COMPUTING FUNDAMENTALS

Computer Concepts

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Estimated Time: 2 hours

LESSON 1

Computers and Computer Systems

OBJECTIVES

Upon completion of this lesson, you should be able to:

- Understand the importance of computers.
- Define computers and computer systems.
- Classify computers.
- Use computer systems.
- Identify system components.
- Identify types of storage devices.
- Care for storage media.
- Explore computers in your future.

DATA FILES

You do not need data files to complete this lesson.

WORDS TO KNOW

arithmetic/logic unit (ALU)
central processing unit (CPU)
circuit board
computer
control unit
data
hard disk
hardware
information
memory
mobile device
motherboard
notebook computer
random access memory (RAM)
read-only memory (ROM)
server
software
supercomputer
tablet PC
USB flash drive

This lesson introduces you to computers, starting with a brief history and ending with a look into the future. You will learn how to classify computers and their components and identify and care for storage devices.

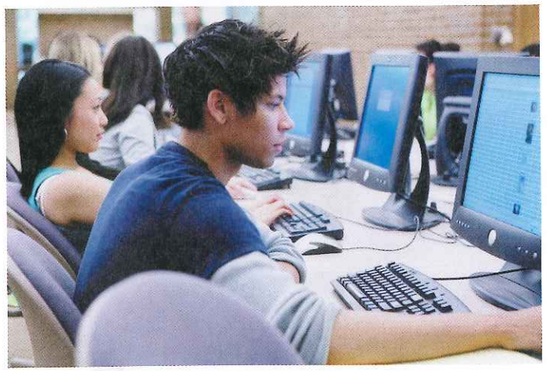
Understanding the Importance of Computers

The computer is one of the most important inventions of the past century. The widespread use of computers affects each of us individually and as a society. You can see computers in use almost everywhere! For instance, consider the following:

- Educational institutions use computers to enhance instruction in all disciplines and to provide online instruction.
- Video game systems transport you to an imaginary world.
- Using ATMs, you can withdraw money from your bank account from almost any location in the world.
- On television and at the movies, you can see instant replays in sports or amazing special effects that take you to outer space.
- Mobile computing, text messaging, e-mail, and online audio/video conferencing allow you to communicate with people at almost any location.

As indicated by these examples, you find computers and computer technology everywhere throughout society—from businesses and financial organizations, to home electronics and appliances, and to personal applications such as clothing embedded with iPod controls.

The importance of the computer is not surprising. Many people consider the computer to be the single most important invention of the 20th century. This technology affects all aspects of everyone's daily lives. Computers are no longer bulky machines that sit on desktops—they come in every shape and size and are found everywhere. As more powerful and special-purpose computers become available, society will find more ways to use this technology to enhance everyone's lives. See **Figure 1–1**.

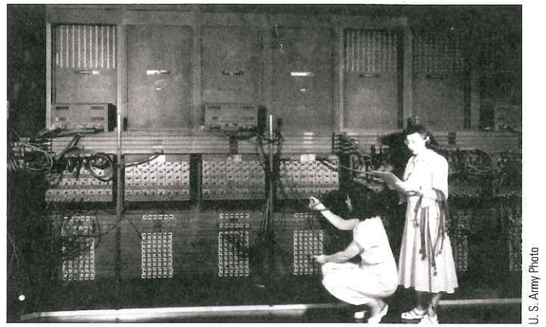


© Andersen Ross/Getty Images

FIGURE 1–1 Students doing online research

A Brief History of the Computer

Computers have been around for more than 60 years. The first computers were developed in the late 1940s and early 1950s. They were massive, special-purpose machines with names like UNIVAC and ENIAC and were designed initially for use by the military and government. These early computers had less processing power than today's iPhone, occupied small buildings or entire city blocks, and cost millions of dollars. Computers in the mid-1950s through early 1970s were somewhat smaller and more powerful, but still were limited in what they could do. They remained expensive, so only major companies and government organizations could afford these systems. See **Figure 1–2**.



U.S. Army Photo

FIGURE 1–2 Early computers

In 1971, Dr. Ted Hoff developed the microprocessor. It took visionaries such as Steve Jobs and Steve Wozniak to see a future for the microprocessor and its application to personal computers. Jobs and Wozniak built the first Apple computer in 1976. Shortly thereafter, a second version, the Apple II, was released. It became an immediate success, especially in schools. In 1980, Bill Gates worked with IBM to develop the disk operating system (DOS) for the IBM PC. This computer, introduced in 1981, quickly became the PC of choice for businesses. See **Figure 1–3**.

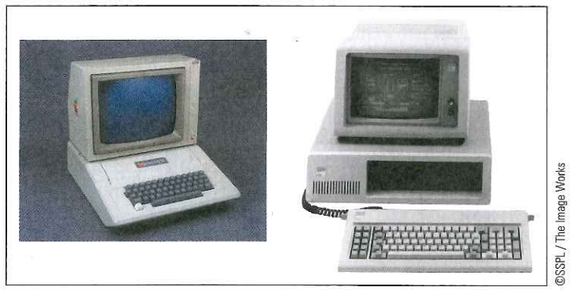


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FIGURE 1–3 The Apple II and IBM PC

ABOVE AND BEYOND

The first IBM PC ran on a 4.77 MHz Intel 8088 microprocessor. The PC came equipped with 16 kilobytes (KB) of memory, expandable to 256 KB. The PC came with one or two 160 KB floppy disk drives and an optional color monitor.

1-1.1.1

Defining Computers and Computer Systems

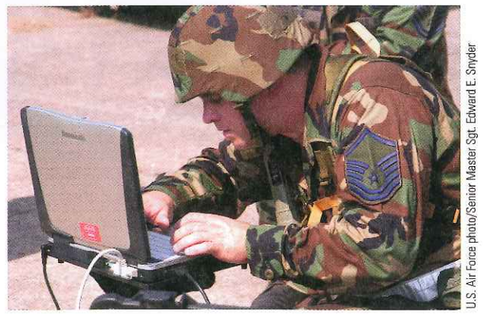
Throughout a normal workday, millions of people interact globally with computers and other digital devices, often without even knowing it. Doctors, lawyers, warehouse workers, store clerks, homemakers, teachers, musicians, and students—to name a few examples—constantly depend on computers to perform part of their daily duties.

So, what exactly is a computer? What does it really do? A ***computer*** is an electronic device that receives data (input), processes data, stores data, and produces a result (output).

A ***computer system*** includes hardware, software, data, and people. The actual machine—wires, transistors, and circuits—is called ***hardware***. Peripheral devices such as printers and monitors also are types of hardware. ***Software*** consists of instructions or programs for controlling the computer. ***Data*** is text, numbers, sound, images, or video. The computer receives data through an input device, processes the data, produces output (or ***information***), and stores the data and information on a storage device. The users, the people who use computers, are also part of the system. See **Figure 1–4**.

