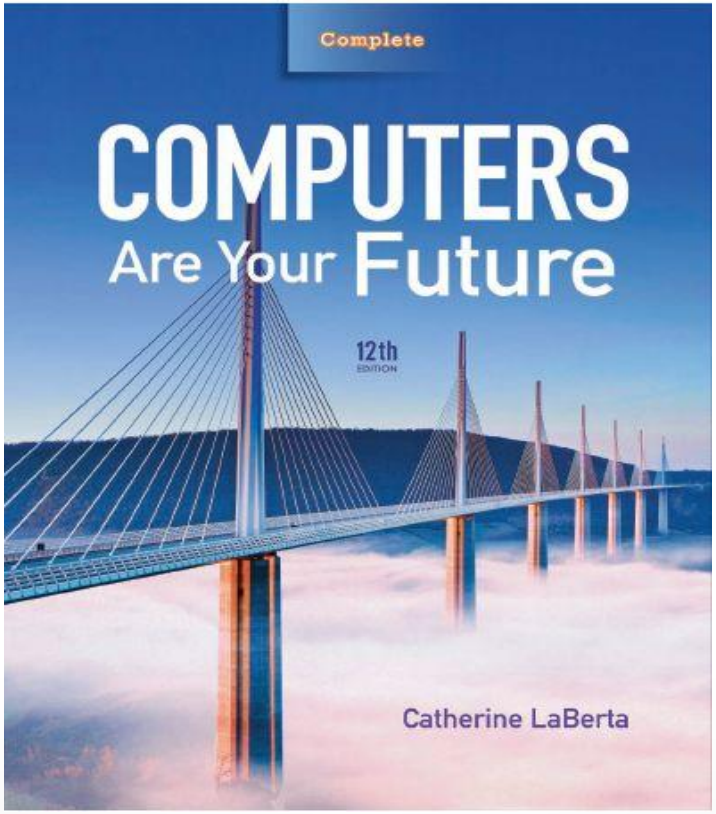
Computers Are Your Future

Twelfth Edition

Chapter 3: Input/Output and Storage



Input/Output & Storage

Objectives

- Explain the various types of keyboards and the purpose of the special keys on the keyboard, identify the commonly used pointing devices, and list alternative input devices.
- List the types of monitors and the characteristics that determine a monitor's quality.

Objectives

- 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 and how data is stored on a hard drive.

Objectives

- List factors that affect hard disk performance.
- Explain how data is stored on flash drives.

Objectives

- List and compare the various optical storage media and devices available for personal computers.
- Describe solid-state storage devices and compare them with other types of storage devices.

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

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

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

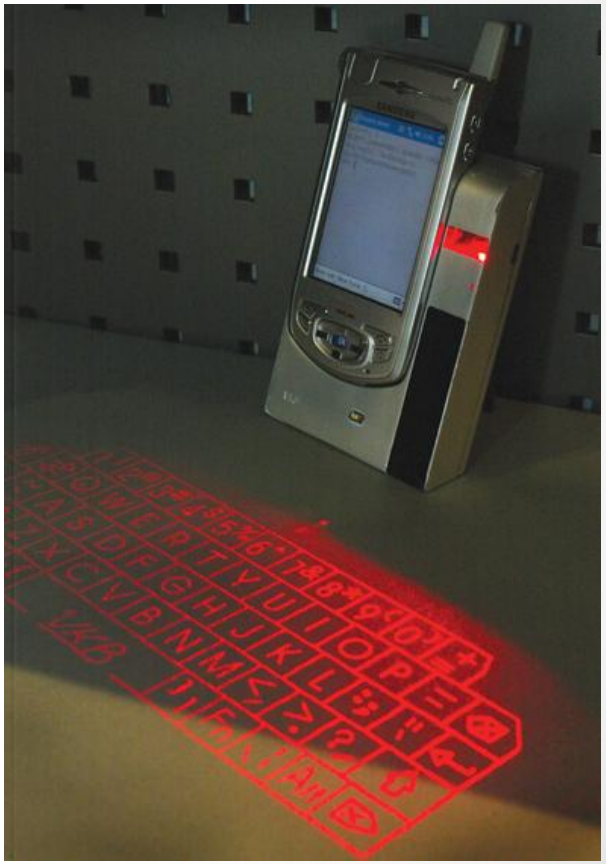
- **Keyboards**
  - Connect with:
    - Universal Serial Bus (USB) connector
    - PS/2 cable
    - Infrared
    - Radio frequency
    - Bluetooth

