Computers Are Your Future
Tenth Edition
Chapter 7: Input/Output & Storage

What You Will Learn

- Explain the purpose of the special keys on the keyboard and list the most frequently used pointing devices.
- List the types of monitors and the characteristics that determine a monitor's quality.

What You Will Learn

- Identify the two major types of printers and indicate the advantages and disadvantages of each.
- Distinguish between memory and storage.
- Discuss how storage media and devices are categorized.

What You Will Learn

- List factors that affect hard disk performance.
- Explain how data is stored on hard disks and flash drives.
- List and compare the various optical storage media and devices available for personal computers.

What You Will Learn

- Describe solid-state storage devices and compare them with other types of storage devices.

Input/Output & Storage
### Input Devices: Giving Commands

- **Input**: is any data or instructions that are entered into a computer.
- An **input device** is a type of hardware that gives users the ability to enter data and instructions into the computer's memory.

### The Keyboard

- **Keyboard**, the most popular input device, enables data and instruction entry through the use of a variety of keys.

### Special Keys on a Keyboard

- **Toggle keys**: Keys that are either on or off
- **Function keys**: Keys that are program dependent and perform specific actions
- **Modifier keys**: Keys used for keyboard shortcuts, resulting in speedy access to computer commands.

### The Insertion Point or Cursor

- The **insertion point** or **cursor** marks the location where characters will display as they are typed.
- Enhanced keyboards often include special keys used for such things as navigation and issuing commands.

### Input Devices: Giving Commands

<table>
<thead>
<tr>
<th>Key Name</th>
<th>Typical Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alt</td>
<td>In combination with another key creates a command (example Alt + F1 = File menu).</td>
</tr>
<tr>
<td>Backspace</td>
<td>Deletes the character to the left of the cursor.</td>
</tr>
<tr>
<td>Caps Lock</td>
<td>Toggle Caps Lock mode on or off.</td>
</tr>
<tr>
<td>Ctrl</td>
<td>In combination with another key enters a command (example Ctrl + C = Copy).</td>
</tr>
<tr>
<td>Delete</td>
<td>Deletes the character to the right of the cursor.</td>
</tr>
<tr>
<td>Home</td>
<td>Moves the cursor to the beginning of the current line.</td>
</tr>
<tr>
<td>Insert</td>
<td>In combination with another key enters a command (example Insert + Home = Insert mode).</td>
</tr>
<tr>
<td>Left arrow</td>
<td>Moves the cursor to the left of the current line.</td>
</tr>
<tr>
<td>Mem</td>
<td>Displays on-screen help.</td>
</tr>
<tr>
<td>Page Up</td>
<td>Moves up one full screen or window.</td>
</tr>
<tr>
<td>Pause/Break</td>
<td>Pauses a program.</td>
</tr>
<tr>
<td>Print Screen</td>
<td>Captures the screen image and places it in memory.</td>
</tr>
<tr>
<td>Right arrow</td>
<td>Moves the cursor to the right of the current line.</td>
</tr>
<tr>
<td>Up arrow</td>
<td>Moves the cursor up one line or one page.</td>
</tr>
</tbody>
</table>
Input Devices:
Giving Commands

- A pointer device controls an on-screen pointer’s movements.
- A pointer is an on-screen symbol that signifies the command, input, or possible response.

The mouse is the most popular pointing device.
A wheel mouse provides a wheel for easy vertical scrolling on documents or Web pages.

Input Devices:
Giving Commands

Mouse alternatives
- Trackball
- Pointing stick
- Touchpad or trackpad
- Joystick
- Touch screen
- Kiosk
- Stylus

Alternative specialized input devices include:
- Microphones for voice or speech recognition
- Scanner for optical character recognition (OCR)
- Bar code reader
- Optical mark reader (OMR)

Output Devices:
Engaging Our Senses

Output devices are computer hardware devices that give users the ability to see, hear, or feel the end result of processing operations.
- The two most popular output devices are monitors and printers.
- Monitors display a temporary copy (soft copy) of processed data.
- Types of monitors include:
  - Cathode-ray tube (CRT) monitors
  - Liquid crystal display (LCD) monitors
  - Active-matrix/ thin film transistor (TFT) monitors
Output Devices: Engaging Our Senses

- **Cathode-ray tube monitors** display colored output and are large in size. CRTs are usually used with older desktop computers.

