

Computing Fundamentals Module

Lesson 21 — Computer Hardware

Computer Literacy BASICS



Objectives

- Identify computer system components.
- Explain how the CPU works.
- Differentiate between RAM and ROM.
- Describe how data is represented.

Objectives (cont.)

- Identify and describe the most common input devices.
- Identify and describe the most common output devices.
- Identify and describe storage devices.

Vocabulary

- American Standard Code for Information Interchange (ASCII)
- Bit
- Byte
- CD-ROM
- Central processing unit (CPU)
- Controller
- DVD
- Execution cycle (E-cycle)
- Hard disk drive

Vocabulary (cont.)

- Impact printers
- Input devices
- Instruction cycle (I-cycle)
- Keyboard
- Main memory
- Memory
- Motherboard
- Mouse
- Network drive
- Nonimpact printers

Vocabulary (cont.)

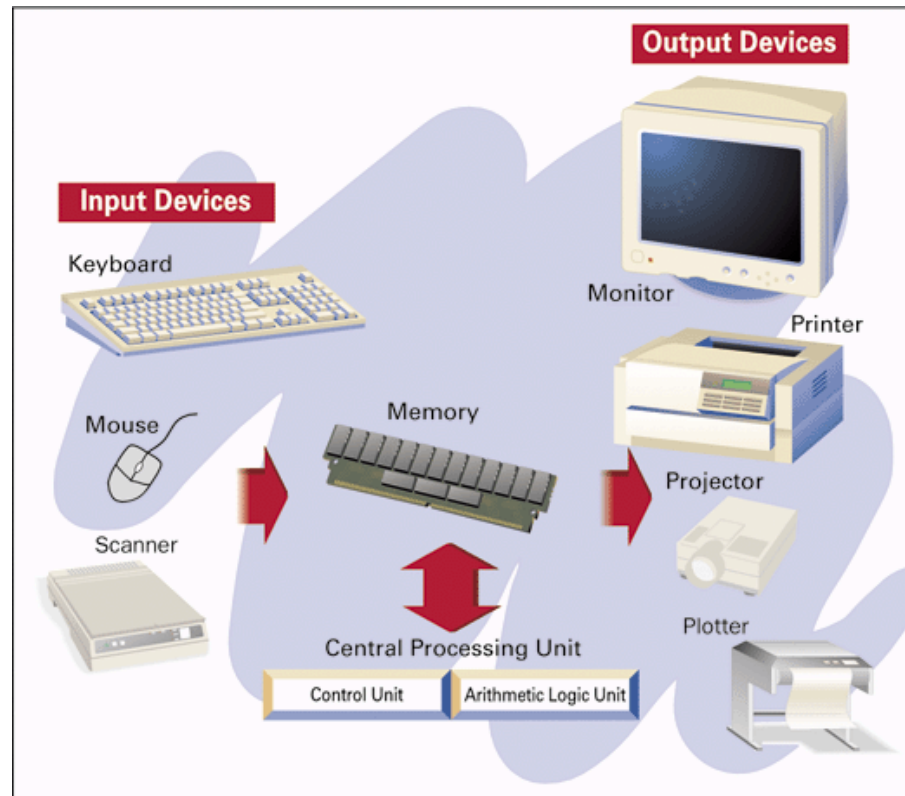
- Optical storage devices
- Output devices
- Plotter
- Pointer
- Random access memory (RAM)
- Read-only memory (ROM)
- Scanner
- System clock

System Components and IPOS

A computer system requires many components to do its job:

- **Input:** Some device or method to input data so it can be processed
- **Process:** Circuits and programs in order to process the data
- **Output:** Some type of output device to give the result of its processing to the user
- **Storage:** Some mechanism for storing data