Input Devices: Giving Commands

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

Input Devices: Giving Commands

- **Alternate keyboards**
  - **Virtual** (soft keyboard or on-screen keyboard)—a touch-sensitive screen; accepts input with a stylus or finger
  - **Smartphone**
    - **Mini-keyboard**—keys for each letter of the alphabet; option on many smartphones
    - **Keypad**—smaller, more compact, has keys that represent multiple letters
  - V**irtual 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**
  - **Optical**—most popular pointing device
  - **Travel**—all the capabilities of a normal mouse, half the size
  - **Wheel**—has a wheel for easy vertical scrolling
  - **Wireless**—connects through an infrared or radio signal (RF)
  - **Air—**does not need to work on a surface, works as it moves through the air

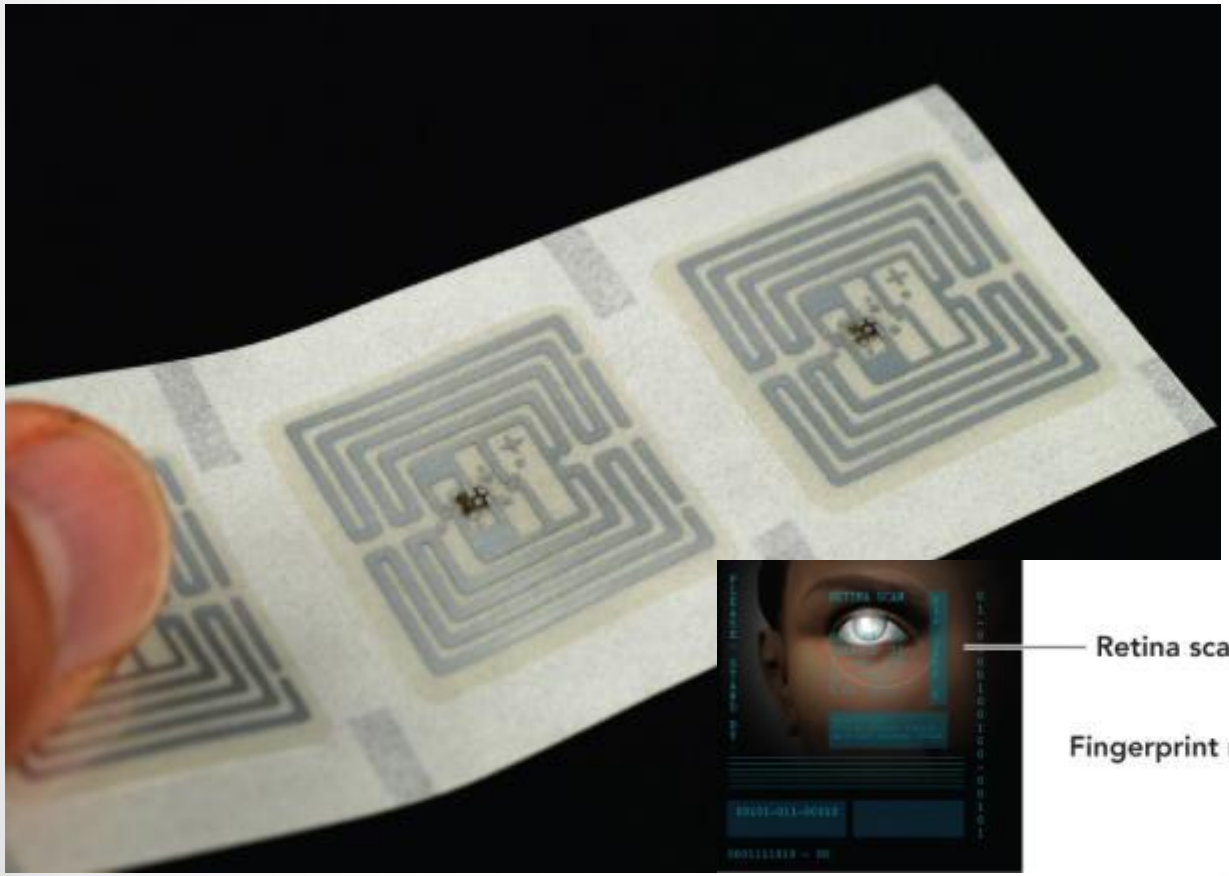
Input Devices: Giving Commands

- **Mice alternatives**
  - Trackball
  - Pointing stick
  - Touchpad (also called a trackpad)
  - Click wheel
  - Joystick
  - 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**
  - Enable users to see, hear, or feel the end result of processing operations
  - 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.)**
  - 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.)**
  - Size is diagonal measurement
  - Size is straightforward for LCDs but more complex for CRTs.
  - Quoted size—the size of the screen
  - Viewable area—the area unobstructed by the housing
  - Both must be disclosed by the manufacturer.

Output Devices: Engaging Our Senses

- **Resolution**
  - Refers to the sharpness of an image
  - Number of pixels (picture elements) controls the resolution
  - **Video Graphics Array (VGA)**—lowest resolution standard (640 × 480)
  - **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.)**
  - **Inkjet** (nonimpact)—popular with home users
    - Provide excellent images—made up of small dots
