backup software is a set of utility programs designed to back up and restore some or all of the files on a computer's primary storage device. Backup software usually includes options that make it easy to schedule periodic backups, define a set of files that you want to regularly back up, and automate the restoration process.

Backup software differs from most copy and synchronization routines because it compresses all the files for a backup and places them in one large file. The backup file is indexed so that individual files can be located, uncompressed, and restored.

How do I use backup software? To use backup software, you specify which files you want to back up, select the location of the backup device, and select the days and times for automatic backups to proceed. Because the backup process uses system resources, most people schedule backups for times when their computer is on, but when they are not using it.

Backup software is usually used for copying the entire contents of a hard disk. A backup made by copying all the files to a backup device is called a full backup. Full backups take lots of time; alternative options that take less time include differential and incremental backups.

What is a differential backup? A **differential backup** makes a backup of only those files that were added or changed since your last full backup session. After making a full backup of your important files, you can make differential backups at regular intervals. If you need to restore all your files after a hard disk crash, first restore the files from your full backup, and then restore the files from your latest differential backup.

What is an incremental backup? An **incremental backup** backs up files that were added or changed since the last backup—not necessarily the files that changed from the last full backup, but the files that changed since any full or incremental backup. To restore a set of incremental backups, you must first install a full backup, then install each of the incrementals in succession.

How do I avoid backing up files that contain viruses? Viruses can damage files to the point that your computer can't access any data on its hard disk. It is really frustrating when you restore data from a backup only to discover that the restored files contain the same virus that wiped out your original data. If your antivirus software is not set to constantly scan for viruses on your computer system, you should run an up-to-date virus check as the first step in your backup routine.

How do I recover from a hard disk crash? To recover from a hard disk crash, you have to get your computer booted up so that you can run your backup software. If your computer won't boot from the hard disk, you can use a boot disk or a recovery disk. Next, use the Restore option from your backup utility to install your applications, settings, and data files.

TRY IT!

You're using third-party backup software, and you want a set of backups that are easy to restore and won't take long to make. What option should you use?

- ❍ Full system backup
- ❍ Incremental backup
- ❍ Differential backup

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Can I restore my computer in one simple operation?

Restoring a computer usually entails several steps that can require a boot disk, a recovery disk, backup disks, and file backups. The objective of this extended and sometimes frustrating process is to get optical and hard drive device drivers running so the computer can access its storage devices to get the operating system running, which can then run backup and restore software.

Some backup systems streamline the process by restoring a computer's operating system, device drivers, settings, and data in a single step—a process called **bare-metal restore**.

Bare-metal restore backup software stores the operating system, boot program, drivers, software applications, and data necessary to restore a backed up system to an entirely new computer, without requiring intermediate steps to install the operating system and device drivers. Bare-metal restore software usually works with a disk image.

What is a disk image?

A **disk image** is a bit-by-bit copy of the data from all sectors of a disk. Disk imaging utilities create an exact clone of the original disk, unlike most backup software that makes file-by-file copies. The advantage of disk imaging is that it includes all the data from a disk, even boot information and other data locked by the operating system.

The disadvantage of disk imaging is that it copies data from the entire disk; it generally cannot be configured like traditional backup software to copy only selected files. Disk imaging takes time and is best used while other applications are not running. It is valuable for periodic backups, but cumbersome for daily backups.

Popular Mac disk imaging utilities include SuperDuper! and Carbon Copy Cloner. Popular Windows disk imaging utilities include Paragon Drive Backup, Norton Ghost, and Acronis True Image (Figure 4-58).

TRY IT!

The advantage of a disk image is that it contains a bit-for-bit copy of the operating system, settings, software, and data files on your computer. What is the disadvantage?

- ❍ You can't back up the Windows Registry
- ❍ You can't restore individual files
- ❍ You can't restore it
- ❍ You have to put it on a cloud server

Software © 2002–2012 Acronis Inc.

FIGURE 4-58

Disk imaging software, such as Acronis True Image, creates a bit-by-bit copy of all the data on your computer's hard disk that can be used to restore all operating system, program, and data files.

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VIRTUAL MACHINES

Are there any other backup options? Today's trend toward the use of virtual machines offers another option for backups. Reinstalling an operating system on a blank hard disk can be tricky, but you can avoid that hassle if you run your operating system as a virtual machine.

For example, if you run Windows as a virtual machine on a Mac, you can simply back up the entire Windows machine as one folder or file. If a virus or corrupted file begins to disrupt the operation of Windows, instead of reformatting your hard disk and reinstalling Windows, you can simply copy the image of your Windows virtual machine from your backup device to your primary storage device and continue working (Figure 4-59).

FIGURE 4-59

When you run Windows as a virtual machine, the Windows operating system, program files, and settings, along with your data files, are stored in a folder. The entire Windows computer runs essentially like any other software application on the host machine.

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TABLET AND SMARTPHONE BACKUP

What about my handheld device? Handheld devices are usually backed up by synching them to a desktop or laptop computer. The procedure is a legacy from the days of personal digital assistants that used synchronization as a mechanism to update contacts and appointments from a handheld device to those on a desktop computer.

Synching is usually initiated by tethering your handheld device to a full-size computer using a USB cable. Synchronization software examines files on both devices and asks you which files you want to sync.

iPhones, iPods, and iPads synch with iTunes software, and you have the option to encrypt the backup to prevent your data from exposure if your computer falls victim to an unauthorized intrusion (Figure 4-60).

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© MediaTechnics

FIGURE 4-60

iTunes creates a backup of the data stored on your iPad, iPod, or iPhone.

Can I back up my Android device? Many Android devices include backup software, usually accessible from the Settings icon. Generally, backups from Android devices are stored in the cloud on Google servers. If your Android device accepts SD cards, you may also be able to make backups of individual files.

If you want to go beyond data backup and back up your Android system files, you can use third-party backup software, such as Titanium Backup or Backup Master.

QuickCheck

SECTION E

1. _____ software, such as Time Machine, keeps your backup files up to date with the original files on your hard disk.
2. One of the best devices for home backup is a(n) _____ hard drive.
3. A(n) _____ backup makes copies of only those files that have changed since your last full backup.
4. A(n) _____ point is essentially a backup of the settings in the Windows Registry.
5. A bare- _____ restore includes the operating system, boot program, drivers, software applications, and data necessary to rebuild a replacement hard disk in one easy operation.

CHECK ANSWERS

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Issue: Cyberterrorists or Pranksters?

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SOME COMPUTER CRIMES require no special digital expertise. Setting fire to a computer doesn't require the same finesse as writing a stealthy virus, but both can have the same disastrous effect on data. Old-fashioned crimes, such as arson, that take a high-tech twist because they involve a computer can be prosecuted under traditional laws.

Traditional laws do not, however, cover the range of possibilities for computer crimes. Suppose a person unlawfully enters a computer facility and steals backup drives. That person might be prosecuted for breaking and entering. But would common breaking and entering laws apply to a person who remotely accesses a corporate computer system without authorization? And what if a person copies a data file without authorization? Has that file really been stolen if the original remains on the computer?

Many countries have computer crime laws that specifically define computer data and software as personal property. These laws also define as crimes the unauthorized access, use, modification, or disabling of a computer system or data. But laws don't necessarily stop criminals. If they did, we wouldn't have to deal with malicious code and intrusions.

One of the first computer crime cases involved a worm unleashed on the ARPANET in 1988 that quickly spread through government and university computer systems. The worm's author, Robert Morris, was convicted and sentenced to three years of probation, 400 hours of community service, and a US$10,000 fine.

A 1995 high-profile case involved a computer hacker named Kevin Mitnick, who was accused of breaking into dozens of corporate, university, government, and personal computers. Although vilified in the media, Mitnick had the support of many hackers and other people who believed that the prosecution grossly exaggerated the extent of his crimes. Nonetheless, Mitnick was sentenced to 46 months in prison and ordered to pay restitution in the amount of $4,125 during his three-year period of supervised release.

Forbes reporter Adam L. Penenberg took issue with the 46-month sentence imposed by Judge Mariana Pfaelzer and wrote, "Mitnick's crimes were curiously innocuous. He broke into corporate computers, but no evidence indicates that he destroyed data. Or sold anything he copied. Yes, he pilfered software—but in doing so left it behind. This world of bits is a strange one, in which you can take something and still leave it for its rightful owner. The theft laws designed for payroll sacks and motor vehicles just don't apply to a hacker."

This world of bits is a strange one, in which you can take something and still leave it for its rightful owner.

The USA PATRIOT Act and the Cybersecurity Enhancement Act carry stiff penalties for cybercrimes—ranging from ten years to life in prison. CNET editor Robert Vamosi questions the harshness of such penalties: "What bothers me most is that here in the United States, rapists serve, on average, ten years in prison. Yet if, instead of assaulting another human being, that same person had released a virus on the Net, the criminal would get the same or an even harsher sentence."

Modern society has an ambivalent attitude toward computer hackers. On the one hand, they are viewed as evil cyberterrorists who are set on destroying the glue that binds together the Information Age.

From this perspective, hackers are criminals who must be hunted down, forced to make restitution for damages, and prevented from creating further havoc.

From another perspective, hackers are viewed more as Casper the Friendly Ghost in our complex cybermachines—as moderately bothersome entities whose pranks are tolerated by the computer community, along with software bugs and hardware glitches.

Seen from this perspective, a hacker's pranks are part of the normal course of study that leads to the highest echelons of computer expertise. "Everyone has done it," claims one hacking devotee, "even Bill Gates and Steve Jobs."

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TRY IT! Which perspective is right? Are hackers dangerous cyberterrorists or harmless pranksters? Before you make up your mind about computer hacking and cracking, here's more for you to explore.

1. After the publicity from Kevin Mitnick's trial, consumers might expect corporate databases to be rigorously guarded; but hacking incidents continue to escalate. To find information about recent data breaches, check the Wikipedia article on data breaches or sites such as DatalossDB (*datalossdb.org*). What were the three largest data breaches in the past five years, how many accounts were exposed, and did you have accounts with any of the breached organizations?
2. Data breaches are a major source of information used for identity theft. You probably know basic steps to take to avoid identity theft, but there's always more to learn. Check sites such as *www.identitytheft.org/protect.htm* or the National Crime Prevention Council's online booklet *Preventing Identity Theft*. What are five identity-protection techniques that you didn't know about before this project?
3. In 2010, a mysterious computer worm spread across the Internet and targeted industrial equipment that happened to be used in Iran's nuclear program. According to one security expert, Stuxnet was designed to probe the security of a wide variety of crucial industrial plants throughout the world and gauge potential weaknesses for future cyberwarfare attacks. Use Web resources to learn more about Stuxnet and recent attacks against RSA, a cyber security company, and Google's Gmail system. What is the difference between cyberwarfare and cybercrime?
4. The media labeled an attack against the country of Estonia a "cyber war." Use Web resources to explore this incident. How might a similar incident affect your country?
5. The world of cybercrime has a jargon all its own. What do the following terms mean?
   - a. Zero-day attack
   - b. Data diddling
   - c. Salami shaving
   - d. Vandalism
   - e. Denial of service
   - f. Man-in-the-middle
   - g. Dead drop
   - h. Honeypot

INFOWEBLINKS

You can check the **NP2014 Chapter 4** InfoWebLink for updates to these activities.

CLICK TO CONNECT
www.infoweblinks.com/np2014/ch04

ISSUE

What Do You Think?

1. Should a computer virus distribution sentence carry the same penalty as manslaughter?
2. Should it be a crime to steal a copy of computer data while leaving the original data in place and unaltered?
3. Should hackers be sent to jail if they cannot pay restitution to companies and individuals who lost money as the result of a prank?
4. Do you think that a hacker would make a good computer-security consultant?

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Information Tools: Fact Checking

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These days, you have to be a skeptic. Bloggers have opinions that are not always based on facts. Scam artists say anything to get your money. Even reputable journalists sometimes make mistakes.

