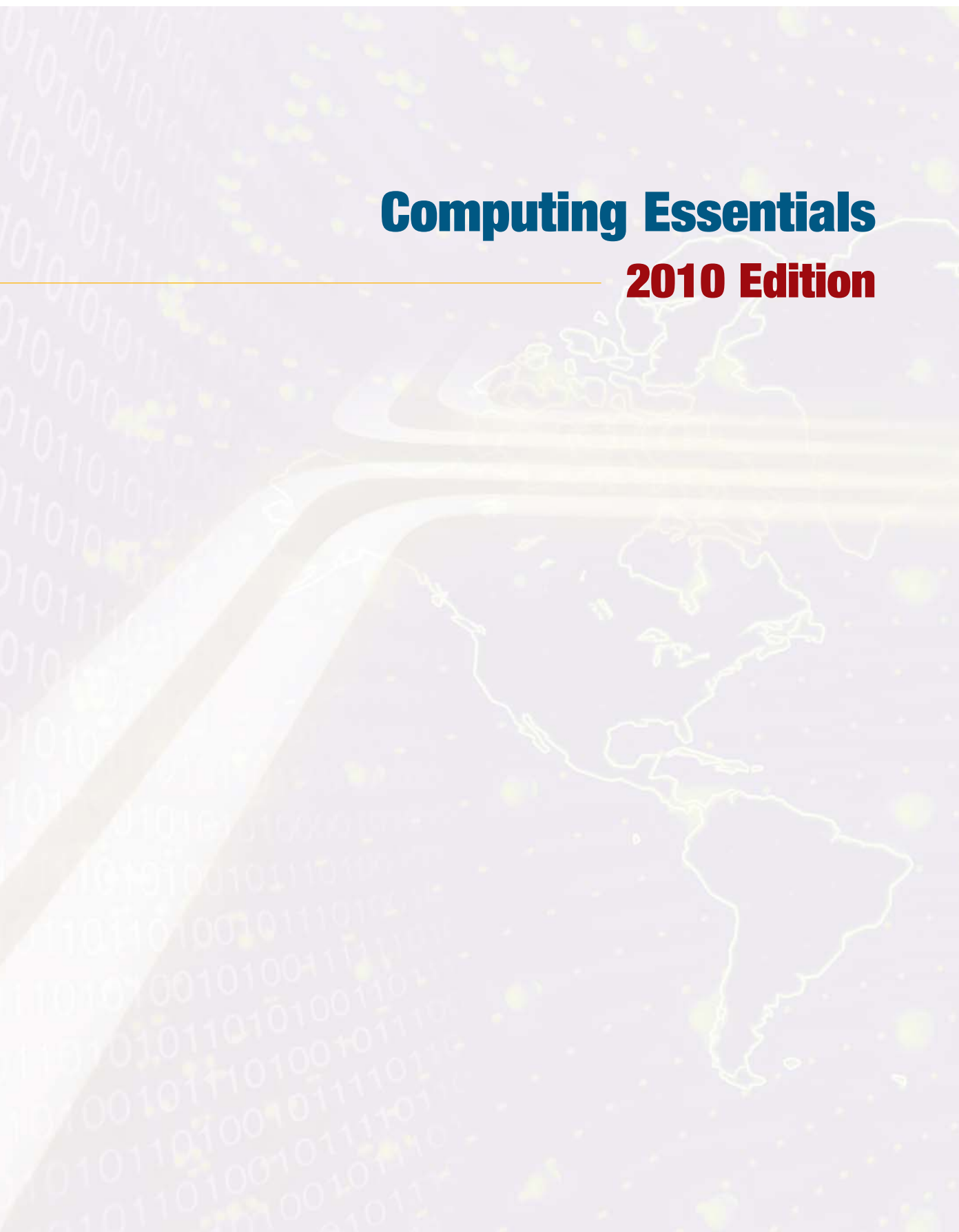
Computing Essentials

2010 Edition



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2010 Edition

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Contents

INFORMATION TECHNOLOGY, THE INTERNET, AND YOU

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Explain the five parts of an information system: people, procedures, software, hardware, and data.**
2. **Distinguish between system software and application software.**
3. **Discuss the three kinds of system software programs.**
4. **Distinguish between basic and specialized application software.**
5. **Identify the four types of computers and the four types of microcomputers.**
6. **Describe the different types of computer hardware including the system unit, input, output, storage, and communication devices.**
7. **Define data and describe document, worksheet, database, and presentation files.**
8. **Explain computer connectivity, the wireless revolution, and the Internet.**

CONTENTS

Information Systems
Consist of people, procedures, software, hardware, and data

Software
Program to control computer operations

Hardware
Includes system unit, input, output, and secondary storage devices

CHAPTER 1

Just as the Internet and the Web have affected all of us, they have affected computer technology as well. Today, communication links to the Internet are a common feature of almost all computer systems. Information technology (IT) is a modern term that describes this combination of traditional computer and communication technologies.

The purpose of this book is to help you become competent with computer technology. Computer competency refers to acquiring computer-related skills. These skills are indispensable tools for today. They include how to efficiently and effectively use popular application packages and the Internet.

In this chapter, we first present an overview of an information system: people, procedures, software, hardware, and data. It is essential to understand these basic parts and how connectivity through the Internet and the Web expands the role of information technology in our lives. In subsequent chapters, we will describe these parts of an information system in detail.

Fifteen years ago, most people had little to do with computers, at least directly. Of course, they filled out computerized forms, took computerized tests, and paid computerized bills. But the real work with computers was handled by specialists—programmers data entry clerks, and computer operators.

Then microcomputers came along and changed everything. Today it is easy for nearly everybody to use a computer.

- Microcomputers are common tools in all areas of life. Writers write, artists draw, engineers and scientists calculate—all on microcomputers. Students and businesspeople do all this, and more.
- New forms of learning have developed. People who are homebound, who work odd hours, or who travel frequently may take courses on the Web. A college course need not fit within the usual time of a quarter or a semester.
- New ways to communicate, to find people with similar interests, and to buy goods are available. All kinds of people are using electronic mail, electronic commerce, and the Internet to meet and to share ideas and products.

What about you? How are you using information technology? Many interesting and practical uses have recently surfaced to make our personal lives richer and more entertaining. These applications range from recording digital video clips to creating personalized Web sites.

To be competent with IT, you need to know the five parts of an information system: people, procedures, software, hardware, and data. Additionally, you need to understand connectivity, the wireless revolution, the Internet, and the Web and to recognize the role of information technology in your personal and professional life.

Wireless revolution is dramatically affecting communications and computing

INFORMATION SYSTEMS

An information system has five parts: people, procedures, software, hardware, and data. Connectivity allows computers to connect and share information, thereby greatly expanding the capability and usefulness of an information system.

When you think of a microcomputer, perhaps you think of just the equipment itself. That is, you think of the monitor or the keyboard. Yet, there is more to it than that. The way to think about a microcomputer is as part of an information system. An **information system** has five parts: *people, procedures, software, hardware,* and *data*. (See Figure 1-1.)

- **People:** It is easy to overlook people as one of the five parts of an information system. Yet this is what microcomputers are all about—making **people, end users** like you, more productive.
- **Procedures:** The rules or guidelines for people to follow when using software, hard ware, and data are **procedures.** These procedures are typically documented in manuals written by computer specialists. Software and hardware manufacturers provide manuals with their products. These manuals are provided either in printed or electronic form.
- **Software:** A **program** consists of the step-by-step instructions that tell the computer how to do its work. **Software** is another name for a program or programs. The purpose of software is to convert **data** (unprocessed facts) into **information** (processed facts). For example, a payroll prgram would instruct the computer to take the number of hours you worked in a week (data) and multiply it by your pay rate (data) to determine how much you are paid for the week (information).

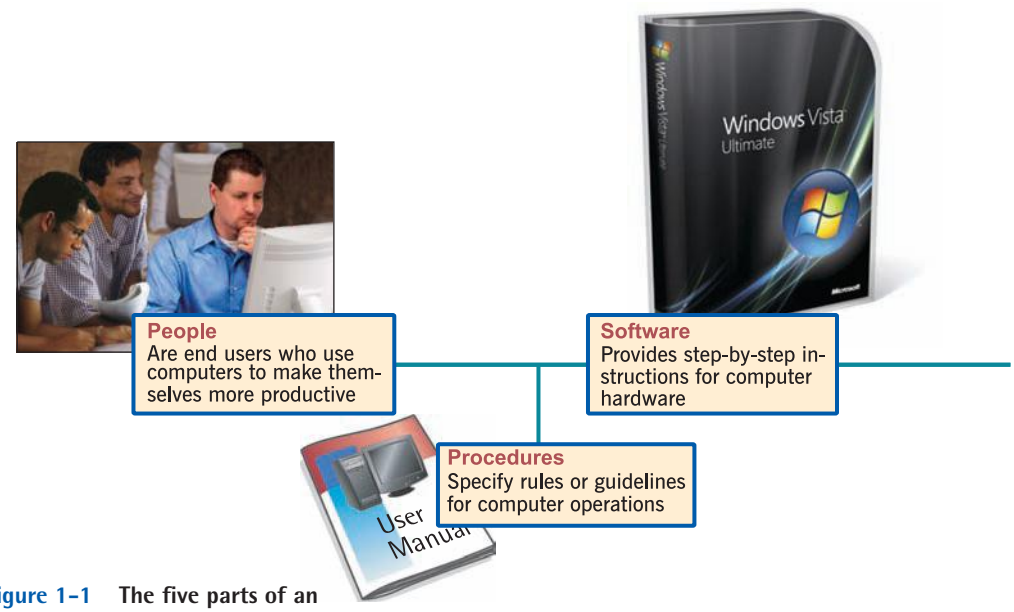


Figure 1-1 The five parts of an information system

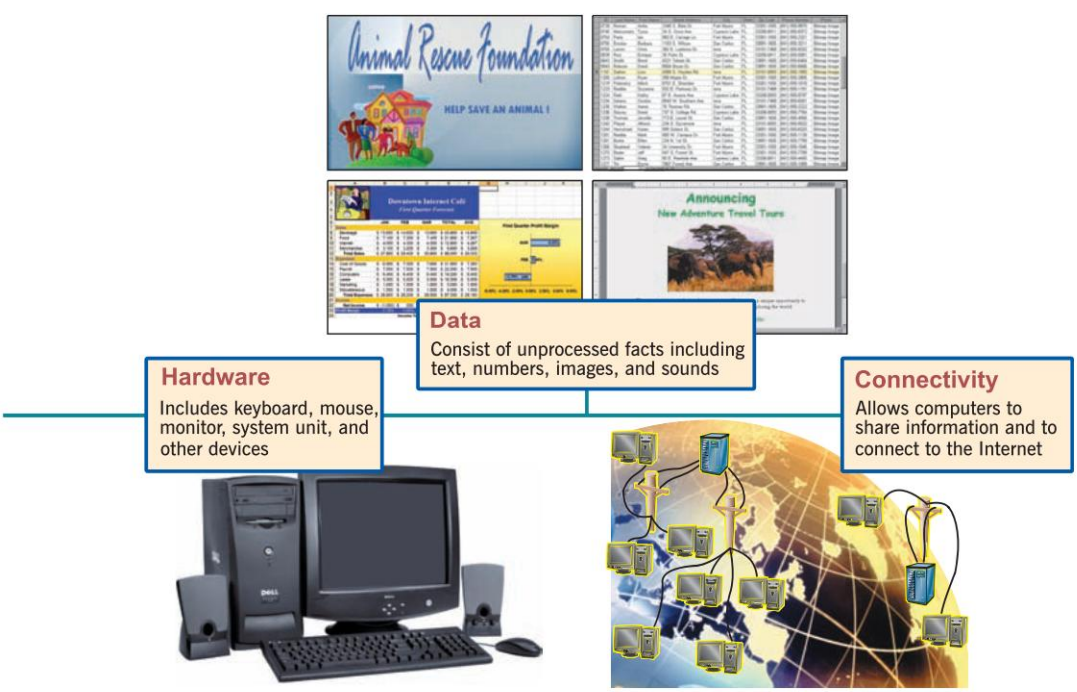
- **Hardware:** The equipment that processes the data to create information is called hardware. It includes the keyboard, mouse, monitor, system unit, and other devices. Hardware is controlled by software.
- **Data:** The raw, unprocessed facts, including text, numbers, images, and sounds, are called data. Processed, data yields information. Using the previous example, the data (number of hours worked and pay rate) are processed (multiplied) to yield information (weekly pay).

Almost all of today's computer systems add an additional part to the information system. This part, called **connectivity,** allows computers to connect and to share information. These connections, including Internet connections, can be by telephone lines, by cable, or through the air. Connectivity allows users to greatly expand the capability and usefulness of their information systems.

In large computer systems, there are specialists who write procedures, develop software, and capture data. In microcomputer systems, however, end users often perform these operations. To be a competent end user, you must understand the essentials of **information technology (IT),** including software, hardware, and data.

CONCEPT CHECK

- What are the five parts of an information system?
- What is the difference between data and information?
- What is connectivity?



PEOPLE

People are the most important part of an information system. Features in this book include Making IT Work for You, Tips, and an interactive CD.

Although easy to overlook, people are surely the most important part of any information system. Our lives are touched every day by computers and information systems. Many times the contact is direct and obvious, such as when we create documents using a word processing program or when we connect to the Internet. Other times, the contact is not as obvious. Consider just the four examples in Figure 1-2.

Throughout this book you will find a variety of features designed to help you become computer competent and knowledgeable. These features include Making IT Work for You, Tips, and the Computing Essential CD.

- **Making IT Work for You.** In the chapters that follow, you will find Making IT Work for You features that present interesting and practical IT applications. Using a step-by-step procedure, you are provided with specific instructions on how to use each application. Figure 1-3 presents a list of these applications.

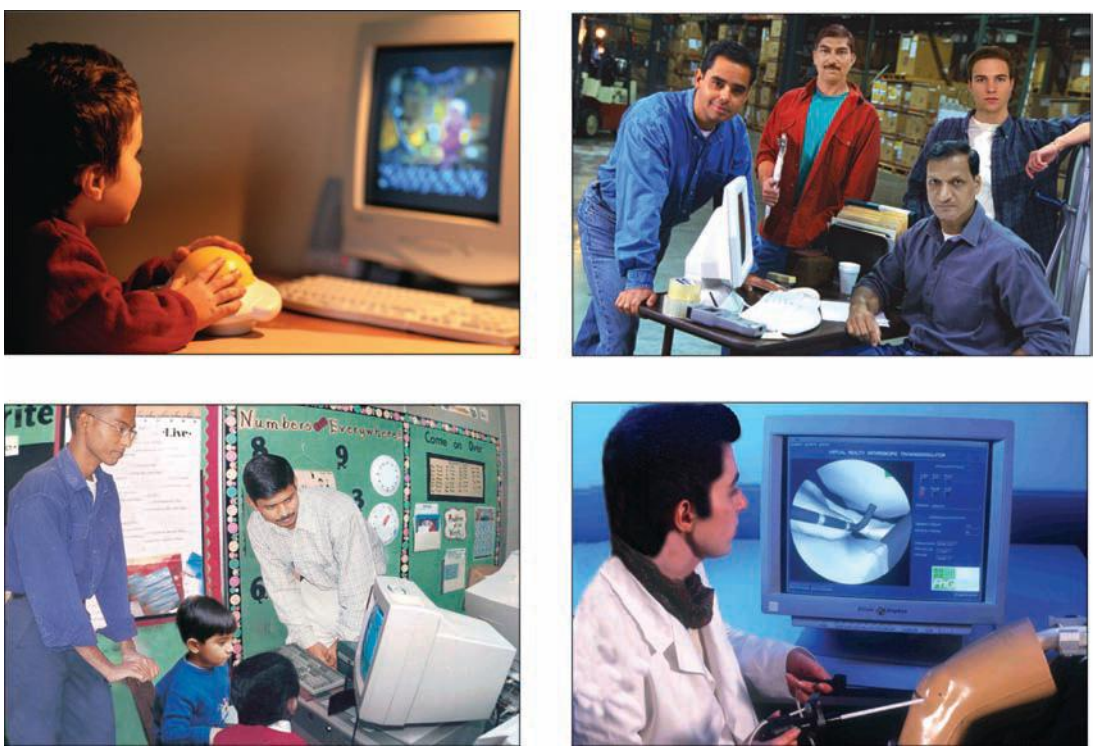


Figure 1-2 Computers in entertainment, business, education, and medicine

MAKING IT WORK FOR YOU

INFORMATION TECHNOLOGY TOPICS

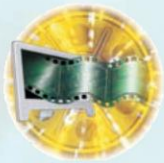
Information technology touches our lives every day in a personal way. Many interesting and practical uses of IT have recently surfaced to make our lives richer and more entertaining. In the following chapters, you will find these applications presented in detail.

Blocking Spam Are you tired of unwanted e-mail in your Inbox? Do you frequently spend valuable time sorting through junk e-mail? Installing spam blocking software can help. One of the best known is Spam Bully. See page 6-11.

Speech Recognition Tired of using your keyboard to type term papers? Have you ever thought about using your voice to control application software? Perhaps speech recognition is just what you are looking for. See page 8-5.

Digital Video Editing Do you want to make your own movie? Would you like to edit some home movies and distribute them to family and friends on DVDs? It's easy with the right equipment and software. See page 9-9.

Virus Protection and Internet Security Worried about computer viruses? Did you know that others could be intercepting your private e-mail? It is even possible for them to gain access and control of your computer system. Fortunately, Internet security suites are available to help ensure your safety while you are on the Internet. See page 5-15.



TV Tuner Cards and Video Clips Want to watch your favorite television program while you work? Perhaps you would like to include a video clip from a television program or from a DVD in a class presentation. It's easy using a TV tuner card. See page 4-15.

WebCams and Instant Messaging Do you enjoy chatting with your friends? Are you working on a project and need to collaborate with others in your group? What if you could see and hear your group online? Perhaps instant messaging is just what you're looking for. See page 2-11.

Figure 1-3 Making IT Work for You topics

SOFTWARE

There are two kinds of software: system software and application software. System software includes operating systems, utilities, and device drivers. Application software is categorized as basic and specialized.

Software, as we mentioned, is another name for programs. Programs are the instructions that tell the computer how to process data into the form you want. In most cases, the words software and programs are interchangeable. There are two major kinds of software–*system software* and application software. You can think of application software as the kind you use. Think of system software as the kind the computer uses.

SYSTEM SOFTWARE

The user interacts primarily with application software. **System software** enables the application software to interact with the computer hardware. System software is "background" software that helps the computer manage its own internal resources.

System software is not a single program. Rather it is a collection of programs, including the following:

- **Operating systems** are programs that coordinate computer resources, provide an interface between users and the computer, and run applications. Windows Vista and the Mac OS X are two of the best-known operating systems for today's microcomputer users. (See Figure 1-4.)
- **Utilities,** also known as **service programs,** perform specific tasks related to managing computer resources. For example, the Windows utility called Disk Defragmenter locates and eliminates unnecessary file fragments and rearranges files and unused disk space to optimize computer operations.
- **Device drivers** are specialized programs designed to allow particular input or output devices to communicate with the rest of the computer system.

Figure 1-4 Windows and Mac operating systems

APPLICATION SOFTWARE

Application software might be described as end user software. These programs can be categorized as either *basic* or *specialized applications.*

Basic applications, or **general-purpose applications** are widely used in nearly all career areas. They are the kinds of programs you have to know to be considered computer competent. One of these basic applications is a browser to navigate, explore, and find information on the Internet.

TIPS

Have you used the Internet? If so, then you probably already know how to use a browser. For those of you who do not, here are a few tips to get you starled.

1. **Start browser.** Typically, all you need to do is double-click the browser's icon on the desktop.
2. **Enter URL.** In the browser's location box, type the URL (uniform resource locator, or address) of the Internet or Web location (site) that you want to visit.
3. **Press ENTER.** On your keyboard, press the ENTER key to connect to the site.
4. **Read and explore.** Once connected to the site, read the information displayed on your monitor. Using the mouse, move the pointer on the monitor. When the pointer changes from an arrow to a hand, click the mouse button to explore other locations.
5. **Close browser.** Once you are done exploring, click on your browser's CLOSE button.

Figure 1-5 Internet Explorer browser

Type	Description
Browser	Connect to Web sites and display Web pages
Word processor	Prepare written documents
Spreadsheet	Analyze and summarize numerical data
Database management system	Organize and manage data and information
Presentation graphics	Communicate a message or persuade other people

Figure 1-6 Basic applications

(See Figure 1-5.) The two most widely used browsers are Microsoft's Internet Explorer and Netscape's Navigator. For a summary of the basic applications, see Figure 1-6.

Specialized applications, also known as **special-purpose applications,** include thousands of other programs that are more narrowly focused on specific disciplines and occupations. Some of the best known are graphics, audio, video, multimedia, Web authoring, and artificial intelligence programs.

CONCEPT CHECK

- Describe the two major kinds of software.
- Describe three types of system software programs.
- Define and compare basic and specialized applications.

TYPES OF COMPUTERS

Four types of computers are supercomputer, mainframe computer, minicomputer, and microcomputer. Desktop, notebook, tablet PC, and handheld are types of microcomputers. Microcomputer hardware consists of the system unit, input/output, secondary storage, and communications devices.

Computers are electronic devices that can follow instructions to accept input, process that input, and produce information. This book focuses principally on microcomputers. However, it is almost certain that you will come in contact, at least indirectly, with other types of computers.

There are four types of computers: supercomputers, mainframe computers, minicomputers, and microcomputers.

- **Supercomputers** are the most powerful type of computer. These machines are special high-capacity computers used by very large organizations. For example, NASA uses supercomputers to track and control space explorations.
- **Mainframe computers** occupy specially wired, air-conditioned rooms. Although not nearly as powerful as supercomputers, mainframe computers are capable of great processing speeds and data storage. For example, insurance companies use mainframes to process information about millions of policyholders.
- **Minicomputers,** also known as **midrange computers,** are refrigerator-sized machines. Medium-sized companies or departments of large companies typically use them for specific purposes. For example, production departments use minicomputers to monitor certain manufacturing processes and assembly line operations.
- **Microcomputers** are the least powerful, yet the most widely used and fastest-growing, type of computer. There are four types of microcomputers: *desktop*, *notebook*, *tablet PC*, and *handheld computers*. (See Figure 1-9.) **Desktop computers** are small enough to fit on top of or alongside a desk yet are too big to carry around. **Notebook computers,** also known as **laptop computers,** are portable, lightweight, and Fit into most briefcases.
- A **tablet PC** is a type of notebook computer that accepts your handwriting. This input is digitized and converted to standard text that can be further processed by programs such as a word processor. **Handheld computers** are the smallest and are designed to fit into the palm of one hand. Also known as **palm computers,** these systems typically combine pen input, writing recognition, personal organizational tools, and communications capabilities in a very small package. **Personal digital assistants (PDA)** are the most widely used handheld computer.

HARDWARE

MICROCOMPUTER HARDWARE

Hardware for a microcomputer system consists of a variety of different devices. See Figure 1-8 for a typical desktop system. This physical equipment falls into four basic categories: system unit, input/output, secondary storage, and communication. Because we discuss hardware in detail later in this book, here we will present just a quick overview of the four basic categories.

On the Web Explorations

To learn more about a leading manufacturer of microprocessors,visit our Web site at www.olearyseries.com and select On the Web Explorations.

Figure 1–7 Microcomputers

- **System unit:** The **system unit,** also known as the **system cabinet** or **chassis,** is a container that houses most of the electronic components that make up a computer system. (See Figure 1-9.) Two important components of the system unit are the *microprocessor* and *memory*. The **microprocessor** controls and manipulates data to produce information. Many times the microprocessor is contained within a protective cartridge. **Memory** also known as **primary storage** or **random access memory (RAM),** holds data and program instructions for processing the data. It also holds the processed information before it is output. Memory is sometimes referred to as **temporary storage** because its contents will typically be lost if the electrical power to the computer is disrupted.
- **Input/output: Input devices** translate data and programs that humans can understand into a form that the computer can process. The most common input devices are the **keyboard** and the **mouse. Output devices** translate the processed information from the computer into a form that humans can understand. The most common output devices are **monitors** or **video display screens** (see Figure 1-10) and **printers.**

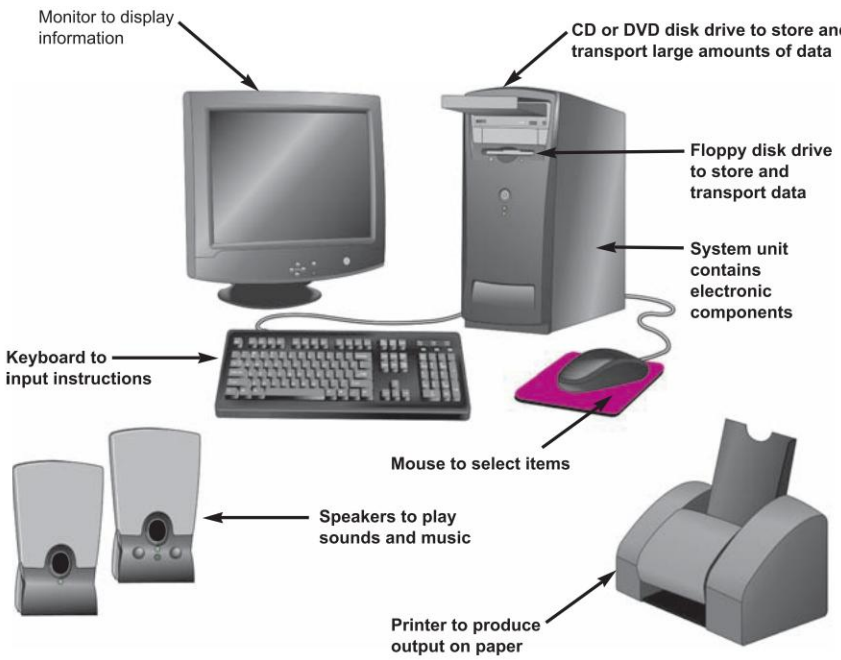


Figure 1-8 Microcomputer system

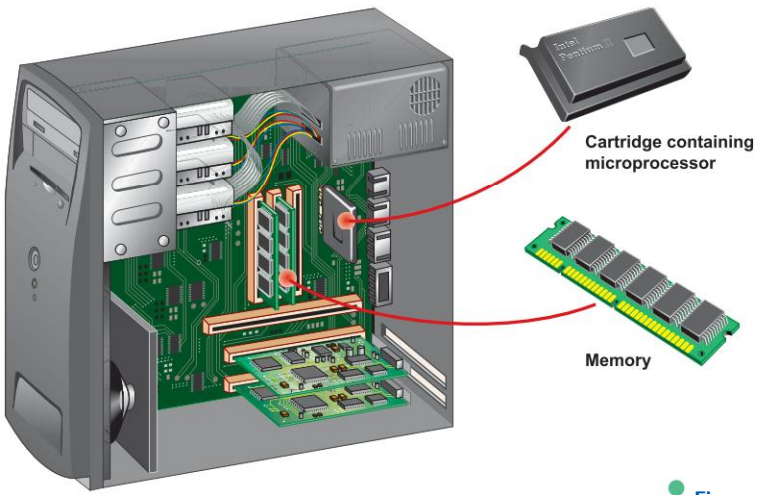


Figure 1-9 System unit

On the Web Explorations

To learn more about one of the leaders in the development of DVD technology, visit our Web site at www.olearyseries.com and select On the Web Explorations.

Secondary storage: Unlike memory, **secondary storage devices** hold data and programs even after electrical power to the computer system has been turned off. The most important kinds of secondary media are *floppy, hard,* and *optical disks*. **Floppy disks** are widely used to store and transport data from one computer to another. (See Figure 1-11.) They are called floppy because data is stored on a very thin flexible, or floppy, plastic disk. **Hard disks** are typically used to store programs and very large data files. Using a rigid metallic platter, hard disks have a much greater capacity and are able to access information much faster than floppy disks. **Optical disks** use laser technology and have the greatest capacity. (See Figure 1-12.) The two basic types of optical disks are **compact discs (CDs)** and **digital versatile** (or **video**) **discs (DVDs).**

Communication: At one time, it was uncommon for a microcomputer system to communicate with other computer systems. Now, using **communication devices,** a microcomputer can communicate with other computer systems located as near as the next office or as far away as halfway around the world using the Internet. The most widely used communication device is a **modem,** which modifies telephone communications into a form that can be processed by a computer. Modems also modify computer output into a form that can be transmitted across standard telephone lines.

CONCEPT CHECK

- What are the four types of computers?
- Describe the four types of microcomputers.
- Describe the four basic categories of microcomputer hardware.

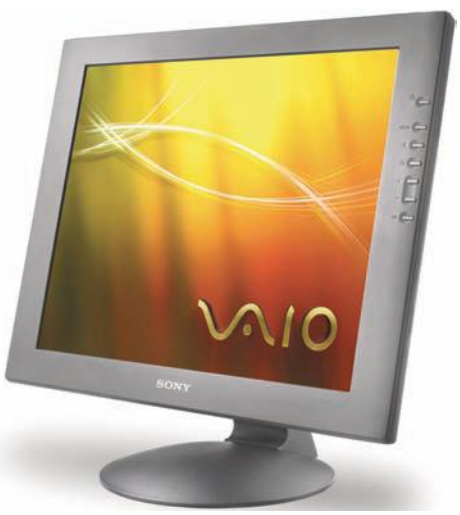


Figure 1-10 Monitor

Figure 1-11 A 3½-inch floppy disk

Figure 1-12 An optical disk

DATA

Data is unprocessed facts. Processing data creates information. Four common file types are document, worksheet, database, and presentation.

Data is raw, unprocessed facts, including text, numbers, images, and sounds. As we have mentioned earlier, processed data becomes information. When stored electronically in files, data can be used directly as input for the system unit.

Four common types of files (see Figure 1-13) are:

- **Document files,** created by word processors to save documents such as memos, term papers, and letters.
- **Worksheet files,** created by electronic spreadsheets to analyze things like budgets and to predict sales.
- **Database files,** typically created by database management programs to contain highly structured and organized data. For example, an employee database file might contain all the workers' names, social security numbers, job titles, and other related pieces of information.
- **Presentation files,** created by presentation graphics programs to save presentation materials. For example, a file might contain audience handouts, speaker notes, and electronic slides.

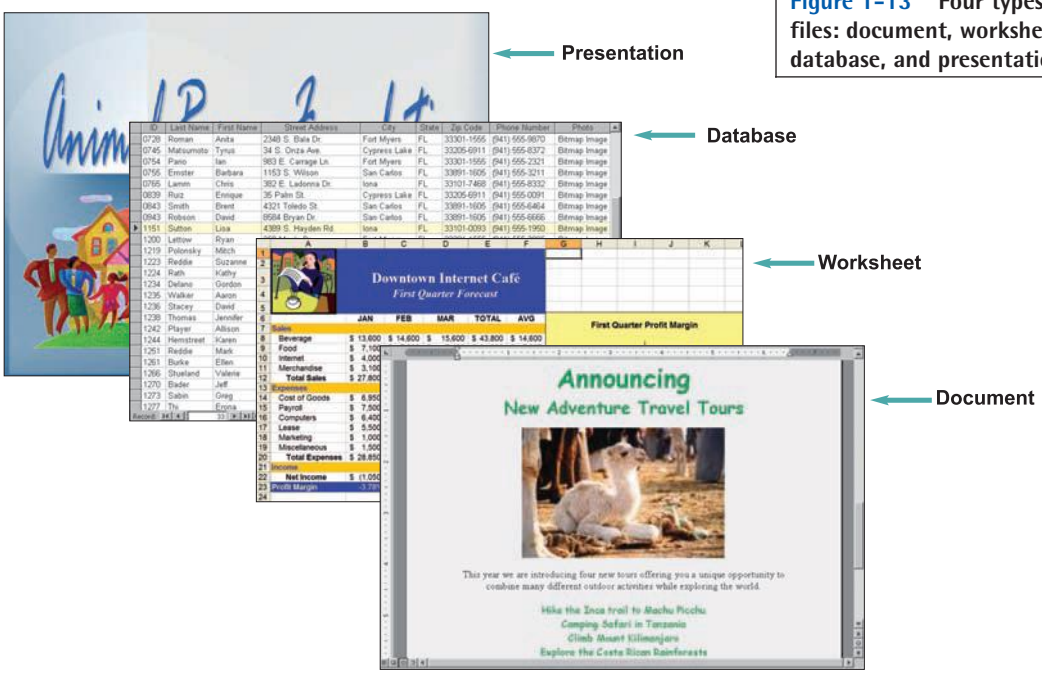


Figure 1-13 Four types of files: document, worksheet, database, and presentation

CONNECTIVITY, THE WIRELESS REVOLUTION, AND THE INTERNET

Connectivity allows sharing of information worldwide. The wireless revolution is expected to alter communications and computer systems. Networks connect computers. The Internet is the largest network in the world.

Connectivity is the capability of your microcomputer to share information with other computers. The single most dramatic change in connectivity in the past five years has been the widespread use of mobile or wireless communication devices. For just a few of these devices, see Figure 1-14. Many experts predict that these wireless applications are just the beginning of the **wireless revolution,** a revolution that is expected to dramatically affect the way we communicate and use computer technology.

Central to the concept of connectivity is the **network** or **computer network.** A network is a communications system connecting two or more computers. The largest network in the world is the **Internet.** It is like a giant highway that connects you to millions of other people and organizations located throughout the world. The **Web,** also known as the **World Wide Web** or **WWW** provides a multimedia interface to the numerous resources available on the Internet.

CONCEPT CHECK

- Define data. List four common types of files.
- Define connectivity and the wireless revolution. What is a network?

Figure 1-14 Wireless communication devices

A Look to the Future

Using and Understanding Information Technology Means Being Computer Competent

The purpose of this book is to help you use and understand infor-mation technology. We want to help you become computer competent in today's world and to provide you with a foundation of knowledge so that you can understand how technology is being used today and anticipate how technology will be used in the future. This will enable you to benefit from four important information technology develop-ments.

THE INTERNET AND THE WEB

The internet and the Web are considered by most to be the two most important technologies for the 21st century. Understanding how to efficiently and effectively use the internet to browse the Web, communicate with others, and locate information are indispensable computer competencies. These issues are presented in Chapter 6, The internet, the Web, and Electronic Commerce.

POWERFUL SOFTWARE

The software now available can do an extra-ordinary number of tasks and help you in an end-less number of ways. You can create professional looking documents, analyze massive amounts of data, create dynamic multimedia Web pages, and much more. Today's employers are expecting the people they hire to be able to effectively and efficiently use a variety of different types of software. Basic and specialized applications are presented in Chapters 8 and 9. System software is presented in Chapter 5.

POWERFUL HARDWARE

Microcomputers are now much more powerful than they used to be. New communication technologies such as wireless networks are dramatically changing the ways to connect to other computers, networks, and the internet. However, despite the rapid change of specific equipment, their essential features remain unchanged. Thus, the competent end user should focus on these features. Chapters 4 through 7 explain what you need to know about hardware. A Buyer's Guide and an Upgrader's Guide are presented at the end of this book for those considering the purchase or upgrade of a microcomputer system.

SECURITY AND PRIVACY

What about people? Experts agree that we as a society must be careful about the potential of technology to negatively impact our personal privacy and security. Additionally, we need to be aware of potential physical and mental health risks associated with using technology. Finally, we need to be aware of negative effects on our environment caused by the manufacture of computerrelated products. Thus, Chapter 10 explores each of these critical issues in detail.

ORGANIZATIONS

Almost all organizations rely on the quality and flexibility of their information systems to stay competitive. As a member or employee of an organization, you will undoubtedly be involved in these information systems. Therefore, you need to be knowledgeable about the different types of organizational information systems and how they are used. Accordingly, we devote Chapters 11 through 14 to detail what you need to know about information systems and how to develop, modify, and maintain these systems.

CHANGING TIMES

Are the times changing any faster now than they ever have? Most people think so. Whatever the answer, it is clear we live in a fast-paced age. The Evolution of the Computer Age section presented at the end of this book tracks the major developments since computers were first introduced.

After reading this book, you will be in a very favorable position compared with many other people in industry today. You will learn not only the basics of hardware, software, connectivity, the internet, and the Web, but you will also learn the most current technology. You will be able to use these tools to your advantage.

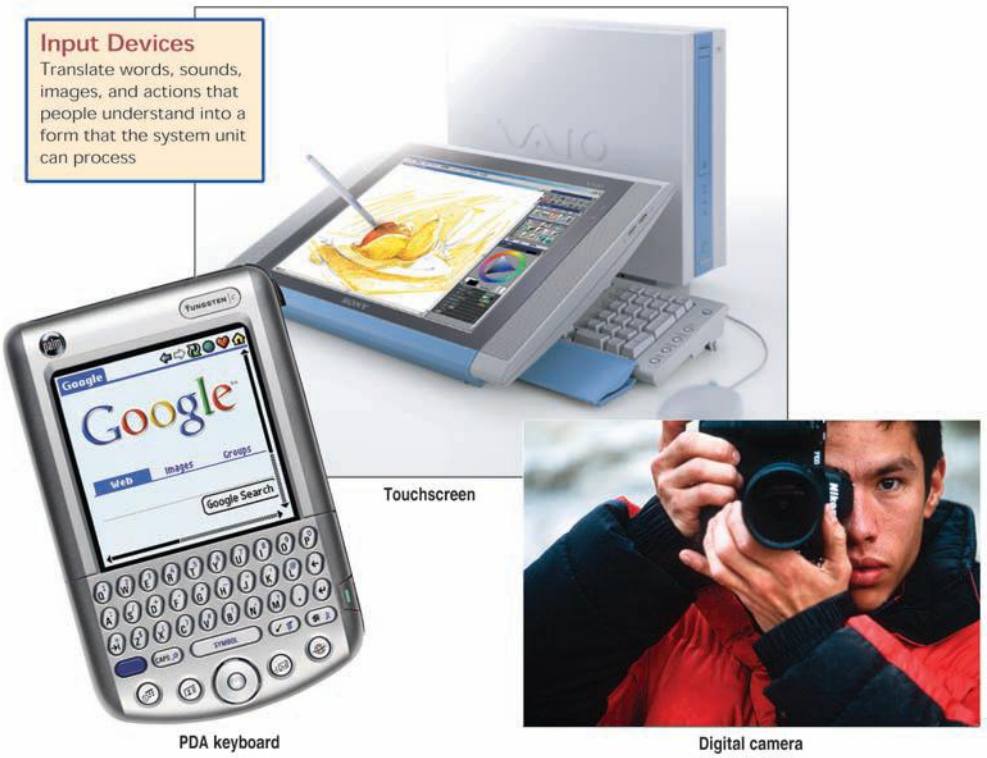
INPUT AND OUTPUT

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Define input.**
2. **Describe keyboard entry, pointing devices, and scanning devices.**
3. **Discuss image capturing devices, including digital cameras, digital video cameras, and audio input devices.**
4. **Define output.**
5. **Describe monitors, printers, and audio output devices.**
6. **Discuss combination input and output devices, including fax machines, multifunctional devices, Internet telephones, and terminals.**

CONTENTS



CHAPTER 2

How do you get data to the CPU? How do you get information out? Here we describe one of the most unportant places where the computer interfaces with people. We input text, music, and even speech, but we probably never think about the relationship between what we enter and what the computer processes. People understand language, which is constructed of letters, numbers, and punctuation marks. However, computers can under stand only the binary machine language of 0s and 1s. Input devices are essentially translators. input devices translate numbers, letters, and actions that people understand into a form that computers can process.

Have you ever wondered how information processed by the system unit is converted into a form that you can use? That is the role of output devices.

While input devices convert what we understand into what the system unit can process, output devices convert what the system unit has processed into a form that we can understand. Output devices translate machine language into letters, numbers, sounds, and images that people can understand.

Competent end users need to know about the most commonly used input devices, including keyboards, mice, scanners, digital cameras, digitizing tablets, voice recognition, and MIDI devices. Additionally, they need to know about the most commonly used output devices, including monitors, printers, and audio output devices. And, end users need to be aware of combination input and output devices such as fax machines, multifunctional devices, internet telephones, and terminals.

WHAT IS INPUT?

Input consists of data and instructions. Input devices translate what people understand into a form that computers can process.

Input is any data or instructions that are used by a computer. They can come directly from you or from other sources. You provide input whenever you use system or application programs. For example, when using a word processing program, you enter data in the form of numbers and letters and issue commands such as to save and to print documents. You also can enter data and issue commands by pointing to items, or using your voice. Other sources of input include scanned or photographed images.

Input devices are hardware used to translate words, sounds, images, and actions that people understand into a form that the system unit can process. For example, when using a word processor, you typically use a keyboard to enter text and a mouse to issue commands. In addition to keyboards and mice, there are a wide variety of other input devices. These include pointing, scanning, image capturing, and audio-input devices.

KEYBOARD ENTRY

Keyboards translate numbers, letters, and special characters. Traditional, ergonomic, flexible, wireless, and PDA are types of keyboards. Numeric keypads, toggle and combination keys are keyboard features.

Figure 2-1 Flexible keyboard

Figure 2-2 Ergonomic keyboard

One of the most common ways to input data is by **keyboard.** As mentioned in Chapter 4, keyboards convert numbers, letters, and special characters that people understand into electrical signals. These signals are sent to, and processed by, the system unit. Most keyboards use an arrangement of keys given the name QWERTY. This name reflects the keyboard layout by taking the letters of the first six alphabetic characters found on the fourth row of keys.

KEYBOARDS

There are a wide variety of different keyboard designs. They range from the full-sized to miniature and from rigid to flexible.

The most common types are:

- **Traditional keyboards**—full-sized, rigid, rectangular keyboards that include function, navigational, and numeric keys.
- **Flexible keyboards**—fold or roll up for easy packing or storage. They are designed to provide mobile users with a fullsized keyboard with minimal storage requirements. (See Figure 2-1.)
- **Ergonomic keyboards**—similar to traditional keyboards. The keyboard arrangement, however, is not rectangular and a palm rest is provided. They are designed specifically to alleviate wrist strain associated with the repetitive movements of typing. (See Figure 2-2.)

- **Wireless keyboards**—transmit input to the system unit through the air. By eliminating connecting wires to the system unit, these keyboards provide greater flexibility and convenience.
- **PDA keyboards**—miniature keyboards for PDAs used to send e-mail, create documents, and more. (See Figure 2-3.)

FEATURES

A computer keyboard combines a typewriter keyboard with a **numeric keypad,** used to enter numbers and arithmetic symbols. It also has many special-purpose keys. Some keys, such as the Caps Lock key, are **toggle keys.** These keys turn a feature on or off. Others, such as the *Ctrl* key, are **combination keys,** which perform an action when held down in combination with another key. To learn more about keyboard features see Figure 2-4.

On the Web Explorations

People are spending more time at their computer than ever before. Consequently, the need for ergonomic keyboards is increasing. To learn more about one manufacturer of ergonomic keyboards, visit our Web site at www.olearyseries.com and select On the Web Explorations.

CONCEPT CHECK

- What is input? What are input devices?
- Discuss the five common types of keyboard designs.
- What are some common keyboard features?

Figure 2-3 PDA keyboard

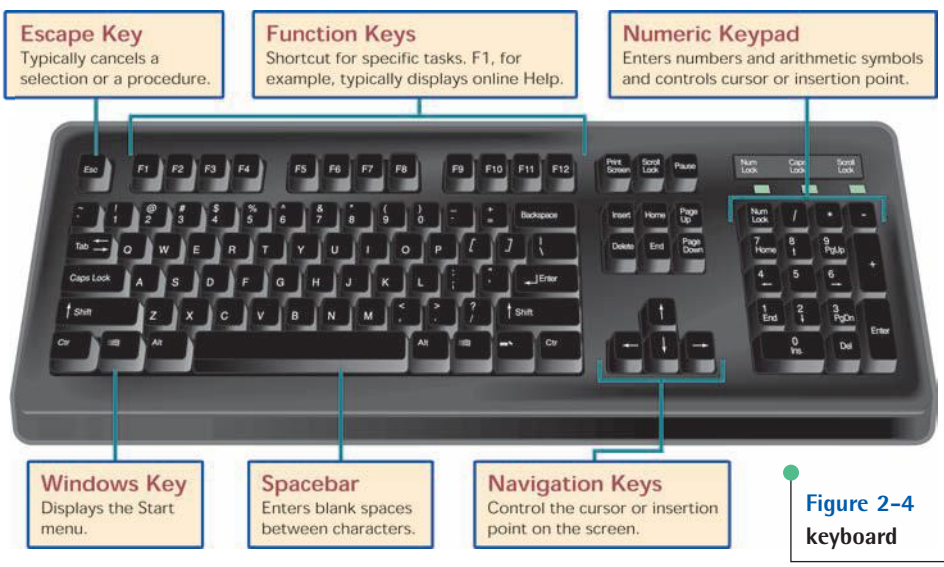


Figure 2-4 Traditional keyboard

POINTING DEVICES

A mouse controls a pointer on the monitor. Joysticks are used primarily for games. Touch screens are pressure-sensitive monitors. Light pens close circuits on special monitors. Tablet PCs and PDAs use styluses.

Pointing, of course, is one of the most natural of all human gestures. **Pointing devices** provide a comfortable interface with the system unit by accepting pointing gestures and converting them into machine-readable input. There is a wide variety of different pointing devices, including the mouse, joystick, touch screen, light pen, and stylus.

MOUSE

A **mouse** controls a pointer that is displayed on the monitor. The **mouse pointer** usually appears in the shape of an arrow. It frequently changes shape, however, depending on the application. A mouse can have one, two, or more buttons, which are used to select command options and to control the mouse pointer on the monitor. Some mice have a **wheel button** that can be rotated to scroll through information that is displayed on the monitor. Although there are several different mouse types, there are three basic designs:

Figure 2–5 Optical mouse

- **Mechanical mouse** is generally considered the traditional type and was the most widely used. It has a ball on the bottom and is attached with a cord to the system unit. As you move the mouse across a smooth surface, or **mouse pad,** the roller rotates and controls the pointer on the screen.
- **Optical mouse** has no moving parts. It emits and senses light to detect mouse movement. This newer type of mouse has some advantages compared to the mechanical mouse: it can be used on any surface, is more precise, and does not require periodic cleaning. (See Figure 2-5.)
- **Cordless** or **wireless mouse** is a battery-powered device that typically uses radio waves or infrared light waves to comunicate with the system unit. These devices eliminate the mouse cord and free up desk space.

Three devices similar to a mouse are trackballs, touch surfaces, and pointing sticks. You can use the **trackball,** also known as the **roller ball,** to control the pointer by rotating a ball with your thumb. (See Figure 2-6.) You can use **touch surfaces,** or **touch pads,** to control the pointer by moving and tapping your finger on the surface of a pad. (See Figure 2-7.) You can use a **pointing stick,** located in the middle of the keyboard, to control the pointer by directing the stick with your finger. (See Figure 2-8.)

Figure 2–6 Trackball

Figure 2–7 Touch surface

Figure 2–8 Pointing stick

JOYSTICK

A **joystick** is the most popular input device for computer games. You control game actions by varying the pressure, speed, and direction of the joystick. Additional controls, such as buttons and triggers, are used to specify commands or initiate specific actions. (See Figure 2-9.)

TOUCH SCREEN

A **touch screen** is a particular kind of monitor with a clear plastic outer layer. Behind this layer are crisscrossed invisible beams of infrared light. This arrangement enables someone to select actions or commands by touching the screen with a finger. Touch screens are easy to use, especially when people need information quickly. They are commonly used at restaurants, automated teller machines (ATMs), and information centers. (See Figure 2-10.)

LIGHT PEN

A **light pen** is a light-sensitive penlike device. The light pen is placed against the monitor. This closes a photoelectric circuit and identifies the spot for entering or modifying data. For example, light pens are used to edit digital images. (See Figure 2-11.)

Figure 2–9 A joystick: a computer game application

Figure 2–10 A touch screen: a consumer application

Figure 2–11 A light pen: a home application

Figure 2–12 Stylus

STYLUS

A **stylus** is a penlike device commonly used with tablet PCs and PDAs. (See Figure 2-12.) A stylus uses pressure to draw images on a screen. A stylus interacts with the computer through handwriting recognition software. **Handwriting recognition software** translates handwritten notes into a form that the system unit can process.

Graphics tablets use a special graphics surface or tablet and a stylus. Either the user sketches directly on the tablet or traces images that have been placed on the tablet. Graphics tablets are very specialized devices used by artists for creating illustrations, by mapmakers to record or trace maps, and by engineers to save mechanical drawings digitally.

CONCEPT CHECK

- What is a pointing device? Describe five pointing devices.
- Describe three basic mouse designs.
- Describe trackballs, touch surfaces, and pointing sticks.

SCANNING DEVICES

Optical scanners copy or reproduce text and images. Bar code readers identify and price products. Character and mark recognition devices recognize special characters and marks.

Scanners move across text and images. **Scanning devices** convert scanned text and images into a form that the system unit can process. There are three types of scanning devices: optical scanners, bar code readers, and character and mark recognition devices.

OPTICAL SCANNERS

An **optical scanner,** also known simply as a scanner, accepts documents consisting of text and/or images and converts them to machine-readable form. These devices do not recognize individual letters or images. Rather, they recognize light, dark, and colored areas that make up individual letters or images. Typically, scanned documents are saved in files that can be further processed, displayed, printed, or stored for later use. There are two basic types of optical scanners: flatbed and portable. (See Figure 2-13.)

- **Flatbed scanner** is much like a copy machine. The image to be scanned is placed on a glass surface and the scanner records the image from below.
- **Portable scanner** is typically a handheld device that slides across the image, making direct contact.

Optical scanners are powerful tools for a wide variety of end users, including graphics and advertising professionals who scan images and combine them with text. Lawyers and students use portable scanners as a valuable research tool to record information.

BAR CODE READERS

You are probably familiar with **bar code readers** or scanners from grocery stores. (See Figure 2-14.) These devices are either handheld **wand readers** or **platform scanners.** They contain photoelectric cells that scan or read **bar codes,** or the vertical zebra-striped marks printed on product containers.

Flatbed scanner

Portable scanner

Figure 2-13 Two types of scanners

Almost all supermarkets use electronic cash registers and a bar code system called the **Universal Product Code (UPC).** At the checkout counter, electronic cash registers use a bar code reader to scan each product's UPC code. The codes are sent to the supermarket's computer, which has a description, the latest price, and an inventory level for each product. The computer processes this input to update the inventory level and to provide the electronic cash register with the description and price for each product. These devices are so easy to use that many supermarkets are offering customers self-checkout stations.

Figure 2-14 A bar code reader is used to record product codes

CHARACTER AND MARK RECOGNITION DEVICES

Character and **mark recognition devices** are scanners that are able to recognize special characters and marks. They are specialty devices that are essential tools for certain applications. Three types are:

- **Magnetic-ink character recognition (MICR)**—used by banks to automatically read those unusual numbers on the bottom of checks and deposit slips. A special-purpose machine known as a **reader/sorter** reads these numbers and provides input that allows banks to efficiently maintain customer account balances.
- **Optical-character recognition (OCR)**—uses special preprinted characters that can be read by a light source and changed into machine-readable code. A common OCR device is the handheld wand reader. (See Figure 2-15.) These are used in department stores to read retail price tags by reflecting light on the printed characters.
- **Optical-mark recognition (OMR)** is also called **mark sensing.** An OMR device senses the presence or absence of a mark, such as a pencil mark. OMR is often used to score multiple-choice tests such as the College Board's Scholastic Aptitude Test (SAT) and the Graduate Record Examination (GRE).

Figure 2-15 A wand reader is used to record product codes

CONCEPT CHECK

- How are pointing and scanning devices different?
- Describe three types of scanners.
- Describe three common character and mark recognition devices.

IMAGE CAPTURING DEVICES

Digital cameras capture still images. Digital video cameras capture motion. WebCams are specialized digital video cameras.

Figure 2–16 A digital camera

Optical scanners, like traditional copy machines, can make a copy from an original. For example, an optical scanner can make a digital copy of a photograph. **Image capturing devices,** on the other hand, create or capture original images. These devices include digital cameras and digital video cameras.

DIGITAL CAMERA

Digital cameras are similar to traditional cameras except that images are recorded digitally on a disk or in the camera's memory rather than on film and then **downloaded,** or transferred, to your computer. (See Figure 2-16.) You can take a picture, view it immediately, and even place it on your own Web page, within minutes.

To learn more about how digital photography works, consult your Computing Essentials CD or visit us on the Web at www.olearyseries. com and select Animations. Digital photographs can be shared easily with others over the Internet.

Figure 2–17 A WebCam

DIGITAL VIDEO CAMERA

Unlike traditional video cameras, **digital video cameras** record motion digitally on a disk or in the camera's memory. Most have the capability to take still images as well. **WebCams (Web cameras)** are specialized digital video cameras that capture images and send them to a computer for broadcast over the Internet. (See Figure 2-17.) To learn more about WebCams, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions. To learn how you can videoconference, see Making IT Work for You: WebCams and Instant Messenging on pages 2-11 and 2-12.

TIPS

Are you having trouble getting the kind of photos you want with a digital camera? Would you like to make the most of digital technology in your photos? Here are some tips to help you get started.

1. **Buttons and Knobs.** Get to know the functions of your camera before you begin. Most cameras have an automatic mode, but be sure you know how to turn on the flash, zoom the lens, and set the image resolution.
2. **Photography Basics.** Many digital cameras have an LCD screen on the back. You can use it to help frame your shots more accurately. Just be aware that using the LCD screen uses more battery power.
3. **Red-eye Reduction.** Many digital cameras have a red-eye reduction feature. When photographing people in low light, you may want to use it to eliminate glassy red eyes in photos. Consult your owner's manual to learn how to use this feature.