    - Advantages:
      - Inexpensive
      - Generate professional color output
    - Disadvantages:
      - Relatively slow

Output Devices: Engaging Our Senses

- **Printers (con't.)**
  - **Laser** (nonimpact)
    - Use electrostatic reproductive technology to produce high-quality output
    - Advantages:
      - High-resolution
      - Print faster than inkjet printers
      - Black-and-white printing costs less per page than inkjet printing
    - Disadvantages
      - Color laser printers more expensive

Output Devices: Engaging Our Senses

- **Printers (con't.)**
  - **Dot-matrix** (impact)
    - Older, less popular
    - Used mostly for printing multipart forms and backup copies
    - Advantages
      - Able to print 3,000 lines per minute
    - Disadvantages
      - Poor print quality
      - Noisy

Output Devices: Engaging Our Senses

- **Printers (con't.)**
  - **Thermal-transfer** (**dye sublimation printers)**
    - Thermal-wax or direct thermal
    - Use heat process
    - Advantages
      - High-quality images from the high-quality thermal-wax printers
      - Popular for mobile printing
    - Disadvantages
      - High-quality thermal printers expensive

Output Devices: Engaging Our Senses

- **Printers (con't.)**
  - **Photo**
    - Uses special ink and paper
    - Often are inkjet printers
    - Prints directly from a digital camera or memory card
  - **Plotters**
    - Produce images through moving ink pens
    - Used for making oversized prints (i.e., maps, charts, blueprints)

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**
  - Process of saving software and data
  - Also called **mass storage, auxiliary storage**, or **secondary storage**

Storage: Holding Data for Future Use

- **Storage devices**
  - Hardware that contains the tools to place data on the **recording media**
  - **Recording media**—hold data
    - Hard disks
    - Floppy disks
    - Flash memory
    - CDs and DVDs