System Components

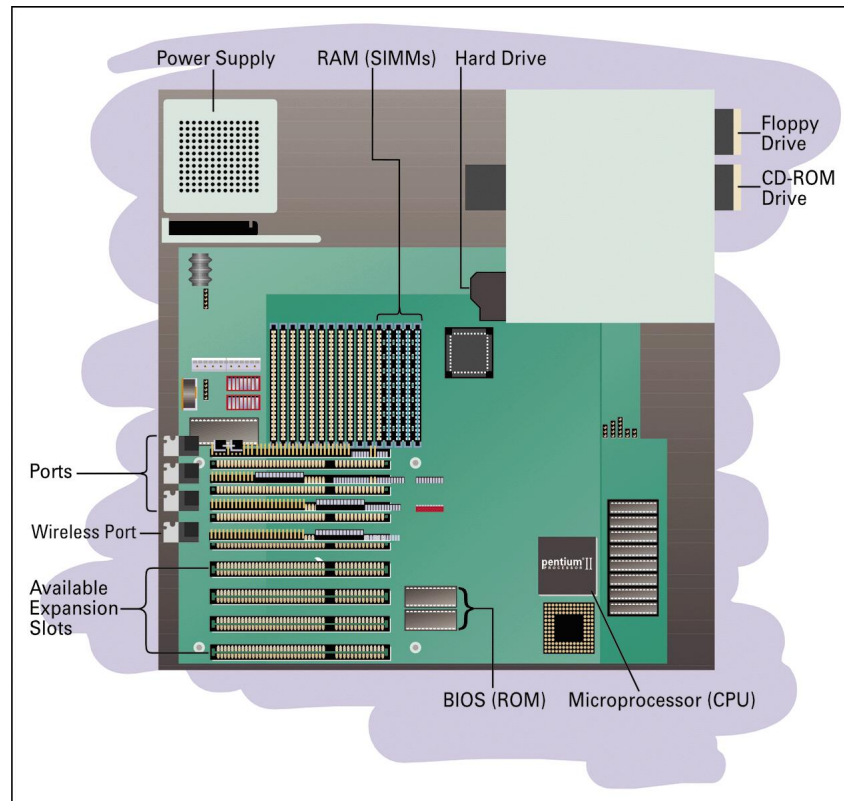


The Motherboard

The motherboard is a circuit board inside the microcomputer's plastic case. It contains integral components including

- The central processing unit or CPU
- Basic controllers
- Expansion ports and slots
- Memory

Diagram of a Simplified Motherboard



The Central Processing Unit

- The CPU is a tiny silicon chip that acts as the brains of a computer system.
- The chip contains switches and pathways that the CPU turns on and off according to instructions from computer programs.
- The system clock is an electronic pulse that controls the speed of the CPU. The rate of the pulse is measured in megahertz (MHz).

The Central Processing Unit (cont.)

The CPU has two primary sections:

- The Arithmetic/Logic Unit (ALU)
 - This section performs arithmetic and logical operations.
- The Control Unit
 - This section coordinates all activity within the CPU. It uses programming instructions to control what actions the CPU performs and when it performs them.

Communicating with the CPU

- The control unit reads and interprets program instructions and then changes it into machine language that the CPU can understand.
- Data is stored in a computer in binary format as a series of 1s and 0s. Every 1 or 0 is a *bit* of information.

Communicating with the CPU (cont.)

- Computers use standardized coding systems (such as ASCII) to determine what character or number is represented by what series of binary digits.
- Data is stored in a series of 8-bit combinations called a *byte*. Every character, such as a letter, number, or punctuation mark, is a byte created from a unique combination of ones and zeros.

Basic Controllers

- A controller is a device that controls the transfer of data from the computer to a peripheral device and vice versa.
- Controllers for standard peripheral devices are contained on a single chip on the motherboard.

Expansion Ports and Slots

- Ports are specialized plugs that connect peripheral devices to the computer's motherboard.
- Expansion slots are openings on the motherboard where a circuit board or memory chip can be added.

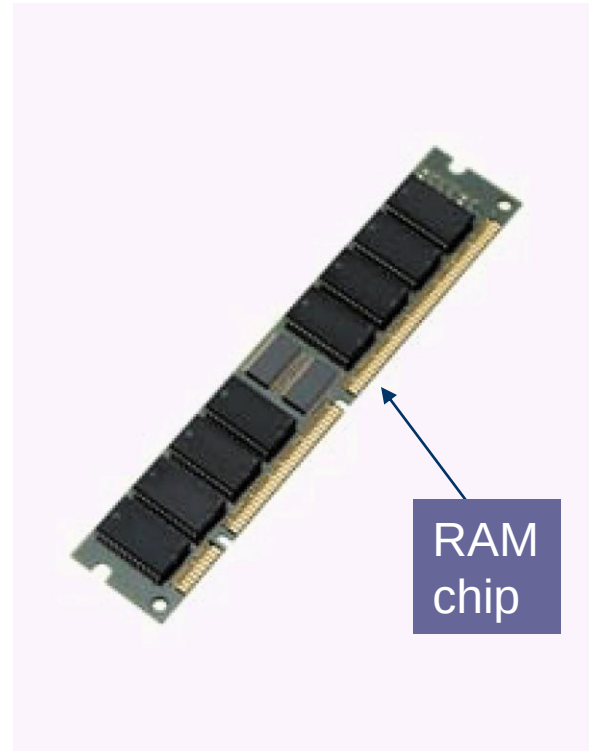
Computer Memory

- Data being processed by a CPU is stored in system memory.
- Memory consists of addressable locations within the machine that the computer can access directly.
- Data stored in memory is not permanent. If the power fails, everything in memory is lost.
- Data must be stored on a disk or some other device when not being processed so it is not lost each time the computer shuts down.

