- Four basic computer functions—input, process, output, and store data—work together in order to process and present information in a meaningful manner.

What are the benefits of becoming computer competent? One advantage of being computer competent is that it makes employees more attractive to potential employers. Because computers have changed the way we work, as listed in Figure 1, many employers expect employees to have basic computer skills when they are hired.

In addition, if you are knowledgeable about computers and their uses, it makes you a better consumer. You will feel more comfortable when it comes to purchasing the right computer hardware and software for your needs, adding a peripheral for a specific use, or detecting basic problems when a system does not work properly. If you have a basic understanding of today's technology, you can also better understand and use *new* technologies.

What are the basic functions of a computer? A ***computer*** is a programmable electronic device that can input, process, output, and store data. The term ***programmable*** means that a device can be instructed to perform a task or a function when fed with a program or software.

A computer takes data and converts it into information. ***Data*** represents text, numbers, graphics, sounds, and videos entered into the computer's memory during input operations. ***Information*** is data that has been processed so that it can be presented in an organized and

■ Continue to the next page to complete the objective.

- The traditional memo has given way to email messages.
- Business reports can now be shared on a network, enabling a group of individuals to collaborate by adding their own notes and comments before the report is finalized.
- Presentation graphic software is widely used to share information with an audience in a conference room or via the company's intranet.
- Spreadsheet software is a key tool in presenting financial information and developing sound business plans.

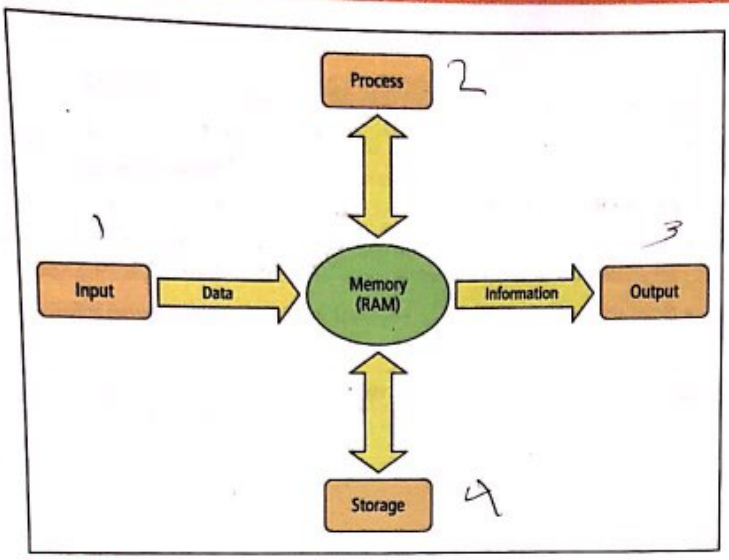

Figure 3 These are the four computer functions within the information processing cycle. *Memory* is not considered a function, but it is the center of flow of data and information within this cycle.

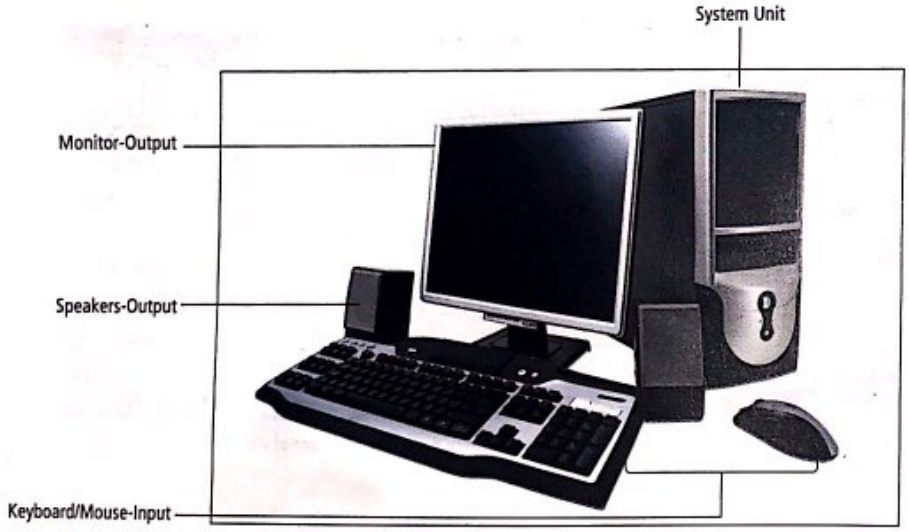

Figure 4 The components of a typical computer system and the appropriate step in the information processing cycle.

meaningful way. Think of data as the pieces of a jigsaw puzzle and information as the finished puzzle. Putting the pieces of the puzzle together gives you the overall picture. For example, CIS110, the letter B, and the name Amy Stevens are pieces of data. Individually, these pieces of data seem meaningless. However, when processed, this data becomes the information on a grade report that indicates Amy Stevens received a grade of B in her CIS 110 class.

These four basic computer functions work in a cycle known as the ***information processing cycle*** as shown in **Figure 3**.

The functions of this cycle are:

- ***Input***—The computer gathers data or enables a user to enter data.
- ***Process***—Data is manipulated and converted into information.
- ***Output***—Information is displayed to the user in a way that is understandable.
- ***Storage***—Data and/or information is stored for future use.

In the grade report, the instructor used a computer to enter, or input, the students' grades into the computerized grading system. A computer then processed this data along with data for other classes the students might have taken. In the example, the student Amy then received a record of her grade. The grade report was output by the computer. In addition, her grades remain stored in the system so they can be used to generate her transcript or to determine her future grade point average. See **Figure 4**.

Done! You have completed Objective 1 of 6.

OBJECTIVE 2:

- Computers have the same basic components; however, they vary in shape and size.
- Other computers include ***mainframe computers, supercomputers,*** and ***embedded computers*** and all vary in the tasks they perform.

What are the different types of computers and what are their uses? Although computers come in a variety of sizes, the basic components required to complete the information processing cycle must be present. In addition to microcomputers, there are specialty computers, including servers, mainframes, supercomputers, and embedded computers.

What are microcomputers? The term ***microcomputer*** means the main component of a computer is a microprocessor, a powerful chip that is very small in size compared to a mainframe or a supercomputer. Microcomputers are classified as small, inexpensive, and designed for personal use or as part of a network of computers in a business environment. As shown in **Figure 5**, some of the most common types of microcomputers include:

- ***Desktop computers*** are computers that sit on the desk, floor, or table as shown in **Figure 6**. These computers typically have a detachable keyboard, mouse, monitor, and possibly other peripheral devices, such as digital cameras, scanners, and music players.

■ Continue to the next page to complete the objective.

Desktop

Tablet

Netbook/ Mini Laptop

Notebook

Smartphone

Figure 6 Type

Microcomputer	Description
Desktop computer	A computer that sits on the desk, floor, or table and has peripheral devices such as a keyboard, mouse, and/or printer.
Gaming computer	A computer that is configured with a fast central processing unit, large amount of memory, a special video card, and joystick.
Notebook computer	A portable computer with a built-in screen, keyboard, and mouse.
Tablet computer	A portable computer has special features such as an onscreen keyboard.
Mobile devices	Personal digital assistants, handheld computers, and smartphones that are ultra-light and portable.

Figure 5 Most common types of microcomputers.

Figure 6 Types of microcomputers.

- **Desktop computers,** as shown in Figure 7, are used in most homes and in business applications where portability is not needed. They can be configured in a multitude of arrangements depending on the specific needs and budget constraints. To ***configure*** means to put together by selecting a specific combination of components, features, and options.

- ***Gaming computers*** are mostly used by video game enthusiasts. They are usually configured with a fast CPU, large amount of memory, a special video card, a ***joystick*** as shown in Figure 8, or game pad, and sound card with surround sound speaker system.

Desktop computers generally fall into two main categories: PCs or Macs. The PC, or personal computer, originally referred to as the IBM personal computer when it was released in the early 1980s, is now manufactured by a variety of companies including Hewlett-Packard, Dell, and Gateway. The term *PC* commonly refers to a small microprocessor-based computer that typically runs a Windows operating system; however Macintosh computers are also known as personal computers. The Apple Macintosh computer, commonly known as Mac, is manufactured exclusively by Apple Inc. with an Intel microprocessor and can perform the same functions as the PC. The primary difference, then, between a personal computer and a Mac is the operating system as well as the user interface, application software and the cost of the computer.

There are pros and cons to both types of computers, but in reality, both are good systems and the choice usually comes down to personal preference and price. Although the PC and the Mac

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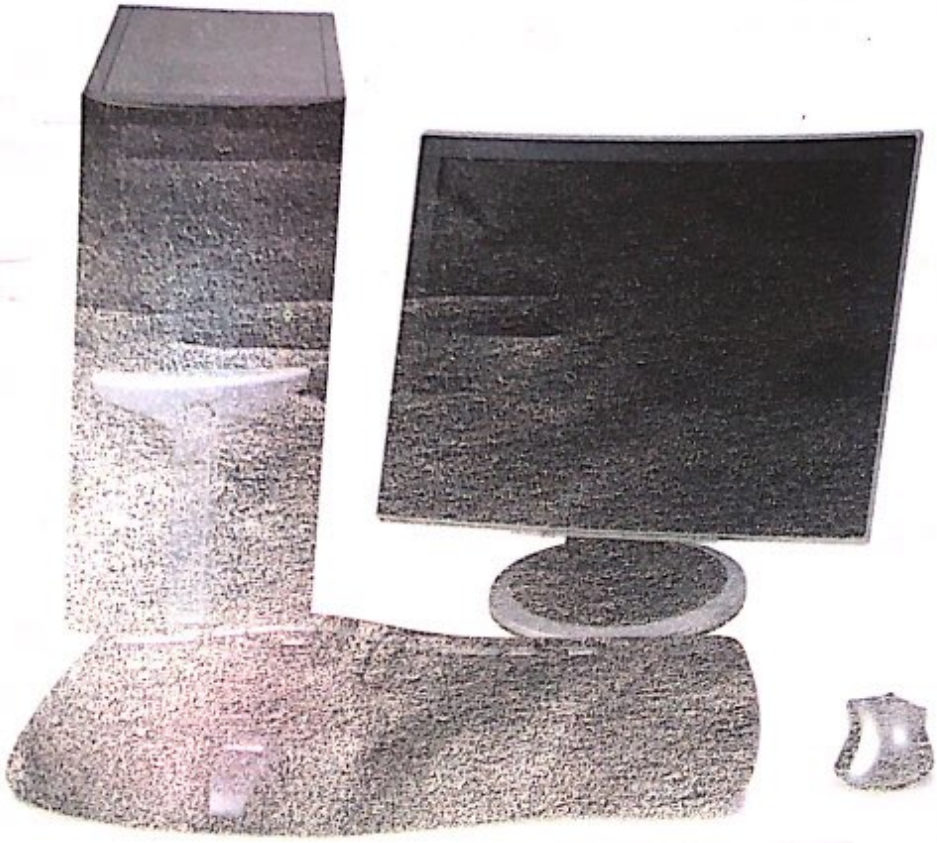

Figure 7 An example of a desktop computer.

Figure 8 An example of a joystick used to control games.

each process information differently, both can perform the same types of tasks. The PC has a larger market share among general computer users and in business settings, whereas the Mac is popular with graphic design, advertising, and professional audio and film industries.

Notebook computers, as shown in **Figure 9**, are ideal for people "on-the-go." Often referred to as laptops, they are equipped with rechargeable batteries and are designed to be portable. Notebooks typically have a built-in display screen, a keyboard, and a pointing device; although it is possible to connect them to detachable devices for more comfortable desktop use. A ***docking station*** enables the user to connect a notebook to a full-size keyboard, monitor, and other devices in an office setting.

Tablet computers are similar to notebooks because they are portable; however, they have some special features that set them apart.

Some tablet computers have a convertible touch screen that swivels, enabling the tablet to be used like a standard notebook computer in one position or like a clipboard in the second position. Information is typically typed into the tablet computer using an onscreen keyboard, as shown in **Figure 10**; the keyboard appears on the screen as opposed to a physical keyboard that sits on a desk.

Continue to the next page to complete the objectives

Figure 9 Primary differences between a personal computer and a Macintosh computer include user interface, application software, and the cost and availability of parts and accessories.

Figure 10 A tablet.

Some also use ***speech-recognition*** technology, which enables the user to record discussions or lectures, or to control the computer functions using voice commands.

Mobile devices include items such as ***handheld computers*** (Pocket PCs), and ***smartphones***. These devices vary in size and purpose, but they are all ultra-lightweight and portable. Handheld computers enable users to access personal productivity software and send email over the Internet. Smartphones, as shown in **Figure 11**, add Internet capability to the wireless communication aspects of cell phones. The Blackberry, iPhone, and Android are all examples of smartphones.

The newest mobile devices, often referred to simply as "handhelds," include personal productivity software and enable the user to play music, take photos and videos, make phone calls, and access the Internet as shown in **Figure 12**. As the features of mobile devices continue to converge, permitting them to perform similar tasks, it becomes more difficult to differentiate between them. If you are in the process of buying one of these handhelds, you need to do some research and make sure that you get the features and functions you want.

■ **Continue to the next page to complete the Objectives.**

Servers

What are servers? When computers are connected together in a ***network*** environment, ***servers,*** as shown in **Figure 13**, are specialized computers that manage network resources through the use of administrative software. They provide other computers with access to the network and can handle a variety of functions or may be assigned to just one particular type of task. Thus, within the same company, you might find a web server that holds and delivers the organization's web pages, a file server that handles the storage and retrieval tasks for all of the company's files, and a printer server that handles all print requests.

What are mainframe computers? ***Mainframe computers,*** as shown in **Figure 14**, are large computers often found in large businesses, organizations, and government agencies where thousands of users need to simultaneously use the data and resources of their institution such as in bulk data processing or when you use an automated teller machine to interact with your bank. Mainframes can store vast amounts of data using a variety of storage. Mainframes are often used for high-security applications, bulk data processing such as data surveys and censuses, and statistics. Early mainframe computers were very large and required separate rooms to house them, while today's mainframes are significantly smaller, faster, and more powerful than their predecessors. Today, mainframes are giving way to cloud computing. ***Cloud computing***, in its simplest form, is the use of resources and applications which are accessible through a network connection to the Internet. These applications are housed on the Internet in a "cloud" and are

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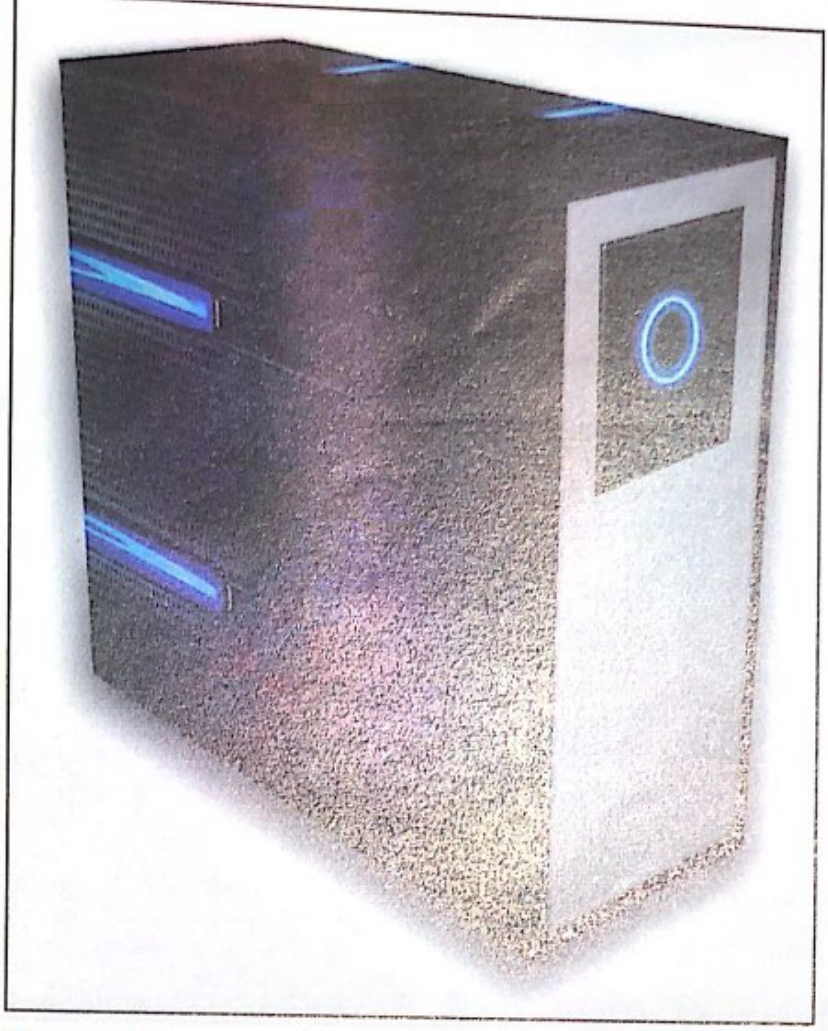

Figure 13 Network server.

Figure 14 Mainframe computer.

then accessed through a laptop or some other computing device with an Internet connection as opposed to installing the application on the laptop directly.

Supercomputers

What are supercomputers? ***Supercomputers*** are large, powerful, and ultrafast computers that perform specialized tasks. Some of these are used for research at a university, processing intensive scientific calculations like at NASA, and multi-scale simulations, for example. Since June 2008, the IBM nicknamed "Roadrunner," a the Department of Energy's Los Alamos Nation Laboratory in New Mexico, holds the top spot as the world's fastest supercomputer. (See http://www.top500.org/ for more information.)

Supercomputers, as shown in **Figure 15**, are the fastest and most expensive computers. Unlike a mainframe computer that can handle number of programs simultaneously, the supercomputer is designed to run fewer programs at one time, but to do so as quickly as possible. They perform sophisticated mathematical calculations, track weather patterns, monitor satellites, and perform other complex tasks.

Embedded Computers

What are embedded computers? ***Embedded computers*** are small specialized computers built into larger components such as automobiles and appliances as demonstrated in the table in **Figure 16**. These computers use a specially programmed microprocessor to perform a set of predefined tasks, and may require little or no input from the user.

Done! You have completed

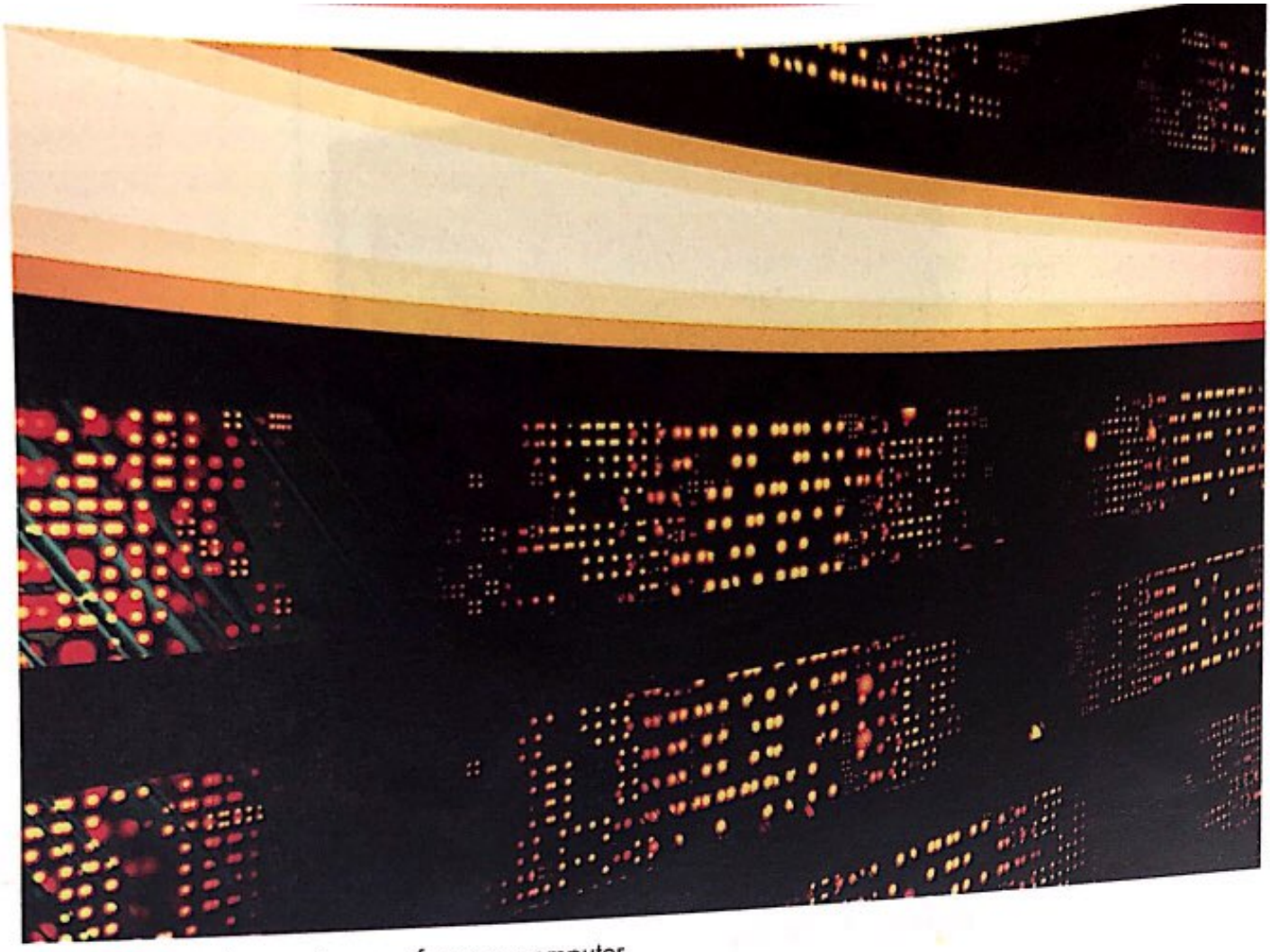

Figure 15 A close up image of a supercomputer.

In Automobiles...	In Appliances...
• Emission control systems • Antilock braking systems (ABS) • Airbags • Stability control systems	• Electronic appliances • Microwave ovens • Digital cameras • Programmable thermostats • Medical devices • Diagnostic equipment

Figure 16 Examples of embedded computers.

- ***Hardware*** is the computer and any equipment connected to it such as input devices, keyboards, the mouse, output devices, and monitors.
- Hardware also consists of the system unit, which includes the ***motherboard*** and the ***central processing unit (CPU)***.

What is computer hardware? Hardware devices are the physical components of the computer. Items such as the monitor, keyboard, mouse, and printer as shown in Figure 4 are also known as ***peripherals*** because they attach to the computer.

The computer itself is known as the ***system unit,*** and it contains many of the critical hardware and electrical components. The system unit is sometimes referred to as the tower, box, or console. When the system unit is combined with the appropriate peripheral devices, the system can perform the four basic computer functions: input, process, output, and storage. Peripheral devices are used to input and output data and information, and the system unit processes and stores the data.

System Unit

What is inside the system unit? If you remove the cover from the system unit, you will find several key components inside. One of the most essential components is the ***motherboard,*** a large printed circuit board, as shown in **Figure 17**, to which all the other components are connected.

The ***microprocessor chip,*** also known as the ***central processing unit (CPU)*** and RAM, the computer's main memory, are connected to the motherboard. The table in **Figure 18** lists the motherboard features and their descriptions.

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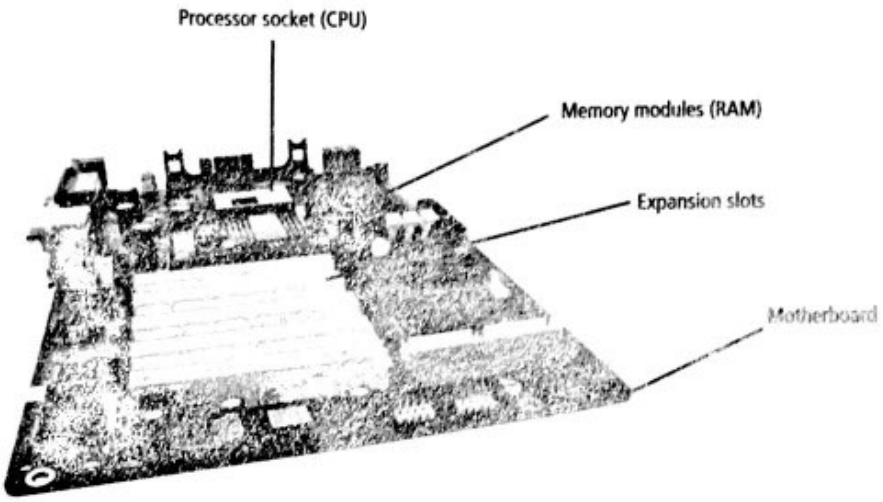

Figure 17 The motherboard and some of its components.

Component	Description
Motherboard/System board	The main computer circuit board into which all components are plugged. It is installed safely inside the box or case called the system unit.
CPU المعالج	The central processing unit is responsible for getting data from memory, performing arithmetic and logical operations and converting data to information.
Memory modules (RAM)	Temporary storage area where data is stored before processing, output, or storage. RAM is the center of flow of data and information within the information processing cycle.
Expansion slots	Slots or connectors on the motherboard that allow you to connect expansion cards.
Expansion cards	Removable circuit boards used to add new peripherals or increase the computer's capabilities. If the motherboard does not have a specific port to connect a peripheral device, the appropriate expansion card will allow you to do so.
Ports	Connecting points used as an interface between peripherals and the motherboard.

Motherboard features

The motherboard also provides some of th ports used to connect peripheral devices, whic are explained later in this chapter to the system

Input Devices

Input devices are used to enter data into memory (RAM) and are the primary way we interface with a computer. Some of the common input devices are the keyboard and the mouse as shown in **Figure 19**.