Storage: Holding Data for Future Use

Hard drive with enclosure opened

Flash memory card in reader

USB drive

DVD

Storage: Holding Data for Future Use

- **Memory (RAM) versus storage**
  - Storage devices retain data even if power is turned off
  - Data stored in memory (RAM) will be lost
  - Storage devices are less expensive than memory

		Access Speed	Cost per MB	Storage Capacity
Memory	Cache memory	Fastest	Highest	2 MB
	RAM	Fast	High	4 GB
Storage	Hard disk	Medium	Medium	1 TB
	CD-R disc	Slow	Low	700 MB

Storage: Holding Data for Future Use

- **Memory (RAM)**
  - Primary memory
  - Temporary holding area for items in use
  - **Primary storage**
- **Storage devices**
  - Required during the computer system's start-up operations
  - Used as an output device for saving data

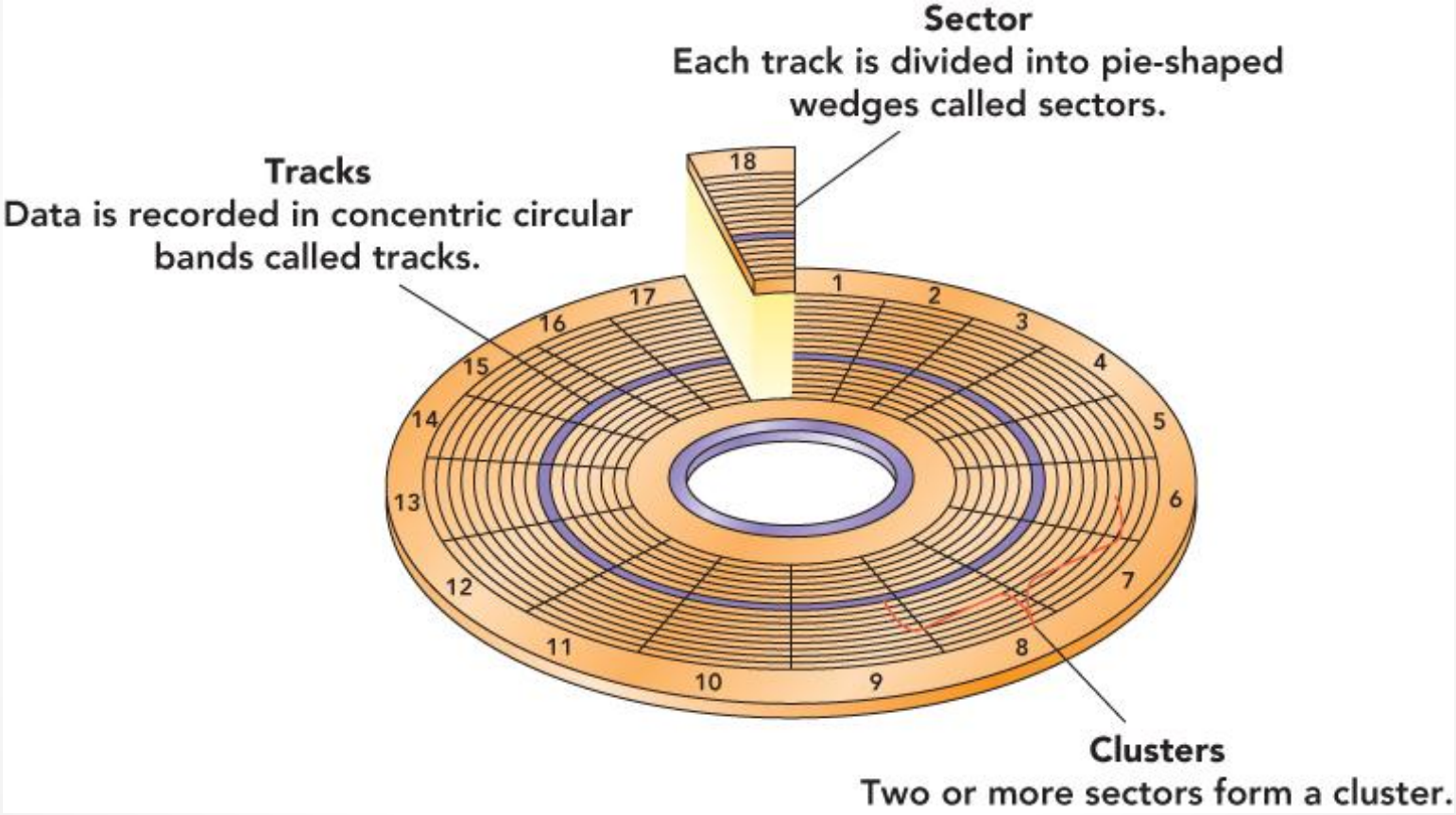
Storage: Holding Data for Future Use

- **Hard disk drive (hard drive)**
  - Most important storage device
  - High-capacity, high-speed device
  - Considered **secondary storage** (**online; fixed storage**), compared with memory/RAM, which is categorized as primary storage