CONCEPT CHECK

- How are digital cameras different from traditional cameras?
- What is a WebCam?

AUDIO-INPUT DEVICES

Audio-input devices convert sounds for processing. Voice recognition systems accept voice commands to control computer operations and to create documents. MIDI is a standard for connecting musical instruments to the system unit.

Audio-input devices convert sounds into a form that can be processed by the system unit. By far the most widely used audio-input device is the microphone. **Audio-input** can take many forms, including the human voice and music.

VOICE

Voice recognition systems use a microphone, a sound card, and special software. These systems allow users to operate computers and to create documents using voice commands. Portable voice recognition systems are widely used by doctors, lawyers, and others to record dictation. (See Figure 2-18.) These devices are able to record for several hours before connecting to a computer system to edit, store, and print the dictated information. Some systems are even able to translate dictation from one language to another; such as from English to Japanese.

Voice recognition is a common feature with many of today's newest software applications. For example, recent versions of Microsoft's Word support voice recognition. Using the **Language bar,** you can switch between voice command mode and dictation mode. (See Figure 2-19.)

Figure 2-18 A portable voice recognition system

- **Voice command mode** allows the user to select menu items, toolbars, and dialog box options. For example, to specify the use of the Times New Roman font requires this command sequence:

Format>Font>Times New Roman>OK

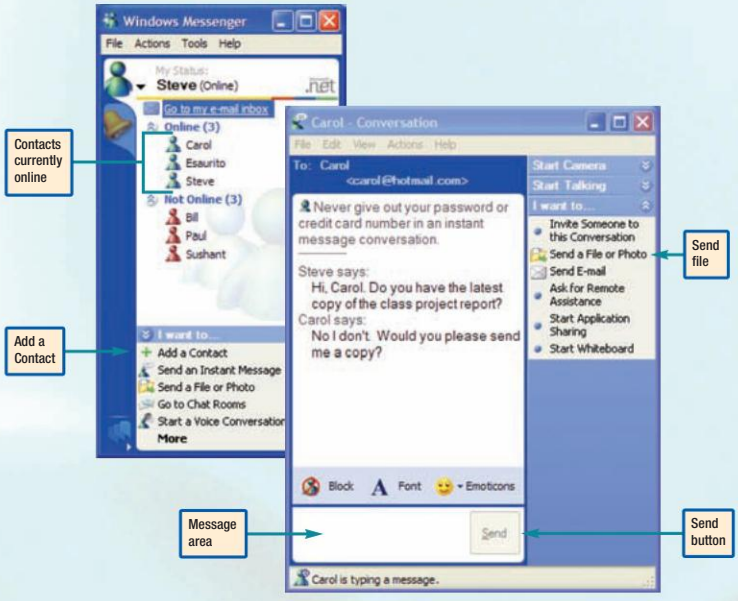
WEBCAMS AND INSTANT MESSAGING

Do you enjoy chatting with your friends? Are you working on a project and need to collaborate with others in your group? What if you could see and hear your group online? Perhaps instant messaging is just what you're looking for. It's easy and free with an Internet connection and the right software.

Sending Messages and Transferring Files Affer installing free instant messaging soffware, you can exchange messages and files with friends. Your friends are added to a list of contacts that shows you when your friends are online and available to chat. For example, you could use Windows Messenger as follows:

1. **Add contacts by clicking *Add a contact* and following the on-screen instructions.**
2. **Double-click the name of a friend who appears in the *Online* section.**
3. **Enter your message in the window that appears.**
4. **Click the *Send* button.**

Your message appears on your friend's screen instantly. Your friend can then continue the conversation by following the steps above.

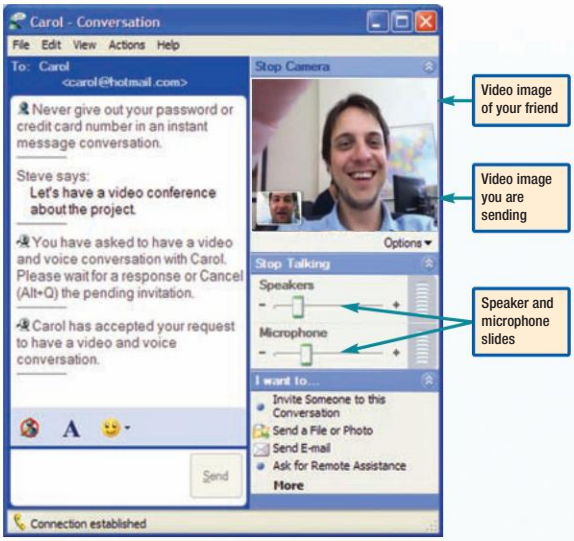


2. **Click *Send a File or Photo* in the *I want to*.., menu in the sidebar.**
3. **Browse for the file you would like to share, and click *Open*.**

Your friend is given an option to accept the file. Once your friend accepts, you can continue your conversation without interruption while the file is transferred.

Using a WebCam

In addition to typing text messages, some instant messaging soffware allows you to have voice or video conversations over the Internet so you can see and hear the person you are collaborating with. To do this, both users must have a microphone an speakers, as well as Web cameras for video conferencing. You could hold a video conference using Windows Messenger by following these steps.



1. **Start a conversation with a contact as shown in the Sending Messages and Transferring Files section.**
   - **Click *Start Camera* in the sidebar.**

Your friend is given the option to accept the video conference. Once he or she accepts, the video conference begins.

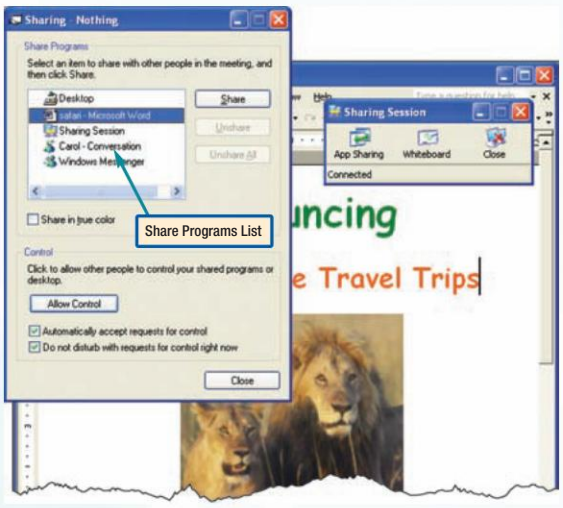
2. **As you speak, adjust the *Speakers* and *Microphone* sliders to comfortable levels.**

Sharing and Application

Sharing application is another way to collaborate using instant messaging software. Sharing application allows you to surf the Web or edit a document over the Internet while working with a friend. For example, you could collaborate with a friend on a Microsoft Word document by following the steps below:

1. **Start a conversation with a contact as shown in the Sending Messages and File Transfer section.**
   - **Click *Start Application Sharing* in the sidebar.**

Your friend is given the option to accept the application sharing session. Once he or she accepts, the application sharing session begins.



2. **Select the application you want to share in the Share Programs list, and click the *Share* button.**
   - **Click the *Allow Control* button to allow your friends to control the shared application.**
   - **Click the *Close* button.**

Your application can be controlled by you and your friend simultaneously.

The Web is continually changing, and some of the specifics presented in this Making IT Work for You may have changed. To learn more about other ways to make information technology work for you, visit our Web site at www.olearyseries.com and select Making IT Work for You.

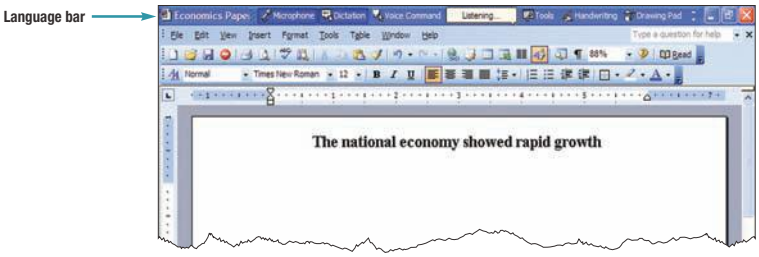


Figure 2-19 Voice recognition with Microsoft Word

Figure 2-20 Yamaha MIDI Silent Cello

You could issue this command using a mouse, or you could use a microphone and state:

"Format font Times New Roman OK"

- **Dictation mode** allows the user to dictate text directly into a Word document. For example, consider the following sentence:

  "The national economy showed rapid growth."

  You could enter this text using a keyboard or you could use a microphone and state:

  "The national economy showed rapid growth"

MUSIC

Musical instrument digital interface or **MIDI** is a standard that allows musical instruments to connect to the system unit using a special MIDI port. **MIDI devices** are specialized musical instruments that provide input in the form of encoded digital signals representing musical sounds. MIDI devices can be used to create, record, and play back musical compositions. The most commonly used MIDI device is an electronic keyboard. Others include MIDI violins, guitars, and even cellos. (See Figure 2-20.)

CONCEPT CHECK

- Describe voice recognition systems.
- What is MIDI? What are some common MIDI devices?

WHAT IS OUTPUT?

Output is processed data or information. Text, graphics, audio, and video are types of output. Output devices translate processed information into a form humans can understand.

Output is processed data or information. Output typically takes the form of text, graphics, photos, audio, and/or video. For example, when you create a presentation using a presentation graphics program, you typically input text and graphics. You could also include photographs and even add voice narration. The output would be the completed presentation.

Output devices are any hardware used to provide or to create output. They translate information that has been processed by the system unit into a form that humans can understand. There are a wide range of output devices. The most widely used are monitors, printers, and audio-output.

MONITORS

Monitor features include resolution, dot pitch, refresh rate, and size. CRT and flat-panel are types of monitors. E-books, data projectors, and HDTV are specialty monitors.

The most frequently used output device is the **monitor.** Also known as **display screens** or simply as **screens,** monitors present visual images of text and graphics. The output is often referred to as **soft copy.** Monitors vary in size, shape, and cost. Almost all, however, have some basic distinguishing features.

FEATURES

The most important characteristic of a monitor is its clarity. **Clarity** refers to the quality and sharpness of the displayed images. It is a function of several monitor features, including reolution, dot pitch, refresh rate, and size.

- **Resolution** is one of the most important features. Images are formed on a monitor by a series of dots or **pixels (picture elements).** (See Figure 2-21.) Resolution is expressed as a matrix of these dots or pixels. For example, many monitors today have a resolution of 1,280 pixel columns by 1,024 pixel rows for a total of 1,310,720 pixels. The higher a monitor's resolution (the more pixels) the clearer the image produced. See Figure 2-22 for the most common monitor resolutions.
- **Dot pitch** is the distance between each pixel. Most newermonitors have a dot pitch of .31 mm (31/100th of a millimeter) or less. The lower the dot pitch (the shorter the distance between pixels), the clearer the images produced.
- **Refresh rate** indicates how often a displayed image is updated or redrawn on the monitor. Most monitors operate at a rate of 75 hertz, which means that the monitor is redrawn 75 times each second. Images displayed on monitors with refresh rates lower than 75 hertz appear to flicker and can cause eye strain. The faster the refresh rate (the more frequently images are redrawn), the better the quality of images displayed.
- **Size** or **viewable size** is measured by the diagonal length of a monitor's viewing area. Common sizes are 15, 17, 19, and 21 inches. The smaller the monitor size the better the quality of images displayed.

Figure 2-21 Monitor resolution

Standard	pixels
SVGA	800 600
XGA	1,024 768
SXGA	1,280 1,024
UXGA	1,600 1,200

Figure 2-22 Resolution standards

CATHODE-RAY TUBE

The most common type of monitor for the office and the home is the **cathode ray tube (CRT).** (See Figure 2-23.) These monitors are typically placed directly on the system unit or on the desktop. CRTs are similar in size and technology to televisions. Compared to other televisions. Compared to other types

On the Web Explorations

Flat-panel monitors are quickly becoming the standard for personal computers. To learn more about a leading manufacturer in this industry, visit our Web site at www.olearyseries.com and select On the Web Explorations.

of monitors, their primary advantages are low cost and excellent resolution. Their primary disadvantage is that they are bulky and occupy a considerable amount of space on the desktop.

FLAT-PANEL MONITOR

Because CRTs are too bulky to be transported easily, portable monitors, known as **flat-panel monitors,** were developed. Flat-panel monitors are much thinner and require less power to operate than CRTs. These monitors are widely used with desktop, tablet PC, and handheld computers. (See Figure 2-24). There are two basic types of flat-panel monitors: passive-matrix and active-matrix. **Passive-matrix,** or **dual-scan monitors,** create images by scanning the entire screen. This type requires very little power, but the clarity of the images is not as sharp. **Active-matrix** or **thin film transistor (TFT)** monitors do not scan down the screen; instead, each pixel is independently activated. They can display more colors with better clarity. Active-matrix monitors are more expensive and require more power.

Figure 2-23 CRT monitor

Figure 2-24 A flat-panel monitor

OTHER MONITORS

There are several other types of monitors. These monitors are used for more specialized applications, such as reading books, making presentations, and watching television. Three of these specialized devices are e-books, data projectors, and high-definition television.

- **E-books,** also known as **e-book readers,** are handheld, book-sized devices that display text and graphics. Using content downloaded from the Web or from special cartridges, these devices are used to read newspapers, magazines, and entire books. (See Figure 2-25.)
- **Data projectors** are specialized devices similar to slide projectors. These devices, however, connect to microcomputers and project computer output just as it would appear on a monitor. Data projectors are commonly used for presentations almost anywherefrom the classroom to the boardroom.

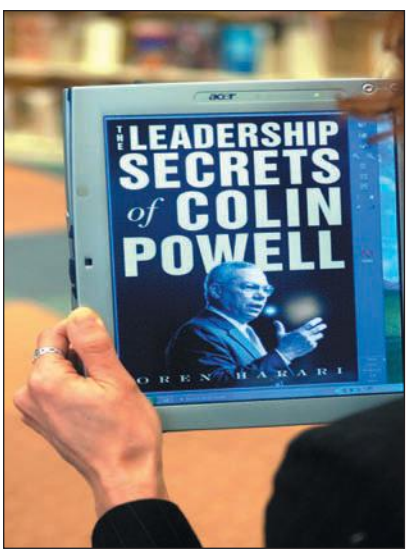


Figure 2-25 E-book

- **High-definition television (HDTV)** is a recent development in the merger of microcomputers and television, called **PC/TV.** HDTV delivers a much clearer and more detailed wide-screen picture than regular television. (See Figure 2-26.) Because the output is digital, users can readily freeze video sequences to create high-quality still images. The video and still images can then be digitized, edited, and stored on disk for later use. This technology is very useful to graphic artists, designers, and publishers.

Figure 2–26 HDTV

CONCEPT CHECK

- What is output? What are output devices?
- Define these monitor features: resolution, dot pitch, refresh rate, and size.
- Describe CRTs, flat-panel, and specialty monitors.

On the Web Explorations

HDTV is expected to be the standard in television broadcasting by 2006. To learn more about HDTV visit our Web site at www.olearyseries.com and select On the Web Explorations.

PRINTERS

Printer features include resolution, color capability, speed, and memory. Ink-jet, laser, and thermal are common types of printers. Other types include dot-matrix, ploffer, photo, and portable.

You probably use a printer with some frequency to print homework assignments, photographs, and Web pages. **Printers** translate information that has been processed by the system unit and present the information on paper. Printer output is often called **hard copy.**

FEATURES

There are many different types of printers. Almost all, however, have some basic distinguishing features, including resolution, color capability, speed, and memory.

- **Resolution** for a printer is similar to monitor resolution. It is a measure of the clarity of images produced. Printer resolution, however, is measured in **dpi (dots per inch).** (See Figure 2-27.) Most printers designed for personal use average 1,200 dpi. The higher the dpi, the better the quality of images produced.
- **Color capability** is provided by most printers today. Users typically have the option to print either with just black ink or with color. Because it is more expensive to print in color, most users select black ink for letters, drafts, and homework. Color is used more selectively for final reports containing graphics and for photographs.
- **Speed** is measured in the number of pages printed per minute. Typically, printers for personal use average 15 to 19 pages per minute for single color (black) output and 13 to 15 pages per minute for color output.

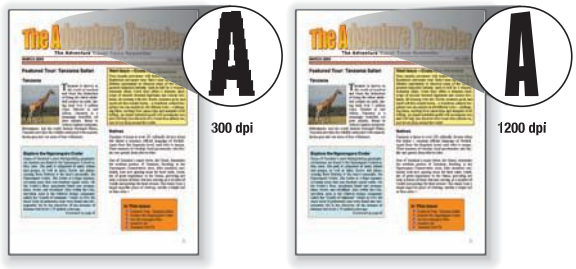


Figure 2–27 Dpi comparison

- **Memory** within a printer is used to store printing instructions and documents waiting to be printed. The more memory in a printer, the faster it will be able to create large documents.

INK-JET PRINTER

Figure 2–28 A special application ink-jet printer

Ink-jet printers spray ink at high speed onto the surface of paper. This process not only produces a letter-quality image but also permits printing to be done in a variety of colors making them ideal for select special applications. (See Figure 2-28.) Ink-jet printers are the most widely used printers. They are reliable, quiet, and relatively inexpensive. The most costly aspect of ink-jet printers is replacing the ink cartridges. For this reason, most users specify black ink for the majority of print jobs and use the more expensive color printing for select applications. Typical ink-jet printers produce 17 to 19 pages per minute of black-only output and 13 to 15 pages of color output.

LASER PRINTER

The **laser printer** uses a technology similar to that used in a photocopying machine. Laser printers use a laser light beam to produce images with excellent letter and graphics quality. More expensive than ink-jet printers, laser printers are faster and are used in applications requiring high-quality output. (See Figure 2-29.)

On the Web Explorations

For fast high-quality printouts, laser printers are the standard. To learn more about a company that makes laser printers, visit our Web site at www.olearyseries.com and select On the Web Explorations.

TIPS

Do you find extra pages in the printer when you try to print from the Web? Would you like to print your favorite articles without the ads and hyperlinks? There are several ways to get what you want in a printout. Here are a few suggestions you can use in Internet Explorer.

1. **Preview.** To see what will be printed, choose *Print Preview* from the *File* menu. You can scroll through the pages and make sure the items you want will be printed.
2. **Choose Printer Friendly.** Many Web pages have a Printer Friendly button that removes ads and sidebars. Look for the button at the top of Web articles.
3. **Print Selection.** You can highlight the text you would like to print. Right-click the highlighted text you would like to print and choose *Print Selection* option under the

There are two categories of laser printers. **Personal laser printers** typically do not support color, are less expensive, and are used by many single users. They typically can print 15 to 17 pages a minute. **Shared laser** printers typically support color, are more expensive, and are used (shared) by a group of users. Shared laser printers typically print over 50 pages a minute.

Figure 2–29 A laser printer

THERMAL PRINTER

A **thermal printer** uses heat elements to produce images on heat-sensitive paper. Originally these printers were only used in scientific labs to record data. More recently, color thermal printers have been widely used to produce very high-quality color artwork and text.

Color thermal printers are not as popular because of their cost and the requirement of specially treated paper. They are special-use printers that produce near-photographic output. They are widely used in professional art and design work where very high-quality color is essential.

Figure 2–30 Photo printer

OTHER PRINTERS

There are several other types of printers. These printers include dot-matrix printers, chain printers, plotters, photo printers, and portable printers:

- **Dot-matrix printers** form characters and images using a series of small pins on a print **head.** Once a widely used microcomputer printer, they are inexpensive and reliable but quite noisy. In general, they are used for tasks where high-quality output is not required.
- **Plotters** are special-purpose printers for producing a wide range of specialized output. Using output from graphics tablets and other graphical input devices, plotters can create maps, images, and architectural and engineering drawings. Plotters are widely used by graphic artists, engineers, and architects to print out designs, sketches, and drawings.
- **Photo printers** are special-purpose printers designed to print photo-quality images from digital cameras. (See Figure 2-30.) Most photo printers print 3" × 5" or 4" × 6" images on glossy, photo-quality paper.
- **Portable printers** are usually small and lightweight printers designed to work with a notebook computer. Portable printers may be ink-jet or laser printers, print in black and white or color, and connect with USB or parallel port connections.

CONCEPT CHECK

- Discuss these printer features: resolution, color capability, speed, and memory.
- What are the three printer types commonly used with microcomputers?
- Discuss dot-matrix, plotter, photo, and portable printers.

AUDIO-OUTPUT DEVICES

Audio-output devices produce sounds for people. Speakers and headphones are the most common types.

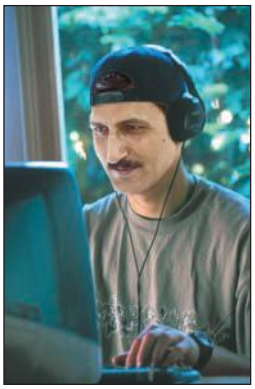


Figure 2-31 Headphones

Audio-output devices translate audio information from the computer into sounds that people can understand. The most widely used audio-output devices are **speakers** and **headphones.** (See Figure 2-31) These devices are connected to a sound card in the system unit. The sound card is used to capture as well as play back recorded sounds. Audio-output devices are used to play music, vocalize translations from one language to another, and communicate information from the computer system to users.

Creating voice output is not anywhere near as difficult as recognizing and interpreting voice input. In fact, voice output is quite common. It is used with many soft-drink machines, telephones, and cars. It is used as a reinforcement tool for learning, such as to help students study a foreign language. It is also used in many supermarkets at the checkout counter to confirm purchases. One of its most powerful capabilities is to assist the physically challenged.

COMBINATION INPUT AND OUTPUT DEVICES

Fax machines send and receive images over telephone lines. Multifunction devices have input and output capabilities. Internet telephones use telephony to connect people. Dumb, intelligent, network, or Internet are types of terminals.

On the Web Explorations

Multifunctional devices save space and money, making them a favorite in home offices and small businesses. To learn more about MFDs, visit our Web site at www.olearyseries.com and select On the Web Explorations.

Many devices combine input and output capabilities. ometimes this is done to save space. Other times it is done for very specialized applications. Common **combination devices** include fax machines, multifunction devices, Internet telephones, and terminals.

FAX MACHINES

A **fax machine,** also known as a **facsimile transmission machine,** is a standard tool in nearly every office. At one time, all fax machines were separate stand-alone devices for sending and receiving images over telephone lines. Now, most computer systems have that capability with the simple addition of a fax/modem board. To send a fax, these devices scan the image of a document converting the light and dark areas into a format that can be sent electronically over standard telephone lines. To receive a fax, these devices reverse the process and print the document (or display the document on your monitor) using signals received from the telephone line.

MULTIFUNCTION DEVICES

Multifunctional devices (MFD), also known as **all in one (AIO)** devices, typically combine the capabilities of a scanner, printer, fax, and copy machine. These multifunctional devices offer a cost and space advantage. They cost about the same as a good printer or copy machine but require much less

space than the single-function devices they replace. Their disadvantage is that the quality and functionality are not quite as good as those of the separate singlepurpose devices. Even so, multifunctional devices are widely used in home and small business offices.

INTERNET TELEPHONE

Internet telephones are specialized input and output devices for receiving and sending voice communication. Typically, these devices connect to the system unit through a USB port and operate much like a traditional telephone.

Telephony is the transmission of telephone calls over computer networks. Also known as **Internet telephony, IP telephony,** and **Voice-over IP (VoIP)**, telephony uses the Internet rather than traditional communication lines to support voice communication. To place telephone calls using telephony requires a high speed Internet connection and special software and/or hardware. The three most popular approaches are:

- **Computer-to-computer** communications allow individuals to place free long-distance calls. This application requires that both parties have a computer and that their computers are on and connected to the Internet when a call is placed. The required software is available from a variety of sources for free or at very low cost. MSN Explorer is one of the most widely used.
- **Computer-to-traditional telephone** communications allow a user to call almost any traditional telephone from his or her computer. Only he person making the call needs to have a computer connected to he Internet. The calling party subscribes to a special Internet phone service provider that supplies the required software and charges a small monthly and/or per-minute fee. To see how this works, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations.
- **Traditional telephone-to-traditional telephone** communications do not require a computer. The calling party subscribes to a special Internet phone service provider that supplies a special hardware adapter that connects a traditional telephone to the Internet. The cost for this service is similar to the computer-to-traditional telephone approach.

Compared to traditional telephone calls, Internet supported calls may have a lower sound quality. However, most users report that this difference is not significant. Telephony promises to dramatically impact the telecommunications industry and to reduce our costs for telephone communications.

TERMINALS

A **terminal** is an input and output device that connects you to a mainframe or other type of computer called a **host computer** or **server.** There are four kinds of terminals:

- A **dumb terminal** can be used to input and receive data, but it cannot process data independently. It is used to gain access and to send information to a computer. Such a terminal is often used by airline reservation clerks to access a mainframe computer for flight information. (See Figure 2-32.)
- Essentially, an **intelligent terminal** is a microcomputer with communications software and a telephone hookup (modem) or other communications link. These connect the terminal to the larger computer or to the Internet. An increasingly popular type

Figure 2–32 Dumb terminal

is the **Net PC,** also known as the **Net Personal Computer.** These low-cost and limited microcomputers typically have only one type of secondary storage (an internal hard disk drive), a sealed system unit, and no expansion slots.

- **A network terminal,** also known as a **thin client** or **network computer,** is a low-cost alternative to an intelligent terminal. Most network terminals do not have a hard-disk drive and must rely on a host computer or server for application and system software. These devices are becoming increasingly popular in many organizations.
- An **Internet terminal,** also known as a **Web terminal** or **Web appliance,** provides access to the Internet and typically displays Web pages on a standard television set. These special-purpose terminals offer Internet access without a microcomputer. Unlike the other types of terminals, Internet terminals are used almost exclusively in the home.

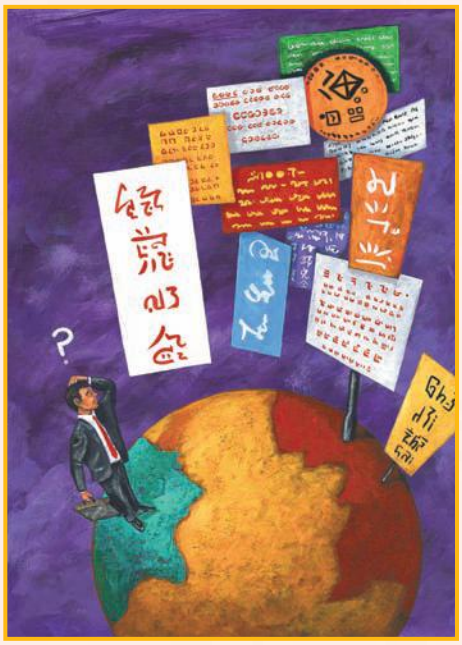
CONCEPT CHECK

- What are the two most widely used audio-output devices?
- Describe the three most popular Internet telephony approaches.
- Describe the following combination devices: fax machine, MFD, Internet telephone, and terminal.

A Look to the Future

Electronic Translators May Be in Your Future

Have you ever wished you could speak more than one language fluently? What if you could speak hundreds of languages instantly? Would you like to have your own personal interpreter to accompany you whenever you traveled to a foreign country? What if you could take a picture of a foreign road sign or restaurant menu and have it immediately translated for you? Technology called electronic interpretation may soon exist to do all of these things. The military and private sector are funding a variety of research projects on electronic interpreters, and the commercial opportunities are enormous. The worldwide translation services market is already a $5 billion a year industry and is expected to grow to $7.6 billion by 2006.



Prototype portable handheld electronic interpreters are currently in a testing phase at the U.S. Office of Naval Research. in fact, it is expected that these devices will be widely used within the next year. The company SpeechGear has developed a machine called interact that takes verbal statements in one language, converts the statements to text, translates that text to another language, and then vocalizes the translated text. And it does all this in two seconds! The military is particularly interested in electronic interpreters as they focus on peacekeeping objectives. More than ever before, U.S. soldiers find themselves needing to communicate with non-English-speaking civilians to settle disputes and maintain order.

Despite the achievements of interact and other hardware, several challenges remain that translation hardware. Current translation are labor intensive; they require linguists and programmers to create large lists of words and their corresponding meanings. Unfortunately, computers have a difficult time understanding idioms, such as "It is raining cats and dogs." They may also have difficulty correctly identifying words by their context. For example, the sentences "The refrigerator is cool" and "The Fonz is *cool*" use the same word, cool, but it has a very different meaning in each sentence. Entrepreneurs in New York City may have a solution to these problems with the E1iMT project. instead of translating from word to word, E1iMT compares books that have been translated in different languages, looking for sentence fragment patterns. By comparing sentence fragments, it is hoped that translation programs will be able to identify word groupings and translate them into another language's comparable word grouping, essentially translating concepts instead of individual words.

What are the uses for such a device? Will the average person want or need an electronic translator? What type of professions and professionals will use them? What industries would benefit most from electronic translators? How could you use this technology?

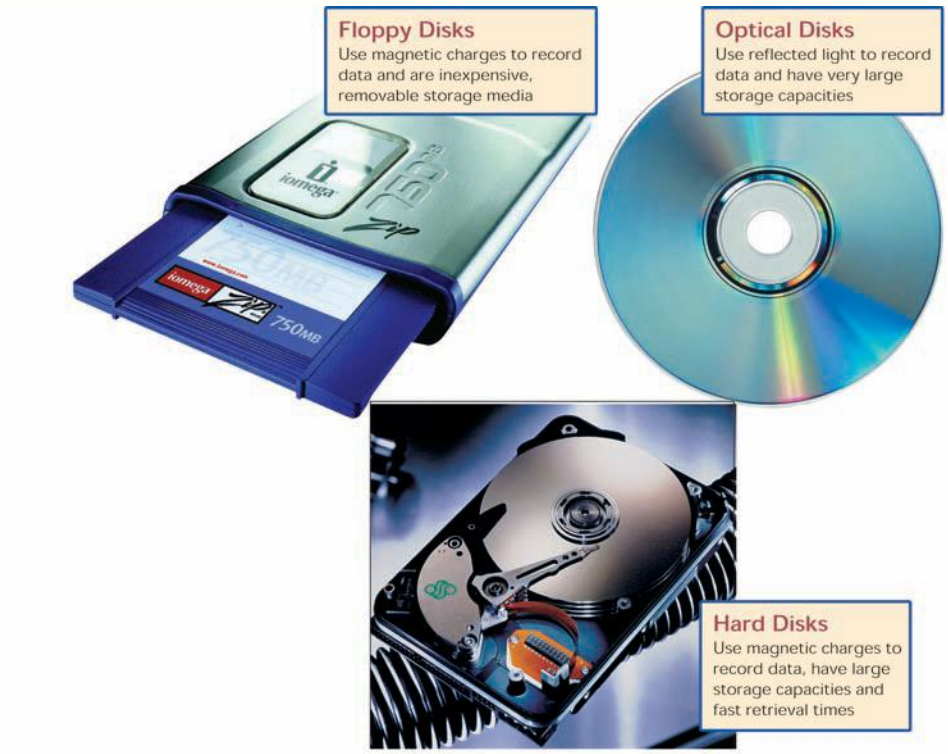
SECONDARY STORAGE

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Distinguish between primary and secondary storage.**
2. **Describe the traditional floppy disk and compare it to high capacity floppy disks.**
3. **Compare internal hard disks, hard-disk cartridges, and hard-disk packs.**
4. **Describe ways to improve hard-disk operations, including disk caching, redundant arrays of inexpensive disks, and data compression and decompression.**
5. **Discuss the different types of optical disks.**
6. **Describe solid-state storage, Internet drives, and magnetic tape.**
7. **Discuss mass storage and mass storage devices.**

CONTENTS



CHAPTER 3

Secondary storage devices are used to save, to back up, and even to transport files consisting of data or programs from one location or computer to another. Not long ago, almost all files contained only numbers and letters. The demands for saving these files were easily met with low capacity floppy and hard-disk drives. For example, to save a 100-page research paper might require 400 KB of storage, which easily fits onto a single floppy disk.

In the past five years, however, secondary storage devices have been required to service much greater demands. Data storage has expanded from text and numeric files to include digital music files, photographic files, video files, and much more. These new types of files require secondary storage devices that have much greater capacity. For example, a 10-minute video might require 100 MB of storage.

Today's secondary storage devices are routinely used for a variety of tasks that were impossible just a few years ago. CDs and DVDs, for example, store data that can be used over and over again. You can download music from the Internet, play it on your computer, and create custom CDs with the right hardware and software.

Secondary storage devices have always been an indispensable element in any computer system. They have similarities to output and input devices. Like output devices, secondary storage devices receive information from the system unit in the form of the machine language of 0s and 1s. Rather than translating the information, however, secondary storage devices save the information in machine language for later use. Like input devices, secondary storage devices send information to the system unit for processing. However, the information, since it is already in machine form, does not need to be translated. it is sent directly to memory (RAM), where it can be accessed and processed by the CPU.

Competent end users need to be aware of the different types of secondary storage. They need to know the capabilities, limitations, and uses of floppy disks, hard disks, optical disks, and other types of secondary storage. Additionally, they need to be aware of specialty storage devices for portable computers and to be knowledgeable about how large organizations manage their extensive data resources.

STORAGE

Primary storage is volatile. Secondary storage is nonvolatile. Important storage characteristics include media, capacity, storage devices, and access speed.

An essential feature of every computer is the ability to save, or store, information. Random-access memory (RAM) holds or stores data and programs that the CPU is presently processing. Before data can be processed or a program can be run, it must be in RAM. For this reason, RAM is sometimes referred to as **primary storage.**

Unfortunately, most RAM provides only temporary or **volatile storage.** That is, it loses all of its contents as soon as the computer is turned off. Its contents are also lost if there is a power failure that disrupts the electric current going into the system unit. This volatility results in a need for more permanent or **nonvolatile storage** for data and programs. We also need external storage because users need much more storage capacity than is typically available in a computer's primary or RAM memory.

Figure 3–1 Secondary storage media

Secondary storage provides permanent or nonvolatile storage. Using **secondary storage devices,** such as a floppy disk drive, data and programs can be retained after the computer has been shut off. This is accomplished by *writing* files *to* and *reading* files from secondary storage devices. **Writing** is the process of saving information to the secondary storage device. **Reading** is the process of accessing information *from* secondary storage. This chapter focuses on secondary storage devices.

Some important characteristics of secondary storage include:

- **Media** or **medium,** which is the actual physical material that holds the data and programs. (See Figure 3-1.)
- **Capacity** measures how much a partiular storage medium can hold.
- **Storage devices** are hardware that read data and programs from the medium. Most also write to the medium.
- **Access speed** or **access time** measures the amount of time required by the storage device to retrieve data and programs.

Most desktop microcomputer systems have floppy, hard, and optical disk drives.

FLOPPY DISKS

Floppy disks are removable storage media. The traditional floppy disk is 1.44 MB. Data is recorded on tracks and sectors. Zip, SuperDisk, and HiFD are high capacity floppy disks.

Floppy disks, often called **diskettes** or simply **disks**, are portable or removable storage media. They are typically used to store and transport word processing, spreadsheet, and other types of files. They use flat circular pieces of Mylar plastic that have been coated with a magnetic material. **Floppy disk drives (FDD)** store data and programs by altering the electromagnetic charges on the

disk's surface to represent 1s and 0s. Floppy disk drives retrieve data and programs by reading these charges from the magnetic disk. Characters are represented by positive (+) and negative (–) charges using the ASCII, EBCDIC, or Unicode binary codes. For example, the number 3 would require a series of 8 charges. (See Figure 3-2.)

Floppy disks are also called **flexible disks** and **floppies**. This is because the plastic disk inside the diskette cover is flexible, not rigid. There are several types of floppy disks with different capacities ranging from the traditional floppy disk to a variety of high capacity floppy disks.

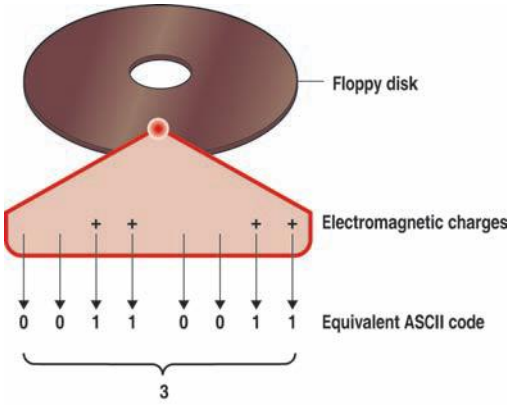


Figure 3–2 How charges on a disk surface store the number 3

TRADITIONAL FLOPPY DISK

The traditional floppy disk is the **1.44 MB 3½-inch disk.** (See Figure 3-3.) Although introduced over 20 years ago, they are still in used. The most common type is labelled **2HD,** which means "two-sided, high-density." Two-sided indicates that data can be stored on both sides of the disk. **Density** refers to how tightly the bits (electromagnetic charges) can be packed next to one another. These disks have a capacity of 1.44 megabytes-the equivalent of over 350 typewritten pages.

Figure 3–3 A 1.44 MB 3½–inch floppy disk

Floppy disks have a thin exterior jacket made of hard plastic to protect the flexible disk inside. (See Figure 3-4.) A **shutter** on the disk slides to the side to expose the recording surface. **Labels** provide users with an area to write or document the contents of the disk. The **write-protection notch** has a slide that opens and closes. In either position, files can be read from the floppy disk. When the notch is closed, files can be saved to the disk. If you save a file with the same name as a file already on the disk, the original file is lost. As a protection against accidentally losing important files, the write-protection notch can be set to the open position as shown in Figure 3-4. In this position, files cannot be saved to the floppy disk.

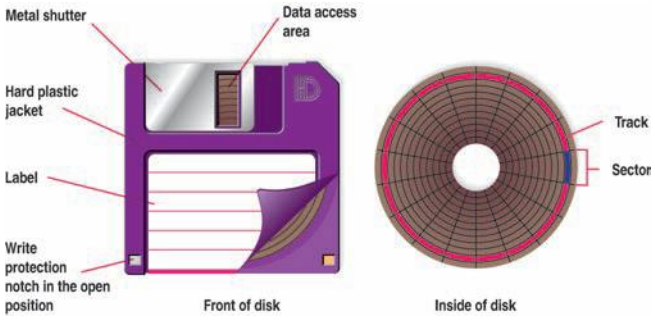


Figure 3–4 The parts of a 3½–inch floppy disk

Files are stored and organized on the flexible disk according to tracks and sectors. **Tracks** are rings of concentric circles without visible grooves. Each track is divided into invisible wedge-shaped sections called **sectors.** Each track's sector can store up to 512 bytes or characters.

To see how a floppy disk drive works, consult your Computing Essentials CD or visit our Web site at

www.olearyseries.com and select Animations.

Figure 3–5 Zip disk and drive

HIGH CAPACITY FLOPPY DISKS

While the traditional floppy disk is very reliable and still widely used to store data, it has very limited capacity. While 1.44 MB is fine for many text and spreadsheet files, it is not sufficient to hold larger files. For example, many PowerPoint presentation files far exceed 1.44 MB. Most multimedia applications require even greater capacity. **High capacity disks,** also known as **floppy-disk cartridges**, are rapidly replacing the traditional floppy disk. Like the traditional floppy, the high capacity disks are 3½ inches in diameter. However, they are able to store more information, are thicker, and require special disk drives. The three best known high capacity disks are Zip, HiFD, and SuperDisks.

- **Zip disks** are produced by Iomega and typically have a 100 MB, 250 MB, or 750 MB capacity—over 500 times as much as today's standard floppy disk. Internal Zip drives are a standard feature on many of today's system units. External Zip drives are generally connected to the system unit using parallel or USB ports. Zip disks are widely used to store multimedia, database, large text, and spreadsheet files. (See Figure 3-5.)
- **HiFD disks** from the Sony Corporation have a capacity of 200 MB or 720 MB. They have one major advantage over Zip disks. HiFD drives are able to read and store data on today's 1.44 MB traditional disk as well as on their own higher capacity disks. For this reason, HiFD are popular for use with notebook computers.
- **SuperDisks** are produced by Imation and have a 120 MB or 240 MB capacity. Like HiFD drives, SuperDisk disk drives are able to use today's 1.44 MB standard disks.

Each of these will likely improve its capacity and speed in the near future. Will one of them become the next standard floppy disk? While most observers believe one will become the next standard, they are less certain which one and when this will occur. For a summary of floppy disk capacities, see Figure 3-6.

On the Web Explorations

As more people share digital music and video, the need for high capacity disks is increasing. To learn more about a company in this field, visit our Web site at www.olearyseries.com and select On the Web Explorations

Description	Capacity
2HD	1.44 MB
Zip	100/250/750 MB
HiFD	200/720 MB
SuperDisk	120/240 MB

Figure 3–6 Typical floppy disk capacities

TIPS

Are you concerned about losing the data stored on your floppy disks? Actually, floppy disks are quite durable, and taking care of them boils down to just a few basic rules.

1. **Don't bend.** Don't bend them, flex them, or put heavy weights on them
2. **Don't touch.** Don't touch what is visible through the protective jacket.
3. **Don't remove.** Never attempt to remove a disk when it is rotating and in use.
4. **Avoid extreme conditions.** Keep disks away from strong magnetic fields, extreme heat, and cold, as well as alcohol and other solvents.
5. **Use storage boxes.** Store disks in a plastic storage box.

Of course the best protection is to make a duplicate copy of your disk.

CONCEPT CHECK

- Discuss four important characteristics of secondary storage.
- What is the traditional floppy disk? Why is it likely to be replaced in the future?

HARD DISKS

Hard disks store files using tracks, sectors, and cylinders. Internal hard disks are fixed. Hard-disk cartridges are removable. Hard-disk packs are high capacity and removable. Disk caching, RAID, and file compression/decompression improve hard disk performance.

Like floppy disks, hard disks save files by altering the magnetic charges of the disk's surface. While a floppy disk uses a thin flexible plastic disk, a **hard disk** uses thicker, rigid metallic **platters** that are stacked one on top of another. Hard disks store and organize files using tracks, sectors, and cylinders. A **cylinder** runs through each track of a stack of platters. Although not needed by floppy disks that have a single platter, cylinders are necessary to differentiate files stored on the same track and sector of different platters. When a hard disk is formatted, tracks, sectors, and cylinders are assigned.

Compared to floppy disks, hard disks are able to store and retrieve information much faster and have a greater capacity. They are, however, sensitive instruments. Their read/write heads ride on a cushion of air about 0.000001 inches thick. It is so thin that a smoke particle, fingerprint, dust, or human hair could cause what is known as a head crash. (See Figure 3-7.)

A **head crash** occurs when a read/write head makes contact with the hard disk's surface or Human hair with particles on its surface. A head crash is a disaster for a hard disk. The disk surface is scratched and some or all of the data is destroyed. At one time, head crashes were commonplace. Now, fortunately, they are rare.

There are three types of hard disks: internal hard disk, hard-disk cartridge, and hard-disk pack.

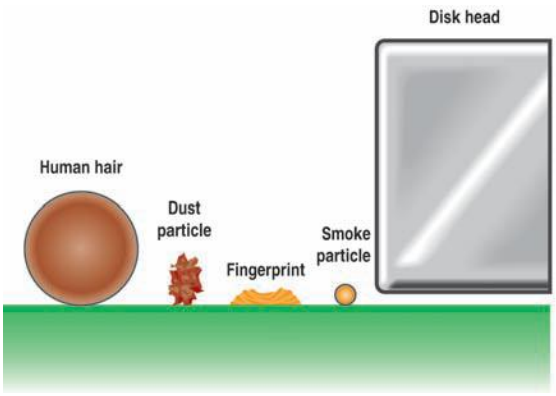


Figure 3-7 Materials that can cause a head crash

INTERNAL HARD DISK

An **internal hard disk,** also known as a **fixed disk,** is located inside the system unit. For most microcomputer systems, the internal hard disk drive is designated as the **C drive**. It is used to store programs and large data files. For example, nearly every microcomputer uses its internal hard disk to store its operating system and major applications such as Word and Excel.

Internal hard disks have two advantages over floppy disks: capacity and access speed. A 200-gigabyte internal hard disk, for instance, can hold almost as much information as 140,000 standard floppy disks. Because hard disks rotate faster and their read/write heads are closer to the recording surface, the time required to find and retrieve information (access speed) is much faster than floppy disks. For these reasons, almost all of today's powerful applications are designed to be stored on and run from an internal hard disk. Adequate internal hard disk capacity is essential.

On the Web Explorations

A computer can be a library, a jukebox, even a home entertainment system, but to do any of these tasks requires large amounts of hard disk space. To learn more about the leaders in high capacity hard disks, visit our Web site at www.olearyseries.com and select On the Web Explorations.

To see how a hard disk works, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations.

To ensure adequate performance of your internal hard disk, you should perform routine maitenance and periodically make backup copies of all important files. For hard disk maintenance and backup procedures, refer to Chapter 5's coverage of the Windows utilities Backup, Disk Cleanup, and Disk Defragmenter.

TIPS

Does your internal hard-disk drive run a lot and seem slow? Are you having problems with lost or corrupted files? The problem could be with fragmented files—files that when saved were broken into pieces (fragments) and stored in different locations on your hard disk. To clear up the clutter and speed up access, consider defragging. If you are using Windows 98, 2000, or XP:

1. **Start Disk Defragmenter.** Use Start/All Programs/Accessories/System Tools/Disk Defragmenter to start defragmenting your disk. Defragmenting reorganizes file parts so that they are stored in adjacent locations.
2. **Keep working.** You can continue to use applications while your disk is being defragmented. However, your computer operates more slowly and it takes longer to finish.
3. **Automate.** Use Start/All Programs/Accessories/System Tools/Scheduled tasks to schedule defragmentation tasks for you in the future.

HARD-DISK CARTRIDGES

While internal hard disks provide fast access, they have a fixed amount of storage and cannot be easily removed from the system cabinet. **Hard-disk cartridges**, also known as **removable hard disks,** are as easy to remove as a cassette from a video cassette recorder. The amount of storage available to a computer system is limited only by the number of cartridges.

Hard-disk cartridges are used primarily to complement an internal hard disk. Because the cartridges are easily removed, they are particularly useful to protect or secure sensitive information. Other uses for hard-disk cartridges include backing up the contents of the internal hard disk and providing additional hard disk capacity.

Hard-disk cartridges for desktop computers have typical capacities of 10 to 20 GB (gigabytes). One of the most widely used hard-disk cartridges is Peerless disks from Hard-disk Iomega. (See Figure 3-8.) Credit card cartridge size hard-disk cartridges called **PC Card hard disks** are available for notebook computers with typical capacities up to 5 gigabytes. Two well-known PC Card hard disks are IBM's Hard-disk Microdrive and Toshiba's MK5002.drive (See Figure 3-9.)

Figure 3-8 Hard-disk cartridge and card from Iomega

HARD-DISK PACKS

Hard-disk packs are removable storage devices used to store massive amounts of information. (See Figure 3-10.) Their capacity far exceeds the other types of hard disks. Although you may never have seen one, it is almost certain that you have used them. Microcomputers that have access to the Internet, minicomputers, or mainframes often have access to external hard-disk packs through communication lines. Banks and credit card companies use them to record financial information.

Figure 3-9 PC card hard disk from Toshiba

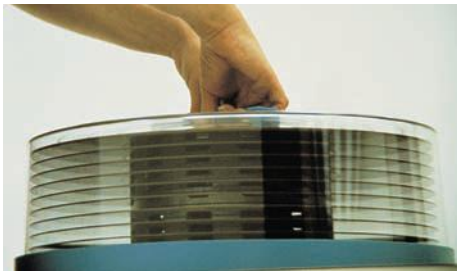


Figure 3-10 Hard-disk pack enclosed in a plastic cover

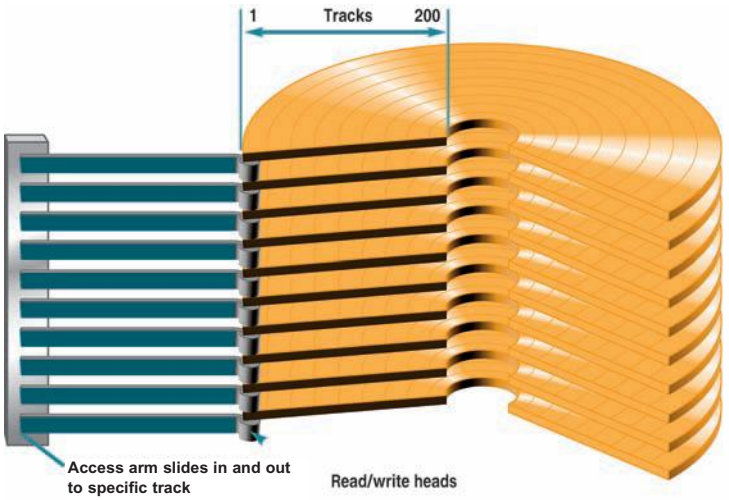


Figure 3–11 Hard-disk pack

Like internal hard disks, hard-disk packs have multiple recording platters aligned one above the other. Hard-disk packs, however, use much larger platters, use more platters, and are not enclosed in a special container. Hard-disk packs are stored in a hard plastic cover that is removed when the pack is mounted onto special drives. The drive rotates the pack and access arms move in and out between the rotating platters. Each access arm has two read/write heads. One reads the other reads the disk surface below it. All the access arms move in and out together. However, only one of the read/write heads is activated at a given moment. A disk pack with 11 disks provides 20 recording surfaces. This is because the top and bottom outside surfaces of the pack are not used. (See Figure 3-11.)

For a summary of the different types of hard disks, see Figure 3-12.

Type	Description
Internal	Fast access to applications, fixed
Cartridge	Complement to internal hard disk, removable
Disk pack	Massive storage capacity, removable

Figure 3–12 Types of hard disks

PERFORMANCE ENHANCEMENTS

Three ways to improve the performance of hard disks are disk caching, redundant arrays of inexpensive disks, and file compression/decompression.

Disk caching improves hard-disk performance by anticipating data needs. It performs a function similar to RAM caching discussed in Chapter 4. While RAM caching improves processing by acting as a temporary high-speed holding area between memory and the CPU, disk caching improves processing by acting as a temporary high-speed holding area between a secondary storage device and the CPU. Disk caching requires a comb ination of hardware and software. During idle processing time, frequently used data is read from the hard disk into memory (cache). When needed, the data is then accessed directly from memory. The transfer rate from memory is much faster than from the hard disk. As a result, overall system performance is often increased by as much as 30 percent.

Redundant arrays of inexpensive disks (RAID) improve performance by expanding external storage, improving access speed, and providing reliable storage. Several inexpensive hard-disk drives are connected to one another.

Figure 3-13 RAID storage device

These connections can be used by a network or within specialized RAID devices. (See Figure 3-13.) Using special software, the connected hard-disk drives are related or grouped together, and the computer system interacts with the RAID system as though it were a single large capacity hard disk drive. Files written to a RAID system are saved using more than one hard disk and are automatically duplicated. The result is expanded storage capability, fast access speed, and high reliability. For these reasons RAID is often used by Internet servers and large organizations.

File compression and **file decompression** increase storage capacity by reducing the amount of space required to store data and programs. File compression is not limited to hard-disk systems. It is frequently used to compress files on floppy disks as well. File compression also helps to speed up transmission of files from one computer system to another. Sending and receiving compressed Files across the Internet is a common activity.

File compression programs scan files for ways to reduce the amount of required storage. One way is to search for repeating patterns. The repeating patterns are replaced with a token, leaving enough tokens so that the original can be rebuilt or decompressed. These programs often shrink files to a quarter of their original size. To learn more about file compression, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions.

You can compress and decompress files using specialized utilities such as WinZip from Nico Mak Computing and PKZip from PKWare. Or, if these specialized utilities are not available, you can use utility programs in Windows XP.

For a summary of performance enhancement techniques, see Figure 3-14.

Technique	Description
Disk caching	Uses cache and anticipates date needs
RAID	Linked, inexpensive harddisk drives
File compression	Reduces file size
File decompression	Expands compressed files

Figure 3-14 Performance enhancement techniques

TIPS

Are you running short of hard-disk storage space? Want to send a large file or several files at once over the Internet? You can save both space and valuable connection time by compressing the files first. Compression/decompression utility programs are available in Windows XP. If you don't have Windows XP, consider using WinZip, a popular compression program.

1. **Start.** Start the WinZip program.
2. **Create file.** Click the New button on the toolbar to create and name a zip file.
3. **Select.** Locate and select the file(s) you want to compress.
4. **Compress.** Click the Add button and add the selected file(s) to the zip file.

You can now replace the selected files with the zip file. To access the original files at any time, start WinZip, select the file(s) to decompress and click the Extract button.

CONCEPT CHECK

- Compare floppy and hard disks. What is a head crash?
- What are the three types of hard disks? Briefly describe each.
- List and describe three ways to improve the performance of hard disks.

OPTICAL DISKS

Optical disks use laser technology to provide high capacity storage. Basic CDs include read only, write once, rewriteable, Picture CD, and Photo CD. DVDs are replacing CDs. Basic DVDs include read only, write once, and rewriteable.

Today's **optical disks** can hold over 17 gigabytes of data. (See Figure 3-15.) That is the equivalent of over several million typewritten pages or a medium-sized library all on a single disk. Optical disks are having a great impact on storage today, but we are probably only beginning to see their effects.

Figure 3–15 Optical disk

In optical-disk technology a laser beam alters the surface of a plastic or metallic disk to represent data. Unlike floppy and hard disks, which use magnetic charges to represent is and 0s, optical disks use reflected light. The 1s and 0s are represented by flat areas called **lands** and bumpy areas called **pits** on the disk surface. The disk is read by an **optical disk drive** using a laser that projects a tiny beam of light on these areas. The amount of reflected light determines whether the area represents a 1 or a 0. To see how an optical disk drive works, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations.