Keyboards

Are there different types of keyboards? The ***keyboard*** is the primary input device for computers. There are actually several different kinds of keyboards; a small sample is shown in **Figure 20**.

(1) The QWERTY keyboard is the most common. It is based on the original typewriter keyboard and is named for the arrangement of the letters on the upper left alphabetic row of keys. Another style is

(2) the Dvorak keyboard, which arranges the letters and numbers in a different pattern for increased typing speed. Some ergonomic keyboards use a split keyboard arrangement, offsetting each half at an angle to reduce the incidence of repetitive stress injuries such as carpal tunnel syndrome. The

(4) onscreen keyboard, as found on the iPad, supplies the actual keyboard on the actual screen. This type of keyboard, along with smartphone keyboards are not only changing the way we type but are also a more desirable alternative for those who tend to be more mobile.

Keyboard size and layout on notebook and tablet computers can differ slightly from a standard keyboard due to space constraints. Keyboards usually send information to the computer through a cable connected to a USB

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Figure 19 Examples of input devices.

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Figure 20 Examples of keyboards.

port; however, ***wireless*** or remote keyboards are gaining in popularity. A wireless keyboard communicates with the computer by infrared or radio frequency technology. These wireless devices require batteries.

What are all these other keys used for? In addition to the standard keys originally found on typewriters, computer keyboards have a variety of keys that provide additional functionality.

1 ***Control keys***, such as the Ctrl, Alt, and Cmd keys (the Cmd key is typically only found on Mac computers), provide shortcuts or increased functionality to the keyboard when used in combination with another key as listed in the table in **Figure 21**. If you press the Shift key and a letter, the result is an uppercase letter. In the same way, using one of the control keys enables the standard keys to be used for additional purposes. For example, pressing Ctrl and the letter P opens the Print dialog box. Another example of a control key is the Esc key, which can often be used to stop, or *escape*, from a currently running task. A unique control key that is found only on Windows-based keyboards is the Windows key; when pressed alone, it serves as a shortcut key to open the Start menu, and when pressed in combination with other keys, it opens many common functions through the keyboard.

2 The ***numeric keypad***, located at the right of the keyboard, provides an alternative method of quickly entering numbers. This is useful for individuals who are accustomed to using an adding machine or calculator.

3 ***Function keys*** are located above the standard row of number keys as shown in **Figure 22**. Numbered F1 through F12, these keys are generally associated with certain software-specific commands. Pressing the F1 key will usually

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Windows Shortcut	Mac Shortcut	Command
Ctrl-A	Cmd-A	Select All
Ctrl-P	Cmd-P	Print
Ctrl-O	Cmd-O	Open
Ctrl-N	Cmd-N	New (window, document)
Ctrl-S	Cmd-S	Save
Ctrl-C	Cmd-C	Copy
Ctrl-X	Cmd-X	Cut
Ctrl-V	Cmd-V	Paste
Ctrl-W	Cmd-W	Close Window
Ctrl-B	Cmd-B	Bold (selected text)
Ctrl-I	Cmd-I	Italic (selected text)

Figure 21 Keystroke shortcuts.

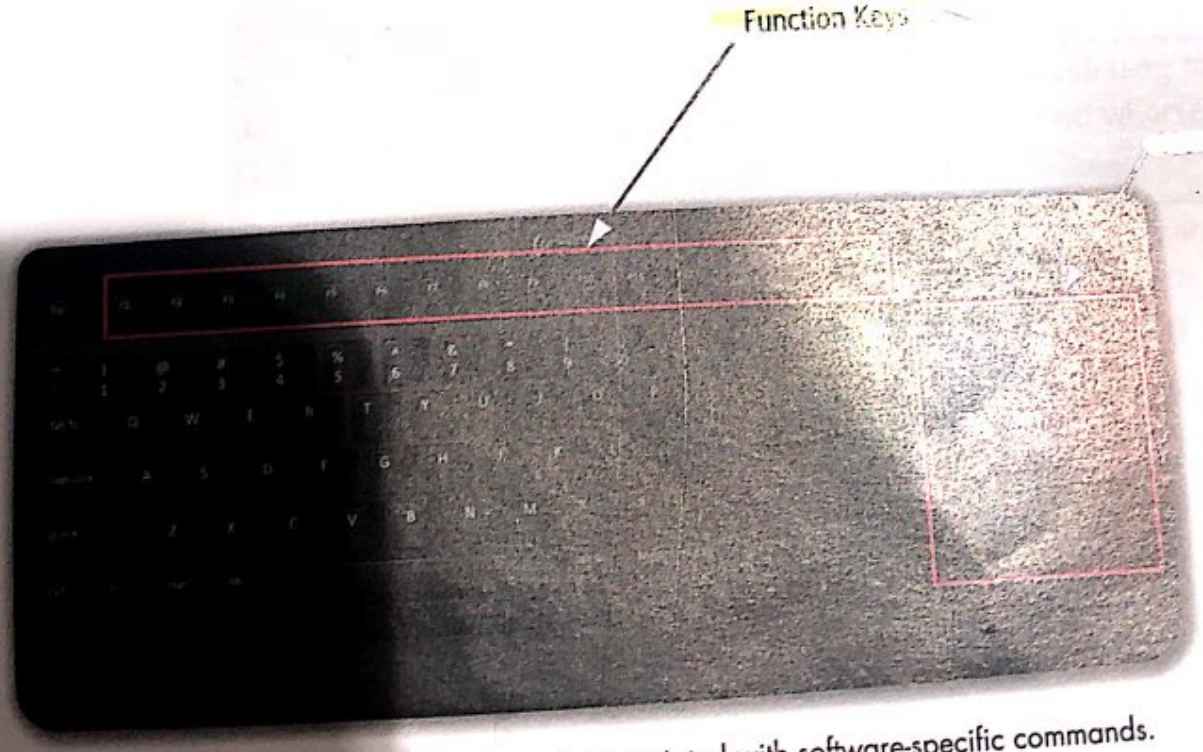

Figure 22 The function keys are generally associated with software-specific commands.

open the Help menu for a program; however, pressing one of the other function keys can produce different results, depending on the software program running.

4 ***Arrow keys*** are located at the bottom of the keyboard between the standard keys and the numeric keypad as shown in **Figure 23**. These keys enable the user to move the insertion point around the window one space at a time.

5 ***Toggle and other keys*** are used for various purposes, including navigation and editing. The Insert, Num Lock, and Caps Lock keys are all examples of toggle keys. A ***toggle key*** works just like a light switch; press it once and the feature is turned on, press it again and it is turned off. If you've ever accidentally pressed the Caps Lock key and typed a long string of all capital letters, you've seen this feature in action. Pressing the Caps Lock key again allows you to return to normal keyboarding mode.

Multimedia and Internet control keys are typically found at the top edge of the keyboard. The precise placement and function of these keys usually depends on the keyboard manufacturer. However, most modern keyboards have at least a few keys or buttons that can be used for such tasks as muting or adjusting speaker volume, opening a ***web browser***, and sending an email. Generally, each button has an ***icon*** that indicates its function.

The Mouse

Is there an easier way to control the action on the computer screen? Yes, the ***mouse***, as shown in **Figure 24**, is an input device (also called a

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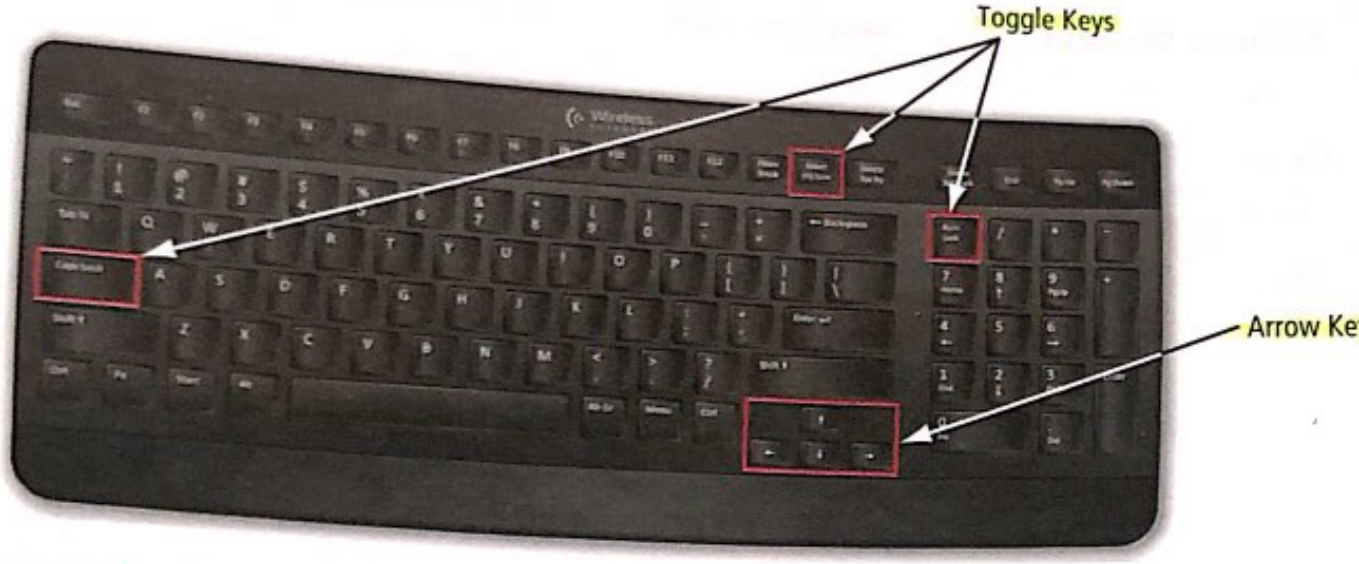

Figure 23 The arrow keys allow users to move the insertion point while the toggle keys are used for various purposes.

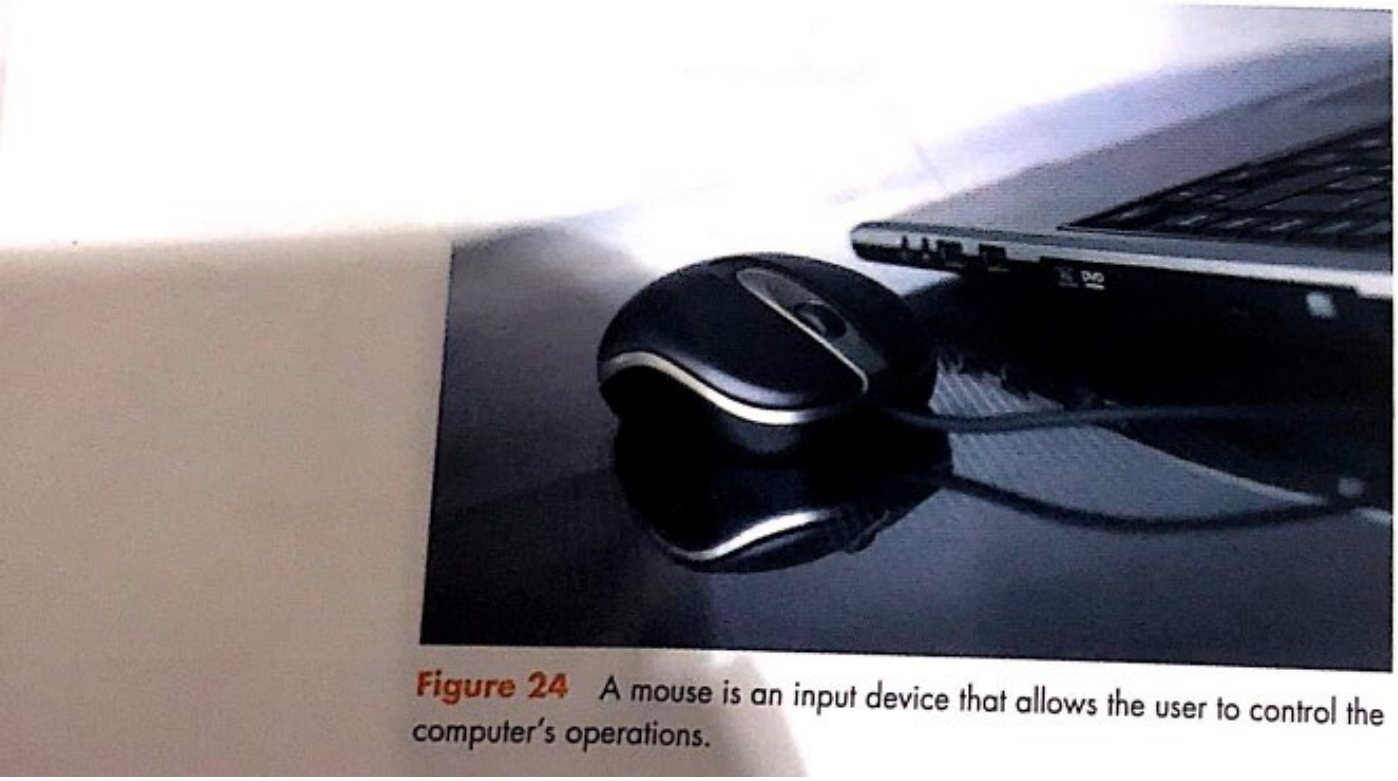

Figure 24 A mouse is an input device that allows the user to control the computer's operations.

pointing device) that, together with the keyboard, enables the user to control the operations of the computer. The mouse became popular with the introduction of graphical user interfaces, such as Microsoft Windows. This point-and-click device is useful for positioning the ***insertion point*** by translating hand movements into corresponding actions on the screen. The mouse is represented on the screen by a symbol called the ***mouse pointer***. The user moves the mouse and positions this pointer anywhere on the screen to move objects or make selections from available program icons or menus.

Some mice have a roller ball on the bottom that, as you move it, translates your movement into electrical impulses. Others use laser technology (optical) to control the pointer movement. Because the bottom of an optical mouse is sealed, dirt and debris are less likely to get inside and interfere with the mouse's internal mechanisms. Just like a keyboard, the mouse can be wired or wireless.

Notebook and tablet computers can use a mouse, but most of them have a built-in touchscreen, touchpad, a trackball, or track point to move the insertion point and mouse pointer. Most mice today are equipped with two buttons and a wheel button in the center that provides easy zoom and scroll functions.

How can the mouse be used more efficiently? Although there are different kinds of mice, the traditional mouse has two buttons and a scroll wheel. The table in **Figure 25** provides a brief description of some of the ways the mouse can be used.

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Action	Description
Click	By default, the left mouse button is considered the primary button. When instructed to click, it is understood that the mouse pointer is moved to a certain location on the screen, and the left mouse button is pressed and released one time.
Double-click	When instructed to double-click, it is understood that the mouse pointer is moved to a certain location on the screen and the left mouse button is pressed and released twice in rapid succession. It is important that the mouse does not move while double-clicking or the command will not produce the expected results.
Drag	This means to press the left mouse button and continue to hold it while dragging, or moving, the mouse and then releasing it. This action can be used to select large blocks of text, to move objects, or to resize other objects.
Right-click	Pressing and releasing the right mouse button one time will open a ***shortcut menu***. Shortcut menus are usually context-sensitive, which means they will vary depending on what or where you have clicked and what program you are using. The right mouse button is also known as the secondary button and is not typically pressed more than one time. After the shortcut menu has been opened, you select the appropriate choice by clicking it with the left mouse button.
Right-drag	This is done by pressing the right mouse button and continuing to hold it while dragging, or moving, the mouse. This action is used when copying or moving files or folders within different storage devices.
Scroll wheel	If your mouse is equipped with a scroll wheel (a scroll wheel can also be a clickable button), it can be used to quickly move a page up or down in a window, thus the name of the action to ***scroll***. It is an easy way to navigate through lengthy documents or websites.

Are there other input devices? Although the keyboard and mouse are the two most common input devices, there are many other input devices. ***Scanners*** are similar to copy machines, but instead of producing a paper copy, they convert documents or photos to digital files that can then be saved on your computer.

The Processor

What does the CPU do? The CPU, as shown in Figure 26, is the brain of the computer and is responsible for executing program instructions and manipulating data to convert to information. It has two main parts—the ***control unit*** and the ***arithmetic logic unit (ALU)*** as shown in Figure 27. The control unit is responsible for obtaining and executing instructions from the computer's memory. Example: The user wants to print a document and selects the "Print" command from an icon on the screen. The CPU gets the command from memory (RAM), interprets the command, and sends the document as output to a selected printer. In other words, the CPU coordinates the internal activities and the activities of all the other computer components.

The arithmetic logic unit (ALU) performs the arithmetic and logic functions for the computer. The ALU handles addition, subtraction, multiplication, and division and also makes logical and comparison decisions. This enables the CPU to perform tasks such as sorting data alphabetically or numerically and filtering data to locate specific criteria.

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Figure 26 An example of a CPU.

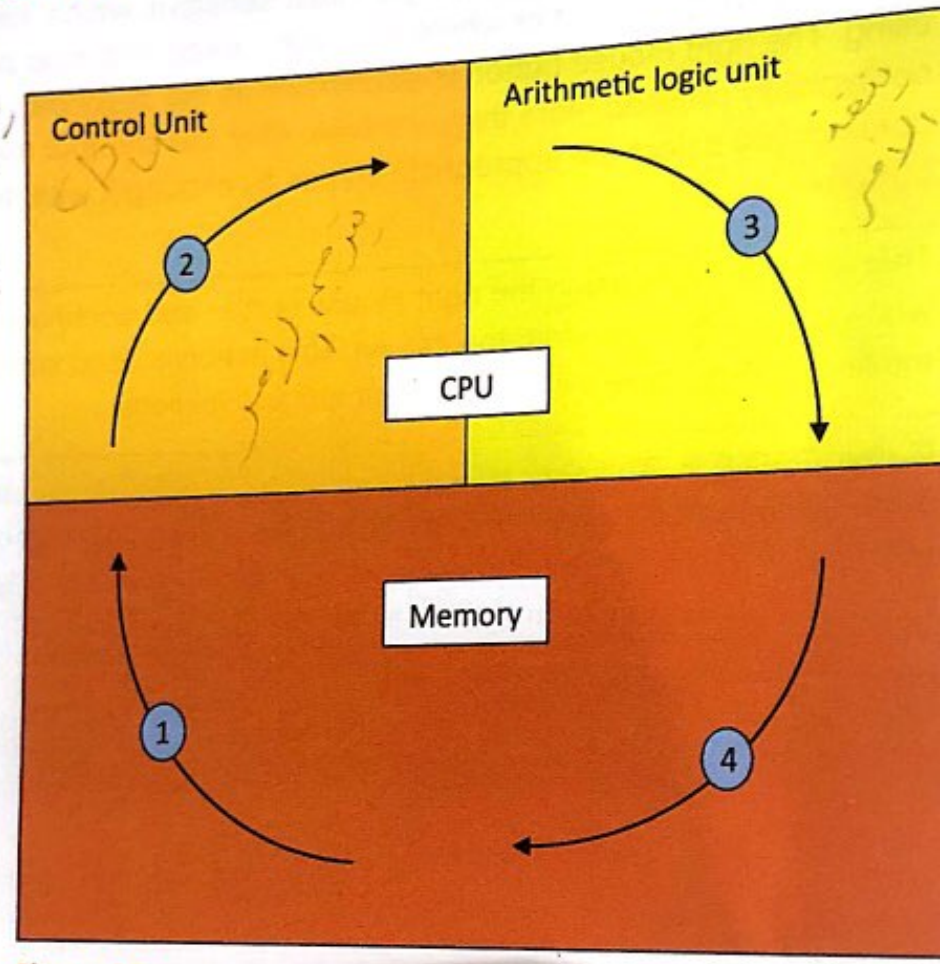

Figure 27 The four steps of the machine cycle are the same in all system from personal computers to mainframes. What differs is the speed at which the cycle is performed.

OBJECTIVE 3: Describe Ha

Different CPUs

As important as the CPU is to your computer, you might expect it to take up a large amount of space in the console. However, a CPU is actually rather small, thus the term *microchip*. Over the years, manufacturers have reduced the size of microprocessor chips while continuing to increase their computing power.

In fact, Moore's law (formulated in 1965 by Gordon Moore, cofounder of Intel) addresses this increase in computing power, as shown in **Figure 28**, observing that current production methods enable CPU capacity to double about every 24 months or so!

Are there different brands of CPUs? Yes, the most well-known chip manufacturers include Intel and Advanced Micro Devices (AMD). Chip manufacturers often produce several different models of chips. Some of the chips that Intel makes include the *Intel® Core™ i7 processor Extreme Edition*, the *Intel Core™2 Quad Processor* for desktops, and the *Intel Centrino® 2 Processor Technology* for portable computers. AMD manufactures chips such as the *AMD Phenom™ II X4* for desktops, and the *AMD Turion™ X2 Ultra Dual-Core Mobile Processor* for portable computers. Intel and AMD chips are the mainstays for PCs. Using multiple processors (***dual core*** or quad core) has several advantages over a single-processor CPU as shown in **Figure 29**, including improved multitasking capabilities and system performance, lower power consumption, reduced usage of system resources, and lower heat emissions.

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How is a CPU's processing power measured? One indicator of a CPU's processing power is its ***clock speed,*** which measures the speed at which a CPU processes data and is measured in ***megahertz (MHz)*** or ***gigahertz (GHz),*** depending on the age of the CPU. Figure 30 displays various processors and their speeds. However, looking at clock speed is not always the best indicator. Instead, how many millions of instructions processed per second, or MIPS, is a better measurement. These instructions can also be measured in billions, and trillions of instructions per second (BIPS and TIPS).

What types of memory does a computer have? Memory is another computer component of a computer system. The term *memory* signifies storage. There are two basic types of memory: temporary or ***volatile*** and permanent or ***nonvolatile.***

Permanent memory includes ***Read-Only Memory (ROM),*** which is prerecorded on a chip. The information on a ROM chip cannot be changed, removed, or rewritten and is generally inaccessible to the computer user. ROM is nonvolatile memory because it retains its contents even if the computer is turned off. ROM contains critical information, such as the program used to start up or boot the computer.

Storage devices such as hard disks and flash drives and storage media such as CDs and DVDs are considered permanent or nonvolatile memory and are presented later in this chapter.

Temporary memory, the computer's temporary or volatile memory, is ***Random Access Memory (RAM).*** RAM, as shown in Figure 31, acts as the computer's short-term memory and stores data and program instructions waiting

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Early processors	Processed at speeds of less than 5 MHz
Modern processors	Operate at over 3 GHz (equivalent of 3,000 MHz)
Newer processors	Continue to surpass 3 GHz

Figure 30 CPU processors.

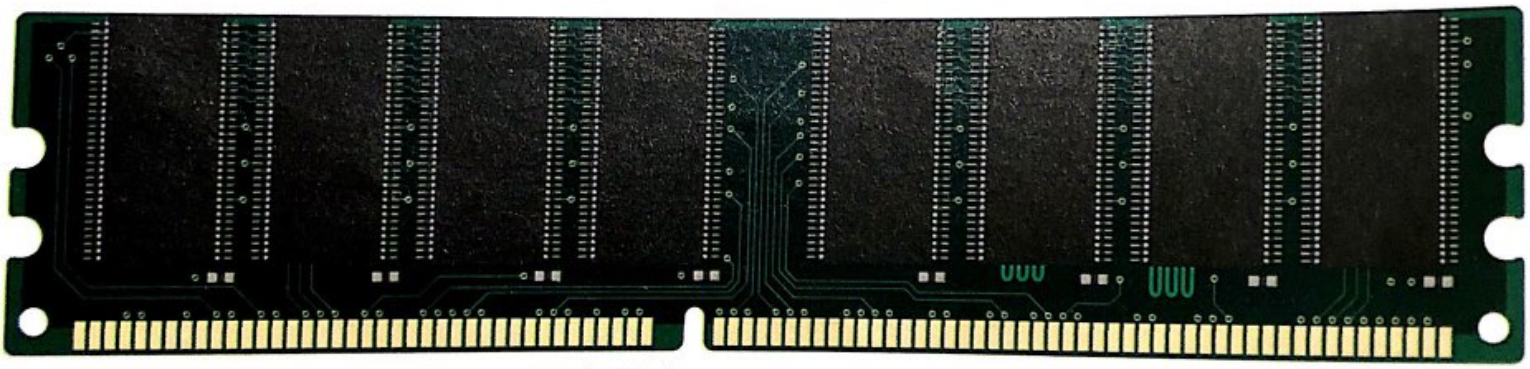

Figure 31 Random Access Memory (RAM)/RAM chips.

to be processed. RAM is considered volatile because its contents are erased when the computer is turned off.

Why is it important to have enough RAM? The more tasks your computer performs at the same time, or the more programs you have open, the more RAM it uses. We described RAM earlier as the center of the flow of data and information in the information-processing cycle as shown in **Figure 32**. That flow slows down when there is not enough RAM. Your computer's RAM is like the top of your desk. The size of the desk that you need is determined by the work you do at a given moment. You may need to use a notebook computer, several books, a clipboard with notes, a holder for pens and pencils, and a telephone. If your desk is not big enough to fit these items, you cannot work with all of them at the same time. If you do not have a sufficient amount of RAM in your system, you might notice your computer slows down or even stops responding when you try to perform tasks.

Computer users often think this means they have too much information saved on their computers' hard drives. What it actually means is that they are running out of memory, not permanent storage space. To fix this problem, you can reduce the number of programs running at the same time, disable some features of the operating system, or simply add more RAM to your system as shown in **Figure 33**. Installing additional memory is one of the most inexpensive and easiest upgrades for your computer and often results in noticeable performance improvements.