VOCABULARY

computer
computer system
hardware
software
data
information



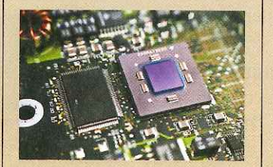
U.S. Air Force photo/Senior Master Sgt. Edward E. Snyder

FIGURE 1–4 Using a mobile computer to process data into information

Consider how a store clerk might use a computer system to complete a sale for a customer who has an account at the store:

- *Inputs data*: The store clerk enters the customer's name and scans the barcode of an item into the computer through input devices, such as a keyboard and digital scanner.
- *Processes data*: The computer uses stored instructions to process the data into information.
- *Outputs information*: An output device, such as a monitor or a printer, displays the information.
- *Stores data and information*: The data and information are stored in temporary memory and then on a permanent storage device, such as a hard drive.

This series of steps—input, processing, output, and storage (IPOS)—is often referred to as the information processing cycle. See **Figure 1–5**.

Inputs data	Processes data	Outputs information	Stores data and information
Emmet Bender 20 East Street Tampa, Florida 33222	 (a)	 (b)	 (c)

(a) © Thomas Staiger/Shutterstock.com / (c) © Studio Foxy/Shutterstock.com

FIGURE 1–5 Information processing cycle

ABOVE AND BEYOND

Deep Blue was a chess-playing computer developed by IBM. On May 11, 1997, the machine won a six-game match by two wins to one with three draws against world champion Garry Kasparov.

This brief overview of a computer and the tasks you can accomplish with it might make the computer seem very complicated. A computer, however, performs only two operations:

- Arithmetic computations such as addition, subtraction, multiplication, and division, and comparisons such as greater than, less than, or equal to
- Logical operations using logical operators, such as AND, OR, and NOT

Classifying Computers

1-1.1.1

Computers today come in all shapes and sizes, with specific types being especially suited for specific tasks. Computers are classified as either special purpose or general purpose. ***Special-purpose computers*** are used mostly to control something else. Tiny chips are embedded in devices, such as a dishwasher, bathroom scale, or airport radar system, and these chips control these particular devices.

General-purpose computers are divided into categories based on their physical size, function, cost, and performance:

- ***Desktop computers*** and ***notebook computers*** (also called ***laptop computers***) are today's most widely used ***personal computers (PCs)***, which are computers designed for one person to use at a time. Most desktop computers are designed so that all components fit on or under a desk. The all-in-one desktop computer is a single-unit desktop. Two popular types of personal computers are the PC (based on the original IBM personal computer design) and the Apple Macintosh. Notebook computers are small personal computers that include a built-in monitor and keyboard. They are designed to be carried from one location to another.
- A ***server*** generally is used by small to medium-size companies and can support a few users or hundreds of users. Most servers are referred to as network servers or application servers. A computer that delivers Web pages to browsers and other files to applications via the HTTP protocol is considered a ***Web server***. A ***database server*** stores databases and database management systems. A ***file server*** stores remote programs and data files that are shared by a set of designated users.
- ***Mobile devices*** generally can fit into the palm of your hand. Examples of mobile devices (or handheld devices) are calculators, smart phones and other cell phones, electronic organizers, handheld games, and other similar tools. Many mobile devices can connect wirelessly to the Internet.
- A ***tablet PC*** is a personal computer similar in size and thickness to a notepad. You can take notes using a stylus or digital pen on a touch screen. This device functions as your primary personal computer as well as a note-taking device.

VOCABULARY

special-purpose computer
desktop computer
notebook computer
laptop computer
personal computer (PC)
server
Web server
database server
file server
mobile device
tablet PC

VOCABULARY

mainframe computer

supercomputer

embedded computer

ABOVE AND BEYOND

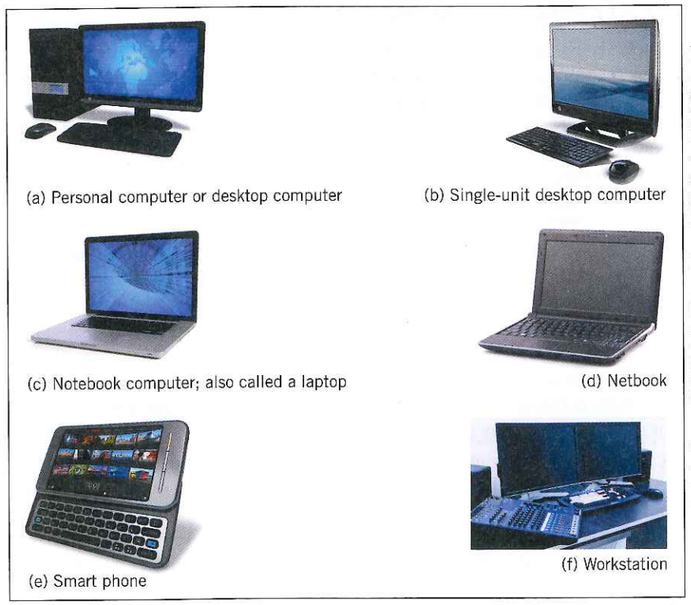
Supercomputers are often used to conduct and test medical experiments.

- The modern ***mainframe computer*** is a large, expensive computer capable of supporting hundreds or even thousands of users. This type of computer is much bigger than personal computers. Large companies use these to perform processing tasks for many users.
- A ***supercomputer*** is the fastest type of computer. Government agencies and large corporations use these computers for specialized applications to process enormous amounts of data. The cost of a supercomputer can be as much as several million dollars.

Other types of computer devices include the following:

- ***Embedded computers*** perform specific tasks and can be found in a range of devices such as digital watches, traffic lights, automobiles, household appliances, and system controllers for high end medical equipment.
- *Portable music and media players* are usually smaller than a deck of cards. They can store and play back music and video. Examples are MP3 players and portable DVD players.

Today's small personal and handheld computers are more powerful than the mainframes and supercomputers of yesteryear. **Figure 1–6** shows examples of different types of computers.



(a) Personal computer or desktop computer

(b) Single-unit desktop computer

(c) Notebook computer; also called a laptop

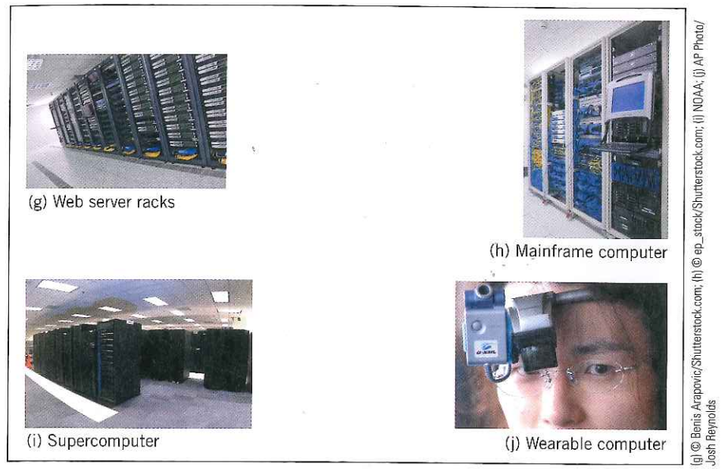
(d) Netbook

(e) Smart phone

(f) Workstation

(a) Courtesy of Hewlett-Packard Company; (b) © Oleksiy Mark/Shutterstock.com; (c) © R. Gino Santa Maria/Shutterstock.com; (d) © Andrew Buckin/Shutterstock.com; (e) © Oleksiy Mark/Shutterstock.com; (f) © Mihai Simonia/Shutterstock.com

FIGURE 1–6 Types of computers



(g) Web server racks

(h) Mainframe computer

(i) Supercomputer

(j) Wearable computer

(g) © Denis Arapovic/Shutterstock.com; (h) © ep_stock/Shutterstock.com; (i) NOAA; (j) AP Photo/Josh Reynolds

FIGURE 1–6 Types of computers (continued)

Other computer devices include the following:

- *Calculators* are used for performing mathematical calculations.
- *Computer game systems* are specialized computers used to play games. Some of the more popular are the Sony PlayStation, Nintendo Wii, and Microsoft Xbox.