Like floppy and hard disks, optical disks use tracks and sectors to organize and store files. Unlike the concentric tracks and wedge-shaped sectors used for floppy and hard disks, however, optical disks typically use a single track that spirals toward the center of the disk. This single track is divided into equally sized sectors.

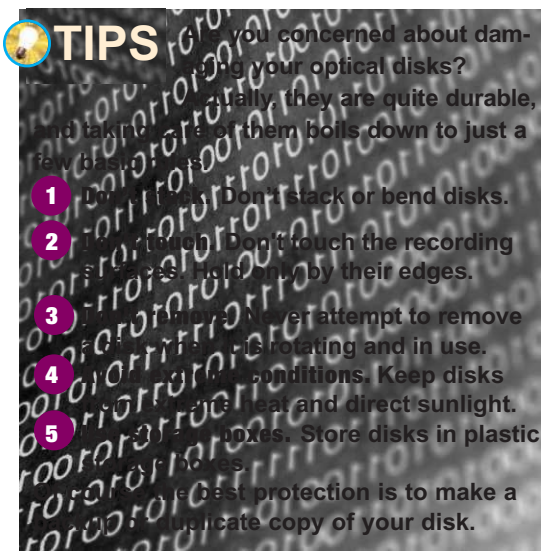
Optical disks come in many different sizes, including 3½, 4¾ 5¼, 8, 12, and 14 inches. The most common size is 4¾ inches. These disks are typically stored in clear protective boxes called **jewel boxes.** Data is stored on these disks in different ways or different formats. The two most common are CD and DVD.

COMPACT DISC

Compact disc, or as it is better known, **CD,** is one of the most widely used optical formats. CD drives are standard on many microcomputer systems. Typically, CD drives can store from 650 MB (megabytes) to 1 GB (gigabyte) of data on one side of a CD. One important characteristic of CD drives is their **rotational speed.** This speed is important because it determines how fast data can be transferred from the CD. For example, a 24X or 24-speed CD drive can transfer 3.6 MB per second, while a 48X drive can transfer 7.2 MB per second. The faster the drive, the faster data can be read from the CD and used by the computer system.

There are four basic types of CDs: read only, write once, rewritable, and Picture and Photo CDs:

- **Read only-CD-ROM,** which stands for ***compact disc-read only memory,*** is similar to a commercial music CD. *Read only* means it cannot be written on or erased by the user. Thus, you as a user have access only to the data imprinted by the publisher. CD-ROMs are used to distribute large databases and references. They are also used to distribute large software application packages.



- **Write once-CD—R,** which stands for **CD-recordable,** can be written to once. After that they can be read many times without deterioration but cannot be written on or erased. CD-R drives, also known as **CD burners,** are often used to archive data and to record music downloaded from the Internet. To learn about how music is downloaded from the Internet, consult your Computing Essentials CD or visit our Web site at www. olearyseries.com and select Animations. To learn more about the specifics of finding music on the Internet, creating custom CDs, and up loading to a portable player, see Making IT Work for You: Music from the Internet on pages 3-13 and 3-14.
- **Rewriteable—CD-RW** stands for **compact disc rewriteable.** Also known as **erasable optical disks,** these disks are very similar to CD-Rs except that the disk surface is not permanently altered when data is recorded. Because they can be changed, CD-RWs are often used to create and edit multimedia presentations. One limitation of CD-R and CD-RW disks is that older CD-ROM drives may not be able to read them. Most newer CD-ROM drives are **multiread** or able to read both CD-R and CD-RW disks.
- **Picture CDs** and **Photo CDs** use a special format developed by Eastman Kodak to store digital images. Picture CDs are less expensive and typically are used by non-professionals. Today, most film developers provide traditional printed pictures and digital images. The digital images are delivered by the Internet or by Picture CD. These disks are typically **single-session,** meaning that all images must be transferred at one time to the CD. Photo CDs, however, are **multisession,** meaning that new images can be added at any time.

DIGITAL VERSATILE DISC

DVD stands for **digital versatile disc** or **digital video disc.** This is a newer format that is rapidly replacing CDs as the standard optical disk. DVD drives are very similar to CDs except that more data can be packed into the same amount of space. DVD discs can store 4.7 GB to 17 GB on a single DVD disk—17 times the capacity of CDs.

Today's more powerful microcomputer systems come with DVD drives. There are three basic types of DVDs similar to CDs: read only, write once, and rewriteable.

- **Read only—DVD—ROM** stands for **digital versatile disc-read only memory** DVD-ROM drives are also known as **DVD players.** DVD-ROMs are having a major impact on the video market. While CD-ROMs are effective for distributing music, they can only contain just over an hour of fair- quality video. DVD-ROMs can provide over two hours of very high-quality video and sound comparable to that found in motion picture theatres. The motion picture industry has rapidly shifted video distribution from video cassettes to DVD-ROMs.
- **Write once—DVD+R and DVD-R** are two competing write once formats. Both stand for **DVD recordable.** Each has a slightly different way in which they format their disks. Fortunately, most new DVD players can use either format. These drives are typically used to create permanent archives for large amounts of data and to record videos. DVD recordable drives are rapidly replacing CD-R drives due to their massive capacity.
- **Rewriteable—DVD+RW, DVD-RW,** and **DVD-RAM** are the three most widely used formats. DVD+RW and DVD-RW stand for **DVD rewriteable**. **DVD-RAM** stands for **DVD random-access memory.** Each format has a unique way of storing data. Unfortunately, older DVD players typically can only read one type of format. Newer DVD players, however, are able to read and to use any of the formats. Rewriteable DVD disc drives have rapidly replace CD rewriteable drives. Applications range from recording video from camcorders to developing large multimedia presentations that include extensive graphics and video. For a summary of optical disk storage capacities, see Figure 3-16.

Format	Typical Capacity	Type	Description
CD	650 MB to 1 GB	CD-ROM	Read only, used to distribute databases, reference books, and software
		CD-R	Write one time only, used to archive large amounts of data
		CD-RW	Rewriteable, used to create and edit large multimedia presentations
		Picture CD	Single-session CD, used to store images
		Photo CD	Multisession CD, used to store images
DVD	4.7 GB to 17 GB	DVD-ROM	Read only, distribute theater-quality video and sound presentations
		DVD-R and DVD+R	Written-to one time only, used to archive very large amounts of data
		DVD-RW, DVD+RW and DVD-RAM	Rewriteable, able to create and read CD disks, used to create and edit large-scale multimedia presentations

Figure 3–16 Types of optical disks

CONCEPT CHECK

- How is data represented on optical disks?
- Compare CD and DVD formats. Why are DVDs replacing CDs?
- What are DVD-RW, DVD+RW, and DVD-RAM?

OTHER TYPES OF SECONDARY STORAGE

Solid-state storage does not have moving parts. Internet drives use the Internet to store data and information. Magnetic tape provides sequential access for backup.

For the typical microcomputer user, the three basic storage options—floppy disk, hard disk, and optical disk—are complementary, not competing. Almost all microcomputers today have at least one floppy-disk drive, one hard-disk drive, and one optical drive. For many users, these secondary storage devices are further complemented with more specialized storage such as solid state storage, Internet hard drives, and magnetic tape.

SOLID-STATE STORAGE

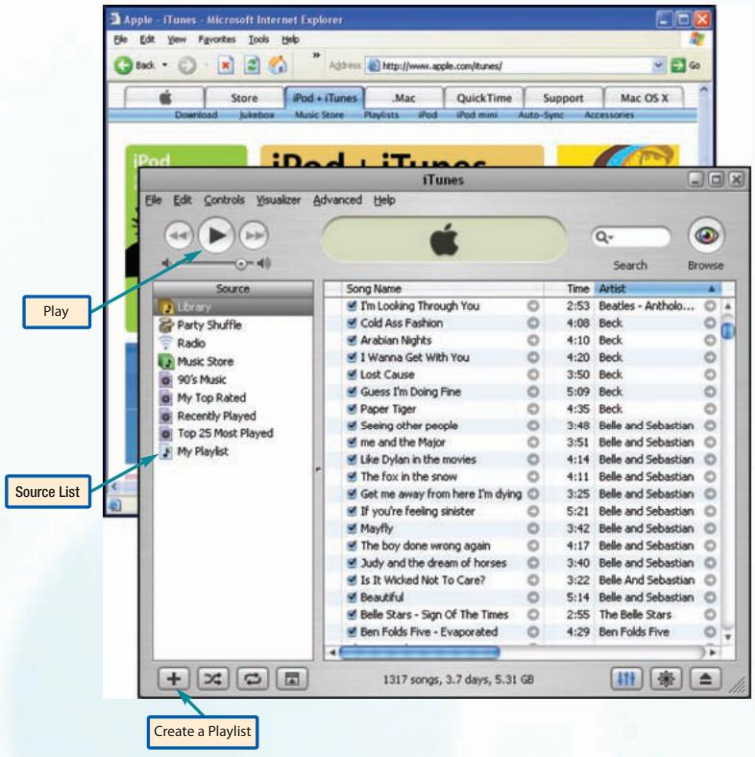
Each of the secondary storage devices discussed thus far has moving parts. For example, hard disks rotate and read/write heads move in and out. Unlike these devices, **solid-state storage** devices have no moving parts. Data and information are stored and retrieved electron cally directly from these devices much as they would be from conventional computer memory. While this type of storage is more expensive than the others, it is more reliable and requires less power.

MUSIC FROM THE INTERNET

Did you know you can use the Internet to locate and play music? You can even create your own compact discs, or transfer music to a portable player. All you need is the right software, hardware, and a connection to the Internet.

Finding Music There are many services on the Internet for finding music.The first step is to download software that connects with a music service. You can use this software to search for songs, create a playlist of songs you will listen to frequently, and play them. For example, to create a playlist using Apple iTunes:

1. **Connect to *www.apple.com* and follow the on-screen instructions for downloading and installing the iTunes software.**
2. **Select *Music Store* from the Source List and follow the on-screen instructions to locate and purchase music files.**
3. **Click the *Create a Playlist* button and enter a name for your playlist.**
4. **Click *Library* in the Source list to view your songs.**
5. **Drag songs you would like to hear to your playlist.**
6. **Select your playlist and click the *Play* button to hear your music.**



Creating a Custom CD If your computer is equipped with a CD-R or CD-RW drive, creating a custom CD is one way to take your favorite tunes with you. To create a CD using iTunes:

1. **Create a playlist as shown in the previous step.**
2. **Select your playlist from the Source list.**
3. **Click the *Burn Disc* button.**
4. **Insert a blank CD into your CD drive.**
5. **Click the *Burn Disc* button once more to create the CD.**

Uploading to a Portable Player

Another popular way to take your favorite tunes with you is to upload them to a portable music player. Portable music players are lightweight digital storage devices that do not require cassettes or discs but that store music files internally. For example, you could transfer music to an iPod portable music player using iTunes software by following the steps below:

1. **Connect your iPod to your computer. iTunes starts automatically and synchronizes with the songs in the iTunes library.**
2. **To transfer individual music files, select them from the Library and drag them to *iPod* in the source list.**

The Web is continually changing, and some of the specifics presented in this Making IT Work for You may have changed. To learn more about other ways to make information technology work for you, visit our Web site at www.olearyseries.com and select Making IT Work for You.

Figure 3-17 Flash memory cards

For these reasons, this technology is becoming widely used for specialized secondary storage.

Flash memory cards, are credit card sized solid-state storage devices widely used in notebook computers. (See Figure 3-17.) Flash memory is also used in a variety of specialized input devices to capture and transfer data to desktop computers. For example, flash memory is used to store images captured from digital cameras and then to transfer the images to desktop and other computers. Flash memory also is used to record MP3 music files and to transfer those files to computers and other devices.

Key chain hard drives have recently been introduced. These devices, also known as **key chain flash memory devices,** are so compact that they can be transported on a key ring or a necklace. (See Figure 3-18.) Key chain hard drives conveniently connect directly to a computer's USB port to transfer files and have typical capacities of 1 GB. Due to their convenient size and large capacities, some predict that key chain hard drive devices may replace the floppy disk for transporting data and information between computers and a variety of specialty devices.

Figure 3-18 Key chain flash memory

INTERNET HARD DRIVES

Special service sites on the Web provide users with storage. This storage is called an **Internet hard drive,** also known as **i-drive** or **online storage.** (See Figure 3-19.)

Advantages of Internet hard drives compared to other types of secondary storage include low cost and the flexibility to access information from any location using the Internet. Because all information must travel across the Internet, however, access speed is slower. Another consideration is that users are dependent on the availability and security procedures of the service site. Because of these limitations, Internet hard drives are typically used as a specialized secondary storage device and not for storing highly personalized or sensitive information.

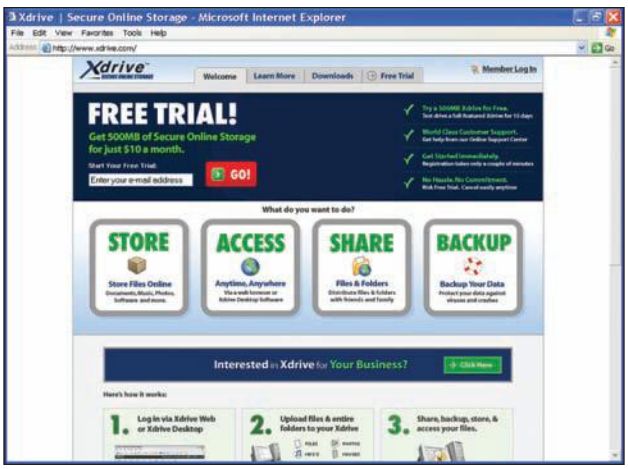


Figure 3-19 An Internet hard drive site

Typically, Internet hard drive sites focus on supplying their services either to businesses or to individuals. The business-oriented sites provide faster access and greater security for a fee. The individual-focused sites provide limited storage for much lower cost and some sites are free. (See Figure 3-20.)

Focus	Company	Location
Individual	Apple	itools.mac.com
Individual	Freedrive	www.freedrive.com
Individual	Yahoo	briefcase.yahoo.com
Business	Amerivault	www.amerivault.com
Business	Connected TLM	connected.com

Figure 3-20 Internet hard drive sites

MAGNETIC TAPE

To find a particular song on an audiotape, you may have to play several inches of tape. Finding a song on an audio compact disc, in contrast, can be much faster. You select the track, and the disc player moves directly to it. That, in brief, represents the two different approaches to external storage. The two approaches are called **sequential access** and **direct access.**

Disks provide fast direct access. Tapes provide slower sequential access. With tape, information is stored in sequence, such as alphabetically. For example, all the grades of students at your school could be recorded on tape arranged alphabetically by their last names. To find the grades for one student, say Chris Reed, the search would begin at the start of the tape and search alphabetically past all the last names beginning with A to Q before ultimately reaching Reed. This may involve searching several inches or feet, which takes time.

Figure 3-21 Magnetic tape cartridge

Like floppy and hard disks, **magnetic tape** stores data and programs by altering the electromagnetic charges on a recording surface. Although slower to access specific information, magnetic tape is an effective and commonly used tool for backing up data. At one time mainframe computers used **magnetic tape reels** exclusively. This type of tape is typically $\frac{1}{2}$-inch wide and $1\frac{1}{2}$-mile long and provides massive storage capacity. Now, most mainframes as well as microcomputers use **tape cartridges** or **magnetic tape streamers** to back up data. (See Figure 3-21.)

CONCEPT CHECK

- What is solid-state storage? What are key chain hard drives?
- What are Internet hard drives? What are they used for?
- Discuss magnetic tape reels and tape cartridges.

MASS STORAGE DEVICES

Mass storage devices are specialized high capacity secondary storage devices. Mass storage devices include file servers, RAID systems, tape libraries, optical juke boxes, and organizational Internet storage.

It is natural to think of secondary storage media and devices as they relate to us as individuals. It may not be as obvious how important these matters are to organizations. **Mass storge refers t**o the tremendous amount of secondary storage required by large organizations. **Mass storage devices** are specialized high capacity secondary storage devices designed to meet organizational demands for data.

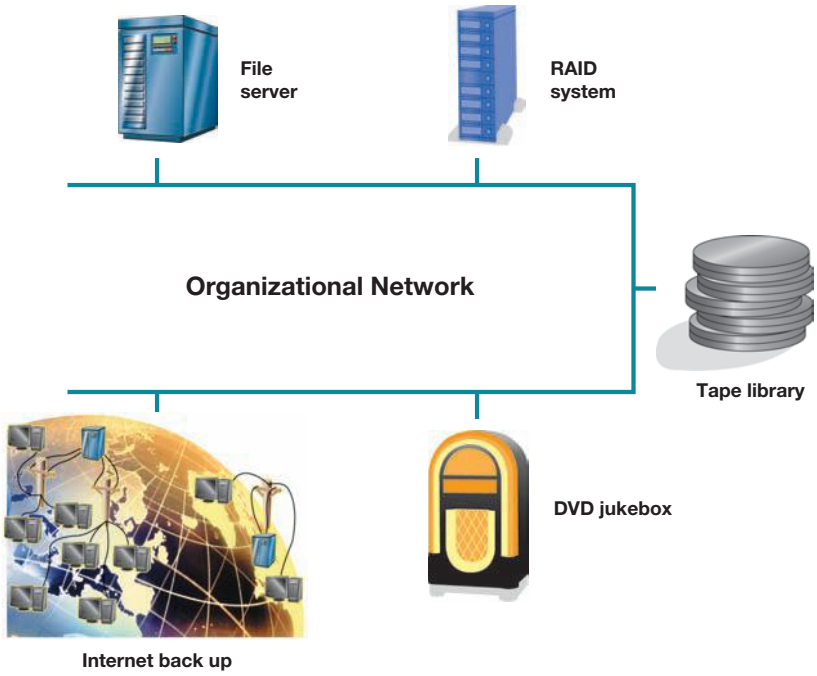


Figure 3-22 Enterprise storage system

Most large organizations have established a strategy called an **enterprise storage system** to promote efficient and safe use of data across the networks within their organizations. (See Figure 3-22.) Some of the mass storage devices that support this strategy are:

- **File servers**—dedicated computers with very large storage capacities that provide users access to fast storage and retrieval of data.
- **RAID systems—**larger version of the specialized devices discussed earlier in this chapter that enhances organizational security by constantly making backup copies of files moving across the organization's networks.
- **Tape library—**device that provides automatic access to data archived on a large collection or library of tapes.
- **DVD-ROM** and **CD-ROM jukeboxes—**provide automatic access to a large collection or library of optical disks.
- **Organizational Internet storage—**high speed Internet connection to a dedicated remote organizational Internet drive site.

The availability, security, and organization of data are essential to the efficient operations of any organization.

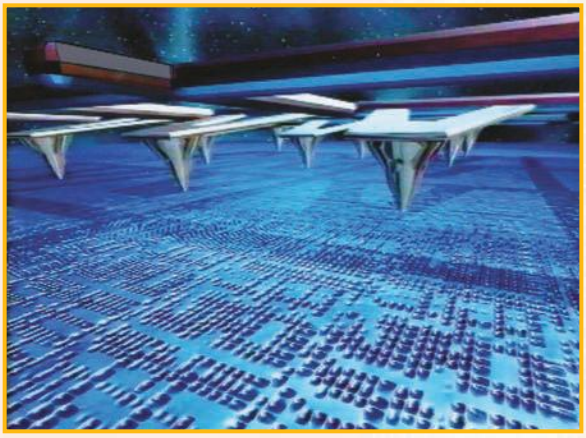
CONCEPT CHECK

- Define mass storage and mass storage devices.
- What is an enterprise storage system?
- List and describe five mass storage devices.

A Look to the Future

Blu-Ray Technology and Plastic Memory Expected to Replace DVD

Have you ever run out of space on a disk? How would you like to store hours of music on one disk? Would you like to record 13 hours of broadcast television or several movies on a single disk? What if you could record an entire library on a single disk? Blu-Ray and plastic memory are emerging storage technologies that promise to do that and much more.



Nine of the largest manufacturers of electronics, including Hitachi, Pioneer, and Sony, have recently agreed to support new optical disk technology that will allow users to record and play back much more information than is currently possible. This new storage is called Blu-Ray, because the new discs use blue laser light instead of the red laser light used in traditional CD players. Blu-Ray discs may ultimately hold over 50 GB on a single disk.

Existing CD and DVD players and recorders, however, will not be able to play or record on the new optical disks. In the near future, new players and recorders will likely incorporate both red and blue laser technology to accommodate both technologies. Manufacturers and media developers hope that cooperation on the Blu-Ray pro ject will help prevent the incompatibility problems that limited the expansion of the DVD in its early development. They hope that this new larger and easy-to-use format will expedite the transition to these new discs.

Further into the future, the next great leap in data storage may be nano devices that store information on plastic sheets. IBM has already successfully tested these memory plastics. Tiny prongs, less than a nanometer (one billionth of a meter) in length, press small dimples onto a plastic sheet. A dimple indicates a zero, no dimple indicates a one. Compared to optical and metallic disks, these plastic sheets have a far greater capacity, are more durable, require less energy to operate, and are unaffected by power surges and magnetic fields.

While Blu-Ray disks are just around the corner, widespread use of memory plastics likely will be years away. What impact do you think these new technologies will have on businesses and individuals? How could these ultra high capacity secondary storage technologies affect you?

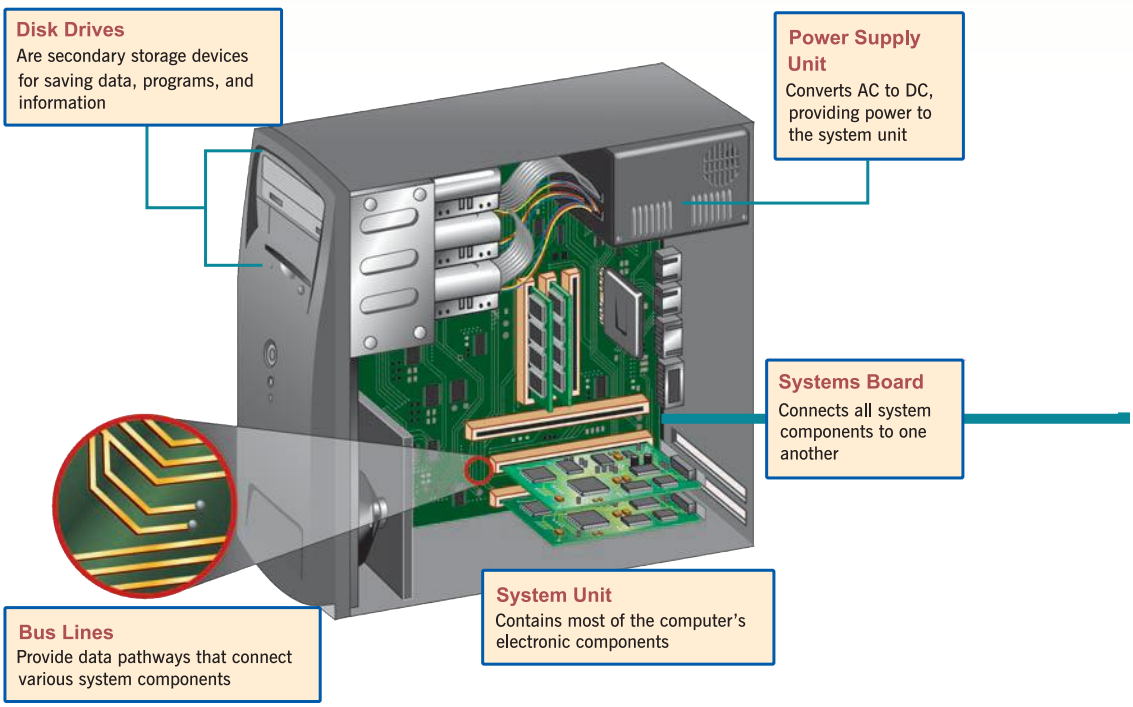
THE SYSTEM UNIT

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Describe the four basic types of system units.**
2. **Discuss how a computer uses binary codes to represent data in electronic form.**
3. **Describe each of the major system unit components.**
4. **Discuss microprocessors, including specialty processors.**
5. **Describe the different types of memory.**
6. **Discuss expansion slots and boards.**
7. **Describe the five principal types of expansion buses.**
8. **Discuss the four standard ports.**

CONTENTS

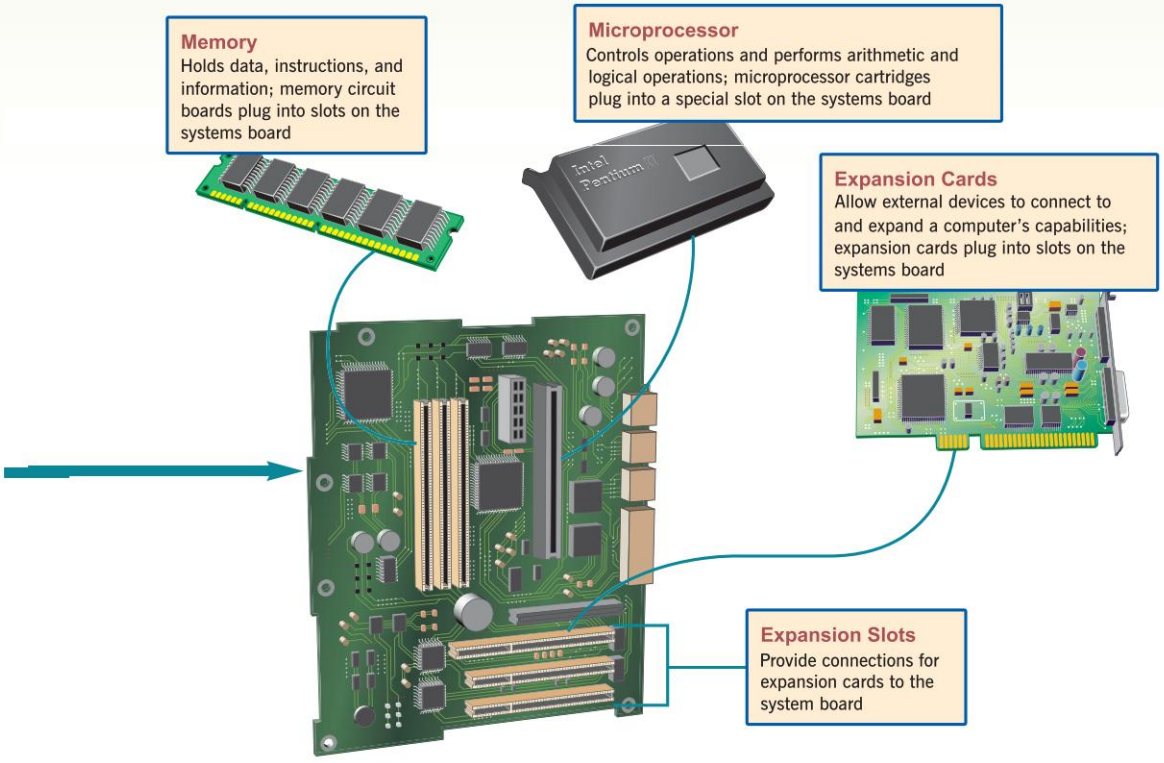


CHAPTER 4

Why are some microcomputers more powerful than others? The answer lies in three words: speed, capacity, and flexibility. After reading this chapter, you will be able to judge how fast, powerful, and versatile a particular microcomputer is. As you might expect, this knowledge is valuable if you are planning to buy a new microcomputer system or to upgrade an existing system. (The Buyer's Guide and the Upgrader's Guide at the end of this book provide additional information.) It will also help you to evaluate whether or not an existing microcomputer system is powerful enough for today's new and exciting applications. For example, with the right hardware, you can use your computer to watch TV while you work and to capture video clips for class presentations.

Sometime you may get the chance to watch when a technician opens up a microcomputer. You will see that it is basically a collection of electronic circuitry. While there is no need to understand how all these components work, it is important to understand the principles. Once you do, you will be able to determine how powerful a particular microcomputer is. This will help you judge whether it can run particular kinds of programs and can meet your needs as a user.

Competent end users need to understand the functionality of the basic components in the system unit, including the system board, microprocessor, memory, system clock, expansion slots and cards, bus lines, ports, cables, and power supply units.



SYSTEM UNIT

System components are housed within the system unit or system cabinet. Desktop, notebook, tablet PC, and handheld are four types of system units.

The **system unit**, also known as the **system cabinet** or **chassis,** is a container that houses most of the electronic components that make up a computer system. All computer systems have a system unit. For microcomputers, there are four basic types (see Figure 4-1):

- **Desktop system units** typically contain the system's electronic components and selected secondary storage devices. Input and output devices, such as a mouse, keyboard, and monitor, are located outside the system unit. This type of system unit is designed to be placed either horizontally or vertically. Vertical units are often called **tower models.**
- **Notebook system units** are portable and much smaller. These system units contain the electronic components, selected secondary storage devices, and input devices (keyboard and pointing device). Located outside the system unit, the monitor is attached by hinges. Notebook system units are often called **laptops.**

Desktop (tower model)

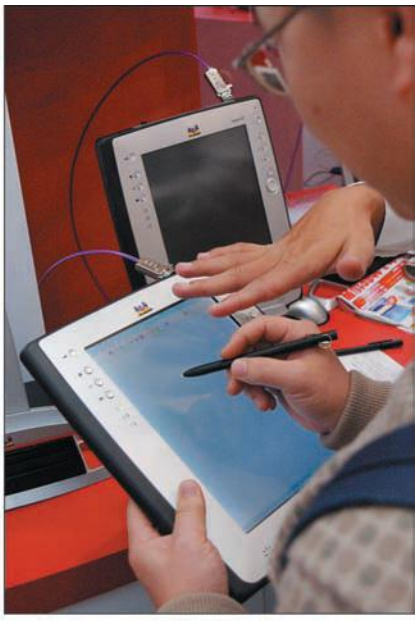
PDA

Notebook

Tablet PC

Figure 4–1 Basic types of system units

Convertible tablet PC



Slate

Figure 4–2 Tablet PCs

- **Tablet PC system units** are similar to notebook system units. **Tablet PCs** are highly portable devices that support the use of a stylus or pen to input commands and data. There are two basic categories: convertible and slate. The **convertible tablet PC** is effectively a notebook computer with a monitor that swivels and folds onto its keyboard. The **slate tablet PC** is similar to a notebook computer except that its monitor is attached to the system unit and does not have a keyboard integrated into the system unit. (See Figure 4-2.)
- **Handheld computer system units** are the smallest and are designed to fit into the palm of one hand. Also known as **palm computers,** these systems contain an entire computer system, including the electronic components, secondary storage, and input and output devices. **Personal digital assistants (PDAs)** are the most widely used handheld computers.

While the actual size may vary, each type of system unit has the same basic system components including system board, microprocessor, and memory. Before considering these components, however, a more basic issue must be addressed. How do we as human beings communicate with and control all this electronic circuitry?

CONCEPT CHECK

- What is the system unit?
- Describe the four basic types of microcomputer system units.
- What is a tablet PC? Describe the two basic categories.

ELECTRONIC DATA AND INSTRUCTIONS

Data and instructions are represented electronically with a binary, or two-state, numbering system. ASCII, EBCDIC, and Unicode are binary coding schemes.

Have you ever wondered why it is said that we live in a *digital world*? (See Figure 4-3.) It's because computers cannot recognize information the same way you and I can. People follow instructions and process data using letters, numbers, and special characters. For example, if we wanted someone to add the numbers 3 and 5 together and record the answer, we might say "please add 3 and 5." The system unit, however, is electronic circuitry and cannot directly process such a request.

Figure 4–3 The digital world. Data and information in digital form can be processed and sent almost anywhere in the world in seconds.

Our voices create **analog,** or continuous signals, that vary to represent different tones, pitches, and volume. Computers, however, can recognize only **digital** electronic signals. Before any processing can occur within the system unit, a conversion must occur from what we understand to what the system unit can electronically process.

What is the most fundamental statement you can make about electricity? It is simply this: It can be either on or off. Indeed, there are many forms of technology that can make use of this **two-state** on/off, yes/no, present/absent arrangement. For instance a light switch may be on or off, or an electric circuit open or closed. A specific location on a tape or disk may have a positive charge or a negative charge. This is the reason, then, that a two-state or binary system is used to represent data and instructions.

Code	Uses
ASCII	Microcomputers
EBCDIC	Large computers
Unicode	International languages

Figure 4–4 Binary codes

The decimal system that we are all familiar with has 10 digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9). The **binary system,** however, consists of only two digits—0 and 1. Each 0 or 1 is called a **bit**—short for binary digit. In the system unit, the 0 can be represented by electricity being off, and the 1 by electricity being on. In order to represent numbers, letters, and special characters, bits are combined into groups of eight called **bytes.** Each byte typically represents one character.

BINARY CODING SCHEMES

Now let us consider an important question. How are characters represented as 0s and 1s ("off" and "on" electrical states) in the computer? The answer is in the use of **binary coding schemes.** (See Figure 4-4.) Two of the most popular binary coding schemes use eight bits or one byte. These two codes are ASCII and EBCDIC. (See Figure 4-5.) A recently developed code, unicode, uses sixteen bits.

- **ASCII,** pronounced "as-key," stands for **A**merican **S**tandard **C**ode for **I**nformation **I**nterchange. This is the most widely used binary code for microcomputers. For example, the number 3 is represented in ASCII code as 0011 0011.
- **EBCDIC,** pronounced "eb-see-dick," stands for **E**xtended **B**inary **C**oded **D**ecimal **I**nterchange **C**ode. It was developed by IBM and is used primarily for large computers. For example, the number 3 is represented in EBCDIC code as 1110011.

Symbol	ASCII	EBCDIC	Symbol	ASCII	EBCDIC
A	0100 0001	1100 0001	X	0101 1000	1110 0111
B	0100 0010	1100 0010	Y	0101 1001	1110 1000
C	0100 0011	1100 0011	Z	0101 1010	1110 1001
D	0100 0100	1100 0100	!	0010 0001	0101 1010
E	0100 0101	1100 0101	"	0010 0010	0111 1111
F	0100 0110	1100 0110	#	0010 0011	0111 1011
G	0100 0111	1100 0111	$	0010 0100	0101 1011
H	0100 1000	1100 1000	%	0010 0101	0110 1100
I	0100 1001	1100 1001	&	0010 0110	0101 0000
J	0100 1010	1101 0001	(	0010 1000	0100 1101
K	0100 1011	1101 0010	)	0010 1001	0101 1101
L	0100 1100	1101 0011	*	0010 1010	0101 1100
M	0100 1101	1101 0100	+	0010 1011	0100 1110
N	0100 1110	1101 0101	0	0011 0000	1111 0000
O	0100 1111	1101 0110	1	0011 0001	1111 0001
P	0101 0000	1101 0111	2	0011 0010	1111 0010
Q	0101 0001	1101 1000	3	0011 0011	1111 0011
R	0101 0010	1101 1001	4	0011 0100	1111 0100
S	0101 0011	1110 0010	5	0011 0101	1111 0101
T	0101 0100	1110 0011	6	0011 0110	1111 0110
U	0101 0101	1110 0100	7	0011 0111	1111 0111
V	0101 0110	1110 0101	8	0011 1000	1111 1000
W	0101 0111	1110 0110	9	0011 1001	1111 1001

ASCII code for +

ASCII code for 3

ASCII code for 5

Figure 4–5 ASCII and EBCDIC binary coding schemes

- **Unicode** is a 16-bit code designed to support international languages like Chinese and Japanese. These languages have too many characters to be represented by the eight-bit ASCII and EBCDIC codes.

When you press a key on the keyboard, a character is automatically converted into a series of electronic pulses that the system can recognize. For example, pressing the number 3 on a keyboard causes an electronic signal to be sent to the microcomputer's system unit where it is converted to the ASCII code of 0011 0011.

Coding schemes are particularly important to computer specialists for tracking down errors and other types of problems. But why are coding schemes important to end users? There are several reasons. One of the most important is that data created by one computer system using one coding scheme cannot be directly accessed and used by another computer system using a different coding scheme. Generally, this is not a problem if both computers are microcomputers since both would most likely use ASCII code. And most microcomputer applications store data using this code. However, problems occur when data is shared between microcomputers and larger computers that use EBCDIC code. The data must be translated from one coding scheme to the other before processing can begin. Fortunately, special conversion programs are available to help with this translation.

CONCEPT CHECK

- What are decimal and binary systems? How are they different?
- What are binary coding schemes? Name and describe three.
- Describe how ASCII code is used to represent numbers and letters.

SYSTEM BOARD

The system board connects all system components and allows input and output devices to communicate with the system unit. Sockets, slots, and bus lines are components of the system board.

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The **system board** is also known as the **main board** or **motherboard.** The system board is the communications medium for the entire computer system. Every component of the system unit connects to the system board. It acts as a data path allowing the various components to communicate with one another. External devices such as the keyboard, mouse, and monitor could not communicate with the system unit without the system board.

On a desktop computer, the system board is located at the bottom of the systems unit or along one side. (See Figure 4-6.) It is a large flat circuit board covered with a variety of different electronic components including sockets, slots, and bus lines. (See Figure 4-6.)

- **Sockets** provide a connection point for small specialized electronic parts called chips. **Chips** consist of tiny circuit boards etched onto squares of sandlike material called silicon. These circuit boards can be smaller than the tip of your finger. (See Figure 4-7.) A chip is also called a **silicon chip, semiconductor,** or **integrated circuit.** Chips are mounted on **carrier packages.** (See Figure 4-8.) These packages either plug directly into sockets on the system board or onto cards that are then plugged into slots on the system board. Sockets are used to connect the system board to a variety of different types of chips, including microprocessor and memory chips.
- **Slots** provide a connection point for specialized cards or circuit boards. These cards provide expansion capability for a computer system. For example, a modem card plugs into a slot on the system board to provide a connection to the Internet.
- Connecting lines called **bus lines** provide pathways that support communication among the various electronic components that are either located on the system board or attached to the system board. (See Figure 4-9.)

Notebook, tablet PC, and handheld system boards are smaller than desktop system boards. However, they perform the same functions as desktop system boards.

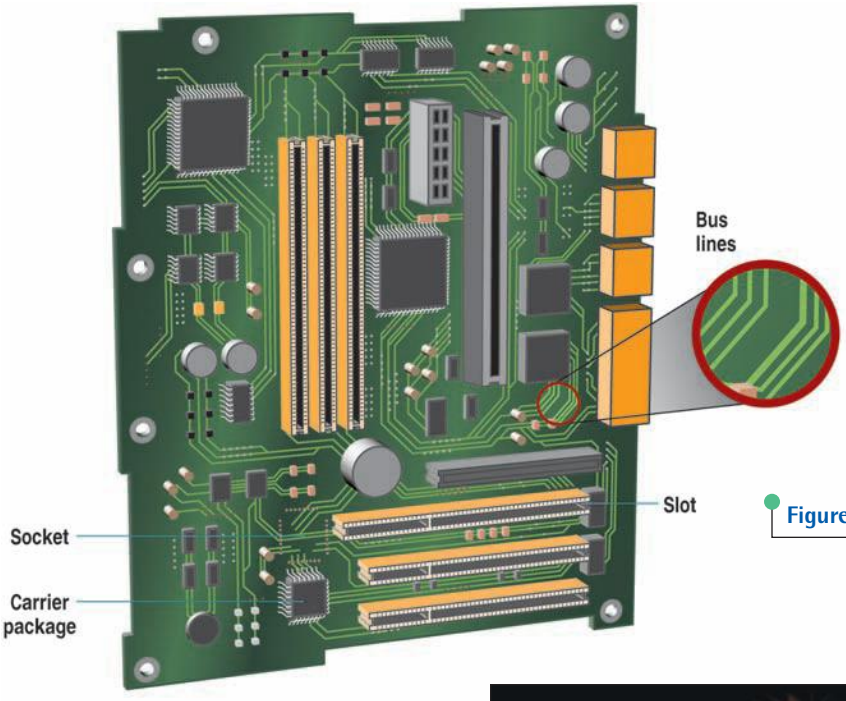


Figure 4-6 System board

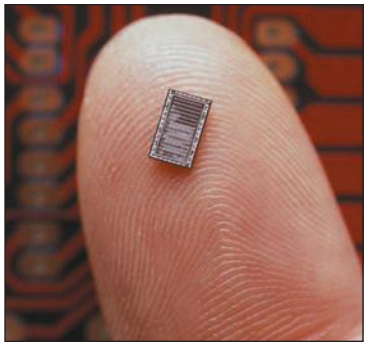


Figure 4-7 Chip

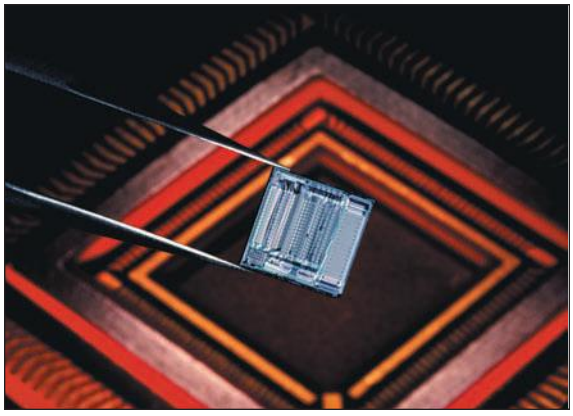


Figure 4-8 Chip being mounted onto a carrier package

CONCEPT CHECK

- What is the system board and what does it do?
- Define and describe sockets, slots, and bus lines.
- What are chips? How are chips attached to the system board?

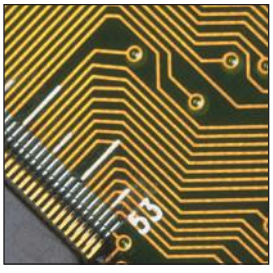


Figure 4-9 Bus lines

MICROPROCESSOR

Microprocessors have two components–control and arithmetic–logic units. RISC and CISC are types of microprocessor chips. Coprocessors, parallel processors, and smart cards are specialty processors.

In a microcomputer system, the **central processing unit (CPU)** or **processor** is contained on a single chip called the **microprocessor.** The microprocessor is either mounted onto a carrier package that plugs into the system board or contained within a cartridge that plugs in to a special slot on the system board. (See Figure 4-10.) The microprocessor is the "brains" of the computer system. It has two basic components: the control unit and the arithmetic-logic unit.

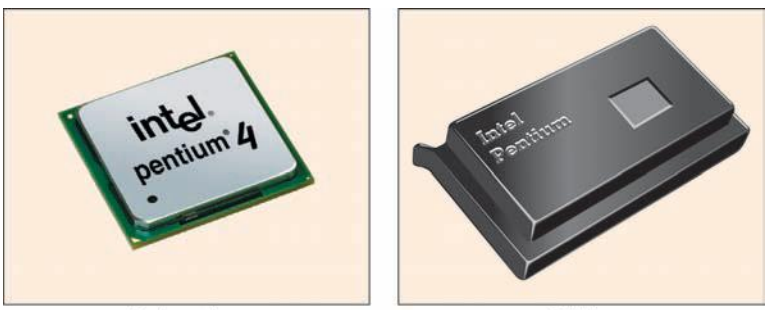
- **Control unit:** The **control unit** tells the rest of the computer system how to carry out a program's instructions. It directs the movement of electronic signals between memory, which temporarily holds data, instructions, and processed information, and the arithmetic-logic unit. It also directs these control signals between the CPU and input and output devices.
- **Arithmetic-logic unit:** The **arithmetic-logic unit,** usually called the **ALU,** performs two types of operations—arithmetic and logical. **Arithmetic operations** are, as you might expect, the fundamental math operations: addition, subtraction, multiplication, and division. **Logical operations** consist of comparisons. That is, two pieces of data are compared to see whether one is equal to (=), less than (<), or greater than (>) the other.

MICROPROCESSOR CHIPS

Chip capacities are often expressed in word sizes. A **word** is the number of bits (such as 16, 32, or 64) that can be accessed at one time by the CPU. The more bits in a word, the more powerful—and the faster—the computer is. As mentioned previously, eight bits group together to form a byte. A 32-bit-word computer can access 4 bytes at a time. A 64-bit-word computer can access 8 bytes at a time. Therefore, the computer designed to process 64-bit-words is faster.

Older microcomputers typically process data and instructions in millionths of a second, or **microseconds.** Newer microcomputers are much faster and process data and instructions in billionths of a second, or **nanoseconds.** Supercomputers, by contrast, operate at speeds measured in **picoseconds**—1,000 times as fast as microcomputers. (See Figure 4-11.)

Figure 4–10 Microprocessor carrier package and cartridge



Carrier package Cartridge

There are two types of microprocessor chips.

- **CISC chips:** The most common type of microprocessor is the **complex instruction set computer (CISC) chip.** This design was popularized by Intel and is the basis for its line of microprocessors. It is the most widely used chip design with thousands of programs written specifically for it. Intel's Pentium microprocessors are CISC chips. While Intel is the leading manufacturer of microprocessors, other manufacturers produce microprocessors using a nearly identical design. These chips, referred to as **Intel-compatible** processors, are able to process programs originally written specifically for Intel chips. For example, AMD Corporation produces Intel-compatible chips known as Athlon and Hammer.
- **RISC chips: Reduced instruction set computer (RISC) chips** use fewer instructions. This design is simpler and less costly than CISC chips. The PowerPC is a RISC chip produced by Motorola. SPARC is a RISC chip produced by Sun. These chips are used in many of today's most powerful microcomputers known as **workstations**.

See Figure 4-12 for a table of popular microprocessors.

Unit	Speed
Microsecond	Millionth of a second
Nanosecond	Billionth of a second
Picosecond	Trillionth of a second

Figure 4–11 Processing speeds

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RISC and [illegible] some of today's most [illegible] computers. To learn [illegible] one of the manufacturers of RISC chips, visit our Web site at www.clearyseries.com and select On the Web Explorations.

SPECIALTY PROCESSORS

In addition to microprocessor chips, a variety of more specialized processing chips have been developed. One of the most common is coprocessors. **Coprocessors** are specialty chips designed to improve specific computing operations. One of the most widely used is the **graphics coprocessor.** These processors are specifically designed to handle the processing requirements related to displaying and manipulating 2-D and 3-D graphics images.

Another specialty processor is the **parallel processor**. These processors work with one or more other parallel processor chips to run or process large programs. The processors use special software that takes a large program, breaks it down into parts, and assigns the parts to separate processors. The processors then work on their respective parts simultaneously and share results as required by the program. This approach is called **parallel processing**. Although not commonly used with microcomputers, parallel processing is commonly used by supercomputers to run very large and complex programs.

Smart cards use another type of specialty processor. A **smart card** is essentially a plastic card the size of a regular credit card that has an embedded chip. While most current smart cards can store 80 times the information stored on the magnetic strip of a regular credit card, larger capacity cards are expected soon. Visa, MasterCard, and American Express have introduced their smart cards to millions of users. (See Figure 4-13.)

Manufacturer	Processor	Type	Typical Use
Intel	Pentium	CISC	Microcomputers
AMD	Athlon	CISC	Microcomputers
	Hammer	CISC	Workstations
Motorola	PowerPC	RISC	Apple computers
Sun	SPARC	RISC	Workstations

Figure 4–12 Popular microprocessors

Figure 4–13 Smart card

Many colleges and universities are distributing smart cards to their students for identification. The University of Michigan, for example, provides its students with a smart card called the Mcard that allows them to access their dorms and use their meal plans.

CONCEPT CHECK

- Name and describe the two components of a microprocessor.
- Name and describe the two types of microprocessor chips.
- What are specialty chips? Name and discuss two types of specialty processors.

MEMORY

Memory holds data, instructions, and information. RAM, ROM, and CMOS are three types of memory chips.

Memory is a holding area for data, instructions, and information. Like microprocessors, **memory** is contained on chips connected to the system board. There are three well-known types of memory chips: random-access memory (RAM), read-only memory (ROM), and complementary metal-oxide semiconductor (CMOS).

RAM

Random-access memory (RAM) chips hold the program (sequence of instructions) and data that the CPU is presently processing. (See Figure 4-14.) RAM is called temporary or **volatile storage** because everything in most types of RAM is lost as soon as the microcomputer is turned off. It is also lost if there is a power failure or other disruption of the electric current going to the microcomputer. Secondary storage, which we described in Chapter 3, does not lose its contents. It is permanent or **nonvolatile storage,** such as the data stored on diskettes. For this reason, as we mentioned earlier, it is a good idea to save your work in progress to a secondary storage device. That is, if you are working on a document or a spreadsheet, every few minutes you should save, or store, the material.

Figure 4–14 RAM chips mounted on circuit board

Cache (pronounced "cash") **memory** or **RAM cache** improves processing by acting as a temporary high-speed holding area between the memory and the CPU. In a computer with a cache (not all machines have one), the computer detects which information in RAM is most frequently used. It then copies that information into the cache. When needed, the CPU can quickly access the information from the cache.

Flash RAM or **flash memory** chips can retain data even if power is disrupted. This type of RAM is the most expensive and used primarily for special applications such as for digital cell telephones, digital video cameras, and portable computers.

Having enough RAM is important! For example, to effectively use Excel requires 32 MB of RAM and additional RAM is needed to hold any data or other applications. Some microcomputers—particularly

older ones—do not have this much memory. Additional RAM, however, can be added to these computer systems. The capacity or amount of RAM is expressed in bytes. There are three commonly used units of measurement to describe memory capacity. (See Figure 4-15.)

Unit	Capacity
Megabyte (MB)	1 million bytes
Gigabyte (GB)	1 billion bytes
Terabyte (TB)	1 trillion bytes

Figure 4–15 Memory capacity

Other types of RAM include DRAM, DDR, SDRAM, and Direct RDRAM. To learn more about these other types of RAM, consult your Computing Essentials CD or visit us on the Web at www.olearyseries.com and select Expansions.

Even if your computer does not have enough RAM to hold a program, it might be able to run the program using **virtual memory.** Most of today's operating systems support virtual memory. With virtual memory, large programs are divided into parts and the parts are stored on a secondary device, usually a hard disk. Each part is then read into RAM only when needed. In this way, computer systems are able to run very large programs. To learn more about how virtual memory works, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions.

ROM

Read-only memory (ROM) chips have programs built into them at the factory. Unlike RAM chips, ROM chips are not volatile and cannot be changed by the user. "Read only" means that the CPU can read, or retrieve, data and programs written on the ROM chip. However, the computer cannot write—encode or change—the information or instructions in ROM.

ROM chips typically contain special instructions for detailed computer operations. For example, ROM instructions are needed to start a computer, give keyboard keys their special control capabilities, and put characters on the screen. ROMs are also called **firmware.**

Type	Use
RAM	Programs and data
ROM	Fixed start-up instructions
CMOS	Flexible start-up instructions

Figure 4–16 Memory

CMOS

A **complementary metal-oxide semiconductor (CMOS)** chip provides flexibility and expandability for a computer system. It contains essential information that is required every time the computer system is turned on. The chip supplies such information as the current date and time, amount of RAM, type of keyboard, mouse, monitor, and disk drives. RAM Unlike RAM, it is powered by a battery and does not lose its contents when the power is turned off. Unlike ROM, its contents can be ROM changed to reflect changes in the computer system such as increased RAM and new hardware devices.

See Figure 4-16 for a summary of the three types of memory.

CONCEPT CHECK

- What is memory? Name and describe the three types of memory chips.
- Define cache memory, flash RAM, and virtual memory.

SYSTEM CLOCK

The system clock is like a bass drum. Clock speed is measured in gigahertz or billions of beats per second.

The **system clock** is located on a small specialized chip that produces precisely timed electrical beats or impulses. The system clock performs a function similar to the bass drum in a marching band. Just as the bass drum determines the cadence, or how fast the band marches, the system clock emits a beat or pulse that sets the operating pace for all of the components in the system unit.

Unlike a bass drum, which can beat faster to increase cadence, a computer's system clock has a fixed speed that cannot be varied. For that reason, a computer system's clock speed is an important measurement indicating the speed of processing or power of a computer system. The **clock speed** or **clock rate** for powerful microcomputers is measured in **gigahertz (GHz)** or billions of beats per second. The faster the clock speed, the faster the computer can process instructions.

CONCEPT CHECK

- What is a system clock? How is it like a bass drum?
- What is clock speed? How is it measured?

TIPS

Does your computer seem to be getting slower and slower? Perhaps it's so slow you are thinking about buying a new one. Before doing that, consider the following suggestions that might add a little zip to your current system.

1. **Uninstall programs you no longer need.** Examine the contents of your hard disk and identify programs that you no longer need. If you have Windows XP, use Start/Control Panel/Add/Remove Programs (for Windows 2000 use Start/Settings/Control Panel/Add/Remove Programs) to access the Uninstall feature.
2. **Remove unneeded fonts.** If you have Windows XP, use Start/Control Panel/Fonts in the classic view (for Windows 2000 use Start/Settings/Control Panel/Fonts) to determine the different font types stored on your system. To see a font type, double-click it. Review the fonts and delete those you will not need.
3. **Empty the Recycle Bin.** If you have Windows XP, files are not removed from your hard disk when you delete them. They are moved to the Recycle Bin. To empty or remove files from the Recycle Bin, open the Recycle Bin and use File/Empty Recycle Bin.

EXPANSION SLOTS AND CARDS

Expansion slots provide an open architecture. Expansion cards provide connections for video, network, TV tuner cards, and more. Plug and play is a set of standards. PC cards are for notebook and handheld computers.

Computers are known for having different kinds of "architectures." Machines that have **closed architecture** are manufactured in such a way that users cannot easily add new devices. Most microcomputers have **open architecture.** They allow users to expand their systems by providing **expansion slots** on the system board. Users can insert optional devices known as **expansion cards** into these slots. (See Figure 4-17.)