  - R**andom access storage devices**—permit direct retrieval of desired data
  - Contain a coating of magnetic material used for data storage

Storage: Holding Data for Future Use

- **Platters**—rapidly rotating disks on which programs, data, and processed results are stored
- **Tracks**—concentric bands on which data is recorded
  - Are divided into **sectors**
  - Two or more sectors is a **cluster**.

Storage: Holding Data for Future Use



Storage: Holding Data for Future Use

- **The computer's operating system stores a file's name and its location on the disk in a table.**
- **New technology file system (NTFS)**
  - The present system used for tracking file locations in:
    - Windows NT
    - Windows 2000
    - Windows XP
    - Windows Vista
    - Windows 7

Storage: Holding Data for Future Use

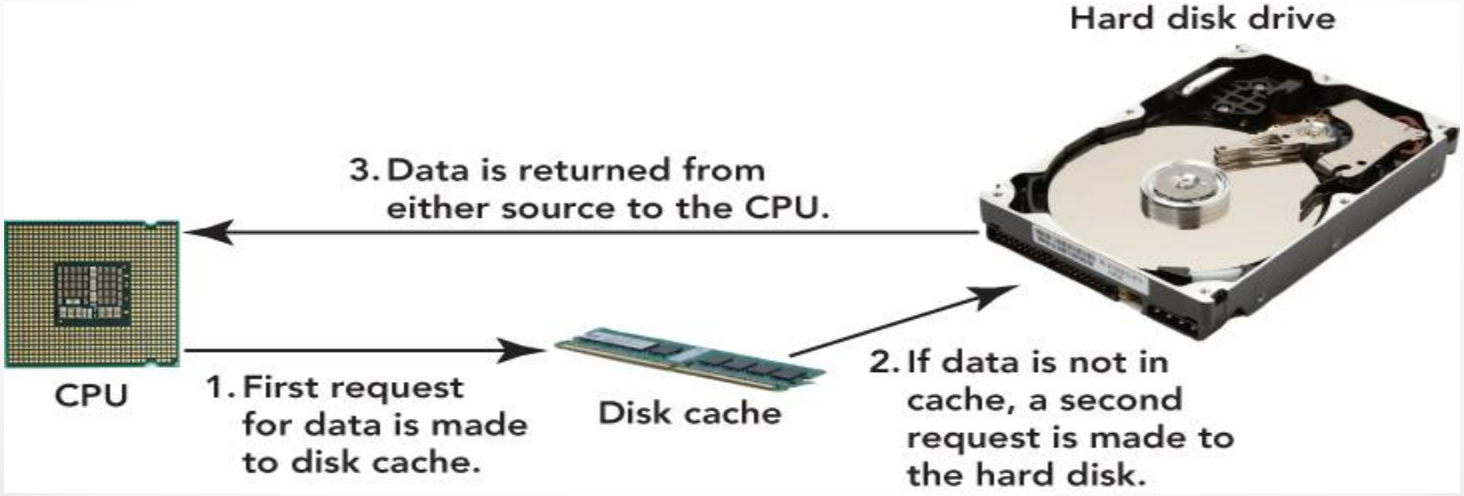
- **Partitions**
  - Portion of a hard disk set aside as if it were a physically separate disk
  - Often used to house different operating systems
  - Allows users to use programs developed for different systems