Output Devices: Engaging Our Senses

- **Liquid crystal display (LCD) monitors**
  - Also called flat-panel displays
  - Thin
  - Used on newer desktops and notebooks
  - Growing in user popularity

Output Devices: Engaging Our Senses

- **Active-matrix monitors**
  - Also known as thin film transistor (TFT) technology
  - Used for better on-screen color quality
  - Other types of flat-panel displays include:
    - Gas-plasma displays
    - Field-emission displays

Output Devices: Engaging Our Senses

- **Resolution** is a key factor to consider regarding a monitor’s quality.
  - Resolution affects the sharpness of an image.
  - There are standard resolutions.
  - The refresh rate is the rate at which the monitor refreshes the screen image.
    - Measured in hertz (Hz)
    - Flicker noticeable at 60 Hz, but not at 72 Hz

Output Devices: Engaging Our Senses

- **High-definition television (HDTV)**, a type of high-quality television, can be connected to personal computers.
  - Requires a video card to supply the required DVI or HDMI port on the computer and a corresponding output on the TV
  - Provides very high resolution: 1920 x 1080
**Output Devices:** Engaging Our Senses

- **Printers** supply a **hard copy** of output displayed on a computer's monitor.
- Types of printers include:
  - Inkjet printers
  - Laser printers
  - Dot-matrix printers
  - Thermal-transfer printers
  - Photo printers
  - Plotters

**Inkjet printers**
- Popular with home users and provide excellent images made up of small dots
- Advantages:
  - Inexpensive
  - Generate professional color output
- Disadvantages:
  - Relatively slow
  - Require expensive cartridges

**Laser printers**
- Use electrostatic reproductive technology to produce high-quality output
- Advantages:
  - Print faster than inkjet printers
  - Black-and-white printing costs less per page than inkjet printers
- Disadvantages:
  - Color laser printers are still more expensive

**Dot-matrix printers (impact printers)**
- Older, less popular printers
- Used mostly for printing multipart forms and backup copies
- Advantage:
  - Able to print 3,000 lines per minute
- Disadvantage:
  - Poor print quality
  - Noisy

**Thermal-transfer printer**
- Used for industrial applications
- Uses a heat process to place color inks on paper
- Advantage:
  - High-quality images
  - Difficult to distinguish from photos
- Disadvantages:
  - Expensive
  - Slow

**Photo printers**
- Used to produce quality pictures
- Often are inkjet printers
- Advantage:
  - Can provide commercial photo processing quality

**Plotters**
- Produce images through moving pens
- Used for map-making
- Advantage:
  - High-quality images
Output Devices: Engaging Our Senses

- Other output devices include:
  - Speakers
  - LCD projectors
  - DLP (digital light-processing) projectors
  - Multifunction devices

Storage: Holding Data for Future Use

- Storage is the process of saving software and data.
- Storage is also called mass storage or auxiliary storage.

Storage: Holding Data for Future Use

- Storage is dependent on two parts:
  - A storage device, which has the ability to save data even when the user turns the power off
  - Storage media that run on storage devices:
    - Hard disks
    - Floppy disks
    - Flash memory
    - CDs and DVDs

Storage: Holding Data for Future Use

- Reasons that demand for storage capacity is continually increasing:
  - Storage devices hold onto data even if the computer’s power is turned off, whereas all data stored in RAM will be lost.
  - Storage devices are less expensive than RAM/memory.

Storage: Holding Data for Future Use

- Reasons that demand for storage capacity is continually increasing (continued):
  - Storage devices are required during the computer system’s start-up operations.
  - Storage devices are also used as an output device for saving data.

<table>
<thead>
<tr>
<th>Type</th>
<th>Capacity</th>
<th>Speed</th>
<th>Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory</td>
<td>Cache</td>
<td>Fast</td>
<td>Small</td>
</tr>
<tr>
<td></td>
<td>RAM</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Storage</td>
<td>Disks</td>
<td>Normal</td>
<td>High</td>
</tr>
<tr>
<td></td>
<td>Floppy</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td></td>
<td>CDs/DVDs</td>
<td>Slow</td>
<td>Medium</td>
</tr>
</tbody>
</table>

A hard disk drive (hard disk)

- High capacity
- High speed
- Considered secondary storage (online or fixed storage), compared with RAM, which is categorized as primary storage.
Storage: Holding Data for Future Use

- Hard disk drives
  - Are random access storage devices and permit direct retrieval of desired data
  - Contain a coating of magnetic material used for data storage.