Before you form an opinion, make a decision, or take action based on what you read, see, or hear, you can easily use your computer or smartphone to verify facts and look up background information.

Search Google. You can use Google or a similar search engine to find information from all corners of the Web. You can search for information in specific formats, such as videos, images, and news reports. Check out Google Scholar for links to authoritative information in peer-reviewed journals, theses, and other professional publications. Remember that you can formulate searches such as "Define zero-day attack" to learn the meaning of technical terms and find the meaning of acronyms.

Search within sites. Rather than conducting a wide-ranging Google search, you can go to a specific Web site and search within it. Search Wikipedia for definitions and topic overviews. Search a news site for articles and video footage about current events. Start at Snopes.com or *www.hoaxbusters.org* to identify e-mail scams. Try LexisNexis for links to authoritative primary and secondary source material.

When you check facts or use them in your own research papers, primary sources tend to be more reliable than secondary or tertiary sources. How can you tell the difference?

PRIMARY SOURCES

Original material such as speeches, interviews, letters, photos, e-mail messages, tweets, artwork, diaries, laws, database reports, and accounting records

Example: A video of Apple's CEO announcing a new music product for the iPhone and iPad

SECONDARY SOURCES

Reviews, critiques, panel discussions, biographies, and other sources that analyze, summarize, or otherwise repackage information from primary sources

Example: An article on Google News that describes Apple's new music product

TERTIARY SOURCES

A list or compilation of material that pertains to a topic; from sources that include bibliographies, dictionaries, almanacs, indexes, timelines, and inventory lists

Example: Apple's e-commerce site that lists and sells all versions of its new music product

FACT CHECKING TIPS

- **Two sources are better than one.** Cross-check facts between two or more sites.
- **Use common sense.** Claims that seem outlandish require extra verification.
- **Understand your priorities.** For example, you can go to YouTube and view the trailer for Live Free or Die Hard. That might be fun, but it might not be relevant for a term paper on cyberterrorism.
- **Use primary sources when possible.** Go to the original text of a speech, check the product manufacturer's Web site, or watch the video clip.
- **Use reputable sources.** The Web contains billions of documents; few of them follow strict journalistic standards for accuracy. Check the author's credentials, look at the general quality of the Web site, and make sure the information is up to date.
- **Maintain a list of the sites you frequently use for fact checking.** You can create a Fact Check folder in your browser's Bookmarks or Favorites list.
- **Nail down your search terms.** When using voice search on your mobile phone, think about an exact set of keywords before you launch Speak Now.

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TRY IT! Fact checking can be fun and it can lead you to all sorts of intriguing factoids as well as to substantive information. Practice your fact-checking skills by completing the following activities.

1. After investigating a worm that infiltrated U.S. Army networks, the NSA (National Security Agency) and Department of Defense banned USB flash drives from military computers. From which one of the following sources are you most likely to obtain primary source information about the USB flash drive ban?

   Under Worm Assault, Military Bans Disks, USB Drives | Danger ...
   www.wired.com/dangerroom/2008/11/army-bans-usb-d/ - Cached
   Nov 19, 2008 – Under Worm Assault, Military Bans Disks, USB Drives ...
   The ban comes from the commander of U.S. Strategic Command, according to an...

   [PDF] USB Storage Drives
   www.nsa.gov/ia/_files/factsheets/I731-002R-2007.pdf
   File Format: PDF/Adobe Acrobat - Quick View
   of devices not described by other policy settings". To allow administrators to ...
   www.nsa.gov. Information ... cameras, and USB hard drives. Windows. Linux ..

   Judging the cyber war terrorist threat : The New Yorker
   www.newyorker.com/reporting/2010/11/.../101101fa_fact_hersh
   Subscribe to New Yorker ... by Seymour M. Hersh ... N.S.A. unit commanders, facing penetration of their bases' secure networks, concluded that the break-in was caused by a disabling thumb drive...

2. Suppose that you receive an e-mail message warning of a zero-day cyberwar worm called Storm that is spreading rapidly. The message warns that your security software doesn't yet have the ability to identify and quarantine this virus. According to the e-mail, it is your civic duty to stop this virus by following a set of instructions to alter the Windows Registry or Mac OS kernel. Of the following options, which would be the best way to find out if this warning is legitimate?
   a. Use Google to search for "Storm worm."
   b. Go to the Web site Snopes.com and search for "Storm."
   c. Reply to the e-mail and ask for the app's security certificate.

3. Suppose you're gathering information for a term paper about enforcement efforts to catch cybercriminals, and you come across the following short article posted on a security blog. Operation Shady RAT sounds intriguing; but before you add material from this article to your research notes, you should do a fact check by answering the questions in the diagram below.

Operation Shady RAT Exposed

In a massive sting operation called Shady RAT, a U.S. security firm raided the command and control server used by a group of Romania-based hackers.

An extensive investigation led up to the discovery of the clandestine server and the passwords necessary to gain entry. Data gathered from this server revealed hundreds of active targets and terabytes of illicit data waiting to be claimed by hackers.

Victims ranged from the U.S. Olympic Committee to government agencies in the U.S., Canada, India, South Korea, Taiwan, Pakistan, and Vietnam.

Dmitri Alperovitch of McAfee, the security firm spearheading the investigation, describes the discovery "even we were surprised by the enormous diversity of the victim organizations and were taken aback by the audacity of the perpetrators."

a. Was the sting operation called Shady RAT?

b. Were the hackers based in Romania?

c. Are these statistics accurate?

d. Is this list of victims correct?

e. Check the primary source: Is this quote correct?

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Technology in Context: Law Enforcement

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SIRENS WAIL. Blue lights flash. A speeding car slows and pulls off to the side of the road. It looks like a routine traffic stop, but the patrol car is outfitted with a mobile data computer. The police officers on this high-tech force have already checked the speeding car's license plate number and description against a database of stolen cars and vehicles allegedly used in kidnappings and other crimes.

Mounted in the dashboard of marked and unmarked police cars, a mobile data computer resembles a laptop computer with its flat-panel screen and compact keyboard. Unlike a consumer-grade laptop, however, the computers in police cruisers use hardened technology designed to withstand extreme conditions, such as high temperatures in parked vehicles. The dashboard-mounted computer communicates with an office-based server using a wireless link, such as short-range radio, mobile phone technology, or Wi-Fi. With this wireless link, police officers can access data from local, state, and national databases.

One national database, the National Crime Information Center (NCIC), is maintained by the FBI and can be accessed by authorized personnel in local, state, and federal law enforcement agencies. The system can process more than 5 million queries per day related to stolen vehicles, wanted criminals, missing persons, violent gang members, stolen guns, and members of terrorist organizations. The officers who pulled over the speeding car received information from the NCIC that the car was stolen, so they arrested the car's occupant and took him to the police station for booking.

At the police station, digital cameras flash and the suspect's mug shot is automatically entered into an automated warrants and booking system. The system stores the suspect's complete biographical and arrest information, such as name, aliases, addresses, Social Security number, charges, and arrest date. The system also checks for outstanding warrants against the suspect, such as warrants for other thefts. Booking agents can enter those charges into the system, assign the new inmate to a cell, log his or her personal items, and print a photo ID or wrist band.

Automated warrants and booking systems have been proven to increase police productivity. New York City's system handles more than 300,000 bookings per year, with gains in productivity that have put nearly 300 officers back into action investigating crimes and patrolling neighborhoods.

As part of the booking process, the suspect is fingerprinted. A standard fingerprint card, sometimes called a ten-print card, contains inked prints of the fingers on each hand, plus name, date of birth, and other arrest information. Now, however, instead of using ink, a biometric scanning device can electronically capture fingerprints. Text information is entered using a keyboard and stored with digital fingerprint images.

The fingerprint information can be transmitted in digital format from local law enforcement agencies to the FBI's Integrated Automated Fingerprint Identification System (IAFIS). This biometric identification system uses digital imaging technology and sophisticated algorithms to analyze fingerprint data. IAFIS can classify arriving prints for storage or search for a match in its database containing 66 million criminal prints, 25 million civilian prints, and prints from 73,000 known and suspected terrorists.

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Conventional crimes, such as car theft, are often solved by using standard investigative techniques with information from computer databases. To solve cybercrimes, however, the special skills of computer forensic investigators are often required.

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Computer forensics is the scientific examination and analysis of data located on computer storage media, conducted to offer evidence of computer crimes in court. Computer crimes can be separated into two categories. The first includes crimes that use computers, such as transmitting trade secrets to competitors, reproducing copyrighted material, and distributing child pornography. The second includes crimes targeted at computers, such as denial-of-service attacks on servers, Web site vandalism, data theft, and destructive viruses. Computer forensics can be applied to both categories.

Whether investigators suspect that a computer is the origin of a cyber-attack or contains evidence, the first step in the forensic process is to use disk imaging software to make an exact replica of the information stored on the hard disk. The disk image is collected on a write-once medium that cannot be altered with planted evidence, and the forensic scientist begins analyzing the disk image data with simple search software that looks through files for keywords related to the crime. In the case of the Gap-Toothed Bandit who was convicted for robbing nine banks, analysis of the disk image revealed word processing files containing notes he handed to tellers demanding money.

Criminals might attempt to delete files with incriminating evidence, but a good forensic scientist can retrieve data from deleted files with undelete software or data recovery software. Temporary Internet or cache files can also yield evidence, pointing law enforcement officers to Web sites the suspect visited that might be fronts for illegal activity.

When a computer is a target of a cyber-attack, forensic investigators use three techniques to track the source. The first option is to make an immediate image of the server's hard disk and look through its log files for evidence of activity coming from unauthorized IP addresses. A second technique is to monitor the intruder by watching login attempts, changes to log files, and file access requests. Sophisticated intruders might be able to detect such monitoring, however, and cover their tracks. A third technique is to create a honeypot—an irresistible computer system or Web site containing fake information that allows investigators to monitor hackers until identification is possible.

Despite the many techniques and tools available to forensic investigators, they have three main constraints. First, they must adhere to privacy regulations and obtain warrants to set up wiretaps or gather information from ISPs about their customers. Second, they must scrupulously document their procedures so that the evidence they produce cannot be discredited in court as planted or fabricated. Third, forensic investigators must examine a wide range of alternatives pertaining to the crime, such as the chance that an IP or e-mail address used to commit a cybercrime might belong to an innocent bystander being spoofed by the real hacker.

Privacy, documentation, and evidentiary constraints cost forensic investigators time, and failure to adhere to strict standards can sometimes allow criminals to avoid conviction and penalties. But even within these constraints, careful forensic investigation is an important aspect of catching and convicting high-tech criminals.

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New Perspectives Labs

To access the New Perspectives Labs for Chapter 4, open the NP2014 interactive eBook and then click the icon next to the lab title.

MANAGING FILES

IN THIS LAB YOU'LL LEARN:

- How to access File Explorer
- How to expand and collapse the directory structure
- How to rename or delete a file or folder
- The basic principles for creating an efficient directory structure for your files
- How to create a folder
- How to select a single file or a group of files
- How to move files from one folder to another

LAB ASSIGNMENTS

1. Start the interactive part of the lab. Make sure you've enabled Tracking if you want to save your QuickCheck results. Perform each lab step, and answer all the lab QuickCheck questions.
2. Use File Explorer or Finder to look at the directory of the disk or USB flash drive that currently contains most of your files. Draw a diagram showing the hierarchy of folders. Write a paragraph explaining how you could improve this hierarchy, and draw a diagram to illustrate your plan.
3. On a blank USB flash drive, create three folders: Music, Web Graphics, and Articles. Within the Music folder, create four additional folders: Jazz, Reggae, Rock, and Classical. Within the Classical folder, create two more folders: Classical MIDI and Classical MP3. If you have Internet access, go on to #4.
4. Use your browser software to connect to the Internet, and then go to a Web site, such as *www.zdnet.com* or *www.cnet.com*. Look for a small graphic (perhaps 100 KB or less) and download it to your Web Graphics folder. Next, use a search engine to search for "classical MIDI music." Download one of the compositions to the Music\Classical\Classical MIDI folder. Open File Explorer and expand all the directories for your USB flash drive. Open the Music\Classical\Classical MIDI folder and make sure your music download appears. Capture a screenshot. Follow your instructor's directions to submit this screenshot as a printout or an e-mail attachment.