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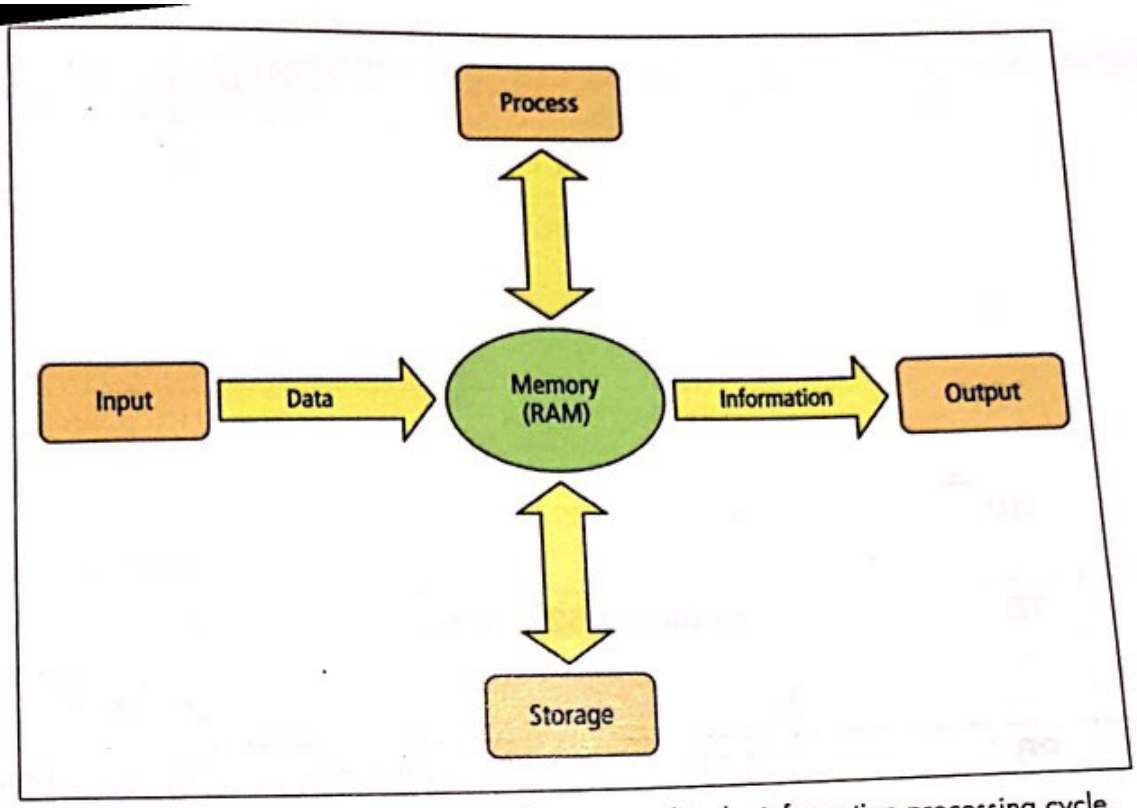

Figure 32 These are the four computer functions within the information processing cycle. Memory is not considered a function, but it is the center of flow of data and information within this cycle.

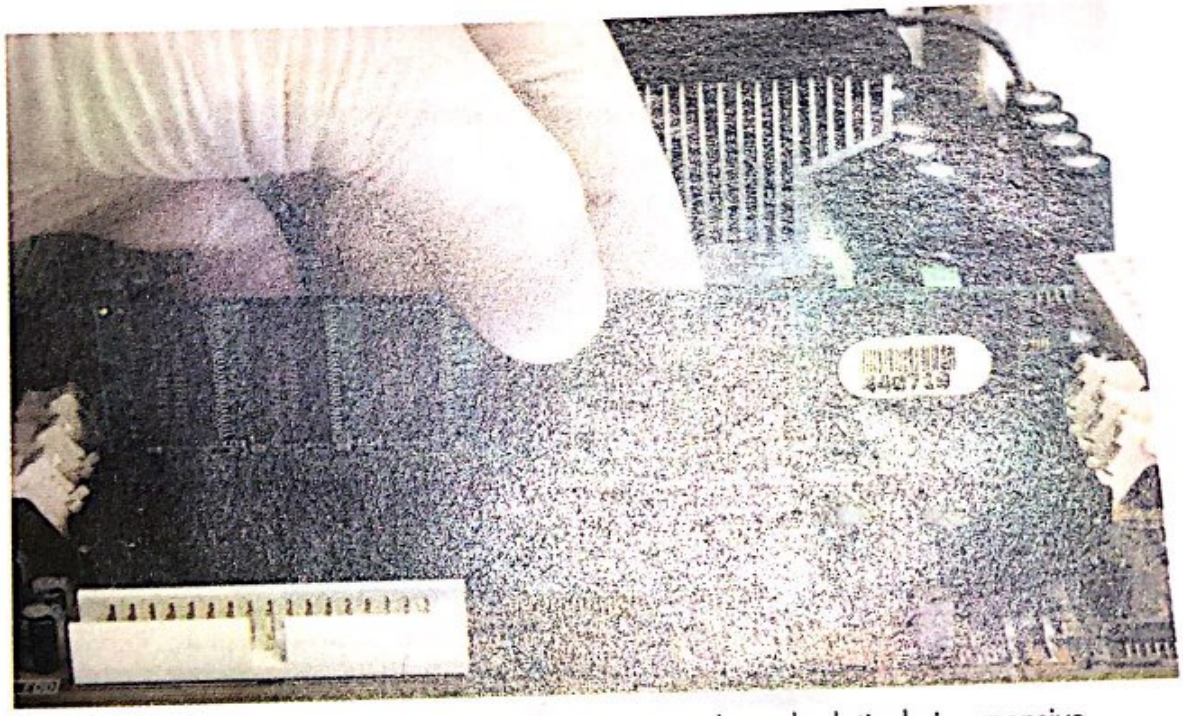

Figure 33 Adding RAM to a computer is quite simple and relatively inexpensive.

Memory is measured in several units such as ***megabytes (MB)***, which is approximately one million bytes, ***gigabytes (GB)***, which is approximately one billion bytes, or ***terabytes (TR)***, which is one trillion bytes. The table in **Figure 34** displays some of the units of memory and their relative size.

RAM size requirements vary depending on the operating system in use. Older computers that run Windows XP should have between 512 MB to 1 GB of RAM. For newer computers, a minimum of 2 GB possibly more is recommended.

Output Devices

Output devices display information after data has been processed in a useful format. This format can be text, graphics, audio, or video. Monitors and printers are the two most common output devices.

Monitors

What are monitors? A monitor, as shown in **Figure 35**, is a display devices that shows images of text, graphics, and video once data has been processed. The image on a monitor is called ***soft copy***; you can view it, but you cannot touch it.

What is an LCD monitor? Monitors come in a variety of sizes and styles, but the standard today is the ***LCD (liquid crystal display)***. ***Flat-panel*** LCD monitors use a liquid crystal display and are thin and energy efficient.

What factors determine a monitor's display quality? The number of ***pixels,*** a monitor's display, is made up of millions of tiny dots known as pixels or picture element. Each pixel represents a single point on a display screen or in a graphic image.

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Units to Measure Memory			
Name	**A**	**Number of Bytes**	**Relative Size**
Byte	B	1 byte	Holds one character of data
Kilobyte	KB	1,024 bytes	Holds about a half page of double-spaced text
Megabyte	MB	1,048,576 bytes	Holds about 768 pages of typed text
Gigabyte	GB	1,073,741,824 bytes	Holds approximately 786,432 pages of text
Terabyte	TB	1,099,511,627,776 bytes	This represents a stack of typewritten pages almost 51 miles high
Petabyte	PB	1,125,899,906,842,624 bytes	This represents a stack of typewritten pages almost 52,000 miles high

igure 34 *Measuring memory—these units are used to measure the size and capacity of RAM and also of storage devices/ edia.*

The number of pixels on the screen determines a monitor's sharpness and clarity, also known as ***resolution,*** as shown in **Figure 36.** A higher number of pixels results in a clearer and sharper monitor resolution. A standard screen resolution might be expressed as 1024 x 768, which means there are 1,024 columns, each containing 768 pixels, for a total of more than 786,000 pixels on the screen. Monitor sizes are determined by measuring their screens diagonally.

Dot pitch is another display characteristic and refers to the diagonal distance between two pixels of the same color. Dot pitch is measured in millimeters with smaller measurements resulting in a crisper viewing image because there is less blank space between the pixels. For best viewing, monitors should have a dot pitch measurement of .28 mm or less. LCD monitors use an electric current to illuminate the pixels.

Refresh rate is the speed at which the pixels are illuminated, and it's measured in cycles per second, expressed as hertz (Hz). Refresh rates generally average between 75 and 85 Hz, which means the screen image is redrawn 75 to 85 times per second. Higher refresh rates result in less screen flicker and less eye strain.

What are touch screen monitors? Touch screen monitors are both input and output devices. They display images just like regular monitors but also enable users to touch their surfaces and make selections directly from the screen as shown in **Figure 37.**

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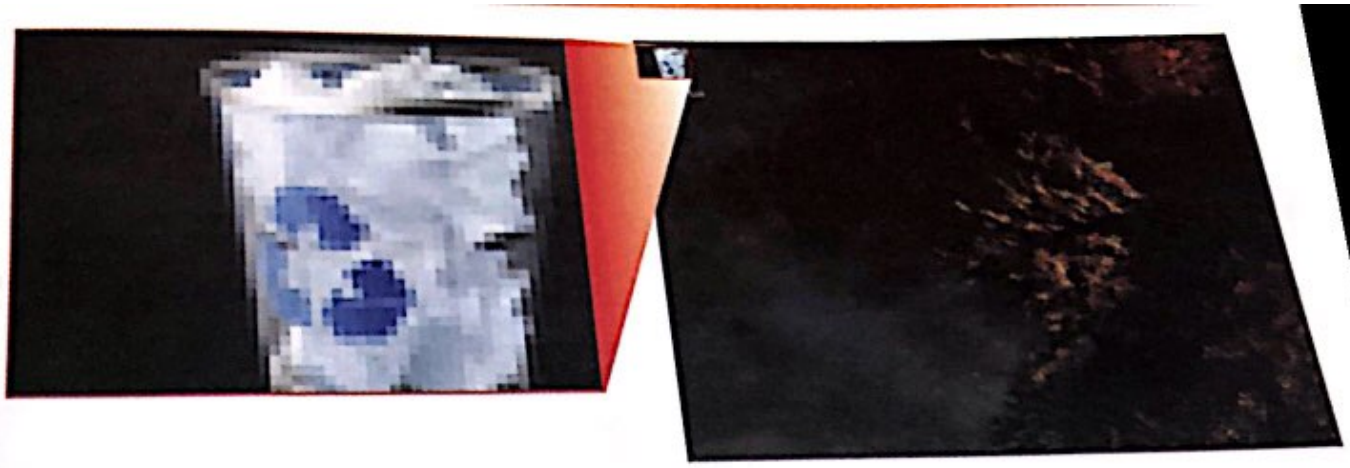

Figure 36 An image on a computer display is made up of rows of tiny colored pixels. A monitor's image is refreshed many times per second; with each refresh, the color displayed by each pixel might change.

Figure 37 A touch screen monitor.

These monitors are widely used in retail stores at checkout counters, in airports for passengers' fast check-ins, and HP has released a personal computer in which the monitor is also the system unit and uses ***touch screen technology***.

Which monitor is best? Choosing the right monitor is always a combination of what you like, want, and can afford. A higher resolution, small dot pitch, fast refresh rate, and large monitor size are desirable, but all come with a higher price tag.

Printers

Using a monitor is a good way to view the information on your computer, but sometimes a soft copy isn't sufficient for your needs. ***Printers*** generate a ***hard copies*** or ***printouts***, which are a permanent record of your work on paper.

What types of printers are available? There are two categories of printers: impact and nonimpact. ***Impact*** printers have small hammers, similar to a typewriter's, that strike an ink ribbon against paper as shown on the right in **Figure 38**, leaving behind the image of the character or symbol. The ***dot matrix*** printer as shown on the left in **Figure 38** is also an impact printer. Once very popular because of their low cost, dot matrix printers are still in use today, limited only to certain applications that require continuous forms or multipart forms (an original and several copies), such as invoices or purchase orders.

How does a nonimpact printer work? ***Nonimpact*** printers, as shown in **Figure 39**, do not actually touch the paper when printing. There are varieties of nonimpact printers,

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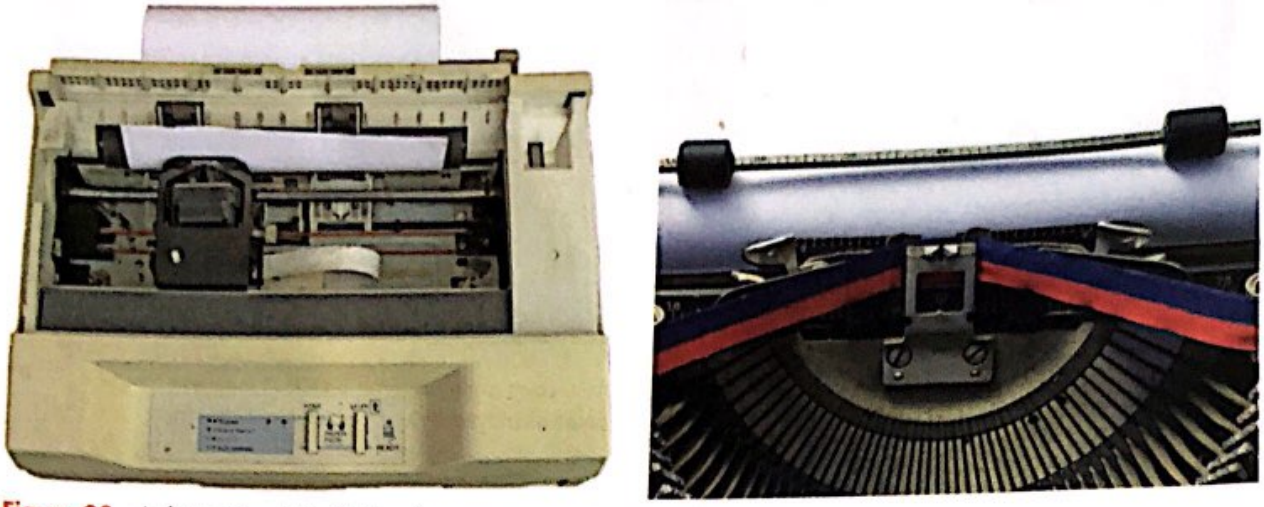

Figure 38 A dot matrix printer (left) and a typewriter (right) are both impact printers.

Figure 39 Inkjet printers are popular among home users, especially with the rise of digital photography.

but the two most commonly used with home computers are the ink-jet printer and the laser printer.

The ***inkjet*** printer uses a special nozzle and ink cartridges to spray ink in small droplets onto the paper. Inkjet printers easily print in color, in black, and in grayscale to produce good quality printouts. They are relatively inexpensive to buy and maintain.

Laser printers, as shown in **Figure 40**, use a special cylinder known as a drum, dry ink or toner, and a laser. Static electricity attracts toner to the surface of the drum, and the laser distributes the toner in the correct pattern. The drum transfers the toner to the paper, and heat is used to permanently fuse the toner to the paper. Laser printers are generally more expensive to purchase than inkjet printers, although they often print more quickly and are more cost effective. Lower-end laser printers print only in black and white; however, more expensive printers can produce color copies.

How do you assess a printer's capabilities? When you select a printer, there are some key characteristics to consider.

Print speed is often expressed as ***pages per minute*** (*ppm*). Print speed can vary depending on the manufacturer and model, as well as printer type and is also affected by whether the page is text-only, if it includes graphics, and if the printout is in color or in black and grayscale. **Figure 41** shows a relatively fast laser printer as compared to an inkjet printer, for example, as it has higher ppms.

■ **Continue to the next page to complete the objective.**

Figure 40 *Output devices—a laser printer.*

Figure 41 *Laser printers print quickly and offer high-quality printouts.*

Just as with monitors, resolution is also important to print quality. For printing purpos resolution is expressed as ***dots per inch*** or ***dpi***. The higher the dpi, the better the print quality. Print qualities of 300 to 600 dpi are typical of most printers, although special photo printers can offer resolutions up to 1,200 dpi. Professior printers can reach even higher values.

Color output and its related cost is anoth important consideration. Ink-jet printers offe four- or six-color options. Many ink-jet print. ers use one cartridge for black ink and one or more cartridges for color. When available, printers that offer a separate cartridge for each color are a practical choice because you need to replace only one color at a time as the cartridges run out. Laser printers use separate toner cartridges for each color.

Some printers are considered all-in-one-printers and bundle multiple capabilities into one device as listed in **Figure 42**.

Speakers and Multimedia Projectors

Are there other output devices? Speakers and ***multimedia projectors,*** as shown in **Figure 43**, are also examples of output devices. Many computers include small speakers to enable the user to listen to CDs or DVDs and hear any auditory signals the computer sends. However, if you're serious about multimedia, you will probably want to invest in a better set of speakers for improved performance. Multimedia projectors are used to conduct presentations and training sessions. These projectors enable information to be displayed on a big screen so it can be easily viewed by a large group of attendees.

■ **Continue to the next page to complete the objectives.**

All-in-one devices usually include:

- A printer, either inkjet (color or black and grayscale) or laser (output)
- A scanner to convert text or images into files that can be stored and further manipulated by the computer (input)
- A facsimile (fax) function to send and receive documents via
- the telephone (communications)
- A copier function to duplicate documents (output)
- Network capabilities to enable this multifunction device (MFD) to work as part of a network environment both wired or wireless (communications)

Figure 42 What are all-in-one printers?

▶ OBJECTIVE 3: Describe Ha

Under what category do digital cameras fall? A digital camera is a device that stores pictures digitally rather than using conventional film. After images are captured, they are stored in the camera's internal memory. Some cameras use removable flash memory cards as storage media. These cards can be read by a computer, which can then edit them and save them as files. So, the camera itself is a form of "handheld" computer, which, if connected to a computer, serves as an input/output device. The same thing can describe camcorders.

Storage Devices

What are storage devices? Storage devices are used to store the data, information, and programs for future use. This storage is often referred to as ***permanent memory*** because, unlike data that is in RAM, data saved to a storage device remains there until the user deletes or overwrites it. Data can be stored using internal hardware devices located in the system unit or in removable units that enable portability. See **Figure 44**.

How is a storage device different than storage media? A ***storage device*** is a piece of hardware such as a hard drive or a DVD drive. Media is the removable part that actually contains the stored data. Media requires a device to ***read*** and ***write*** on it. Read is the action of retrieving or opening existing data and write is the action of saving or storing data. See **Figure 45** for a list of devices and their media.

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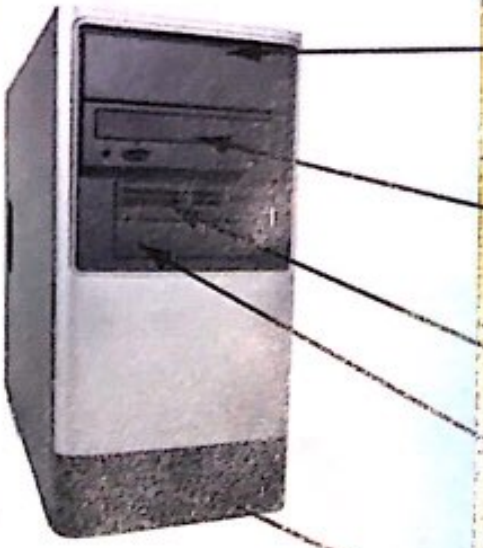

	STORAGE MEDIUM	CAPABILITIES	STORAGE CAPACITY
	Hard Drive	Read and write	External: Up to 2 TB (Terabyte) Internal. Up to 500 GB
	DVD DVD+RW	Read-only Read and write	4.7 GB (for single-sided, single-layered DVDs) 9.4 GB (for single-sided, double-layered DVDs)
	Flash Memory Cards	Read and write	16 MB to 8 GB
	Floppy Disk	Read and write	1.44 MB
	Flash Drive	Read and write	Up to 6 GB

Figure 44 Storage devices.

Device	Media
CD and DVD optical drives	Read and write on CDs and DVDs
Card readers	Read and write on flash memory cards
USB port	Read and write on flash drives or thumb drives
Tape backup drives	Read and write onto tape cartridges
The hard drive is the exception, in that the hardware and the media are all contained in a sealed unit that cannot be taken apart.	

Figure 45 A list of devices and their media.

How is data stored? Data is generally stored using one of three forms of storage: magnetic, optical, or flash memory:

- ***Magnetic*** storage uses tape or film covered in a thin, magnetic coating that enables data to be saved as magnetic impulses. It works in much the same fashion as an audiocassette or videotape works. Hard drives and backup tape drives are both forms of magnetic storage as shown in **Figure 46**.

  Before magnetic storage can occur, media has to be formatted. This is the process in which media is divided into ***tracks*** and ***sectors***. Tracks are magnetic concentric circles and sectors are segments within those circles. Data is stored magnetically within the spaces created by these tracks sectors. Magnetic media has read/write capability, which means it is possible to use it over and over again, enabling you to delete or revise existing data and save new data.

- ***Optical*** storage uses flat plastic discs coated in a special reflective material as shown in **Figure 47**. Data is saved by using a laser beam to burn tiny pits into the storage medium. A less intensive laser is used to read the saved data. The saved data is organized using sectors, similar to those used in magnetic media. ***Compact discs (CDs)*** and ***digital video discs (DVDs)*** are examples of optical media. Unlike magnetic media, not all optical storage is read/write capable. ***CD-ROMs***—CD media that was burned once and from that moment on can only be read—and ***DVD-ROMs***—

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Figure 46 Hard drives store data magnetically on metal platters. The platters are stacked, and read/write heads move across the surface of the platters, reading data and writing it to memory.

Figure 47 The data on an optical disc is read by a laser.

DVD media that is burned once and from that moment on can only be read—are considered read-only media (ROM). The information contained on them can be read, but not changed or deleted, and it is not possible to save new data to them. If you purchase new software, music, or a movie, it is most likely on a DVD-ROM as shown in **Figure 48**.

A record-only disc (CD-R) enables you to record, or *burn*, information to the disc one time only; information saved this way cannot be deleted or rewritten. A rewritable disc (CD-RW) enables information to be recorded, revised, or deleted, and new data can also be written to the disc, similar to magnetic media. The same possibilities are available in DVDs. While there used to be two competing DVD formats, DVD – R/RW and DVD + R/RW, that were incompatible with one another, manufacturers have since replaced the two competing formats with drives that could read both and are called DVD + R. **Figure 49** summarizes the capabilities of these various formats.

What is LightScribe? ***LightScribe*** is a disc-labeling technology that burns text and graphics onto the surface of a specially coated LightScribe CD or DVD. This is an alternative to printing a conventional sticker label and attaching it to a regular CD or DVD but it does require that you purchase LightScribe media.

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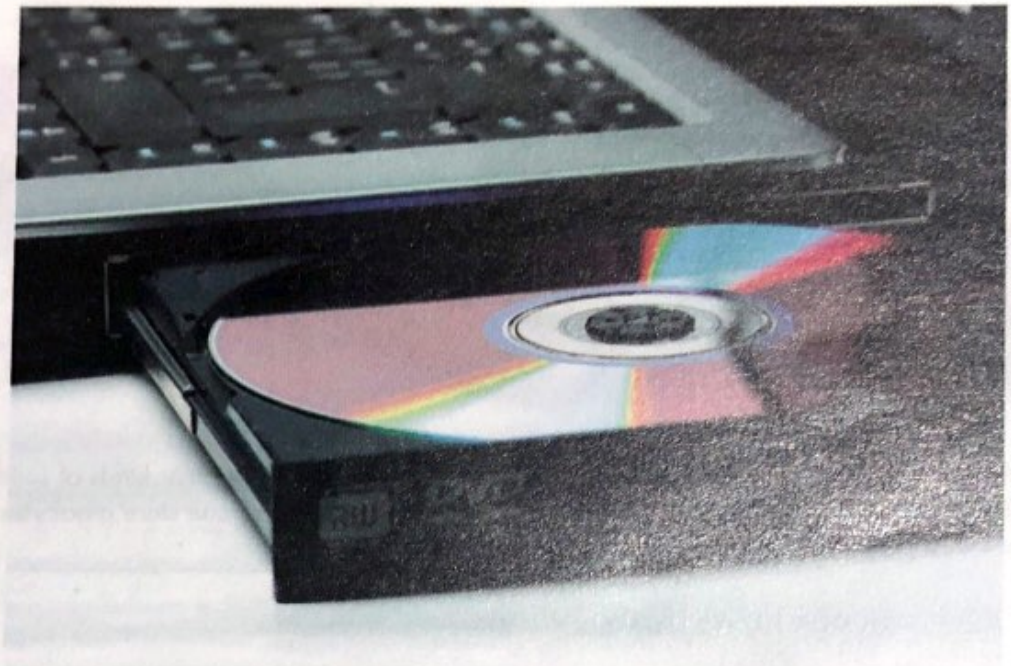

Figure 48 The information contained on a DVD can be read, but not changed.

Format	Capabilities
CD-ROM	Information is recorded once and can only be read. Information cannot be changed or deleted; new information cannot be added.
CD-R	Record information to a disc one time. Information cannot be deleted or rewritten.
CD-RW	Information can be recorded, revised, or deleted; new data can be written to the disc.
DVD-ROM	Media is recorded once and can only be read. Information cannot be changed or deleted; new information cannot be added.
DVD±R/RW	Information can be recorded and rewritten.

Figure 49 CD and DVD formats.

Flash memory, as shown in **Figure 50**, uses solid-state technology. It is completely electronic and has no moving mechanical parts. Flash memory is a quick and easy form of rewritable storage and is often used in mobile devices such as PDAs, digital cameras, and MP3 players. Depending on the manufacturer, flash memory cards may be called Memory Stick, CompactFlash, Secure Digital, or MultiMediaCard. Typically, a device can use only one style of memory card; however, a computer equipped with the appropriate card reader can read any of them. Small, removable storage devices known as flash drives or thumb drives also use flash technology, require a USB port to connect to the system unit, and are very popular to transport data.