Types of Computer Memory

There are two types of memory found on a motherboard:

- **RAM:** Random Access Memory
- **ROM:** Read-Only Memory



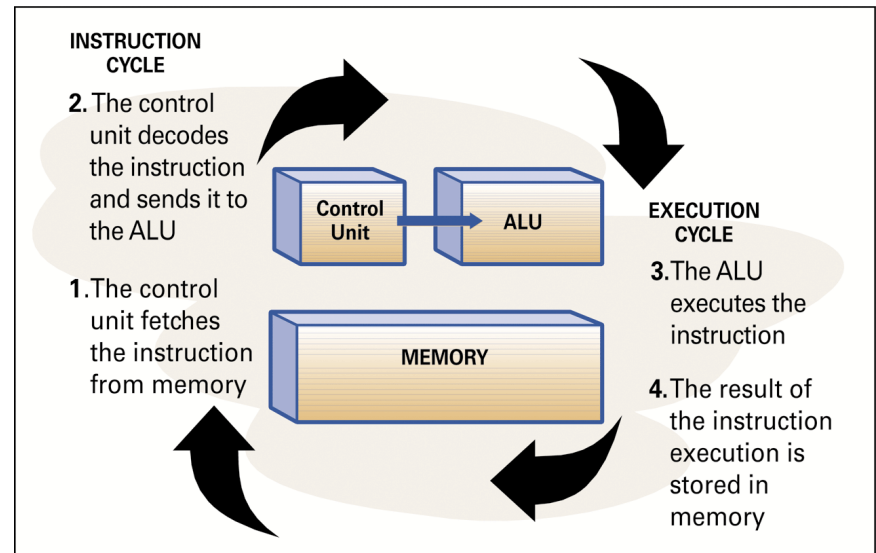
Random Access Memory (RAM)

- RAM is short-term memory where data is processed while a program is running.
- Data stored here can be accessed and modified as needed.
- This type of memory loses any data it holds if the computer is shut down.
- RAM is also called *main memory*.

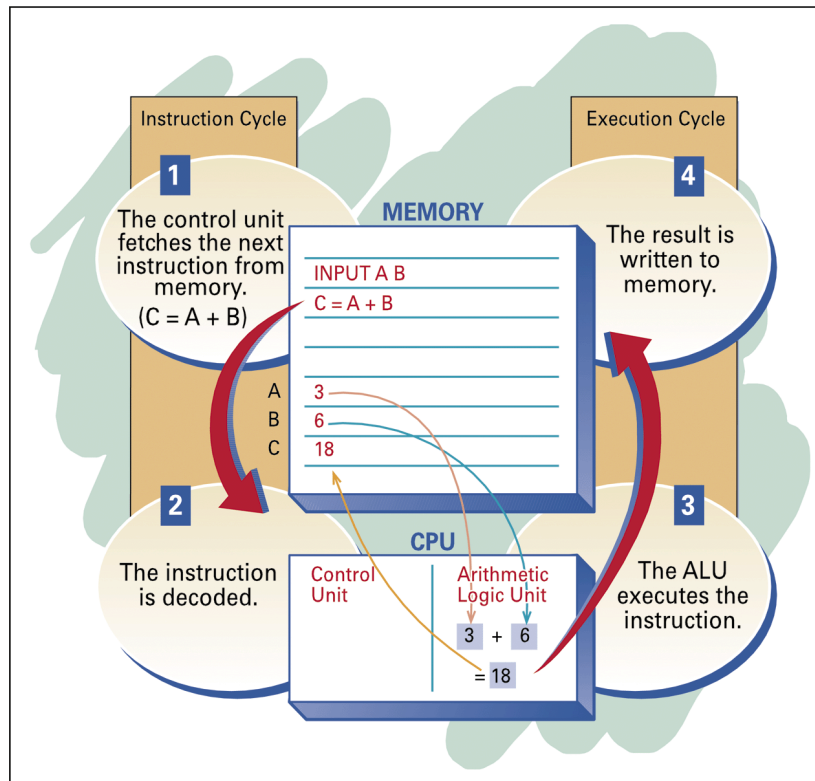
The Instruction Cycle and the Execution Cycle in RAM

The steps in the basic cycle involved in processing a program statement in RAM are shown at left in the figure. This process is called the **instruction cycle** since it must be performed for every instruction to be executed.