Storage: Holding Data for Future Use

- **Hard disk performance**
  - Affected by **bad sectors**—damaged portions of the disk that cannot reliably hold 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

Storage: Holding Data for Future Use

- **Hard disk performance (con't.)**
  - **Disk cache**—type of cache memory
    - CPU looks here first before the hard disk
    - Using the disk cache speeds up data retrieval



Storage: Holding Data for Future Use

- **Network attached storage (NAS)**
  - Permits retrieval or storage of data by any computer connected to the network
- **Remote storage (Internet hard drive)**
  - Storage on a server that is available through the Internet

Storage: Holding Data for Future Use

- **Flash drive (solid-state drive [SSD])**
  - Storage devices that use solid-state circuitry; have no moving parts
  - Increasing in use
- **Flash memory**
  - Nonvolatile electronic memory stored in **blocks** on a chip
  - Limited to 100,000 write cycles

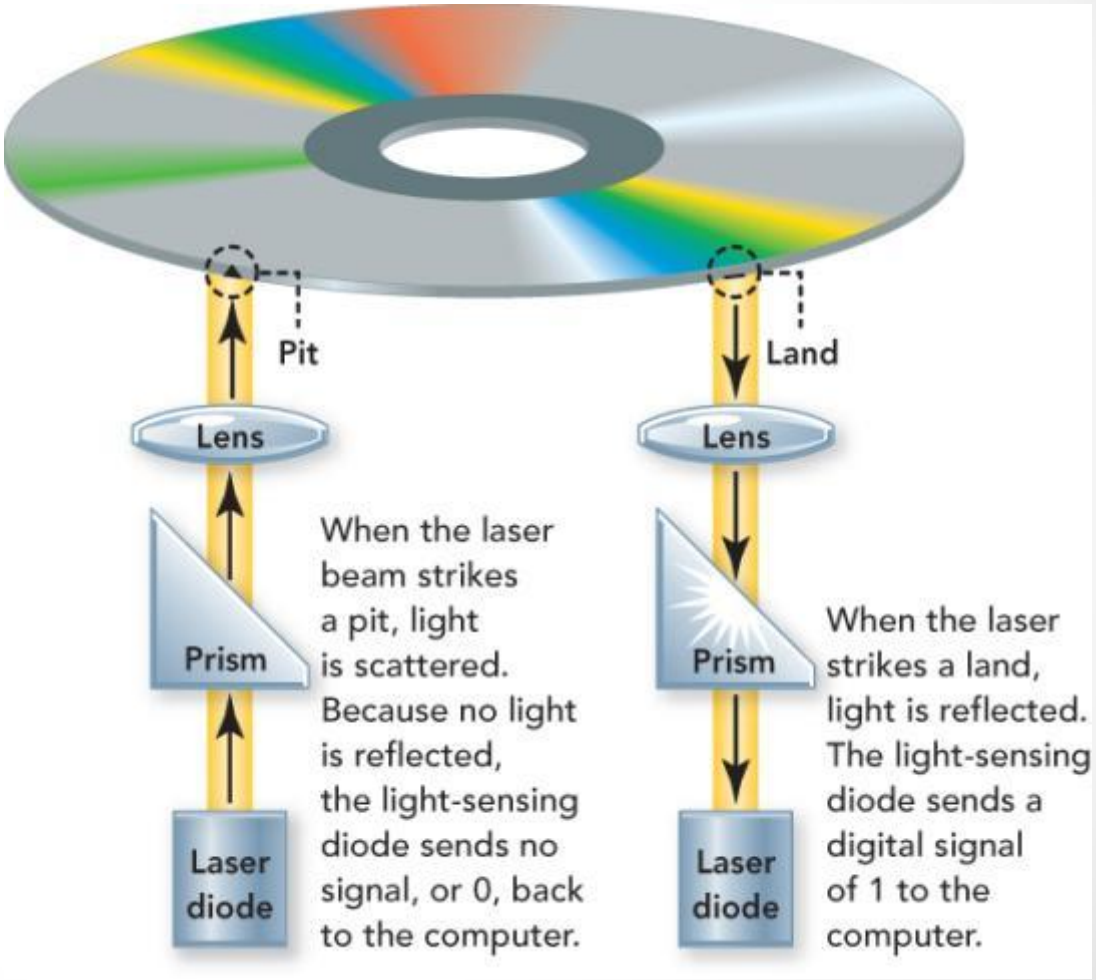
Storage: Holding Data for Future Use

- **Hybrid hard drives (HHDs)**
  - Incorporate flash technology to speed up the boot process
- **USB flash drives (memory stick, thumb drive, jump drive)**
  - Popular **portable** or **removable storage devices**
  - Replace legacy technology of floppy disks and Zip disks
  - Do not require a device driver
  - Should be removed only when not actively in use

Storage: Holding Data for Future Use

- **CD drives and DVD drives**
  - **Optical storage devices**
  - Use laser beams to store data through:
    - **Pits**, the indentations, a binary 0
    - **Lands**, the flat reflective areas, a binary 1
- **Optical discs**
  - **CD-ROM** or **DVD-ROM (compact or digital video disc read-only memory)**
  - Data can be read, not altered
  - Most popular, least expensive

Storage: Holding Data for Future Use



Storage: Holding Data for Future Use

Additional types of optical storage

- CD-R (CD-recordable)
- CD-RW (CD-rewritable)
- DVD+R (DVD recordable; plus)