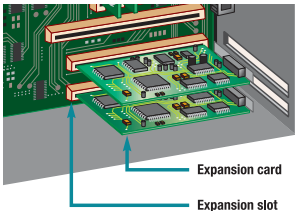


Figure 4–17 Expansion cards fit into slots on the system board

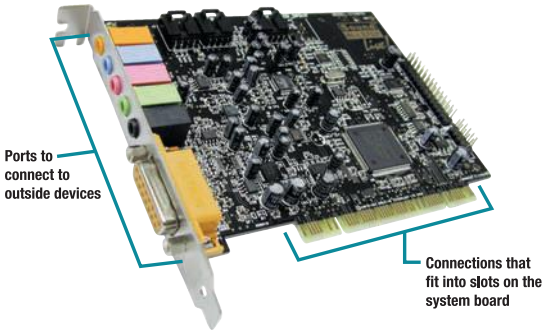


Figure 4–18 Expansion card

Expansion cards are also called **plug-in boards, controller cards, adapter cards,** and **interface cards.** They plug into slots located on the system board. Ports on the cards allow cables to be connected from the expansion cards to devices outside the system unit. (See Figure 4-18.) There are a wide range of different types of expansion cards. Some of the most commonly used expansion cards are:

- **Video cards:** Also known as **graphics cards,** these cards connect the system board to the computer's monitor. The cards convert the internal electronic signals to video signals so they can be displayed on the monitor.
- **Sound cards:** These cards accept audio input from a microphone and convert it into a form that can be processed by the computer. Also, these cards convert internal electronic signals to audio signals so they can be heard from external speakers.
- **Modem cards:** Also known as **internal modems,** these cards allow distant computers to communicate with one another by converting electronic signals from within the system unit into electronic signals that can travel over telephone lines and other types of connections. (See Figure 4-19.)

Figure 4–19 Modem card

- **Network interface cards (NIC):** These cards, also known as **network adapter cards,** are used to connect a computer to one or more other computers. This forms a communication network whereby users can share data, programs, and hardware. The network adapter card typically connects the system unit to a cable that connects to the network.

- **TV tuner cards:** Now you can watch television, capture video, and surf the Internet at the same time. TV tuner cards, also known as **television boards, video recorder cards,** and **video capture cards,** contain a TV tuner and a video converter that changes the TV signal into one that can be displayed on your monitor. To see how TV tuner cards work, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations. (To learn more about using TV tuner cards, see Making IT Work for You: TV Tuner Cards and Video Clips on pages 4-15 and 4-16.)

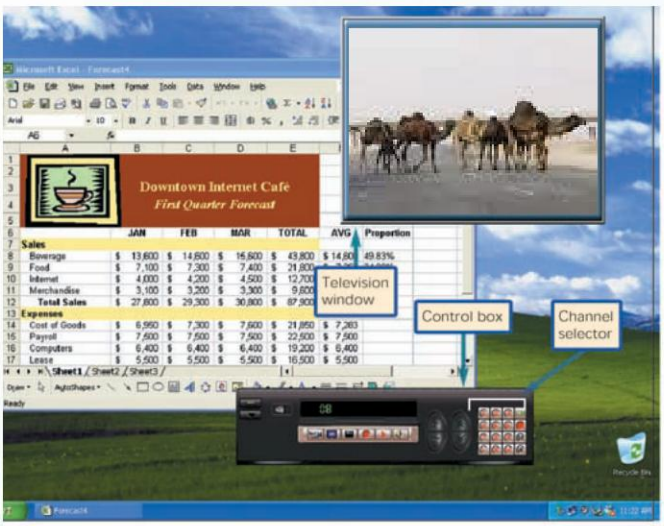
Plug and Play is a set of hardware and software standards developed by Intel, Microsoft, and others. It is an effort by hardware and software vendors to create operating systems, processing units, and expansion boards, as well as other devices that are able to configure themselves. Ideally, to install a new expansion board all you have to do is insert the board and turn on the computer. As the computer starts up, it will search for these Plug and Play devices and automatically configure the devices and the computer system. Unfortunately, not all computer systems and expansion cards have this capability. For those devices that do not, reconfiguration involves installing device drivers as discussed in Chapter 5.

TV TUNER CARDS AND VIDEO CLIPS

Want to watch your favorite television program while you work? Perhaps you would like to include a video clip from television and include it in a class presentation. It's easy using a TV tuner card.

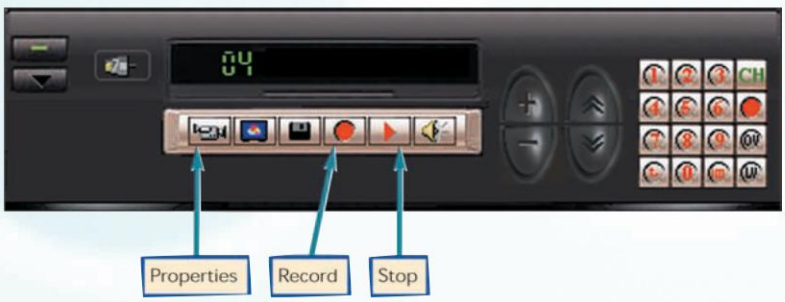
Viewing Once a TV tuner card has been installed, you can view your favorite TV shows, even while running other applications such as Excel, by taking the steps shown here.

1. Click the *TV icon* on the desktop.
2. Size and move the television window and control box window.
3. Select the channel.



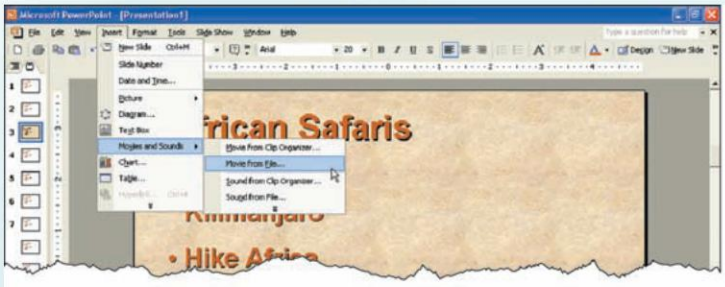
Capturing You can capture the video playing in the TV window into a digital file by taking the steps shown here.

1. Specify where to save the video clip on your computer by clicking the *Properties* button.
2. Click the *Record* button to start recording.
3. Click the *Stop* button to stop recording.

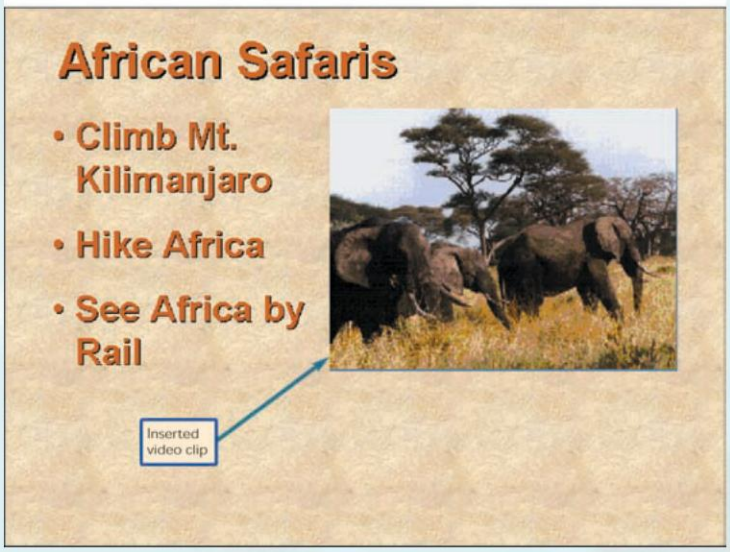


Using Once captured in a file, a video can be used in any number of ways. It can be added to a Web page, attached to an e-mail, or added to a class presentation. For example, you could include a video clip in a PowerPoint presentation by taking the steps shown here.

1. **Insert the video clip into a page in the presentation by clicking *Insert/Movies and Sounds/Movie from File*.**

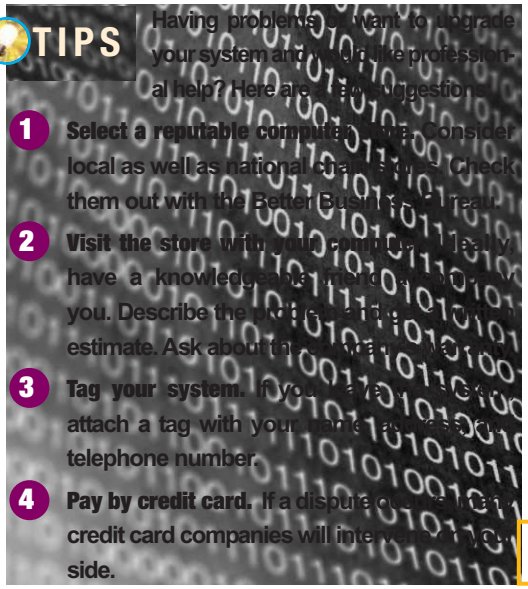


2. **Click on the image of the inserted video clip anytime during your presentation to play it.**



TV tuner cards are relatively inexpensive and easy to install. Some factors limiting their perforemance on your computer are the speed of your processor, the amount of memory, and secondary storage capacity.

TV tuner cards are continually changing, and some of the specifics presented in this Making IT Work for You may have changed. To learn about other ways to make information technology work for you, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Making IT Work.



To meet the size constraints of notebook and handheld computers, credit card-sized expansion cards have been developed. These cards can be easily inserted and removed. They are called **PC cards** or **Personal Computer Memory Card International Association** (PCMCIA) cards. (See Figure 4-20.)

CONCEPT CHECK

- What does open versus closed architecture mean?
- What are expansion slots and cards? Name five expansion cards.
- What is Plug and Play? What are PC cards?

BUS LINES

Bus lines provide data pathways that connect various system components. System and expansion are two categories of buses.

Figure 4-20 Inserting a PC card into a notebook computer

A **bus line**—also known simply as a **bus**—connects the parts of the CPU to each other. Buses also link the CPU to various other components on the system board. (See Figure 4-21.) A bus is a pathway for bits representing data and instructions. The number of bits that can travel simultaneously down a bus is known as the **bus width.**

A bus is similar to a multilane highway that moves bits rather than cars from one location to another. The number of traffic lanes detemines the bus width. A highway (bus line) with more traffic lanes (bus width) can move traffic (data and instructions) faster. For example, a 64-bit bus is twice as fast as a 32-bit bus. Why should you even care about what a bus line is? Because as microprocessor chips have changed, so have bus lines. Bus design or bus architecture is an important factor relating to the speed and power for a particular computer. Additionally, many devices, such as expansion boards, will work with only one type of bus.

EXPANSION BUSES

Every computer system has two basic categories of buses. One category, called **system buses,** connects the CPU to memory on the system board. The other category, called **expansion buses,** connects the CPU to other components on the system board, including expansion slots.

Computer systems typically have a combination of different types of expansion buses. The principal types are ISA, PCI, AGP, USB, and HPSB.

- **Industry standard architecture (ISA)** was developed for the first IBM Personal Computer. Originally, it had an 8-bit bus width. Later, it was expanded to 16 bits. Although too slow for many of today's applications, the ISA bus is still widely used.

- **Peripheral component interconnect (PCI)** was originally developed to meet the video demands of graphical user interfaces. PCI is a high-speed 32-bit or 64-bit bus that is over 20 times faster than ISA buses.
- **Accelerated graphics port (AGP)** is over twice as fast as the PCI bus. While the PCI bus is used for a variety of purposes, the AGP bus is dedicated to the acceleration of graphics performance. Widely used for graphics and 3-D animations, the AGP is replacing the PCI bus for the transfer of video data.
- **Universal serial bus (USB)** combines with a PCI bus on the system board to support several external devices without using expansion cards or slots. External USB devices are connected from one to another and then onto the USB bus. The USB bus then connects to the PCI bus on the motherboard. The first universal serial bus was called USB 1.1 and is over twice as fast as the AGP bus. Recently, a new version called USB 2.0 has been introduced that is 40 times faster than USB 1.1.

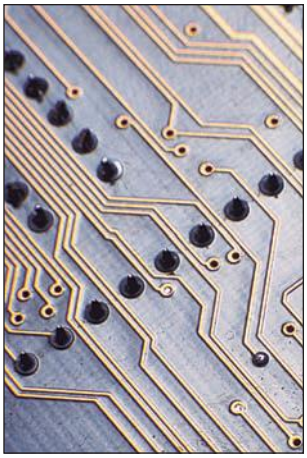


Figure 4–21 Bus is a pathway for bits

- **FireWire buses,** also known as **high performance serial bus (HPSB),** operate much like USB buses and perform at speeds comparable to USB 2.0. FireWire and USB 2.0 buses are used for special applications that provide support for digital camcorders and video editing software.

PORTS

Ports are connecting sockets on the systems unit. Serial, parallel, USB, and FireWire are standard ports. Cables connect external devices to ports.

A **port** is a socket for external devices to connect to the system unit. (See Figure 4-22.) Some ports connect directly to the systems board while others connect to cards that are inserted into slots on the systems board. Some ports are standard features of most computer systems and others are more specialized.

Figure 4–22 Ports

STANDARD PORTS

Many ports, like the mouse, keyboard, and video ports, are for specific devices. Others, like those listed below, can be used for a variety of different devices.

- **Serial ports** are used for a wide variety of purposes. They are often used to connect a mouse, keyboard, modem, and many other devices to the system unit. Serial ports send data one bit at a time and are very good for sending information over a long distance.
- **Parallel ports** are used to connect external devices that need to send or receive a lot of data over a short distance. These ports typically send eight bits of data simultaneously across eight parallel wires. Parallel ports are mostly used to connect printers to the system unit.
- **Universal serial bus (USB) ports** are gradually replacing serial and parallel ports. They are faster, and one USB port can be used to connect several devices to the system unit.
- **FireWire ports,** also known as **high performance serial bus (HPSB) ports,** are as fast as USB 2.0 ports and provide connections to specialized FireWire devices such as camcorders.

CABLES

Cables are used to connect exterior devices to the system unit via the ports. One end of the cable is attached to the device and the other end has a connector that is attached to a matching connector on the port.

POWER SUPPLY

DC powers computers. Desktop computers use power supply units. Notebook and handheld computers use AC adapters and batteries.

Computers require **direct current (DC)** to power their electronic components and to represent data and instructions. DC power can be provided indirectly by converting **alternating current (AC)** from standard wall outlets or directly from batteries.

- Desktop computers have a **power supply unit** located within the system unit. (See Figure 4-23.) This unit plugs into a standard wall outlet, converts AC to DC, and provides the power to drive all of the system unit components.
- Notebook computers use **AC adapters** that are typically located outside the system unit. (See Figure 4-24.) AC adapters plug into a standard wall outlet, convert AC to DC, provide power to drive the system unit components, and can recharge batteries. Notebook computers can be operated either using an AC adapter plugged into a wall outlet or using battery power. Notebook batteries typically provide sufficient power for 2 to 4 hours before they need to be recharged.
- Like notebook computers, handheld computers use AC adapters located outside the system unit. Unlike notebook computers, however, handheld computers typically operate only using battery power. The AC adapter is used to recharge the batteries.

Figure 4–23 Power supply unit

Figure 4–24 AC adapter

CONCEPT CHECK

- What is a bus and what is its function? Describe five types.
- What are ports? What do they do? Describe four standard ports.
- What is a power supply unit? What is an AC adapter?

A Look to the Future

Xybernaut Corporation Makes Wearable Computers a Reality

Wouldn't it be nice if you could conveniently access the Internet wirelessly at any time during the day? What if you could send and receive e-mail from your waist-mounted computer? What if you could maintain your personal schedule book, making new appointments with others on the fly? What if you could play interactive games, and surf the Web from anywhere?

Of course you can do all this and more using wireless technology and PDAs. Many people currently use this technology when they are away from their home or office. What if these users could accomplish these tasks with an even smaller, more portable, and less intrusive system? Will people be wearing computers rather than carrying them? What if your computer featured a head-mounted display?

Xybernaut Corporation is currently marketing a personal wearable computer called POMA®. The device is described as a personal multimedia appliance. It is composed of a processor that runs Windows CE, a wireless pointing device, and a head-mounted display. The display allows you to see the equivalent of a desktop monitor via a small screen that is worn in front of one eye. This screen is only one inch square and weighs a mere 3 ounces. The device includes an MP3 player that plays songs and displays videos, and abridged versions of Windows Office programs.

Devices made by Xybernaut® are currently being evaluated for use in airports by security personnel. These devices are currently being used by the U.S. Department of Defense for military applications and by the Toronto Blue Jays to end long lines at ticket windows. When coupled with face recognition technology, Xybernaut's Mobile Assistant® V provides security personnel portable and instant communication with the command center. Police and security officers may someday use this technology to check IDs and verify your identity. Experts say that wearable computers will be used by surgeons in operating rooms to "view" their patients. Will we be wearing a computer soon? Some of us already are. And some experts predict the majority of us will employ a wearable computer before the end of the decade. Many computer manufacturers are currently working on wearable computers, and there is even a wearable computer fashion show that showcases the latest designs. Many people are already wearing their computers, and making use of this mobile technology to read e-mail while waiting in lines or even studying their notes for the next exam. What do you think? Will Americans someday grab their keys and their computers before they leave the house? Will your computer one day be housed in your jacket?

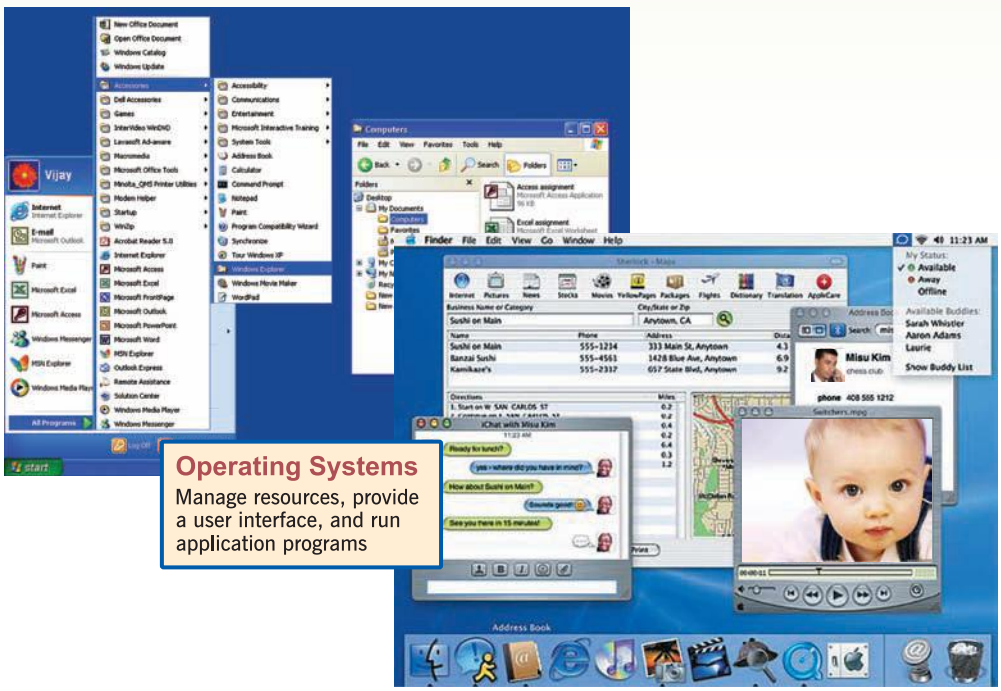
SYSTEM SOFTWARE

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Describe the differences between system software and application software.**
2. **Discuss the four types of system software.**
3. **Discuss the basic functions, features, and categories of operating systems.**
4. **Describe the Windows, Mac OS, UNIX, and Linux operating systems.**
5. **Describe the purpose of utilities and utility suites.**
6. **Identify the five most essential utilities.**
7. **Discuss Windows utility programs.**
8. **Describe device drivers, including printer drivers.**

CONTENTS



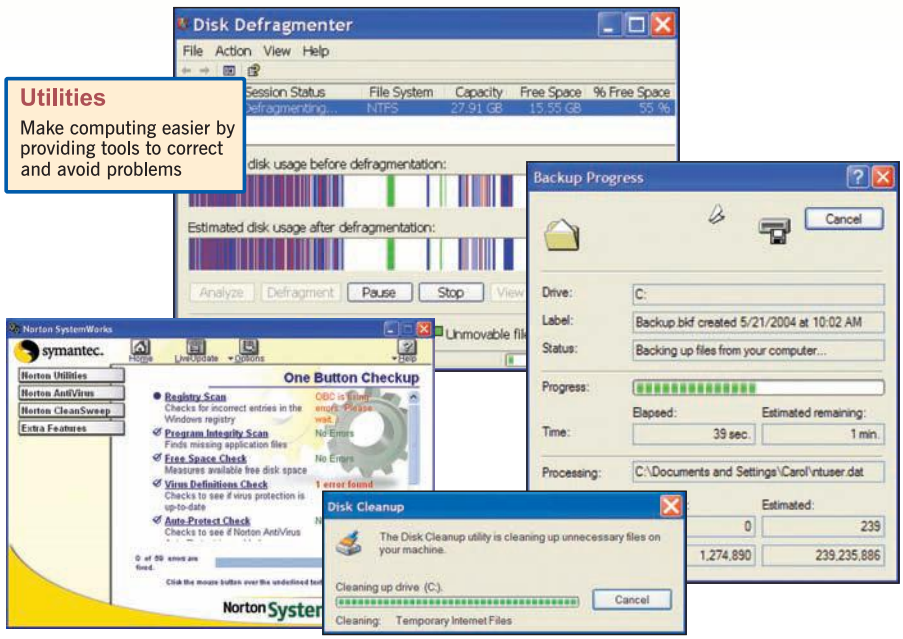
CHAPTER 5

When most people think about computers, they think about surfing the Web, creating reports, analyzing data, storing information, making presentations, and any number of other valuable applications. We typically think about applications and application software. Computers and computer applications have become a part of the fabric of our everyday lives. Most of us agree that they are great . . . as long as they are working.

We usually do not think about the more mundane and behind-the-scenes computer activities: loading and running programs, coordinating networks that share resources, organizing files, protecting our computers from viruses, performing periodic maintenance to avoid problems, and controlling hardware devices so that they can communicate with one another. Typically, these activities go on behind the scenes without our help.

That is the way it should be, and the way it is, as long as everything is working perfectly. But what if new application programs are not compatible and will not run on our current computer system? What if we get a computer virus? What if our hard disk fails? What if we buy a new digital video camera and can't store and edit the images on our computer system? What if our computer starts to run slower and slower?

These issues may seem mundane, but they are critical. This chapter covers the vital activities that go on behind the scenes. A little knowledge about these activities can go a long way to making your computing life easier. To effectively use computers, competent end users need to understand the functionality of system software, including operating systems, utility programs, and device drivers.



SYSTEM SOFTWARE

System software handles technical details. Operating systems, utilities, device drivers, and language translators are types of system software programs.

End users use application software to accomplish specific tasks. For example, we use word processors to create brochures, letters, and reports. However, end users also use system software. **System software** works with end users, application software, and computer hardware to handle the majority of technical details. For example, system software controls where a word processing program is stored in memory, how commands are converted so that the system unit can process them, and where a completed document or file is saved. See Figure 5-1.

System software is not a single program. Rather it is a collection or a system of programs that handle hundreds of technical details with little or no user intervention. System software consists of four types of programs:

- **Operating systems** coordinate computer resources, provide an interface between users and the computer, and run applications.
- **Utilities,** also known as **service programs,** perform specific tasks related to managing computer resources.
- **Device drivers** are specialized programs that allow particular input or output devices to communicate with the rest of the computer system.
- **Language translators** convert the programming instructions written by programmers into a language that computers understand and process.

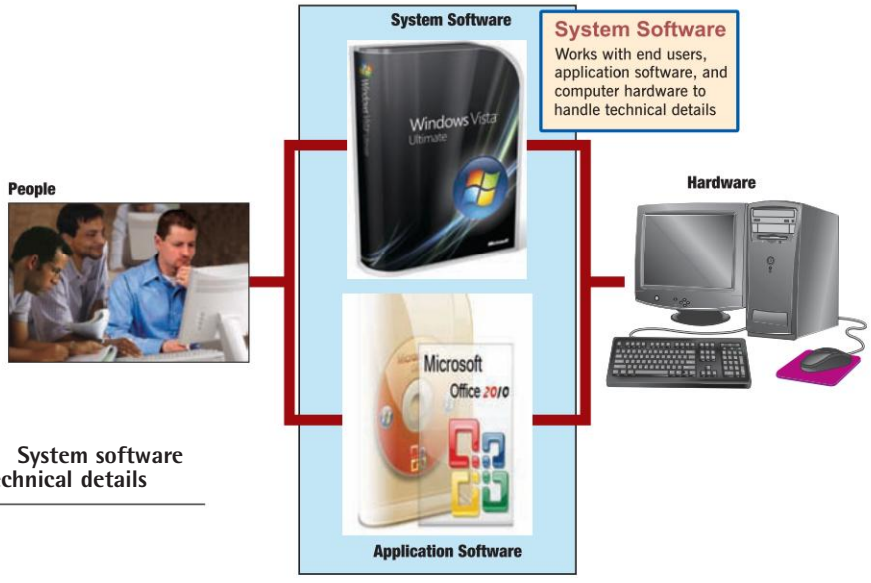


Figure 5-1 System software handles technical details

OPERATING SYSTEMS

Operating systems are programs that manage resources, provide user interface, and run applications. Three categories of operating systems are embedded, network, and stand-alone. Windows, Mac OS, UNIX, and Linux are operating systems.

An **operating system** is a collection of programs that handle many of the technical details related to using a computer. In many ways, an operating system is the most important type of computer program. Without it your computer would be useless.

FUNCTIONS

Every computer has an operating system and every operating system performs a variety of functions. These functions can be classified into three groups:

- **Managing resources:** These programs coordinate all the computer's resources including memory, processing, storage, and devices such as printers and monitors. They also monitor system performance, schedule jobs, provide security, and start up the computer.
- **Providing user interface:** Users interact with application programs and computer hardware through a user interface. Many older operating systems used a **character based interface** in which users communicated with the operating system through written commands such as "Copy A: assign.doc to C:". Almost all newer operating systems use a **graphical user interface (GUI).** As we discussed in Chapter 8, a graphical user interface uses graphical elements such as icons and windows.
- **Running applications:** These programs load and run applications such as word processors and spreadsheets. Most operating systems support **multitasking,** or the ability to switch between different applications stored in memory. With multitasking, you could have Word and Excel running at the same time and switch easily between the two applications. The program that you are currently working on is described as running in the **foreground.** The other program or programs are running in the **background.**

FEATURES

Starting or restarting a computer is called **booting** the system. There are two ways to boot a computer: a warm boot and a cold boot. A **warm boot** occurs when the computer is already on, and you restart it without turning off the power. A warm boot can be accomplished in several ways. For example, in Windows XP, a running computer can be restarted by pressing a sequence of keys. Starting a computer that has been turned off is called a **cold boot.** To learn more about booting your computer system and POST, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions.

You typically interact with the operating system through the graphical user interface. Most provide a place, called the **desktop,** which provides access to computer resources. (See Figure 5-2.) Operating systems have several features in common with application programs including:

- **Icons—**graphic representations for a program or function.
- **Pointer—**controlled by a mouse and changes shape depending upon its current function. For example, when shaped like an arrow, the pointer can be used to select items such as an icon.

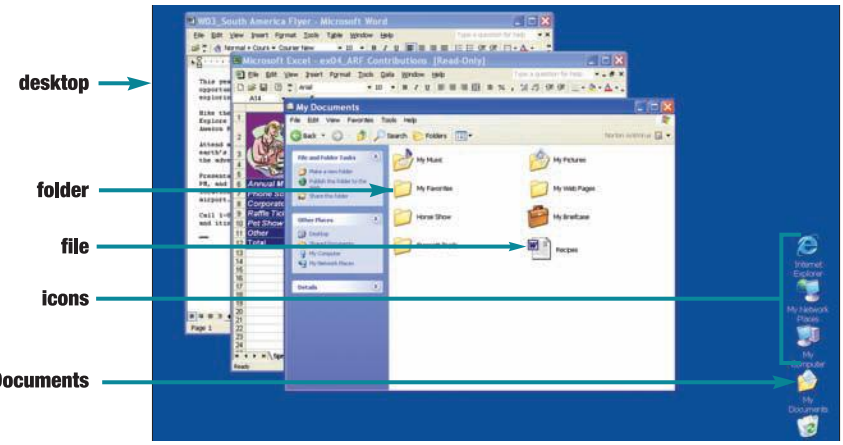


Figure 5-2 Desktop

- **Windows—**rectangular areas for displaying information and running programs.
- **Menus—**provide a list of options or commands.
- **Dialog boxes—**provide information or request input.
- **Help—**provides online assistance for operating system functions and procedures.

Most operating systems store data and programs in a system of files and folders. Unlike the traditional Filing cabinet, computer files and folders are stored on a secondary storage device such as your hard disk. **Files** are used to store data and programs. Related files are stored within a **folder,** and for organizational purposes, a folder can contain other folders. For example, you might organize your electronic files in the *My Documents* folder on your hard disk. This folder could contain other folders, each named to indicate their contents. One might be "Computers" and could contain all the files you have created (or will create) for this course.

Figure 5-3 PDAs have embedded operating systems

CATEGORIES

While there are hundreds of different operating systems, there are only three basic categories: embedded, network, or stand-alone.

- **Embedded operating systems** are used for handheld computers and smaller devices like PDAs. (See Figure 5-3.) The entire operating system is stored within or embedded in the device. The operating system programs are permanently stored on ROM or read only memory chips. Popular embedded operating systems include Windows CE .NET and Palm OS.
- **Network operating systems (NOS)** are used to control and coordinate computers that are networked or linked together. Many networks are small and connect only a limited number of microcomputers. Other networks like those at colleges and universities are very large and complex. These networks may include other smaller networks and typically connect a variety of different types of computers.

Figure 5–4 Stand-alone operating system

Network operating systems are typically located on one of the connected computers' hard disks. Called the **network server,** this computer coordinates all communication between the other computers. Popular network operating systems include NetWare, Windows NT Server, Windows XP Server, and UNIX.

- **Stand-alone operating systems,** also called **desktop operating systems,** control a single desktop or notebook computer. (See Figure 5-4.) These operating systems are located on the computer's hard disk. Often desktop computers and notebooks are part of a network. In these cases, the desktop operating system works with the network's NOS to share and coordinate resources. In these situations, the desktop operating system is referred to as the **client operating system**. Popular desktop operating systems include Windows, Mac OS, and some versions of UNIX.

The operating system is often referred to as the **software environment** or **platform**. Application programs are designed to run with a specific platform. For example, AppleWorks is designed to run with the Mac OS environment. There are many different types of operating systems. Windows, Mac OS, and Linux are operating systems commonly used by individuals.

Most operating systems are **proprietary operating systems;** that is, they are owned and licensed by a corporation. The Windows operating system is a proprietary operating system owned by the Microsoft Corporation. Some individuals and organizations have developed **nonproprietary operating systems** in which the operating system program or source code is provided to outside individuals. These individuals are encouraged to use, improve, and modify the programs. The objective is to produce better and more useful programs in the long run. Programs released in this way are called **open source.** For example, Linux is an open source program currently provided to software developers under an open source agreement.

CONCEPT CHECK

- What is system software? What are the four kinds of system software programs?
- What is an operating system? Discuss operating system functions and features.
- Describe each of the three categories of operating systems.

WINDOWS

Microsoft's **Windows** is by far the most popular microcomputer operating system today with over 90 percent of the market. Because its market share is so large, more application programs are developed to run under Windows than any other operating system. Windows comes in a variety of different versions and is designed to run with Intel and Intel-compatible microprocessors such as the Pentium IV. For a summary of Microsoft's desktop operating systems, see Figure 5-5.

The latest release of the Windows operating system is **Windows XP**. It provides a new user interface called **Luna**. Compared to other user inte support tablet PC functions such as faces, Luna emphasizes functions over programs. For example, the new **Start menu** displays categories like E-mail and Internet, rather than individual programs such as Outlook and Internet Explorer. This menu displays a list of commands that can be used to access information, change hardware settings, find information, get online help, run programs, log off a network, and shut down your computer system.

For example, you could use the Start menu to run the Internet Explorer program as shown in Figure 5-6.

Name	Description
Windows NT Workstation	Client operating system designed to work with the Windows NT Server
Windows 98	Stand alone operating system
Windows 2000 Professional	Upgrade to Windows NT Workstation
Windows ME	Upgrade to Windows 98 specifically designed for home users
Windows XP	One of Microsoft's newest and most powerful desktop operating systems
Windows XP Tablet PC Edition	Version of Windows XP designed to spport tablet PC functions such as converting handwritten input to digital form

Figure 5-5 Microsoft desktop operating systems

1. Click *Start* on the task bar to open the Start Menu.
2. Click the Internet Explorer icon to open your home page.

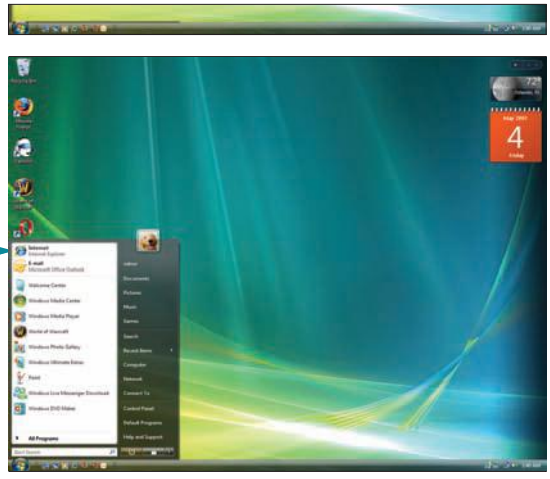


Figure 5-6 Using the Start menu with Windows XP

MAC OS

Macintosh introduced its first operating system and microcomputer in 1984. It provided one of the first GUIs, making it easy even for novice computer users to move and delete files. Designed to run with Apple computers, **Mac OS** is not nearly as widely used as the Windows operating system. As a result, fewer application programs have been written for it. Nonetheless, Mac OS is considered to be one of the most innovative operating systems. It is a powerful, easy-to-use operating system that is popular with professional graphic designers, desktop publishers, and many home users.

Figure 5–7 Mac OS X

One of the latest versions of the Macintosh operating system, **Mac OS X**, features a new user interface called **Aqua**. It is an intuitive interface providing photo-quality icons and easy-to-use menus. The desktop features **Dock**, a tool for visually organizing files. Additionally, Mac OS X provides an updated version of its **Sherlock** search tool for locating information on the Web as well as on the user's computer system. (See Figure 5-7.)

UNIX AND LINUX

The **UNIX** operating system was originally designed to run on minicomputers in network environments. Now, it is also used by powerful microcomputers and by servers on the Web. There are a large number of different versions of UNIX. One receiving a great deal of attention today is **Linux**.

Figure 5–8 Recent version of Linux

While Windows, Mac OS, and many version of UNIX are proprietary operating systems, Linux is not. It is open source software free and available from many sources, including the Web. As a graduate student at the University of Helsinki, Linus Torvalds developed Linux in 1991. He has allowed distribution of the operating system code and has encouraged others to modify and further develop the code. Linux is one of the most popular and powerful alternatives to the Windows operating system. (See Figure 5-8.)

CONCEPT CHECK

- What is Windows? What is Luna? How is it different from the classic interface?
- What is Mac OS? What is Aqua? Dock? Sherlock?
- What is UNIX? What is Linux?

UTILITIES

Backup, Disk Cleanup, and Disk Defragmenter are Windows utilities. McAfee Office, Norton SystemWorks, and V Communications System Suite are utility suites.

Ideally, microcomputers continuously run without problems. However, that simply is not the case. All kinds of things can happen—internal hard disks can crash, computers can freeze up, operations can slow down, and so on. These events can make computing very frustrating. That's where utilities come in. **Utilities** are specialized programs designed to make computing easier. There are hundreds of different utility programs. The most essential are the following:

- **Troubleshooting** or **diagnostic** programs that recognize and correct problems, ideally before they become serious.
- **Antivirus** programs that guard your computer system against viruses or other damaging programs that can invade your computer system.
- **Uninstall** programs that allow you to safely and completely remove unneeded programs and related files from your hard disk.
- **Backup** programs that make copies of files to be used in case the originals are lost or damaged.
- **File compression** programs that reduce the size of files so they require less storage space and can be sent more efficiently over the Internet.

Most operating systems provide some utility programs. Even more powerful utility programs can be purchased separately or in utility suites.

WINDOWS UTILITIES

The Windows operating systems are accompanied by several utility programs, including Backup, Disk CleanUp, and Disk Defragmenter. These utilities can be accessed from the System Tools menu. (See Figure 5-9.)

1. Click *Start*.
2. Select *All Programs*.
   - Select *Accessories*.
   - Choose *System Tools*.

Figure 5-9 Accessing Windows XP utilities

Backup is a utility program included with the many versions of Windows that makes a copy of all files or selected files that have been saved onto a disk. It helps to protect you from the effects of a disk failure. For example using the Professional edition of XP, you can select Backup from the Windows XP System Tools menu to create a backup for your hard disk as shown in Figure 5-10. (While most versions of XP include the Backup utility, the XP Home edition does not.)

When you surf the Web, a variety of programs and files are saved on your hard disk. Many of these and other files are not essential. **Disk CleanUp** is a troubleshooting utility that identifies and eliminates nonessential files. This frees up valuable disk space and improves system performance.

1. Click *Start*.
   - Select *Accessories* from the *All Programs* menu.
   - Select *Backup* from the *System Tools* menu.
2. Run the Restore Wizard and specify your settings.
   - Choose *Backup* and choose the files you want to include.
   - Choose the destination for the backup.
3. Finish the Restore Wizard to back up the selected drive.
   - Close the *Backup Progress* window or view the report.

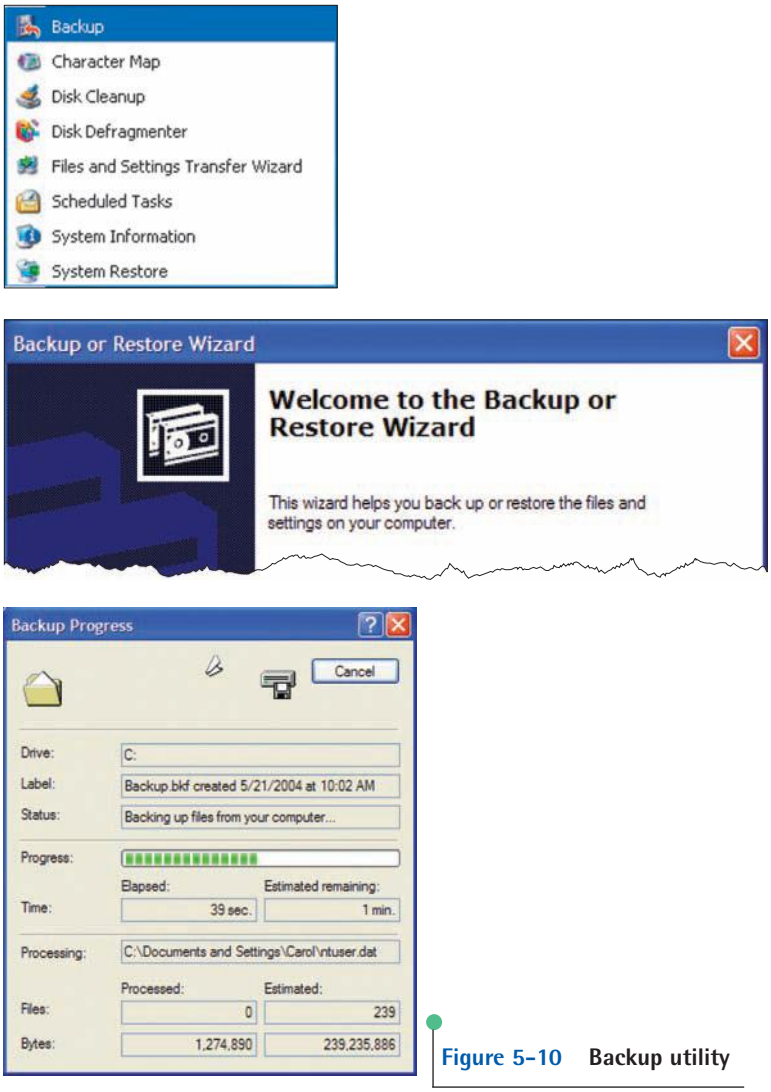


Figure 5-10 Backup utility

For example, by selecting Disk Cleanup from the Windows XP System Tools menu, you can eliminate unneeded files on your hard disk as shown in Figure 5-11.

As we will discuss in detail in Chapter 3, files are stored and organized on a disk according to tracks and sectors. A **track** is a concentric ring. Each track is divided into wedge-shaped sections called **sectors**. (See Figure 5-12.) The operating system tries to save a file on a single track across contiguous sectors Often, however, this is not possible and the file has to be broken up, or **fragmented**, into small parts that are stored wherever space is available. Whenever a file is retrieved, it is reconstructed from the fragments. After a period of time, a hard disk becomes highly fragmented, slowing operations.

1. **Click *Start.***
   - **Select *Accessories* from the *All Programs* menu.**
   - **Select *Disk Cleanup* from the *System Tools* menu.**
2. **Verify the files suggested for clean up.**
   - **Click *OK*.**
   - **Click *Yes* to begin disk clean up.**
3. **The utility cleans the selected files.**

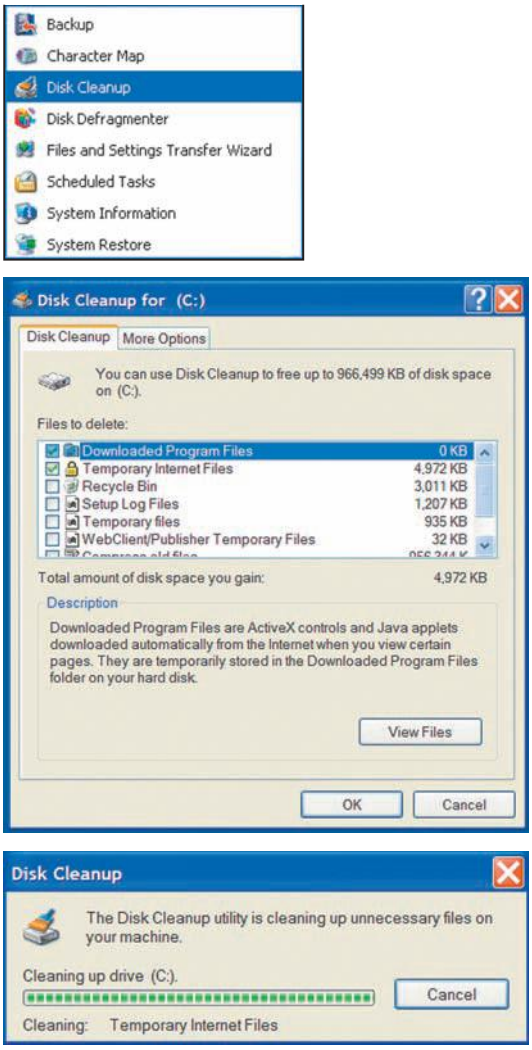


Figure 5-11 Disk CleanUp utility

Disk Defragmenter is a utility program that locates and eliminates unnecessary fragments and rearranges files and unused disk space to optimize operations. For example, by selecting Disk Defragmenter from the Windows XP Systems Tool menu, you can defrag your hard disk as shown in Figure 5-13.

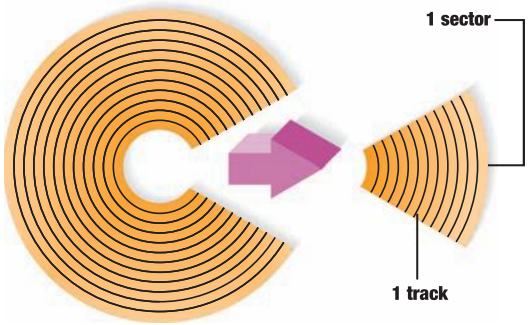


Figure 5-12 Tracks and sectors

UTILITY SUITES

Like application software suites, **utility suites** combine several programs into one package. Buying the package is less expensive than buying the programs separately. The three best known utility suites are McAfee Office, Norton SystemWorks, and V Communications SystemSuite. These suites provide a variety of utilities, including programs that will protect your system from dangerous programs called **computer viruses.** You can "catch" a computer virus many ways, including by opening attachments to e-mail messages and downloading software from the Internet.

1. Click *Start.*
2. Select *Accessories* from the *All Programs* menu.
3. Select *Disk Defragmenter* from the *System Tools* menu.

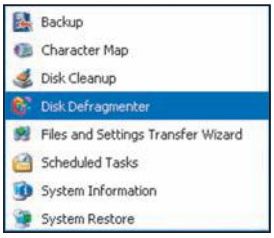
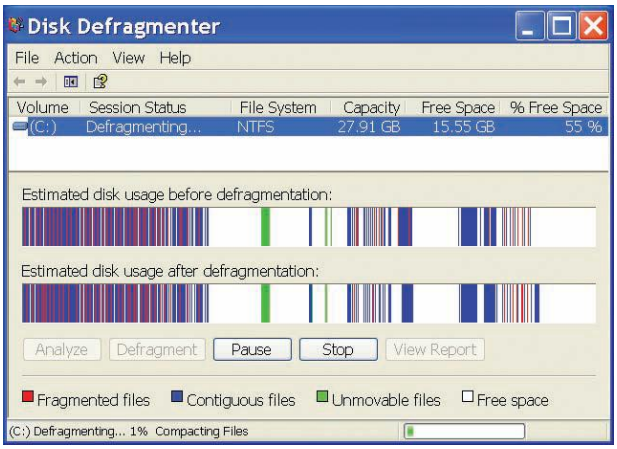


Figure 5-13 Disk Defragmenter utility

2. If necessary, choose the drive you want to analyze and defragment.
3. Click the *Analyze* button to determine whether defragging is needed.
4. View the report or, if necessary, defragment the drive.
5. Click the *Defragment* button to begin defragging.
6. When defragmentation is complete for the selected drive, view the report or close the window.



To learn more about virus protection, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations. Also see Making IT Work for You: Virus Protection and Internet Security on pages 5-15 and 5-16.

Norton SystemWorks is one of the most widely used utility suites. It includes the following:

- **Norton AntiVirus** is a collection of antivirus programs that can protect your system from over 21,000 different viruses, quarantine or delete existing viruses, and automatically update its virus list to check for the newest viruses.
- **Norton CleanSweep** is a collection of programs that guide you through the process of safely removing programs and files you no longer need. Additionally, they will archive, move, and make backups of programs as well as clean up your hard disk. They can also protect your existing files from damage when you install new programs.
- **Web CleanUp** is a collection of programs that check your computer system for unnecessary files, including temporary files created by application programs, cache files, history Files, and cookies. You can then eliminate these files with a click of a button.
- **Connection Keep Alive** prevents dial-up Internet connections from timing out by simulating online user activity during periods of inactivity.
- **GoBack Personal Edition** will restore system configurations, help to locate lost files, and repair damaged files.
- **Norton Utilities** is a collection of several separate troubleshooting utilities. These programs can be used to Find and fix problems, improve system performance, prevent problems from occurring, and troubleshoot a variety of other problems. One of the programs, **One Button Checkup,** integrates several of the separate troubleshooting utilities. (See Figure 5-14.)

On the Web Explorations

Utility software can make your computer faster, safer, and more productive. To learn more about a market leader of utility software, visit our Web site at www.olearyseries.com and select On the Web Explorations.

CONCEPT CHECK

- What is the difference between a utility and a utility suite?
- Describe Backup, Disk CleanUp, and Disk Defragmenter.
- What is a computer virus? How you can you protect yourself against them?

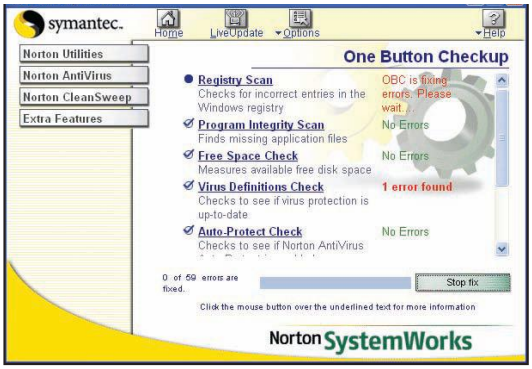


Figure 5-14 Norton SystemWorks' One Button Checkup

DEVICE DRIVERS

Device drivers are specialized programs that allow devices such as a mouse, keyboard, and printer to communicate with the rest of the computer system.

Every device, such as a mouse or printer, that is connected to a computer system, has a special program associated with it. This program, called a **device driver** or simply a **driver,** works with the operating system to allow communication between the device and the rest of the computer system. Each time the computer system is started, the operating system loads all of the device drivers into memory.

Whenever a new device is added to a computer system, a new device driver must be installed before the device can be used. Windows supplies hundreds of different device drivers with its system software. For many devices, the appropriate drivers are automatically selected and installed when the device is first connected to the computer system. For others, the device driver must be manually installed. Fortunately, Windows provides wizards to assist in this process. For example, Windows **Add Printer Wizard** provides step-by-step guidance for selecting the appropriate printer driver and installing that driver (See Figure 5-15.) If a particular device driver is not included with the Windows system software, the product's manufacturer will supply one. Many times these drivers are available directly from the manufacturer's Web site.

You probably never think about the device drivers in your computer However, when your computer behaves unpredictably, you may find reinstalling or updating your device drivers solves your problems. Windows makes it easy to update the drivers on your computer using **Windows Update,** as shown in Figure 5-16.

CONCEPT CHECK

- What are device drivers? What does the Window's Add Printer Wizard do?
- What is Windows Update? When would you use it?

To access the Add Printer Wizard

- **Select *Control Panel* from the *Start* menu.**
- **Click *Printers* and *faxes.***
- **Click *Add a printer.***

Figure 5-15 Add Printer Wizard

VIRUS PROTECTION AND INTERNET SECURITY

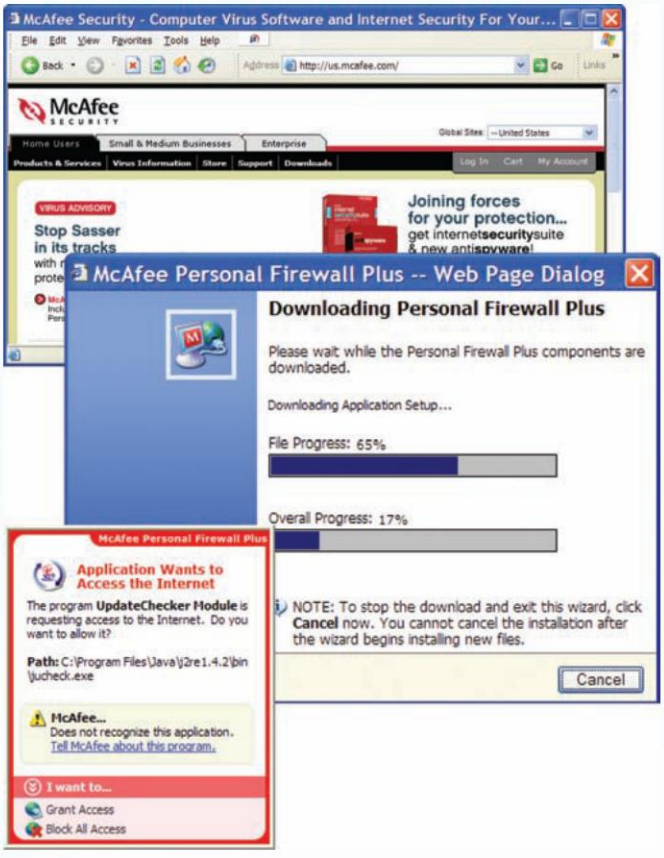
Are you worried that a computer virus will erase your personal files? Did you know that others could be intercepting your private e-mail? It is even possible for others to gain access to and control over your computer system. For tunately, Internet security suites are available to help ensure your safety while you are on the Internet.

Getting Started The first step is to install an Internet security suite. Once installed, the soffware will continually work to ensure security and privacy. One of the best known suites is McAfee Internet Security Suite, which can be installed by following the instructions below.

1. **Connect to *www.mcafee.com* and follow the on-screen instructions to subscribe to this Internet security suite.**

2. **The security suite is downloaded and installed to your computer directly from the Web site.**

Once installed, the security suite will automatically be activated each time you start your computer. An alert similar to the one on the right is displayed when any privacy or security vulnerabilities are detected.



Internet Security Suite Internet Security Suite runs a number of programs continually to monitor your computer. Some of Internet Security Suite's most powerful programs include VirusScan, PersonalFirewall, and PrivacyService. You can modify the way these programs run with the McAfee SecurityCenter.

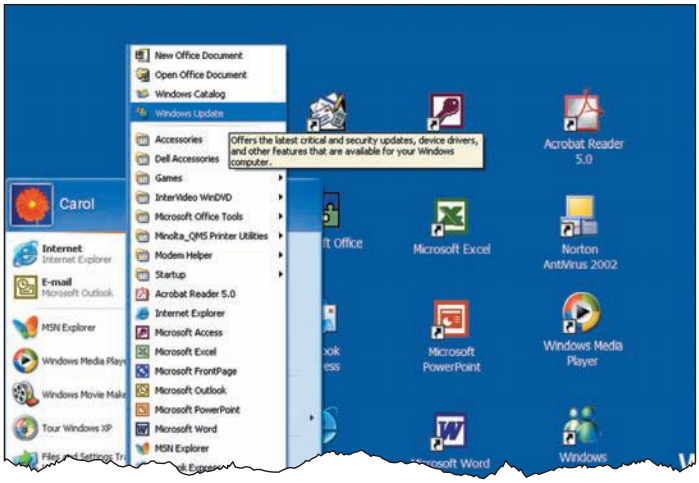
VirusScan VirusScan controls how frequently the computer system is searched for computer viruses. When a file is checked, it is compared to the profile of known viruses. Once a virus is detected, the infected file is quarantined or deleted.