The amount of time required to complete the instruction cycle is referred to as the **execution cycle**, shown at right in the figure.



The Machine Cycle



The instruction cycle and one or more execution cycles create a **machine cycle**. Machine cycles are measured in microseconds. The faster your computer can process machine cycles, the faster it can process data.

Read-Only Memory (ROM)

- ROM is memory placed on the motherboard by the manufacturer and contains instructions, such as BIOS ROM, that tell the computer how to start itself.
- This data cannot be accessed or modified by application programs.
- The contents of this memory are not lost when the computer is shut down.

Input and Output Devices

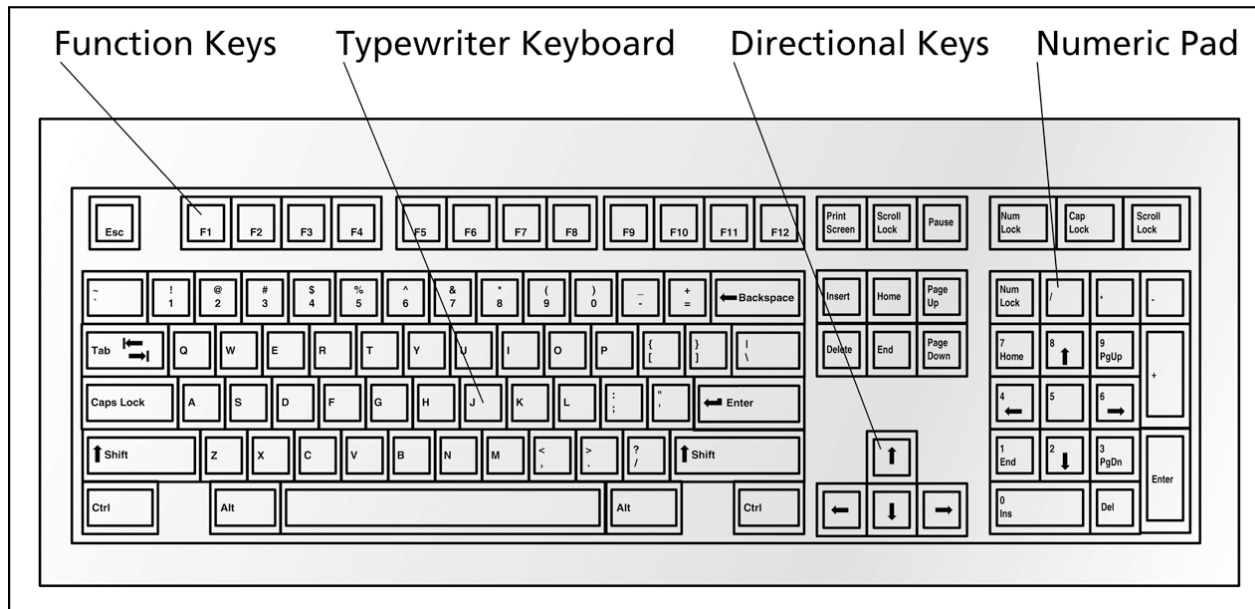
- Input devices enable a user to input data and commands to the computer to be processed.
- Output devices enable the computer to give or show you the results of its processing.
- Some devices, such as a modem, can perform both input and output operations.

Examples of Input Devices

- Keyboard
- Mouse
- Voice recognition devices
- Scanners
- Joysticks
- Trackballs
- Graphics tablet
- Touch display screen
- Digital cameras
- Sensors and remote recording devices

Keyboard

The four sections of a typical computer keyboard are indicated in this figure.



Mouse

- The mouse is a pointing device that controls the pointer on the screen.
- The following techniques allow you to use the mouse to input information:
 - **Point:** Place the screen pointer at a specific location.
 - **Click:** Press and release the mouse button.
 - **Drag:** Hold down the mouse button and move the mouse.
 - **Double-click:** Press and release the mouse button twice in quick succession.
 - **Right-click:** Press the right mouse button.

Voice Recognition Devices

- These input devices are used to speak directly to a computer to issue commands and enter text.
- Voice recognition technology enables people with disabilities to control computerized devices with spoken commands.