BACKING UP YOUR COMPUTER

IN THIS LAB YOU'LL LEARN:

- How to work with restore points
- How to create a recovery disk
- How to create a disk image
- How to make a Windows backup
- How to restore files from a backup

LAB ASSIGNMENTS

1. Start the interactive part of the lab. Make sure you've enabled Tracking if you want to save your QuickCheck results. Perform each lab step as directed, and answer all the lab QuickCheck questions. When you exit the lab, your answers are automatically graded and your results are displayed.
2. Describe where most of your data files are stored, and estimate how many megabytes of data (not programs) you have in all these files. Next, take a close look at these files and estimate how much data (in megabytes) you cannot afford to lose. Would your data fit on a USB flash drive? If so, what capacity?
3. Start the backup software that is provided for your computer, specify its name, and list which of the following features it provides: file backup, system image, disk image, automatic backup, manual backup. If an automatic backup is available, list the user-definable options for selecting backup intervals, days, and times.
4. Explore your computer to discover how its recovery disk is provided. For example, is it a partition, a download, or a utility? Use the built-in Help provided by your computer manufacturer or go to its Web site to learn how to make a recovery disk. Write a short summary of the procedure.

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Key Terms

Make sure you understand all the boldfaced key terms presented in this chapter. With the NP2014 interactive eBook, you can use this list of terms as an interactive study activity. First, try to define a term in your own words, and then click the term to compare your definition with the definition presented in the chapter.

Android, 201
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Backup software, 228
Bare-metal restore, 229
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Interactive Summary

To review important concepts from this chapter, fill in the blanks to best complete each sentence. When using the NP2014 interactive eBook, click the Check Answers buttons to automatically score your answers.

SECTION A: An operating system interacts with application software, device drivers, and hardware to manage a computer's _____, such as the processor, memory, and input/output devices. To allow two or more programs to run simultaneously, an OS can offer _____ services. Within a single program, _____ allows multiple parts, or threads, to run simultaneously. An operating system's _____ capability supports a division of labor among all the processing units. An operating system might have to deal with a memory, _____, a situation caused by an application that requests memory, but never releases it. Operating systems are informally categorized and characterized using one or more of the following terms: A(n) _____-user operating system expects to deal with one set of input devices—those that can be controlled by one person at a time. A(n) _____-user operating system is designed to deal with input, output, and processing requests from many users. A(n) _____ operating system provides management tools for distributed networks, e-mail servers, and Web site hosting. A(n) _____ operating system is one that's designed for a personal computer. A(n) _____ operating system is designed for devices such as iPhones and Droids.

The core part of an operating system is called the _____, which is loaded into RAM during the _____ process. In addition to behind-the-scenes activities, operating systems also provide tools, called operating system _____, that you can use to control and customize your computer equipment and work environment. Many operating systems also influence the "look and feel" of your software, or what's known as the user _____.

CHECK ANSWERS

SECTION B: Popular _____ operating systems include Microsoft Windows, Mac OS, and Linux. Windows has evolved to keep pace with 16-bit, 32-bit, and _____-bit architectures. Its strengths include a huge library of Windows _____, support for a variety of peripheral devices, and plenty of documentation. Two of the weakest features of Microsoft Windows are reliability and _____. Windows _____ is the mobile version of Windows 8, designed to run on devices with ARM processors. Mac OS evolved from the original Classic Mac OS designed for _____ computers based on the Motorola 68000 microprocessor. In 2001, Mac OS X was released for Apple's new line of computers using IBM's PowerPC processor. OS X was again revised for a line of computers using _____ processors. These Macs can be set up to dual _____ Mac OS and Windows. Intel Macs also offer a good platform for _____ machine technologies that allow you to use one computer to simulate the hardware and software of another. One of the potential problems with Mac OS is its use of _____ forks, which make cross-platform file sharing clumsy. Apple also has a mobile operating system called _____ used on iPhones, iPads, and iPod Touches. Linux is a(n) _____ source operating system that is used extensively for servers. One of the reasons it has not become a popular desktop OS is that it requires a bit more technical savvy than Windows or Mac OS. Developed by Microsoft and supplied on the original IBM PCs, _____ was one of the first operating systems for personal computers. _____ is a mobile operating system developed by Google and used extensively for tablets and smartphones.

CHECK ANSWERS

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SECTION C: A computer _____ is a named collection of data that exists on a storage medium, such as a hard disk, CD, DVD, or USB drive. Every file has a name and might also have a file extension. The rules that specify valid file names are called file-naming _____ . These rules typically do not allow you to use certain characters or _____ words in a file name. A file _____ is usually related to a file format—the arrangement of data in a file and the coding scheme used to represent the data. A software program's _____ file format is the default format for storing files created with that program. A file's location is defined by a file _____ (sometimes called a path), which includes the storage device, folder(s), file name, and extension. In Windows, storage devices are identified by a drive letter, followed by a(n) _____ . Every storage device has a(n) _____ containing a list of files stored on the device. The top-level list of a device is referred to as the _____ directory, which can be subdivided into several smaller lists called subdirectories that are depicted as _____ .

CHECK ANSWERS

SECTION D: File _____ encompasses any procedure that helps you organize your computer-based files so that you can find them more effectively. _____ -based file management uses tools provided with a software program to open and save files. Additional tools might also allow you to create new folders, rename files, and delete files. The Save and Save As dialog boxes are examples of these file management tools. Most operating systems provide file management _____ that give you the "big picture" of the files you have stored on your disks. The structure of folders that you envision on your disk is a(n) _____ model, which is often represented by a storage _____ , such as a tree structure or filing cabinet. Windows File Explorer and the Mac _____ are examples of file management utilities provided by operating systems. These utilities allow you to find, rename, copy, move, and delete files and folders. In addition, they allow you to perform file management activities with more than one file at a time. The way that data is actually stored is referred to as the _____ storage model. Before a computer stores data on a disk, CD, or DVD, it creates the equivalent of electronic storage bins by dividing the disk into _____ , and then further dividing the disk into _____ . This dividing process is referred to as _____ . Each sector of a disk is numbered, providing a storage address that the operating system can track. Many computers work with a group of sectors, called a(n) _____ , to increase the efficiency of file storage operations. An operating system uses a file _____ to track the physical location of files.

CHECK ANSWERS

SECTION E: A backup is a copy of one or more files that have been made in case the original files become damaged. A good backup plan allows you to _____ your computing environment to its pre-disaster state with a minimum of fuss. Your personal backup plan depends on the files you need to back up, the hardware you have available to make backups, and your backup software. In any case, it is a good idea to back up the Windows _____ and make sure your files are free of _____ . Backups should be stored in a safe place, away from the computer. Personal computer backups are typically recorded on _____ hard drives, USB flash drives, network servers, and online storage services. An easy way to get a backup of important data files is to use a _____ management utility to select important files and copy them to a USB flash drive. _____ compares files on two devices and makes them the same. Backup software differs from most copy routines because it _____ all the files for a backup into one large file. A(n) _____ backup saves time by backing up only those files that have been changed since the last backup. Restoring a Windows computer usually requires several steps, such as reinstalling the operating system, before a backup can be restored. The process can be simplified by using a backup system that offers bare- _____ restore.

CHECK ANSWERS

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Interactive Situation Questions

Apply what you've learned to some typical computing situations. When using the NP2014 interactive eBook, you can type your answers, and then use the Check Answers button to automatically score your responses.

1. While using several Windows programs at the same time, your computer displays an error message that refers to a program that is not responding. You recognize this message as one that might result from a(n) _____ leak and decide to close the non-responding program using the Task Manager.

2. Your friend wants to open a window on his Mac computer in which he can run Microsoft Windows and play some games designed for the Windows platform. You tell your friend to create a(n) _____ machine using software such as Parallels Desktop.

3. Suppose you are using Microsoft Word and you want to open a file. When your software lists the documents you can open, you can expect them to be in Word's _____ file format, which is DOCX.

4. Can you use a Windows application, create a document, and store it using the file name *I L*ve NY*? Yes or no? _____

5. When you want to work with several files—to move them to different folders, for example—it would be most efficient to use a file management utility, such as the Windows File _____ or the Mac Finder.

6. When specifying a location for a data file on your hard disk, you should avoid saving it in the _____ directory.

7. Your computer seems to be taking longer to store and retrieve files. You use a(n) _____ utility to rearrange the files in contiguous clusters.

8. You have an old computer that you will donate to a school, but you want to make sure its hard disk contains no trace of your data. To do so, you use file _____ software that overwrites empty sectors with random 1s and 0s.

9. You just finished copying data files to an external USB hard disk. Before you depend on these files as a backup, you should test to make sure you can _____ the data in the event of a hard disk crash.

10. Your hard disk crashed for some unknown reason. Now when you switch on the computer power, all you get is an "Error reading drive C:" message. You use a(n) _____ CD that contains the operating system files and device drivers needed to start your computer without accessing the hard disk.

CHECK ANSWERS

Interactive Practice Tests

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CLICK TO START

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Learning Objectives Checkpoints

Learning Objectives Checkpoints are designed to help you assess whether you have achieved the major learning objectives for this chapter. You can use paper and pencil or word processing software to complete most of the activities.

1. List and describe the four main resources that an operating system manages.
2. Explain the significance of multitasking, multithreading, and multiprocessing.
3. Explain the term *memory leak*, and describe what you can do if one occurs on your PC.
4. Watch your computer while it boots, and then revise the list on page 188 so that it reflects what happens when your computer boots.
5. Describe five tasks for which you must interact directly with the operating system.
6. Describe the basic elements of a graphical user interface and contrast them with the elements of a command-line interface.
7. List four operating systems used on personal computers, two operating systems used on servers, and four operating systems used on handheld devices. List advantages and disadvantages of the three most popular personal computer operating systems.
8. Explain the difference between dual booting and virtual machine technology. Give examples of tasks that might benefit from dual booting or virtual machine capability.
9. Make a list of five file names that are valid under the file-naming conventions for your operating system. Also, create a list of five file names that are not valid, and explain the problem with each one.
10. Pick any five files on the computer that you usually use, and write out the full path for each one.
11. Describe the significance of file formats. List at least ten common formats and their extensions. Make a list of at least 20 file extensions you find on the computer you use most often. Group these extensions into the following categories: system files, graphics files, sound files, text files, other.
12. Demonstrate that you can manage files on a computer by looking at the files on your computer and locating at least five files or folders that should be renamed or relocated to improve the organization and make it easier to locate information on your computer.
13. Describe what happens in the MFT when a file is stored or deleted. Explain what it means when a file is fragmented.
14. Discuss the pros and cons of using an external hard drive, USB flash drive, network server, or online storage service for backups.
15. Describe how synchronization software works and give two examples of synchronization utilities. Describe the way backup software deals with the files in the backup. Explain the differences between full, differential, and incremental backups.
16. Describe the significance of restore points, bare-metal restore, disk imaging, virtual machines, boot disks, and recovery disks.
17. Describe the basic technique for backing up an iPhone, iPad, or iPod Touch.

Study Tip: Make sure you can use your own words to correctly answer each of the purple focus questions that appear throughout the chapter.

Concept Map

Fill in the blanks to illustrate the hierarchy of OS resource management activities.