- *Electronic book readers* enable you to read an electronic version of a traditional print book (see **Figure 1–7**).

© iQoncept/Shutterstock.com

FIGURE 1–7 Electronic book reader

IC3 1-1.1.2

Using Computer Systems

Computers are used for all kinds of tasks—to predict weather, fly airplanes, control traffic lights, play games, access the Internet, send e-mail, and so on. You might wonder how a machine can do so many things.

To appreciate how a computer operates requires knowledge of calculus, probability, and statistics—all of which are needed to understand physics and circuit analysis. Most of us, however, do not need this level of comprehension. Instead, we need only a fundamental understanding. Just about all computers, regardless of size, take raw data and change it into information. Recall that computers follow the IPOS procedure—input, processing, output, and storage. For example:

- You enter programs and data with some type of input device.
- The computer uses instructions to process the data and to turn it into information.
- You send the information to some type of output device.
- You store it for later retrieval.

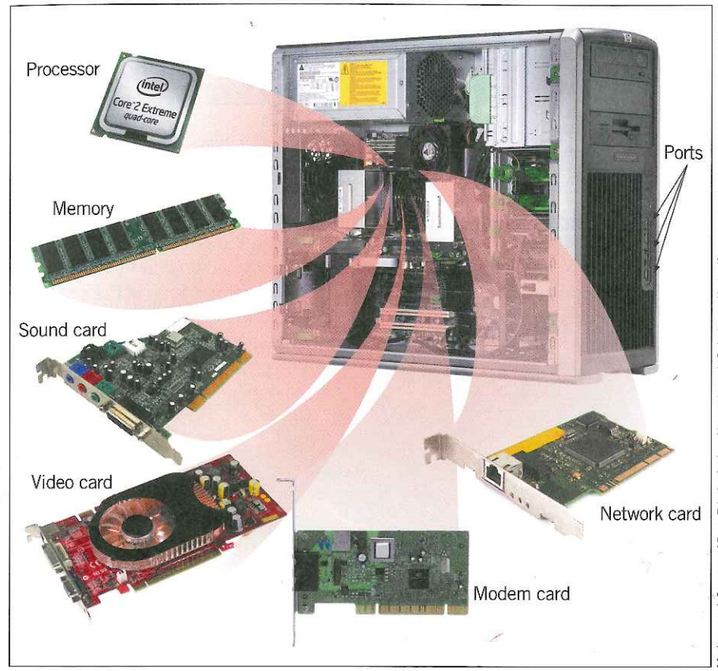
TECHNOLOGY CAREERS

Computers on the Job

In the past few decades, computers have had dramatic effects on how we live, learn, and work. For example, the kinds of jobs available have changed because of computers. Fifty years ago, only a handful of people were computer programmers, and none were Web designers or software entrepreneurs. Today, nearly all jobs require some computer skills.

Time-consuming, labor-intensive communication tasks that used to require face-to-face meetings, telephone calls, overnight deliveries, or paging through printed materials are now performed quickly and efficiently using Internet browsers and e-mail. Students can participate in distance-learning classes to take courses not available where they live. Even the electric-meter reader and delivery person now carry handheld computers that track a consumer's electricity use or the location of a package. Cashiers use computers for retail sales, and managers use them to update the store's inventory, handle customer calls, and advertise products. All of these advances, now taken for granted by many of us, are recent innovations.

Input, output, and processing devices grouped together represent a computer system. The components that the computer uses to process data are contained within the system case. **Figure 1–8** shows many of these components.



Modem card: Courtesy of Zoom Telephonics Inc.; Network card: © Jouke van Keulen/Shutterstock.com; Sound card: © Sergei Devyatkin/Shutterstock.com; Video card: © Jim Guy/Shutterstock.com

FIGURE 1–8 Computer system components

1-1.1.2
1-1.1.3

Identifying System Components

VOCABULARY
motherboard
circuit board
central processing unit (CPU)

The PC system case is the metal and plastic case that houses the main system components of the computer. Central to all of this is the ***motherboard***, or system board, that mounts into the case. The motherboard is a circuit board that contains many integral components. A ***circuit board*** is simply a thin plate or board that contains electronic components. See **Figure 1–9**. The following are some of the most important of these components:

- Central processing unit
- Memory
- Connectors
- Expansion ports and expansion slots

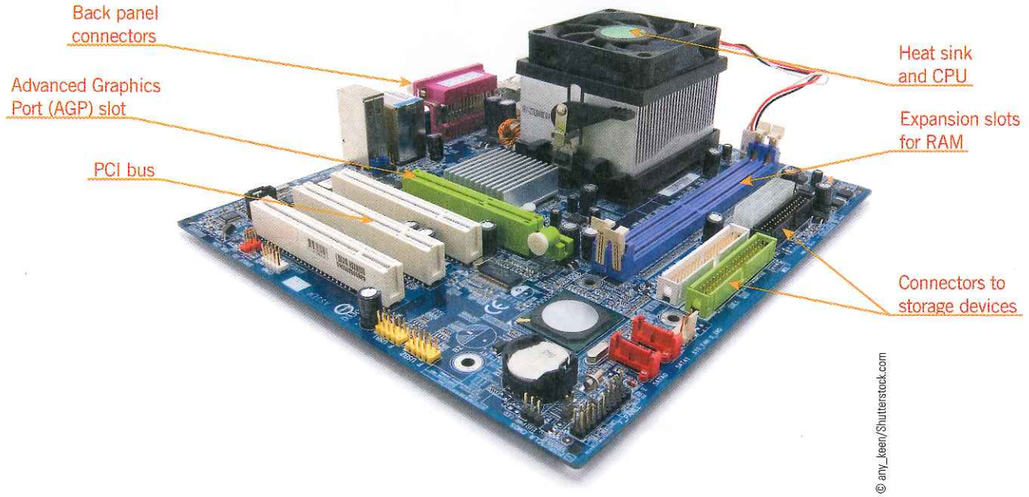


FIGURE 1–9 Motherboard

The Central Processing Unit

The ***central processing unit (CPU)***, also called the microprocessor or central processor, is the brains of the computer. The processor is housed on a tiny silicon chip similar to that shown in **Figure 1–10**. This chip contains millions of switches and pathways that help your computer make important decisions. The switches control the flow of the electricity as it travels across the pathways. The processor knows which switches to turn on and which to turn off because it receives its instructions from computer programs. Programs are a set of special instructions, written by programmers, which control the activities of the computer. Programs also are known as software.