What are the main types of storage devices? Depending on the age and type of computer you have, you might find some or all of the following internal storage options:

- ***Hard disk drive***—shown in **Figure 51**, is the computer's main internal storage device. Also referred to as a hard drive, its storage space is usually measured in gigabytes (GB), with newer computers ranging in size from 80 GB to 750 GB, although it is possible to find some specialized, high-end computers with storage space measuring up to 2 terabytes (TB). As with everything else in computing, these numbers tend to increase with each new model. Hard drives are traditionally permanent storage devices fixed inside the system unit.

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a. b.

Figure 50 Flash memory devices. a. An SD flash memory card is one of the most popular kinds of solid-state storage used in digital cameras and other digital media devices. b. A USB flash (thumb) drive can store gigabytes of data and plug into a computer's USB port.

Figure 51 Internal hard drives hold the data and instructions that the computer needs and are inaccessible from outside the system.

- ***Floppy disk drive***—This is a device that reads/writes ***floppy diskettes*** that have a maximum storage capacity of 1,450 MB. Because of this limited storage capacity, you will seldom see floppy disks used today.
- ***CD and/or DVD drives***—Previously, computers contained either one or two of these optical drives in the system unit. Today, however, computers typically contain a drive that can read and/or write DVDs. It's important to know whether these drives are simple CD-ROM drives, which can only read CDs, or if it is a ***CD-RW*** drive, also known as a CD burner. A ***CD burner*** gives you the ability to save, or burn, files to a ***CD-R*** (compact disk recordable).

Although CDs and DVDs look alike, DVDs are capable of holding more information than CDs. A CD can hold up to 700 MB of data, but a DVD can store almost 10 GB! Because of their differences, a CD drive is unable to read DVDs, although a DVD drive can read CDs. Figure 52 displays a some of the storage devices just discussed.

Is it possible to add a storage device to a system? If you are running out of hard disk space or your system doesn't have a particular storage device, it may be possible to add storage space, provided your system has enough room. You would need an available drive bay, which is the physical location within the system unit, or you might consider removing an existing device and replacing it with another as shown in Figure 53. For instance, if you only

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Figure 52 Storage devices in a notebook computer.

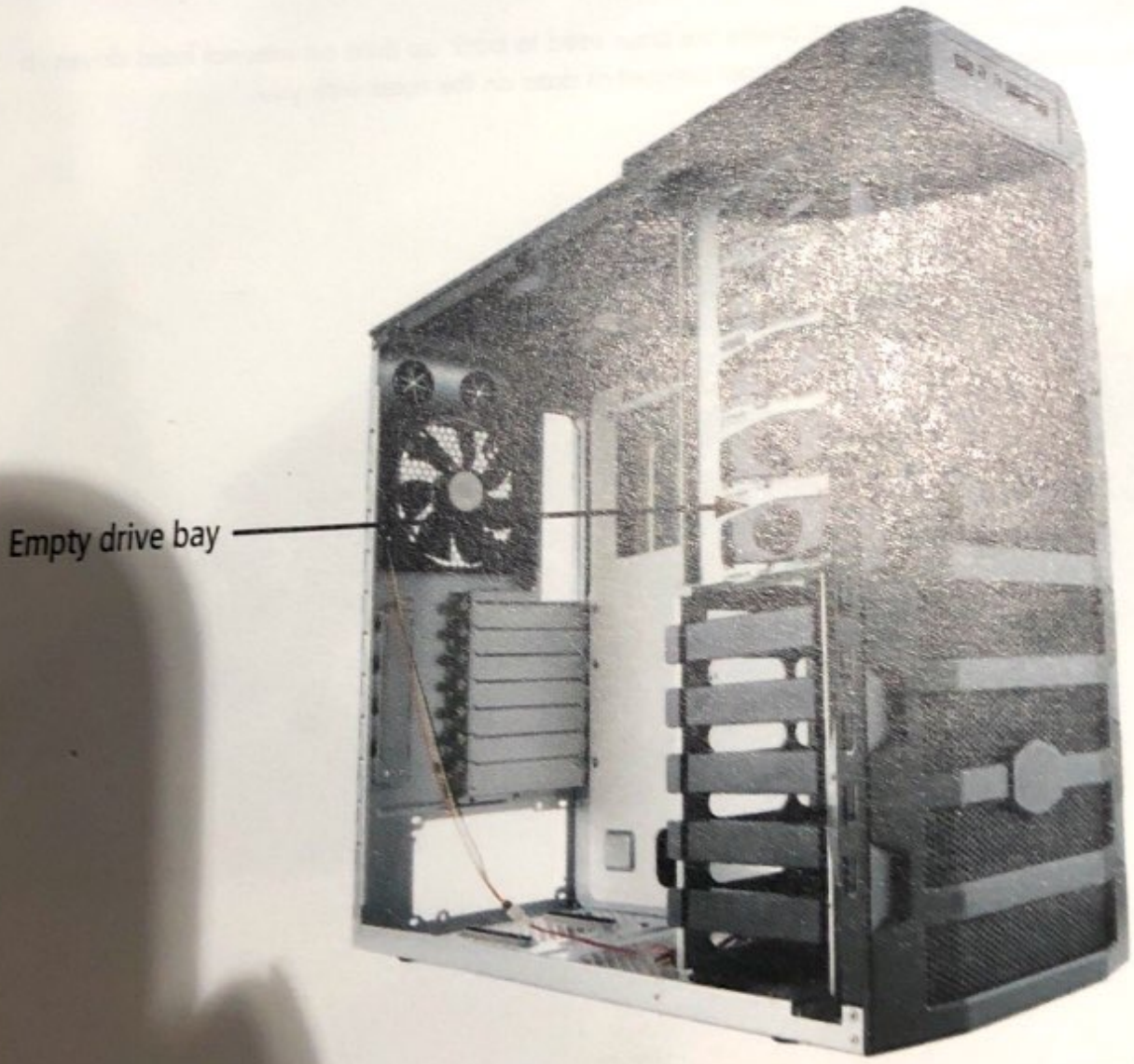

Figure 53 A desktop computer with an available drive bay for adding a storage device.

have a CD-ROM drive, you could remove that and replace it with a CD-RW/DVD dri thereby giving you the ability to read and b CDs and play DVDs too. It is also possible t purchase many of these units as external sto age devices. An external storage device is a peripheral that attaches to the computer via a port and performs the same tasks as its cor- responding internal device. One of the most popular is the external hard drive as shown in Figure 54, which can greatly increase a comp ter's storage capacity and make your data full portable.

Are there other types of storage devices? Other storage devices you might be familiar with include flash drives, a currently popular form of data storage, and older but still reliable backup tape drives.

Flash drives are removable storage device that use flash memory and connect to the computer by a USB port. Flash drives are also known as thumb drives, universal serial bus (USB) drives, and jump drives. The flash drive is typically a device small enough to fit on a keychain or in a pocket (as shown in Figure 55 and, because of its solid-state circuitry and lack of moving parts, is extremely durable. Available in several storage sizes ranging from 16 MB to 64 GB, a flash drive is a quick and easy way to save and transport files. As an example, a 128-MB flash drive, which is relatively small, holds the equivalent of almost 35 songs! To use one of these devices, you simply plug

a. b.

Figure 54 a. High capacity external hard drives are often used to back up data on internal hard drives. b. Smaller external hard drives enable you to take a significant amount of data on the road with you.

Figure 55 Flash drives are a convenient means of portable storage and come in many different shapes and sizes.

it into a computer's USB port. The computer recognizes the new device and enables the user to save or retrieve files from the flash drive.

Backup tape drives are storage devices that save data to magnetic tape media as shown in **Figure 56**. Although they are rarely used for home computers anymore, many businesses still rely on tape backup systems to safeguard data.

The capacity of the components found in your system unit is measured in terms of storage size or speed. Computer systems continue to increase in storage capacity and computing speed, while decreasing in size. Generally, higher measurements indicate a system that is quicker and more powerful than a system with lower measurements. However, it is important to balance size and speed with financial considerations too.

Although it is tempting to consider buying a computer with the most power possible, a lesser computer may be more reasonably priced and still be sufficient for your needs. Recall CPU speeds are measured in gigahertz (GHz). The amount of RAM in a computer is generally measured in gigabytes (GB) and terabytes (TB) while storage space is usually measured in megabytes or gigabytes (GB), depending on the device.

Ports

What are ports? A ***port*** acts as an interface or connector between a system's peripheral devices and the computer, enabling data to be exchanged easily. Ports have different shapes and sizes as shown in **Figure 57**.

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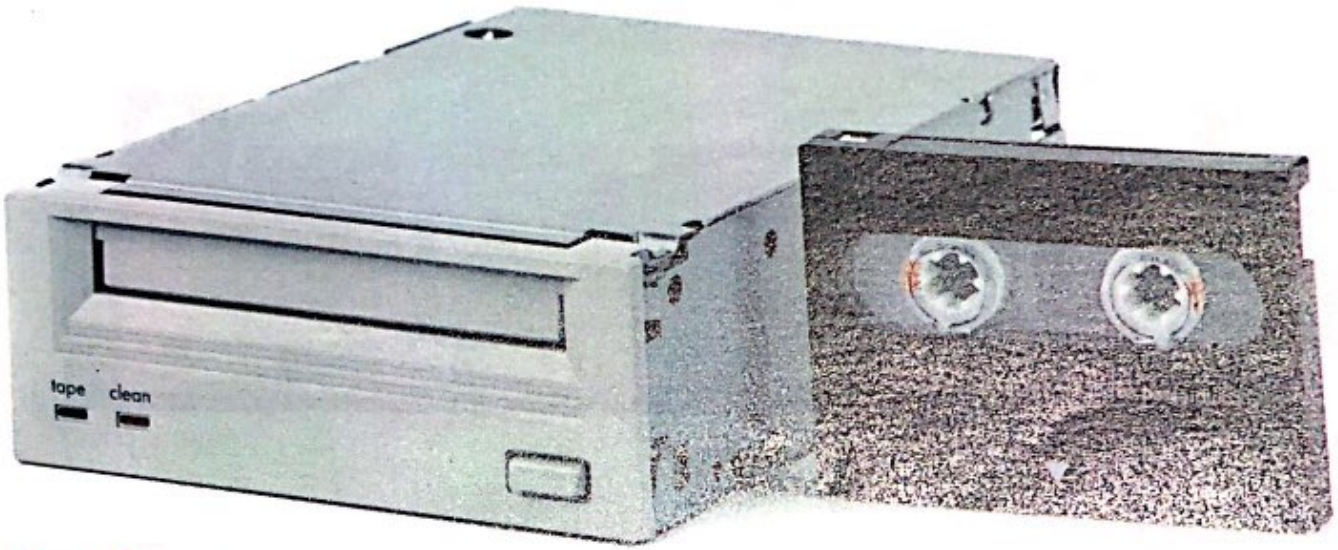

Figure 56 Tape backup drive and media.

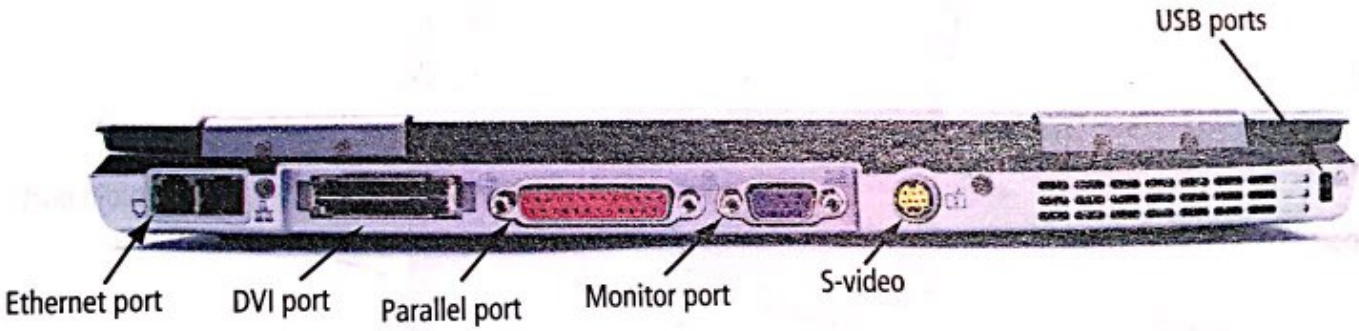

Figure 57 Ports.

Various input and output devices use different data exchange methods, requiring different types of ports and connectors (or plugs) as shown in Figure 58. If your computer does not have a particular port, you can buy an expansion card that connects to the motherboard and provides the needed connection.

How do you determine which port a peripheral device needs? Manufacturers have attempted to make the process of connecting peripheral devices less complicated on newer computers. Rather than trying to match the size and shape of a connector to its port, many manufacturers now use a color-coding system that coordinates the colors of the connectors with their corresponding ports. Additionally, many newer desktop computers include ports, such as USB and audio ports as shown in Figure 59. Positioning these ports on the front or side panels makes it a simple process to connect and disconnect devices that are used only occasionally, such as digital cameras, external hard drives, or MP3 players. Peripherals that are rarely disconnected, such as a keyboard or printer, are generally plugged into the ports on the back of the computer.

What are the different ports used for? Serial and parallel ports are two of the oldest types of

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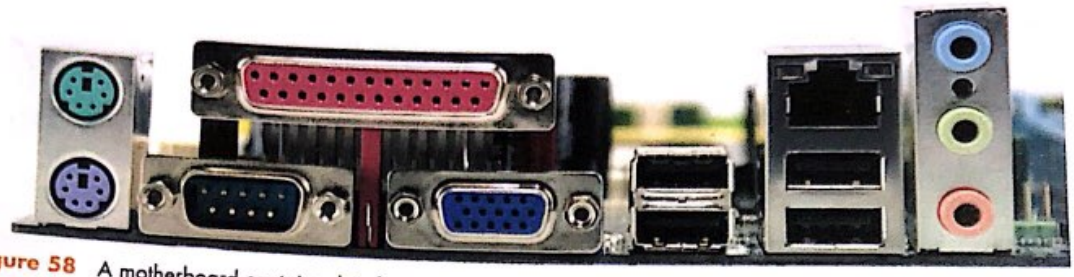

Figure 58 A motherboard contains slots for expansion cards.

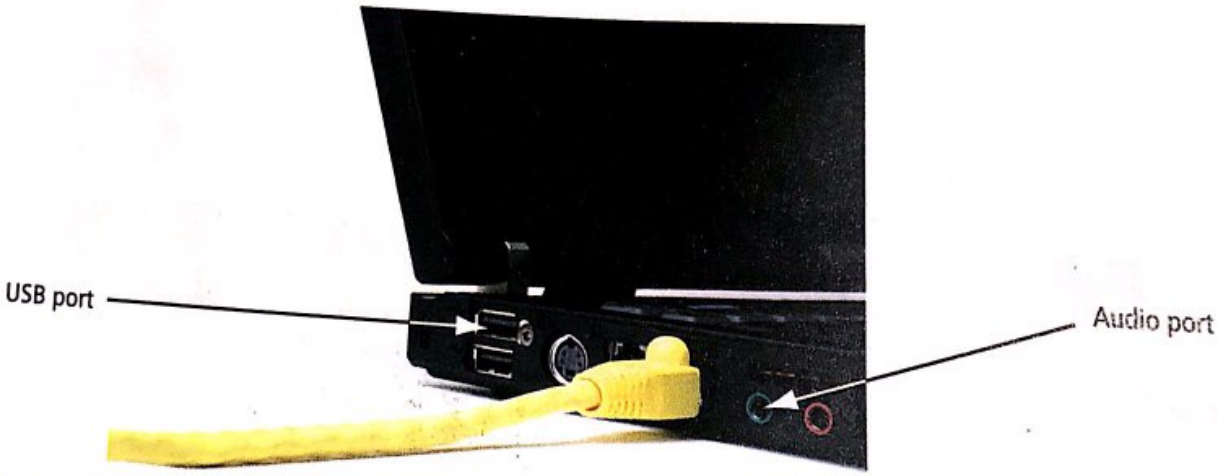

Figure 59 Examples of a USB and an audio port.

ports found on a computer. ***Serial ports*** send data one bit at a time, so the data exchange rate is slow compared to newer technology.

The maximum rate at which a standard serial port can transfer data is 115 ***kilobits*** or one thousand bits per second (Kbps). The mouse and modem are examples of devices that might use a serial port. A ***parallel port,*** as shown in **Figure 60**, sends data in groups of bits, at transfer rates of up to 500 Kbps, so it is a considerably faster method of transferring data than the serial port.

Are there faster ports? Over the years, newer ports have come into existence. One of these is the ***universal serial bus (USB) port,*** as shown in **Figure 61**, which is able to interface with several different peripheral devices, reducing the need for individual, dedicated ports. USB ports are also able to transfer data at extremely high rates of speed. Original USB ports, known as USB 1.1, are capable of speeds of 12 ***megabits*** or one million bits per second (Mbps). The newest version, USB 3.0, can attain a rate of 5 Gbps, 10 times faster than USB 2.0 technology. USB 3.0 ports are backward compatible, which means that older USB devices work with them. The higher data transfer capabilities of USB ports, coupled with their capability to work with multiple devices,

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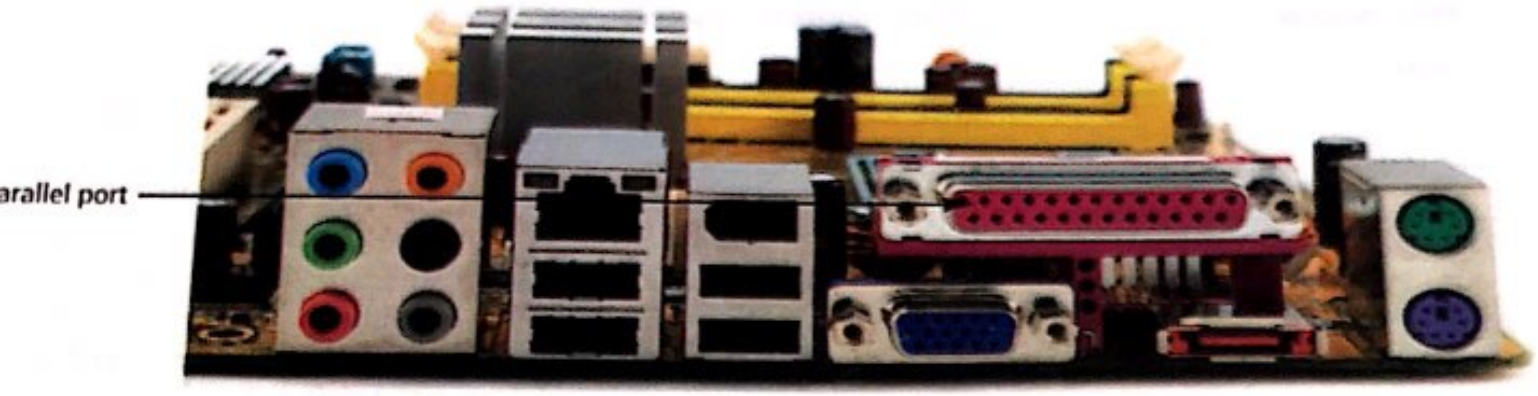

ure 60 Example of a parallel port.

Figure 61 A USB port and a USB connector.

have made the older serial and parallel ports obsolete. Because of the USB port's speedy data transfer rate and its capability to be used with numerous devices, new computers often include six or more USB ports. Devices using USB ports include keyboards, mice, printers, scanners, digital cameras, MP3 players, and PDAs. In general, it's a good idea to get a computer with as many USB ports as possible. See the table in **Figure 62** for information about ports and their uses.

The ***FireWire port,*** developed by Apple and also known as IEEE 1394, is another means of transferring data quickly. The FireWire 400 has a data transfer rate of 400 Mbps, while the newer FireWire 800 transfers data at a blazing 800 Mbps! This port is typically used to connect devices that need to transfer huge amounts of data to a computer quickly, such as digital cameras, ***digital video recorders,*** or external hard drives. FireWire ports are standard on many Apple products, but are usually found only on higher-end Windows PCs and peripheral devices. Some peripheral devices offer users a choice of connecting using a USB port or a FireWire port.

What kind of port is used to connect to another computer? Connectivity ports, such as Ethernet and modem ports, are used to connect a computer to a local network or to the Internet. An ***Ethernet port,*** also known as an RJ-45 jack, resembles a standard phone jack, but is slightly larger as shown in **Figure 63**.

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Port Name	Data Transfer Speed	Typical Use
Serial	115 Kbps	Mice/External modems
Parallel	500 Kbps	Printers/External Zip drives
USB 1.1	12 Mbps	Mice/Keyboards/Printers/ Scanners/Game controllers
USB 2.0	400 Mbps	Same as USB 1.1 but at faster transfer rates. Also, camcorders, digital cameras, and MP3 players. It maintains compatibility with USB 1.1.
USB 3.0	5 Gbps	Same as USB 2.0 plus high-def video, music, and digital imaging applications. Backward compatible with USB 2.0.
FireWire/FireWire 800	400 Mbps/800 Mbps	Digital video camcorders/ Digital cameras
Ethernet/Gigabit Ethernet	Up to 100 Mbps/Up to 1,000 Mbps	Network connections/Cable modems

Figure 62 Ports and their uses.

The Gigabit Ethernet port is used for network access and can also be used to connect a cable modem or router for Internet access as shown in Figure 64. A ***phone port*** is the same size and shape as a phone jack, shown in Figure 65, and is then used to connect the modem to a phone system, enabling ***digital subscriber line (DSL)*** or dial-up Internet access as shown in Figure 64. DSL is a type of communications line in which signals travel through copper wires between a telephone switching station and a home or business as shown in Figure 65. The maximum data transfer rate for a modem is 56 Kbps, whereas the most common Ethernet standard, Fast Ethernet, transfers data at the rate of 100 Mbps. However, Gigabit Ethernet, with a potential transfer rate of 1,000 Mbps, is becoming an option on higher-end systems and is standard on many Mac systems.

Even faster Ethernet technologies, such as 10 Gigabit Ethernet or 10 GbE exist, are currently used for network backbones and enterprise network infrastructures rather than home users.

Are there special purpose ports? Despite the prevalence of USB ports, there are still some devices that require special ports. These ports include IrDA, Bluetooth, video, and audio ports.

MIDI ports, used to be used to connect electronic musical devices, such as keyboards and synthesizers, to a computer, enabling musicians to create digital music files. However, these ports have since been replaced by USB ports which are usually plug-and-play and don't require any software configuration.

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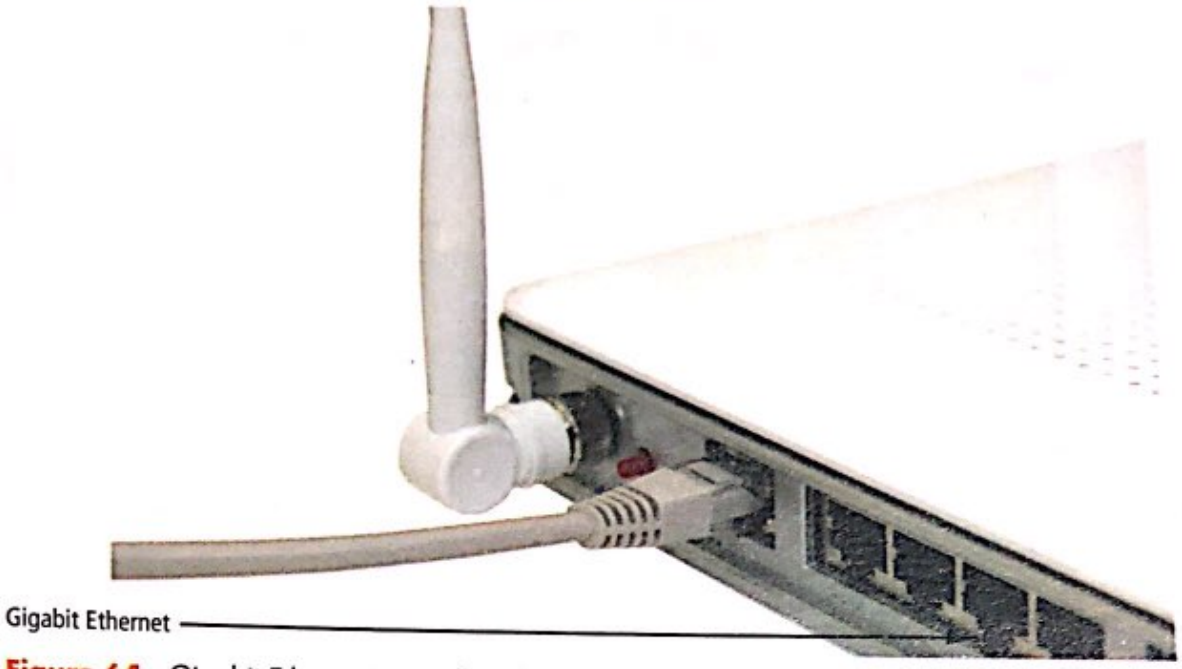

Figure 64 Gigabit Ethernet ports allow for connecting a modem or router to the Internet.