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GLOSSARY

3-D graphics software The software used to create three-dimensional wireframe objects, then render them into images. 124

64-bit processor A microprocessor with registers, an address bus, and a data bus that holds 64 bits of data, in contrast to 32-bit processors that hold 32 bits of data. 68

Absolute reference In a worksheet formula, cell references (usually preceded by a $ symbol) that cannot change as a result of a move or copy operation. 138

Access time The estimated time for a storage device to locate data on a disk, usually measured in milliseconds. 77

Accounting software A category of software that includes accounting, money management, and tax preparation software. 126

Adaptive utilities Utility software that alters a device's user interface to create an accessible environment for individuals with disabilities. 130

All-in-one computer A desktop computer form factor in which the system unit and screen are integrated into a single unit. 58

ALU (Arithmetic Logic Unit) The part of the CPU that performs arithmetic and logical operations on the numbers stored in its registers. 31

Analog data Data that is measured or represented on a continuously varying scale, such as a dimmer switch or a watch with a sweep second hand. 22

Android An open source operating system used primarily for handheld devices. 201

Anonymizer tools Software and/or hardware that cloaks the origin of an e-mail or a Web page request. 11

Antivirus software A computer program used to scan a computer's memory and disks to identify, isolate, and eliminate viruses. 167

Application software Computer programs that help you perform a specific task such as word processing. Also called application programs, applications, or programs. 16

Application windows Rectangular-shaped areas on a computer desktop that hold program menus and workspaces. 191

Apps Short for applications; popularly used to refer to applications available for the iPhone, iPad, and other mobile devices. 16

ASCII (American Standard Code for Information Interchange) A code that represents characters as a series of 1s and 0s. Most computers use ASCII code to represent text, making it possible to transfer data between computers. 24

Audio editing software A program that enables users to create and edit digital voice and music recordings. 121

Authentication protocol Passwords, user IDs, and biometric measures used to verify a person's identity. 34

Automatic recalculation A feature found in spreadsheet software that automatically recalculates every formula after a user makes a change to any cell. 138

Backup A duplicate copy of a file, disk, or tape. Also refers to a Windows utility that allows you to create and restore backups. 222

Backup software A set of utility programs that performs a variety of backup-related tasks, such as helping users select files for backup, copying, and restoring. 228

Bare-metal restore A process by which a backup is restored to a hard disk without first reinstalling the operating system and device drivers. 229

Benchmarks A set of tests used to measure computer hardware or software performance. 70

Binary number system A method for representing numbers using only two digits: 0 and 1. Contrast to the decimal number system, which uses ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. 23

Biometrics The use of physical attributes, such as a fingerprint, to verify a person's identity. 34

BIOS A small set of basic input/output system instructions stored in ROM. 74

Bit The smallest unit of information handled by a computer. A bit is one of two values, either a 0 or a 1. Eight bits constitute a byte, which can represent a letter or number. 23

BlackBerry OS The operating system software designed for handheld BlackBerry devices. 203

Blu-ray A high-capacity storage technology that stores up to 25 GB per layer on Blu-ray discs (BDs). 81

Blue screen of death An error condition in which a PC "freezes" and displays a blue screen (black screen in some versions of Windows); usually turning the computer off and turning it on again clears the error. 103

Boot disk A floppy disk or CD that contains the files needed for the boot process. 226

Boot process The sequence of events that occurs within a computer system between the time the user starts the computer and the time it is ready to process commands. 188

Bootstrap loader A program that automatically runs when a computer is first turned on in order to load the operating system. 74

Bootstrap program A program stored in ROM that loads and initializes the operating system on a computer. 192

Bot An intelligent agent that autonomously executes commands behind the scenes. Sometimes used to refer to a remote access Trojan horse that infects computers. 164

Botnet A group of bots under the remote control of a botmaster, used to distribute spam and denial-of-service attacks. 164

Brute force attack A method of breaking encryption code by trying all possible encryption keys. 37

BSD license (Berkeley Software Distribution license) An open source software license patterned on a license originally used by the University of California. 160

Buffers Memory that is temporarily used to store input or other data until the processor is ready to use it. 187

Button An on-screen graphical control that can be clicked to initiate an action or a command. 192

Byte An 8-bit unit of data that represents a single character. 26

CAD software (computer-aided design software) A program designed to draw 3-D graphics for architecture and engineering tasks. 124

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Capacitors Electronic circuit components that store an electrical charge; in RAM, a charged capacitor represents an "on" bit, and a discharged one represents an "off" bit. 72

Card reader A device that can be used to read and record data on solid state storage devices, such as flash memory cards. 84

Case sensitive A condition in which uppercase letters are not equivalent to their lowercase counterparts. 35

CD (compact disc) An optical storage medium used to store digital information. CD-ROMs are read only. CD-Rs and CD-RWs can be used to record data. 81

Cell In spreadsheet terminology, the intersection of a column and a row. In cellular communications, a limited geographical area surrounding a cellular phone tower. 136

Cell references The column letter and row number that designate the location of a worksheet cell. For example, the cell reference C5 refers to a cell in column C, row 5. 137

Central processing unit (CPU) The main processing circuitry within a computer or chip that contains the ALU, control unit, and registers. 15

Character data Letters, symbols, or numerals that will not be used in arithmetic operations (name, Social Security number, etc.). 24

CISC (complex instruction set computer) A general-purpose microprocessor chip designed to handle a wider array of instructions than a RISC chip. 69

Client A computer or software that requests information from another computer or server. 18

Cloud computing A type of computing in which local devices access applications that run on an Internet-based server, where data can also be stored. 9

Cluster A group of sectors on a storage medium that, when accessed as a group, speeds up data access. 219

Color depth The number of bits that determines the range of possible colors that can be assigned to each pixel. For example, an 8-bit color depth can create 256 colors. 90

Command-line interface A style of user interface that requires users to type commands, rather than use a mouse to manipulate on-screen controls. 190

Commercial software Copyrighted computer applications sold to consumers for profit. 159

Compiler Software that translates a program written in a high-level language into low-level instructions before the program is executed. 30

Compute-intensive Refers to any task, problem, or product that is able to handle massive amounts of data and complex mathematical calculations. 19

Computer A device that accepts input, processes data, stores data, and produces output according to a stored program. 14

Computer network A collection of computers and related devices connected in a way that allows them to share data, hardware, and software. 8

Computer program A detailed set of instructions that tells a computer how to solve a problem or carry out a task. 15

Computer virus A program designed to attach itself to a file, reproduce, and spread from one file to another, destroying data, displaying an irritating message, or otherwise disrupting computer operations. 163

Computer worm A software program designed to enter a computer system, usually a network, through security "holes" and then replicate itself. 163

Control unit The part of the microprocessor that directs and coordinates processing. 31

Convergence In the context of technology, the melding of digital devices into a single platform that handles a diverse array of digital content, such as cell phones that also play digital music and display digital video. 9

Copyright A form of legal protection that grants certain exclusive rights to the author of a program or the owner of the copyright. 156

Copyright notice A line such as "Copyright 2014 by ACME CO" that identifies a copyright holder. 156

CPU (central processing unit) The main processing circuitry within a computer or chip that contains the ALU, control unit, and registers. 15

CPU cache Special high-speed memory providing the CPU rapid access to data that would otherwise be accessed from disk or RAM. 68

Cryptographic algorithm A specific procedure for encrypting and decrypting data. 285

Cryptographic key A specific word, number, or phrase that must be used to encrypt or decrypt data. 285

Data In the context of computing and data management, *data* refers to the symbols that a computer uses to represent facts and ideas. 15

Data bus An electronic pathway or circuit that connects the electronic components (such as the processor and RAM) on a computer's system board. 94

Data fork An element of the Macintosh file system that comprises the part of the file that contains the text, audio, or video data; contrast with resource fork. 199

Data processing An input-processing-output cycle that converts data into information. 6

Data representation The use of electronic signals, marks, or binary digits to represent character, numeric, visual, or audio data. 22

Data transfer rate The amount of data that a storage device can move from a storage medium to computer memory in one time unit, such as one second. 77

Database A collection of information that might be stored in more than one file or in more than one record type. 139

Database software Software designed for entering, finding, organizing, updating, and reporting information stored in a database. 139

Dedicated graphics Circuitry for graphics that is supplied on an expansion card rather than integrated into the main system board of a digital device. 91

Defragmentation utility A software tool used to rearrange the files on a disk so that they are stored in contiguous clusters. 221

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Demoware Commercial software that is distributed for free, but expires after a certain time limit and then requires users to pay to continue using it. 159

Desktop A term used to refer to the main screen of a graphical user interface that can hold objects such as folders and widgets. 191

Desktop computer A computer that is small enough to fit on a desk and built around a single microprocessor chip. 58

Desktop operating system An operating system specifically designed for use on personal computers, such as Microsoft Windows or Mac OS X. 188

Desktop publishing software (DTP) Software used to create high-quality output suitable for commercial printing. DTP software provides precise control over layout. 127

Device driver A type of system software that provides the computer with the means to control a peripheral device. 131

Dialog box An element of graphical user interfaces that appears in a window and requests information, such as command parameters, from a user. 193

Dictionary attack A method of discovering a password by trying every word in an electronic dictionary. 36

Differential backup A copy of all the files that changed since the last full backup of a disk. 228

Digital data Text, numbers, graphics, or sound represented by discrete digits, such as 1s and 0s. 22

Digital divide A gap between those who have access to digital technologies and those who do not. 13

Digital revolution A set of significant changes brought about by computers and other digital devices during the second half of the 20th century. 4

Digitization To convert non-digital information or media to a digital format through the use of a scanner, sampler, or other input device. 5

Directory In the context of computer file management, a list of files contained on a computer storage device. 206

Disc mastering The process of creating a CD or DVD by selecting all the files to be copied and then writing them in a single session. Contrast with packet writing. 219

Discovery mode The status of a Bluetooth device that is open for pairing. 261

Disk image A bit-by-bit copy of the contents of a disk created for backup, archiving, or duplication of data. 229

Disk partition An area of a hard disk created by dividing a large hard disk into several smaller virtual ones, such as when using two operating systems on a single computer. 206

DNS cache poisoning An exploit in which the DNS database is changed in such a way that a URL no longer connects to the correct Web site. 308

Dock The area of a Mac desktop (usually at the bottom on the screen) that displays program icons. 191

Document formatting The specifications applied to fonts, spacing, margins, and other elements in a document created with word processing software. 135

Document production software Computer programs that assist the user in composing, editing, designing, and printing documents. 125

DOS (Disk Operating System) The operating system software shipped with the first IBM PCs, then used on millions of computers until the introduction of Microsoft Windows. 194

Dot matrix printer A printer that creates characters and graphics by striking an inked ribbon with small wires called pins, generating a fine pattern of dots. 93

Dot pitch (dp) The diagonal distance between colored dots on a display screen. Measured in millimeters, dot pitch helps to determine the quality of an image displayed on a monitor. 90

Download The process of transferring a copy of a file from a remote computer to a local computer's storage device. 18

Drive bays Areas within a computer system unit that can accommodate additional storage devices. 86

Dual boot A computer that contains more than one operating system and can boot into either one. 198

Duplex printer A printer that prints on both sides of the paper in a single pass. 94

Duty cycle A measurement of how many pages a printer is able to produce per day or month. 93

DVD (digital video disc or digital versatile disc) An optical storage medium similar in appearance and technology to a CD but with higher storage capacity. 81

DVD authoring software Computer programs that offer tools for creating DVD menus and transferring digital video onto DVDs that can be played in a computer or standalone DVD player. 122

DVI (Digital Visual Interface) A standard type of plug and connector for computer display devices. 96

Dynamic RAM (DRAM) Random access memory that requires a power source to hold data; used as main memory on most computers. 72

EBCDIC (Extended Binary-Coded Decimal Interchange Code) A method by which digital computers, usually mainframes, represent character data. 25

EEPROM (electrically erasable programmable read-only memory) A type of non-volatile storage typically used in personal computers to store boot and BIOS data. 74

Enhanced media player Handheld devices designed to play music, but with enhanced features, such as a browser and apps. 65

eSATA A standard for high-speed ports, plugs, and connectors typically used to connect external hard drives to computers. 96