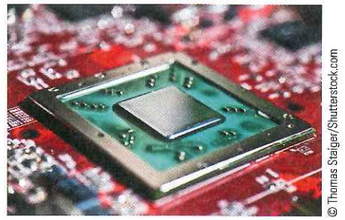


FIGURE 1–10 Microprocessor

VOCABULARY
dual-core processor
multicore processor
arithmetic/logic unit (ALU)
control unit
binary code

Some chip manufacturers now offer dual-core and multicore processors. A ***dual-core processor*** is a single chip that contains two separate processors, and a ***multicore processor*** is an expansion that provides for more than two separate processors. These processors do not necessarily double the processing speed of a single-core processor, but do provide increased performance when running multiple programs simultaneously. Microprocessor speed generally is measured in gigahertz (GHz). Speeds for current microprocessors are in the 2 GHz to 4 GHz range.

The CPU has two primary sections: the arithmetic/logic unit and the control unit.

The Arithmetic/Logic Unit

The ***arithmetic/logic unit (ALU)*** performs arithmetic computations and logical operations. The arithmetic computations include addition, subtraction, multiplication, and division. The logical operations involve comparisons—asking the computer to determine if two numbers are equal or if one number is greater than or less than another number. These might seem like simple operations. However, by combining these operations, the ALU can execute complex tasks. For example, a video game uses arithmetic operations and comparisons to determine what appears on your screen.

The Control Unit

The ***control unit*** is the boss, so to speak, and coordinates all of the processor's activities. Using programming instructions, it manages the flow of information through the processor by controlling what happens inside the processor.

You communicate with the computer through programming languages. You might have heard of programming languages called Java, COBOL, C++, or Visual Basic. These are just a few of the many languages you can use to give instructions to a computer. For example, you might have a programming statement such as *Let X = 2 + 8*. With this statement, you are using a programming language to ask the computer to add the numbers 2 and 8 and assign the calculated value to *X*. However, when you input this instruction, something else has to happen. The computer does not understand human language. It understands only machine language, or ***binary code***, which contains only 1s and 0s. This is where the control unit takes over.

Recognizing How a Computer Represents Data

The control unit reads and interprets the program instruction and changes the instruction into machine language. Earlier, this chapter discussed the processor and its pathways and switches. As electricity travels through processor pathways, it turns switches on and off, which represents the 1s and 0s. When electricity is present, it represents a 1. The absence of electricity represents a 0. After changing the instructions into machine language (binary), the control unit then sends out the necessary messages to execute the instructions. A single zero or a single one is called a ***bit***, which is the smallest unit of information storage. Eight bits are equal to one byte. A ***byte*** is a single character, such as a letter or number. See **Table 1–1** for a list of measurement terms. As a comparison, 1 gigabyte (GB) of data is equivalent to about 450 digital songs.

VOCABULARY

bit

byte

QUICK TIP

The Step-by-Step exercises in this book are written for a personal or notebook computer with the Windows 7 operating system. The windows and desktop for earlier versions of Windows are similar. Please make appropriate adjustments if you are using a different Windows version or are working on a network.

TABLE 1–1 Measurement terms

TERM	ABBREVIATION	NUMBER OF BYTES
Kilobyte	K or KB	1024 (approximately 1,000)
Megabyte	MB	1,048,576 (approximately 1 million)
Gigabyte	GB	1,073,741,824 (approximately 1 billion)
Terabyte	TB	1,099,511,627,776 (approximately 1 trillion)

To view an example of a binary number and perform other calculations, use your computer's calculator to complete Step-by-Step 1.1.

Step-by-Step 1.1

1. Click the **Start** button on the taskbar, point to **All Programs**, click **Accessories**, and then click **Calculator**. The Standard calculator is displayed (see **Figure 1–11**).

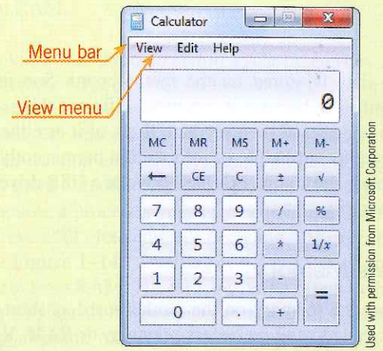


FIGURE 1–11
Windows Standard calculator

2. Click **View** on the menu bar and then click **Scientific** to display the Scientific calculator. Click **View** on the menu bar and then click **Programmer** to display the Programmer calculator.
3. If necessary, click the **Dec** (decimal) option button. Enter **30** by clicking the calculator numeric buttons. Click the **Bin** (binary) option button to calculate the binary equivalent of 30: 11110.
4. Click the **Dec** option button and convert **1112** to binary. The number 10001011000 is displayed.
5. Click **View** on the menu bar and then click **Date calculation** (see **Figure 1–12**). The dates on your calculator might differ.

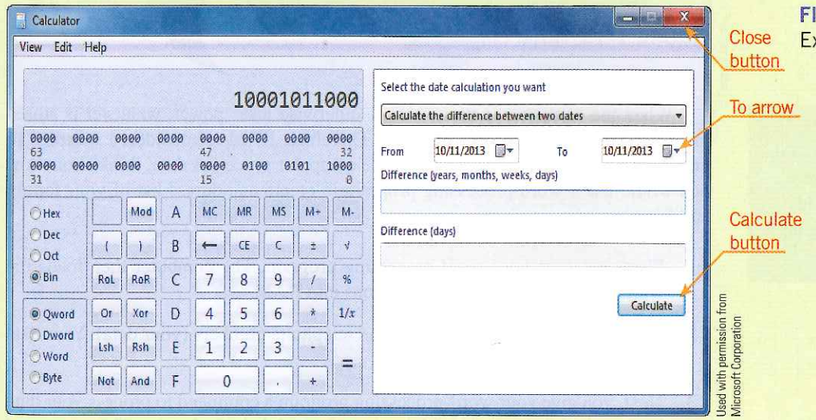


FIGURE 1–12
Expanded calculator

6. Click the **To** arrow and then select the date of your next birthday.

7. Click the **Calculate** button.
8. What is the difference in months and weeks? What is the difference in days?
9. Click the **Close** button to close the Windows Calculator.

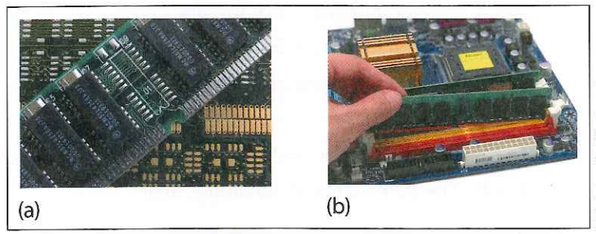
Memory

VOCABULARY
memory
random access memory
RAM

Memory is where data is stored on the motherboard. Sometimes understanding memory can be confusing because it can mean different things to different people. The easiest way to understand memory is to think of it as either short term or long term. When you want to store a file or information permanently, you use secondary storage devices such as the computer's hard drive or a USB drive. You might think of this as long term memory.

Random Access Memory

You can think about the memory on the motherboard as short term memory. This type of memory is called ***random access memory***, or ***RAM***. RAM is also referred to as main memory and primary memory. You might have heard someone ask, "How much memory is in your computer?" Most likely, they are asking how much RAM is in your computer. The computer can read from and write to this type of memory. Data, information, and program instructions are stored temporarily within the CPU on a RAM chip or a set of RAM chips, such as those shown in **Figure 1–13**.