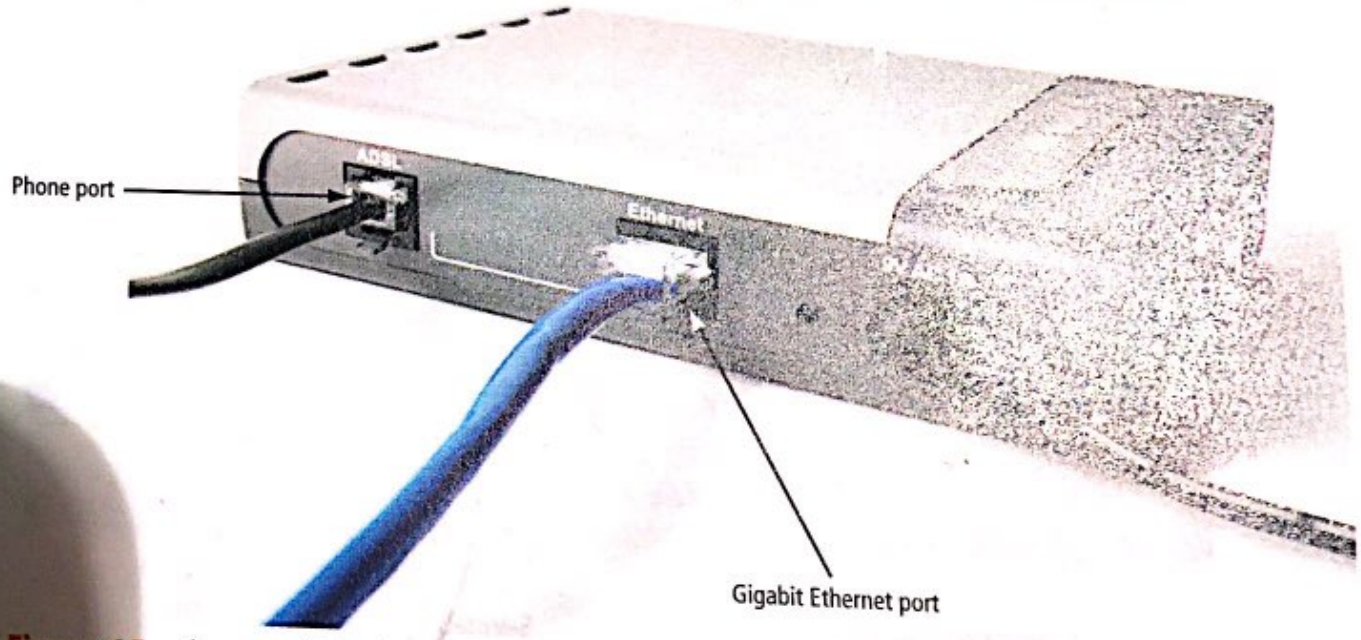

Figure 65 Phone and Gigabit Ethernet ports.

The ***IrDA port*** is used to enable devices such as PDAs, keyboards, mice, and printers to transmit data wirelessly to another device by using infrared light waves. In order to transmit information, each of the devices must have an IrDA port and a clear line of sight, with no other objects blocking the transmission.

Bluetooth is another type of wireless technology that relies on radio wave transmission and doesn't require a clear line of sight. Bluetooth-enabled devices such as smartphones, as shown in **Figure 66**, or other mobile devices can communicate only with each other over short distances, typically less than 30 feet.

Video ports include standard monitor ports, DVI ports, and S-video ports as shown in **Figure 67**. A ***monitor port*** is used to connect the monitor to the graphics processing unit, which is usually located on the motherboard or on a video card. However, to get the best results from a flat-panel (LCD) monitor, the ***Digital Video Interface (DVI) port*** should be used instead. The DVI port transmits a pure digital signal, eliminating the need for digital-to-analog conversion and resulting in a higher quality transmission and a clearer picture on the monitor. The ***S-video port*** is typically used to connect other video sources, such as a television, projector, or digital recorder, to the computer.

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Figure 66 Many wireless keyboards, PDAs, and other devices use a radio technology called Bluetooth to communicate over short devices.

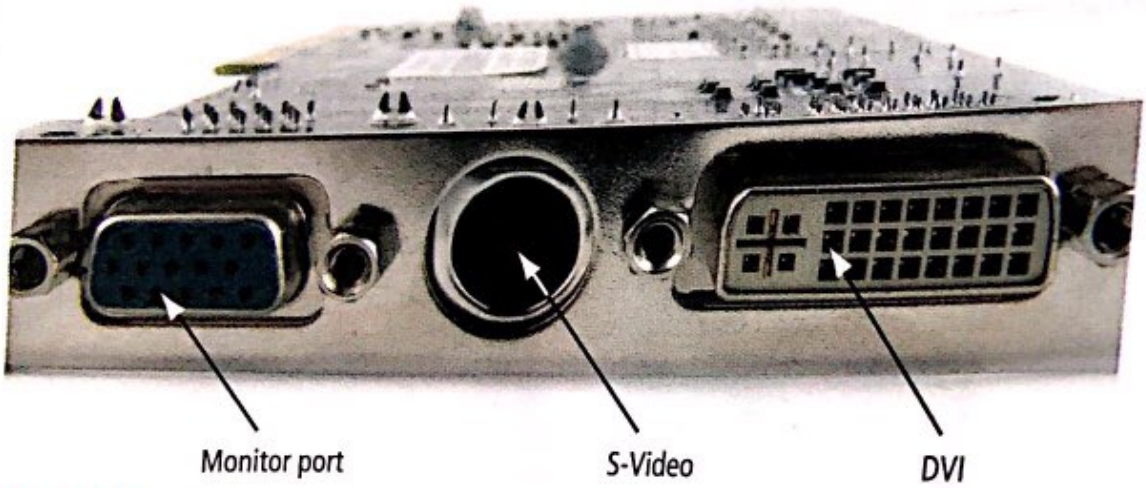

Figure 67 Examples of monitor, S-Video, and DVI parts.

Similar to video ports, ***audio ports*** connect audio devices, such as speakers, headphones, and ***microphones***, as shown in Figure 68, to the computer's sound card. These jacks will be familiar to anyone who is used to using standard stereo components.

Evaluating Your System

Each computer might have a different configuration. The way a computer system is set up or the combination of components that make up the system is called its ***configuration***. This is important when buying a computer, expanding an existing system, or when connecting computers together in a network environment as shown in Figure 69.

Now that you have learned most of the hardware components of a typical personal computer, you are ready to explore the computer's configuration, specifications, and features. If you didn't buy your computer brand new, you might not know all the details about your computer. If you did buy a new computer, the easiest way is to check your paperwork; all the basic information should be there. However, if your computer isn't new or you didn't keep the paperwork, there are some ways to determine exactly what is in your system. Also if you start a new job or a new position and are given a computer system, you can do a number of things again to determine exactly what is in your system.

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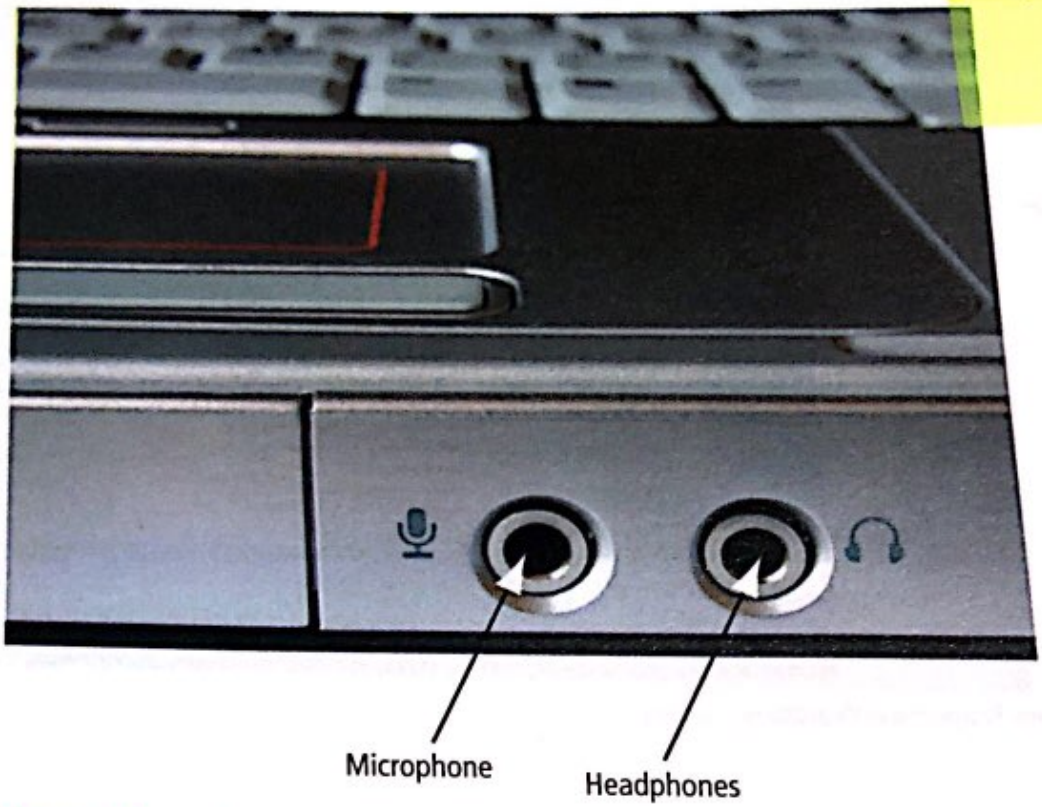

Figure 68 Audio ports are used to connect microphones and headphones to a computer.

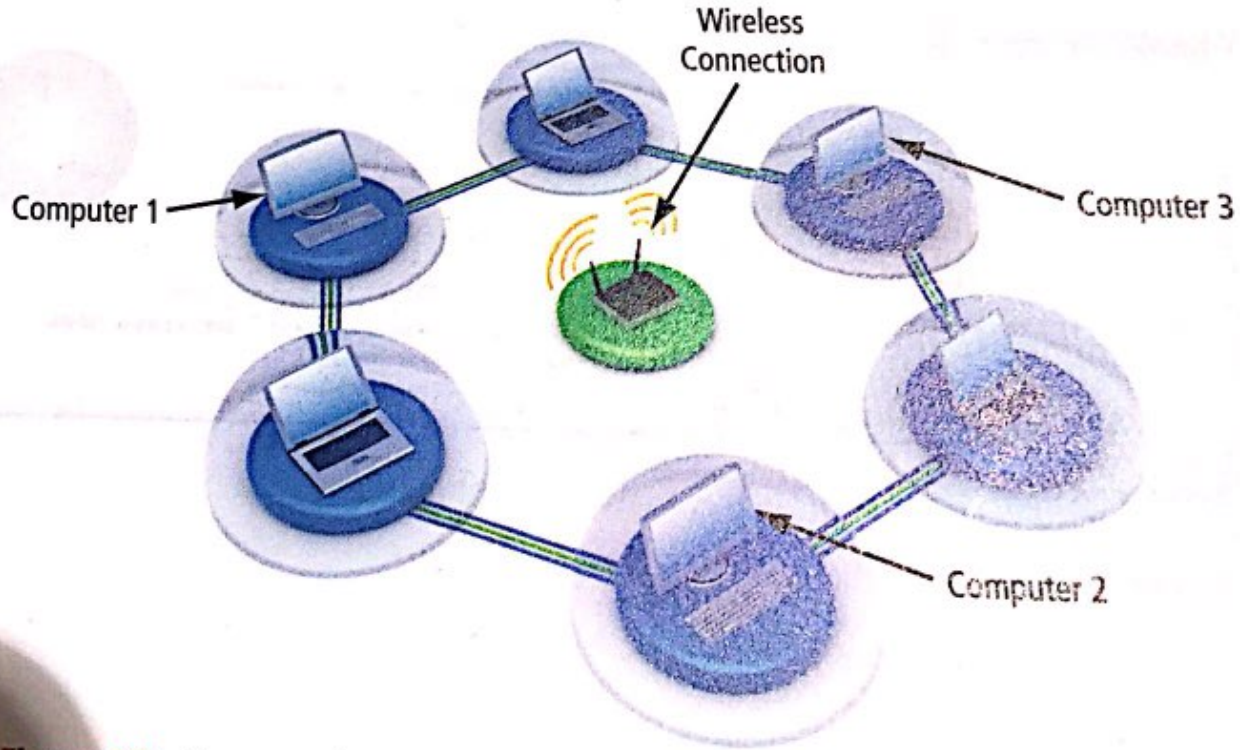

Figure 69 The networking configuration and the way the computer is set up allows sharing of resources.

What kind of computer do you have? This is one of the easiest questions to answer. Like almost every other appliance you've used, you can probably find the manufacturer's name and a brand name or model number on the case of the computer. If not, check the back of the unit; there should be a metal tag that includes the manufacturer's name, model number, and serial number. This information might be necessary if you have to have service performed under warranty. Use the following steps to see your system properties on the screen, which will answer some questions.

If you are a Windows 7 user, follow these steps:

1. Click the **Start** menu, select **Control Panel,** and then click **System and Security.**
2. From the next window, click **System.** See **Figure 70.**

Windows Vista users can follow these steps:

1. Right-click the **My Computer** icon on the desktop and select **Properties.**
2. If the icon is not on the desktop, open the **Start** menu and then right-click the **Computer** button and select **Properties.** See **Figure 71.**

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Windows 7 users

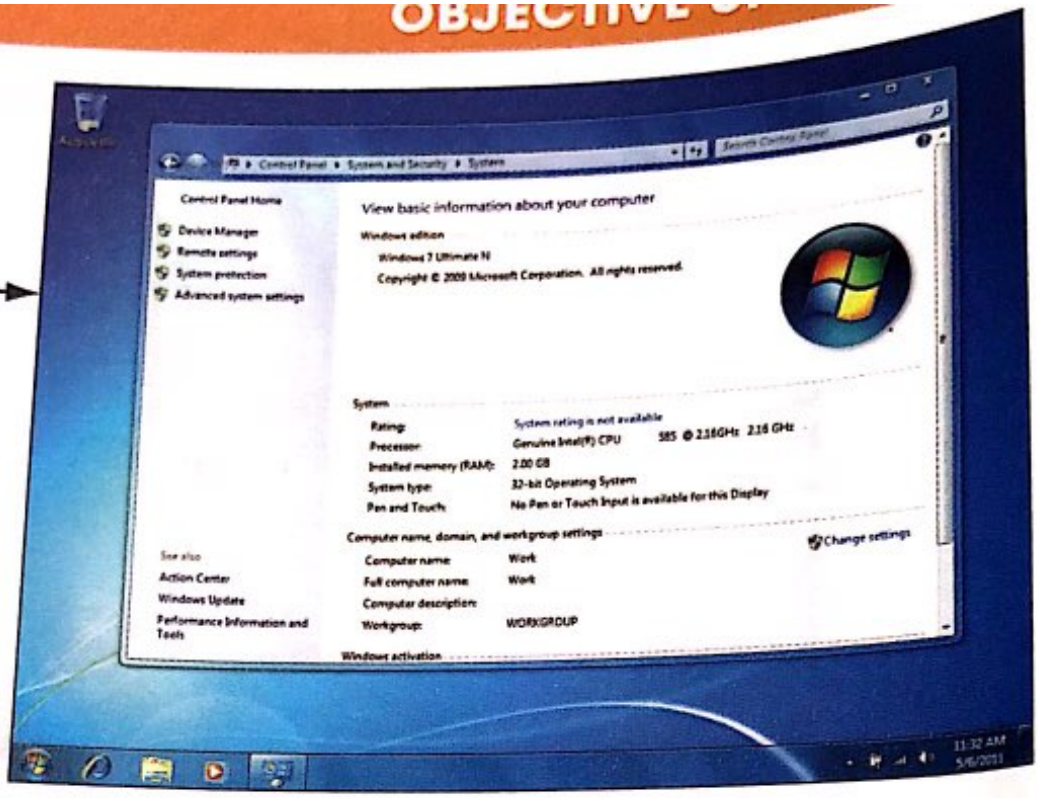

Figure 70 System Properties–Windows 7 users.

Windows Vista users

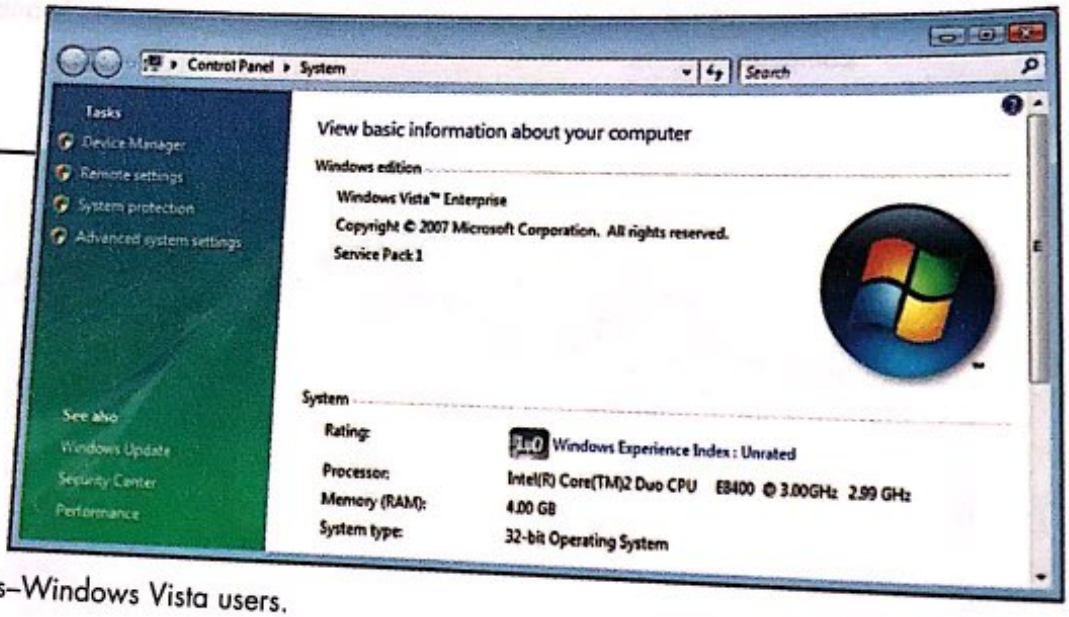

Figure 71 System Properties–Windows Vista users.

▶ OBJECTIVE 3: Describe Hardware Devices and Their Uses

What operating system does the computer use? If you watch carefully as a computer boots up, you can often determine the operating system. You will usually see a ***splash screen*** showing the version of Windows that runs—for example, Windows 7, Windows ME, Windows XP, or Windows Vista.

How do you determine what drives are on the system and how much storage space is available? It's important to know how much information you can store on your computer, what disk drives are available, and how much room you have left on each drive. Figures 72 and 73 display windows with information on which drives are available. Is there enough storage space or are the storage devices getting full? Use My Computer (or Computer) to find the answers. If the desktop does not have a My Computer (or Computer) icon, you can access it through the Start menu.

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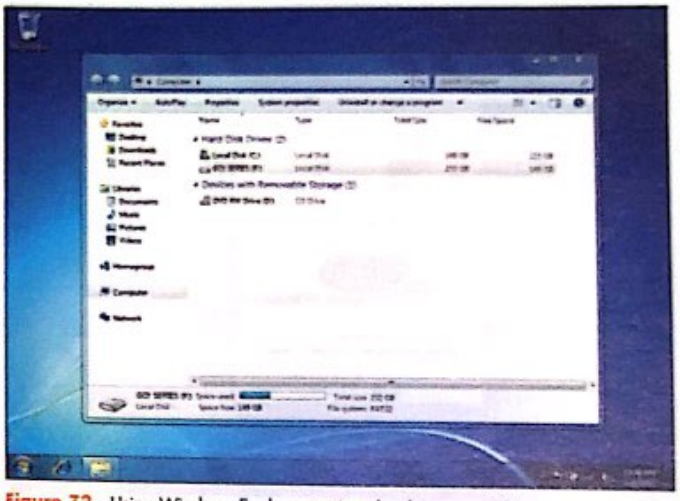
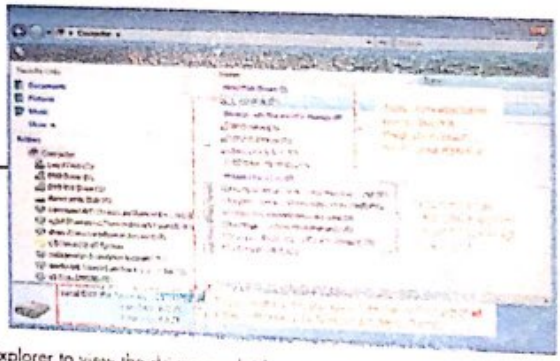


Figure 72 Using Windows Explorer to view the drives available to your computer—Windows 7 users.

Windows Vista users



Windows Vista

Figure 73 Using Windows Explorer to view the drives available to your computer—Windows Vista.

The Computer (or Windows Explorer) window displays all available local drives (devices within the system unit or peripherals to that unit) and network drives (devices available through a network). Right-click on any drive symbol, and select Properties from the shortcut menu to display the drive's information similar to the one shown in Figure 74. The pie chart displayed on the General tab is a good visual tool that shows the size of your storage device and how much space is free.

Done! You have completed OBJECTIVE 3 of 6.

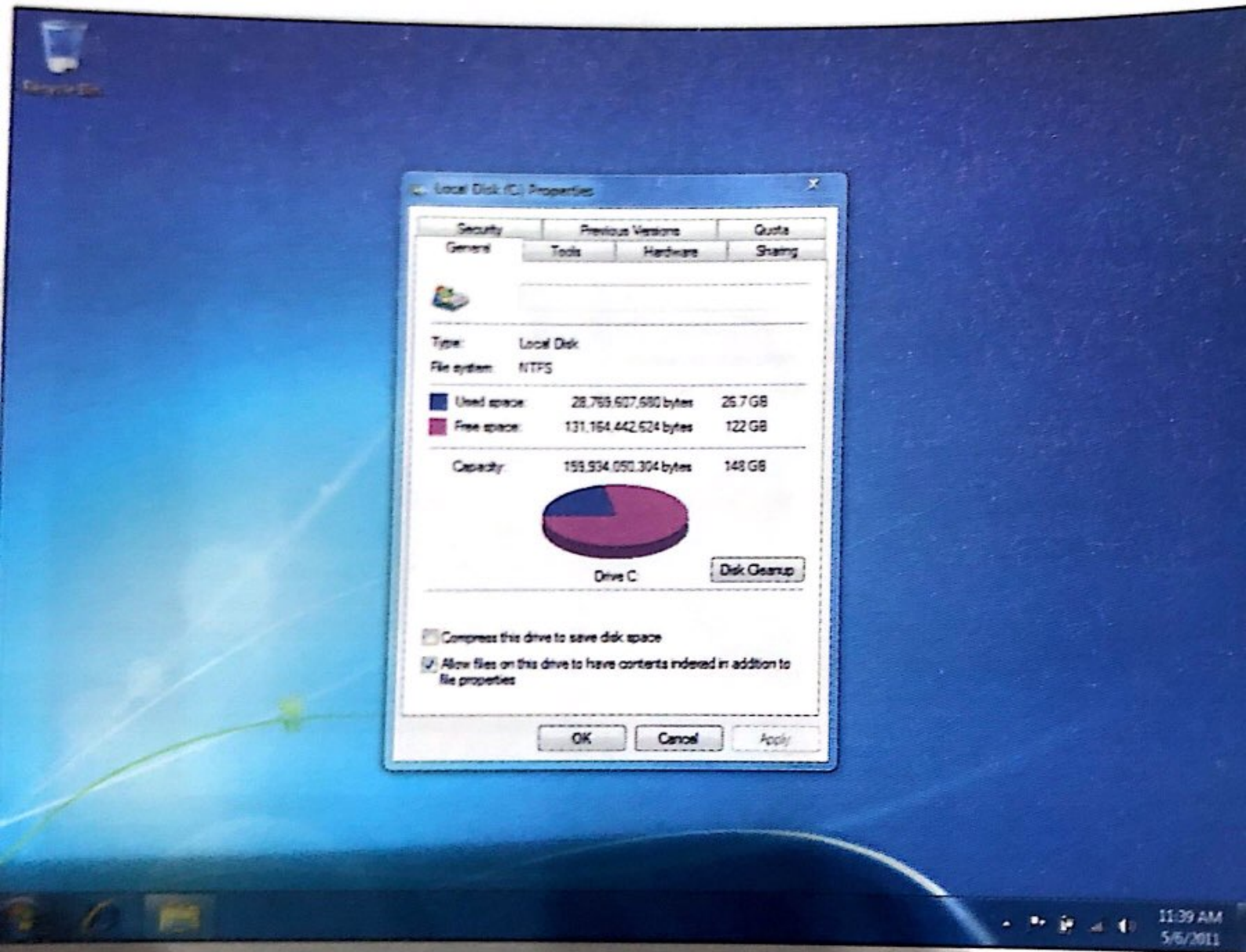


Figure 7.4 The properties of one of the storage drives (the hard drive).

▶ OBJECTIVE 4: Identify Ty

- ▶ Without software, the computer would just be a collection of useless electronic and mechanical parts.
- ▶ There are two categories of computer software—***system software*** and ***application software***. Both types of software are required to work effectively with your computer.

Software provides the instructions or commands that tell the computer what to do. To perform various tasks, the computer requires a set of instructions called ***programs***. These programs enable individuals to use the computer without the need for special programming skills. **Figure 75** displays an example of software provided via a disk that users would then purchase and download onto their computer.

System Software

System software provides the instructions that the computer needs to run. It contains the directions needed to interface or interact with the computer and its peripheral devices so that you can use them. System software consists of two main programs: the ***operating system*** and ***utility programs***, as shown in **Figure 76**.

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Figure 75 Software suites provide users with a cheaper method of obtaining all the software they want in one bundle.