PrivacyService PrivacyService is a program that helps protect your privacy online. You can use it to block certain Web sites, prevent sensitive information from being sent over the Internet, and block cookies and ads.

PersonalFirewall PersonalFirewall is a program that monitors all inbound and outbound traffic to a computer system. It limits access to authorized users and applications.

The Web is continually changing, and some of the specifics presented in this Making IT Work for You may have changed. To learn more about other ways to make information technology work for you, visit our Web site at www.olearyseries.com and select Making IT Work for You.

1. Access ***Windows Update*** from the ***All Programs*** list of the ***Start*** menu.



2. Click ***Scan for updates.***
   - Click ***Driver Updates.***

3. Click ***Add.***
   - Click ***Review and Install Drivers.***
   - Click ***Install Now*** and ***Accept*** the license agreement.
   - Click ***OK*** to restart the computer.

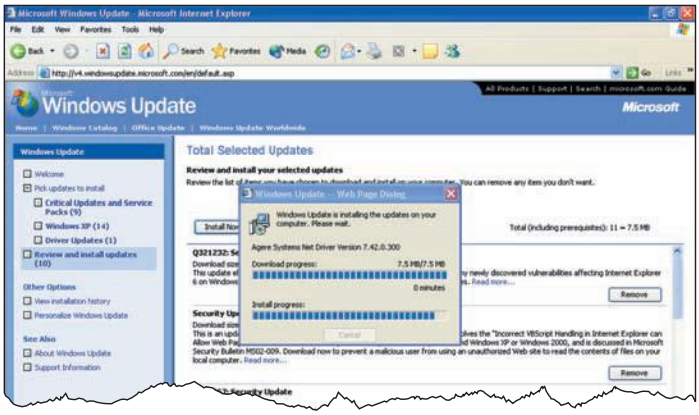


Figure 5-16 **Using Windows Update**

A Look to the Future

IBM Builds an Aware Supercomputer

Wouldn't it be nice if computers could fix themselves? What if you never had to worry about installing or updating software? What if your computer could continually fine-tune its operations to maintain peak performance? What if your computer could fight off viruses and malicious attacks from outsiders? For many people this sounds too good to be true. Maintenance and security tasks like these can be time consuming and frustrating.

Now imagine you run a business and unless these tasks are performed, you will lose valuable time and money. It is not a pleasant daydream and it quickly becomes a nightmare without properly trained systems administrators to keep servers running smoothly. Yet many experts predict that supercomputers and business systems are not far from becoming too complex for humans to oversee. Recent news from IBM makes the dream of a self-repairing, self-updating, and self-protecting server seem ever closer.

IBM has announced plans to concentrate research efforts on developing just such a server. The project, called the Autonomic Computing initiative (ACI), hopes to free businesses from the time-consuming maintenance and the complexity of business infrastructure. IBM hopes the new system will be self-regulating and virtually invisible. They believe ACI has the potential to revolutionize the way businesses run.

Autonomic computing is a system that allows machines to run with little human intervention. Such computers would not have self-awareness, but rather would be self-correcting. Autonomic processes in machines are modeled after autonomic processes in the human body. For example, you are not consciously breathing as you read this. Instead, your body monitors and maintains your respiration without your constant input. Scientists hope autonomic computing will behave in a similar manner and maintain self-regulating systems without intervention.

Autonomic machines would be able to sense security flaws and repair them. They would be able to sense slow operation's programs and take corrective action. They would be able to sense new equipment, format it, and test it. These goals are impressive and the autonomic computer is still in development.

As technology continues to develop, many computer systems have become too complex for human maintenance. This progress makes autonomic computing more valuable now than ever. However, it is important to note that autonomic computing is not artificial intelligence, because autonomic machines do not have human cognitive abilities or intelligence. Instead, these machines have knowledge of their own systems and the capability to learn from experiences to correct errors in such systems.

Given the potential for a self-maintaining server, the possibility of a similar system designed for a microcomputer seems less like a dream and more like a reality. What do you think? Will microcomputers someday care for themselves?

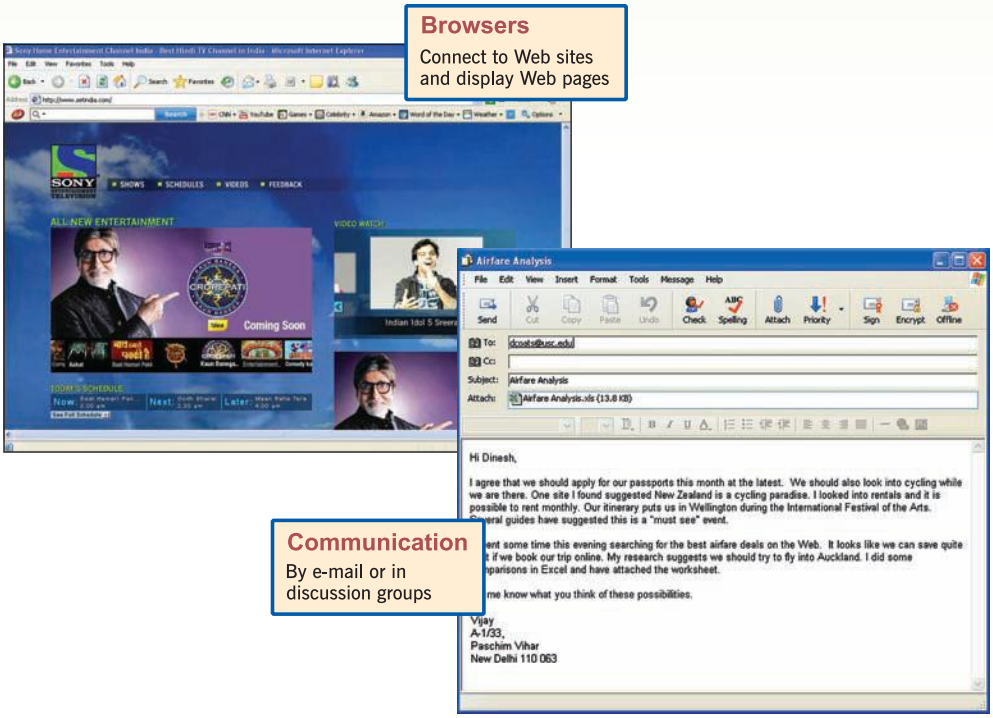
THE INTERNET, THE WEB, AND ELECTRONIC COMMERCE

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Discuss the origins of the Internet and the Web.**
2. **Describe how to access the Web using providers and browsers.**
3. **Discuss Internet communications, including e-mail, instant messaging, and discussion groups.**
4. **Describe search tools, including search engines and metasearch engines.**
5. **Discuss electronic commerce, including B2C, C2C, B2B, and security issues.**
6. **Describe these Web utilities: Telnet, FTP, plug-ins, and filters.**

CONTENTS



CHAPTER 6

Want to communicate with a friend across town, in another state, or even in another country? Perhaps you would like to send a drawing, a photo, or just a letter. Looking for travel or entertainment information? Perhaps you're researching a term paper or exploring different career paths. Where do you start? For these and other information-related activities, try the internet and the Web.

The internet is often referred to as the information Superhighway. In a sense, it is like a highway that connects you to millions of other people and organizations. Unlike typical highways that move people and things from one location to another, the internet moves your ideas and information. Rather than moving through geographic space, you move through cyberspace-the space that moves ideas and information electronically. The Web provides an easy-to-use, exciting, multimedia interface to connect to the internet and to access the resources available in cyberspace. It has become an everyday tool for all of us to use. For example, you can create personal Web sites to share information with others and use instant messaging to chat with friends and collaborate on group projects.

Competent end users need to be aware of the resources available on the internet and the Web. Additionally, they need to know how to access these resources, to effectively communicate electronically, to efficiently locate information, to understand electronic commerce, and to use Web utilities.

THE INTERNET AND THE WEB

The Internet is a worldwide network. The Web, introduced at CERN, is a multimedia interface. Internet uses include communication, shopping, searching, entertainment, and education.

The **Internet,** or **Net,** was launched in 1969 when the United States funded a project that developed a national computer network called **Advanced Research Project Agency Network (ARPANET)**. The Internet is a large network that connects together smaller networks all over the globe. The **Web,** also known as **WWW** and the **World Wide Web,** was introduced in 1992 at the **Center for European Nuclear Research (CERN)** in Switzerland. Prior to the Web, the Internet was all text—no graphics, animations, sound, or video. The Web made it possible to include these elements. It provided a multimedia interface to resources available on the Internet. From these early research beginnings, the Internet and the Web have evolved into one of the most powerful tools of the 21st century.

It is easy to get the Internet and the Web confused, but they are not the same thing. The Internet is the actual physical network. It is made up of wires, cables, and satellites. Being connected to this network is often described as being **online.** The Internet connects millions of computers and resources throughout the world. The Web is a multimedia interface to resources available on the Internet. Every day over a billion users from every country in the world use the Internet and the Web. What are they doing? The most common uses are the following:

- **Communicating** is by far the most popular Internet activity. You can exchange e-mail with your family and friends almost anywhere in the world. You can join and listen to discussions and debates on a wide variety of special-interest topics. You can even create your own personal Web page for Friends and family to visit.
- **Shopping** is one of the fastest-growing Internet applications. You can visit individual stores or a **cybermall,** which provides access to a variety of different stores. You can window shop, look for the latest fashions, search for bargains, and make purchases. (See Figure 6-1.) You can purchase goods using checks, credit cards, or electronic cash.

On the Web Explorations

Many individuals and institutions played a part in the development of the Internet and the Web. To learn more about the history of Internet and Web visit our site at www.oleary-series.com and select On the Web Explorations.

Figure 6-1 Shopping over the Internet is one of the Web's fastest growing activities.

- **Searching** for information has never been more convenient. You can access some of the world's largest libraries directly from your home computer. You can visit **virtual libraries,** search through their stacks, read selected items, and even check out books. You will also find the latest local, national, and international news. Most newspapers maintain an online presence and include interactive and multimedia presentations related to current news stories.
- **Entertainment** options are nearly endless. You can Find music, movies, magazines, and computer games. You will find live concerts, movie previews, book clubs, and interactive live games. (See Figure 6-2.)

Figure 6–2 Entertainment site

- **Education** or **e-learning** is another rapidly emerging Web application. You can take classes on almost any subject. There are courses just for fun and there are courses for high school, college, and graduate school credit. Some cost nothing to take and others cost a lot.

The first step to using the Internet and Web is to get connected, or to gain access to the Internet.

CONCEPT CHECK

- Describe how the Internet and the Web Started.
- What is the difference between the Internet and the Web?
- List and describe five of the most common uses of the Internet and the Web.

ACCESS

Providers give us access to the Internet. National, regional, and wireless are three types of ISPs. Browsers provide access to Web resources.

The Internet and the telephone system are similar—you can connect a computer to the Internet much like you connect a phone to the telephone system. Once you are on the Internet, your computer becomes an extension of what seems like a giant computer—a computer that branches all over the world. When provided with a connection to the Internet, you can use a browser program to search the Web.

PROVIDERS

The most common way to access the Internet is through an **Internet service provider (ISP).** The providers are already connected to the Internet and provide a path or connection for individuals to access the Internet. Your college or university most likely provides you with free access to the Internet either through its local area networks or through a dial-up or telephone connection. There are also some companies that offer free Internet access.

Figure 6-3 TATA Indicom ISP

Commercial Internet service providers offer national, regional, and wireless service.

- **National service providers** like America Online (AOL) are the most widely used. They provide access through standard telephone connections. Users can access the Internet from almost anywhere within the country for a standard fee without incurring long-distance telephone charges. (See Figure 6-3.)

- **Regional service providers** also use telephone lines. Their service area, however, is smaller, typically consisting of several states. If users access the Internet from outside the regional area, they incur long-distance connection charges in addition to the service's standard fees.

- **Wireless service providers** do not use telephone lines. They provide Internet connections for computers with wireless modems and a wide array of wireless devices.

As we will discuss in Chapter 7, users connect to ISPs using one of a variety of connection technologies including **dial-up, DSL, cable,** and **wireless modems**. This creates a **client-server network.** The user's computer is the **client** that requests services from the provider's computer or **server.**

BROWSERS

Browsers are programs that provide access to Web resources. This software connects you to remote computers, opens and transfers files, displays text and images, and provides in one tool an uncomplicated interface to the Internet and Web documents. Browsers allow you to explore, or to **surf,** the Web by easily moving from one Web site to another Two well-known browsers are Netscape Navigator and Microsoft Internet Explorer. (See Figure 6-4.)

Figure 6-4 Internet Explorer

For browsers to connect to resources, the **location** or **address** of the resources must be specified. These addresses are called **uniform resource locators (URLs).** All URLs have at least two basic parts. (See Figure 6-5.) The first part presents the protocol used to connect to the resource. As we will discuss in Chapter 7, **protocols** are rules for exchanging data between computers. The protocol *http://* is the most widely used Web protocol. The second part presents the **domain name,** also know as the **top level domain,** it is the name of the server where the resource is located. In Figure 6-5 the server is identified as www.mtv.com.

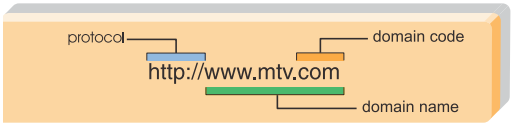


Figure 6–5 Two basic parts of a URL

(Many URLs have additional parts specifying directory paths, file names, and pointers.) The last part of the domain name following the dot (.) is the **domain code.** It identifies the type of organization. For example, *.com* indicates a commercial site. The URL *http:// www.mtv.com* connects your computer to a computer that provides information about MTV.

Once the browser has connected to the Web site, a document file is sent back to your computer. This document contains **Hypertext Markup Language (HTML)** commands. The browser interprets the HTML commands and displays the document as a **Web page.** For example, when your browser first connects to the Internet, it opens up to a Web page specified in the browser settings. This page presents information about the site along with references and **hyperlinks** or **links** that connect to other documents containing related information—text files, graphic images, audio, and video clips. (See Figure 6-6.)

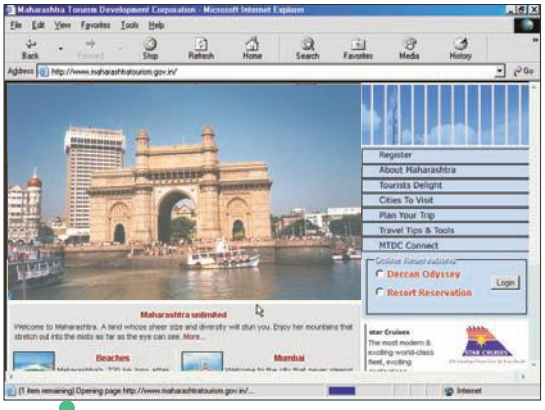


Figure 6–6 Maharashtra Tourism Web site

These documents may be located on a nearby computer system or on one halfway around the world. The computer that stores and shares these documents is called a **Web server.** The references appear as underlined and colored text/images on the Web page. To access the referenced material, all you do is click on the highlighted text or image. A connection is automatically made to the computer containing the material, and the referenced material appears on your display screen.

On the Web Explorations

Popup ads often appear while you surf the Web. They can be a real annoyance. There are many programs available to eliminate these ads. To learn more about getting rid of popup ads, visit our Web site at www.olearyseries.com and select On the Web Explorations.

Web pages also can contain special programs called **applets** that are typically written in a programming language called **Java**. These programs can be downloaded quickly and run by most browsers. Java applets are widely used to add interest and activity to a Web site by presenting animation, displaying graphics, providing interactive games, and much more.

To learn more about browsers, consult your Computing Essentials CD or visit our site at www.olearyseries.com and select Expansions.

CONCEPT CHECK

- What is the function of an ISP? Describe three types of ISPs.
- What is the function of a browser?
- What are URLs, HTML, Web pages, hyperlinks, applets, and Java?

COMMUNICATION

E-mail is the transmission of electronic messages, and it is the most popular Internet activity. Instant messaging extends e-mail to direct, live communication. Discussion groups include mailing lists, news groups, and chat groups.

As previously mentioned, communication is the most popular Internet activity, and its impact cannot be overestimated. At a personal level, friends and family can stay in contact with one another even when separated by thousands of miles. At a business level, electronic communication has become a standard, and many times preferred, way to stay in touch with suppliers, employees, and customers. The three most popular types of Internet communication are e-mail, instant messaging, and discussion groups.

E-MAIL

E-mail or **electronic mail** is the transmission of electronic messages over the Internet. At one time, e-mail consisted only of basic text messages. Now e-mail routinely includes graphics, photos, and many different types of file attachments. People all over the world send e-mail to each other. You can e-mail your family, your co-workers, and even your senator. All you need to send and receive e-mail is an e-mail account, access to the Internet, and an e-mail program. Two of the most widely used e-mail programs are Microsoft's Outlook Express and AOL's Netscape Mail.

A typical e-mail message has three basic elements: header, message, and signature. (See Figure 6-7.) The **header** appears first and typically includes the following information:

- **Addresses:** Addresses of the persons sending, receiving, and, optionally, anyone else who is to receive copies. E-mail addresses have two basic parts. (See Figure 6-8.) The first part is the user's name and the second part is the domain name, which includes the domain code. In our example e-mail, *dcoats* is Dan's user name. The server providing e-mail service for Dan is *usc.edu*. The domain code indicates that the provider is an educational institution.
- **Subject:** A one-line description, used to present the topic of the message. Subject lines typically are displayed when a person checks his or her mailbox.
- **Attachments:** Many e-mail programs allow you to attach files such as documents and worksheets. If a message has an attachment, the File name appears on the attachment line.

On the Web Explorations

Almost all ISPs and online service providers offer e-mail service to their customers. But you can get this service for free from several sources. To learn more about these free services, visit our site at: www.olearyseries.com and select On the Web Explorations.

The letter or **message** comes next. It is typically short and to the point. Finally, the **signature line** provides additional information about the sender. Typically, this information includes the sender's name, address, and telephone number.

E-mail can be a valuable asset in your personal and professional life. However, like many other valuable technologies, there are drawbacks too. Americans receive billions of unwanted and unsolicited e-mails every year. This unwelcome mail is called **spam**. While spam is indeed a distraction and nuisance, it also can be dangerous. For example, **computer viruses** or destructive programs are often attached to unsolicited e-mail. Computer viruses and ways to protect against them will be discussed in Chapter 5.

In an attempt to control spam, anti-spam laws have been added to our legal system. This approach, however, has had minimal impact since over 50 percent of all spam originates from servers outside

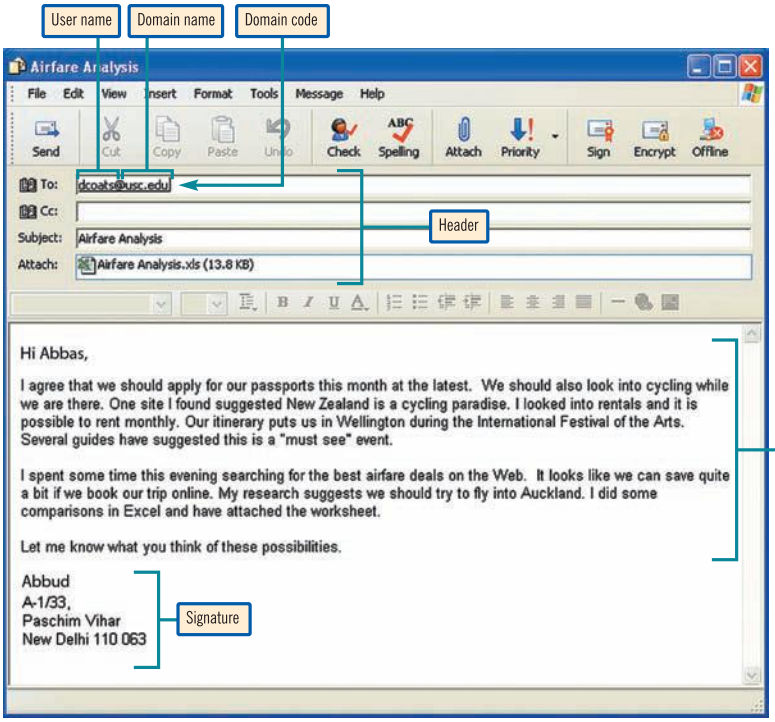


Figure 6-7 Basic elements of an e-mail message

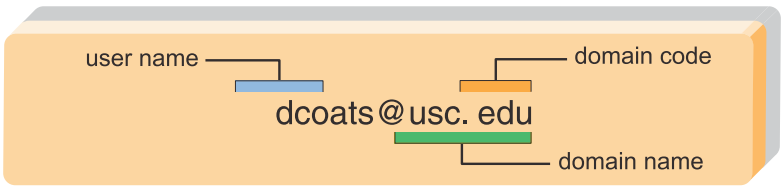


Figure 6-8 Two parts of an e-mail address

TIPS

Are you tired of sorting through an inbox full of spam? [illegible] 200 billion spam e-mails every year. Here are a few [illegible] that your inbox is spam-free:

1. **Choose a complex address.** sally_smith@hotmail.com [illegible] to get spam than 4it3scoq2@hotmail.com. Consider using a [illegible] personal, user name.
2. **Keep a low profile.** Many spammers collect e-mail addresses [illegible] personal Web sites, chat rooms, and message boards. Use caution [illegible] address and be sure to read the privacy policy of a site before you [illegible].
3. **Don't ever respond to spam.** Once you [illegible] request or to opt out of a list, you have confirmed the address is valid [illegible] more to spammers, who then sell the address to others.
4. **Use e-mail filter options.** Most [illegible] filter option that screens incoming e-mail based on a set of [illegible] up your inbox to accept only mail from certain addresses [illegible].
5. **Use anti-spam [illegible]** to help protect your inbox. For example, MailWasher [illegible] program available at www.mailwasher.com.

the United States. A more effective approach has been the development and use of **anti-spam programs.** Also known as **junk mail filters** and **spam blockers,** these programs use a variety of different approaches to identify and eliminate spam. To learn about these approaches, consult your Computing Essentials CD or visit us at www.olearyseries.com and select Expansions. To learn how to block spam from your inbox see Making IT Work for You: Blocking Spam on pages 6-11 and 6-12.

INSTANT MESSAGING

Instant messaging (IM) is an extension of e-mail that allows two or more people to contact each other via direct, live communication. To use instant messaging, you specify a list of **friends** (also known as **buddies** or **contacts**) and register with an instant messaging server. Whenever you connect to the Internet, special software informs your messaging server that you are online. In response, the server will notify you if any of your contacts are online. At the same time, it notifies your contacts that you are online. You can then send messages directly back and forth to one another. Many new instant messaging programs also include video conferencing features, File sharing, and remote assistance. To see how Instant Messaging works, consult your Computing Essentials CD or visit us at www.olearyseries.com and select Animations.

The most widely used instant messaging services are AOL's Instant Messenger, Microsoft's MSN Messengei and Yahoo Messenger. One limitation, however, is that many instant messaging services do not support communication with other services. For example, at the time of this writing, a user registered with AOL cannot use AOL's Instant Messenger software to communicate with a user registered with Yahoo Messenger. Recently, however, some software companies have started providing **universal instant messenger** programs that overcome this limitation. For example, Gain, Odigo, and Trillian provide instant messaging services that do support communication with other services.

CONCEPT CHECK

- Define e-mail. What are the three basic elements of a typical e-mail message?
- What is SPAM? What are anti-spam programs?
- Define instant messaging. What is a universal instant messenger?

Description	Subscription Address
Music and bands	dbird@netinfo.com.au
Movies	moviereview@cuenet.com
Jokes	jokeaday.com
Travel	tourbus@listserv.aol.com

Figure 6-9 Popular mailing lists

DISCUSSION GROUPS

You can also use e-mail to communicate in **discussion groups** with people you do not know but with whom you wish to share ideas and interests. You can participate in forums and debates that range from general topics like curren events and movies to specialized forums like computer troubleshooting and Hollywood animations. Discussion groups include mailing lists, news-groups, and chat groups.

- **Mailing lists** allow members to communicate by sending messages to a **list address**. Each message is then copied and sent via e-mail to every member of the mailing list. To participate in a mailing list, you must first subscribe by sending an e-mail request to the mailing list **subscription address.** (See Figure 6-9.) once you are a member of a list, You may find the number of messages to be overwhelming. If you want to cancel a mailing list, send an e-mail request to "unsubscribe" to the subscription address.

- **Newsgroups,** unlike mailing lists, use a special network of computers called the **UseNet**. Each of these computers maintains the newsgroup listing. There are over 10,000 different newsgroups organized into major topic areas that are further subdivided into subtopics. (See Figure 6-10.) Contributions to a particular newsgroup are sent to one of the computers on the UseNet. This computer saves the messages on its system and periodically shares all its recent messages with the other computers on the UseNet. Unlike mailing lists, a copy of each message is not sent to each member of a list. Rather, interested individuals check contributions to a particular newsgroup, reading only those of interest. There are thousands of news groups covering a wide variety of topic areas. (See Figure 6-11.)
- **Chat groups,** like IM, allow direct live communication. Unlike IM, chat groups typically connect individuals who have never met face-to-face. To participate, you join a chat group, select a **channel** or topic, and communicate live with others by typing words on your computer. Other members of your channel immediately see those words on their computers and can respond in the same manner. One popular chat service is called **Internet Relay Chat (IRC)**. This software is available free from several locations on the Internet. Using the chat-client software, you log on to the server, select a channel or topic in which you are interested, and begin chatting. To participate, you need access to a server or computer that supports IRC. This is done using special chat-client software.

Figure 6-10 Google Groups connects you to UseNet

Description	Newsgroups
Aerobics fitness	misc.fitness.aerobic
Cinema	rec.arts.movies
Mountain biking	rec.bicycles.off-road
Music	rec.music.hip-hop
Clip art	alt.binaries.clipart

Figure 6-11 Popular newsgroups

Before you submit a contribution to a discussion group, it is recommended that you observe or read the communications from others. This is called **lurking**. By lurking, you can learn about the culture of a discussion group. For example, you can observe the level andstyle of the discussions. You may decide that a particular discussion group is not what you were looking for—in which case, unsubscribe. If the discussions are appropriate and you wish to participate, try to fit into the prevailing culture. Remember that your contributions will likely be read by hundreds of people.

For a list of commonly used discussion group terms, see Figure 6-12.

Term	Description
Flaming	Insulting, putting down, or attacking
Lurking	Reading news but not joining in to contribute
RFD	Request for discussion
Saint	Someone who aids new users by answering questions
Thread	A sequence of ongoing messages on the same subject
Wizard	Someone who has comprehensive knowledge about a subject

Figure 6-12 Common discussion group terms

CONCEPT CHECK

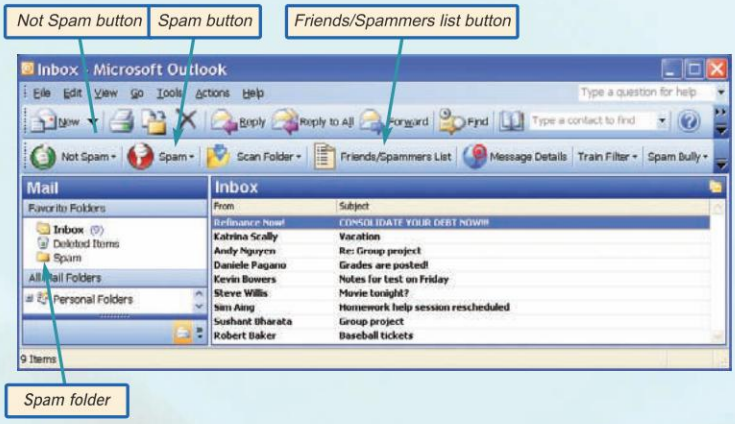
- What is a discussion group? Discuss mailing lists, newsgroups, and chat groups.
- Compare and contrast mailing lists and newsgroups.
- What is a chat group? What are channels?

BLOCKING SPAM

Are you tired of unwanted e-mail in your inbox? Do you frequently spend valuable time sorting through junk e-mail? Installing spam blocking software can help. One of the best known spam blockers is Spam Bully, available from www.spambully.com, which integrates with Microsoft Outlook. Once Spam Bully has been installed, the Spam Bully toolbar will be displayed each time Outlook is started.

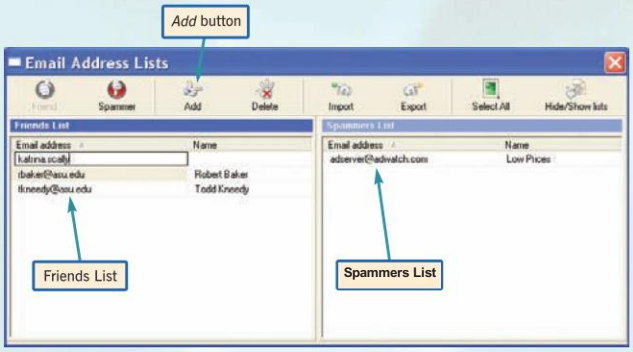
Training the Software Before Spam Bully can detect spam for you automatically, it needs to be trained to recognize unwanted messages. As you follow the steps below for several weeks, Spam Bully should become more and more accurate at categorizing your incoming e-mail and moving it to the correct folder automatically. Affer opening Outlook, you can begin training Spam Bully.

1. Select each spam message in your inbox and click the *Spam* button.
2. Open the Spam folder and review the new messages.
   - For any nonspam message, select the message and click the *Not Spam* button to return it to your inbox.



Specifying Friends and Spammers To ensure that e-mail messages from certain senders are never accidentally categorized as spam, you can add them to a list of friends. Likewise, you can also maintain a list of addresses that should always be considered spam. To specify friends and spammers:

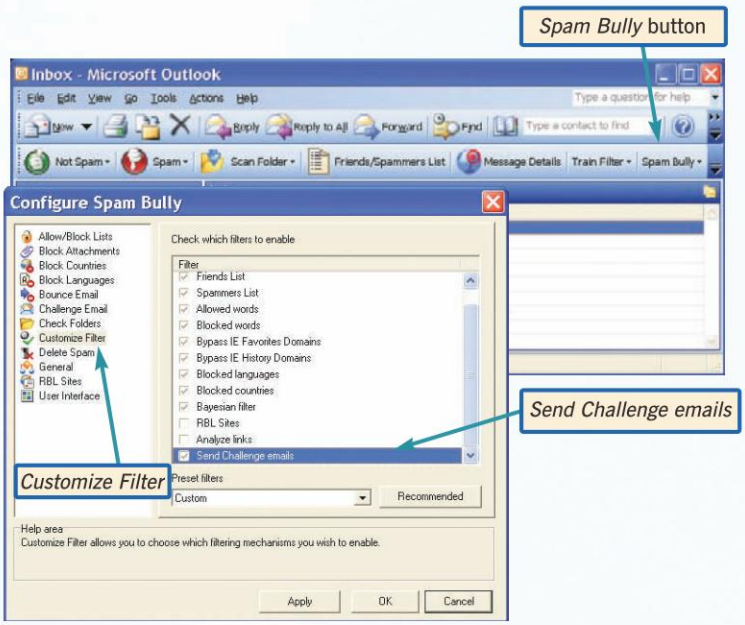
1. Click the *Friends/ Spammers List* button to open the Email address lists.
2. Click within the Friends List to select it.
   - To specify a friend, click the *Add* button and enter the friend's address.



Messages from the Friends List will always be delivered to your inbox. Repeat the above procedures for the Spammers List to specify addresses for messages that should always be considered spam.

Sending Challenge Messages Challenge messages increase the effectiveness of spam-blocking software. Unknown senders are required to respond to an automated e-mail with a password or phrase before their original message is delivered to you. This minimizes the chances that the e-mail came from a spam program. To enable challenge messages in Spam Bully:

1. Click the *Spam Bully* button, and select *Configure Spam Bully*.
2. Select *Customize Filter* from the list on the left.
   - Check the *Send Challenge emails* box in the list on the right.
   - Click OK.

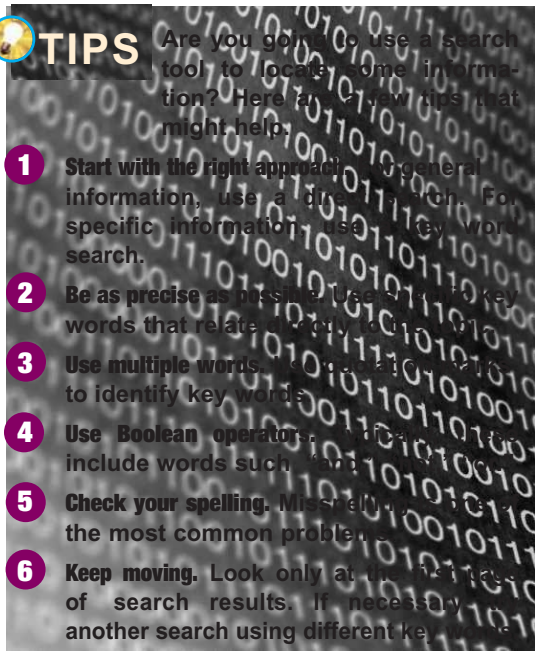


Spam-blocking programs are continually changing and some of the specifics presented in this Making IT Work for You may have changed. To learn about other ways to make information technology work for you, consult your Computing Essentials CD or visit us at www.olearyseries.com and select Making IT Work for You.

SEARCH TOOLS

Search engines locate information. Metasearch engines submit search requests to several search engines simultaneously. Specialized search engines focus on subject-specific Web sites.

The Web can be an incredible resource, providing information on nearly any topic imaginable. Are you planning a trip? Writing an economics paper? Looking for a movie review? Trying to locate a long-lost friend? Information sources related to these questions, and much, much more are available on the Web.



With over 2 billion pages and more being added daily, the Web is a massive collection of interrelated pages. With so much available information, locating the precise information you need can be difficult. Fortunately, a number of organizations called **search services** or **search providers** operate Web sites that can help you locate the information you need. They maintain huge databases relating to information provided on the Web and the Internet. The information stored at these databases includes addresses, content descriptions or classifications, and keywords appearing on Web pages and other Internet informational resources. Special programs called **spiders,** or **Webcrawlers** continually look for new information and update the search services' databases. Additionally, search services provide special programs called search engines that you can use to locate specific information on the Web.

SEARCH ENGINES

Search engines are specialized programs that assist you in locating information on the Web and the Internet. To find information, you go to a search service's Web site and use its search engine. For example, see Figure 6-13 for Yahoo's search engine. This search engine, like most others, provides two different search approaches.

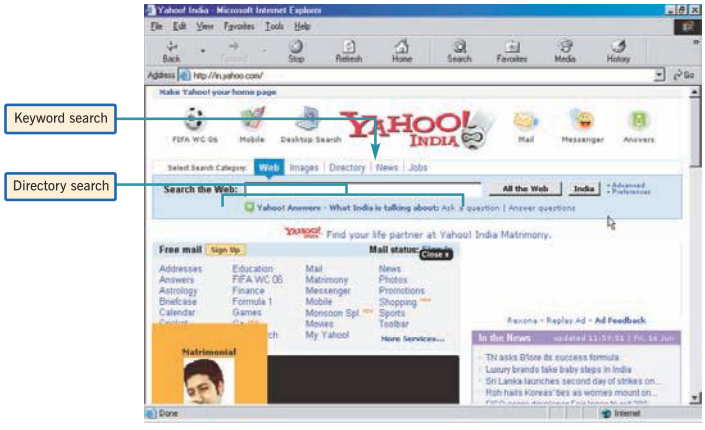


Figure 6-13 Yahoo's search engine provides keyword and directory search

- **Keyword search:** In a **keyword search,** you enter a keyword or phrase reflecting the information you want. The search engine compares your entry against its database and returns a list of **hits,** or sites that contain the keywords. Each hit includes a hyperlink to the referenced Web page (or other resource) along with a brief discussion of the information contained at that location. Many searches result in a large number of hits. For example, if you were to enter the keyword *travel*, you would get thousands of hits. Search engines order the hits according to those sites that most likely contain the information requested and present the list to you in that order, usually in groups of 10.
- **Directory search:** Most search engines also provide a directory or list of categories or topics such as Finance, Health, and News. In a **directory search,** also known as an **index search,** you select a category or topic that fits the information that you want. Another list of subtopics related to the topic you selected appears. You select the subtopic that best relates to your topic and another subtopic list appears. You continue to narrow your search in this manner until a list of Web sites appears. This list corresponds to the hit list previously discussed.

As a rule, if you are searching for general information, use the directory search approach. For example, to find general information about music, use a directory search beginning with the category Entertainment and then select the subtopic Music. If you are searching for specific information, use the keyword approach. For example, if you were looking for a specific music file, you would use a keyword search that includes the album title and/or the artist's name

A recent study by the NEC Research Institute found that any one search engine includes only a fraction of the informational sources on the Web. Therefore, it is highly recommended that you use more than one search engine when researching important topics. See Figure 6-14 for a list of some of the most widely used search engines. Or, you could use a special type of search engine called a metasearch engine.

Search Service	Site
Alta Vista	www.altavista.com
Excite	www.excite.com
Google	www.google.com
Ask Jeeves	www.ask.com
Teoma	www.teoma.com
Yahoo!	www.yahoo.com

Figure 6-14 Search engines

METASEARCH ENGINES

One way to research a topic is to visit the Web sites for several individual search engines. At each site, you would enter the search instructions, wait for the hits to appear, review the list, and visit selected sites. This process can be quite time-consuming and duplicate responses from different search engines are inevitable. Metasearch engines offer an alternative.

Metasearch engines are programs that automatically submit your search request to several search engines simultaneously. The metasearch engine receives the results, eliminates duplicates, orders the hits, and then provides the edited list to you. See Figure 6-15 for a list of several metasearch engines available on the Web. One of the best known is Dogpile, see Figure 6-16.

Metasearch Service	Site
Dogpile	www.dogpile.com
Ixquick	www.ixquick.com
Mamma	www.mamma.com
MetaCrawler	www.metacrawler.com
ProFusion	www.profusion.com
Search	www.search.com
Vivisimo	www.vivisimo.com

Figure 6-15 Metasearch sites

SPECIALIZED SEARCH ENGINES

Specialized search engines focus on subject-specific Web sites. Specialized sites can potentially save you time by narrowing your search. For a list of just a few selected specialized search engines, see Figure 6-17. For example, let's say you are researching a paper about the fashion industry. You could begin with a general search engine like Yahoo! Or you could go to a search engine that specializes specifically in fashion, such as infomat.com.

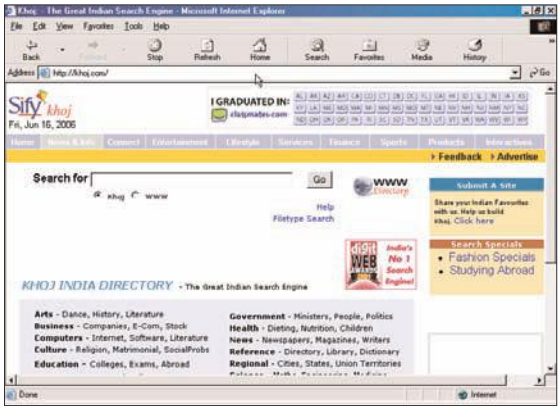


Figure 6–16 Khoj search site

Topic	Site
Environment	www.eco-web.com
Fashion	www.infomat.com
History	www.historynet.com
Law	www.llrx.com/guide
Medicine	www.medsite.com

Figure 6–17 Select specialized search engines

CONCEPT CHECK

- What is the difference between a search engine and a metasearch engine?
- What is a specialized search engine? When would a specialized search engine be useful?

ELECTRONIC COMMERCE

E-commerce is buying and selling over the Internet. B2C, C2C, and B2B are types of e-commerce. Web storefronts are B2C. Web auctions are C2C. The greatest challenge to e-commerce development is security.

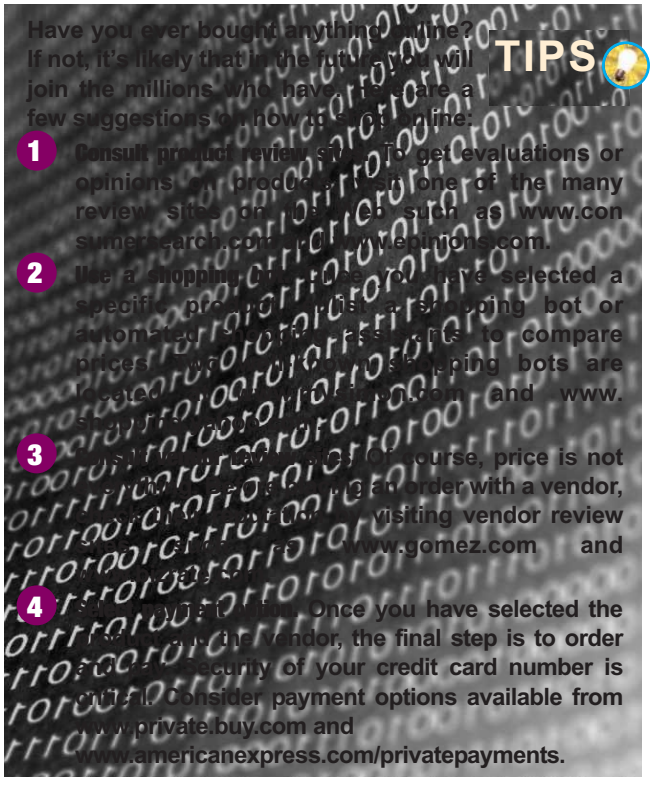
Electronic commerce, also known as **e-commerce,** is the buying and selling of goods over the Internet. Have you ever bought anything over the Internet? If you have not, there is a very good chance that you will within the next year or two. Shopping on the Internet is growing rapidly and there seems to be no end in sight. Just like any other type of commerce, electronic commerce involves two parties: businesses and consumers. There are three basic types of electronic commerce:

- **Business-to-consumer (B2C)** involves the sale of a product or service to the general public or end users. Oftentimes this arrangement eliminates the middleman by allowing manufacturers to sell directly to customers. Other times, existing retail stores use B2C e-commerce to create a presence on the Web as another way to reach customers.
- **Consumer-to-consumer (C2C)** involves individuals selling to individuals. This often takes the form of an electronic version of the classified ads or an auction. Goods are described and interested buyers contact sellers to negotiate prices. Unlike traditional sales via classified ads and auctions, buyers and sellers typically never meet face-to-face.
- **Business-to-business (B2B)** involves the sale of a product or service from one business to another This is typically a manufacturer-supplier relationship. For example, a furniture manufacturer requires raw materials such as wood, paint, and varnish. In B2B e-commerce, manufacturers electronically place orders with suppliers and many times payment is made electronically. The most popular B2B e-commerce is for automobile parts, electronics including computers, and health care.

WEB STOREFRONTS

Web storefronts are virtual stores for B2C electronic commerce. Shoppers visit the stores on the Web to inspect merchandise and make purchases. A new type of program called **Web storefront creation packages** or **commerce servers** has recently evolved to help businesses create virtual stores. These programs create Web sites that allow visitors to register, browse, place products into virtual shopping carts, and purchase goods and services. And they do even more behind the scenes. They calculate taxes and shipping costs, handle a variety of payment options, update and replenish inventory, and ensure reliable and safe communications. Additionally, the storefront sites collect data about visitors and generate reports to evaluate the site's profitability. (See Figure 6-18.)

Using commerce servers, a start-up company can become operational with a Web storefront in just a few weeks for as little as $2,000 and monthly server costs of $100.



WEB AUCTIONS

A recent trend in C2C e-commerce is the growing popularity of Web auctions. **Web auctions** are similar to traditional auctions except writing the buyers and sellers seldom, if ever, meet face-to face. Sellers post descriptions of products at a Web site and buyers submit bids electronically. Like traditional auctions, sometimes the bidding becomes highly competitive and enthusiastic. There are two basic types of Web auction sites:

- **Auction house sites** sell a wide range of merchandise directly to bidders. The auction house owner presents merchandise that is typically from a company's surplus stock. These sites operate like a traditional auction, and bargain prices are not uncommon. Auction house sites are generally considered safe places to shop.
- **Person-to-person auction sites** operate more like flea markets. The owner of the site provides a forum for numerous buyers and sellers to gather. While the owners of these sites typically facilitate the bidding process, they are not involved in completing transactions or in verifying the authenticity of the goods sold. (See Figure 6-19.) As with purchases at a flea market, buyers and sellers need to be cautious.

For a list of the most popular Web auction sites, see Figure 6-20.

Figure 6-18 Web storefront creation package site

Figure 6-19 Person-to-person Web auction site

Organization	Site
Amazon	www.auctions.amazon.com
eBay	www.ebay.com
uBid.com	www.ubid.com
Sotheby's	www.sothebys.com
Yahoo	www.auctions.yahoo.com

Figure 6-20 Auction sites

SECURITY

The single greatest challenge for e-commerce is the development of fast, secure, and reliable payment methods for purchased goods. The three basic payment options are check, credit card, and electronic cash.

- Checks are the most traditional and perhaps the safest. Unfortunately, check purchases require the longest time to complete. After selecting an item, the buyer sends a check through the mail. Upon receipt of the check, the seller verifies that the check is good. If it is good, then the purchased item is sent out.
- Credit card purchases are faster and more convenient than check purchases. Credit card fraud, however, is a major concern for both buyers and sellers. Criminals known as **carders** specialize in stealing, trading, and using stolen credit cards over the Internet. We will discuss this and other privacy and security issues related to the Internet in Chapter 10.
- **Electronic cash,** or **e-cash,** is the Internet's equivalent to traditional cash. It is also known as **cybercash** and **digital cash**. Buyers purchase e-cash from a third party (a bank that specializes in electronic currency) by transferring funds from their banks. (See Figure 6-21.) Buyers purchase goods using e-cash. Sellers convert the e-cash to traditional currency through the third party. Although not as convenient as credit card purchases, e-cash is more secure. For a list of e-cash providers, see Figure 6-22.

Figure 6-21 PayPal offers electronic payment

Organization	Site
ECash	www.ecash.com
EmoneyMail	www.emoney.com
World Pay	www.worldpay.com
PayPal	www.paypal.com

Figure 6-22 Electronic cash providers

CONCEPT CHECK

- What is electronic commerce?
- What are the three basic types of e-commerce?
- What are the three basic options for electronic payment?

WEB UTILITIES

Web utilities are programs that make working with the Web and the Internet easier and safer. Telnet and FTP are Internet standards. Plug-ins operate as part of a browser. Filters block access and monitor use of selected Web sites.

Utilities are programs that make computing easier. **Web utilities** are specialized utility programs that make using the Internet and the Web easier and safer. Some of these utilities are Internet services for connecting and sharing resources over the Internet. Others are browser-related programs that either become part of your browser or are executed from your browser

TELNET

Many computers on the Internet will allow you to connect to them and to run selected programs on them. **Telnet** is an Internet standard that allows you to connect to another computer (host) on the Internet and to log on to that computer as if you were on a terminal in the next room. There are hundreds of computers on the Internet that you can connect to. Some allow limited free access, and others charge fees for their use.

FTP

File transfer protocol (FTP) is an Internet standard for transferring files. Many computers on the Internet allow you to copy files to your computer. This is called **downloading.** You also can use FTP to copy files from your computer to another computer on the Internet. This is called **uploading.**

PLUG-INS

Plug-ins are programs that are automatically started and operate as a part of your browser. Many Web sites require you to have one or more plug-ins to fully experience their content. Some widely used plug-ins include:

- Acrobat Reader from Adobe—for viewing and printing a variety of standard forms and other documents saved in a special format called PDF.
- Cosmos from Silicon Graphics—for displaying three-dimensional graphics.
- Windows Media Player from Microsoft—for playing audio files, video files, and much more.
- QuickTime from Apple—for playing audio and video files. (See Figure 6-23.)

Figure 6-23 QuickTime movie at Apple.com

Plug-in	Source
Acrobat Reader	www.adobe.com
Media Player	www.microsoft.com
QuickTime	www.apple.com
RealPlayer	www.real.com
Shockwave	www.macromedia.com

Figure 6-24 Plug-in sites

- RealPlayer from RealNetworks—for playing audio and video files.
- Shockwave from Macromedia—for playing Web-based games and viewing concerts and dynamic animations.

Some of these utilities are included in many of today's browsers and operating systems. Others must be installed before they can be used by your browser. To learn more about plug-ins and how to download them, visit some of the sites listed in Figure 6-24.

FILTERS

Filters block access to selected sites. The Internet is an interesting and multifaceted arena. But one of those facets is a dark and seamy one. Parents, in particular, are concerned about children roaming unrestricted across the Internet. (See Figure 6-25.) Filter programs allow parents as well as organizations to block out selected sites and set time limits. (See Figure 6-26.) Additionally, these programs can monitor use and generate reports detailing the total time spent on the Internet and the time spent at individual Web sites, chat groups, and newsgroups. Three well-known filters are CyberPatrol, Cybersitter, and Net Nanny.

Figure 6-25 Parents play an important role in Internet supervision

CONCEPT CHECK

- What are Web utilities?
- Describe Telnet and FTP.
- What are plug-ins and filters used for?

Figure 6-26 CyberPatrol is a Web filter

On the Web Explorations

Some privacy groups object to the use of Web filtering programs on the grounds that they accidentally censor valuable Web content. To learn more about this issue visit our Web site at www.olearyseries.com and select On the Web Explorations.

TIPS

Do your children or little brother or sister use the Internet a lot? While you may want them to be able to take advantage of the educational and entertainment side of the Internet, you also want to protect them from the negative side. To help protect them from viewing inappropriate material, consider the following suggestions:

1. **Locate.** Place the computer in a common area where children can be easily supervised.
2. **Discuss.** Discuss browsing with children to explain what type of content you consider to be appropriate. Create a specific agreement and limit the amount of time your child spends on the Internet.
3. **Surf.** Spend time with your child on the Web. Visit family-oriented sites. Create a shared e-mail account.
4. **Filter.** Use a filter program and/or investigate your browser's security capabilities. Recent versions of Internet Explorer, for example, include [illegible]
5. **Verify.** Check up on your child's Web activities. [illegible] the Web for their screen names.

A Look to the Future

Internet2 Is a High-Performance Network

Have you ever been unable to connect to the Internet? Have you ever waited a long time for a graphic to download? Would you like to have high-speed access to multimedia content? What if you could work in a virtual science lab? Internet2 is a project designed to develop the software and resources needed to meet these bandwidth-heavy services.

Internet2 is a collaborative project between an assembly of universities, the government, and private research groups. Over 60 private companies and 200 universities are currently working together to develop the technology and applications they believe will power the internet in the future. Internet2 is currently 100 times faster than the Internet. Students and faculty at participating universities are currently using Internet2 to collaborate on very media-intensive files and projects. In fact, exchange of digital video is expected to become a major component of Internet2. In order to supply large and uninterrupted digital video files, Internet2 must be a high-bandwidth connect with little delay.

Faster downloads and less waiting are the ultimate goal of this group, but the main objective of their combined efforts is to provide access to new applications. For example, it is anticipated that Internet2 will provide individuals access to virtual libraries and science labs. Internet2 is also expected to enhance the distance learning experience. Current tests are allowing music and video equipment to have music lessons with instructors in other countries. Students are using Internet2 to examine atoms with electron microscopes. Doctors are participating in video surgeries.

Internet2 is not a separate network; it is designed to use advanced networking technology and is not expected to replace the current Internet. It is a super-fast connection over a fiber-optic network that is less likely to lose data or be interrupted. It is nearly 3,000 times faster than a modem connection to the Internet. Private industry is using university experiences with internet2 to develop products for public use later. For example, Cisco Systems is currently working with universities on the next generation of network hardware.

Do you think developments like these will eventually benefit the public? What are the benefits of such collaboration between the public and private sectors? The original Internet and e-mail are the result of private and public partnership. What do you think? Will students one day attend university courses virtually? Some experts suggest the applications currently in development may make it possible.

COMMUNICATIONS AND NETWORKS

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Discuss connectivity, the wireless revolution, and communication systems.**
2. **Describe physical and wireless communications channels.**
3. **Discuss connection devices, including modems, T1, DSL, cable modem, and satellite connections.**
4. **Describe data transmission factors, including bandwidths and protocols.**
5. **Discuss networks and key network terminology.**
6. **Describe different types of networks, including local area, metropolitan area, and wide area networks.**
7. **Describe network architectures, including configurations and strategies.**
8. **Describe organizational uses of Internet technologies, including intranets, extranets, and firewalls.**

CONTENTS

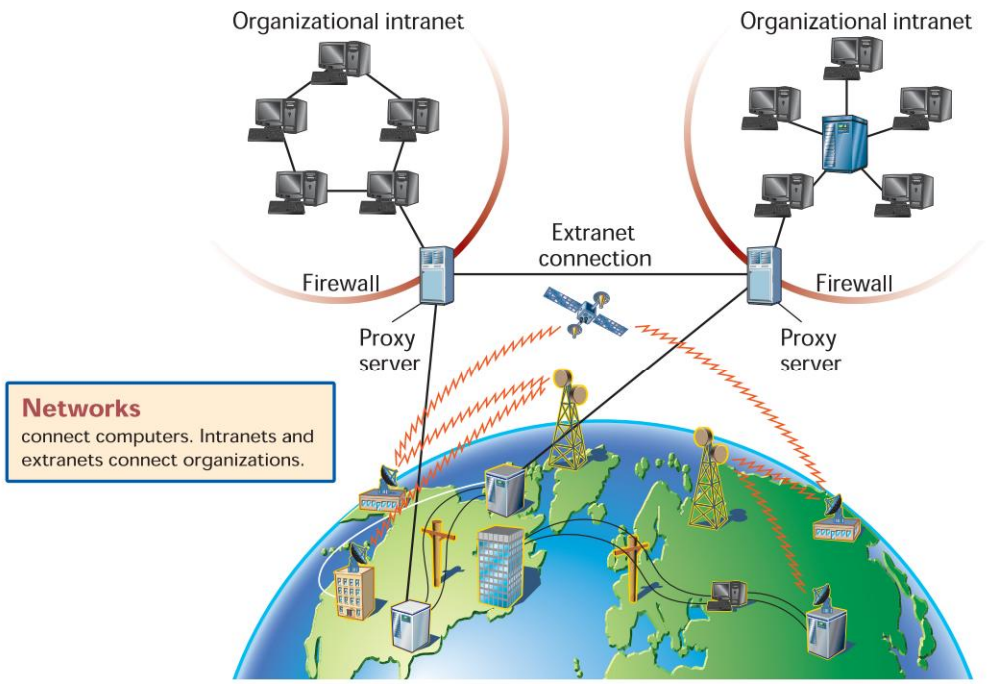
CHAPTER 7

Communications has extended our uses for the microcomputer enormously. The mobile telephone and other wireless technologies are revolutionizing how we use computers today. You can connect your microcomputer to the other people's microcomputers, to the Internet, and to other, larger computers located throughout the world. As we've mentioned earlier, this connectivity puts incredible power on your desk. The result is increased productivity—for you as an individual and for the groups and organizations of which you are a member. Connectivity has become particularly important in business, where individuals now find themselves connected in networks to other individuals and departments.