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(b) © Norman Chan/Shutterstock.com

FIGURE 1–13 RAM chips

QUICK TIP

Can't afford that new computer, but need more speed? Try adding more RAM or purchasing an optimizer software program.

When the computer is turned off or otherwise loses power, whatever is stored in the RAM memory chips disappears. Therefore, RAM is considered volatile. To understand how RAM works and how the computer processes data, think about how you would use a word-processing program to create an address list of your family and friends:

1. First, you start your word-processing program. The computer then loads the word-processing program instructions into RAM.
2. You input the names, addresses, and telephone numbers (your data). Your data is also stored in RAM.
3. Next, you give your word-processing program a command to process your data by arranging it in a special format, such as alphabetical order. This command and your processed data, or information, now also are stored in RAM.

4. You then click the Print button. Instructions to print are transmitted to RAM, and your document is sent to your printer.
5. Next, you click the Save button. Instructions to provide you with an opportunity to name and save your file are loaded into RAM. The information is now stored in permanent memory at the saved location. After you save your file, you exit your word-processing program and turn off the computer.
6. All instructions, data, and information that you used to create your address list are erased from RAM.

This process is known as the ***instruction cycle*** or ***I-cycle,*** and the ***execution cycle*** or ***E-cycle***. When the CPU receives an instruction to perform a specified task, the instruction cycle is the amount of time it takes to retrieve the instruction and complete the command. The execution cycle refers to the amount of time it takes the CPU to execute the instruction and store the results in RAM. Together, the instruction cycle and one or more execution cycles create a ***machine cycle***.

For every instruction, a processor repeats a set of four basic operations, which compose a machine cycle: (1) fetching, (2) decoding, (3) executing, and, if necessary, (4) storing (see **Figure 1–14**). ***Fetching*** is the process of obtaining a program instruction or data item from RAM. The term ***decoding*** refers to the process of translating the instruction into signals the computer can execute. ***Executing*** is the process of carrying out the commands. ***Storing***, in this context, means writing the result to memory (not to a storage medium).

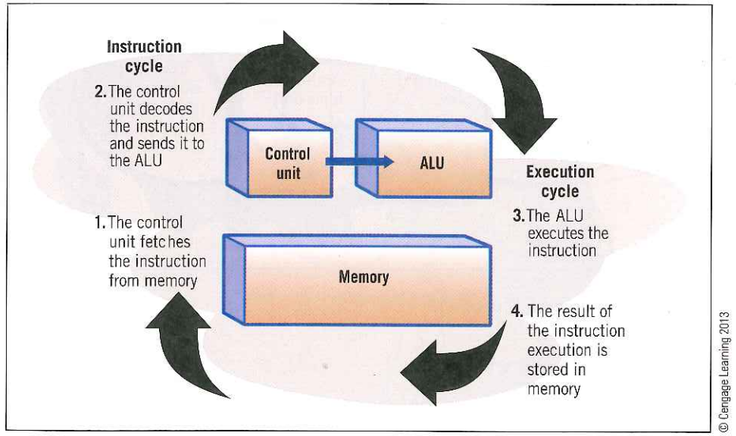

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FIGURE 1–14 Processing cycle

ABOVE AND BEYOND

Cache memory is another type of memory. This high-speed RAM is used to increase the speed of the processing cycle.

VOCABULARY
instruction cycle
I-cycle
execution cycle
E-cycle
machine cycle
fetching
decoding
executing
storing

ABOVE AND BEYOND

If you read computer ads, you are likely to see the abbreviations MHz (megahertz) and GHz (gigahertz). These speed specifications indicate the speed of the microprocessor clock—a timing device that specifies the speed for executing instructions.

Machine cycles are measured in microseconds (millionths of a second), nanoseconds (billionths of a second), and even picoseconds (trillionths of a second) in some of the larger computers. The faster the machine cycle, the faster your computer processes data. The speed of the processor has a lot to do with the speed of the machine cycle. However, the amount of RAM in your computer can also help increase the speed with which the computer processes data. The more RAM you have, the faster the computer processes data. See **Figure 1–15**.

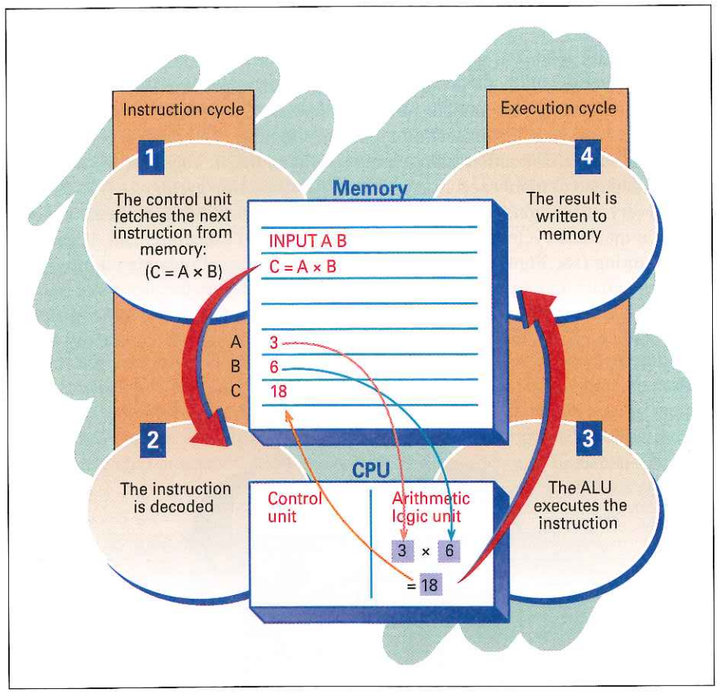


FIGURE 1–15 Machine cycle

ABOVE AND BEYOND

In the time it takes to blink your eyes, certain computers can perform certain operations 10 billion times.

Read-Only Memory

VOCABULARY
read-only memory
ROM
BIOS ROM

Another type of memory you will find on the motherboard is ***read-only memory***, or ***ROM***, which is permanent storage of data, usually burned onto chips. ROM chips are found throughout a computer system. The computer manufacturer uses a ROM chip to store specific instructions that are needed for computer operations. Because ROM is nonvolatile, these instructions remain on the chip even when the power is turned off. A common ROM chip is the ***BIOS ROM***. The computer uses instructions contained on the BIOS ROM chip to start the system when you turn on your computer. A computer can read from a ROM chip, but cannot write or store data on the chip.

IC3 1-1.1.4

Identifying Types of Storage Devices

As data is entered in the computer and processed, it is stored in RAM (temporary memory). If you want to keep a permanent copy of the data, you must store it on some type of storage medium. Storage devices are categorized by the method they use to store data. The categories include magnetic technology, optical technology, and solid-state storage.

Magnetic Storage Devices

Magnetic storage devices contain oxide-coated polyester film, usually in the shape of a disk, that has been magnetized to hold data. As the disk rotates in the computer, an electromagnetic read/write head stores or retrieves data in circles called ***tracks***. The number of tracks on a disk varies with the type of disk. The tracks are numbered from the outside to the inside. As data is stored on the disk, it is stored on a numbered track. Each track is labeled and the location is kept in a special log on the disk called a ***file allocation table (FAT)***. Types of magnetic storage media include hard disks, magnetic tape, 3½-inch disks, and Zip disks.