EULA (end user license agreement) A type of software license that appears on the computer screen when software is being installed and prompts the user to accept or decline. 157

Executable file A file, usually with an .exe extension, containing instructions that tell a computer how to perform a specific task. 146

Expansion bus The segment of the data bus that transports data between RAM and peripheral devices. 94

Expansion card A circuit board that is plugged into a slot on a computer system board to add extra functions, devices, or ports. 95

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Expansion port A socket into which the user plugs a cable from a peripheral device, allowing data to pass between the computer and the peripheral device. 95

Expansion slot A socket or "slot" on a computer system board designed to hold a circuit board called an expansion card. 95

Extended ASCII Similar to ASCII but with 8-bit character representation instead of 7-bit, allowing for an additional 128 characters. 24

Field The smallest meaningful unit of information contained in a data file. 139

File A named collection of data (such as a computer program, document, or graphic) that exists on a storage medium, such as a hard disk or CD. 15

File Explorer A file management utility included with Windows 8 that helps users manage their files. 216

File extension A set of letters and/or numbers added to the end of a file name that helps to identify the file contents or file type. 204

File format The method of organization used to encode and store data in a computer. Text formats include DOCX and TXT. Graphics formats include BMP, TIFF, GIF, and PNG. 207

File header Hidden information inserted at the beginning of a file to identify its properties, such as the software that can open it. 207

File management utility Software, such as Finder and File Explorer, that help users locate, rename, move, copy, and delete files. 214

File shredder software Software designed to overwrite sectors of a disk with a random series of 1s and 0s to ensure deletion of data. 220

File specification A combination of the drive letter, subdirectory, file name, and extension that identifies a file (such as C:\Pictures\Photo.jpg); also called a path. 206

File system A method that is used by an operating system to keep files organized. 219

File tag In the context of Windows, a piece of information that describes a file. Tags, such as Owner, Rating, and Date Taken, can be added by users. 212

File-naming conventions A set of rules, established by the operating system, that must be followed to create a valid file name. 204

FireWire A standard for fairly high-speed ports, plugs, and connectors typically used to connect external storage devices, and for transferring data from cameras to computers. 96

Floppy disk A removable magnetic storage medium, typically 3.5" in size, with a capacity of 1.44 MB. 80

Folder The subdirectories, or subdivisions of a directory, that can contain files or other folders. 206

Font A typeface or style of lettering, such as Arial, Times New Roman, and Gothic. 135

Footer Text that appears in the bottom margin of each page of a document. 135

Form factor The configuration of a computer's system unit; examples include tower, mini-tower, and cube. 58

Formatting The process of dividing a disk into sectors so that it can be used to store information. 219

Formula In spreadsheet terminology, a combination of numbers and symbols that tells the computer how to use the contents of cells in calculations. 137

Fragmented files Files stored in scattered, noncontiguous clusters on a disk. 221

Freeware Copyrighted software that is given away by the author or copyright owner. 161

Front side bus (FSB) The data bus that carries signals between the CPU and RAM, disks, or expansion slots. 68

Full system backup A copy of all the application, system, and data files that exist on a computer's hard disk. 226

Fully justified The horizontal alignment of text where the text terminates exactly at both margins of the document. 135

Function (1) In the context of spreadsheet software, a built-in formula for making a calculation. (2) In the context of programming, a section of code that manipulates data, but is not included in the main sequential execution path of a program. 137

Game controllers Devices such as joysticks, wands, and steering wheels; used to control on-screen action in computer games. 88

Gigabit (Gb or Gbit) Approximately 1 billion bits, exactly 1,024 megabits. 26

Gigabyte (GB) Approximately 1 billion bytes; exactly 1,024 megabytes (1,073,741,824 bytes). 26

Gigahertz (GHz) A measure of frequency equivalent to 1 billion cycles per second. 67

Globalization A group of social, economic, political, and technological interdependencies linking people and institutions from all areas of the world. 12

GPL (General Public License) A software license often used for freeware that insures it will be distributed freely whether in its original form or as a derivative work. 160

Grammar checker A feature of word processing software that coaches the user on correct sentence structure and word usage. 134

Graphical user interface (GUI) A type of user interface that features on-screen objects, such as menus and icons, manipulated by a mouse. 190

Graphics Any picture, photograph, or image that can be manipulated or viewed on a computer. 123

Graphics card A circuit board inserted into a computer to handle the display of text, graphics, animation, and videos. Also called a video card or graphics board. 91

Graphics processing unit (GPU) A microprocessor dedicated to rendering and displaying graphics on personal computers, workstations, and videogame consoles. 91

Graphics software Computer programs for creating, editing, and manipulating images; types include paint software and drawing software. 123

Hard disk drive A computer storage device that contains a large-capacity rigid storage surface sealed inside a drive case. Typically used as the primary storage device in desktop and laptop computers. 78

Hard disk platter The component of a hard disk drive on which data is stored. It is a flat, rigid disk made of aluminum or glass and coated with a magnetic oxide. 78

Hash value A number produced by a hash function to create a unique digital "fingerprint" that can be used to allow or deny access to a software application. 161

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HDMI (High-Definition Multimedia Interface) A standard type of plug and connector for computer display devices. 96

Head crash A collision between the read-write head and the surface of the hard disk platter, resulting in damage to some of the data on the disk. 79

Header Text that is placed in the top margin of each page of a document. 135

Home computer system A personal computer designed for use with mainstream computer applications such as Web browsing, e-mail, music downloads, and productivity software. 60

Horizontal market software Any computer program that can be used by many different kinds of businesses (for example, an accounting program). 126

Hot-plugging The ability of a component, such as a USB flash drive, to connect to or disconnect from a computer while it is running; also referred to as hot-swapping. 97

Icon A graphical object, such as those that represent programs or folders on a computer desktop. 192

Identity theft An illegal practice in which a criminal obtains enough information to masquerade as someone. 36

Incremental backup A backup that contains files that changed since the last backup. 228

Ink jet printer A non-impact printer that creates characters or graphics by spraying liquid ink onto paper or other media. 92

Input As a noun, the information that is conveyed to a computer. As a verb, to enter data into a computer. 15

Instruction cycle The steps followed by a computer to process a single instruction: fetch, interpret, execute, then increment the instruction pointer. 32

Instruction set The collection of instructions that a CPU is designed to process. 30

Integrated circuit (IC) A thin slice of silicon crystal containing microscopic circuit elements such as transistors, wires, capacitors, and resistors; also called chips and microchips. 27

Integrated graphics Circuitry for graphics processing that is integrated into the mainboard rather than as an expansion card. 91

Intellectual property A legal concept that refers to ownership of intangible information, such as ideas. 12

Internet The worldwide communication infrastructure that links computer networks using the TCP/IP protocol. 8

Interpreter A program that converts high-level instructions in a computer program into machine language instructions, one instruction at a time. 30

iOS The operating system used for iPhones, iPods, and iPads. 200

Jailbreak Making unauthorized changes to an iPod, iPhone, or iPad to get apps from a source other than the official iTunes App Store. 145

Kernel The core module of an operating system that typically manages memory, processes, tasks, and storage devices. 188

Keylogger A program, sometimes part of a Trojan horse, that records a person's keystrokes, saves them, and then sends them to a system administrator or remote hacker. 37

Keyword search The process of looking for information by providing a related word or phrase. 141

Kilobit (Kbit or Kb) 1024 bits. 26

Kilobyte (KB) Approximately 1,000 bytes; exactly 1,024 bytes. 26

Label In the context of spreadsheets, any text used to describe data. 136

Lands Non-pitted surface areas on a CD that represent digital data. (See also *pits*.) 81

Laptop computer A small, lightweight, portable computer that usually runs on batteries. Sometimes called a notebook computer. 59

Laser printer A printer that uses laser-based technology, similar to that used by photocopiers, to produce text and graphics. 92

LCD (liquid crystal display) Technology used for flat panel computer screens typically found on laptop computers. 90

Leading Also called line spacing, the vertical spacing between lines of text. 135

LED (light-emitting diode) Either a display technology that uses LEDs to produce an image on the screen, or one that uses LEDs as backlighting. 90

Library In the context of Microsoft Windows, a superfolder that contains pointers to various folders and files; examples include Documents, Pictures, and Videos. 217

Linux An operating system that is a derivative of UNIX, available as freeware, and widely used for servers though it is also used on personal computers and workstations. 202

Linux distribution Usually a download that includes the Linux operating system, a Linux desktop, and other Linux utilities. 202

Linux platform A computer that is running the Linux operating system. 64

Local software Computer applications that are installed on and run from a local device, usually a computer hard drive. 7

Location-based software Applications that are able to access your current location using, for example, a smartphone's GPS or nearby LAN signals. 125

Logical storage models Any visual or conceptual aid that helps a computer user visualize a file storage system. Also called a storage metaphor. 215

Mac OS The operating system software designed for use on Apple Macintosh computers. 197

Mac platform A family or category of Macintosh-compatible personal computers designed and manufactured by Apple Computer. 64

Machine code Program instructions written in binary code that the computer can execute directly. 30

Machine language A low-level language written in binary code that the computer can execute directly. 30

Magnetic storage A technology for recording data onto disks or tape by magnetizing particles of an oxide-based surface coating. 78

Mainframe computer A large, fast, and expensive computer generally used by businesses or government agencies to provide centralized storage, processing, and management for large amounts of data. 18

Malicious software Any program or set of program instructions, such as a virus, worm, or Trojan horse, designed to surreptitiously enter a computer and disrupt its normal operations. 162

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Malware Programs such as viruses, worms, and bots designed to disrupt computer operations. 162

Mapping application An application that displays satellite, aerial, or street maps that can be used to locate places and get directions. 125

Mass-mailing worm A worm that sends itself to every e-mail address in the address book of an infected computer. 163

Mathematical modeling software Software for visualizing and solving a wide range of math, science, and engineering problems. 126

Mathematical operators Symbols such as + - / * that represent specific mathematical functions in a formula. 137

Megabit (Mb or Mbit) 1,048,576 bits. 26

Megabyte (MB) Approximately 1 million bytes; exactly 1,048,576 bytes. 26

Megahertz (MHz) A measure of frequency equivalent to 1 million cycles per second. 68

Memory The computer circuitry that holds data waiting to be processed. 15

Memory card A small, flat, solid state storage medium, frequently used to store data on cameras and handheld devices. 84

Memory leak An undesirable state in which a program requests memory but never releases it, which can eventually prevent other programs from running. 187

Menu In the context of user interfaces, a list of commands or options often displayed as a list. 192

Menu bar A standard component of most graphical user interfaces that is displayed as a strip of clickable options, that in turn display a list of commands. 192

Metadata Data that contains information about other data; file tags are an example of metadata. 214

Microcontroller A special-purpose microprocessor that is built into the device it controls. 20

Microprocessor An integrated circuit that contains the circuitry for processing data. It is a single-chip version of the central processing unit (CPU) found in all computers. 15

Microprocessor clock A timing signal that sets the pace for executing instructions in a microprocessor. 67

Microsoft Windows An operating system, developed by Microsoft Corporation, that provides a graphical interface. Versions include Windows 3.1, 95, 98, Me, NT, 2000, XP, Vista, 7, and 8. 194

Mobile app An application designed to be downloaded to a handheld device, such as a smartphone or tablet computer. 145

Mobile operating system An operating system used by a handheld device, such as a smartphone or tablet computer. 188

Module A component or part of a software program or an office suite (e.g., a word processing module). 132

Money management software Software used to track monetary transactions and investments. 128

Mouse An input device that allows the user to manipulate objects on the screen by clicking, dragging, and dropping. 88

Multi-core processor A microprocessor that contains circuitry for more than one processing unit. 68

Multiple-user license Legal permission for more than one person to use a particular software package. 157

