Input/Output & Storage
Input Devices: Giving Commands

- **Input**
  - Data or instructions entered into a computer

- **Input device**
  - Hardware that gives users the ability to enter data and instructions into the computer’s random access memory (RAM)
Input Devices: Giving Commands

- **Input device (con’t.)**
  - **Keyboard**
    - Most common input device—enables data and instruction entry through the use of a variety of keys
  - **Enhanced keyboards**—additional keys, such as media control buttons to adjust speaker volume, or Internet control buttons that open e-mail, a browser, or a search window with a single keystroke
Input Devices: Giving Commands

Function keys
The purpose of these keys changes depending on the program in use

Esc
Used to cancel or interrupt an operation

Tab
Used to indent text or navigate forms or tables

Caps lock
Switches the keyboard between all-caps and normal mode

Window key
Displays the Start menu on a Microsoft-based PC

Internet controls
Usually open e-mail, a browser or search window

Media controls
Volume, pause, forward, and reverse options

Num lock
Switches the keypad between number entry and cursor movement

Toggle keys
Turn on and off features

Status indicators
Lights that indicate whether a toggle key’s function is on or off

Numeric keypad
Used for numeric data entry or cursor movement

Cursor movement keys
Move the cursor up, down, left, or right on the screen

Shift
Allows the entry of a capital letter or punctuation mark

Ctrl and Alt
Pressed with other keys to issue commands to the program in use
Input Devices: Giving Commands

• **Key matrix**
  - Grid of circuits located under the keys

• **Character map**
  - Chart that tells the processor what key has been pressed

![Image of a key matrix and character map](image.png)
Input Devices: Giving Commands

• **Insertion point**
  - Blinking vertical line, underscore, or highlighted box

• **Wireless keyboards**
  - Connect to the computer through infrared (IR), radio frequency (RF), or Bluetooth connections
Input Devices:
Giving Commands

- **Keyboards**
  - Connect with:
    - Universal Serial Bus (USB) connector
    - PS/2 cable
    - Infrared
    - Radio frequency
    - Bluetooth
Input Devices: Giving Commands

• Special keyboard keys include:
  o **Cursor movement keys (arrow keys)**—set of four keys that move the cursor up, down, right, or left
  o **Toggle keys**—either on or off
  o **Function keys**—perform specific actions depending on the program
  o **Modifier keys**—used for shortcuts
Input Devices: Giving Commands

• **Alternate keyboards**
  o **Virtual** (soft keyboard or on-screen keyboard)—a touch-sensitive screen; accepts input with a stylus or finger
  o **Smartphone**
    • **Mini-keyboard**—keys for each letter of the alphabet; option on many smartphones
    • **Keypad**—smaller, more compact, has keys that represent multiple letters
  o **Virtual laser**—used with devices as smartphones, an alternate way to do e-mail, word processing, spreadsheets
Input Devices: Giving Commands

- Alternate keyboards (con’t.)
  - **Flexible keyboards**—full-sized, lightweight portable devices
  - Wireless keyboards for **media center PCs**—allow users to control media components
Input Devices: Giving Commands

- **Media center PCs**
  - All-in-one entertainment devices
  - Make it easy to access photos, TV, movies, and online media by using a remote control
  - Uses
    - Remote controls
    - Remote miniature keyboards
Input Devices: Giving Commands

• **Pointing device**
  - Controls an on-screen pointer’s movements

• **Pointer**
  - On-screen symbol that signifies the command, input, or possible response
Input Devices: Giving Commands

• Mice
  o **Optical**—most popular pointing device
  o **Travel**—all the capabilities of a normal mouse, half the size
  o **Wheel**—has a wheel for easy vertical scrolling
  o **Wireless**—connects through an infrared or radio signal (RF)
  o **Air**—does not need to work on a surface, works as it moves through the air
Input Devices: Giving Commands

• Mice alternatives
  o Trackball
  o Pointing stick
  o Touchpad (also called a trackpad)
  o Click wheel
  o Joystick
  o Stylus
  Touch screen
Input Devices: Giving Commands

- **Alternative input devices include:**
  - Microphones for speech or voice recognition
  - Scanner for optical character recognition (OCR)
  - Bar code reader
  - Optical mark reader (OMR)
  - Radio frequency identification (RFID reader)
  - Magnetic-ink character recognition (MICR reader)
  - Magnetic stripe care reader
  - Biometric input device
  - Digital cameras and digital video cameras
  - Webcams
Input Devices: Giving Commands

- Retina scan
- Fingerprint reader
Output Devices: Engaging Our Senses

• **Output devices**
  o Enable users to see, hear, or feel the end result of processing operations
  o The two most popular output devices
    • **Monitors** (also called displays)
    • **Printers**
Output Devices: Engaging Our Senses

• **Monitors**
  - Display a temporary copy (**soft copy**) of processed data
  - Types of monitors include:
    - **Cathode-ray tube (CRT)**—legacy technology
    - **Liquid crystal display (LCD)**
Output Devices: Engaging Our Senses

• Monitors (con’t.)
  o LCD (flat-panel) displays:
    • Have a thin profile
    • Are used with newer desktops and notebooks
    • Have largely replaced CRT monitors
    • May accommodate high-definition video
Output Devices: Engaging Our Senses

- **Monitors (con’t.)**
  - **Passive-matrix** (Also known as dual scans)
    - Least expensive
    - Too slow for full-motion video
    - Electrical current charges groups of pixels
  - **Active-matrix** (also known as thin-film transistor [TFT] technology)
    - Used for better on-screen color quality
    - Charges each pixel individually as needed
Output Devices: Engaging Our Senses

• Monitors (con’t.)
  o Size is diagonal measurement
  o Size is straightforward for LCDs but more complex for CRTs.
  o Quoted size—the size of the screen
  o Viewable area—the area unobstructed by the housing
  o Both must be disclosed by the manufacturer.
Output Devices: Engaging Our Senses

• Resolution
  o Refers to the sharpness of an image
  o Number of pixels (picture elements) controls the resolution
  o **Video Graphics Array (VGA)**—lowest resolution standard (640 × 480)
  o **Extended Graphics Array (XGA)**—most used by computers today (1024 × 768)
Output Devices: Engaging Our Senses

• **Field-emission displays (FEDs)**
  - Considered more rugged; better in harsh environments
  - Operate similar to an LCD monitor
  - Tiny stationary carbon nanotubes illuminate each on-screen pixel

• **Televisions as monitors**
  - High-definition (HDTVs)
  - Higher resolution (usually 1920 × 1080 or better)
  - Require a HDTV tuner
  - Needs a video card with **digital video interface (DVI)** or **high-definition multimedia interface (HDMI)** port on PC
Output Devices: Engaging Our Senses

- **Organic light emitting diode (OLED) displays**
  - Emit light rather than modulate transmitted or reflected light

- **Flexible OLED displays (FOLED)**
  - Can be paper thin and appear as posters on the wall
  - Can be worn on wrist and used to watch movies or surf the Web
Output Devices: Engaging Our Senses

• **Printers**
  - Supply a **hard copy** of output displayed on a computer’s monitor
  - Types include:
    - Inkjet
    - Laser
    - Dot-matrix
    - Thermal-transfer (sometimes called dye sublimation printers)
    - Photo
    - Plotters
Output Devices: Engaging Our Senses

• **Printers (con’t.)**
  o **Inkjet** (nonimpact)—popular with home users
    • Provide excellent images—made up of small dots
    • **Advantages:**
      o Inexpensive
      o Generate professional color output
    • **Disadvantages:**
      o Relatively slow