VOCABULARY
track
file allocation table (FAT)
hard disk

Hard Disks

Most ***hard disks*** (also called hard drives) are used to store data inside the computer, although external (removable) hard disks are also available. Internal hard disks provide two advantages: speed and capacity. Accessing data is faster, and the amount of data that can be stored is much larger than what can be stored on other types of magnetic storage devices. The size of the hard disk is measured in gigabytes or terabytes and can contain several platters (see **Figure 1–16**).

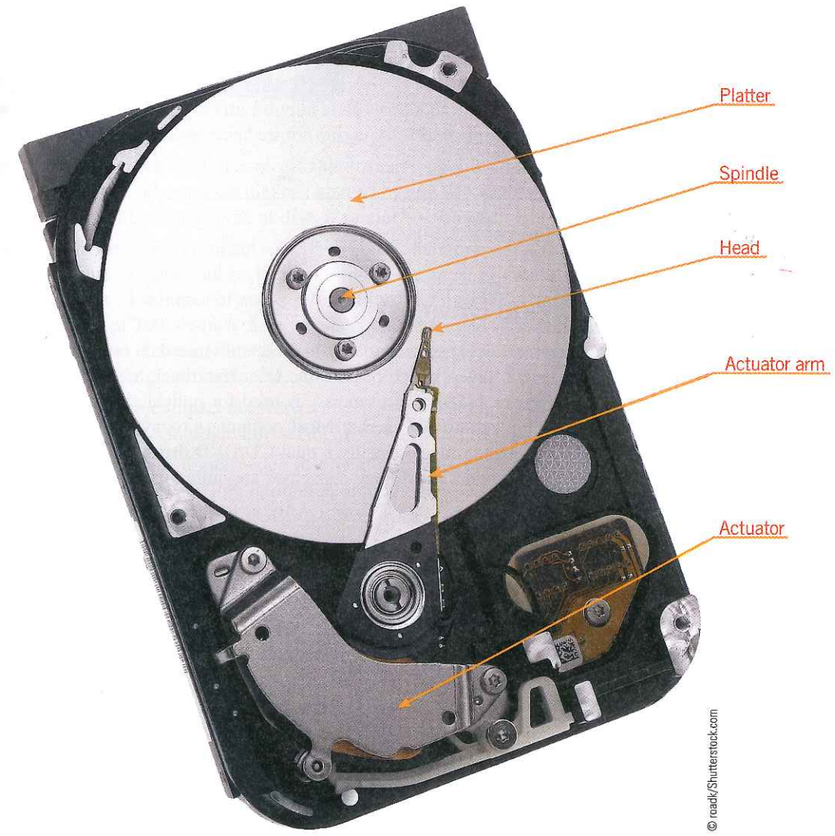


FIGURE 1–16 Hard disk

Removable Disks

Removable disks are designed to be removed from the computer without turning off the power. Removable magnetic media are rarely used and include 3½-inch disks and Zip disks. A 3½-inch disk, usually just called a disk, is a flat circle of iron oxide-coated plastic enclosed in a hard plastic case. Although the 3½-inch is the most common size, you might see other sizes. A 3½-inch disk can hold about 1.44 megabytes (MB) of data, or around 690 characters (see **Figure 1–17**). To protect unwanted data from being added to or removed from a disk, write protection is provided. To write-protect a disk, open the write protect window on the disk. A Zip drive looks like a thicker 3½-inch disk but requires a special drive and can hold 100–750 MB of data. Both types of removable magnetic media are practically obsolete since the introduction of USB drives and solid-state storage media, which can store thousands of times more data.

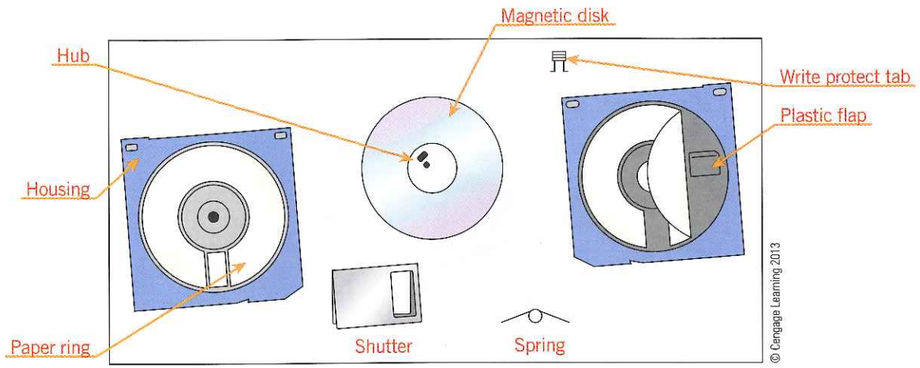


FIGURE 1–17 Parts of a 3½-inch disk

Optical Storage Devices

VOCABULARY
optical storage device

Optical storage devices use laser technology to read and write data on plastic platters that contain a metal layer, which reflects the laser light back to a sensor in an optical drive (see **Figure 1–18**). The term *disc* is used for optical media. CDs and DVDs are types of optical storage media. Most computers today come equipped with some type of optical storage—usually a dual CD/DVD drive. The technology for CDs and DVDs is similar, but storage capacities are quite different, and several variations exist.

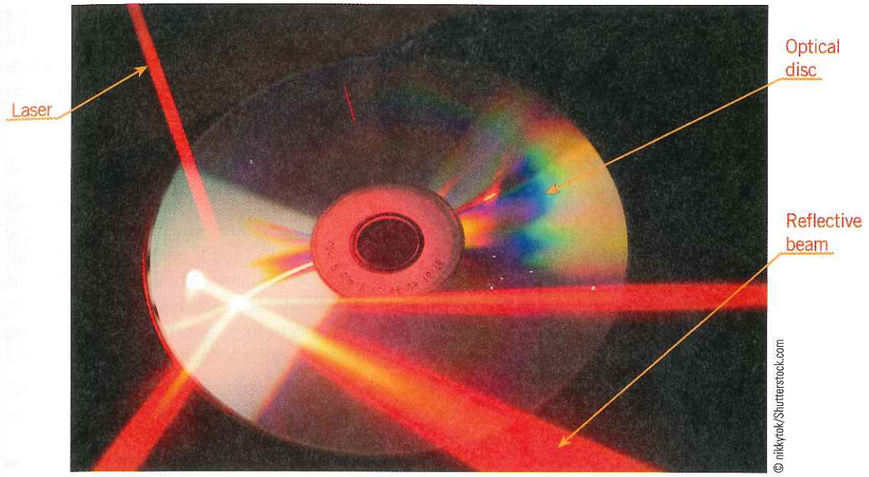


FIGURE 1–18 Laser reads data on a CD or DVD

These storage devices come in the formats listed below:

- *CD-DA*: The compact disc digital audio format is also known as an audio CD; it is the industry-wide standard for music publishing and distribution.
- *CD-R*: The compact disc-recordable format makes it possible for you to create your own compact discs that can be read by any CD-ROM drive. After information is written to this type of disc, it cannot be changed.
- *CD-ROM*: The compact disc read-only memory format can store large amounts of data—up to 1 GB, although the most common size is 650 MB, or about 74 minutes of audio information. A single CD-ROM has the storage capacity of 700 3½-inch disks with enough memory to store about 300,000+ text pages. You can read data from the CD; you cannot store data on a CD unless you are using a writable CD.
- *CD-RW*: The compact disc-rewritable is a type of compact disc that enables you to write onto it multiple times. Not all CD players can read CD-RWs.
- *DVD-ROM*: The digital video disc read-only memory is a read-only DVD format commonly used for distribution of movies and computer games; its capacity ranges from 4.7 GB to 17 GB.
- *DVD-R*: The digital video disc-recordable is similar to the CD-R except it has a much larger capacity; after information is written to this type of disc, it cannot be changed.
- *DVD-RW*: The digital video disc-rewritable stores data using technology similar to that of a CD-RW, but with a much larger capacity.
- *Blu-ray*: Also known as Blu-ray discs (BD), these discs provide more than five times the storage capacity of traditional DVDs. A single-layer disc can hold up to 25 GB, and a dual-layer disc can hold up to 50 GB. This format was developed for storing large amounts of data and to enable recording and playback of high-definition video.

ABOVE AND BEYOND

Blu-ray optical discs use a blue-violet laser to read and write data, unlike earlier optical discs such as DVDs, which use a red laser. Although they use different lasers, Blu-ray products can be backwards compatible with CDs and DVDs.

VOCABULARY

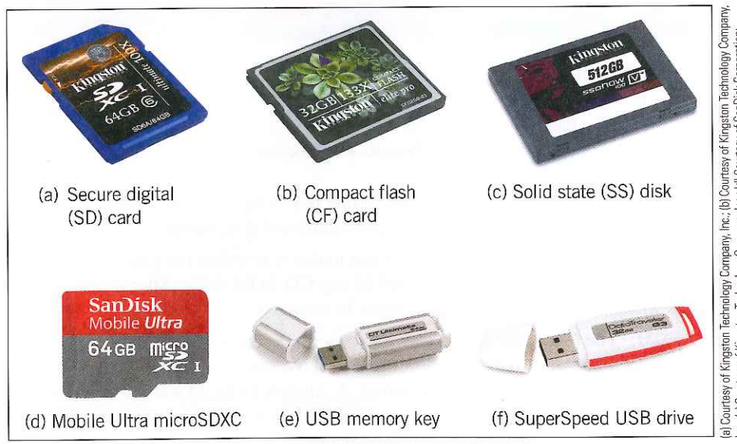
solid-state storage

USB flash drive

The color of a CD/DVD indicates its quality. It is best to look for a gold or silver CD/DVD. When viewing the color, look at it from the underside of the disk and not from the top. The shelf-life of a CD/DVD is cited as approximately 2 to 25 years or longer. The quality of the storage media and the storage environment affects the shelf life.

Solid-State Storage Media

Solid-state storage, also referred to as removal media, is a nonvolatile, removable medium that uses integrated circuits. The main advantage of this type of storage medium is that everything is processed electronically, and it contains no mechanical parts. Several types of solid-state storage are available. Miniature mobile storage media, for example, are popular solid-state storage devices for cameras, smart phones, music players, and other such electronics. **Figure 1–19** contains an assortment of miniature mobile storage media, most of which are no larger than a matchbook.



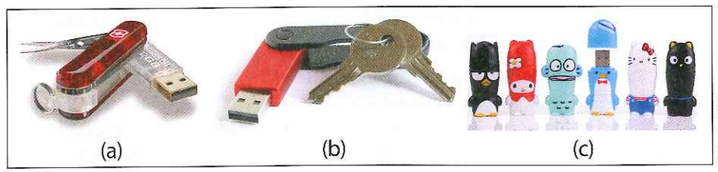
(a) Secure digital (SD) card (b) Compact flash (CF) card (c) Solid state (SS) disk

(d) Mobile Ultra microSDXC (e) USB memory key (f) SuperSpeed USB drive

(a) Courtesy of Kingston Technology Company, Inc.; (b) Courtesy of Kingston Technology Company, Inc.; (c) Courtesy of Kingston Technology Company, Inc.; (d) Courtesy of SanDisk Corporation; (e) Courtesy of OCZ Technology Group; (f) Courtesy of Kingston Technology Company, Inc.

FIGURE 1–19 Miniature mobile storage media

Another popular solid-state storage medium is the ***USB flash drive***. This small removable data storage device comes in a variety of configurations, such as those shown in **Figure 1–20**. It uses a USB connector to connect to your computer's USB port or other electronic device. Flash drives are also known by other names such as a key drive, thumb drive, jump drive, USB flash memory drive, and USB stick.



(a) (b) (c)

(a) Handout/KRT; (b) © TakeStockPhotography/Shutterstock.com; © MCT/Newscom

FIGURE 1–20 Examples of USB flash drives

Network Drives

A ***network drive*** can be a hard drive or a tape drive located on a computer other than the user's local system. It is connected to a network server and is available to and shared by multiple users.

Remote storage is used to extend disk space on a server and to eliminate the addition of more hard disks or other storage devices. When the amount of available space on the server falls below a designated level, the remote storage process frees up disk space by moving excess content to an attached storage device. Doing this frees up additional disk space on the specified server. The storage device could be on the same network, a separate network, or on the Internet.

VOCABULARY

network drive

remote storage

Caring for Storage Media

Removable storage media require special care if the stored data is to remain undamaged. Here are some safeguards that should be taken:

- Keep away from magnetic fields such as those contained in televisions and computer monitors (magnetic media).
- Avoid extreme temperatures.
- Remove media from drives and store them properly when not in use.
- When handling DVDs and other optical discs, hold them at the edges.
- Never try to remove the media from a drive when the drive indicator light is on.
- Keep discs in a sturdy case when transporting.

Exploring Computers in Your Future

Computers of the future will be more powerful and less expensive than contemporary computers. It is also fair to assume that almost every type of job will somehow involve a computer. With long-distance connectivity, more people will work full-time or part-time from home. See **Figure 1–21**.

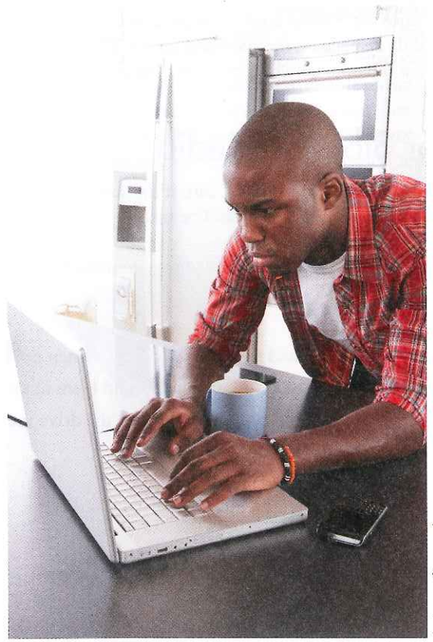

© oliveromg/Shutterstock.com

FIGURE 1–21 Working from home

A major focus of new types of computers is connectivity, or the ability to connect with other computers. Wireless and mobile devices are now as common as wired desktop machines. Computer literacy, which is the knowledge and understanding of computers and their uses, will become even more important.