Multiprocessing The ability of a computer or an operating system to support dual-core processors or multiple processors. 186

Multitasking The ability of a computer, a processor, or an operating system to run more than one program, job, or task at the same time. 186

Multithreading A technology that allows multiple parts or threads from a program to run simultaneously. 186

Multiuser operating system An operating system that allows a single computer to deal with simultaneous processing requests from multiple users. 187

Music software A broad category of software that can be used to play, record, compose, or manipulate sound files. 121

Native file format A file format that is unique to a program or group of programs and has a unique file extension. 209

Natural language query A query formulated in human language as opposed to an artificially constructed language such as machine language. 141

Non-volatile Any electronic component that does not require a constant supply of power to hold data. 84

Numeric data Numbers that represent quantities and can be used in arithmetic operations. 23

Object code The low-level instructions that result from compiling source code. 30

Office suite A collection of productivity programs, typically word processing, spreadsheet, presentation, and database modules. 132

Online backup services Space for backup data provided through a Web site. 223

Op code Short for *operation code*; an assembly language command word that designates an operation, such as add (ADD), compare (CMP), or jump (JMP). 31

Open source An approach to developing and licensing software in which source code remains public so it can be improved and freely distributed. 12

Open source software Software that includes its source code, allowing programmers to modify and improve it. 160

Operand The part of an instruction that specifies the data, or the address of the data, on which the operation is to be performed. 31

Operating system The software that controls the computer's use of its hardware resources, such as memory and disk storage space. Also called an OS. 16

Optical storage A technology that records data as light and dark spots on a CD, DVD, or other optical media. 81

Output The results produced by a computer (for example, reports, graphs, and music). 15

Overclocking Forcing a computer component, such as a microprocessor, to run at a higher speed than intended by the manufacturer. 71

Packet writing The process of recording data to a CD or DVD in multiple sessions. Contrast with disc mastering. 219

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Page layout The physical positions of elements on a document page such as headers, footers, page numbering, and graphics. 135

Paint software Software that creates and manipulates bitmap graphics. 123

Paragraph alignment The horizontal position (left, right, justified, centered, for example) of the text in a document. 135

Paragraph style A specification for the format of a paragraph, which includes the alignment of text within the margins and line spacing. 135

Parallel processing The simultaneous use of more than one processor to execute a program. 69

Password A special set of symbols used to restrict access to a user's computer or network. 35

Password manager Software that keeps track of sites at which a user has registered and the password that corresponds to each site. 40

Path A file's location specified by the drive on which it is stored and the hierarchy of folders in which it is stored. (See *file specification*.) 206

Payroll software Horizontal market business software used to track employee hours, calculate pay, and print pay checks. 126

PC platform A family of personal computers that use Windows software and contain Intel-compatible microprocessors. 64

PDF (Portable Document Format) A standard format for exchanging files that can be viewed using Adobe Reader software. 129

Peripheral device A component or equipment, such as a printer, that expands a computer's input, output, or storage capabilities. 56

Personal computer A microcomputer designed for use by an individual user for applications such as Web browsing and word processing. 17

Personal computing A type of computing characterized by the use of standalone computers designed for single users. 7

Personal finance software Software geared toward individual finances that helps track bank account balances, credit card payments, investments, and bills. 128

Phishing An e-mail based scam that's designed to fool users into revealing confidential information. 37

Photo editing software The software used to edit, enhance, retouch, and manipulate digital photographs. 123

Physical storage model A representation of data as it is physically stored. 218

Pipelining A technology that allows a processor to begin executing an instruction before completing the previous instruction. 69

Pirated software Software that is copied, sold, or distributed without permission from the copyright holder. 156

Pits Spots on a CD that are "burned" onto an optical storage medium to represent digital data. 81

Pixels Short for *picture elements*; the smallest unit in a graphic image. Computer display devices use a matrix of pixels to display text and graphics. 90

Point size A unit of measure (1/72 of an inch) used to specify the height of characters in a font. 135

Pointing device An input device, such as a mouse, trackball, pointing stick, or trackpad, that allows users to manipulate an on-screen pointer and other screen-based graphical controls. 88

Portable computer Any type of computer, such as a laptop computer, that runs on batteries and is designed to be carried from one location to another; also called a mobile computer. 59

Portable software Software designed to be stored on a flash drive or CD, and that does not require installation before it is used. 151

PostScript A printer language, developed by Adobe Systems, that uses a special set of commands to control page layout, fonts, and graphics. 94

Power surge A spike in electrical voltage that has the potential to damage electronic equipment such as computers. 99

Presentation software Software that provides tools to combine text, graphics, graphs, animation, and sound into a series of electronic "slides" that can be output on a projector, or as overhead transparencies, paper copies, or 35-millimeter slides. 142

Printer Command Language (PCL) A standard for codes embedded within a document that specify how a printer should format each page. 94

Processing The manipulation of data by a computer's microprocessor or central processing unit. 15

Product activation The process of becoming a registered user of a software product; the process might include entering a validation code to unlock the software. 161

Productivity software Software that helps people work more efficiently; traditionally word processing, spreadsheet, presentation, e-mail, and database software. 132

Programming language A set of keywords and grammar (syntax) that allows a programmer to write instructions that a computer can execute. 29

Project management software Software specifically designed as a tool for planning, scheduling, and tracking projects and their costs. 126

Proprietary software Software that carries restrictions on its use that are delineated by copyright, patents, or license agreements. 159

Public domain software Software that is available for public use without restriction except that it cannot be copyrighted. 158

Quarantined file A file suspected to be infected with a virus that antivirus software moves to a special folder to prevent accidental access to it. 169

Query A search specification that prompts the computer to look for particular records in a file. 141

Query by example (QBE) A type of database interface in which the user fills in a field with an example of the type of information that is being sought. 141

Query language A set of command words that can be used to direct the computer to create databases, locate information, sort records, and change the data in those records. 141

RAM (random access memory) Computer memory circuitry that holds data, program instructions, and the operating system while the computer is on. 72

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Random access The ability of a storage device (such as a disk drive) to go directly to a specific storage location without having to search sequentially from a beginning location. 77

Read-only technology Storage media that can only be read from, but not recorded on. 82

Read-write head The mechanism in a disk drive that magnetizes particles on the storage disk surface to write data, or senses the bits that are present to read data. 78

Readability formula A feature found in some word processing software that can estimate the reading level of a written document. 134

Record In the context of database management, a record is the fields of data that pertain to a single entity in a database. 139

Recordable technology The devices and standards that allow computers to write data permanently on CDs and DVDs, but do not allow that data to be changed once it has been recorded. 82

Recovery disk A CD that contains all the operating system files and application software files necessary to restore a computer to its original state. 226

Recovery partition A section of a hard disk that contains the files necessary to restore a computer's hard disk contents to factory condition. 227

Registers A sort of "scratch pad" area of the microprocessor into which data or instructions are moved so that they can be processed. 31

Relative reference In a worksheet, a cell reference that can change if cells change position as a result of a move or copy operation. 138

Remote Access Trojan (RAT) A type of Trojan horse that provides a "backdoor" into a computer for remote hackers to transmit files, snoop, run programs, and launch attacks on other computers. 163

Reserved words Special words used as commands in some operating systems that may not be used in file names. 205

Resource A component, either hardware or software, that is available for use by a computer's processor. 185

Resource fork A storage characteristic of Mac OS that creates a file containing a description of the data stored in an accompanying raw data file. 199

Response rate In the context of display technology, response rate is the time it takes for one pixel to change from black to white then back to black. 90

Restore The process of copying files from a backup back to a computer's hard disk. 222

Restore point Data stored about the state of files and the operating system at a given point in time, then used to roll back the computer system to that state. 227

Rewritable technology The devices and standards that allow users to write data on a storage medium and then change that data. 82

Ribbon An element of the user interface popularized by Microsoft Office 2007 that presents users with multiple tabs instead of menus at the top of the application window. 192

RISC (reduced instruction set computer) A microprocessor designed for rapid and efficient processing of a small set of simple instructions. 69

ROM (read-only memory) Refers to one or more integrated circuits that contain permanent instructions that the computer uses during the boot process. 74

Root directory The main directory of a disk. 206

Rooting A process that enables users to gain root access to Android mobile devices with the purpose of overcoming limitations imposed by mobile service providers. 145

Rootkit Software that conceals running processes; used by hackers to disguise security breaches and break-ins. 165

Safe Mode A boot option that appears when an operating system is unable to complete the boot sequence. By entering Safe Mode, a user can gracefully shut down the computer, and then try to reboot it. 105

Screen resolution The density of the grid used to display text or graphics on a display device; the greater the horizontal and vertical density, the higher the resolution. 91

Search and Replace A feature of document production software that allows the user to automatically locate all instances of a particular word or phrase and substitute another word or phrase. 133

Sectors Subdivisions of the tracks on a storage medium that provide storage areas for data. 219

Security software Any software package that is designed to protect computers from destructive software and unauthorized intrusions. 162

Security suite A software suite containing modules to protect computers against viruses, worms, intrusions, spyware, and other threats. 166

Semiconducting materials (semiconductors) Substances, such as silicon or germanium, that can act as either a conductor or an insulator. Used in the manufacture of computer chips. 27

Sequential access A characteristic of data storage, usually on computer tape, that requires a device to read or write data one record after another, starting at the beginning of the medium. 77

Serial processing Processing data one instruction at a time, completing one instruction before beginning another. 69

Server A computer or software on a network that supplies the network with data and storage. 18

Server operating system A type of operating system, sometimes called a network operating system, that provides management tools for distributed networks, e-mail servers, and Web hosting sites. 187

Service pack A collection of patches designed to correct bugs and/or add features to an existing software program. 152

Setup program A program module supplied with a software package for the purpose of installing the software. 148

Shareware Copyrighted software marketed under a license that allows users to use the software for a trial period and then send in a registration fee if they wish to continue to use it. 159

Shrink-wrap license A legal agreement printed on computer software packaging, which becomes binding when the package is opened. 157

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Single-user license Legal permission for one person to use a particular software package. 157

Single-user operating system A type of operating system that is designed for one user at a time using one set of input devices. 187

Site license Legal permission for software to be used on any and all computers at a specific location (for example, within a corporate building or on a university campus). 157

Smartphone A cellular phone that has a high-resolution color screen, a browser, and the ability to run apps. 65

Sniffing In the context of computer hacking, a technique that uses packet sniffer software to capture packets as they are sent over a network. 37

Social media Online Web sites and services, such as Facebook, Twitter, and LinkedIn, that help users create content and share it with others. 10

Software The instructions that direct a computer to perform a task, interact with a user, or process data. 15

Software installation The process by which programs and data are copied to the hard disk of a computer system and otherwise prepared for access and use. 143

Software license A legal contract that defines the ways in which a user may use a computer program. 157

Software update A section of code or a program module designed to correct errors or enhance security on an already installed software product. 152

Software upgrade A new version of a software product containing new features and designed to replace the entire earlier version of the product. 152

Solid state drive A data storage device that utilizes erasable, rewritable circuitry. 85

Solid state storage A technology that records data and stores it in a microscopic grid of cells on a non-volatile, erasable, low-power chip. 84

Source code Computer instructions written in a high-level language. 29

Spelling checker A feature of document production software that checks each word in a document against an electronic dictionary of correctly spelled words, and then presents a list of alternatives for possible misspellings. 134

Spelling dictionary A data module that is used by a spelling checker as a list of correctly spelled words. 134

Spreadsheet A numerical model or representation of a real situation, presented in the form of a table. 136

Spreadsheet software Software for creating electronic worksheets that hold data in cells and perform calculations based on that data. 136

Spyware Any software that covertly gathers user information without the user's knowledge, usually for advertising purposes. 164

Start screen The Windows 8 screen that contains all of the tiles for applications. 191

Statistical software Software for analyzing large sets of data to discover patterns and relationships within them. 126