Scanners

- Scanners change images into digital data that a computer can understand.
- Types of scanners include
 - **Image scanners:** Used for photos and other graphics
 - **Bar code scanners:** Used to read product codes in stores and warehouses
 - **Magnetic scanners:** Used to read information encoded on credit cards

Other Input Devices

- Joysticks are often used to control input for video games. They frequently have buttons that can be pushed or clicked to control input/output.
- Trackballs work like a mouse turned upside down. Moving the ball controls the pointer on the screen.
- Other specialized input devices, such as graphics tablets, touchscreens, digital cameras, and remote controls, provide data to the computer in a digitized form that the CPU can interpret.

Output Devices — Monitors

- Monitors are used to display video output to a user.
- Monitors may be monochromatic or color. Monochromatic monitors display output in a single-color display.

Output Devices — Monitors (cont.)

- Factors that influence the quality of a monitor are
 - **Screen size:** The diagonal measurement in inches of the display area
 - **Resolution:** The number of pixels that can be displayed in the display area
 - **Dot pitch:** The distance between each pixel in the display area

Output Devices — Printers

- Printers are used to create a hard copy of a document or image. Printers vary by speed, quality, and price.
- The most popular types of printers are
 - **Laser:** Produce images using the same techniques as copier machines
 - **Ink-Jet:** Use fine nozzles to spray ink onto the page as the paper passes through
 - **Dot matrix:** Work similarly to a typewriter in that ink is transferred to the paper by some part of the printer striking a ribbon to transfer an image.

Other Output Devices

- Plotters are printers that use pens to draw lines to create maps, charts, and blueprints.
- Projectors are used to project a large image of what is on the computer screen.
- Speakers allow you to hear recorded music or speech from your computer.

Other Output Devices (cont.)

- Voice synthesizers allow people with disabilities to “speak” through a computer.
- Computer-controlled mechanical devices are robotic controls, and their movements are a form of computer output.

Storage Devices

- If you want to keep a permanent copy of data, you must store it on some type of storage medium.
- Storage media are permanent, such as hard disk drives, or removable, such as floppy disks and CDs.
- Storage devices are categorized by the method they use to store data, including magnetic and optical storage devices.

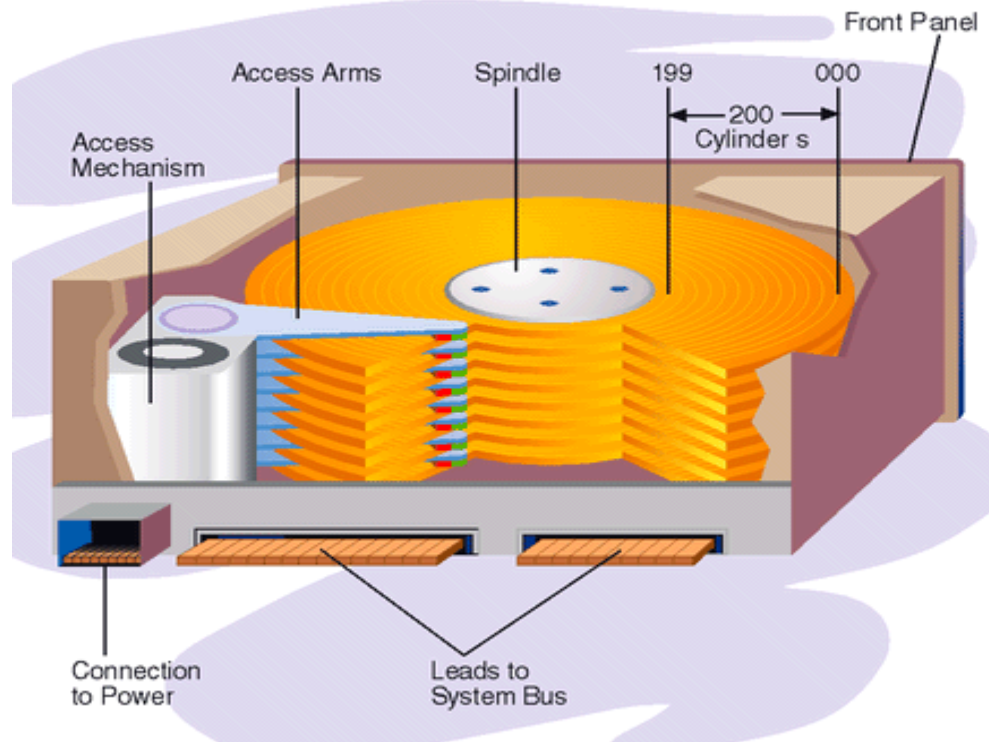
Floppy Diskettes

- Floppy disks are small, portable magnetic disks that hold a limited amount of data.
- Numbered tracks on the disk are used to store the data.
- Each track on the disk is labeled and the location is kept in a special log called a file allocation table (FAT).
- Many newer computers have replaced floppy disk drives with CD/DVD drives.