SUMMARY

In this lesson, you learned:

- A computer is an electronic device that receives data, processes data, produces information, and stores the data and information.
- A computer derives its power from its speed, reliability, accuracy, storage, and communications capability.
- Computer classifications include personal computers (desktop and notebook), mobile devices, servers, mainframes, and supercomputers.
- Almost all computers perform the same general functions: input, processing, output, and storage. Input, output, and processing devices grouped together represent a computer system.
- The machine cycle is made up of the instruction cycle and the execution cycle.
- The motherboard is the center of all processing. It contains the central processing unit (CPU), memory, and basic controllers for the system. It also contains ports and expansion slots.
- The motherboard contains different types of memory. Random access memory (RAM) is volatile and is used to store instructions, data, and information temporarily. Read-only memory (ROM) is nonvolatile and is used to store permanent instructions needed for computer operations.
- The CPU is the brains of the computer. The CPU has two main sections—the arithmetic/logic unit (ALU) and the control unit. All calculations and comparisons take place in the ALU. The control unit coordinates the CPU activities.
- To maintain a permanent copy of data, you should store it on some type of storage medium. The three categories of storage media are magnetic storage, optical storage, and solid-state storage.

LESSON REVIEW

TRUE / FALSE

Circle T if the statement is true or F if the statement is false.

T F **1.** ROM chips are found throughout a computer system.

T F **2.** When data is stored on a disk, it is stored in circles called tracks.

T F **3.** The faster the machine cycle, the faster your computer processes data.

T F **4.** A supercomputer is the slowest type of computer.

T F **5.** The two primary sections of the CPU are the arithmetic/logic unit and the control unit.

MULTIPLE CHOICE

Select the best response for the following statements.

1. A _____ consists of hardware, software, data, and users.
   A. client C. mobile device
   B. node D. computer system
2. A _____ is a personal computer you can use to take notes with a stylus or digital pen on a touch screen.
   A. mainframe computer C. tablet PC
   B. notebook computer D. mobile device
3. A computer system includes which of the following?
   A. hardware C. software
   B. data D. all of the above
4. Random access memory (RAM) is _____.
   A. permanent C. nonvolatile
   B. volatile D. the same as ROM
5. The main advantage of _____ storage media is that they process data electronically and contain no mechanical parts.
   A. optical storage C. 3½-inch
   B. solid-state D. input

FILL IN THE BLANK

1. The instruction cycle and the execution cycle create a(n) _____ cycle.
2. A computer manufacturer uses a(n) _____ chip to store specific instructions that are needed for computer operations.
3. You can think of RAM as _____-term memory.
4. The _____ unit coordinates all of the processor's activities.
5. Optical storage devices use _____ technology to read and write data.

PROJECTS

PROJECT 1–1

Access the Dell computer Web site at *www.dell.com*. Select the For Home, Laptops or the For Small and Medium Business, Laptops link. Using a spreadsheet program or paper and pencil, create a table that compares three computers. Include the following elements in your table: processor speed, amount of RAM, number of expansion slots, number of USB ports, other ports, and price. Based on your comparisons, write a short paragraph explaining which computer you would purchase and why.

PROJECT 1–2

IC³ 1-1.1.2

Using the Internet or other resources, research the history of computers. For the first part of this project, find the answers to the following questions: (1) What was the name of the first commercially available electronic digital computer? (2) In what year was the IBM PC first introduced? (3) What software sent Bill Gates on his way to becoming one of the richest men in the world? (4) In what year did Apple introduce the Macintosh computer? (5) What is the name of the first computer game invented? Use your word-processing program to answer each of these questions and provide some additional historical facts.

For the second part of this project, learn about the history of the central processing unit. Launch your Web browser and open the home page for Wikipedia at *www.wikipedia.org*. When the Web site is displayed, enter *CPU* as the search text. On the Central processing unit page, click the History link. Use a presentation program (such as Microsoft PowerPoint) to create a presentation on what you found at this Web site. Find related images and add them to your presentation. Share your presentation with your class.

PROJECT 1–3

Using Google or another search engine, find an image of a computer system with the case removed. Print a copy of the image or capture a screen shot and copy and paste it into a word-processing document. Examine the image and look for the motherboard and the components connected to the motherboard. Locate and identify the number of available expansion slots. Locate the RAM chips. See if you can find the CPU. Can you see the chip itself? What other elements are visible? Using Figure 1-9 as a guide, label each element you locate and provide a brief description of the elements.

TEAMWORK PROJECT

IC³ 1-1.1.1

Work as a team to gather and analyze research about how people use general-purpose computers. Briefly interview 10–20 people and identify the following information: (1) What types of computers does each person use? (2) What kinds of activities do they perform on each type of computer? Be sure your research covers at least four types of general-purpose computers.

To analyze the results, create a table or spreadsheet listing the types of computers your research identified. Next, use each type of computing activity as a column heading in the table, consolidating similar activities if possible. Enter the number of times each type of computer was used for each type of activity. Create a chart of the results.

CRITICAL THINKING

You are purchasing a new computer and have the option to include a variety of storage devices. Research the storage devices listed in this chapter. Then write a report listing each of the devices you would select for your computer and explain why you would select this particular device.

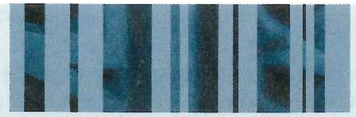
IC3 1-1.1.4

ONLINE DISCOVERY

Google has a feature that lets you search only blogs. This feature, called Blog Search, is located at *http://blogsearch.google.com*. Frequently Asked Questions about Blog Search can be found at *www.google.com/help/about_blogsearch.html*. Access Blog Search and search blogs for three of the following topics: CPUs, computer memory, optical discs, magnetic disks, types of computers, and the future of computers. Write a one-page report or create a three-slide presentation on what you learned. Google also has a Web site where you can start your own blog, located at *https://www.blogger.com*. Recruit two or three teammates and start a blog about your class activities.

JOB SKILLS

Computing jobs are often on the forefront of technology and include Web design, programming, hardware engineering, and software development. Learn about careers in the computer field. Visit a computing career Web site such as *computingcareers.acm.org*, *www.bls.gov/k12/computers.htm*, or *www.sciencebuddies.org/science-fair-projects/science_careers.shtml* (look for the Math and Computer Science section). Identify a job that interests you. Write a one-page report that includes the job title and describes the nature of the work, what types of skills you need to succeed in the job, and the types of organizations that hire people with those skills.



Estimated Time: 2 hours

LESSON 2

Input, Output, and Processing

OBJECTIVES

Upon completion of this domain, you should be able to:

- Identify and describe standard and specialized input devices.
- Identify and describe standard and specialized output devices.
- Connect input and output devices to a computer.
- Consider computer performance factors.

DATA FILES

You do not need data files to complete this lesson.

WORDS TO KNOW

audio input
biometrics
digital camera
expansion slot
FireWire
inkjet printer
input
keyboard
laser printer
modem
monitor
mouse
output
plug and play
pointing device
port
printer
scanner
trackball
Universal Serial Bus (USB)