- DVD-R (DVD recordable; dash)
- DVD+RW (DVD rewritable; plus)
- DVD-RW (DVD rewritable; dash)
- BD-ROM (Blu-ray Disc read only)
- BD-R (BD recordable)
- BD-RE (BDisc rewritable)

Storage: Holding Data for Future Use

- **Protect 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.

Storage: Holding Data for Future Use

- **Solid-state storage devices**
  - No moving parts
  - Nonvolatile
- **ExpressCard**
  - Notebook accessory—size of a credit card
  - Can be used as a modem, as extra memory, or as a network adapter

Storage: Holding Data for Future Use

- **Flash memory cards**
  - Solid-state storage device
  - Used with MP3 players, smartphones, digital cameras
- **Flash memory reader**
  - Slot or compartment allows access to files stored on the card

Storage: Holding Data for Future Use

- **Smart card/chip card/integrated circuit card (ICC)**
  - Combines flash memory with a small microprocessor
  - Stores and processes information
  - **Digital cash system**—smart card application enables users to purchase a prepaid amount of electronically stored money

Storage: Holding Data for Future Use

- **Holographic storage**
  - May make high-density storage possible
  - Able to create 3-D images
- **Eye-Fi wireless memory card**
  - Combines standard flash memory card features with wireless circuitry
  - Enables a direct wireless network connection to devices such as digital cameras

Storage: Holding Data for Future Use

- **Racetrack memory**
  - Under development—possible replacement for flash memory and hard drives
  - Will operate at higher speeds and consume less power

Storage: Holding Data for Future Use

- **Backup**
  - Copy of programs, data, and information created in one secondary storage medium duplicated to another
  - **Secondary storage devices,** such as USB drives and portable (external) hard drives, can be damaged or "lost."
  - Prevents permanent loss of programs, data, and information
  - Keep on a regular schedule

Summary

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