- Hard disks record data on concentric bands called tracks.
  - Tracks are divided into sectors.
  - A group of two or more sectors is a cluster.

- To keep track of files, a table of the file name and its location is stored on the disk by the computer’s operating system.
  - The file allocation table (FAT) is the table created by older versions of Microsoft Windows.
  - The new technology file system (NTFS) is the present system used for tracking file locations.

- A portion of a hard disk set aside as if it were a physically separate disk is a partition.
  - Partitions are often used to house different operating systems.
  - Having partitions for different operating systems allows users to interact with programs developed in either system.

- Network attached storage (NAS) is a form of storage that permits retrieval or storage of data by any computer connected to the network.
  - Remote storage (Internet hard drive) is storage on a server that is available through the Internet.
Hard disk performance
- Affected by bad sectors, which are damaged portions of the disk that cannot reliably hold data.
- Access time: time until reading data begins
- Seek time: time to locate data

Positioning performance: how quickly the read/write head can get into position to transfer data
Transfer performance: how quickly the transfer is made from the disk to storage

Disk cache
- A type of RAM
- CPU looks in disk cache first
- Can speed up data retrieval

Flash drive
- Solid-state drive or SSD
- A storage device that has no moving parts and uses solid-state circuitry

Flash memory
- Electronic memory
- Nonvolatile
- Stores data in blocks on a chip

USB flash drive
- Known as:
  - Memory stick
  - Thumb drive
  - Jump drive
- Is a popular portable or removable storage device
- Replaced legacy technology of floppy disks and Zip disks

CD-ROM or DVD-ROM (compact or digital video disc read-only memory)
- Data can be read but not altered.

CD drive and DVD drive
- Optical storage devices
- Use laser beams to store data through:
  - Pits, the indentations, a binary 0
  - Lands, the flat reflective areas, a binary 1
Additional types of optical storage include:
- CD-R (compact disc-recordable)
- CD-RW (compact disc-rewritable)
- DVD+R (digital video recordable; plus)
- DVD-R (digital video recordable; dash)
- DVD+RW (digital video rewritable; plus)
- DVD-RW (digital video rewritable; dash)
- BD-ROM (Blu-ray Disc read only)
- BD-R (Blu-ray Disc recordable)
- BD-RE (Blu-ray Disc rewritable)

Protecting your discs
- Do not expose discs to excessive heat or sunlight.
- Do not touch the underside of the disc. Hold the edges.
- Do not write on the label side of the disc with a hard implement.
- Do not stack discs.
- Store discs in cases when not in use.

Solid-state storage devices
- Have no moving parts
- Are nonvolatile

ExpressCard
- A notebook accessory the size of a credit card
- Can be used as a modem, extra memory, or a network adapter

Flash memory cards
- Another type of solid-state storage device
- Used with MP3 players and smartphones

Smart card/ chip card/ integrated circuit card (ICC)
- Able to store and process information
- Combines flash memory with a small microprocessor.

Holographic storage
- May make high-density storage possible
- Able to create three-dimensional images

Eye-Fi wireless memory card
- Combines standard flash memory card features with wireless circuitry
- Enables direct wireless network connection to devices such as digital cameras.

The keyboard is the most common input device and includes special keys for cursor movement, toggling between modes, performing functions, and modifying key functions.

The mouse is the most common pointer device. Others include trackballs, pointing sticks, touchpads, joysticks, touch screens, and styluses.
What You’ve Learned

- Newer desktop and notebook monitors use liquid crystal displays (LCDs).
- Monitor quality is dependent on its size, viewable area, resolution, and refresh rate.
- Printers use inkjet or laser technology. Laser printers are faster and produce high-quality text and graphics but are more expensive.

What You’ve Learned

- Memory must have the capacity to hold software and data in use.
- RAM is volatile and does not hold information when the power is off.
- Storage is slower, has greater capacity, and retains data when the power is off.

What You’ve Learned

- Storage media can be categorized in many ways: read only or read/write; random access; magnetic, flash, or optical; and secondary, external, or portable.
- Many factors can affect hard disk performance.

What You’ve Learned

- Disks store data in tracks, which are combined into sectors and clusters to provide a basic unit of storage.
- There are a variety of CD and DVD formats for reading and writing data.
- Solid-state storage media have no moving parts and are lightweight and durable.