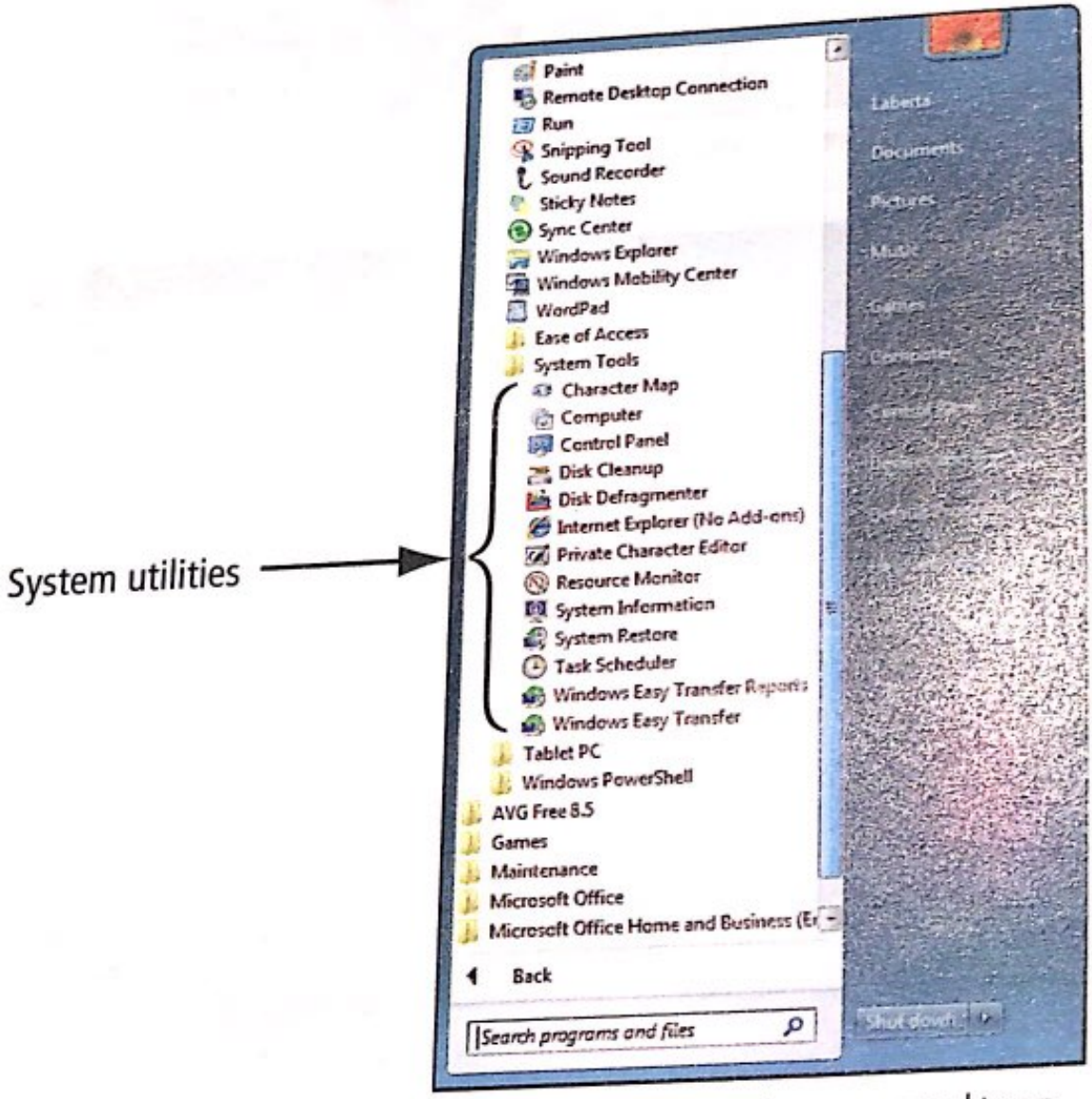

Figure 76 Some utilities run only when selected; others can be programmed to run on a regular schedule.

Operating Systems

What is the operating system? The ***operating system (OS)*** is a computer program that is present on every desktop computer, notebook, smartphone, or mainframe. The operating system controls how the computer works. As shown in **Figure 77**, the operating system manages the hardware components, including the CPU, memory, storage devices, peripheral devices, and network devices. It also coordinates with the various software applications presently running and provides the interaction with the user.

Is it possible to communicate with the operating system? Although the operating system communicates with the computer and its peripherals, it also includes a ***user interface*** that you can use to interact and communicate with the computer. Early operating systems used a text-based or keyboard-driven interface. The early ***Disk Operating System (DOS)*** required knowledge of special commands that had to be typed to achieve the desired results. This type of system was not very ***user friendly***. Most current operating systems use a point-and-click format known as a ***graphical user interface (GUI)***. GUIs are more user friendly and intuitive than DOS systems.

Rather than typing specific commands, you can use a mouse to select screen objects such as ***icons*** (a graphical depiction of an object such as a file or program) as shown in **Figure 78**, ***menus***

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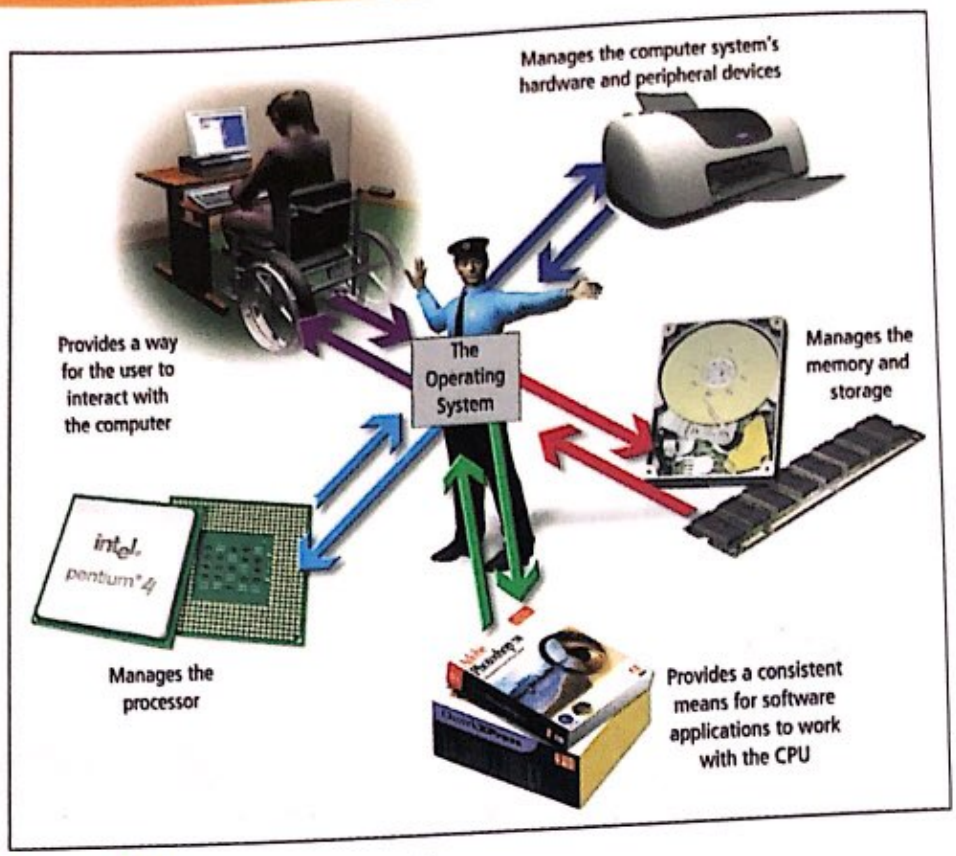

Figure 77 The operating system.

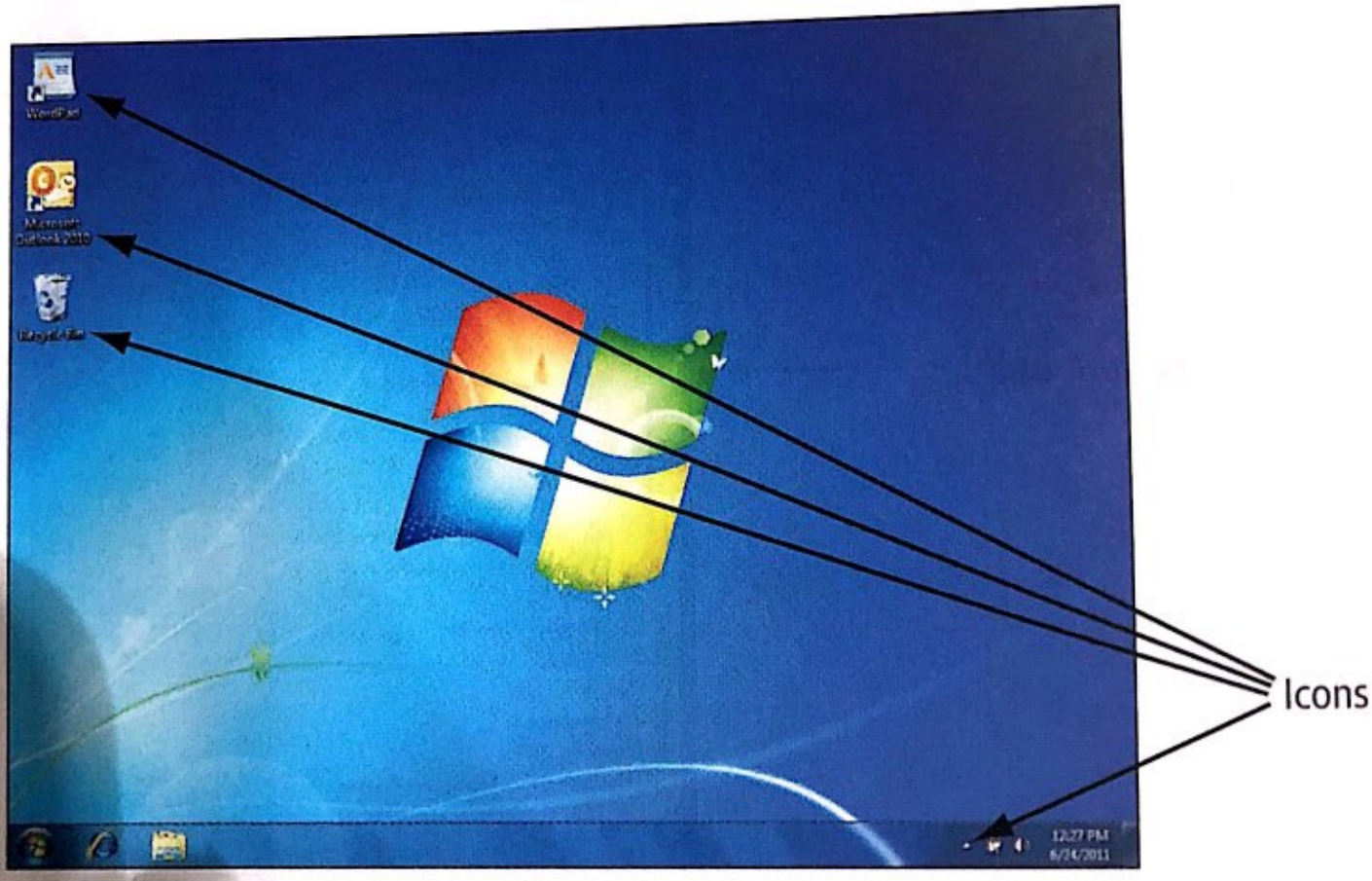

Figure 78 Icons are used to open a file, window or program, for example.

(lists of available commands), or ***dialog boxes*** (windows used to make choices or give the system specific instructions as to the action you want to take or task to perform). GUI operating systems display information on the monitor in the form of rectangular boxes called ***windows*** as shown in **Figure 79**. Although you interact with system software every time you use the computer, in some ways you don't notice it.

Do all computers need an operating system? Yes, the operating system is a critical part of a computer system. Without an OS to provide specific instructions, the computer would be unable to fulfill its four main functions. However, different computers require different types of operating systems. There are several popular operating systems available for home computers. They include Microsoft Windows, Mac OS, and Linux.

Microsoft Windows has the largest market share of the three main operating systems and is found on most of today's desktop and notebook computers. There have been many versions of Microsoft Windows, including Windows 3.0, Windows 95, Windows 98, Windows ME, Windows Vista, and Windows 7. Although a previous version of Windows might be found on an older computer, Windows 7 is the current version installed on most new computers. A sample Windows 7 desktop is displayed in **Figure 80**.

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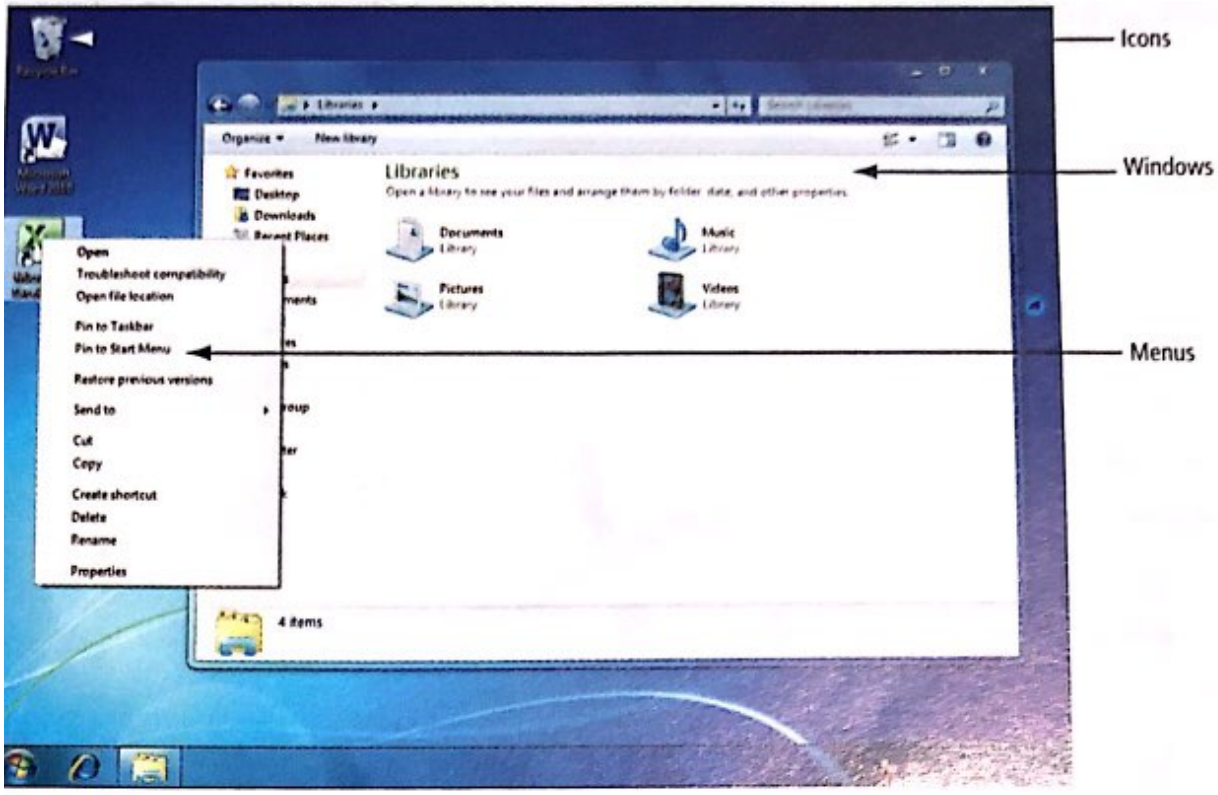

igure 79 Windows are rectangular boxes that display information on the computer.

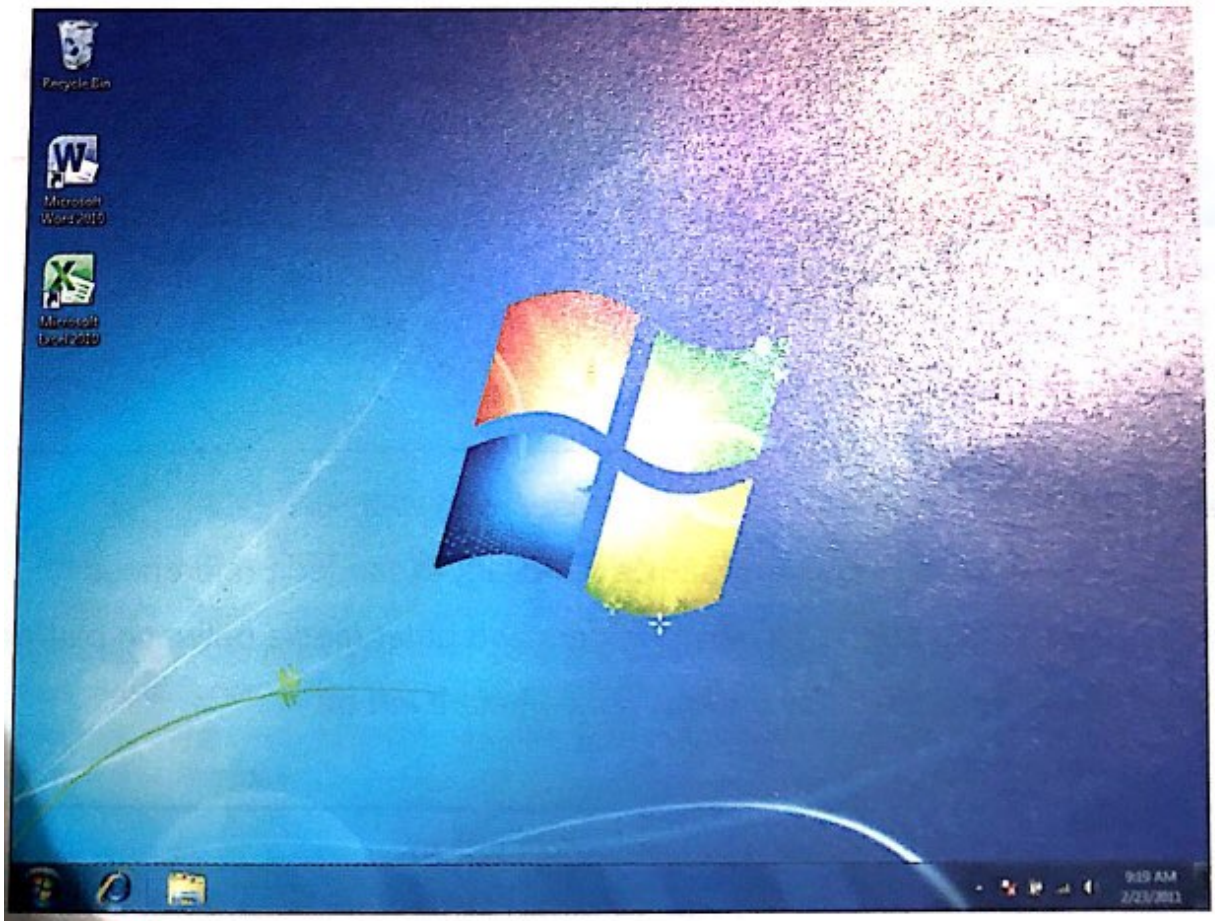

Figure 80 A sample of the Windows 7 desktop.

Why are there so many versions of Windows? Software developers are always updating and refining their software to adapt to new technology, respond to vulnerabilities, and improve their product. Because Microsoft also manufactures application software, some of its products have similar names and users can become confused. It's important to note that even though your computer might use Microsoft Windows for its operating system, as shown in **Figure 81**, it might not have Microsoft Office (an application software suite) installed.

The ***Mac OS*** is an operating system designed specifically for Apple's Macintosh computers.

The Mac OS desktop is similar to Windows because it also uses a GUI. In fact, Apple was the first company to introduce a commercially successful GUI operating system for the consumer market. But, because of the popularity of the Windows-based PCs, Mac OS has a much smaller market share. If you are looking to purchase a PC or a peripheral for a PC, you have a variety of choices among different manufacturers. Only Apple manufactures Apple products and peripherals for its computers, and they tend to be a bit pricier.

Can Windows run on an Apple computer? Until recently, the Windows OS could not run on a Mac. Software is available to start a Mac that will run Windows applications. **Figure 82** demonstrates the features in Microsoft's Virtual PC for Mac. In addition, Mac offers a built-in utility on certain Mac operating systems called Boot Camp which allows users to run Windows XP, Windows Vista, Windows 7 or Linux operating systems on a Mac computer.

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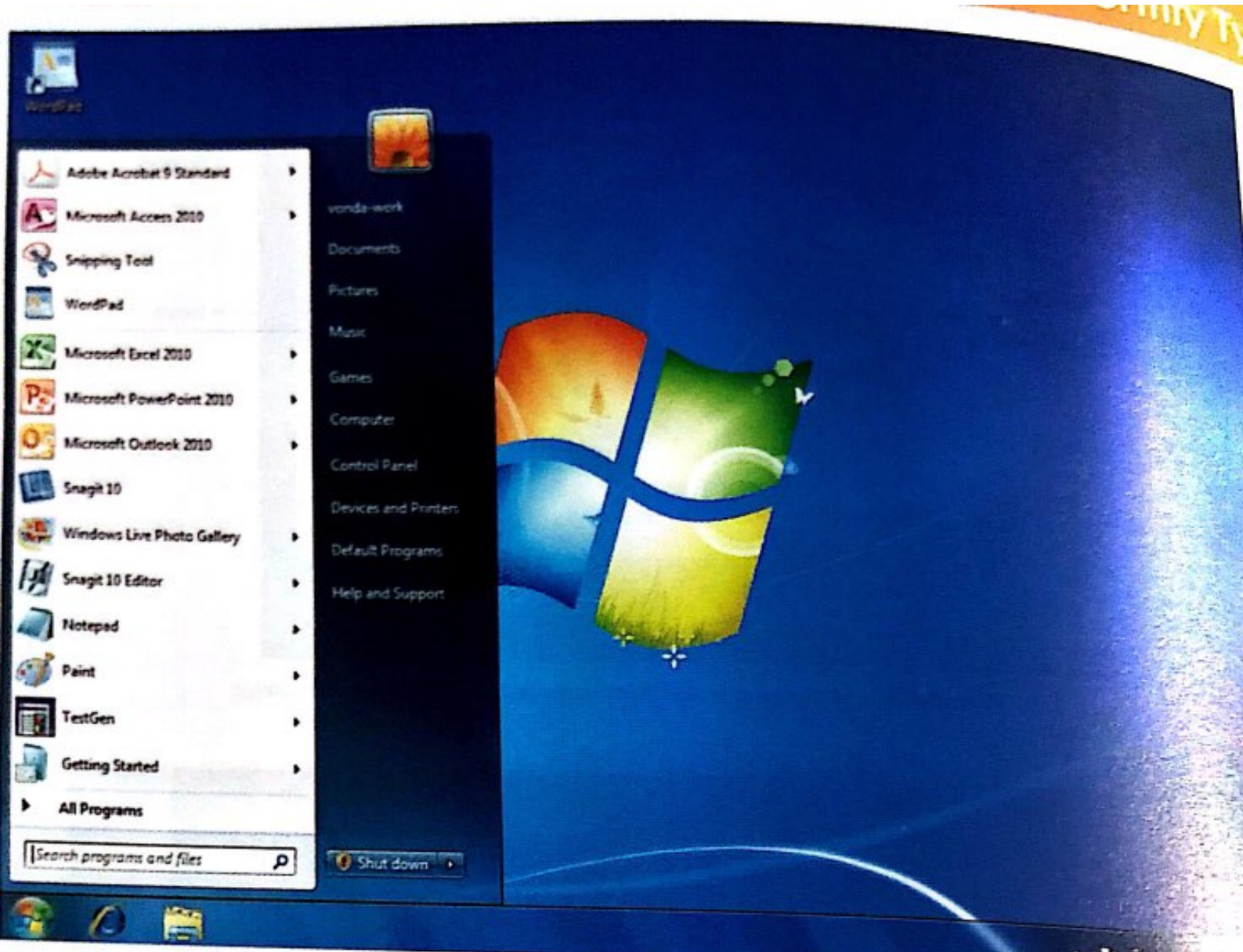

Figure 81 Windows operating system with Microsoft Office installed.

- Access PC software, files, networks, and devices with your Mac
- Zero-configuration printing; better graphics handling; expanded preferences
- Cut and paste between platforms; share folders and other media between platforms
- Easily shut down virtual PC and relaunch right where it left off
- Use PC and Mac peripherals

Figure 82 Microsoft's virtual PC for Mac features specifications such as:

▶ OBJECTIVE 4: Identify Type

Linux is an alternative operating system. Based on the UNIX operating system developed for mainframe computers, it also has a dedicated group of users. Linux is an ***open-source*** operating system, which means it is not owned by a single company and some versions are available at no cost. See the table in **Figure 83**.

How is open-source software different from other types of software? Open-source software makes its source code, essentially the program instructions, available to anyone who would like to see it. Programmers are encouraged to work with and change the code as they see fit, in the hope that having many "eyes" looking at the code will streamline and improve it. Proprietary software, such as Microsoft Windows, keeps this code secret and inaccessible to programmers who are not authorized by the software development company.

Why is Linux used? Linux is rarely used by novice computer users, although it is popular among developers and other technologically advanced individuals who prefer to use an alternative operating system as shown in **Figure 84**. Some people appreciate the opportunity to work in this more "open" programming

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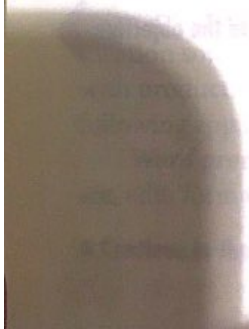

Software Type	Example	Description
Open source software	Linux OpenOffice.org suite Google Docs	Non-proprietary software that is sometimes available at no cost
Proprietary software	Microsoft Windows and Office Apple Mac OS X iWork	Proprietary software available to users at a cost

Figure 83 Examples of open source software and proprietary software.