Communication systems are the electronic systems that transmit data over communications lines from one location to another. You might use a wearable computer and a satellite communication system to access the Internet from almost anywhere. You might work for an organization whose computer system is spread throughout a building, or even throughout the country or world. Or you might use telecommunications lines—telephone lines-to tap into information located in an outside data bank. You could then transmit it to your microcomputer for your own reworking and analysis.

You can even set up a network in your home or apartment using existing telephone lines. Or you can set up a wireless network. Then you can share files, use one Internet connection, and play interactive games with others in your home.

Competent end users need to understand the concept of connectivity, the impact of the wireless revolution, and the elements of a communications system. Additionally, they need to understand the basics of communication channels, connection devices, data transmission, networks, network architectures, and network types.



COMMUNICATIONS

Connectivity relates to linking people and resources by networks. The wireless revolution allows Web-enabled devices to connect to the Internet from almost anywhere in the world. Communication systems comprise sending and receiving devices, a communication channel, connection devices, and transmission specifications.

Computer **communications** is the process of sharing data, programs, and information between two or more computers. We have discussed numerous applications that depend on communication systems, including:

- **E-mail**—provides a fast, efficient alternative to traditional mail by sending and receiving electronic documents.
- **Instant messaging**—supports direct, "live" electronic communication between two or more friends or buddies.
- **Internet telephone**—provides a very low cost alternative to long-distance telephone calls using electronic voice delivery.
- **Electronic commerce**—buying and selling goods electronically.

In this chapter, we will focus on the communication systems that support these and many other applications. Connectivity, the wireless revolution, and communication systems are key concepts and technologies for the 21st century.

CONNECTIVITY

Connectivity is a concept related to using computer networks to link people and resources. For example, connectivity means that you can connect your microcomputer by telephone or other telecommunications links to other computers and information sources almost anywhere. With this connection, you are linked to the world of larger computers and the Internet. This includes minicomputers and mainframes and their extensive information resources. Thus, becoming computer competent and knowledgeable becomes a matter of knowing not only about connectivity through networks to microcomputers, but also about larger computer systems and their information resources.

THE WIRELESS REVOLUTION

The single most dramatic change in connectivity and communications in the past five years has been the widespread use of mobile or wireless telephones. Students, parents, teachers, business people, and others routinely talk and communicate with these devices. It is estimated that over 600 million mobile telephones are in use worldwide. This wireless technology allows individuals to stay connected with one another from almost anywhere at any time.

So what's the revolution? While this wireless technology was originally intended for voice communication, it is now becoming widely used to support all kinds of communication, especially computer communication. In addition, recently released wireless technology promises to allow a wide variety of nearby devices to communicate with one another without any physical connection. You can share a high-speed printer, share data files, and collaborate on working documents with a nearby coworker without having your computers connected by cables or telephone—wireless communication. Other wireless technology allows individuals to connect to the Internet and share information from almost anywhere in the world. (See Figure 7-1.) But is it a revolution? Most experts say yes and that the revolution is just beginning.

COMMUNICATION SYSTEMS

Figure 7–1 Connectivity options

Communication systems are electronic systems that transmit data from one location to another. Whether wired or wireless, every communication system has four basic elements. (See Figure 7-2.)

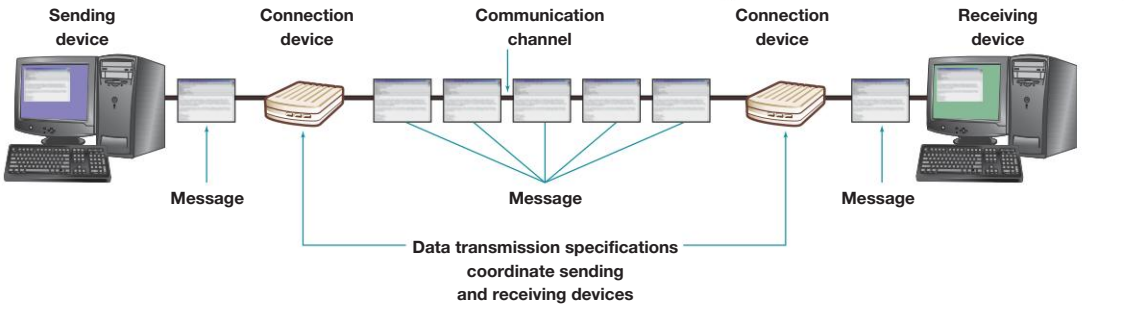
- Sending and receiving devices—These are often a computer or specialized communication device. They originate (send) as well as accept (receive) messages in the form of data, information, and/or instructions.
- Communication channel—This is the actual connecting or transmission medium that carries the message. This medium can be a physical wire or cable, or it can be wireless.
- Connection devices—These devices, also known as communication devices, act as an interface between the sending and receiving devices and the communication channel. They convert outgoing messages into a form and format that can travel across the communication channel. They also reverse the process for incoming messages.
- Data transmission specifications—These are rules and procedures that coordinate the sending and receiving devices by precisely defining how the message will be sent across the communication channel.

For example, if you wanted to send an e-mail to a friend, you could create and send the message using your computer, the *sending device*. Your modem, a *connection device,* would modify and format the message so that it could travel efficiently across *communication channels,* such as telephone lines. The specifications describing how the message is modified, reformatted, and sent would be described in the *data transmission specifications.* After your message traveled across the channel, the receiver's modem, a connection device, would reform it so that it could be displayed on your friend's computer, the receiving device. (Note: This example presents the basic communication system elements involved in *sending* e-mail. It does not and is not intended to demonstrate all the specific steps and equipment involved in an e-mail delivery system.)

CONCEPT CHECK

- Define communications and connectivity.
- What is the wireless revolution?
- Describe the four elements of every communication system.

Figure 7–2 Basic elements of a communication system



COMMUNICATION CHANNELS

Communication channels carry data. Telephone lines, coaxial cables, and fiberoptical cable are physical channels. Infrared, broadcast radio, microwave, and satellite are wireless channels.

Communication channels are an essential element of every communication system. These channels actually carry the data from one computer to another. There are two categories of communication channels. One category connects sending and receiving devices by providing a physical connection, such as a wire or cable. The other category is wireless.

PHYSICAL CONNECTIONS

Physical connections use a solid medium to connect sending and receiving devices. These connections include telephone lines (twisted pair), coaxial cable, and fiber-optic cable.

Figure 7–3 Twisted pair cable

- **Telephone lines** you see strung on poles consist of **twisted pair cable**, which is made up of hundreds of copper wires. A single twisted pair culminates in a wall jack into which you can plug your phone and computer. (See Figure 7-3.) Telephone lines have been the standard transmission medium for years for both voice and data. However, they are now being phased out by more technically advanced and reliable media.

Figure 7–4 Co axial cable

- **Coaxial cable,** a high-frequency transmission cable, replaces the multiple wires of telephone lines with a single solid-copper core. (See Figure 7-4.) In terms of the number of telephone connections, a coaxial cable has over 80 times the transmission capacity of twisted pair. Coaxial cable is use to deliver television signals as well as to connect computers in a network.

Figure 7–5 Fiber-optic cable

- **Fiber-optic cable** transmits data as pulses of light through tiny tubes of glass. (See Figure 7-5.) In terms of the number of telephone connections, fiber-optic cable has over 26,000 times the transmission capacity of twisted pair cable. Compared to coaxial cable, they are lighter and more reliable at transmitting data. They transmit information using beams of light at light speeds instead of pulses of electricity, making them far faster than copper cable. Fiber-optic cable is rapidly replacing twisted pair cable telephone lines.

WIRELESS CONNECTIONS

Wireless connections do not use a solid substance to connect sending and receiving devices. Rather, they use the air itself. Primary technologies used for wireless connections are infrared, broadcast radio, microwave, and satellite.

- **Infrared** uses infrared light waves to communicate over short distances. It is sometimes referred to as **line of sight communication** because the light waves can only travel in a straight line. This requires that sending and receiving devices must be in clear view of one another without any obstructions blocking that view. One of the most common applications is to transfer data and information from a portable device such as a note-book computer or PDA, to a desktop computer.
- **Broadcast radio** communication uses special sending and receiving towers called **transceivers.** These transceivers send and receive radio signals from wireless devices. For example, cellular telephones and many Web-enabled devices use broadcast radio to place telephone calls and/or to connect to the

Internet. Some end users connect their notebook or hand-held computers to a cellular telephone to access the Web from remote locations. Most of these Web-enabled devices follow a standard known as **Wi-FI (wireless fidelity)**. Also known as **802.11**, this wireless standard is widely used to connect computers to each other and to the Internet.

- **Microwave** communication uses high-frequency radio waves. Like infrared, microwave communication provides line of sight communication because microwaves travel in a straight line. Because the waves cannot bend with the curvature of the earth, they can be transmitted only over relatively short distances. Thus, microwave is a good medium for sending data between buildings in a city or on a large college campus. For longer distances, the waves must be relayed by means of **microwave stations** with **microwave dishes** or antennas. (See Figure 7-6.) These stations can be installed on towers, high buildings, and mountaintops.

Figure 7-6 Microwave dish

Bluetooth is a short range wireless communication standard that uses microwaves to transmit data over short distances of up to approximately 33 feet. Unlike traditional microwaves, Bluetooth does not require line of sight communication. Rather it uses radio waves that can pass through nearby walls and other nonmetal barriers. It is anticipated that within the next few years, this technology will be widely used to connect a variety of different communication devices. Figure 7-6 shows a Microwave dish.

- **Satellite** communication uses satellites orbiting about 22,000 miles above the earth as microwave relay stations. (See Figure 7-7.) Many of these are offered by Intelsat, the International Telecommunications Satellite Consortium, which is owned by 114 governments and forms a worldwide communications system. Satellites rotate at a precise point and speed above the earth. They can amplify and relay microwave signals from one transmitter on the ground to another. Satellites can be used to send and receive large volumes of data. **Uplink** is a term relating to sending data to a satellite. **Downlink** refers to receiving data from a satellite. The major drawback to satellite communication is that bad weather can sometimes interrupt the flow of data.

Figure 7-7 Satellite

One of the most interesting applications of satellite communications is for **global positioning.** A network of 24 satellites owned and managed by the Defense Department continuously sends location information to earth. **Global positioning system (GPS)** devices use that information to uniquely determine the geographic location of the device. Available in some automobiles to provide navigational support, these systems are often mounted into the dash with a monitor to display maps and speakers to provide spoken directions. (See Figure 7-8.)

For a summary of communication channels, see Figure 7-9.

Figure 7-8 GPS navigation

CONCEPT CHECK

- What are communication channels?
- Compare telephone, coaxial, and fiber-optic cables.
- Compare physical and wireless channels.
- What is Wi-FI? Bluetooth? GPS?

Channel	Description
Twisted pair	Copper wire, standard voice telephone line
Coaxial cable	Solid copper core, more than 80 times the capacity of twisted pair
Fiber-optic cable	Light carries data, more than 26,000 times the capacity of twisted pair
Infrared	Infrared light travels in a straight line
Broadcast radio	Radio waves used by cellular telephones and other wireless devices
Microwave	High-frequency radio waves, travels in straight line through the air
Satellite	Microwave relay station in the sky, used by GPS devices

Figure 7-9 Types of communication channels

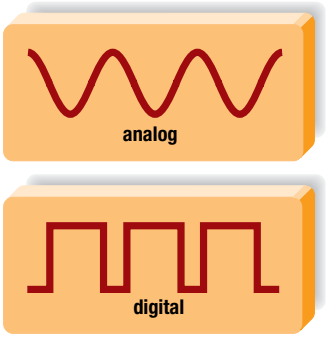


Figure 7-10 Analog versus digital signals

Unit	Speed
bps	bits per second
kbps	thousand bits per second
mbps	million bits per second
gbps	billion bits per second

Figure 7-11 Transfer speeds

CONNECTION DEVICES

Conventional modems convert analog and digital signals. External, internal, PC Card, and wireless are types of modems. Leased high speed telephone lines, DSL, cable modems, and satellites are types of connections.

A great deal of computer communication takes place over telephone lines. However, because the telephone was originally designed for voice transmission telephones typically send and receive **analog signals,** which are continuous electronic waves. Computers, in contrast, send and receive **digital signals.** (See Figure 7-10.) These represent the presence or absence of an electronic pulse—the on/off binary signals we mentioned in Chapter 6. To convert the digital signals to analog signals and vice versa, you need a modem.

MODEMS

The word **modem** is short for *modulator-demodulator.* **Modulation** is the name of the process of converting from digital to analog. **Demodulation** is the process of converting from analog to digital. The modem enables digital microcomputers to communicate across analog telephone lines. This communication includes both voice and data communications.

The speed with which modems transmit data varies. This speed, called **transfer speed** or **transfer rate,** is typically measured in **bits per second** (bps). (See Figure 7-11.) The higher the speed, the faster you can send and receive information. For example, transferring an image like Figure 7-10, might take 75 seconds with a 33.6 kbps modem and only 45 seconds with a 56 kbps modem.

There are four basic types of modems: external, internal, PC Card, and wireless. (See Figure 7-12.)

- The **external modem** stands apart from the computer and typically is connected by a cable to the computer's serial port. Another cable connects the modem to the telephone wall jack.

External

Internal

PC Card

Wireless

Figure 7–12 Basic types of modems

- **The internal modem** consists of a plug-in circuit board inside the system unit. A telephone cable connects the modem to the telephone wall jack.
- The **PC Card modem** is a credit card-size expansion board that is inserted into portable computers. A telephone cable connects the modem to the telephone wall jack.
- A **wireless modem** may be internal, external, or a PC Card. Unlike the other modems, it does not use cables. Instead, wireless modems send and receive through the air.

CONNECTION SERVICE

Standard telephone lines and conventional modems provide what is called a **dial-up service.** Although still the most popular type of connection service, dial-up service is quite slow, and many users find it inadequate to meet their communication needs.

For years, large corporations have been leasing special high-speed lines from telephone companies. These lines—known as **T1, T2, T3,** and **T4 lines**—support all digital communications, do not require conventional modems, and provide very high capacity. Unfortunately, this type of connection is very expensive. For example, T1 lines provide a speed of 1.5 mbps (over 26 times as fast as a conventional modem) and cost several thousand dollars.

While the special high-speed lines are too costly for most individuals, there are affordable connections that provide significantly higher capacity than standard dial-up service. These include **DSL,** cable modems, and satellite. For a comparison of typical user connection costs and speeds, see Figure 7-13.

- **Digital subscriber line (DSL)** uses existing telephone lines to provide high-speed connections. **ADSL (asymmetric digital subscriberline)** is one of the most widely used types of DSL. This technology is widely available in most areas.

Type	Monthly Fee	Speed	Seconds to Receive Image
Dial-up	$16	56 kbps	45.0 seconds
DSL	50	1.5 mbps	1.7 seconds
Cable modem	45	1.5 mbps	1.7 seconds
Satellite	60	900 kbps	2.8 seconds

Figure 7–13 Typical user connection costs and speeds

- **Cable modems** use existing television cables to provide high-speed connections as fast as a T1 or DSL connection, at a lower cost. Although cable connections reach 90 percent of the homes in America, all cable companies do not support cable modems. Industry observers, however, predict 100 percent availability within the next few years.
- **Satellite/air connection services** use satellites and the air to download (down link) or send data to users at a rate seven times faster than dial-up connections. While older satellite services could not upload (uplink) or send data to satellites and had to rely on slow dial-up connections, newer two-way satellite connections are now available. While slower than DSL and cable modems, satellite/air connections are available almost anywhere that a satellite-receiving disk can be aimed at the southern skies.

CONCEPT CHECK

- What is the function of a modem?
- Compare the four types of modems.
- Describe the high-speed Internet connection options affordable to most users.

DATA TRANSMISSION

Bandwidth measures capacity of communication channel. Protocols are rules for exchanging data.

Several factors affect how data is transmitted. These factors include bandwidth and protocols.

BANDWIDTH

Bandwidth is a measurement of the width or capacity of the communication channel. Effectively, it means how much information can move across the communication channel in a given amount of time. For example, to transmit text documents, a slow bandwidth would be acceptable. However, to effectively transmit video and audio, a wider bandwidth is required. There are three categories of bandwidth.

- **Voiceband,** also known as **voice grade** and **low bandwidth,** is used for standard telephone communication. Microcomputers with standard modems and dial-up service use this bandwidth. While effective for transmitting text documents, it is too slow for many types of transmission including high-quality audio and video. Typical speeds are 56 to 96 kbps.
- **Medium band** is the bandwidth used in special leased lines to connect minicomputers and mainframes as well as to transmit data over long distances. Unlike voice band and broadband, medium band is not typically used by individuals.
- **Broadband** is the bandwidth used for high-capacity transmissions. Microcomputers with DSL, cable, and satellite connections as well as other more specialized high-speed devices use this bandwidth. It is capable of effectively meeting most of today's communication needs, including transmitting high-quality audio and video. Speeds are typically 1.5 mbps, although much higher speeds are possible.

PROTOCOLS

For data transmission to be successful, sending and receiving devices must follow a set of communication rules for the exchange of information. These rules for exchanging data between computers are known as **protocols.**

The standard protocol for the Internet is **TCP/IP (transmission control protocol/Internet protocol).** The essential features of this protocol involve (1) identifying sending and receiving devices and (2) reformatting information for transmission across the Internet.

- **Identification:** Every computer on the Internet has a unique numeric address called an **IP address (Internet Protocol address).** Similar to the way a postal service uses addresses to deliver mail, the Internet uses IP addresses to deliver email and to locate Web sites. Because these numeric addresses are difficult for people to remember and use, a system was developed to automatically convert text-based addresses to numeric IP addresses. This system uses a **domain name server (DNS)** that converts text-based addresses to IP addresses. For example whenever you enter a URL, say www.mcgraw-hill.com, a DNS converts this to an IP address before a connection can be made. (See Figure 7-14.)

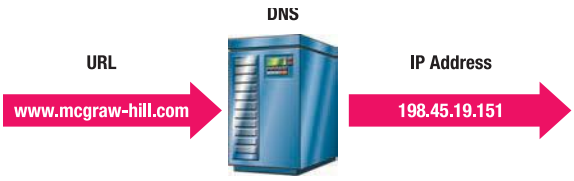


Figure 7-14 DNS converts text-based addresses to numeric IP addresses

- **Reformatting:** Information sent or transmitted across the Internet usually travels through numerous interconnected networks. Before the message is sent, it is reformatted or broken down into small parts called **packets.** Each packet is then sent separately over the Internet, possibly traveling different routes to one common destination. At the receiving end, the packets are reassembled into the correct order.

CONCEPT CHECK

- What is bandwidth? Describe the three categories.
- What are protocols? What is TCP/IP? What is DNS? What are packets?

NETWORKS

Computer networks connect computers. A node may be a client, server, hub, or host computer. Node, client, server, hub, NIC, NOS, distributed processing, host computer, and network manager are specialized network terms.

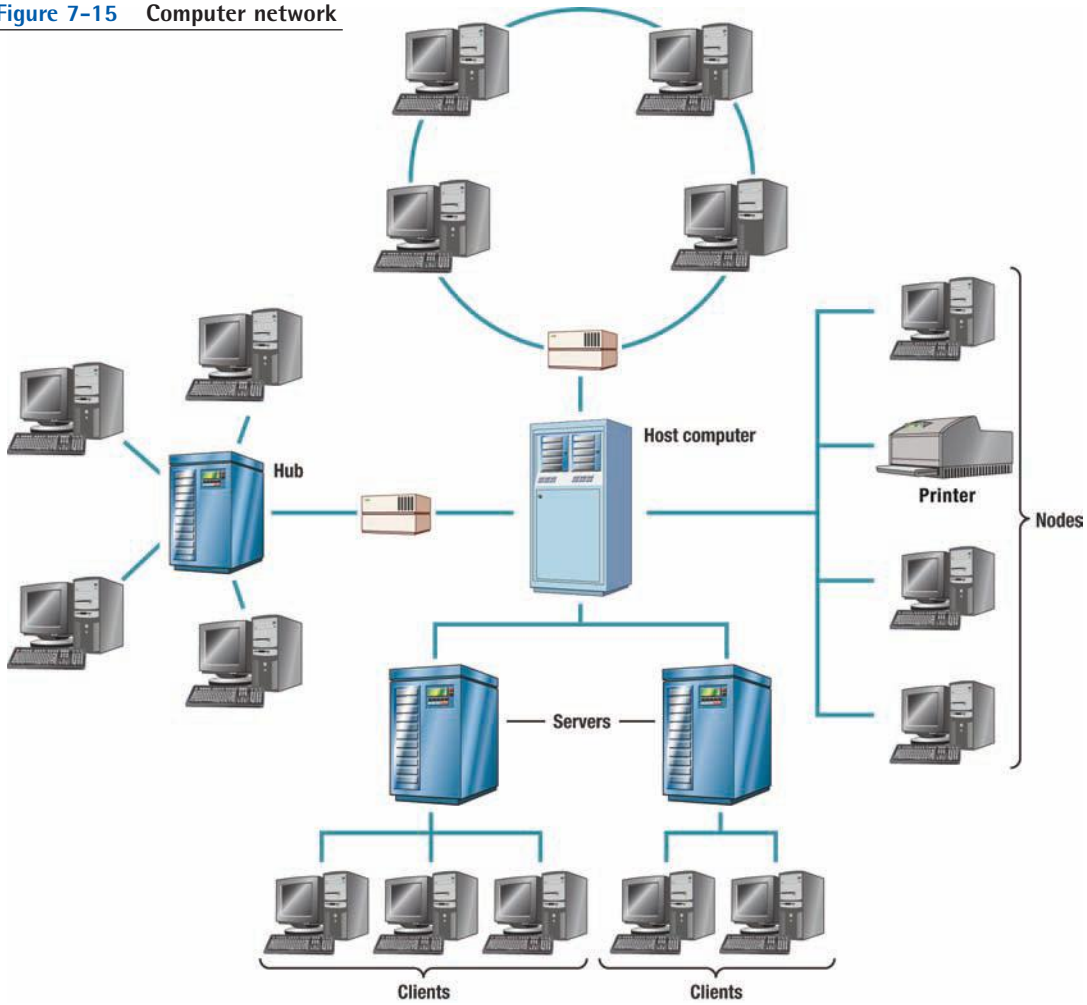
A **computer network** is a communication system that connects two or more computers so that they can exchange information and share resources. Networks can be set up in different arrangements to suit users' needs. (See Figure 7-15.)

TERMS

There are a number of specialized terms that describe computer networks. These terms include:

- **Node**—any device that is connected to a network. It could be a computer, printer, or data storage device.

Figure 7-15 Computer network



- **Client**—a node that requests and uses resources available from other nodes. Typically, a client is a user's microcomputer.
- **Server**—a node that shares resources with other nodes. **Dedicated servers** specialize in performing specific tasks. Depending on the specific task, they may be called an **application server, communication server, database server, file server, printer server,** or **Web server.**
- **Hub**—the center or central node for other nodes. This device can be a server or simply a connection point for cables from other nodes.
- **Network interface cards (NIC)**—as discussed in Chapter 6, these are expansion cards located within the system unit that connect the computer to a network. Sometimes referred to as a **LAN adapter.**
- **Network operating systems (NOS)**—control and coordinate the activities of all computers and other devices on a network. These activities include electronic communication and the sharing of information and resources.

- **Distributed processing**—a system in which computing power is located and shared at different locations. This type of system is common in decentralized organizations where divisional offices have their own computer systems. The computer systems in the divisional offices are networked to the organization's main or centralized computer.
- **Host computer**—a large centralized computer, usually a minicomputer or a mainframe.
- **Network manager**—a computer specialist, also known as **network administrator,** responsible for efficient network operations and implementation of new networks.

A network may consist only of microcomputers, or it may integrate microcomputers or other devices with larger computers. Networks can be controlled by all nodes working together equally or by specialized nodes coordinating and supplying all resources. Networks may be simple or complex, self-contained or dispersed over a large geographical area.

CONCEPT CHECK

- What is a computer network? What are nodes, clients, servers, hubs, and host computers?
- What is the function of an NIC and an NOS?
- What is distributed processing and what is a network manager?

NETWORK TYPES

Communications networks differ in geographical size. LANs, including home networks, connect nearby devices. MANs connect buildings in a city. WANs are countrywide and worldwide networks.

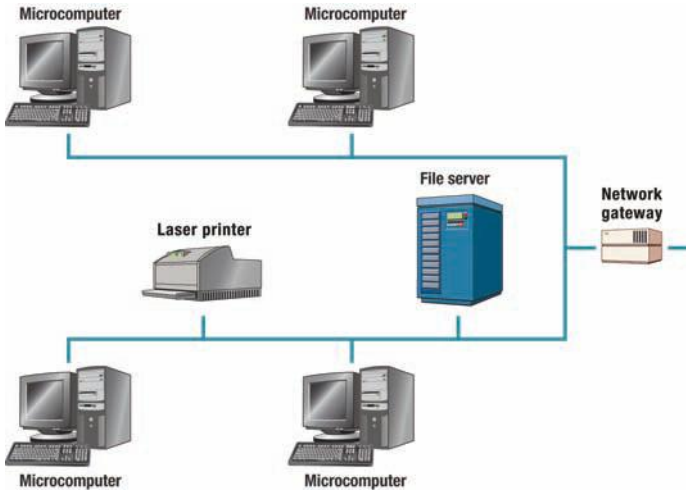
Clearly, different types of channels—cable or air—allow different kinds of networks to be formed. Telephone lines, for instance, may connect communications equipment within the same building or within a home. Networks may also be citywide and even international, using both cable and air connections. Local area, metropolitan area, and wide area networks are distinguished by the geographic area they serve.

LOCAL AREA NETWORKS

Networks with nodes that are in close physical proximity-within the same building, for instance are called **local area networks (LANs).** Typically, LANs span distances less than a mile and are owned and operated by individual organizations. LANs are widely used by colleges, universities, and other types of organizations to link microcomputers and to share printers and other resources. For a simple LAN, see Figure 7-16.

The LAN represented in Figure 7-16 is a typical arrangement and provides two benefits: economy and flexibility. People can share costly equipment. For instance, the four microcomputers share the laser printer and the file server, which are expensive pieces of hardware. Other equipment or nodes may also be added to the LAN—for instance, more microcomputers, a mainframe computer, or optical-disk storage devices. Additionally, the **network gateway** is a device that allows one LAN to be linked to other LANs or to larger networks. For example, the LAN of one office group may be connected to the LAN of another office group.

Figure 7-16 Local area network



There are a variety of different standards or ways in which nodes can be connected to one another and ways in which their communications are controlled in a LAN. The most common standard is known as **Ethernet.** LANs using this standard are sometimes referred to as **Ethernet LANs.**

HOME NETWORKS

On the Web Explorations

Wireless home networks are becoming fast, cheap, and popular. To learn more about a company helping to "unwire" our homes, visit our Web site at www.olearyseries.com and select On the Web Explorations.

While LANs have been widely used within organizations for years, they are now being commonly used by individuals in their homes and apartments. These LANs, called **home networks,** allow different computers to share resources, including a common Internet connection. Computers can be connected in a variety of ways, including electrical wiring, telephone wiring, and special cables. One of the simplest ways, however, is without cables, or wireless.

A wireless local area network is typically referred to as a **wireless LAN (WLAN).** It uses radio frequencies to connect computers and other devices. All communications pass through the network's centrally located **wireless receiver** or **base station.** This receiver interprets incoming radio frequencies and routes communications to the appropriate devices. To see how home networks work, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations.

To learn more about how to set up and use a wireless home network, see Making IT Work for You: Home Networking on page 7-15 and 7-16.

METROPOLITAN AREA NETWORKS

The next step up from the LAN is the **MAN**—the **metropolitan area network.** Also known as **regional networks,** MANs span distances up to 100 miles. These networks are frequently used as links between office buildings that are located throughout a city.

Unlike a LAN, a MAN is typically not owned by a single organization. Rather, it is either owned by a group of organizations who jointly own and operate the network or by a single network service provider who provides network services for a fee. **Cellular phone systems** expand the flexibility of MANs by allowing links to car phone and portable phones.

WIDE AREA NETWORKS

Wide area networks (WANs) are countrywide and worldwide networks. These networks provide access to regional service (MAN) providers and typically span distances greater than 100 miles. They use microwave relays and satellites to reach users over long distances—for example, from Los Angeles to Paris. Of course, the widest of all WANs is the Internet, which spans the entire globe.

The primary difference between a LAN, MAN, and WAN is the geographical range. Each may have various combinations of hardware, such as microcomputers, minicomputers, mainframes, and various peripheral devices.

CONCEPT CHECK

- What are the three types of networks? What is their primary difference?
- What is a home network?
- What is a WLAN? What is a wireless receiver?

NETWORK ARCHITECTURE

Network architecture describes how a computer network is configured and what strategies are employed. Configurations include star, bus, ring, and hierarchical. Strategies include terminal, client-server, and peer-to-peer.

Network architecture describes how a network is arranged and how resources are coordinated and shared. It encompasses a variety of different network specifics, including network configurations and strategies. Network Figure 7-17 Star network configurations describe the physical arrangement of the network. Network strategies define how information and resources are shared.

CONFIGURATIONS

A network can be arranged or configured in several different ways. This arrangement is called the network's **topology.** The four principal network topologies are star, bus, ring, and hierarchical.

In a **star network,** a number of small computers or peripheral devices are linked to a central unit. (See Figure 7-17.) The central unit is the **network hub** and is typically a host computer or file server.

All communications pass through this central unit. Control is maintained by **polling.** That is, each connecting device is asked ("polled") whether it has a message to send. Each device is then in turn allowed to send its message.

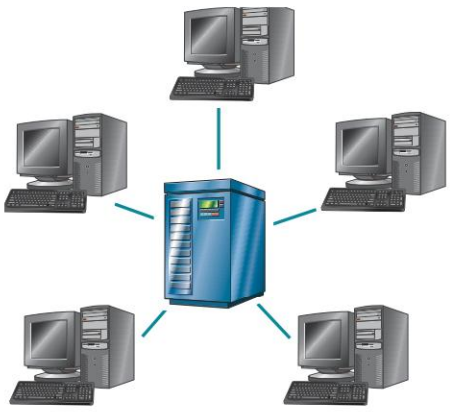


Figure 7-17 Star network

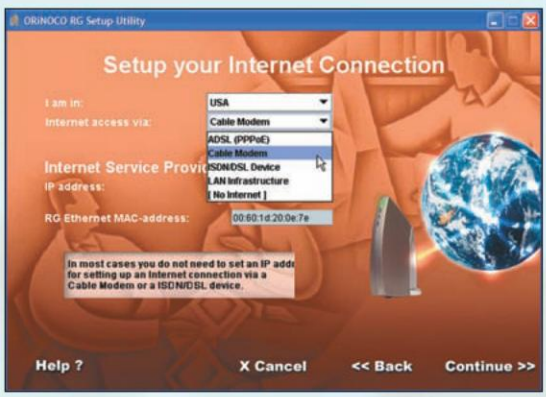
HOME NETWORKING

Computer networks are not just for corporations and schools anymore. If you have more than one computer, you can use a home network to share files and printers, to allow multiple users access to the Internet at the same time, and to play multiplayer computer games.

Installing the Network Each computer on a wireless network requires a wireless network card. Cards are often available in kits that also include a base station. Once the cards are installed in each computer, the base station must be configured for sharing the Internet. Then, each computer can be configured to share files and printers. For example, to set up a wireless network using Agere System's Residential Gateway and Windows XP:

1

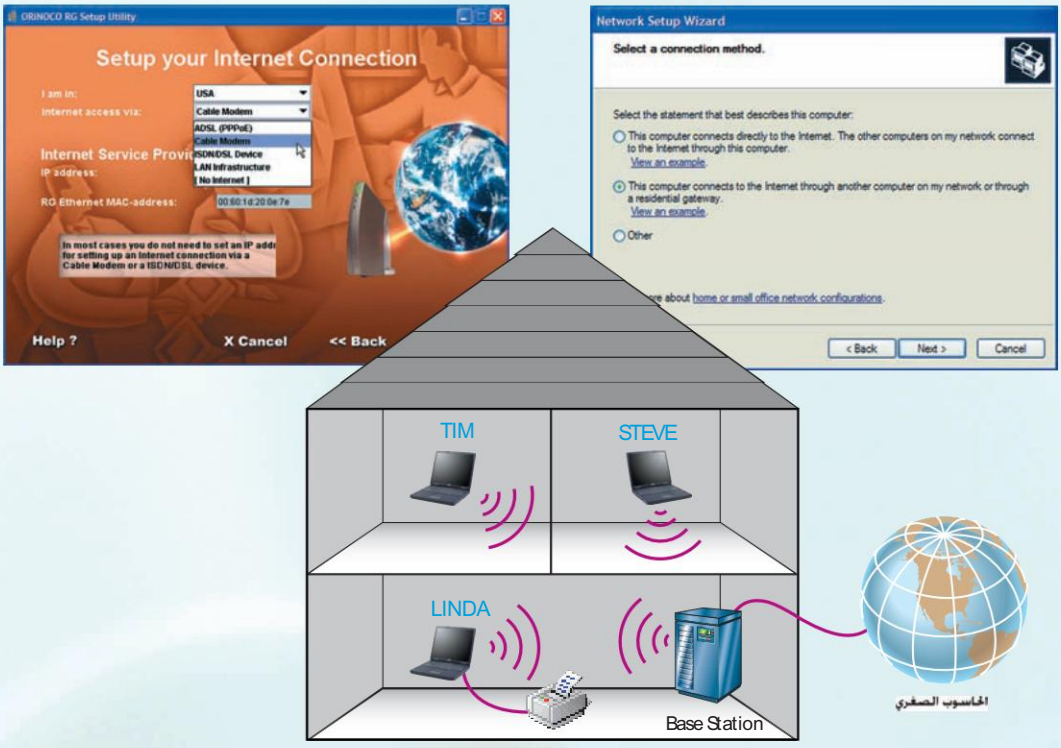
- **Install a compatible wireless card in each computer. In most cases, simply plugging the card in is all that is required.**
- **Run the included software to set up the base station for accessing and sharing the Internet.**

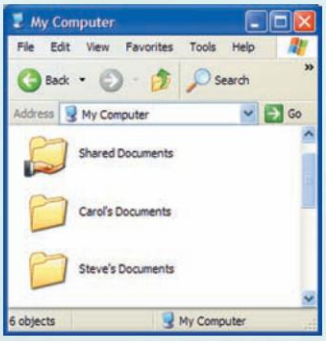


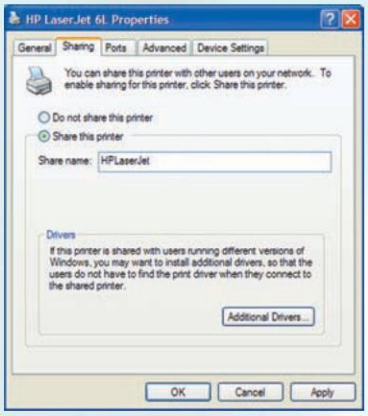
2

- **Click *Start*/*My Network Places* and click *Set up a home or small office network.***
- **Follow the instructions in the wizard to set up your computer for file and printer sharing and to access the Internet through the residential gateway.**

Using the Network Now your computers are ready to share their resources. The four most common uses of a home network are to share files, printers, and Internet access and to run multiplayer computer games.







Home networks are continually changing, and some of the specifics presented in this Making IT Work for You may have changed. To learn about other ways to make information technology work for you, consult your Computing Essentials CD or visit our Web site at www.olearyseries and select Making IT Work for You.

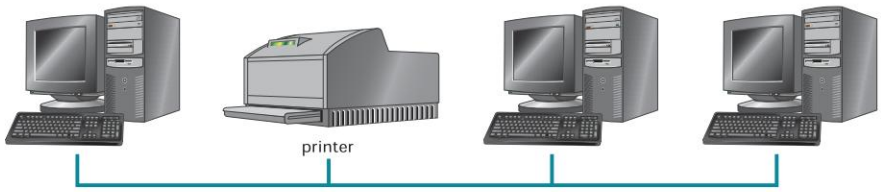


Figure 7–18 Bus network

One particular advantage of the star topology is that it can be used to support a **time-sharing system.** That is, several users can share resources (time) on a central computer. The star is a common topology for linking microcomputers to a mainframe that allows access to an organization's database.

In a **bus network** each device in the network handles its own communications control. There is no host computer. All communications travel along a common connecting cable called a **bus** or **backbone.** (See Figure 7-18.) As the information passes along the bus, it is examined by each device to see if the information is intended for it.

The bus network is typically used when only a few microcomputers are to be linked together. This arrangement is common for sharing data stored on different microcomputers. Because a star network typically provides a more direct path to shared resources, it is more efficient than a bus network for sharing these resources. However, a bus network is easy to install and is less expensive.

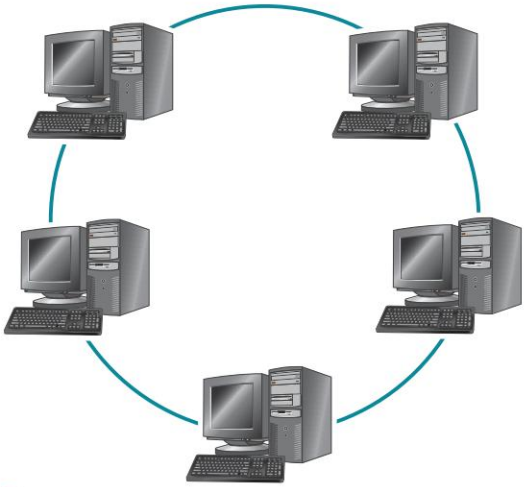


Figure 7–19 Ring network

In a **ring network,** each device is connected to two other devices, forming a ring. (See Figure 7-19.) There is no central file server or computer. Messages are passed around the ring until they reach the correct destination. With microcomputers, the ring arrangement is the least frequently used of the four networks. However, it is often used to link mainframes, especially over wide geographical areas. These mainframes tend to operate fairly autonomously. They perform most or all of their own processing and only occasionally share data and programs with other mainframes.

A ring network is useful in a decentralized organization because it makes possible a **distributed data processing system.** That is, computers can perform processing tasks at their own dispersed locations. However, they also can share programs, data, and other resources with each other.

The **hierarchical network**—also called a **hybrid network**—consists of several com puters linked to a central host computer, just like a star network. However, these other computers are also hosts to other, smaller computers or to peripheral devices. (See Figure 7-20.)

Thus, the host at the top of the hierarchy could be a mainframe. The computers below the mainframe could be minicomputers, and those below, microcomputers. The hierarchical network allows various computers to share databases, processing power, and different output devices.

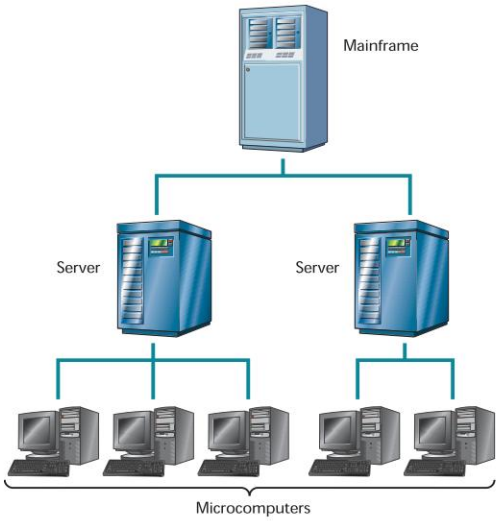


Figure 7–20 Hierarchical network

Topology	Description
Star	Several computers connected to a central server or host; all communications travel through central server; good for sharing common resources
Bus	Computers connected by a common line; communication travels along this common line; less expensive than star
Ring	Each computer connected to two others forming a ring; communications travel around ring; often used to link mainframe computers in decentralized organizations
Hierarchical	One top-level host computer connected to next-level computers, which are connected to third-level computers; often used in centralized organizations

Figure 7–21 Principal network configurations

A hierarchical network is useful in centralized organizations. For example, different departments within an organization may have individual microcomputers connected to departmental minicomputers. The minicomputers in turn may be connected to the corporation's mainframe, which contains data and programs accessible to all.

For a summary of the network configurations, see Figure 7-21.

CONCEPT CHECK

- What is a network topology? What are the four principal network topologies?.
- What is a time-sharing system? What is a distributed data processing system?

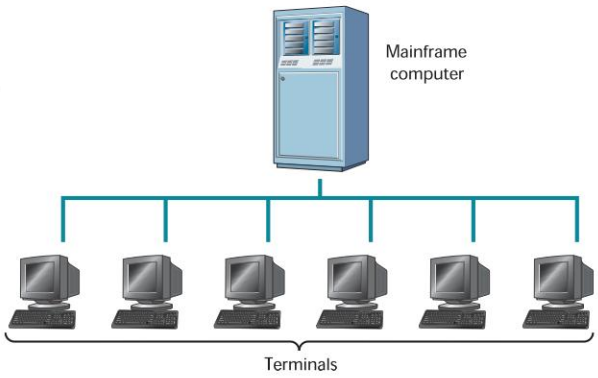
STRATEGIES

Every network has a **strategy,** or way of coordinating the sharing of information and resources. The most common network strategies are terminal, client/server, and peer-to-peer systems.

In a **terminal network system,** processing power is centralized in one large computer, usually a mainframe. The nodes connected to this host computer are either terminals with little or no processing capabilities or microcomputers running special software that allows them to act as terminals. (See Figure 7-22.) The star and hierarchical networks are typical configurations with UNIX as the operating system.

Many airline reservation systems are terminal systems. A large central computer maintains all the airline schedules, rates, seat availability, and so on. Travel agents use terminals to connect to the central computer and to schedule reservations. Although the tickets may be printed along with travel itineraries at the agent's desk, nearly all processing is done at the central computer.

Figure 7-22 Terminal network system



One advantage of terminal network systems is the centralized location and control of technical personnel, software, and data. One disadvantage is the lack of control and flexibility for the end user. Another disadvantage is that terminal systems do not use the full processing power available with microcomputers. Though the terminal strategy was once very popular, most new systems do not use it.

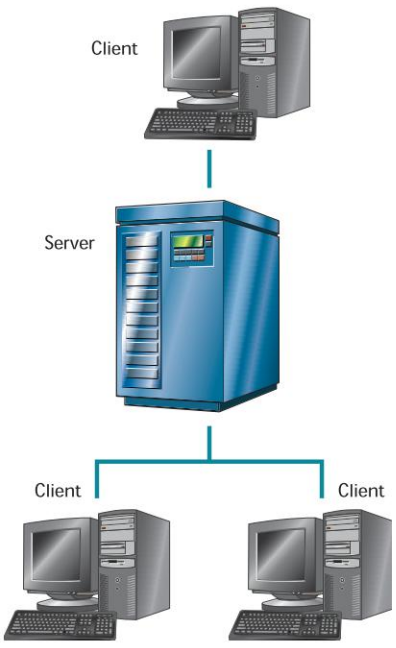


Figure 7-23 Client/server network system

Client/server network systems use one computer to coordinate and supply services to other nodes on the network. The server provides access to resources such as Web pages, databases, application software, and hardware. (See Figure 7-23.) This strategy is based on specialization. Server nodes coordinate and supply specialized services, and client nodes request the services. Commonly used network operating systems are Novell's NetWare, Microsoft's Windows NT, IBM's LAN Server, and Banyan Vines.

Client/server network systems are widely used on the Internet. For example, **Napster** (the once popular music service) employed a version of this strategy. Music enthusiasts used the Internet to connect to Napster servers. The Napster servers provided lists of music files (some of which were copyrighted) that were available to be copied from participating Napster users. The music enthusiasts were clients requesting services (information regarding the location of others willing to share music files) from Napster servers. To learn more about Napster, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions. One advantage of the client/server network strategy is the ability to handle very large networks efficiently. Another advantage is the availability of powerful network management software to monitor and control network activities. The major disadvantages are the cost of installation and maintenance.

In a **peer-to-peer network** system, nodes have equal authority and can act as both clients and servers. For example, one microcomputer can obtain files located on another microcomputer and can also provide files to other microcomputers. (See Figure 7-24.) A typical configuration for a peer-to-peer system is the bus network. Commonly used network operating systems are Novell's NetWare Lite, Microsoft's Windows NT, and Apple's Macintosh Peer-to-Peer LANs.

Many current popular music sharing in services use this network strategy. In fact, the Napster approach was actually a hybrid network in which the Napster server worked in a client-server environment providing a service to clients. Once a Napster user had the location of requested music files, he or she could sign off the net-Files work and then connect directly to the source forming a very simple peer-to peer network. Each node could act as a server by providing access to music files and a client by receiving copies of music files. Today, **Gnutella** is a widely used peer-to-peer network system for sharing all kinds of files, including music files. Unlike the Napster approach, Gnutella networks directly connect users without a center server acting as the focal point for operations. There are various different versions of Gnutella. To learn more about one of the most popular versions, consult your omputing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions.

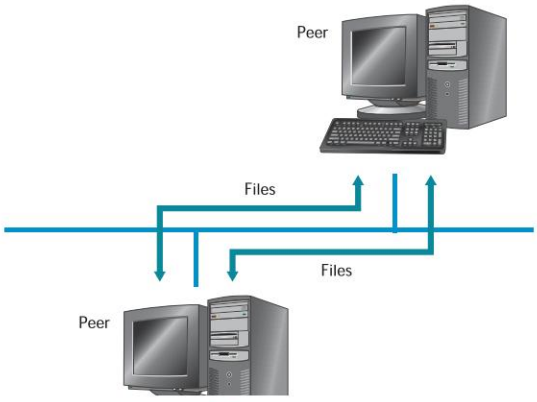


Figure 7-24 Peer-to-peer network system

There are several advantages to the peer-to-peer network strategy. The networks are inexpensive and easy to install, and they usually work well for smaller systems with fewer than 10 nodes. Unlike the client/server network strategy, network operations are not dependent upon a single central node. As the number of nodes increases, however, the performance of the network declines. Another disadvantage is the lack of powerful management software to effectively monitor a large network's activities. For these reasons, peer-to-peer networks are typically used by smaller networks within organizations and for sharing Files on the Internet.

CONCEPT CHECK

- What is a network strategy? Discuss the three most common network strategies.
- Compare the network strategies employed by Napster and Gnutella.

ORGANIZATIONAL INTERNETS: INTRANETS AND EXTRANETS

Intranets are private networks within an organization. Extranets are private networks connecting organizations. Organizational firewalls typically use proxservers to provide security.

Computer networks in organizations have evolved over time. Most large organizations have a complex and wide range of different network configurations, operating systems, and strategies. Integrating or connecting all of these networks has been a very challenging task. One way is to apply Internet technologies to support communication within and between organizations using intranets and extranets.

INTRANETS

An **intranet** is a *private* network within an organization that resembles the Internet. Like the *public* Internet, intranets use browsers, Web sites, and Web pages. Intranets typically provide e-mail, mailing lists, newsgroups, and FTP services accessible only to those within the organization.

Organizations use intranets to provide information to their employees. Typical applications include electronic telephone directories, e-mail addresses, employee benefit information, internal job openings, and much more. Employees find surfing their organizational intranets to be as easy and as intuitive as surfing the Internet.

EXTRANETS

An **extranet** is a *private* network that connects *more than one* organization. Many organizations use Internet technologies to allow suppliers and others limited access to their networks. The purpose is to increase efficiency and reduce costs. For example, General Motors has thousands of suppliers for the parts that go into making an automobile. By having access to the production schedules, suppliers can schedule and deliver parts as they are needed at the General Motors assembly plants. In this way, General Motors can be assured of having adequate parts without maintaining large inventories.

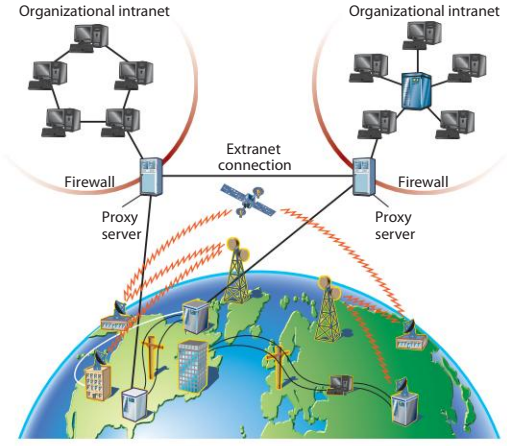


Figure 7–25 Intranets, extranets, firewalls, and proxy servers

FIREWALLS

Organizations have to be very careful to protect their information systems. A **firewall** is a security system designed to protect an organization's network against external threats. It consists of hardware and software that control access to a company's intranet or other internal networks.

Typically organizational firewalls include a special computer called a **proxy server.** This computer is a gatekeeper. All communications between the company's internal networks and the outside world must pass through it. By evaluating the source and the content of each communication, the proxy server decides whether it is safe to let a particular message or file pass into or out of the organization's network. (See Figure 7-25.)

Of course, end users have security issues as well. We are subject to many of the same types of security concerns that face organizations. Additionally, we need to be concerned about the privacy of our personal information. In the next chapter, we will discuss personal firewalls and other ways to protect personal privacy and security.

CONCEPT CHECK

- What are intranets? Compare intranets to the Internet.
- What are extranets? Compare intranets and extranets.
- What are firewalls? What is a proxy server?

A Look to the Future

Toyota and Sony Create Wireless Robotic Car

Have you ever found yourself driving around lost in an unfamiliar city, wishing you could connect to the Internet and download driving directions? Have you ever longed for access to your favorite Internet radio station while you drive around? What if you could send and receive e-mail while you wait in traffic? Wouldn't it be convenient if your car would just send an e-mail whenever it needed maintenance? Toyota and Sony are collaborating on a car called "Pod" that does all this and more.

Pod stands for personalization on demand. Toyota hopes this new car will predict and respond to your moods, likes, and dislikes. It features lighting that may display red if you drive erratically or orange if you seem happy. It features voice recognition technology and responds to verbal commands. Pod is designed to learn and adapt to your driving habits and needs. Some say it is the car equivalent of the Sony AIBO robotic pet.

The Pod connects wirelessly to a portable terminal called the Mini Pod to share data and serve the user's needs. For example, Pod might use the information stored in the PDA-like Mini Pod to download songs from the Internet it thinks you might like. The Pod also uses GPS information and the Internet to make recommendations concerning local restaurants as you drive around.

Pod uses technology developed by Suzuki Motors to phone the owner if it is broken into or needs mechanical attention. Pod can communicate with other cars by using a horn messaging system. It also locates pedestrians and warns the driver to correct speed or course to avoid them. Pod can also phone ahead to your destination to advise those waiting if it detects you will be delayed. It may even alert you when you drive by restaurants that it thinks you may like.

Do these new features appeal to you? Do you think Americans will some day be driving cars that can connect to the Internet? Many new cars come equipped with wireless technology and GPS devices. Some car enthusiasts look forward to a car that senses your mood and downloads songs to match it. For now Pod is a concept vehicle, but many of the features it includes may soon be found in your next car. What do you think? Would you buy a car that communicates with other cars, the Internet, and you?