Storage The area in a computer where data is retained on a permanent basis. 15

Storage density The closeness of the particles on a disk surface. As density increases, the particles are packed more tightly together and are usually smaller. 77

Storage device A mechanical apparatus that records data to and retrieves data from a storage medium. 76

Storage medium The physical material, such as a hard disk or CD, on which data is stored. 76

Stored program A set of instructions that resides on a storage device, such as a hard drive, and can be loaded into computer memory and executed. 16

Style A feature in many desktop publishing and word processing programs that allows the user to apply numerous format settings with a single command. 135

Subdirectory A directory found under the root directory. 206

Submenu A user interface element that emerges after a menu is selected to offer additional options. 193

Supercomputer The fastest and most expensive type of computer, capable of processing trillions of instructions per second. 19

Surge strip A device that filters out electrical spikes that could damage computer equipment. 100

System board The main circuit board in a computer that houses chips and other electronic components. 28

System requirements (1) The minimum hardware and operating system specifications required for a software application to operate correctly. (2) Criteria for developing a successful information system, which are typically compiled into a System Requirements Report at the conclusion of the analysis phase of the SDLC. 155

System software Computer programs, such as an operating system or utility software, that help the computer carry out essential operating tasks. 16

System unit The case or box that contains the computer's power supply, storage devices, main circuit board, processor, and memory. 57

System utilities Utility software that diagnoses and repairs disk errors, corrupted files, and other software or hardware problems. 130

Tablet computer A small, portable computer with a touch-sensitive screen that can be used as a writing or drawing pad. 65

Taskbar A graphical user interface element usually displayed near the bottom of the screen to help users launch and monitor applications. 191

Tax preparation software Software used to help individuals or businesses calculate annual state and federal taxes. 128

Thesaurus A feature of documentation software that provides synonyms. 134

Thunderbolt A high-speed expansion port typically used to connect external storage devices to a computer. 96

Tiles In the context of Windows 8, tiles are the icons that represent programs on the Start screen. 192

Toolbar A component of graphical user interfaces that displays icons representing tools, commands, and other options. 192

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Touchscreen A display device that accepts input from being touched with a stylus or fingertip. 89

Tower case A desktop computer form factor that stores the system board and storage devices in a tall system unit with detached display and keyboard. 58

Trackpad A touch-sensitive surface on which you slide your fingers to move the on-screen pointer. 89

Tracks A series of concentric or spiral storage areas created on a storage medium during the formatting process. 219

Trojan horse A computer program that appears to perform one function while actually doing something else, such as inserting a virus into a computer system or stealing a password. 163

Unicode A 16-bit character-representation code that can represent more than 65,000 characters. 25

Uninstall routine A program that removes software files, references, and registry entries from a computer's hard disk. 153

UNIX A multiuser, multitasking server operating system developed by AT&T Bell Laboratories in 1969. 202

Unzipped Refers to files that have been uncompressed. 150

Upload The process of transferring a file from a local computer to a remote computer over a LAN or the Internet. 18

UPS (uninterruptible power supply) A battery-backed device designed to provide power to a computer during blackouts, brownouts, or other electrical disruptions. 100

USB (universal serial bus) A high-speed bus commonly used for connecting peripheral devices to computers. 96

USB flash drive A portable solid state storage device nicknamed "pen drive" or "keychain drive" that plugs directly into a computer's USB port. 85

USB hub A device that provides several auxiliary USB ports. 96

User ID A combination of letters and numbers that serves as a user's "call sign" or identification. Also referred to as a user name. 34

User interface The software and hardware that enable people to interact with computers. 190

Utility software A type of system software provided by the operating system vendor or third-party vendors that specializes in tasks such as system maintenance, security, or file management. 129

Value A number used in a calculation. 136

Vertical market software Computer programs designed to meet the needs of a specific market segment or industry, such as medical record-keeping software for use in hospitals. 126

VGA (Video Graphics Array) A screen resolution of 640 x 480. 96

Video editing software Software that provides tools for capturing and editing video from a camcorder. 122

Videogame console A computer specifically designed for playing games using a television screen and game controllers. 17

Viewing angle width The angle at which you can clearly see the screen image from the side. 90

Virtual keyboard A keyboard that is displayed on a touchscreen and used for input on smartphones and tablet computers. 89

Virtual machine Software that creates an operating environment that emulates another computer platform; as an example, Parallels Desktop creates a virtual PC on an Intel Macintosh computer. 198

Virtual memory A computer's use of hard disk storage to simulate RAM. 73

Virus definitions A group of virus signatures used by antivirus software to identify and block viruses and other malware. 168

Virus hoax A message, usually e-mail, that makes claims about a virus problem that doesn't actually exist. 166

Virus signature The unique computer code contained in a virus that security software uses to identify it. 167

Voiceband modem The type of modem typically used to connect a computer to a telephone line. 313

Volatile A term that describes data (usually in RAM) that can exist only with a constant supply of power. 72

Web Short for *World Wide Web*; an Internet service that links documents and information from computers located worldwide, using the HTTP protocol. 8

Web application Application software that is accessed and used from within a browser. 143

What-if analysis The process of setting up a model in a spreadsheet and experimenting to see what happens when different values are entered. 136

Windows Registry A group of files on Windows computers that is used by the operating system to store configuration information about hardware and software. 227

Windows RT The version of Microsoft Windows designed for tablet computers. 196

Word processing software Computer programs that assist the user in producing documents, such as reports, letters, papers, and manuscripts. 133

Word size The number of bits that a CPU can manipulate at one time, which is dependent on the size of the registers in the CPU, and the number of data lines in the bus. 68

Word wrap The ability of word processing software to automatically sense the right margin and stream text to the next line. 133

Worksheet A computerized, or electronic, spreadsheet. 136

Workstation (1) A computer connected to a local area network. (2) A powerful desktop computer designed for specific tasks. 17

Zipped Refers to one or more files that have been compressed. 150

Zombie A computer that has been compromised by malware that allows it to be controlled by a remote user. 164

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TRY IT! ANSWERS

CHAPTER 1

005

❍ No, data processing was associated with business and government computing.

● Correct! CompuServe and AOL had some similarities to today's social media, but were designed for people using desktop computers and dial-up Internet connections.

❍ No, CompuServe and AOL were popular in the 1980s and mid-1990s, whereas the first tablet was not introduced until 2000.

❍ No, cloud computing became popular long after the heyday of AOL and CompuServe.

007

❍ No, the Beatles got together in 1960. Beatlemania was in full swing from 1963-1966, ten years before the age of personal computing.

❍ No, the first human spaceflight was in 1961. That's 15 years before the first personal computers hit store shelves.

❍ No, Bill Clinton was president from 1993-2001, which was after the personal computing era.

● Correct! The Apple II computer was one of the devices that characterized the personal computing era.

008

● Correct!

❍ No, the Web consists of sites, and the Internet is a network that can link devices.

010

● Correct! A Google search for "number of Facebook users" will provide you with an estimate of the current number. It's astoundingly huge.

❍ As of this textbook's publication date, Twitter had about half the number of users as Facebook.

011

❍ No, although the United States government monitors information on the Internet, it does not officially censor it.

❍ No, although Russian law allows the government to shut down Web sites that contain offensive content, Russia is not the country with the most censorship.

● Correct! You can find interesting information about Internet censorship in the Wikipedia article "Internet Censorship by Country."

❍ No, in Greece the government may monitor Internet-based communications, but does not engage in full-scale censorship.

012

❍ No, more than 25% of the world population has Internet access.

● Correct! In 2012 when this book went to press, about a third of the world population had Internet access.

❍ No, when this text went to press this figure was too high.

❍ No, when this text went to press, this figure was too high.

015

❍ No, an iPad might have 1 GB of memory, called RAM, for temporary storage, but it would require too much battery power to operate 64 GB of memory.

● Correct! The specification of 64 GB refers to storage where you can save programs and data, even when the power is off.

016

● Correct! Microsoft Windows is an operating system.

❍ No, Microsoft Word is application software.

● Correct! Apple iOS is the operating system used in iPhones and iPads.

● Correct! Mac OS X is the operating system used in Apple desktop and notebook computers.

❍ No, iWork is application software for Apple computers.

❍ No, iTunes is application software.

018

❍ No, the computer is uploading to a server.

● Correct! The computer is a client because it is uploading and downloading from the YouTube server.

❍ No, although the computer shown could be a server, it is acting as a client in this example.

020

❍ No, a microcontroller typically has a built-in program, but would not run apps such as Angry Birds.

❍ No, some handheld devices, such as GPSs and basic mobile phones, don't allow you to download and run apps.

● Correct! Handheld computers, such as iPods and smartphones, are characterized by their ability to download and run a variety of apps.

021

● The black rectangular chip is correct.

023

❍ No, 10111 is binary for 23.

● Correct!

❍ No, 10000 is binary for 16.

❍ No, 1111 is binary for 15.

024

● 01001000

● 01101001

● 00100001

025

● 00110001

● 00110000

● 00100000 OR 11111111

● 01010011

● 01110100

026

● GB OR gigabytes

● MB OR megabyte OR megabytes

● KB OR kilobytes

027

❍ No.

❍ No.

❍ No.

● Correct!

029

❍ No, Bill Gates is the founder of Microsoft.

● Correct! In 1842, Ada devised a way of computing Bernoulli numbers on a proposed computing machine called the Analytical Engine.

❍ No, Grace Hopper was a pioneer in computing, and she did program one of the first operational computers in 1944.

❍ No, although there is a computer language called Fortran, it is not named after a person.

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030

❍ No, an interpreter would convert source code into machine code one instruction at a time, and it would not create a file that could be distributed.

● Correct! A compiler will convert all of the source code instructions into a file that contains object code that can be distributed and run as an iPhone app.

❍ No, COBOL is an old programming language that's not designed for modern devices such as iPhones.

❍ No, ASCII code is not a programming tool.

031

● [The one on the left] op code OR operation code

● [The one on the right] operand

033

● [Accumulator] 9

● [Register 1] 4

● [Register 2] 5

● [RAM] 9

034

❍ No, single-factor authentication involves only one means of identification.

❍ No.

● Correct!

❍ No, password security relies on the complexity of the password you select.

037

● mouse

038

❍ No, this password is based on the user's name.

❍ No, this password is based on the user's name plus an easy-to-guess sequence of numbers.

❍ No, although Gilgamesh is an odd word, it is a historical name listed in most dictionaries.

● Correct! This seems to be a random selection of characters, but it is a passphrase from "It's hard to guess this great password".

❍ No, two words are more secure than one, but they can still be found using a dictionary attack.

041

❍ iPhones include a browser, so your friend can access Web sites that require logins. A password manager would be a good idea.

● Correct!

CHAPTER 2

058

● Prices may have changed since this book was published, but typically Dell offers a desktop computer for less than $300.

059

● These computers are thinner, lighter, and a bit more expensive than a standard laptop computer.

060

● Correct!

❍ No, both have touchscreens.

❍ No, both use the slate form factor.

❍ No, neither offers mobile phone service.

062

❍ No, this price range is typical of enhanced media players, not desktop and laptop computers.

❍ No, this price range is typical of tablet computer prices, not desktops and laptops.

● Correct!

❍ No, this price range is too high.

063

● Correct!

❍ It is possible to install the Mac OS on a PC, but the process is difficult.

❍ No, a tablet computer will not allow you to "access Windows" over the Internet.

❍ No, it can be done. Read the explanation on this page.

064

❍ No, iOS is only used for Apple products, such as iPhones, iPods, and iPads.

● Yes, the Android platform is used for smartphones and tablets from a wide variety of manufacturers.

❍ No, Windows 8 RT is not as widely used as Android.

❍ No, this platform is used only by BlackBerry brand devices.

068

❍ No, faster clock speeds (higher GHz numbers) typically increase performance.

● Correct! Instructions that require multiple cycles will decrease performance.

❍ No, a fast front side gets data to the processor faster and increases performance.