Figure 84 A novel use of the Linux operating system is in the NASA personal satellite assistant, currently under development. The six-inch sphere will float around the International Space Station and act as an environmental monitor and communications device. Its design was inspired by the light saber training droid used by Luke Skywalker in the movie *Star Wars*.

environment. However, one of the disadvantages of Linux is that, because no single company is responsible for it, technical support is not easily found. Users might find help from various resources such as user groups and Internet communities. Alternatively, some software companies have chosen to develop and sell a version of Linux that includes a warranty and technical support as a way of alleviating user concerns. **Figure 85** shows an example of one version of the Linux operating system.

Utility Programs

What are utility programs? Operating system software is the most critical software on the computer, because nothing can run without it. However, ***utility programs,*** as shown in **Figure 86**, are another important component of system software. These small applications handle many important tasks involved with the management and maintenance of your system. Utility programs can be used to help back up important files, remove unwanted files or programs from your system, and schedule various tasks to keep your system running smoothly. Some of these utilities are included with the operating system, whereas others are stand-alone versions that you can purchase or download for free.

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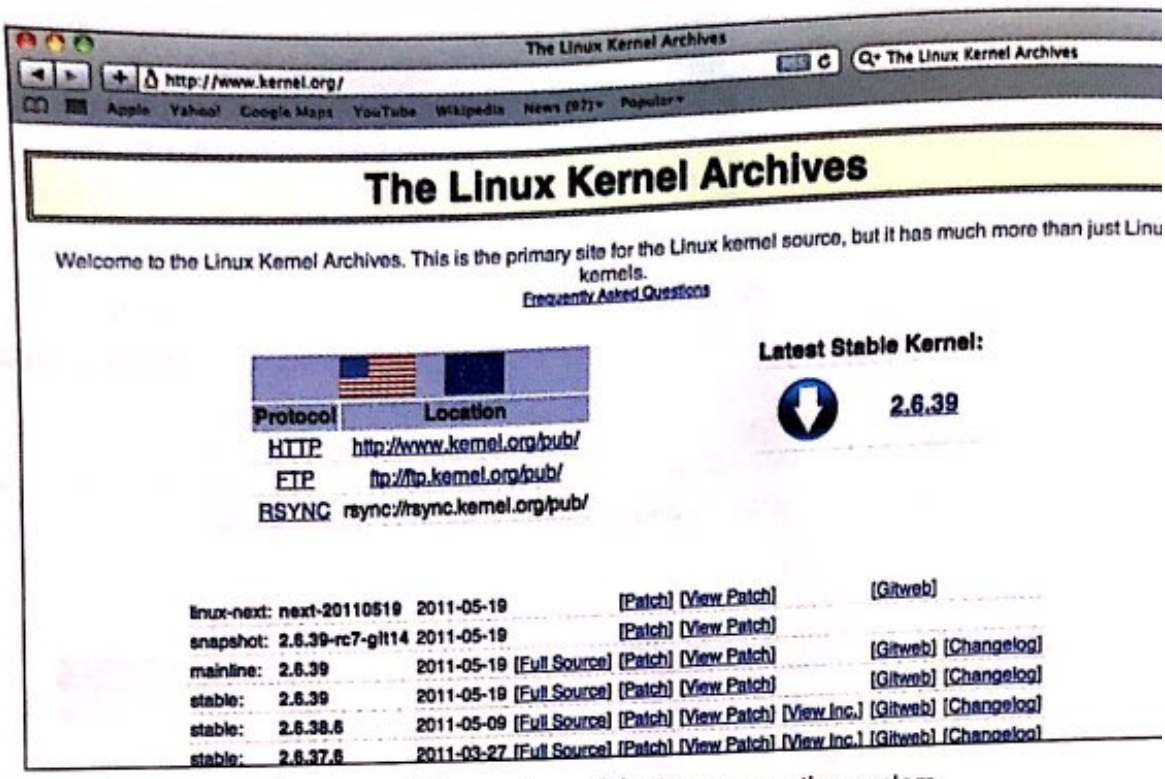

Figure 85 Example of one of the versions of the Linux operating system.

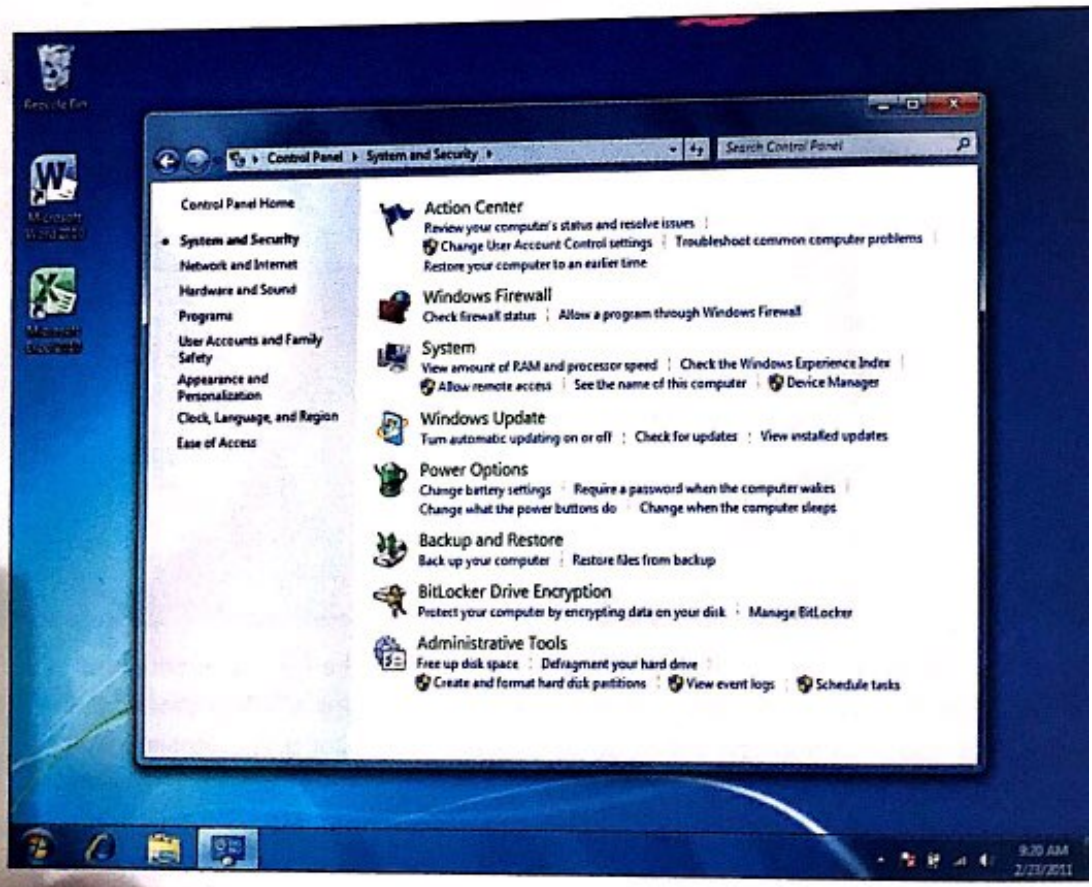

Figure 86 Utility programs in Windows 7.

▸ OBJECTIVE 4: Identify Types of Software and Their Uses

The table in **Figure 87** displays various utility programs that are provided with the Windows operating system and compares them with similar stand-alone products, describing the function of each utility.

Application Software

Application software is comprised of programs that enable you to accomplish tasks and use the computer in a productive manner. Applications are programs created to perform a specific task or address a specific need.

How do system software and application software work together? System software is like breathing; you usually don't think about it unless something goes wrong. Application software can be compared to an instrument like a flute. When a musician combines each of these breaths with the flute, the result may be a beautiful melody. Computer software works similarly; the system software acts as the "breath," while the application software provides the "instrument," enabling you to create something.

There are many different kinds of application software, although they often fall into one of several categories including financial and business-related software, graphics and multimedia software, educational and reference software, entertainment software, and communication software. You might be most familiar with productivity software, which includes the following applications.

Word processing software is used to create, edit, format, print, and save documents

■ Continue to the next page to complete the objective.

Program	Function
• Windows Explorer	Create folders, manage files, and compress/extract files. Read disk drive's properties including view storage capacity and free disk space, check drive for errors, defragment utility, and back up/restore utility
• Windows Task Manager	Lets the user view the list of active applications and switch or end any of them. Also, check the performance of the computer including CPU usage, RAM availability, and network utilization
Control Panel	
• System and Security	Review your computer's status Back up your computer Find and fix problems
• Network and Internet	View network status and tasks Choose home group and sharing options
• Hardware and sound	View devices and printers Add a device Connect to a projector Adjust commonly used mobility settings
• Programs	Install/uninstall programs Add desktop gadgets
• User Accounts and Family Safety	Add or remove user accounts Set up parental controls for any user
• Appearance and Personalization	Change the theme Change desktop background Adjust screen resolution Change keyboards or other input methods
• Clock, Language, and Region	Change display language Let Windows suggest settings
• Ease of Access	Optimizes visual display
Administrative Tools	**Function**
Security	
• Security Configuration Manager	Set account policies, local policies, network list manager policies, software restriction policies, and application control policies
• Firewall and Advanced Security	Set firewall and advanced security on local computer

Figure 87 Windows utility programs

and other text-based files. Word processing software enables you to create or edit letters, reports, memos, and many other types of written documents that you can print or attach to an email message. Revisions to existing documents can be made quickly and easily, without having to re-create the entire document. Documents created with this type of software can also include pictures, charts, hyperlinks, and other graphic elements. A ***hyperlink*** is a connection to another area of a document or a connection to an Internet URL. Microsoft Word, Lotus Word Pro, and Corel WordPerfect are all examples of word processing programs. A document created using Microsoft Word 2010 is shown in **Figure 88**. Notice that the document contains a graphic element as well as text.

Using word processing software replaces the use of conventional typewriters, on which editing was virtually impossible once the document was finished.

Spreadsheet software, as shown in **Figure 89**, enables the user to enter data in rows and columns format and:

- Perform calculations on numeric data with user-defined formulas.
- Convert part of the data into one or more charts, such as a column chart, a pie chart, or a line chart.
- Work with lists to organize data and sort it in alphabetic or numeric order.
- Create different scenarios and perform "what-if" analyses, the basis for sound decision making.

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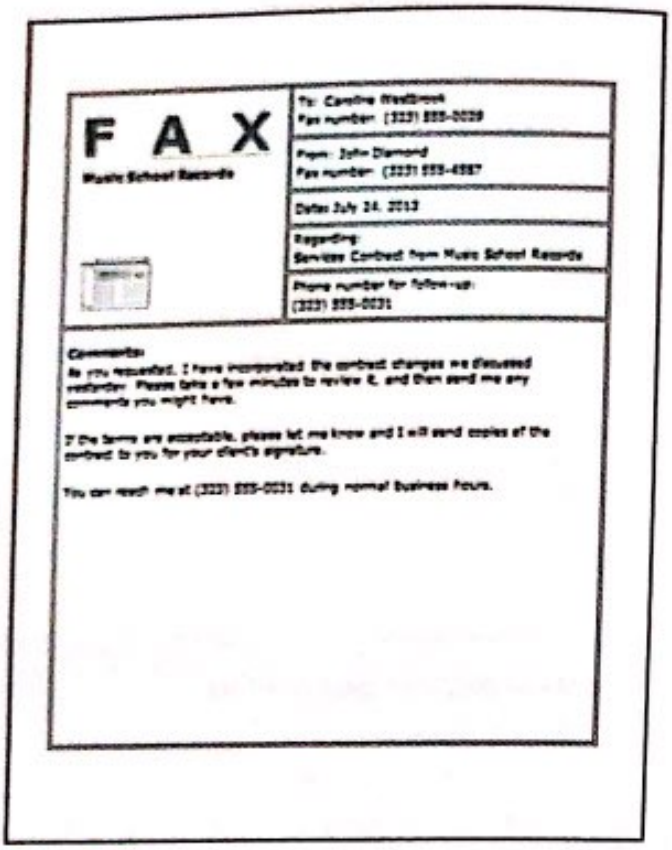

Figure 88 Sample document created with Microsoft Word 2010.

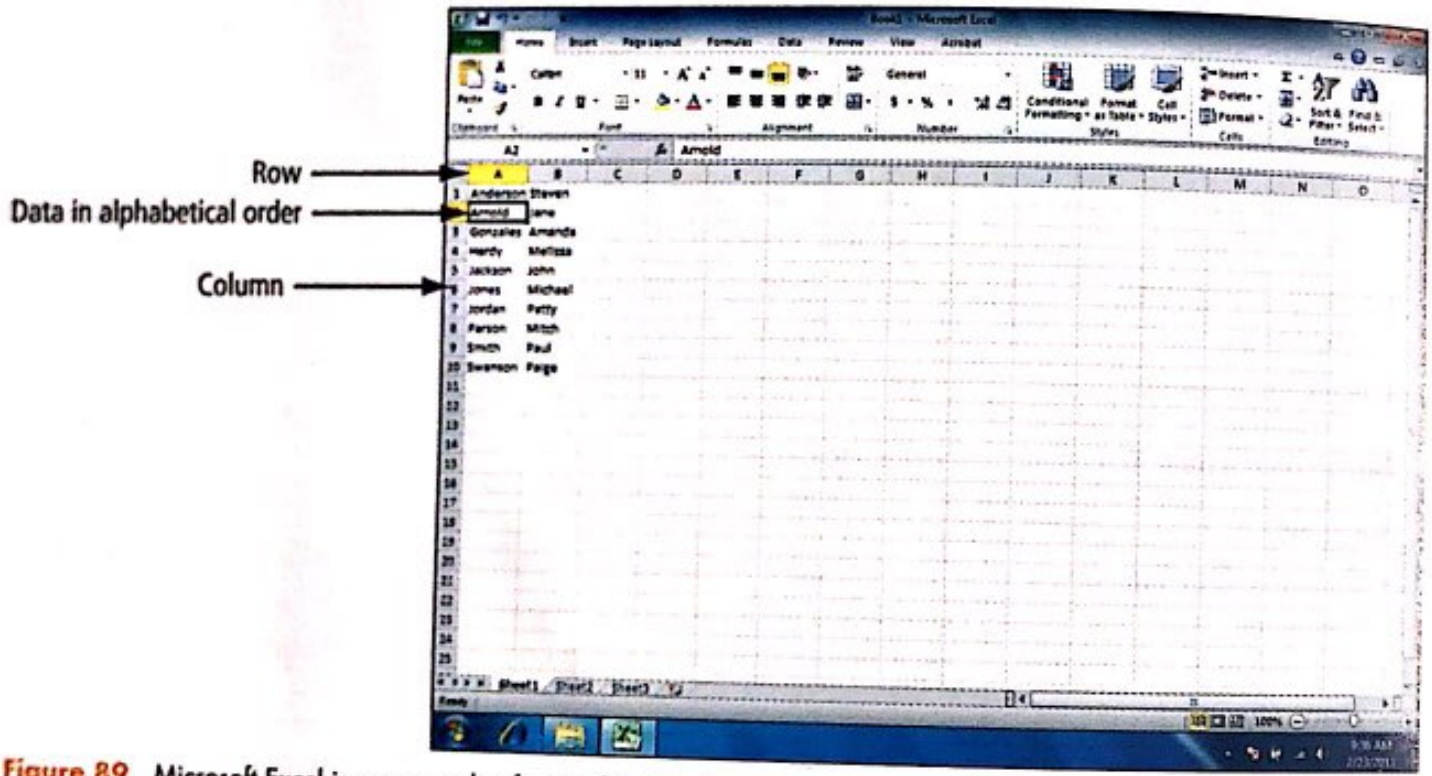

Figure 89 Microsoft Excel is an example of spreadsheet software.

A key advantage of spreadsheet software is its capability to recalculate values without user intervention. When data used in a calculation or a formula is changed, the spreadsheet software automatically updates the worksheet with the correct result. Microsoft Excel, Lotus 1-2-3, and Corel Quattro Pro are examples of spreadsheet programs. Figure 90 shows a worksheet and a chart created with Microsoft Excel 2010. The use of spreadsheet software replaces the old manual method of entering data in ledgers or journals and using a desktop calculator to do the math computations.

A ***database*** is a collection of data or unorganized facts. ***Database software*** is used to store, organize, update, and retrieve large amounts of data making websites, as shown in Figure 91, possible. ***Relational database software (RDBMS)*** stores information in tables, which enable users' quick access to the data by connecting tables with common fields. ***Data mining*** is a function in some databases that looks for hidden patterns in the data to anticipate future patterns. This is commonly used in scientific applications and as a marketing tool to predict future consumer trends. Typically, database software can be used to manage various types of information, such as that found in large mailing lists, inventories, students' records, order histories, and invoicing. Databases help you to enter, store, sort, filter, retrieve, and summarize the information they contain and then generate meaningful

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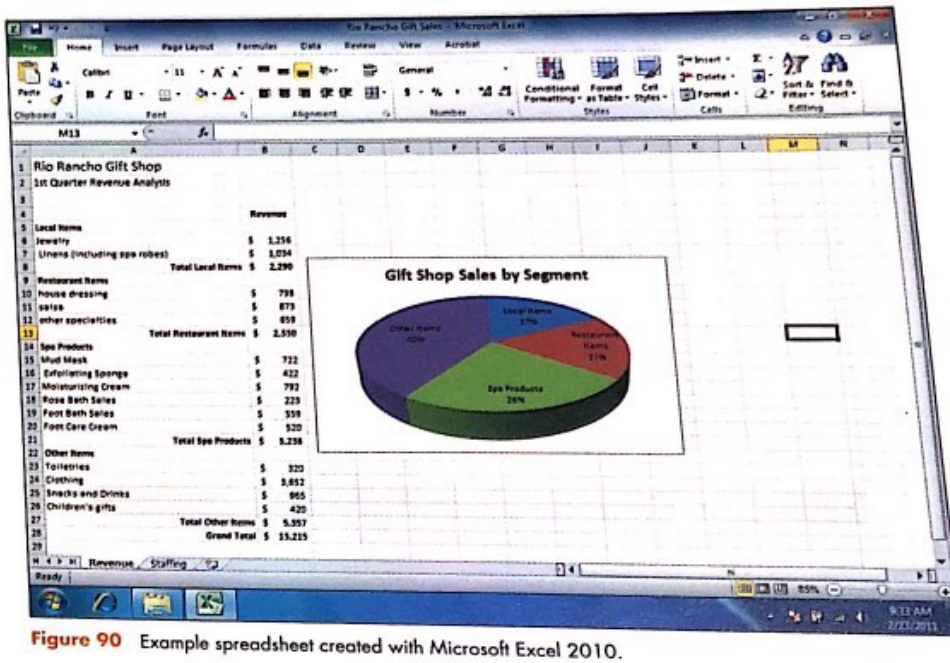

Figure 90 Example spreadsheet created with Microsoft Excel 2010.

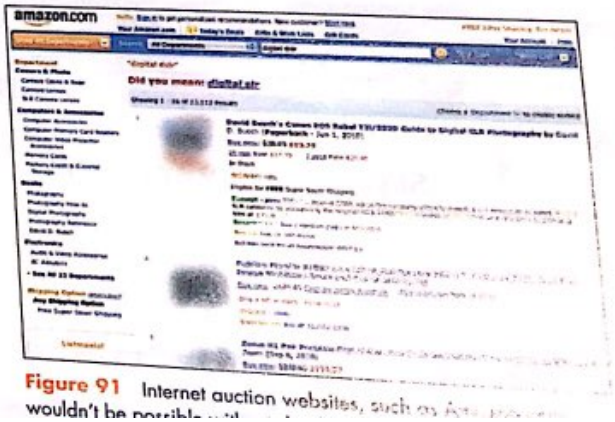

Figure 91 Internet auction websites, such as [illegible] wouldn't be possible [illegible]

reports. Common database programs include Microsoft Access, Lotus Approach, and Corel Paradox. **Figure 92** shows a database object created in Microsoft Access 2010. Database software replaces an old manual filing system where information is stored in filing cabinets in a single location.

Presentation software has replaced flip charts, slide projectors, and overhead transparencies used by speakers and lecturers. This software is used to create electronic slides and project slide shows to visually present materials and ideas to large groups in a conference room or on the Web. Presentation software is also used to create audience handouts, speaker notes, and other materials that can be used during an oral presentation or for distribution to a group of participants. Microsoft PowerPoint, Lotus Freelance Graphics, and Corel Presentations are examples of presentation software programs. **Figure 93** shows a presentation created with Microsoft PowerPoint 2010.

Communication and organizational software—Communication software can cover a broad range of tasks including videoconferencing and telephony. However, applications in the productivity category are most often used to send and receive email. These applications typically include an address book (contacts list), a scheduler, a calendar, and task functions help users organize their personal and

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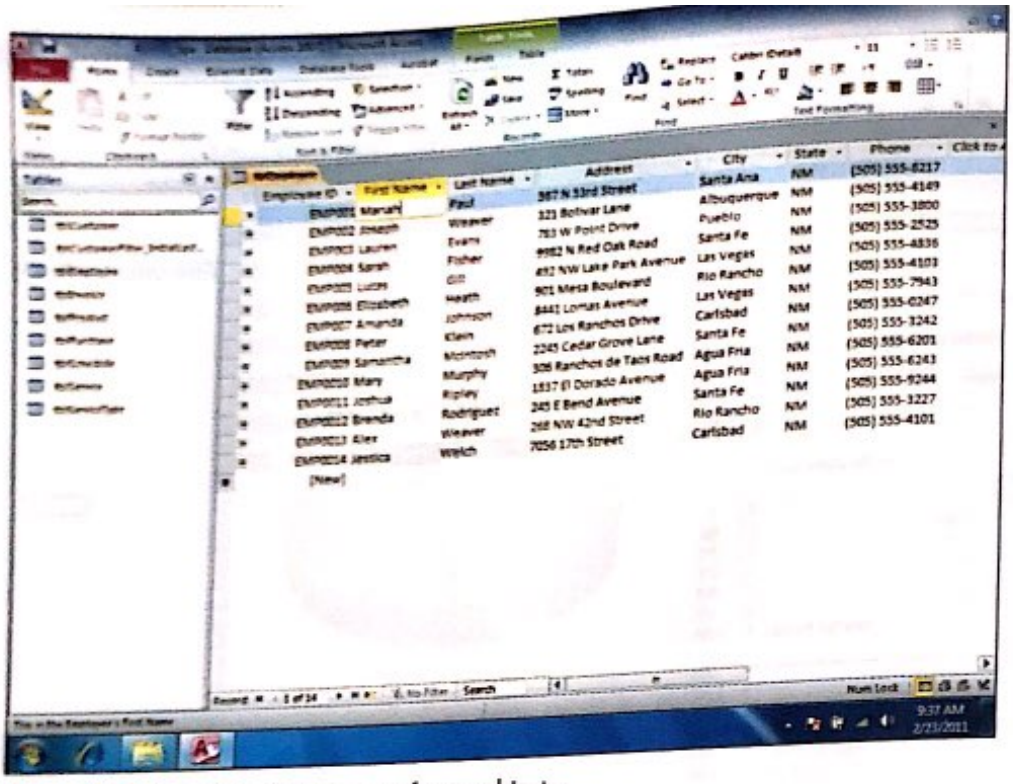

Figure 92 Examples of database software objects.

Figure 93 Example presentation created with Microsoft PowerPoint 2010.

professional responsibilities. Microsoft Outlook, Lotus Notes, and Corel WordPerfect Mail are examples of communication and organizational software. **Figure 94** shows an example of a calendar in Microsoft Outlook 2010.

What is a software suite? Although it is possible to buy any of the previous applications separately, most software manufacturers, including Microsoft, Corel, and Lotus, also group applications together into a package called a ***suite***. There are also alternative suites such as Google Docs and OpenOffice, which are free. They are designed as an open source software in such a way that users can report bugs, request new features, or change and improve the software.

Another advantage of using a suite is that products from the same company have many common elements, such as basic window design and layout, toolbars containing similar tools, dictionaries, and media galleries, so many users find this familiarity makes it easier to switch between the programs in a suite. Examples of suites include Microsoft Office, Corel WordPerfect Office, and Lotus SmartSuite.

What are some other common software applications? Recall that there are many different types of application software besides productivity software, each one with a specific function as shown in the table in **Figure 95**. Some of these are the following:

- You might use Microsoft Publisher or QuarkXPress to create newsletters or brochures.