BASIC APPLICATION SOFTWARE

COMPETENCIES

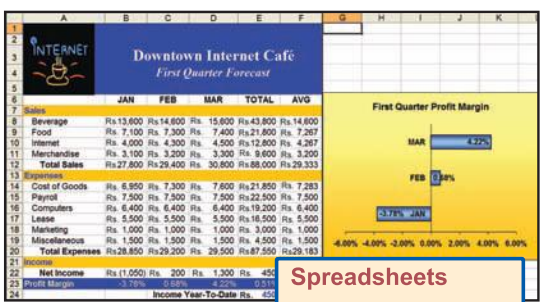
After you have read this chapter, you should be able to:

1. **Discuss common features of most software applications.**
2. **Discuss word processors and word processing features.**
3. **Describe spreadsheets and spreadsheet features.**
4. **Discuss database management systems and database management features.**
5. **Describe presentation graphics and presentation graphics features.**
6. **Discuss integrated software and software suites.**
7. **Describe ways to share data between applications.**

CONTENTS

Word Processing Software
Create text-based documents

Database Management Systems
Organize data for efficient retrieval



Spreadsheets
Use functions and formulas to analyze numeric data

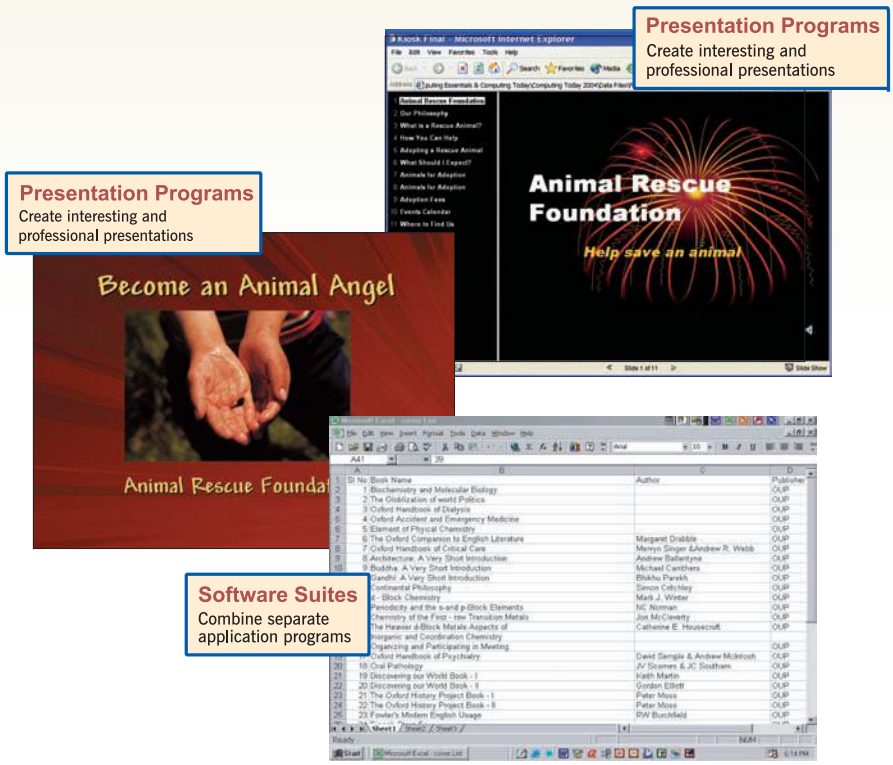
CHAPTER 8

Not long ago, trained specialists were required to perform many of the operations you can now do with a microcomputer. Secretaries used typewriters to create business correspondence. Market analysts used calculators to project sales. Graphic artists created designs by hand. Data processing clerks created electronic files to be stored on large computers. Now you can do all these tasks and many others-with a microcomputer and the appropriate application software.

Think of the microcomputer as an electronic tool. You may not consider yourself very good at typing, calculating, organizing, presenting, or managing information. However, a microcomputer can help you do all these things and much more. All it takes is the right kinds of software.

You are probably most familiar with the software available for sale in retail stores. You purchase these programs, store them on your hard disk, and run them. An emerging trend, however, is to use Web-based applications. These are programs you access from the Internet and run on your microcomputer.

Competent end users need to understand the capabilities of basic application software, which includes word processors, spreadsheets, database management systems, and presentation programs. They need to know how to use application programs effectively and how to share data between applications.



APPLICATION SOFTWARE

There are two categories of application software: basic and specialized. Common interface features include icons, windows, menus, dialog boxes, Help, toolbars, and buttons. Speech recognition accepts voice input. ASPs provide access to Web-based applications.

As we discussed in Chapter 1, there are two kinds of software. **System software** works with end users, application software, and computer hardware to handle the majority of technical details. **Application software** can be described as end user software and is used to accomplish a variety of tasks.

On the Web Explorations

Microsoft is one of the leaders in creating software applications. To learn more about the company, visit our Web site at www.olearyseries.com and select On the Web Explorations.

Application software, in turn, can be divided into two categories. One category, **basic applications,** is the focus of this chapter. These programs, also known as **general-purpose applications** and **productivity applications,** are widely used in nearly every discipline and occupation. They include word processors, spreadsheets, database management systems, and presentation graphics. The other category, **specialized applications,** also known as **special purpose applications,** includes thousands of other programs that are more narrowly focused on specific disciplines and occupations. Some of the best known are graphics programs, audio and video editors, multimedia creation programs, Web authoring, and virtual reality programs.

COMMON FEATURES

A **user interface** is the portion of the application that you work with. Most applications use a **graphical user interface (GUI)** that displays graphical elements called **icons** to represent familiar objects and a mouse. The mouse controls a **pointer** on the screen that is used to select items such as icons. Another feature is the use of windows to display information. A **window** is simply a rectangular area that can contain a document, program, or message. (Do not confuse the term *window* with the various versions of Microsoft's Windows operating systems, which are programs.) More than one window can be opened and displayed on the computer screen at one time.

Almost all software programs have **menus** to present commands. Typically, menus are displayed in a **menu bar** at the top of the screen. When one of the menu items is selected, a **pull-down** or **drop-down menu** appears. This is a list of options or commands associated with the selected menu. Selecting one of these options may display an additional list of menu options or a **dialog box** that provides additional information and requests user input. One of the commands on the menu bar is **Help.** This option provides access to a variety of Help features and acts as an online reference manual.

Toolbars typically are below the menu bar. They contain small outlined areas called **buttons** that provide shortcuts for quick access to commonly used commands. For example, the **standard toolbar** contains a variety of buttons that are common to most applications, including those to open, save, and print files. (See Figure 8-1.) All Microsoft Office applications have a common user interface, including similar commands and menu structures. (See Figure 8-2.) The newest version of Microsoft Office provides **speech recognition** or the ability to accept voice input to select menu options and dictate text. See Making IT Work for You: Speech Recognition on pages 8-5 and 8-6. To learn more about how speech recognition works, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions.

Figure 8-1 Buttons on the standard toolbar

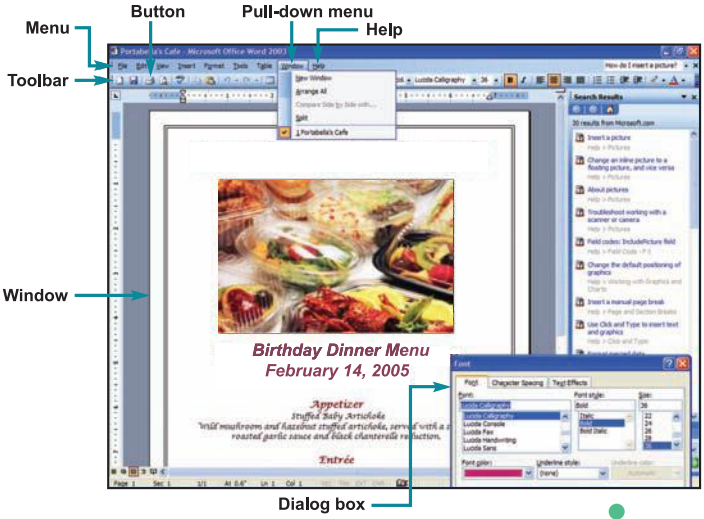


Figure 8-2 Common features

WEB-BASED APPLICATIONS

Typically, application programs are owned by individuals or organizations and stored on their computer system's hard disks. For the application to be used, a copy of the program (or part of the program) is read into the computer system's memory. An emerging trend, however, is to free users from owning and storing applications by using Web-based applications.

Special Web sites, called **application service providers (ASPs),** allow access to their application programs. To use one of these **Web-based applications,** you connect to the ASP, copy the application program to your computer system's memory, and then run the application. Most ASPs provide access to a wide range of application programs and charge a fee for their service. To see how Web-based applications work, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Animations.

CONCEPT CHECK

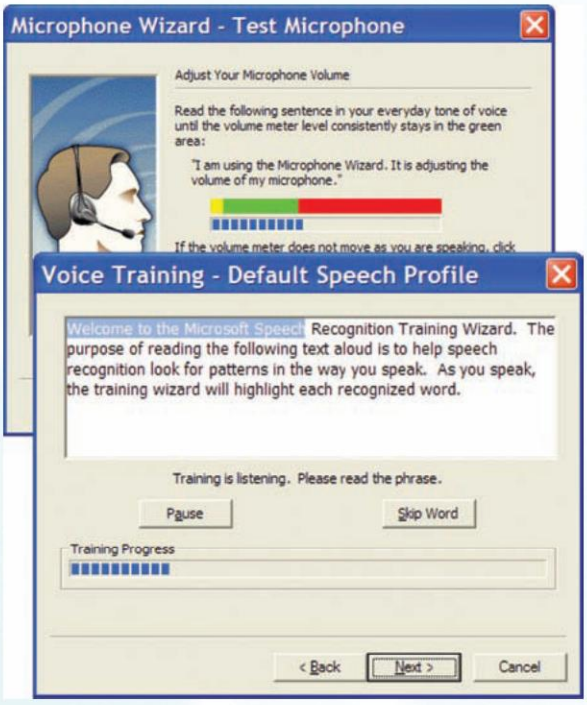
- What is the difference between basic and specialized applications?
- List some common features of application software.
- What are Web-based applications?

SPEECH RECOGNITION

Tired of using your keyboard to type term papers? Have you ever thought about using your voice to control application software? Perhaps speech recognition is just what you are looking for.

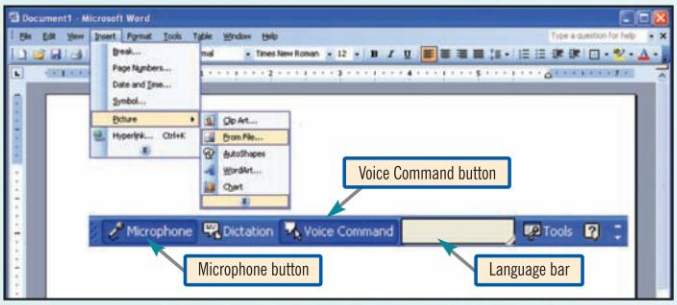
Training the Software The first step is to set up your microphone and train your software to recognize your voice. Start any Microsoft Office 2003 application:

1. Select *Speech* from the *Tools* menu.
2. Follow the on-screen instructions to test your microphone.
3. Read the text presented to teach the software your unique speech patterns.



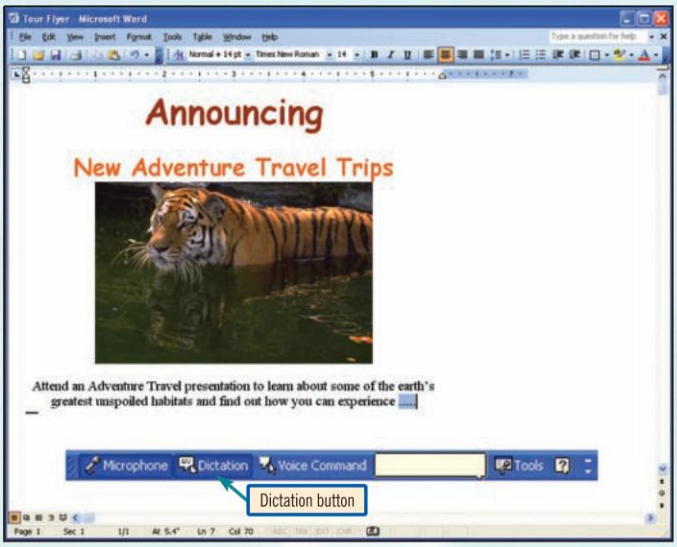
Controlling a Program Once the software is trained, you can control many computer operations with just your voice by using the Language bar. For example, to insert the picture "Tiger" into a Microsoft Word document:

1. Click the *Microphone* button on the Language bar.
2. Click the *Voice Command* button on the Language bar.
3. Say the names of the menus and commands you wish to perform.



Dictating a Document You can also dictate text using the Language bar. For example, to insert text into a Microsoft Word document:

1. Click the *Dictation* button on the Language bar.
2. Dictate the text you want to appear in the Word document.



Although speech recognition technology continues to improve, speech recognition is not yet ready for completely hands-free operation. You will get the best results if you use a combination of your voice and the mouse or keyboard.

The Web is continually changing, and some of the specifics presented in the Making IT Work for You section may have changed. To learn about other ways to make information technology work for you, visit our Web site at www.oleary-series.com and select Making IT Work for You.

WORD PROCESSORS

Word processing software creates text-based documents. Features support entering, editing, and formatting text.

Word processors create text-based **documents** and are one of the most flexible and widely used software tools. All types of people and organizations use word processors to create memos, letters, and faxes. Organizations create newsletters, manuals, and brochures to provide information to their customers. Students and researchers use word processors to create reports. Word processors can even be used to create personalized Web pages.

The three most widely used word processing programs are Microsoft Word, Corel, WordPerfect, and Lotus Word Pro.

FEATURES

Word processors provide a variety of features to make entering, editing, and formatting documents easy. One of the most basic features for entering text is **word wrap.** This feature automatically moves the insertion point to the nextline once the current line is full. As you type, the words wrap around to the next line.

There are numerous features designed to support **editing** or modifying a document. One of these is a **Thesaurus** that provides synonyms, antonyms, and related words for a selected word or phrase. You can quickly locate and replace selected words using the **find and replace** feature. **Spelling** and **grammar checkers** look for misspelled words and problems with capitalization, punctuation, and sentence structure. Other features are designed to improve the **format** or appearance of a document. One of the most basic is the **font** or design of the characters. (See Figure 8-3.) The height of a character is its **font size.** The appearance of characters can be enhanced using such **character effects** as **bold,** *italic*, shadow, and **colors.**

Bulleted and **numbered lists** can make a sequence of topics easy to read.

Font	Sample
Arial	A B C a b c
Impact	A B C a b c
Times New Roman	A B C a b c
Broadway	A B C a b c

Figure 8-3 Sample fonts

CASE

Assume that you have accepted a job as an advertising coordinator for Adventure Travel Tours, a travel agency specializing in active adventure vacations. Your primary responsibilities are to create and coordinate the company's promotional materials, including flyers and travel reports. To see how you could use Microsoft Word, the most widely used word processing program, as the advertising coordinator for the Adventure Travel Tours, see Figures 8-4 and 8-5.

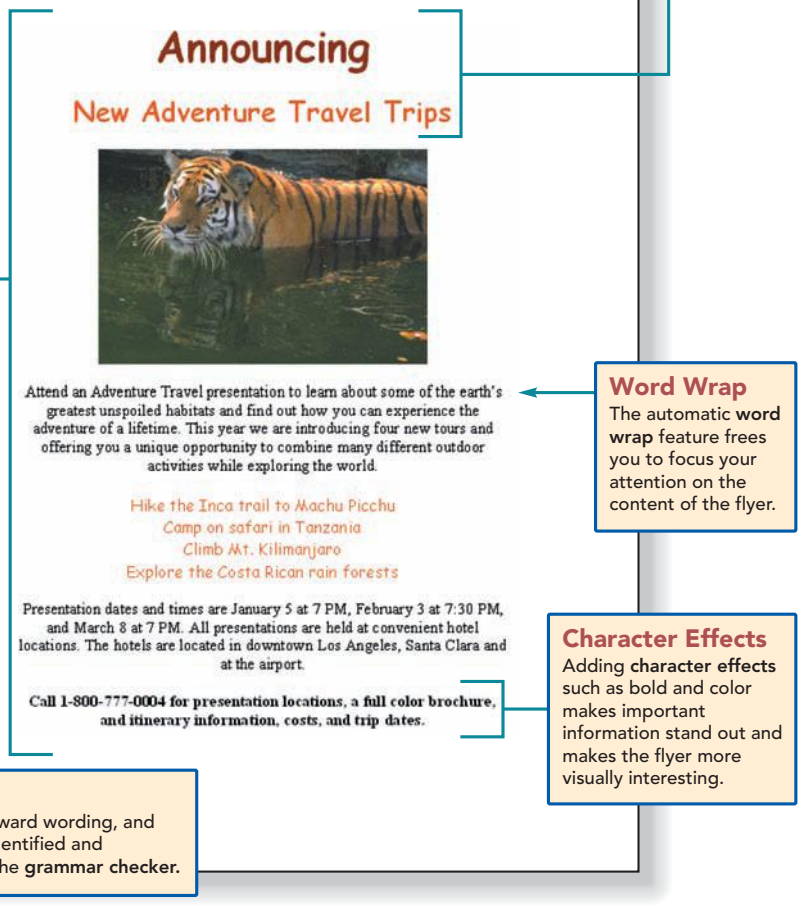
CONCEPT CHECK

- What do word processors do?
- Describe the following editing features: Thesaurus, find and replace, spelling and grammar checkers.
- Describe the following formatting features: font, font size, character effects, numbered and bulleted lists.

Spelling Checker
Correcting spelling and typing errors identified by the **spelling checker** creates an error-free and professional-looking document.

Fonts and Font Size
Using interesting **fonts** and a large **font size** in the flyer's title grabs the reader's attention.

Center Aligning
Center aligning all of the text in the flyer creates a comfortable, balanced appearance.



Word Wrap
The automatic **word wrap** feature frees you to focus your attention on the content of the flyer.

Character Effects
Adding **character effects** such as bold and color makes important information stand out and makes the flyer more visually interesting.

Grammar Checker
Incomplete sentences, awkward wording, and incorrect punctuation are identified and corrections are offered by the **grammar checker.**

CREATING A FLYER

You have been asked to create an advertising flyer for upcoming promotional presentations. After discussing the flyer's contents and basic structure with your supervisor, you start to enter the flyer's text. As you enter, the text, *words wrap* automatically at the end of each line. Also, while entering the text, the *spelling checker* and *grammar checker* catch spelling and grammatical errors. Once the text has been entered, you focus your attention on enhancing the visual aspects of the flyer. You add an interesting graphic and experiment with different character and paragraph formats including *fonts*, *font sizes, colors*, and *alignments*.

Figure 8-4 Flyer

CREATING A REPORT

Your next assignment is to create a report on Tanzania and Peru. After conducing your research, you start writing your paper. As you enter the text for the report, you notice that the *AutoCorrect* feature automatically corrects some grammar and punctuation errors. Your report includes several figures and *tables*. You use the *captions* feature to keep track of figure and table numbers, to enter the caption text, and to position the captions. When referencing figures or tables from the text, you use the *cross reference* feature. You then care fully document your sources using *footnotes*. Finally, you prepare the report for printing by adding *header* and *footer* information.

AutoCorrect

As you enter text, you occasionally forget to capitalize the first word in a sentence. Fortunately, **AutoCorrect** recognizes the error and automatically capitalizes the word.

Header or Footer

Page numbers and other document-related information can be included in a **header** or **footer.**

Captions and Cross References

Identifying figures with **captions** and using **cross-references** in a report makes the report easier to read and more professional.

Footnote

To include a note about Lake Titicaca, you use the **footnote** feature. This feature inserts the footnote superscript number and automatically formats the bottom of the page to contain the footnote text.

Table

To concisely present and organize the weather information, you use a **table.**

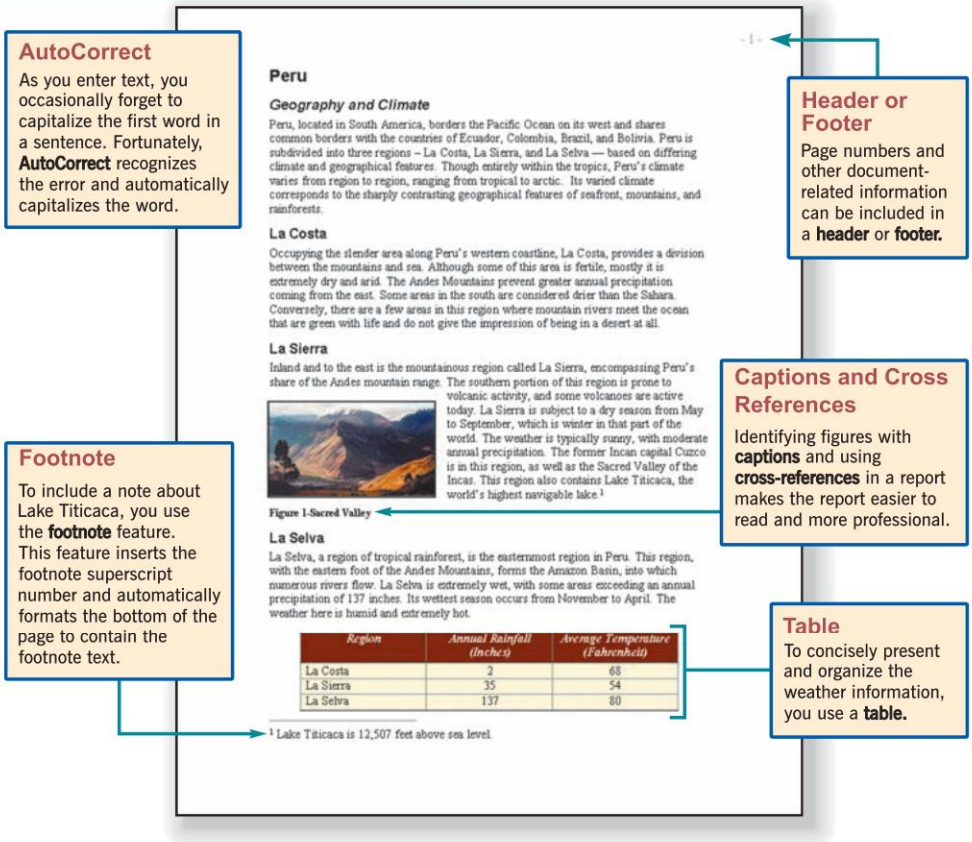


Figure 8-5 Report

SPREADSHEETS

Spreadsheet programs manipulate numeric data. Features include workbooks, worksheets, rows, columns, ranges, text and numeric entries, formulas, functions, cells, charts, recalculation, and what-if analysis.

Spreadsheet programs organize, analyze, and graph numeric data such as budgets and financial reports. Once used exclusively by accountants, spreadsheets are widely used by nearly every profession. Marketing professionals analyze sales trends. Financial analysts evaluate and graph stock market trends. Students and teachers record grades and calculate grade point averages.

The three most widely used spreadsheet programs are Microsoft Excel, Corel Quattro Pro, and Lotus 1-2-3.

FEATURES

Unlike word processors, which manipulate text and create text documents, spreadsheet programs manipulate numeric data and create workbook Files. **Workbook files** consist of one or more related worksheets. A **worksheet,** also known as a **spreadsheet** or **sheet,** is a rectangular grid of **rows** and **columns.** For example in Figure 8-6, the columns are identified by letters and the rows are identified by numbers. The intersection of a row and column creates a **cell.** For example the cell D8 is formed by the intersection of column D and row 8.

A cell can contain text or numeric entries. **Text entries** or **labels** provide structure to a worksheet by describing the contents of rows and columns. For example in Figure 8-6, cell B8 contains the label Food. The cell in D8 contains a number identified as the food expense.

A numeric entry can be a number or a formula. **A formula** is an instruction to calculate or process. For example the cell F 15 contains the formula = E5 – E13. This formula will calculate a value and display that value in cell F 15 (Net). The value is calculated by taking the value in cell E5 (Wages) and subtracting the value in cell E 13 (Total Expenses). **Functions** are prewritten formulas provided by the spreadsheet program that perform calculations such as adding a series of cells. For example, the cell E 13 contains the function SUM(D8:D12),

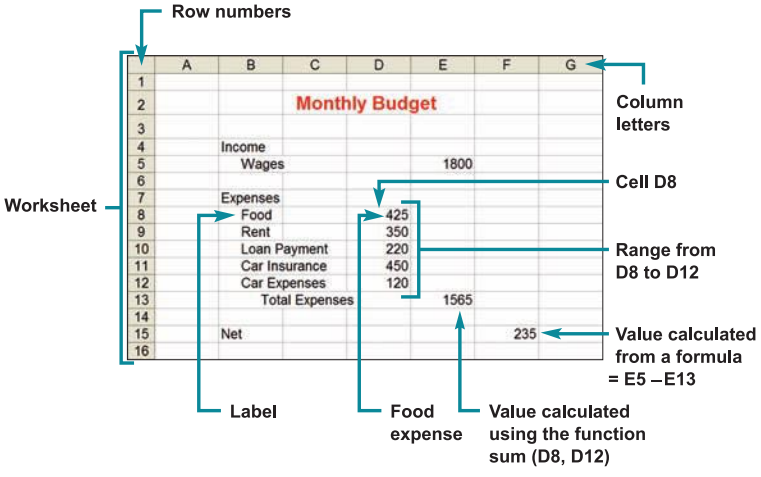


Figure 8-6 Monthly budget worksheet

which adds the values in the range from D8 to D12. A **range** is a series of continuous cells. In this case the range includes D8, D9, D10, D11, and D12. The sum of the values in this range is displayed in cell E13. Spreadsheet programs typically provide a variety of different types of functions, including financial, mathematical, statistical, and logical functions. Some of these functions are presented in Figure 8-7.

Analytical graphs or charts are visual representations of data in a worksheet. You can readily create graphs in a spreadsheet program by selecting the cells containing the data to be charted and then selecting the type of chart to display. If you change one or more numbers in your spreadsheet, all related formulas will automatically recalculate and charts will be recreated. This is called **recalculation.** The process of observing the effect of changing one or more cells is often referred to as **what-if analysis**. For example, to analyze the effect of a rent increase in the Monthly Budget worksheet in Figure 8-6, all you would need to do is replace the contents in cell D9. The entire worksheet, including any charts that had been created, would be recalculated automatically.

CASE

Assume that you have just accepted a job as manager of the Downtown Internet Café. This cafe provides a variety of flavored coffees as well as Internet access. One of your responsibiblities is to create a financial plan for the next year. To see how you could use Microsoft Excel, the most widely used spreadsheet program, as the manager for the Downtown Internet Café, see Figures 8-8 through 8-10.

CONCEPT CHECK

- What are spreadsheets used for? What is a workbook? What is a worksheet?
- Define rows, columns, cells, ranges, text, and numeric entries.
- Describe the following spreadsheet features: formulas, functions, charts, recalculation, and what-if analysis.

Type	Function	Calculates
Financial	PMT	Size of loan payments
	PV	Present value for an investment
Mathematical	SUM	Sum of the numbers in a range of cells
	ABS	Absolute value of a number
Statistical	AVERAGE	Average or mean of the numbers in a range of cells
	MAX	Largest numbers in a range of cells
Logical	IF	Whether a condition is true; if true, a specified value is disyed; if not true, then a different specified value is displayed
	AND	Whether two conditions are true; if both are true, then a specified value is displayed, if either one or both are not true, then a different specified value is displayed

Figure 8-7
Selected spreadsheet functions

CREATING A SALES FORECAST

Your first project is to develop a first quarter sales forecast for the cafe. You begin by studying the sales at the Downtown Internet Café and talking with several managers. After obtaining sales and expense estimates, you are ready to create the first quarter forecast. You start structuring the *worksheet* by inserting descriptive **text entries** for the row and column headings. Next, you insert *numeric entries*, including *formulas* and *functions* to perform calculations. To test the accuracy of the worksheet, you change the values in some cells and compare the recalculated spreadsheet results with hand calculations.

Figure 8–8 Worksheet

Worksheets

Worksheets are used for a wide range of different applications. One of the most common uses is to create, analyze, and forecast budgets.

Text Entries

Text entries provide meaning to the values in the worksheet. The rows are labeled to identify the various sales and expense items. The columns are labeled to specify the months.

	A	B	C	D	E	F
1						
2						
3	INTERNET	Downtown Internet Café				
4		*First Quarter Forecast*				
5						
6		JAN	FEB	MAR	TOTAL	AVG
7	Sales					
8	Beverage	Rs.13,600	Rs.14,600	Rs. 15,600	Rs.43,800	Rs.14,600
9	Food	Rs. 7,100	Rs. 7,300	Rs. 7,400	Rs.21,800	Rs. 7,267
10	Internet	Rs. 4,000	Rs. 4,300	Rs. 4,500	Rs.12,800	Rs. 4,267
11	Merchandise	Rs. 3,100	Rs. 3,200	Rs. 3,300	Rs. 9,600	Rs. 3,200
12	Total Sales	Rs.27,800	Rs.29,400	Rs. 30,800	Rs.88,000	Rs.29,333
13	Expenses					
14	Cost of Goods	Rs. 6,950	Rs. 7,300	Rs. 7,600	Rs.21,850	Rs. 7,283
15	Payroll	Rs. 7,500	Rs. 7,500	Rs. 7,500	Rs.22,500	Rs. 7,500
16	Computers	Rs. 6,400	Rs. 6,400	Rs. 6,400	Rs.19,200	Rs. 6,400
17	Lease	Rs. 5,500	Rs. 5,500	Rs. 5,500	Rs.16,500	Rs. 5,500
18	Marketing	Rs. 1,000	Rs. 1,000	Rs. 1,000	Rs. 3,000	Rs. 1,000
19	Miscellaneous	Rs. 1,500	Rs. 1,500	Rs. 1,500	Rs. 4,500	Rs. 1,500
20	Total Expenses	Rs28,850	Rs29,200	Rs. 29,500	Rs87,550	Rs29,183
21	Income					
22	Net Income	Rs.(1,050)	Rs. 200	Rs. 1,300	Rs. 450	Rs. 150
23	Profit Margin	-3.78%	0.68%	4.22%	0.51%	
24			Income Year-To-Date	Rs. 450		

Functions

One advantage of using functions rather than entering formulas is that they are easier to enter. In this case, cell C20 (Total Expenses for February) contains the function SUM(C14: C19) rather than the formula 5C141C151 C161C171C181C19.

Formulas

Formulas provide a way to perform calculations in the worksheet. In this case Cell B22 (Net Income for January) contains the formula 5 B12 (Total Sales for January) 2B20 (Total Expenses for January).

CREATING A CHART

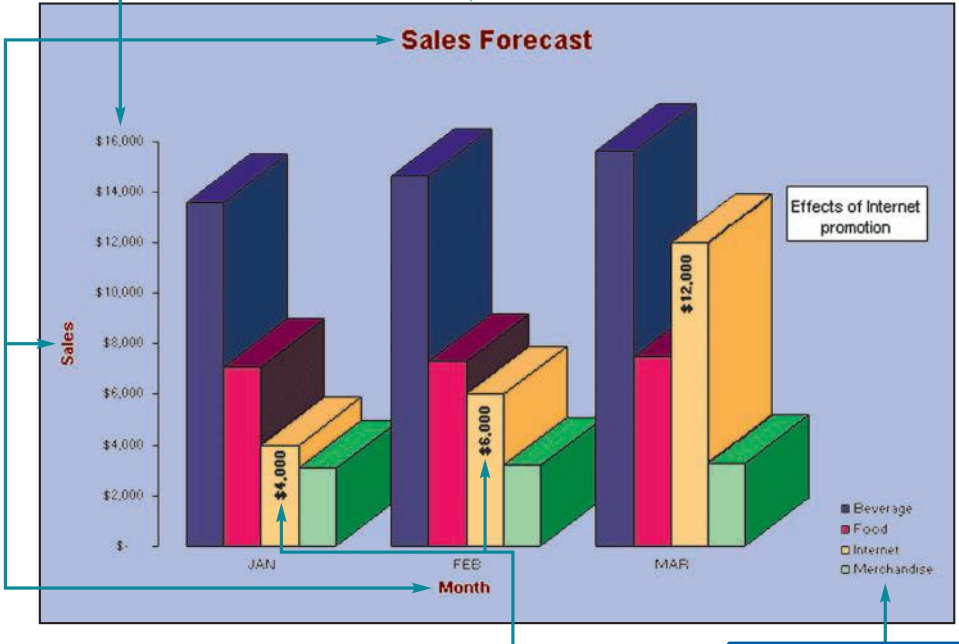
After completing the First Quarter Forecast for the Downtown Internet Café, you decide to *chart* the sales data to better visualize the projected growth in sales. You select the 3D column *chart type to* show each month's projected sales category. Using a variety of chart options, you enter descriptive *titles* for the chart, the *x*-axis, and the *y*-axis. Then you use *data labels* to focus attention on the growing Internet sales. Finally, you insert a *legend* to define the chart's different columns.

Figure 8-9 Chart

Chart Types
To display the monthly expenses over the quarter, you consider several different **chart types** before selecting the 3D column chart. The 3D variation of the chart provides an interesting depth perception to the columns.

Titling
Clearly **titling** the chart as well as the *x*-axis and *y*-axis makes the chart easier to read and understand.

Chart
Once data is in the worksheet, it is very easy to **chart** the data. All you need to do is to select the data to chart, select the chart types, and add some descriptive text.



Data Labels
Data labels draw the viewer's attention to selected pieces of information in the chart.

Legend
The **legend** defines each sales expense by a color. Legends are essential to charts that depict more than one set of data.

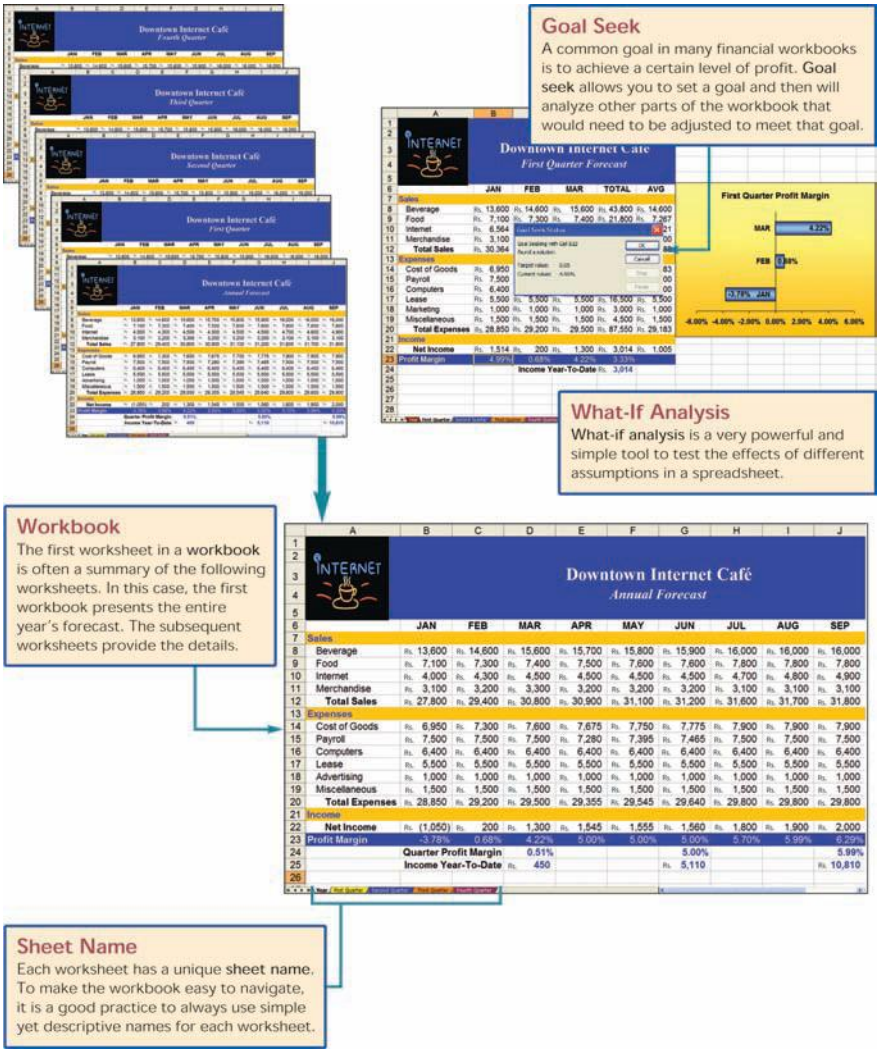


Figure 8-10 Workbook

ANALYZING YOUR DATA

After presenting the First Quarter Forecast to the owner, you revise the format and expand the *workbook* to include worksheets for each quarter and an annual forecast summary. You give each worksheet a descriptive *sheet name*. At the request of the owner, you perform a *what-if analysis* to test the effect of different estimates for payroll, and you use *Goal Seek* to determine how much Internet Sales would have to increase to produce a profit margin of 5.00 percent for January.

DATABASE MANAGEMENT SYSTEMS

A database is like an electronic file cabinet. DBMS structures data and provides tools. Relational databases use tables, records, and fields. Features include tools for sorting, filtering, defining criteria, querying, creating forms, and reports.

A **database** is a collection of related data. It is the electronic equivalent of a File cabinet. A **database management system (DBMS)** or **database manager** is a program that sets up, or structures, a database. It also provides tools to enter, edit, and retrieve data from the database. All kinds of individuals use databases, from teachers recording grades to police officers checking criminal histories. Colleges and universities use databases to keep records on their students, instructors, and courses. Organizations of all types maintain employee databaes.

Three of the most widely used database management systems designed for microcomputers are Microsoft Access, Corel Paradox, and Lotus Approach.

FEATURES

The **relational database** is the most widely used database structure. Data is organized into related **tables.** Each table is made up of rows called **records** and columns called **fields.** Each record contains fields of data about some specific person, place, or thing.

DBMS provides a variety of tools to create and use databases. A **sort** tool will quickly rearrange a table's records according to a selected Field.

The greatest power of a DBMS, however, comes from its ability to quickly find and bring together information stored in separate tables using queries, forms, and reports. A **query** is a question or a request for specific data contained in a database. Database **forms** look similar to traditional printed forms. These electronic forms are displayed on the computer monitor and typically reflect the contents for one record in a table. They are primarily used to enter new records and to make changes to existing records. Data from tables and queries can be printed in a variety of different types of **reports** from a simple listing of an entire field in a table to a list of selected fields based on a query involving several tables.

CASE

Assume that you have accepted a job as an employment administrator for the Lifestyle Fitness Club. One of your responsibilities is to create a database management system to replace the club's manual system for recording employee information. To see how you could use Microsoft Access, one of the most widely used relational DBMS programs, as the employment administrator for the Lifestyle Fitness Club, see Figures 8-11 and 8-12.

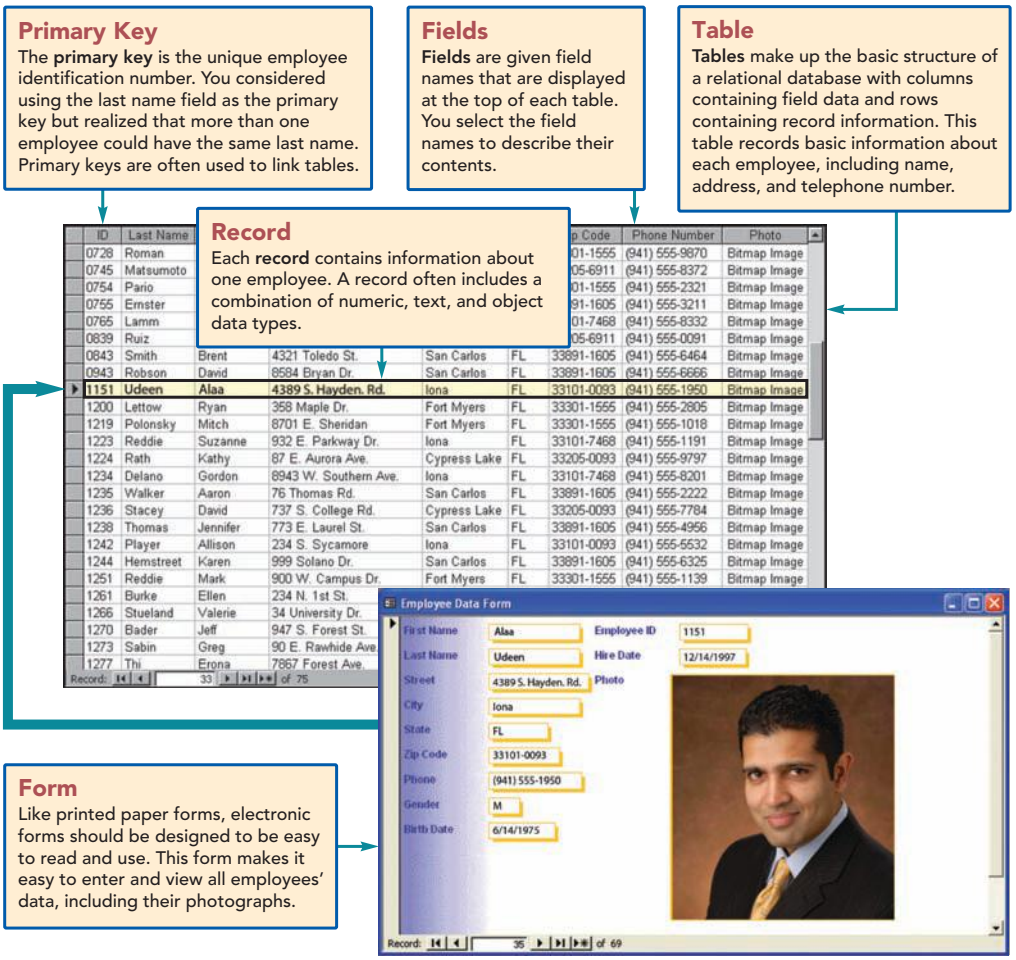
CONCEPT CHECK

- What is a database? What is a DBMS? A relational database?
- What are tables, records, and fields?
- Describe the following DBMS features: sort, query, form, and report.

CREATING A DATABASE

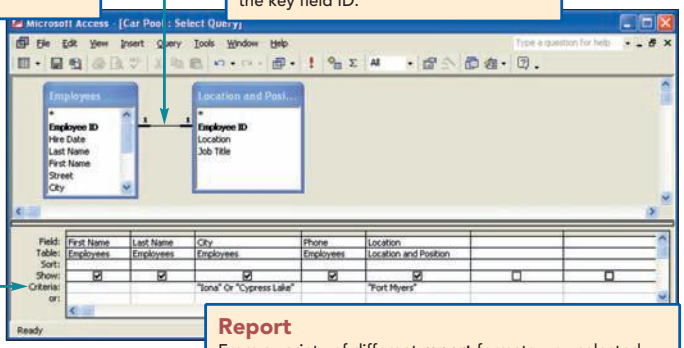
The first step in creating the database management system is to plan. You study the existing manual system focusing on how and what data is collected and how it is used. Next, you design the basic structure or organization of the new database system to have two related *tables,* which will make entering data and using the database more efficient. Focusing on the first table, Employees, you create the table structure by specifying the *fields*, and *primary key* field. To make the process faster and more accurate, you create a *form* and use the form to enter the data for each employee as a *record* in the table.

Figure 8-11 Table and form



Query
Your **query** requests the names, addresses, and telephone numbers of all employees living in Iona or Cypress Lake who work in Fort Myers.

Joined
Since the query involves two tables, they must be linked or **joined** by common fields. You chose to link the tables by the key field ID.



Criteria
The query **criteria** to produce the car pool list require that both the Employees table and the Location and Position table be consulted. The criteria identify all employees who work at Fort Myers and live either in Iona or Cypress Lake.

Report
From a variety of different **report** formats, you selected this format to display the names, addresses, and telephone numbers of all employees who might commute from either Cypress Lake or Iona to the Fort Myers plant.

Iona to Fort Myers Car Pool Report

Last Name	First Name	Street Address	City	Phone Number
Delucchi	Bill	950 S. Terrace Dr.	Cypress Lake	(941) 555-8195
Fromthart	Lisa	32 Redcoat Rd.	Cypress Lake	(941) 555-0110
Helland	Eric	4801 E. Willow Dr.	Iona	(941) 555-9101
Lawrence	Nichol	433 S. Gaucho Dr.	Cypress Lake	(941) 555-7656
Lopez	Mina	4290 E. Alameda Dr.	Cypress Lake	(941) 555-5050
Nichols	Cathy	75 Brooklea Dr.	Cypress Lake	(941) 555-0001
Reddie	Suzanne	932 E. Parkway Dr.	Iona	(941) 555-1191
Schiff	Marc	235 N. Cactus Dr.	Cypress Lake	(941) 555-0010
Sutton	Lisa	4389 S. Hayden Rd.	Iona	(941) 555-1950

Sorted
To make the report easier for employees to locate their name and the names of others, you **sorted** the query results alphabetically by last name.

CREATING A QUERY

You have continued to build the database by creating a second table containing information about each employee's work location and job title. This table is linked or *joined* with the Employee table by the common field, ID. After you completed this second table, you received a request to create car pool information for those employees who live in either Iona or Cypress Lake and work in Fort Meyers. You created a *query* using the appropriate *criteria* to create the car pool list. After *sorting* the resulting list alphabetically according to last name, you created a *report* to distribute to interested employees.

Figure 8-12 Query and report

PRESENTATION GRAPHICS

Presentation graphics create interesting and professional presentations. Features include slides, AutoContent wizard, color schemes, slide layouts, special effects, design templates, and master slides.

Research shows that people learn better when information is presented visually. A picture is indeed worth a thousand words or numbers. **Presentation graphics** are programs that combine a variety of visual objects to create attractive, visually interesting presentations. They are excellent tools to communicate a message and to persuade people.

People in a variety of settings and situations use presentation graphics programs to make their presentations more interesting and professional. For example, marketing managers use presentation graphics to present proposed marketing strategies to their superiors. Sales people use these programs to demonstrate products and encourage customers to make purchases. Students use presentation graphics programs to create high-quality class presentations.

Three of the most widely used presentation graphics programs are Microsoft PowerPoint, Corel Presentations, and Lotus Freelance Graphics.

On the Web Explorations

Lotus is one of the leaders in developing presentation graphics.To learn more about the company, visit our Web site at

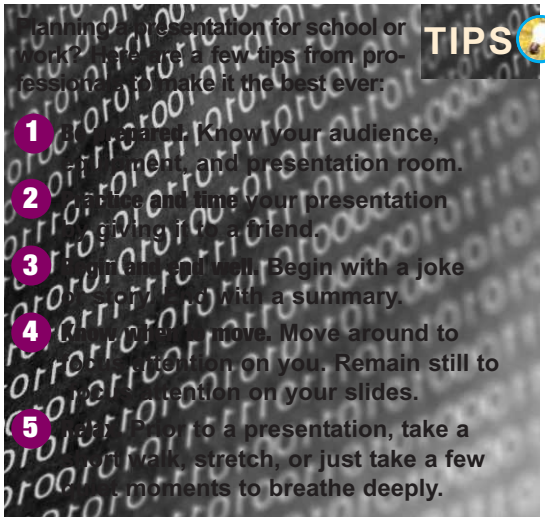
www.olearyseries.com

and select On the Web Explorations.

FEATURES

An electronic presentation consists of a series of **slides.** Presentation programs include a variety of features to help you create effective dynamic presentations. Most include a wizard such as Microsoft's **AutoContent wizard** that steps you through the process of creating a presentation. Other features include tools to select alternative color schemes, slide layouts, special effects, design templates, and master slides. **Design templates** provide professionally selected combinations of color schemes, slide layouts, and special effects.

Every presentation has a **master slide.** It is a special slide that does not appear in a presentation but controls the format and placement of all slides in a presentation. For example, the design for a presentation can be changed easily for the entire presentation using the master slide.

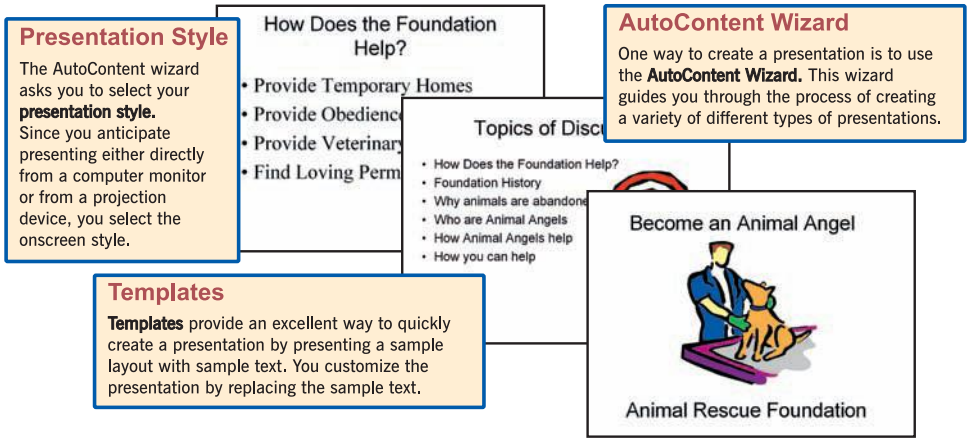


CASE

Assume that you have volunteered for the Animal Rescue Foundation, a local animal rescue agency. You have been asked to create a powerful and persuasive presentation to encourage other members from your community to volunteer. To see how you could use Microsoft PowerPoint, one of the most widely used presentation graphics programs, as a volunteer for the Animal Rescue Foundation, see Figures 8-13 through 8-14.

CONCEPT CHECK

- What are presentation graphics programs? What are they used for?
- What are slides? What is a master slide? What are design templates?
- What is the AutoContent Wizard? What is it used for?



CREATING A PRESENTATION

You start creating the presentation using the *AutoContent Wizard* and specify the *template* and *presentation style* to use. The wizard creates a sample presentation containing suggested content in each slide and uses a consistent design style throughout. After replacing the sample content with the information for your presentation, you are on your way to the director's office to show him what you have.

Figure 8-13 Presentation

UPDATING A PRESENTATION

After discussing the presentation with the director, you have some ideas to enhance the effectiveness of the message. First, you improve the color of selected items and add more graphics. Next, you select one of the *design templates* and make some other changes. You apply these changes to all the slides by simply adjusting the *master slide*. Finally, you practice or rehearse the presentation, create speaker notes, and print out audience handouts. You're ready to give a professionally designed, dynamic presentation.

Figure 8-14 Revised presentation

INTEGRATED PACKAGES

Integrated packages provide the functionality of several separate application programs within a single program. Also known as personal or home software, they provide limited capability at low cost.

An **integrated package** is a single program that provides the **functionality** of a word processor, spreadsheet, database manager, and more. The primary disadvantage of an integrated package is that the capabilities of each function (such as word processing) are not as extensive as in the individual programs (such as Microsoft Word). The primary advantages are cost and simplicity. The cost of an integrated package is much less than the cost of the individual powerful, professional-grade application programs discussed thus far in this chapter.

Integrated packages are popular with many home users and are sometimes classified as **personal** or **home software.** The mostwidey used integrated packages are Microsoft Works and AppleWorks. See Figure 8-15.

Figure 8–15 AppleWorks

CASE

Assume that you publish a gardening newsletter that you distribute to members of the Desert Gardening Club. Using the word processing function, you entered text, formatted titles and subtitles, and inserted several photographs. (See Figure 8-16.) Using the spreadsheet function, you analyzed daily rainfall for the feature article and included a chart. After completing the newsletter, you will use the database function and the membership database to print mailing labels.

CONCEPT CHECK

- What is an integrated package?
- Describe the advantages and disadvantages of an integrated package.

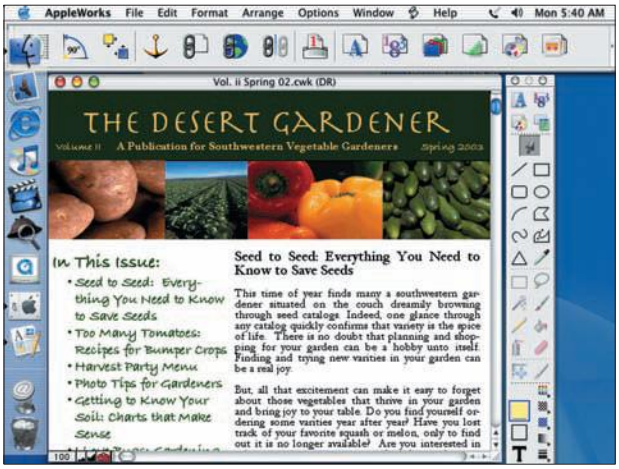


Figure 8–16 Integrated package (AppleWorks)

SOFTWARE SUITES

A software suite is a group of application programs. The four types of software suites are productivity, personal, specialized, and utility.

A **software suite** is a collection of separate application programs bundled together and sold as a group. While the applications function exactly the same whether purchased in a suite or separately, it is significantly less expensive to buy a suite of applications than to buy each application separately. There are four types of suites:

- **Productivity suite** Productivity suites, also known as **business suites,** contain professional-grade application programs, including a word processor, spreadsheet, database manager, and more. The best known is Microsoft Office. (See Figure 8-17.) Two other well-known productivity suites are Corel WordPerfect OfficeSuite and Lotus SmartSuite.
- **Personal suite** Also known as **home suites,** these contain personal software applications or programs intended for home use. The best known is Microsoft Works Suite, which includes the Works integrated package along with Works Calendar, Streets & Trips, and more. (See Figure 8-18.)
- **Specialized suite** Specialized suites focus on specific applications. These include graphics suites, financial planning suites, and many others.
- **Utility suite** These suites include a variety of programs designed to make computing easier and safer. One of the best known is Norton System Works and Norton Internet Security Suite. (Utility suites are discussed in detail in Chapter 5.)

CONCEPT CHECK

- What is a software suite? What are the advantages of purchasing a suite?
- What are the four types of software suites?
- What is the best-known productivity suite? What is the best-known personal suite?

Figure 8-17 Microsoft Office

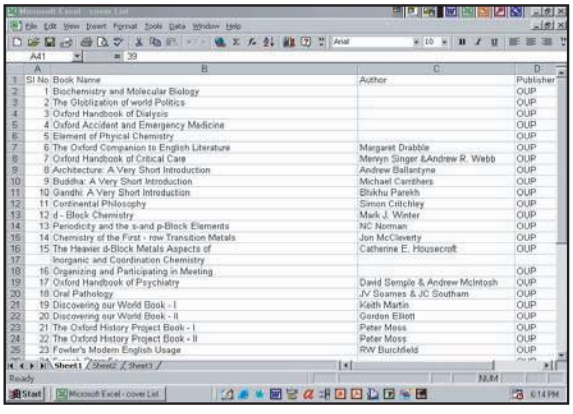


Figure 8-18 Streets & Trips from Microsoft Works Suite

SHARING DATA BETWEEN APPLICATIONS

Ways to share data include copy and paste, object linking, and object embedding. Copy and paste is static. OLE is dynamic.