❍ No, having more cores allows the processor to process more instructions during each clock cycle.

069

❍ No, serial processing is slowest because only one instruction is processed at a time.

❍ No, pipelining is faster than serial processing, but is not as fast as parallel processing.

● Correct! And if you have a good grasp of this concept, you'll understand that combining pipelining with parallel processing can lead to the best performance.

070

● The correct answer is the line containing *Graphics* in Figure 2-18.

072

❍ No, just the opposite is true.

● Correct!

❍ No, *volatile* means that it holds data only when the computer is on.

074

❍ No.

❍ No.

● Correct!

076

❍ No, there is not typically a path for data directly between the processor and the storage device.

● Correct!

❍ No, computers process data in the microprocessor, not in storage devices.

077

● Correct!

❍ No, sequential access was used by old tape drives, not by hard drives, USB drives, and other modern storage devices.

078

● The average price of a 2 TB hard drive is about $100.

079

● Correct!

❍ No, drive capacity is measured in GB or TB.

❍ No, drive rotation speed is measured in rpms.

❍ No, transfer rate is measured in Mbps.

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080

❍ Try again.

❍ That's not correct.

● Correct, USB flash drives use solid state technology.

❍ That's not correct.

081

❍ No, Blu-ray discs have more capacity than DVDs.

❍ No.

● Correct! The capacity of a standard DVD is just about 5 GB, whereas Blu-ray disc capacity is about 25 GB.

082

❍ No.

❍ No.

❍ No.

● Correct!

083

● You should select the row containing DVD-ROM or BD-ROM.

084

● Correct!

❍ No, RAM is more temporary.

❍ No, RAM is not designed to be easily removable.

❍ No, solid state storage typically has more capacity than RAM.

086

● Correct!

❍ No, you need access to the drive to insert and remove CDs.

❍ No, a USB drive plugs into an external port.

❍ No, you need access to the drive to insert and remove Blu-ray discs.

088

● Apple iPad and iPhones use a screen-based QWERTY keyboard as do most tablet computers. Some smartphones use an ABCD layout.

090

❍ No, blue and red produce magenta, a reddish purple.

● Correct!

❍ No, green and blue produce cyan, a bluish green.

❍ No, red, green, and blue at full intensity combine to produce white.

092

● Printers use the CMYK model that has four basic colors, in contrast to the three-color RGB model used by display devices.

093

❍ No, laser printers are faster than ink-jet printers, but more costly to operate.

● Correct!

097

● The Windows icon produces a "Safe to remove hardware" message on the screen. The Mac eject button displays the message, "You can remove your USB device."

099

❍ Plugging directly into a wall outlet leaves your device vulnerable to power surges.

● Plugging into a surge strip will protect your device while it is charging.

100

❍ Try again. A UPS can keep your desktop computer running when the power fails.

● Correct!

❍ Try again. A UPS can keep your home network up and running during a power failure.

❍ Try again. A UPS can maintain your Internet connection during a power failure.

104

❍ No, the blue screen of death is a symptom of a problem, not a solution.

❍ No, Safe Mode provides a way to troubleshoot, but it is not a simple process.

● Correct!

❍ No, a surge strip can prevent problems, but cannot solve them.

CHAPTER 3

122

● When this book was published, popular DVD authoring software included Final Cut Pro, Roxio Creator, and Windows DVD Maker.

123

❍ No, a team logo created with Paint software might not look sharp when you make it larger or smaller.

❍ No, photo editing software provides great tools for working with photos, but does not produce sharp logos.

● Correct! Drawing software will create high-quality graphics regardless of how they are enlarged or shrunk.

126

● Correct! This software automates specialized tasks for retail businesses.

❍ No, point-of-sale software is not generalized for use across all types of businesses.

❍ No, project management software is not used to track sales transactions.

❍ No, CAD software is used to create 3-D drawings.

127

❍ No, don't forget to count the titles and the photo, which are in separate frames.

❍ No, don't forget to count the titles and the photo, which are in separate frames.

❍ No, don't forget to count the titles and the photo, which are in separate frames.

● Correct!

128

● The name of the IRS e-filing software is Free File.

129

❍ Try again.

● Correct! Paint is an application designed for a human-centric task, rather than a utility designed to adjust computer or software settings.

❍ No.

❍ No.

131

❍ No, device drivers are system software.

❍ No, adaptive utilities are usually classified as system software.

❍ No, this is system software.

● Correct! Desktop publishing software (DTP) is application software, not system software.

134

● Correct!

❍ No, a spelling checker might miss misspellings for place names and technical terms that are not in the dictionary.

❍ No, a spelling checker might not catch misused words, such as when you use *their* instead of *there*.

❍ No, although a grammar checker might run along with your spelling checker, they are two separate utilities.

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136

● Correct! The worksheet looks at two "what-ifs:" Scenario 1 and Scenario 2.

❍ Try again.

138

● Correct! These references are relative, so they can automatically change if rows are inserted or deleted. If changed to absolute references, the formula would be =$B$3-$B$4.

❍ No, if these were absolute references, the formula would be =$B$3-$B$4.

140

● Correct! There are two tables, but they are included in the same database.

❍ No, there is only one database containing the two tables.

❍ No, there are four records in each table, but that has nothing to do with how many databases there are.

❍ No, there are eight records shown in the figure, but that has nothing to do with how many databases there are.

141

❍ No.

❍ Try again.

● Correct!

❍ No, make sure you read the FAQ "How do I locate specific data?"

143

● The "Remote computer" icon is correct. Web apps run from a remote computer, usually in the Internet cloud.

146

❍ No.

❍ No.

● Correct! The three files ending in .exe are executable files.

❍ No.

147

❍ No, .app files are applications.

❍ No, .exe files are executable on PCs.

● Correct!

❍ No.

151

❍ No, portable software does not have to run from the hard disk.

❍ No, portable software does not require a setup program.

❍ No, portable software does not run from the cloud.

● Correct! Portable software is not installed on a hard disk and no Registry entries are made.

152

❍ No, an upgrade is a new version of a software or utility program.

● Correct! Both are designed to correct errors or close security holes.

❍ No.

❍ No.

156

● Yes, all software is generally copyrighted, even if it is free.

❍ No, pirated software might or might not contain a copyright notice.

❍ No.

❍ No.

157

❍ No.

❍ No, a site license would allow access to all lab users.

● Correct! Because the license limits the number of copies that can be used simultaneously.

❍ No, let's hope not.

158

● You are licensing the software according to the GRANT OF LICENSE.

● The license goes into effect "by installing, copying, or otherwise using the SOFTWARE."

● You can make a copy for use on a portable computer.

● No, the license says, "you may not rent, lease, or lend the software."

● Technically, you can TRANSFER the software to another person if you retain no copies for your own use.

● Yes.

159

● Correct!

❍ No, shareware IS copyrighted.

❍ No, both shareware and demoware are "free."

❍ No, app stores are not set up to allow users to freely exchange shareware.

160

❍ No.

● Correct!

❍ No.

❍ No.

161

❍ No, read the definition of freeware carefully.

❍ No.

❍ No.

● Correct! The licenses for most free apps prohibit their sale and distribution by end users.

164

● When this book was published, Festi was the largest botnet with more than 300,000 infected computers under its control.

167

● Your computer might use popular antivirus software such as avast!, Windows Defender, Norton AntiVirus, Kaspersky Anti-Virus, AVG AntiVirus, or MacKeeper Antivirus.

168

● Your virus definitions should have been updated within the last week. If not, check your settings.

169

● If your antivirus has quarantined files, you might be frequenting dangerous Web sites or downloading infected files. Think about being more careful online.

CHAPTER 4

185

❍ [Microprocessor] Although some data is stored temporarily in microprocessor registers, this resource's primary function is processing.

● [RAM] Correct! RAM is a resource that temporarily stores data.

❍ [DISK] Disk drives are considered storage resources that hold data on a permanent basis.

❍ [PRINTER] A printer is an example of an output resource.

❍ [MOUSE] User interface elements do not store data.

186

❍ No, read the description of multitasking.

❍ No, read the description of multithreading.

● Correct!

187

❍ Try again.

● Correct! Although Windows 8 allows more than one user to have an account, only one person can use the computer at a time.

188

❍ No, the bootstrap loader remains in ROM

● Correct!

❍ No, ROM is hardware and cannot be loaded into RAM.

❍ No, the desktop is displayed on the screen, not loaded into RAM.

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190

❍ No, computers had GUIs back in 1984. Do the math.

❍ No, computers had GUIs back in 1984. Do the math.

❍ No, computers had GUIs back in 1984. Do the math.

● Correct!

194

● The first PCs used an operating system called DOS that had a command-line user interface.

196

● Correct!

❍ No, Windows Pro is designed for desktops, laptops, and tablets with Intel processors.

❍ No, Windows Server 2012 is designed for desktops and laptops.

❍ No, Windows Enterprise is designed for desktops and laptops.

198

● Virtual machine technology is the correct answer.

199

● The correct answer is forks.

200

❍ Try again.

● Correct! The MacBook Air is a laptop computer that uses Mac OS X.

❍ Try again.

❍ Try again.

201

❍ No, there is no Start menu in the Android user interface.

❍ No, Apple and Microsoft mobile devices feature a physical Home/ Start button.

❍ No.

● Correct!

202

❍ No.

● Correct!

❍ No.

❍ No, UNIX predates many of today's operating systems.

205

● Correct! Budget: contains a colon, which is reserved for drive letters.

❍ No, "macBook Air" is a perfectly acceptable file name.

❍ No, although it contains the reserved word *Aux*, it is acceptable because there are other words in the name.

❍ No, Paint.exe is a perfectly acceptable file name.

206

● You should have fewer than 20 folders in the root directory. On a PC, be sure you looked at the Hard Disk Drive C:. On a Mac, you should have looked at the Macintosh HD.

207

● Correct! Changing the file extension does not change the data or its format.

❍ No.

❍ No.

❍ No.

208

❍ No, check the list of files in the graphics row of Figure 4-35.

● Correct!

❍ No, Microsoft Publisher opens its native .pub format and .docx documents.

209

● Most word processing software can open .doc files, even if its native format is .docx or .odt.

210

● Most computers have Adobe Reader. Look for it on your computer's Start screen (Windows) or in the Applications folder (Mac).

216

● Correct! Its subfolders (Desktop, Downloads, etc.) are displayed.

❍ No.

❍ No.

❍ No.

218

● Your computer's root directory should not contain data files; but if you have a PC, there might be some .txt files containing EULA license agreements. Leave them where you found them.

219

● Correct!

❍ No, read the FAQ, "How does a disk get formatted?"

❍ No, read the FAQ, "How does a disk get formatted?"

❍ No, read the FAQ, "How does a disk get formatted?"

220

● Clusters is the correct answer.

222

● Correct! In a 2012 report, Microsoft study results showed that only 5% of users made backups.

❍ No.

❍ No.

❍ No.

223

❍ No, you have the most control over your backup data when it is on a device you own.

❍ No, you have the most control over your backup data when it is on a device you own.

❍ No, you have the most control over your backup data when it is on a device you own.

● Correct! When you store your data in the cloud, you can access it from anywhere, but do not have full control over who might access it.

224

● If you have files for downloaded software, you should be sure to back up your Downloads folder so you won't have to download all those apps again if your hard disk fails.

227

❍ No, File History is the last thing you'll restore.

● Correct! You'll have to boot your computer from a CD using a recovery disk so that you can install Windows on the new hard drive.

❍ No, a restore point is useful only if your hard drive hasn't failed.

❍ No, Time Machine is for Macs, not PCs.

228

❍ No, a full system backup will take lots of time because it copies every file on your hard disk.

❍ No, although an incremental backup takes the least time to create, it takes the most time to restore.

● Correct! A differential backup takes less time to make than a full system backup, and requires less time to restore than an incremental backup.

229

❍ No.

● Correct!

❍ No.

❍ No.

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