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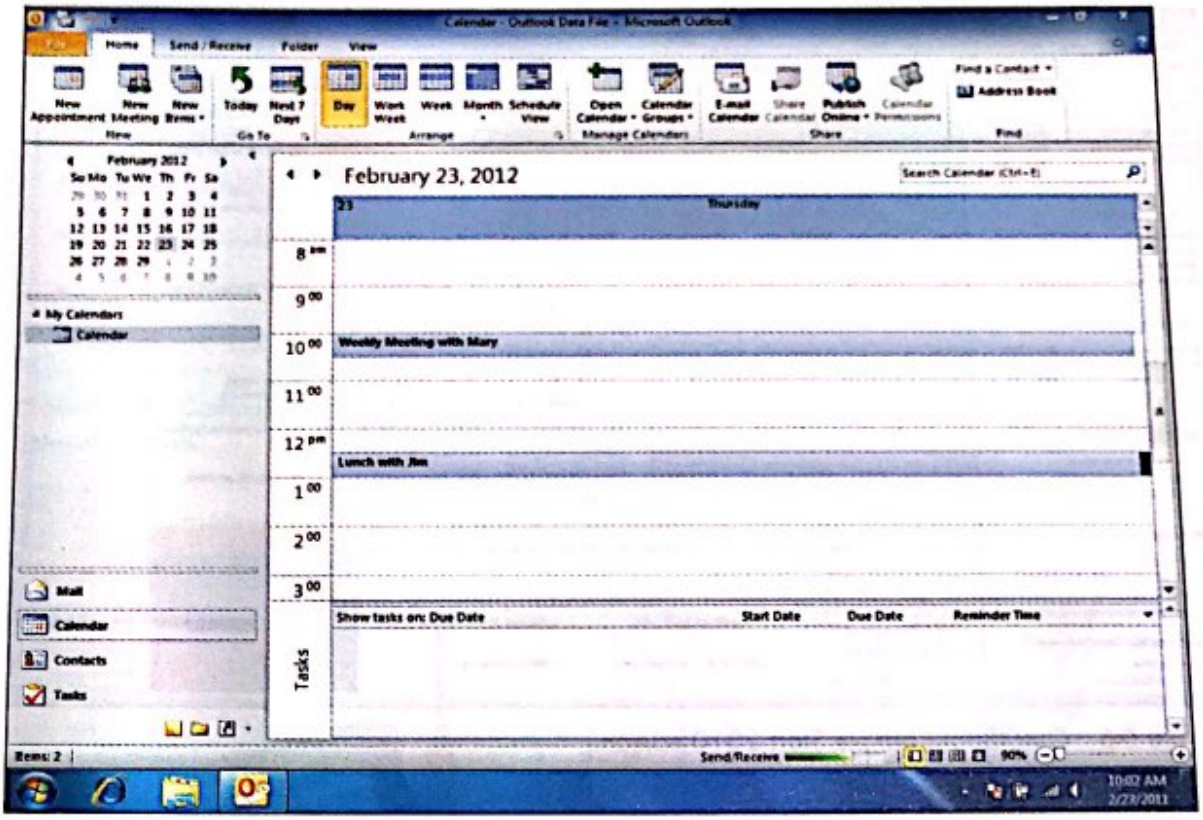

Figure 94 Example of a calendar in Microsoft Outlook 2010.

Category	Program	Manufacturer
Desktop publishing	Publisher QuarkXPress	Microsoft Quark
Paint/image editor	Painter Paint	Corel Microsoft
Drawing/design	Illustrator AutoCAD CorelDraw Graphics Visio	Adobe Autodesk Corel Microsoft
Photo/image editing	PhotoShop PhotoShop Elements PaintShop Photo Pro Picassa GIMP	Adobe Adobe Corel Google

Figure 95 Common drawing, image editing and photo editing applications.

- Bookkeepers rely on special accounting packages such as Peachtree Accounting or QuickBooks to balance the books and handle other accounting functions. See Figure 96.
- Graphic designers turn to packages such as Adobe Photoshop or Adobe Illustrator to develop creative artwork.
- You might use Microsoft Expression Web or Macromedia Dreamweaver to create your own website.
- ***IM (instant messaging)*** software enables users to communicate in real time like a phone conversation but using text only. The software can alert you if a member of your group is online at that moment.
- Web browsers are software used to locate and display web pages and navigate through them. They also enable users to store their frequently used sites for quick access.

If you have a specific need, chances are there is software that will address those needs such as the online financial management tool shown in Figure 97. Today the best way to find software is to do a web search using a search engine.

Done! You have completed Objective 4 of 6.

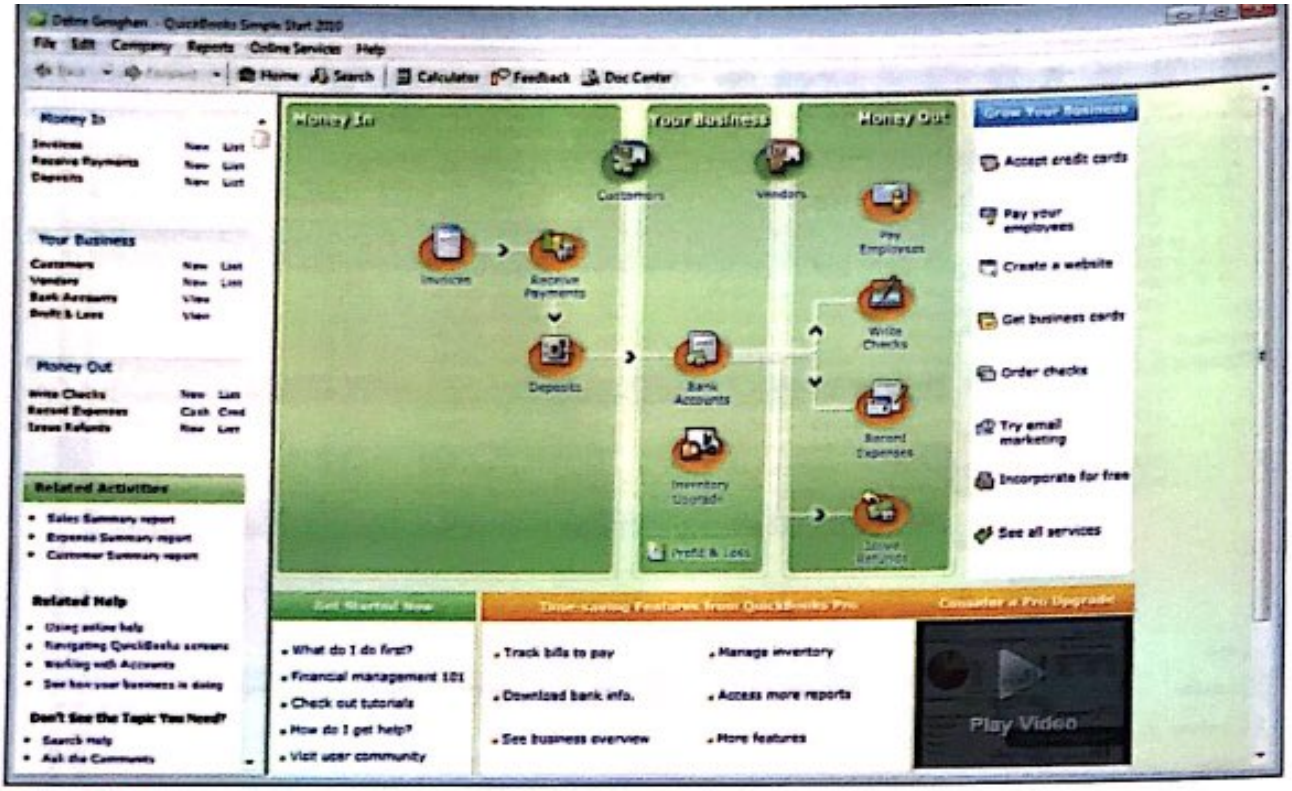

Figure 96 QuickBooks Simple Start 2010 edition.

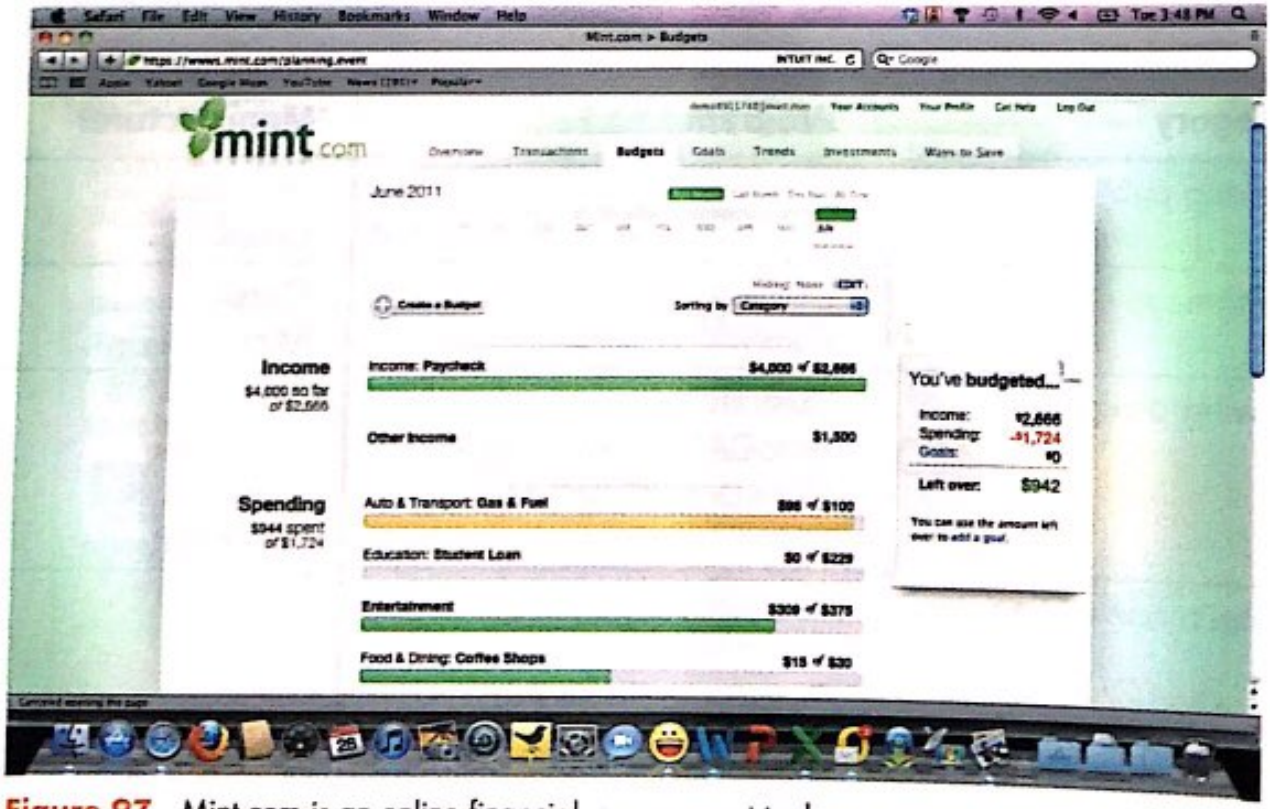

Figure 97 Mint.com is an online financial management tool.

- Connecting one computer to another creates a ***network***.
- Some of the benefits of computer networks include the capability to share data, software, and resources such as printers, scanners, Internet access, video conferencing, and VoIP.

What are the components of a network? Recall that computers and the various peripherals that are connected to them are called hardware. Networks consist of two or more connected computers, which can be connected using several media as shown in **Figure 98**, plus the various peripheral devices that are attached to them. Each object connected to a network, whether it is a computer or a peripheral device, is known as a ***node***.

Wireless networks use radio waves instead of wires or cables to connect. Most networks use a combination of media and wireless communications as shown in **Figure 99**.

Today, using computer networks, institutions are able to ***video conference,*** that is, communicate audio and/or video between two or more individuals in different locations, optimizing communications, information sharing, and decision making.

Voice over Internet Protocol (VoIP) enables voice, facsimile, and voice-messaging communications over networks and the Internet.

■ **Continue to the next page to complete the objective.**

- Existing telephone wires
- Power lines
- Coaxial cables
- Unshielded twisted pair (UTP) cables
- Fiber optic
- Radio waves

Figure 98 Computers can be connected to a network using several media, the conductors of the network signals.

Figure 99 A network using both wireless and wires

Can networks be different sizes? A network that connects computers reasonably close together, say within a few city blocks in adjacent buildings, is called a ***local area network (LAN)***. See Figure 100.

If the network grows to cover a larger geographic area or includes other networks, it becomes a ***wide area network (WAN)***. An example is a college campus that connects its computers with a LAN while all of its campuses connected together form a WAN, as shown in Figure 101. Because the different campuses are connected through WANs, students, faculty, and staff can easily use the resources of the entire network. Both LANs and WANs can be wired, wireless, or a combination of both. The Internet is the largest WAN as it connects computer networks all around the world.

Are networks public or private? They can be either. If you want to post information and make it available to any user, you post it on a website with no restrictions. If you want to protect certain information, you create an ***intranet*** in which access is restricted to authorized users only. Within an intranet, network administrators can limit the specific rights and privileges of different users.

How are networks configured? Networks can be configured in several ways. There are two main categories: peer-to-peer and client/server. ***Peer-to-peer*** or ***P2P networks*** are most commonly found in homes and small businesses. In a peer-to-peer network, each node can communicate with every other node without a dedicated server or hierarchy among computers. Peer-to-peer networks are relatively

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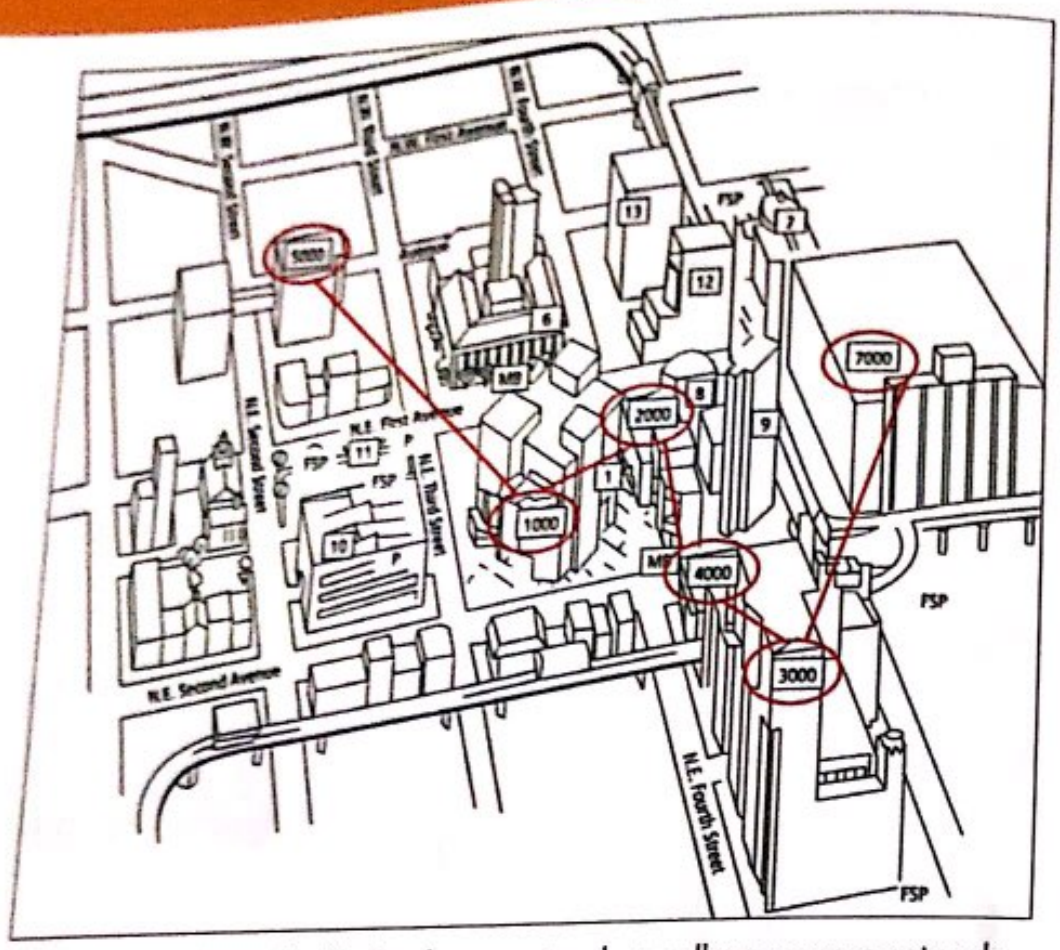

Figure 100 Example of a local area network, a college campus network that covers several buildings within a few city blocks.

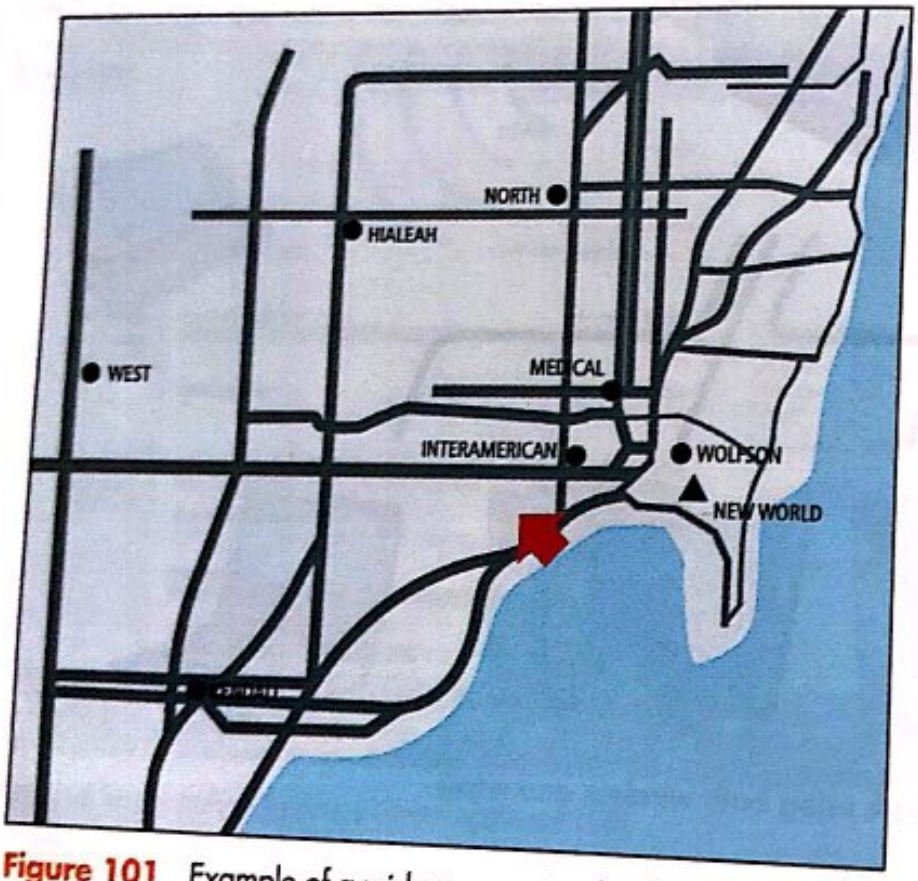

Figure 101 Example of a wide area network, which is a college network that links campus LANs in several cities within a county.

easy to set up, but tend to be small as shown in Figure 102. This makes them ideal for home use, although not as desirable in the workplace. If a network grows to more than, say, ten to fifteen nodes, it is generally best to use the ***client/server network***. In a client/server network, the server manages and controls all network resources. A ***node*** can be a computer, printer, scanner, modem, an external hard disk, or any other peripheral device connected to a computer. Therefore, it isn't difficult to find ten or more nodes in an office or business setting.

How is a client/server network different from a P2P network? Client/server networks typically have two different types of computers as shown in Figure 103. The ***client*** is the computer used at your desk or workstation to write letters, send email, produce invoices, or perform any of the many tasks that can be accomplished with a computer. The client computer is the one most people directly interact with. In contrast, the ***server*** computer is typically kept in a secure location and is used by network technicians and administrators to manage network resources. If a server is assigned to handle only specific tasks, it is known as a ***dedicated server.*** For instance, a web server is used to store and deliver web pages, a file server is used to store and archive files, and a print server manages the printing resources for the network. Each of these is a dedicated server.

■ Continue to the next page to complete the objective.

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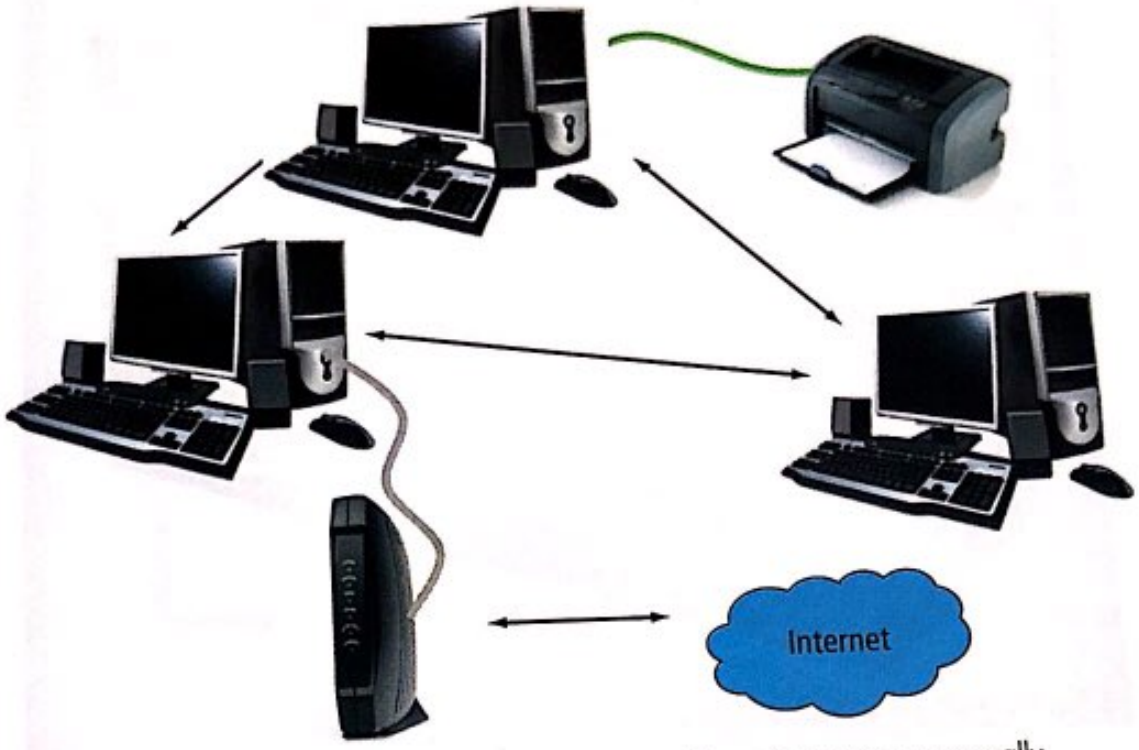

Figure 102 Peer-to-peer networks have no servers. Users share resources equally.

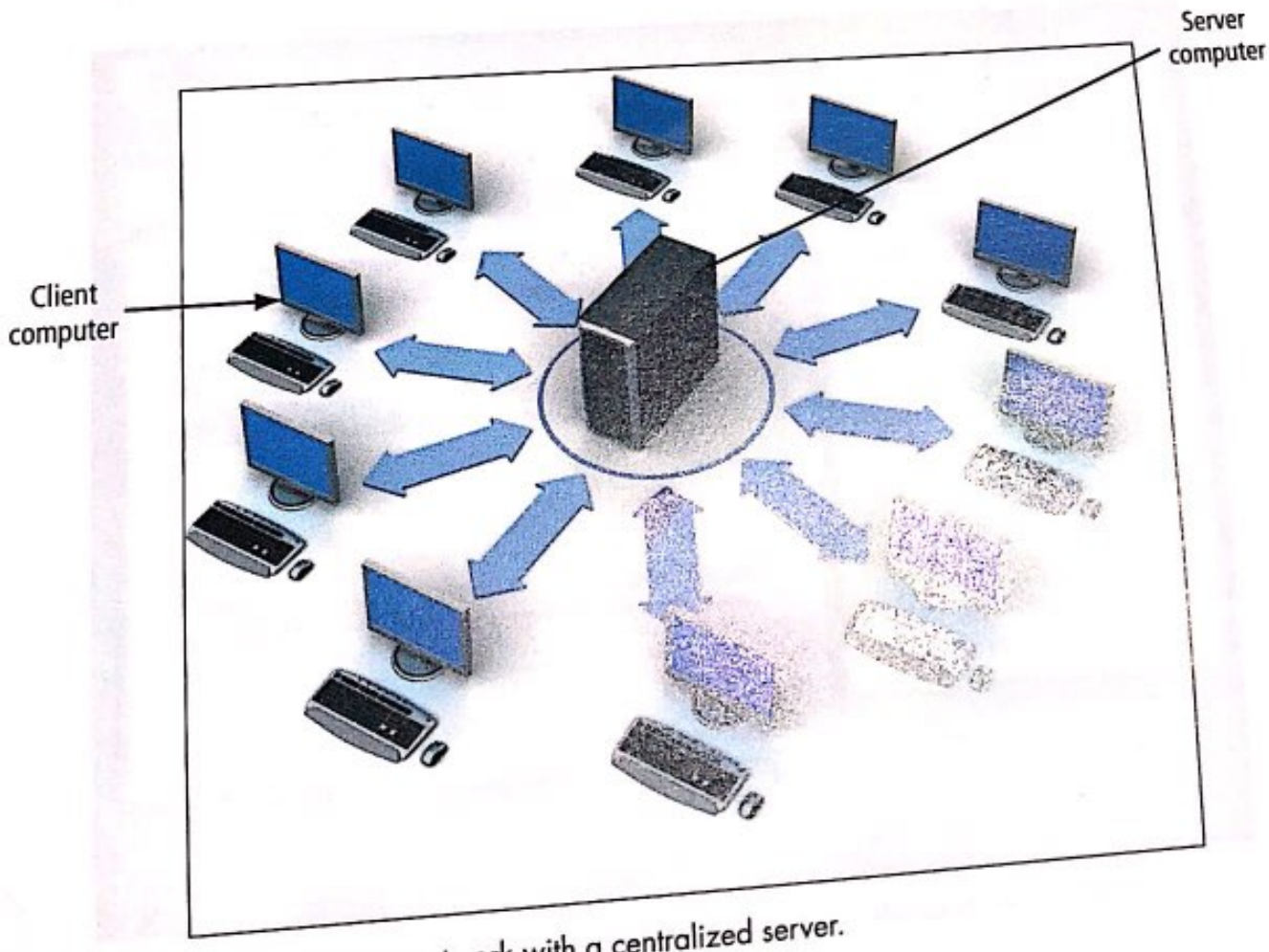

Figure 103 A client-server network with a centralized server.

As a client/server network grows in number of nodes and geographical distance, servers are assisted by distance-spanning devices such as switches and routers to optimize data traffic as shown in Figure 104.

Done! You have completed Objective 5 of 6.

Figure 104 Six ethernet switches.