Many times it is convenient to share data between applications. For example, when writing a report it may be useful to include a chart from a spreadsheet or data from a database. Data created by one application can be shared with another application in a variety of different ways, including copying and pasting, object linking, and object embedding.

COPY AND PASTE

The most straightforward way to share data is to copy and then paste. From the file that contains the data to be shared, you would select the item and then select the copy command. Next, go to the File where the selected data is to be inserted. Position the insertion pointer at the location where the data is to be inserted and select the paste command. The data will be inserted into this file.

This is a static copy in that any changes to one file will not affect the other File. Object linking and object embedding, however, create more dynamic relationships.

OBJECT LINKING AND EMBEDDING

Object linking and embedding (OLE) is a feature that makes it easy to dynamically share and exchange data between applications. For example, you could create a text document using a word processing program that includes a chart created by a spreadsheet program and a presentation created by a graphics program. Whenever the text document is opened, the most up-to-date version of the chart would appear in the document and the presentation could be run. (See Figure 8-19.)

With **object linking,** a copy of the object from a **source file** (the file containing the object) is inserted in a **destination file** (the file receiving the object) and a *link* or connection between the two files is established. In our example, the object is a chart from a spreadsheet (source) file. If a change occurs in the spreadsheet file that affects the chart, the link between the two files will automatically update the chart in the word processing file. Object linking is useful if you want the destination document to always contain the most up-to-date data.

With **object embedding,** the object from the source File is *embedded* or added to the destination document and becomes part of the destination document. In our example, the embedded object is a presentation created by a presentation graphics program. The presentation (embedded object) can be run and edited from within the destination document. However, changes you make to the embedded object are not reflected in the original source file.

Object linking and embedding is a powerful and useful feature to support sharing and exchanging data between files.

CONCEPT CHECK

- Discuss the three ways to share data between applications.
- What are OLE, source files, and destination files?
- What is the difference between object linking and object embedding?

How Object Linking and Embedding Work

Destination File
A **destination file** receives objects (the Excel chart and the PowerPoint presentation) from source files.

Linked Object
A **linked object** (the Excel chart) from the source file appears in the destination file. Any changes in the source file affecting the linked object are automatically made in the destination file.

Embedded Object
An embedded object (presentation) is part of the destination file. Double-clicking the object in the destination file causes the object to run.

Source Files
Source files (Excel and PowerPoint files) provide objects that are either linked or embedded into a destination file.

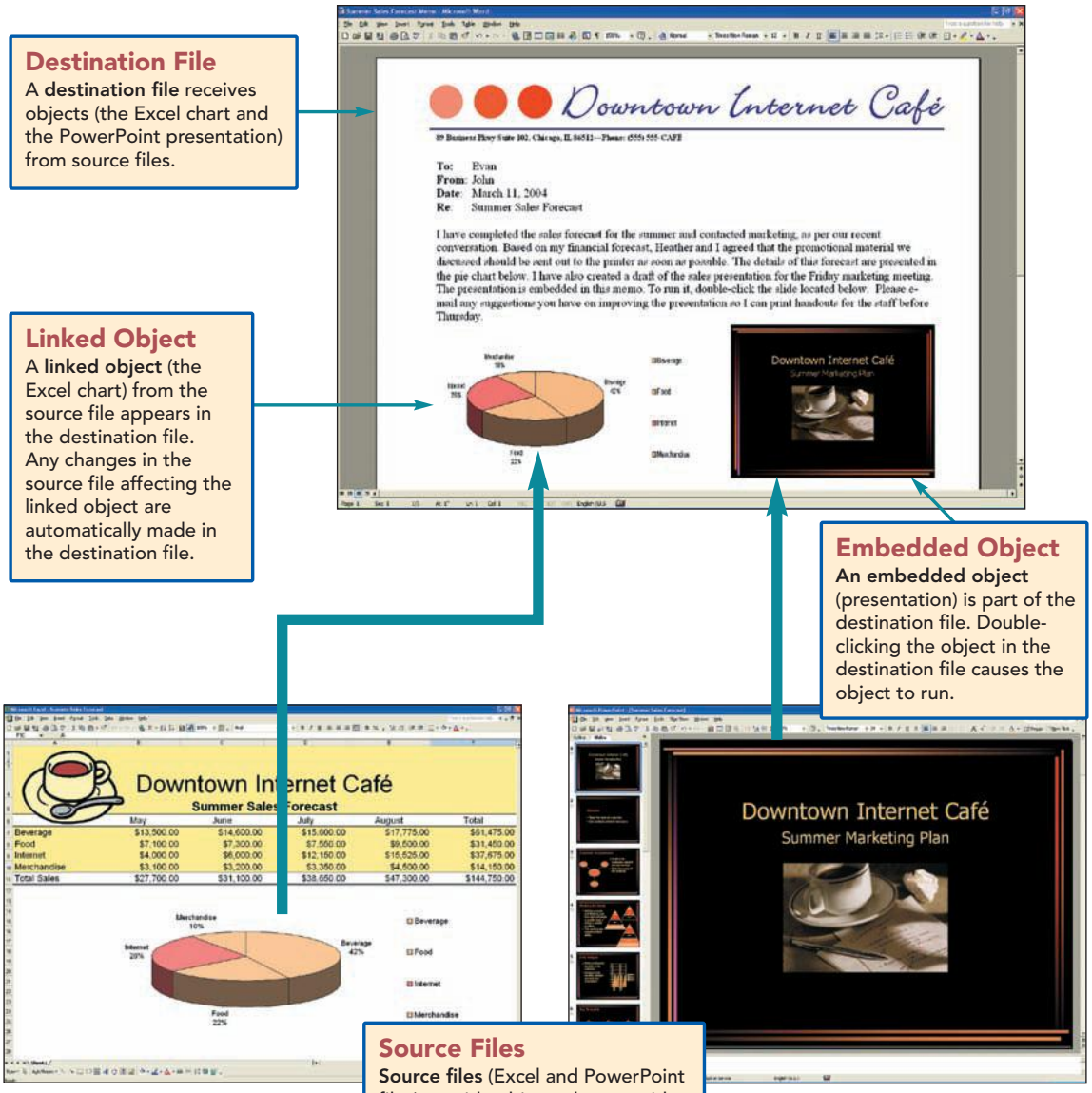
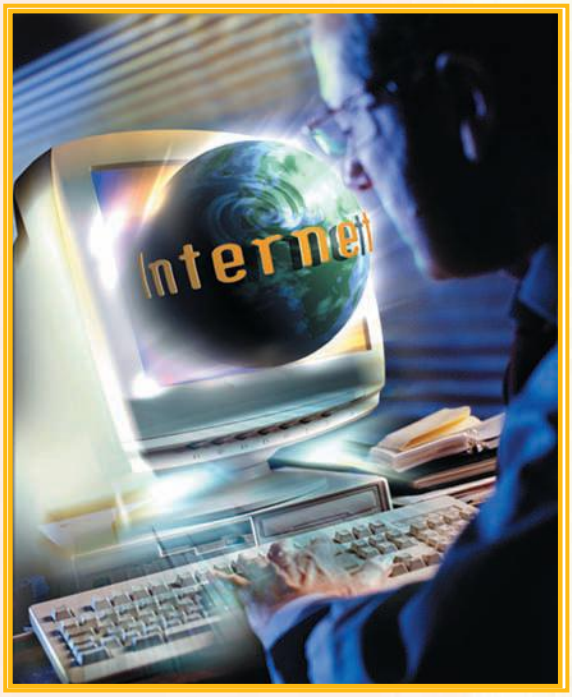


Figure 8-19 How object linking and embedding work

A Look to the Future

Web-based Application Software Updates Ease Maintenance

Wouldn't it be great if you never had to buy software again? What if you could pay as you go, only paying for those parts of a software suite that you actually use? These options sound terrific to end users eager to avoid the high cost and difficulties of software maintenance. They sound even better to large and small corporations, where the costs of maintaining sofware and the information systems department can be huge expenditures.



Of course, that is what Web-based application service providers, ASPs, are all about. As we discussed earlier, you can use the Web to connect to an ASP and use its software. A major advantage of using an ASP is that others do all the administration work—there are no programs for you to install and configure, and you never have to worry about the hassle of upgrades.

With an ASP you can access your data from any internet-connected computer in the world. This means that if a computer is lost or damaged, no data or time has been wasted. And because any computer that can access the internet can connect to an ASP, any platform can be used. For example, PCs and Apple computers could share data and applications in the same office. Finally using an ASP allows for a simpler and cheaper computer system, because you don't have to worry about hardware requirements or storage space.

These considerations may sound tempting to individuals who dislike installing and maintaining software, and some experts predict that eventually all software may be distributed this way. However, ASPs are currently very valuable to smaller companies with fewer dollars to spend on these labor intensive maintenance and installation tasks. ASPs allow them to customize their software in ways that would otherwise be too expensive for them.

Some experts have even suggested ASPs may become widely used by large corprations with IT departments that decide to outsource these projects. They predict that software may become a service that companies receive from an outside company. For example, a large company in the future may have a software contract with a company that agrees to supply a word processing program over the internet. In fact, some traditional software developers are slowly moving toward Web deployment. Microsoft's .NET program is believed to be a step by the corporation toward providing Web services of their popular software programs.

Do you think you and other end users will use ASPs for these new services? Will we be using ASPs to create customized programs for our personal use?

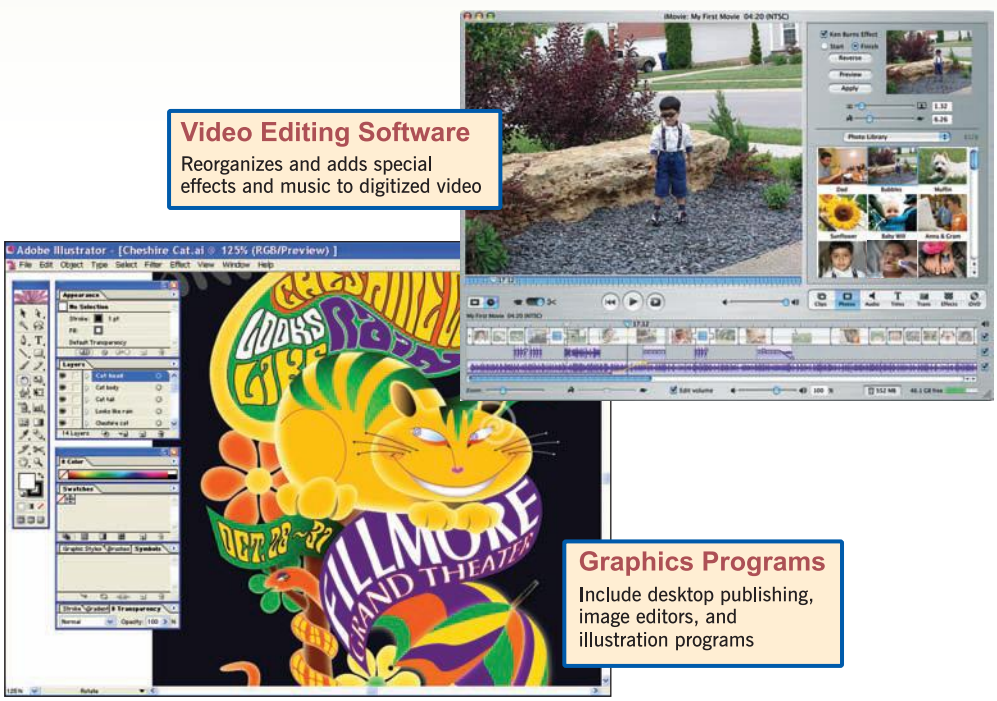
SPECIALIZED APPLICATION SOFTWARE

COMPETENCIES

After you have read this chapter, you should be able to:

1. **Describe graphics software, including desktop publishing, image editors, illustration programs, image galleries, and graphics suites.**
2. **Discuss audio and video editing software.**
3. **Describe multimedia, including story boards and multimedia authoring programs.**
4. **Explain Web authoring, Web site design, and Web authoring programs.**
5. **Describe virtual reality and VRML.**
6. **Discuss knowledge-based (expert) systems.**
7. **Describe robotics including perception systems, industrial robots, and mobile robots.**

CONTENTS



CHAPTER 9

Expect surprises—exciting and positive opportunities. The latest technological developments offer you new opportunities to extend your range of computer competency. As we show in this chapter, software that for years was available only for mainframes has recently become available for microcomputers. A whole new generation of software only recently available for microcomputers, called specialized applications, now makes it possible to perform advanced tasks at home.

The latest technological developments have created an opportunity for home users to take advantage of software previously used only in professional environments. For example, it is now possible, and quite common, for people to create their own Web sites. Home users also have access to software that helps manipulate and create graphic images. Many musicians and artists work from home to create complex and beautiful work using specialized applications.

Some of these same technological advances have allowed researchers and computer scientists to make advances in the field of artificial intelligence that previously were envisioned only in science fiction. Robots now provide security and assistance in homes. Virtual reality is providing opportunities in the fields of medicine and science but also commonly appears in video games.

Competent end users need to be aware of specialized applications. They need to know who uses them, what they are used for, and how they are used. These advanced applications include graphics programs, audio and video editing software, multimedia, Web authoring, and artificial intelligence, including virtual reality, knowledge-based systems, and robotics.

SPECIALIZED APPLICATIONS

Specialized applications are widely used within specific professions. Applications include graphics, audio, video, multimedia, Web authoring, and emerging applications.

In the previous chapter, we discussed basic applications that are widely used in nearly every profession. This chapter focuses on specialized applications that are widely used within specific professions. (See Figure 9-1.) Specifically, we will examine:

- Graphics programs for creating professional-looking published documents, for creating and editing images, and for locating and inserting graphics.
- Audio and video software to create, edit, and play music and videos.
- Multimedia programs to create dynamic interactive presentations.
- Web authoring programs to create, edit, and design Web sites.
- Emerging applications that merge artificial intelligence into a variety of different types of applications, including virtual reality, knowledge-based systems, and robotics.

Figure 9-1 Specialized applications

GRAPHICS

Desktop publishers mix text and graphics. Image editors modify bitmap image files. Illustrators modify vector files. Image galleries are libraries of electronic images. Graphics suites bundle separate programs.

In Chapter 8, we discussed analytical and presentation graphics, which are widely used to analyze data and to create professional-looking presentations. Here we focus on more specialized graphics programs used by professionals in the graphic arts profession.

DESKTOP PUBLISHING

Desktop publishing programs, or **page layout programs,** allow you to mix text and graphics to create publications of professional quality. While word processors focus on creating text and have the ability to combine text and graphics, desktop publishers focus on page design and layout and provide greater flexibility. Professional graphic artists use desktop publishing programs to create documents such as brochures, newsletters, newspapers, and textbooks.

Popular desktop publishing programs include Adobe PageMaker, Microsoft Publisher, and Quark-XPress. While these programs provide the capability to create text and graphics, typically graphic artists import these elements from other sources, including word processors, digital cameras, scanners, image editors, illustration programs, and image galleries.

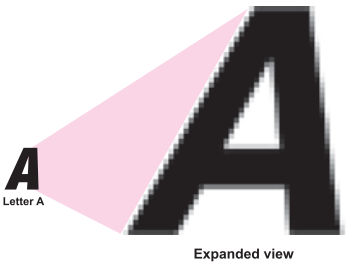


Figure 9-2 Bitmap image

IMAGE EDITORS

One of the most common types of graphic files is bitmap. **Bitmap images,** also known as **raster images,** use thousands of dots or **pixels** to represent images. Each dot has a specific location, color, and shade. One limitation of bitmap images, however, is that when they are expanded, the images can become pixilated or jagged on the edges. For example, when the Letter A in Figure 9-2 is expanded, the borders of the letter appear jagged, as indicated by the expanded view.

Popular professional image editors include Microsoft Paint, Adobe Photoshop, Corel PhotoPaint, and Paint Shop Pro. (See Figure 9-3.)

ILLUSTRATION PROGRAMS

Vector is another common type of graphic file. While bitmap images use pixels to represent images, **vector images,** also known as **vector illustrations,** use geometric shapes or objects. (See Figure 9-4.) These objects are created by connecting lines and curves. Because these objects can be defined by mathematical equations, they can be rapidly and easily resized, colored, textured, and manipulated. An image is a combination of several objects. **Illustration programs,** also known as **drawing programs,** are used to create and to edit vector images.

Popular professional illustration programs include Adobe Illustrator, CorelDraw, Macromedia FreeHand, and Micrografx Designer. (See Figure 9-5.)

ON THE WEB EXPLORATIONS

Graphics programs have made desktop publishing affordable and available to the average user. To learn more about a leading developer of powerful graphics programs, visit our Web site at www.olearyseries.com and select On the Web Explorations.

IMAGE GALLERIES

Image galleries are libraries of electronic images. These images are used for a wide variety of applications from illustrating textbooks to providing visual interest to presentations.

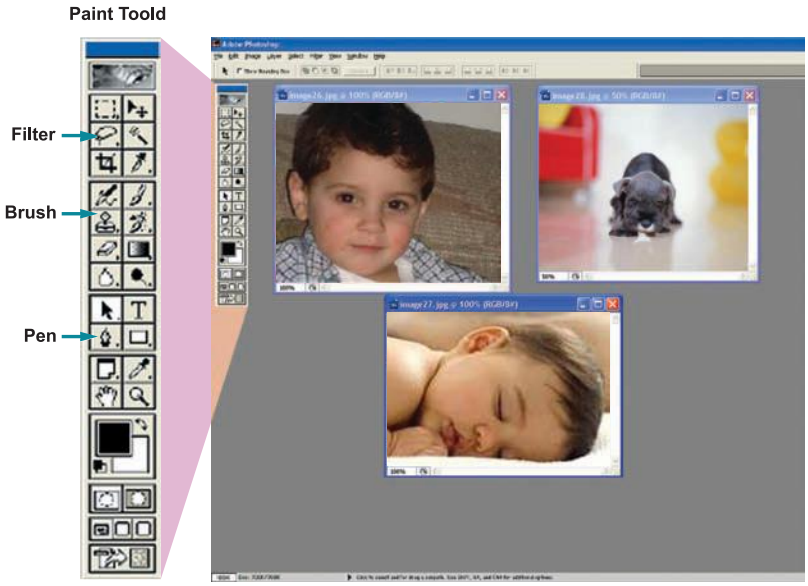


Figure 9-3 Adobe Photoshop

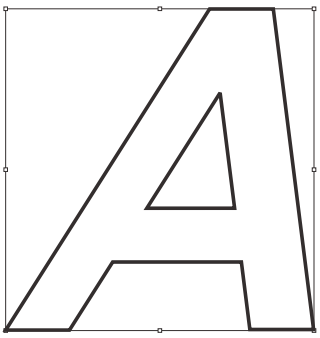


Figure 9-4 Vector Image

There are two basic types of electronic images in these galleries.

- **Stock photographs**—photographs on a variety of subject material from professional models to natural landscapes.
- **Clip art**—graphic illustrations representing a wide range of topics. Most applications provide access to a limited selection of free clip art. For example in Microsoft Word, you can gain access to several pieces of clip art by issuing the command Insert>Pictures>Clip Art.

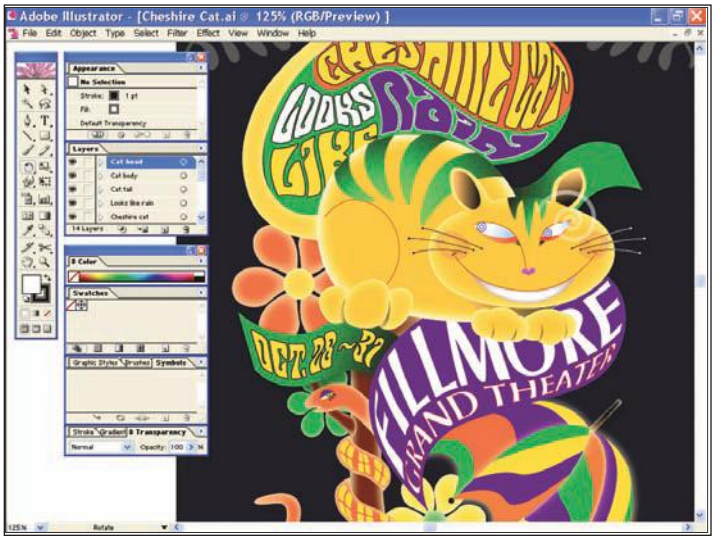


Figure 9-5 Adobe Illustrator

There are numerous Web image galleries. (See Figure 9-6.) Some of these sites offer free images and clip art while others charge a fee.

Organization	Site
Classroom Clipart	www.classroomclipart.com
Broderbund	www.broderbund.com
MS Office clip art	office.microsoft.com/clipart
GifArt	www.gifart.com
ClipArt.com	www.clipart.com

Figure 9-6 Selected Web image galleries

GRAPHICS SUITES

Some companies are combining or bundling their separate graphics programs in groups called **graphics suites.** The advantage of the graphics suites is that you can buy a larger variety of graphics programs at a lower cost than if purchased separately.

One of the most popular suites is from the Corel Corporation. The suite, called CorelDraw Graphics Suite, includes five individual Corel graphics programs plus a large library of clip art, media clips, and fonts. (See Figure 9-7.) Two other popular suites are Adobe's Creative Suites and Macromedia' s Studio.

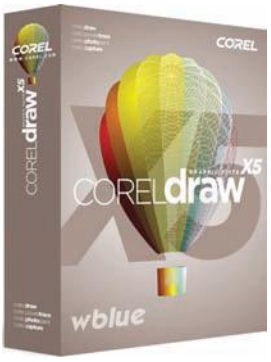


Figure 9-7 CorelDraw

CONCEPT CHECK

- What is desktop publishing?
- What is the difference between an image editor and an illustration program?
- Describe image galleries. What are graphics suites?

AUDIO AND VIDEO

Digital video editing software makes it easy to make digital video into professional quality home movies. Audio editing software makes it easy to record and edit music at home.

In the past, professional quality editing of home audio and video was a job for professional photo labs or studios. For example, if you wanted to assemble footage from all your Fourth of July picnics, you sent all the tapes to a lab and waited for a compilation tape. Now, using audio and video editing software, you can create your own compilation movies.

- **Video editing software** allows you to reorganize, add effects, and more to your digital video footage. Two commonly used video editing software programs are Apple's iMovie and Windows Movie Maker. (See Figure 9-8.) These programs are designed to allow you to assemble and edit new home videos and movies from raw digital video footage. To see how digital video editors work, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions. To learn how to use a digital video editor, see Making IT Work for You: Digital Video Editing on pages 9-9 and 9-10.
- **Audio editing software** allows you to create and edit audio clips. Most audio editing software also has features that allow you to add audio effects, like filters, to your tracks. For example, you can use this type of software to filter out pops or scratches in an old recording. You can even use this software to create your own MP3s. Some commonly used audio editing software programs are Ableton's Live and Sony's ACID. (See Figure 9-9.)

Figure 9-8 Apple iMovie

Figure 9-9 Live audio editing software

MULTIMEDIA

Multimedia presentations can include a variety of media and should include interactivity. Pages are linked by buttons. Plan and analyze, design, create, and support are the steps in developing multimedia presentations. Multimedia authoring programs create presentations.

Multimedia is the integration of all sorts of media into one presentation. For example, a multimedia presentation may include video, music, voice, graphics, and text. You may have seen multimedia applied in video games, Web presentations, or even a word processing document. Many of the basic

application software programs you learned about in Chapter 8 include features that make the incorporation of multimedia in documents easy. Although these applications include multimedia features, they create documents that are generally accessed in a linear fashion and provide very limited user interaction.

Effective multimedia presentations incorporate user participation or interactivity. **Interactivity** allows the user to choose the information to view, to control the pace and flow of information, and to respond to items and receive feedback. When experiencing an interactive multimedia presentation, users customize the presentation to their needs. For example Figure 9-10 presents an opening page of a multimedia presentation titled "About Asthma." Users are able to select the language to be used and decide whether to include sound.

Once used almost exclusively for computer games, interactive multimedia is now widely used in business, education, and the home. Business uses include high-quality interactive presentations, product demonstrations, and Web page design. In education, interactive multimedia is used for in-class presentations and demonstrations, long-distance learning, and online testing over the Internet. In the home, multimedia is primarily used for entertainment.

LINKS AND BUTTONS

An interactive multimedia presentation is typically organized as a series of related pages. Each page presents information and provides **links** or connections to related information. These links can be to video, sound, graphics, and text files, and to other pages and resources. By clicking special areas called **buttons** on a page, you can make appropriate links and navigate through a presentation to locate and discover information. Typically, there are several buttons on a page. You can select one, several, or none of them. You are in control. You direct the flow and content of the presentation. (See Figure 9-11.)

DEVELOPING MULTIMEDIA PRESENTATIONS

To create interactive multimedia presentations, follow these steps: Plan and Analyze, Design, Create, and Support. Follow the same development process regardless of the complexity and size of the project.

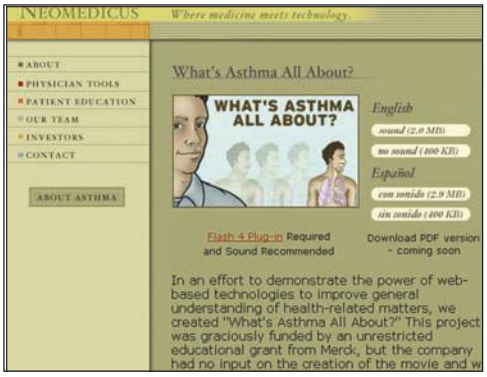


Figure 9-10 Opening page of a multimedia presentation "About Asthma"

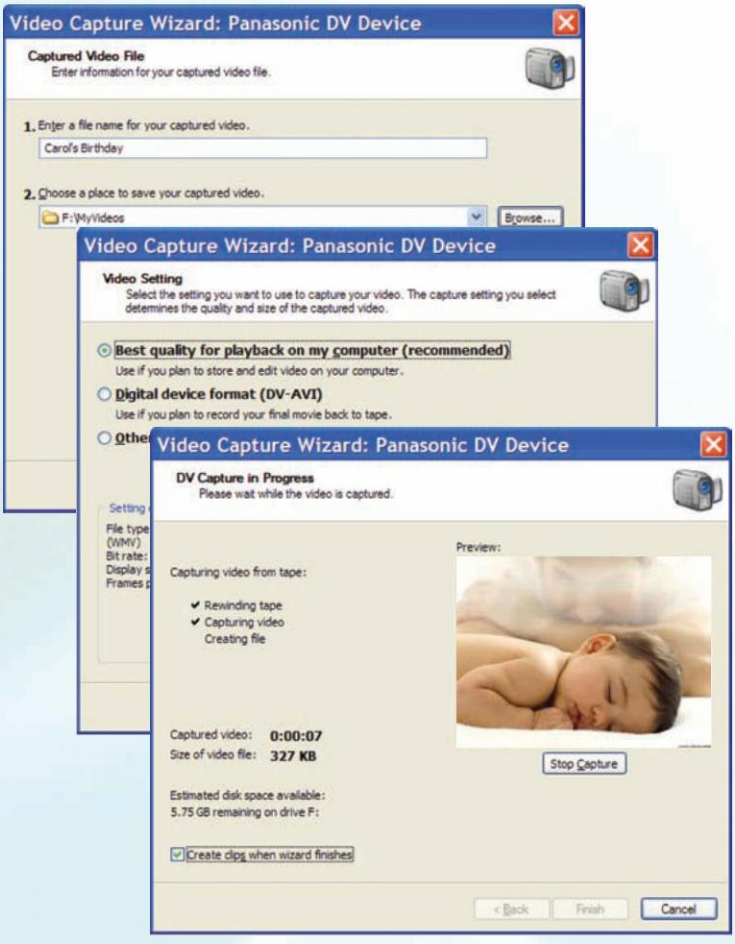
Figure 9-11 Links and buttons are used to navigate the "About Asthma" multimedia presentation

DIGITAL VIDEO EDITING

Do you want to make your own movie? Would you like to edit some home movies and distribute them to family and friends on DVDs? It's easy with the right equipment and software.

Capturing Video You can capture video to your computer from a device such as a digital camcorder. Once captured, the video can be edited using digital video editing software. Follow the steps below to capture video from a digital camcorder using Windows Movie Maker.

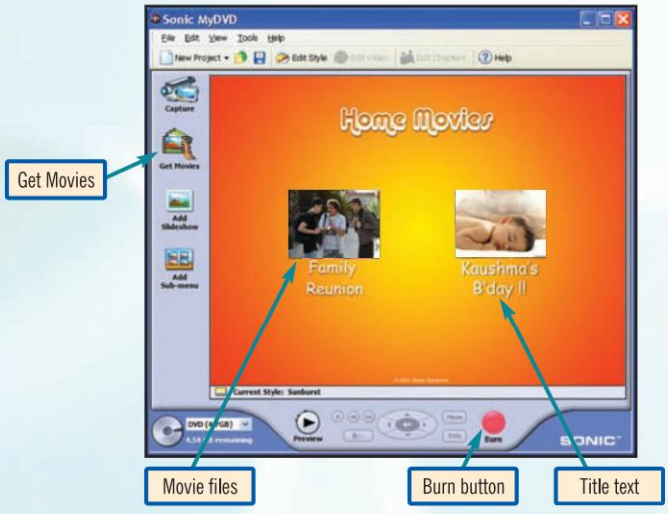
1. **Connect the digital camcorder to your computer. The *Video Capture Wizard* starts automatically.**
2. **Enter a file name for your captured video and select a location to save it to.**
3. **Follow the on-screen instructions to select a video setting and capture method for your video.**
4. **Preview the video as it is captured from your camera to the file you specified.**



Editing a Movie Windows Movie Maker divides your captured video into *clips,* or scenes that make up your movie. Follow the steps below to create a movie by arranging clips and adding special effects.

1. **Drag movie clips from the *Collection Pane* and arrange them in the *Timeline*.**
   - **Use the options in the *Movie Tasks Pane* to add a soundtrack to your movie.**
   - **Use the options in the *Movie Tasks Pane* to add effects, titles, and credits.**
   - **Use the *Monitor* to preview your movie.**

Creating a DVD Once you have edited your movies, you can create a DVD to share with friends and family. You will need a DVD writer and some special software, such as Sonic MyDVD. Follow the steps below to design a menu, add movies, and create your DVD.



1. **Open Sonic MyDVD and select *Create or Modify a DVD-Video Project*.**
2. **Click the title text to change the title of your DVD menu.**
   - **Click *Get Movies* to add your movie files.**
   - **Click the *Burn* button to create your DVD.**

The Web is continually changing, and some of the specifics presented in this Making IT Work for You may have changed. To learn more about other ways to make information technology work for you, visit our site at www.oleary-series.com and select Making IT Work for You.

On the Web Explorations

Many companies develop multimedia presentations for the Web. To learn more about one such company, visit our Web site at www.olearyseries.com and select On the Web Explorations.

- **Plan and analyze:** Determine the overall objective of the project, the resources required, and the person or team of people who will work on the project.
- **Design:** The creation of a story board is essential to the development of the project. A **story board** is a design tool used to record the intended overall logic, flow, and structure of a multimedia presentation. Figure 9-12 presents a partial overall story board. The highlighted path indicates just one of the many different paths a user could take. Each rectangle represents a single page in the presentation. Each page has a detailed story board associated with it that specifies the content, style, and design along with the links to video, audio, graphics, text, or any other media for that particular page.
- **Create:** Use a multimedia authoring program to create the interactive multimedia presentation. For example, see a selection of pages from "About Asthma" in Figure 9-13. This sequence of pages matches the highlighted story board elements in Figure 9-12 and represents just one possible path through the presentation.
- **Support:** Evaluate effectiveness, identify errors, and revise as needed.

MULTIMEDIA AUTHORING PROGRAMS

Multimedia authoring programs are special programs used to create multimedia presentations. They bring together all the video, audio, graphics, and text elements into an interactive framework. Widely used authoring programs include Macromedia Director, uthorware, and Toolbook. (See Figure 9-14.)

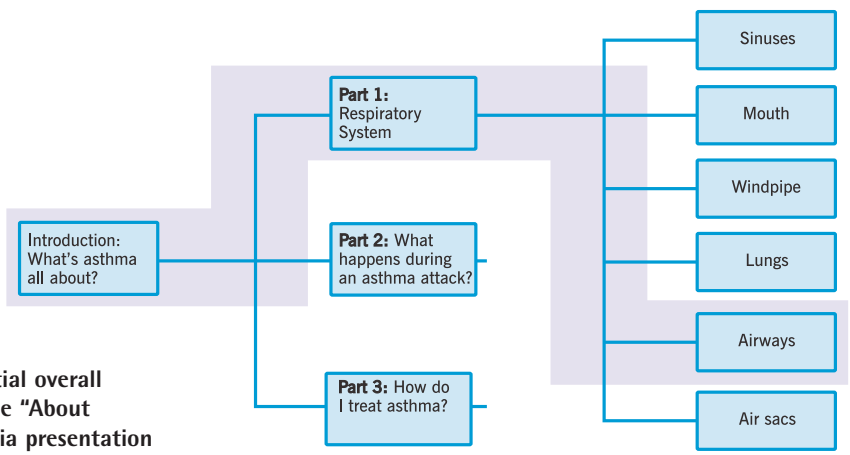


Figure 9-12 Partial overall story board for the "About Asthma"multimedia presentation

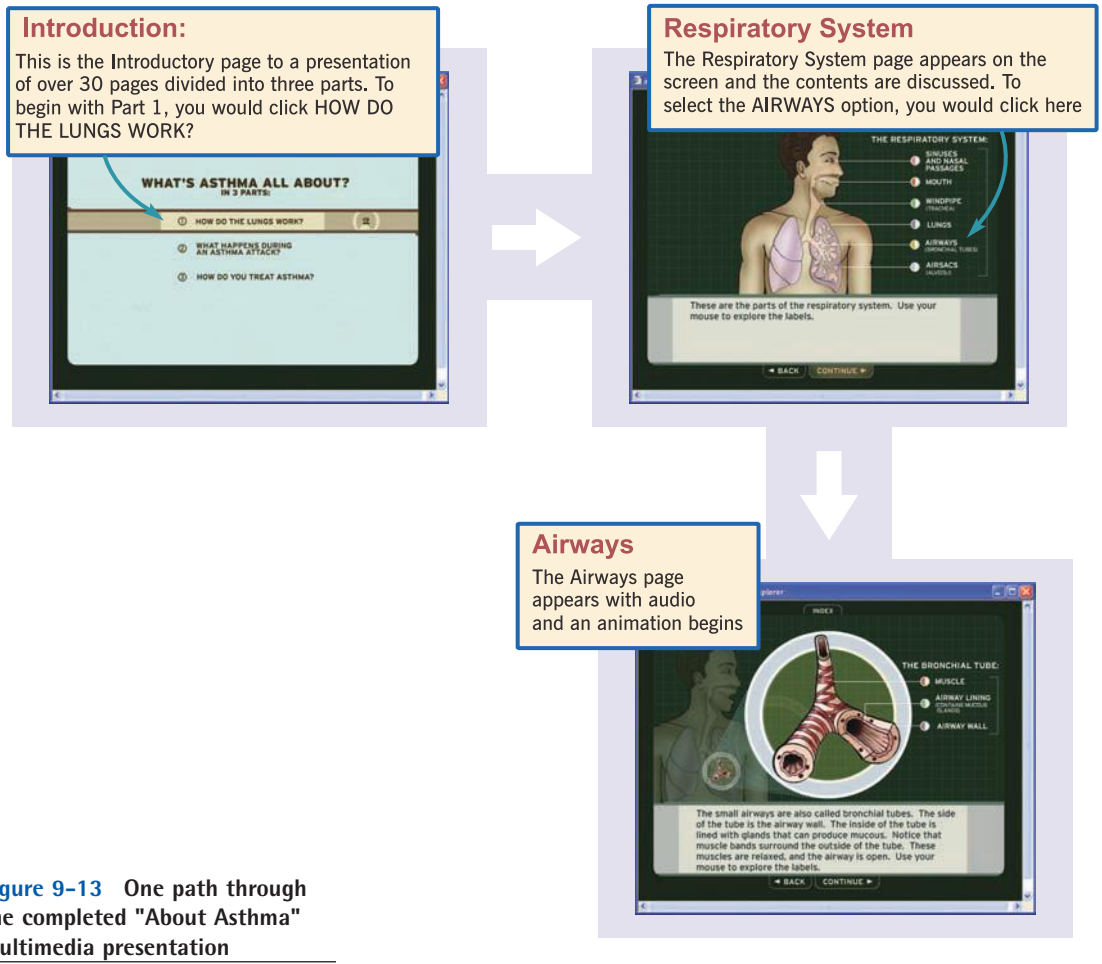


Figure 9-13 One path through the completed "About Asthma" multimedia presentation

CONCEPT CHECK

- What is digital video editing software? What is audio editing software?
- What are multimedia and interactivity? What are *multimedia* authoring programs?
- Describe the steps to create an interactive multimedia presentation.

Figure 9-14 Macromedia Director

WEB AUTHORING

Creating Web sites is called Web authoring. Graphical maps present overall Web site design. Web authoring programs support design and HTML coding.

On the Web Explorations

To learn more about some of the leading companies that develop multimedia authoring programs, visit our Web site at www.olearyseries.com and select On the Web Explorations.

You have probably interacted with a multimedia presentation on a Web site. There are over half a million commercial Web sites on the Internet, and hundreds more are being added every day. Corporations use the Web to reach new customers and to promote their products. (See Figure 9-15.) Many individuals create their own personal sites, called **Web logs** or **blogs,** to keep in touch with Friends and family. Creating a site is called **Web authoring.** It begins with site design followed by creation of a document file that displays the Web site's content.

WEB SITE DESIGN

A Web site is an interactive multimedia form of communication. Designing a Web site begins with determining the site's overall content. The content is then broken down into a series of related pieces of information. The overall site design is commonly represented in a **graphical map.** (See Figure 9-16.)

Figure 9-15 Adventure Travel Tours Web site

Notice that the graphical map shown in Figure 9-16 is very similar to the story board depicted in Figure 9-12. In this case, however, each block in the map represents a Web page. Lines joining the blocks represent links to related pages of information that make up the Web site. The first page typically serves as an introduction and supplies a table of contents. The following pages present the specific pieces or blocks of information.

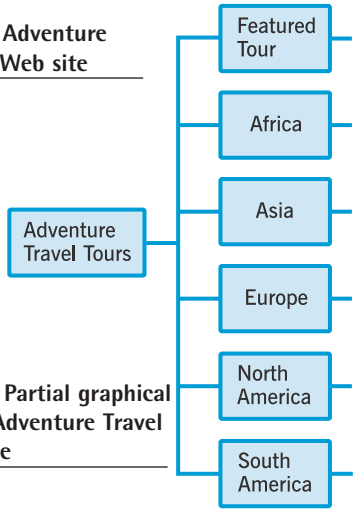


Figure 9-16 Partial graphical map for the Adventure Travel Tours Web site

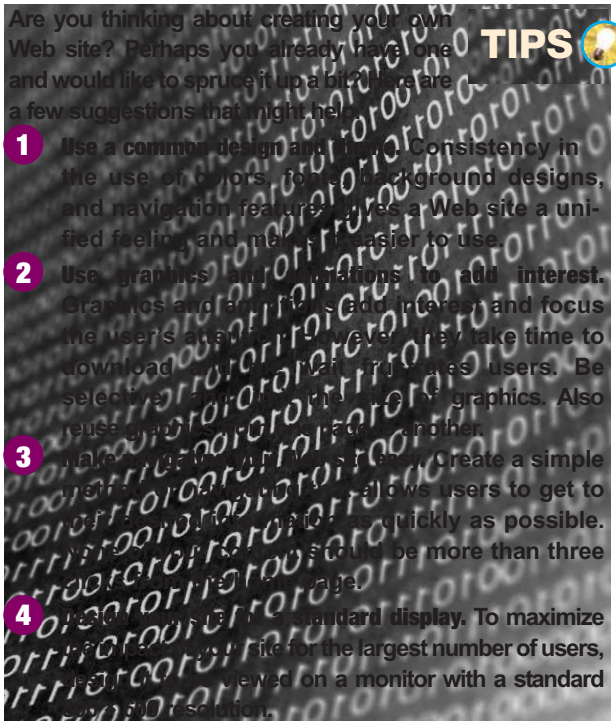
Multimedia elements are added to individual pages to ennance interest ana interactivity. One common multimedia element found on most Web sites is moving graphics called **animations.** These animations can be simple moving text or complicated interactive features. There are many specialized programs available to aid in the creation of animation. One type of interactive animation is produced using software from Macromedia Inc. This type of animation, called **Flash,** is usually full-screen, highly dynamic, and interactive. (See Figure 9-17.) Another common visual effect found on the Web is morphing. **Morphing** is a special effect in which one image seems to melt into another.

WEB AUTHORING PROGRAMS

As we mentioned in Chapter 6, Web pages are displayed using HTML documents. With knowledge of **HTML** and a simple text editor, you can create Web pages. Even without knowledge of HTML you can create Web pages using a word processing package like Microsoft Word.

Name	Address
Ben & Jerry's	www.benjerry.com
Disney	www.disney.com
Red Bull	www.redbull.com
Hard Rock Hotel	www.hardrockhotel.com
Sony Classical	www.hardrockhotel.com

Figure 9-17 Web sites that use Flash animation



More specialized and powerful programs, called **Web authoring programs,** are typically used to create sophisticated commercial sites. Also known as **Web page editors** and **HTML editors,** these programs provide support for Web site design and HTML coding. Widely used Web authoring programs include Macro-media Dreamweaver, Net-Objects Fusion, and Microsoft FrontPage. (See Figure 9-18.) The Web site depicted in Figures 9-15 and 9-16 was created using Microsoft FrontPage. (See Figure 9-19.)

To learn more about creating your own personal Web site, consult your Computing Essentials CD or visit our Web site at www.olearyseries.com and select Expansions.

Figure 9-18 Microsoft FrontPage

CONCEPT CHECK

- Describe Web authoring.
- What are graphical maps, animation, Flash, and morphing?
- What are Web authoring programs?

EMERGING APPLICATIONS

Artificial intelligence attempts to simulate human senses, thought processes and actions. Three areas are virtual reality, knowledge-based (expert) systems, and robotics.

New and revised applications programs are appearing every day. A common thread with most of these emerging applications is the inclusion, however subtle, of artificial intelligence concepts. Clearly, artificial intelligence and its applications are one of the most exciting developments in the 21st century. You have probably seen a portrayal of a robot with the intelligence, sensibilities, and capabilities of a human in a movie or on television. Depictions of robots and computers with artificial intelligence are common. In the past such depictions were pure fiction, but computer science has made great strides in the creation of artificial intelligence and the integration of this intelligence into a wide range of applications.

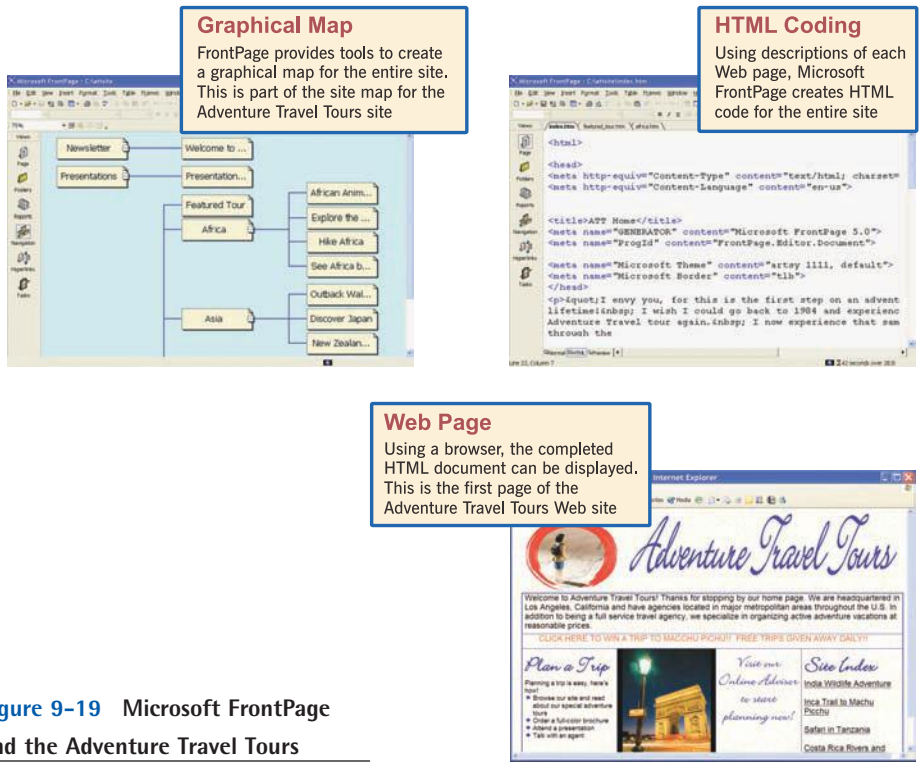


Figure 9-19 Microsoft FrontPage and the Adventure Travel Tours

The field of computer science known as **artificial intelligence (AI)** attempts to develop computer systems that can mimic or simulate human senses, thought processes, and actions. These include reasoning, learning from past actions, and using senses such as vision and touch. Artificial intelligence that corresponds to human intelligence is still a long way off. However, several tools that emulate human senses, problem solving, and information processing have been developed.

On the Web Explorations

Many people believe that the next big leap forward in computing will involve artificial intelligence. To learn about a leading developer of artificial intelligence software, visit our Web site at www.olearyseries.com and select On the Web Explorations.

These modern applications of artificial intelligence are designed to help people and organizations become more productive. Many of these tools have practical applications for business, medicine, law, and so on. In the past, computers used calculating power to solve **structured problems,** which can be broken down into a series of well-defined steps. People—using intuition, reasoning, and memory—were better at solving **unstructured problems,** whether building a product or approving a loan. Organizations have long been able to computerize the tasks once performed by clerks. Now knowledge-intensive work and unstructured problems, such as activities performed by many managers, is being automated. Let us now consider three areas in which human talents and abilities have been enhanced with "computerized intelligence": virtual reality, knowledge-based systems, and robotics.

VIRTUAL REALITY

Suppose you could create and virtually experience any new form of reality you wished. You could see the world through the eyes of a child, a robot or even a lobster. You could explore faraway resorts, the moon, or the inside of a nuclear waste dump, without leaving your chair. This simulated experience is possible with virtual reality.

Virtual reality is an artificial, or simulated, reality generated in 3-D by a computer. Virtual reality is also commonly known as **VR, artificial reality,** or **virtual environments.** To navigate in a virtual space you use virtual reality hardware including headgear and gloves. The headgear has earphones and three-dimensional stereoscopic screens (one type is called Eyephones). The gloves have sensors that collect data about your hand movements (one type is called DataGlove). Coupled with software (such as a program called Body Electric), this interactive sensory equipment lets you immerse yourself in a computer-generated world. See Figure 9-20.

Figure 9–20 Virtual reality

Virtual reality modeling language (VRML) is used to create real-time animated 3-D scenes. Hundreds of sites exist on the Web with virtual reality applications. Users are able to experience these applications with browsers that support VRML.

Creating virtual reality programs once required very high end software costing several thousands of dollars. Recently, several lower-cost yet powerful authoring programs have been introduced. These programs utilize VRML and are widely used to create Web-based virtual reality applications. One of the best known is Cosmo Worlds from Cosmo Software.

There are many number of possible applications for virtual reality. The ultimate recreational use might be something resembling a giant virtual amusement park. More serious applications can simulate important experiences or training environments such as in aviation, surgical operations, spaceship repair, or nuclear disaster cleanup. Modern virtual reality strives to be an **immersive experience,** allowing a user to walk into a virtual reality room or view simulations on a **virtual reality wall.** (See Figure 9-21.)

Figure 9–21 Virtual reality wall

KNOWLEDGE-BASED (EXPERT) SYSTEMS

People who are experts in a particular area—certain kinds of law, medicine, accounting, engineering, and so on—are generally well paid for their specialized knowledge. Unfortunately, for their clients and customers these experts are expensive, not always available, and hard to replace when they move on.

What if you were to somehow capture the knowledge of a human expert and make it accessible to everyone through a computer program? This is exactly what is being done with so-called knowledge-based or expert systems. **Knowledge-based systems,** also known as **expert systems,** are a type of artificial intelligence that uses a database to provide assistance to users. These systems use a database, or **knowledge base,** that contains specific facts, rules to relate these facts, and user input to formulate recommendations and decisions. The sequence of processing is determined by the interaction of the user and the knowledge base. Many expert systems use so-called **fuzzy logic,** which allows users to respond to questions in a very humanlike way. For example, if an expert system asked

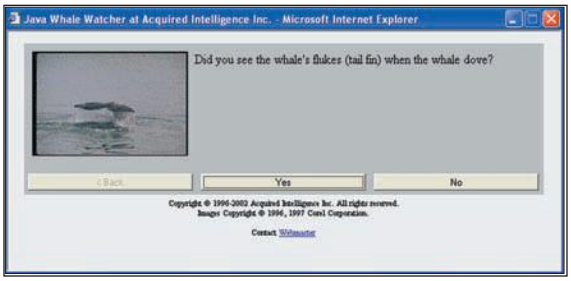


Figure 9-22 Whale identification using an expert system

how your classes were going, you could respond, "great," "OK," "terrible," and so on.

Over the past decade, expert systems have been developed in areas such as medicine, geology, architecture and nature. (See Figure 9-22.) There are expert systems with such names as Oil Spill Advisor, Bird Species Identification, and even Midwives Assistant. A system called Grain Marketing Advisor helps farmers select the best way to market their grain.

ROBOTICS

Robotics is the field of study concerned with developing and using robots. **Robots** are computer-controlled machines that mimic the motor activities of living things. Some robots can solve unstructured problems using artificial intelligence. You may have seen household robots used for mowing the lawn or for entertainment purposes, like Sony's AIBO robotic dog. (See Figure 9-23.)

Figure 9-23 AIBO

Robots are used in factories, manufacturing, home security, the military, and many other fields of human endeavor. They differ from other assembly-line machines because they can be reprogrammed to do more than one task. Robots are often used to handle dangerous, repetitive tasks. There are three types of robots.

- **Perception systems: Perception system robots** imitate some of the human senses. For example, robots with television-camera vision systems are particularly useful. They can guide machine tools, inspected products, and secure homes.

Figure 9-24 Industrial robot

- **Industrial robots: Industrial robots** are used to perform a variety of tasks. Examples are machines used in automobile plants to do welding, polishing, and painting. Some types of robots have claws for picking up objects and handling dangerous materials. (See Figure 9-24.)
- **Mobile robots: Mobile robots** act as transports and are widely used for a variety of different tasks. For example, the police and military use them to locate and disarm explosive devices. Mobile robots have entered the world of entertainment with their own television program called "Battlebots." You can even build your own personal robot using special robot building kits. (See Figure 9-25.)

CONCEPT CHECK

- Define artificial intelligence.
- What is virtual reality? What is VRML?
- Describe knowledge-based systems and fuzzy logic.
- Describe three types of robots.

Site	Description
battlebot.com	Offers a variety of information including links to sites offering different types of robot kits
robotkits.com	Sells beginner as well as advanced robot creation kits
roboticsonline.com	Offers news and advice for the robot enthusiast
lynxmotion.com	Sells robotic equipment and software

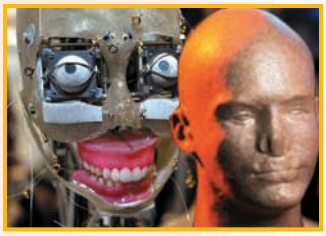
Figure 9-25
Robot kits

A Look to the Future

The Future of Artificial Intelligence Is Emotional

Would you like to voice conference with your mom through robots that resemble you both and demonstrate your emotions on their rubber faces? What if you received a companion robot with a set of moral values? Would you trust a robot to trade the stocks in your portfolio? Researchers are currently at work on robots with the artificial intelligence needed to perform these tasks and more.

The Saya robot, with its artificial skin and muscles, is currently under development in Tokyo. Researchers hope that eventually it will be used as a communication device similar to a current Web cam. For example, you could connect to a robot that resembles you at your mother's house and communicate through it with her. You would see your mother through the robot's visual system. Your mother would hear your voice come from the robot and your emotions would be displayed on its face.



Other research is being conducted that will give robots a sense of values. It is hoped that these robots will be able to make decisions independently based on this set of values. Researchers in California are creating robots that act as surveillance instruments, capable of following a target without direction from a human. The robots can predict potential escape routes and pursue a subject through crowded areas.

At the Sociable Machines Project at MIT, students are working on a robot named Kismet that detects human emotions through social and audio cues and responds with emotions of its own. Kismet recognizes faces and responds to stimuli like an infant would with emotions ranging from surprise to disgust. Researchers believe that robots such as Kismet can interact with and learn from humans better than traditional computer interfaces.

All of these projects are designed to move beyond simple computing and into a decidedly human realm of emotional intelligence. Some experts have even suggested that human intelligence relies on emotional input for all important decision-making. Thus, by definition, for a machine to approximate human intelligence it would have to understand and rely on emotions. If computers could read human emotions, and had emotional intelligence of their own, it could be possible for your computer to act as a stress counselor when you stay up all night working on a project.

Computers with their own emotional intelligence could be the ultimate human companions. Computer scientists have suggested they may read your mood and play music accordingly. Or they could search through audio and video files for media you would find moving, funny, or dramatic. if computers had their own emotional sense, it is possible is that they, like the humans they emulate, would require interaction for mental health.

Would you use a robot as a communication device? Do you think we should build robots with a sense of moral values? Some researchers have suggested that robots with artificial intelligence could serve as ideal supervisors and managers. What do you think? Would you like to have an "emotional" robot for a boss?