Hard Disk Drives

- Hard disks are large-capacity and fast-access storage devices.
- Hard disks are usually built into the computer's case and are not portable.
- Early computers had a storage capacity of about 20MB, but now hard drives of 60GB or more are common.

The Parts of a Hard Disk Drive



Other Types of Drives

- **Zip and Jaz drives:** Auxiliary storage devices that can hold large quantities of data and can be portable
- **Magnetic tape drives:** Used for making system backups and storing large quantities of data

Optical Storage Devices

Optical storage devices use laser technology to read and write data on silver platters:

- CD-ROMs (Compact Disk Read-Only Memory) can store up to 680MB and are used to store data, music, and graphics.
- WORM disks (Write Once, Read Many) permanently store large amounts of data.

Optical Storage Devices (cont.)

- CD-R drives allow you to record your own CD-ROM disks. After information is written to a CD-ROM disk, it cannot be changed.
- DVD (Digital Versatile Disk) media are used to store digital video. Many computers now have a CD/DVD drive that can read both types of optical media.

Network Drives

- A network drive is located on another computer or a server where space is provided for storage of data from many computer terminals.
- Network drives may appear as the Q:\ or R:\ drive on a terminal to distinguish it from the drives that are part of the computer terminal.

Virtual or Internet Storage

- Like a network drive, virtual storage on the Internet is not a physical part of the computer, but it can be used to store data that can be accessed from the computer.
- There are also ways to map virtual addresses to real addresses to create more storage on a physical computer hard drive than actually exists.

Flash Memory and Memory Cards

- Flash memory is rewritable and nonvolatile (it retains data even when power is turned off).
- Flash memory sticks or cards are used in portable devices such as digital cameras, cell phones, and hand-held computers.
- Memory cards the size of credit cards can be used to store monetary value or can serve in place of disk storage in a small computer.

Summary

- Just about all computers perform the same general options: input, process, output, and storage.
- Input, output, and processing devices grouped together represent a computer system.
- The motherboard is the center of all processing.

Summary (cont.)

- The motherboard contains the CPU, memory, and basic controllers for the system.
- The motherboard also contains peripheral ports and expansion slots.
- The central processing unit is the brains of the computer.

Summary (cont.)

- The computer is given instructions through computer programs.
- The CPU has two main sections—the arithmetic logic unit and the control unit.
- All calculations and comparisons take place in the ALU.
- The control unit coordinates the CPU activities.

Summary (cont.)

- The ASCII code is a standard code used to represent the alphabet, numbers, symbols, and punctuation marks.
- A controller is used to control the transfer of data between the computer and peripheral devices.
- The motherboard contains different types of memory.

Summary (cont.)

- Random access memory (RAM) is volatile and is used to store instructions, data, and information temporarily.
- The machine cycle is made up of the instruction cycle and the execution cycle.
- Read-only memory (ROM) is nonvolatile and is used to store permanent instructions needed for computer operations.

Summary (cont.)

- Input devices enable you to input data and commands into the computer. The most common input devices are the keyboard and mouse.
- The mouse is a pointing device used to input data that has evolved from a mechanical device connected to the computer by a cable to more flexible devices such as a wireless mouse, a thumb mouse, or the mouse panel on a notebook computer.

Summary (cont.)

- Other types of input devices include joysticks, trackballs, graphic tablets, touch display screens, voice recognition devices, scanners, digital cameras, electronic sensors, and remote controls.
- Output devices allow you to see and use the results of processing data. The most common output devices are the monitor and printer.

Summary (cont.)

- Monitors can be monochromatic or full color and are available in a range of sizes with different screen resolution.
- Printers are used to produce a paper or hard copy of the processed result.
- Printers are classified as either impact (dot matrix) or nonimpact (laser and inkjet).

Summary (cont.)

- Other types of output devices include plotters, projectors, robotic controls, and voice synthesizers.
- To maintain a permanent copy of data, you must store it on some type of storage medium. These may include floppy diskettes, hard disk drives, CDs or DVDs, magnetic tape cartridges, network drives, virtual storage, and flash memory cards.