Basic Concepts of Computer Hardware

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              ┌─────────────────────────┐
              │     Primary Memory      │
              └─────────────────────────┘
                        ⇧ ⇩
┌──────────┐      ╭───────────────────────────╮      ┌──────────┐
│  Input   │      │                           │      │  Output  │
│  Units   │ ═══▶ │           CPU             │ ══▶  │  Units   │
│          │      │  (Central Processing Unit)│      │          │
└──────────┘      ╰───────────────────────────╯      └──────────┘
```
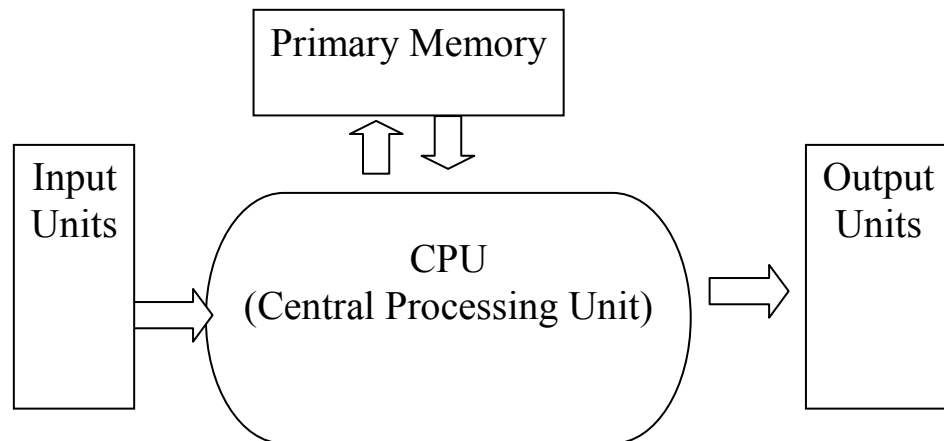
This model of the typical digital computer is often called the **von Neuman** ■ compute

• Programs and data are stored in the same memory: **primary memory.**
• The computer can only perform one instruction at a time
• Input/Output (I/O): Refers to the process of getting information into and out of the computer.
• Input: Those parts of the computer receiving information to programs.
• Output: Those parts of the computer that provide results of computation to the person using the computer.
• Two types of data stored within a computer:
• **Original data** or **information**: Data being introduced to a computing system for the first time.
• Computers can deal directly with printed text, pictures, sound, and other common types of information.
• **Previously stored data** or **information**: Data that has already been processed by a computer and is being stored for later use.
• These are forms of binary data useful only to the computer.
• Examples: Floppy disks, DVD disks, and music CDs.
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• Input Devices
• Two categories of input hardware:
• Those that deal with original data.
• Those that handle previously stored data
• Input hardware: Those that deal with original data.
• Keyboard
• Mouse
• Voice recognition hardware
• Scanner
• Digital camera
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• Digitizing: The process of taking a visual image, or audio recording and converting it to a binary form for the computer.

- Used as data for programs to display, play or manipulate the digitized data.

- Connecting Hardware to the computer:
- Hardware needs access through some general input/output connection.
- **Port**: The pathway for data to go into and out of the computer from external devices such as keyboards.
- There are many standard ports as well as custom electronic ports designed for special purposes.
- Ports follow standards that define their use.
- SCSI, USB: Multiple peripheral devices (chain).
- RS-232, IDE: Individual peripheral devices.
- **Peripheral device**: A piece of hardware like a printer or disk drive, that is outside the main computer.

- Connecting Hardware to the computer: (continued)
- Hardware needs software on the computer that can service the device.
- **Device driver**: Software addition to the operating system that will allow the computer to communicate with a particular device
- Common Basic Technologies for Storing Binary Information:
- Electronic
- Magnetic
- Optical
- Electronic Circuits
- Most expensive of the three forms for storing binary information.
- A flip-flop circuit has either one electronic status or the other. It is said to flip-flop from one to the other.
- Electronic circuits come in two forms:
- Permanent
- Non-permanent
- Magnetic Technology
- Two parts to most of the magnetic forms of information storage:
- The **medium** that stores the magnetic information.
- Example: Floppy disk. Tiny spots on the disk are magnetized to represent 0s and 1s.
- The **device** that can "read" that information from the medium.
- The drive spins the disk.
- It has a magnetic sensing arm that moves over the disk.
- Performs nondestructive reading
- Optical
- Uses lasers to "read" the binary information from the medium, usually a disc.
- Millions of tiny holes are "burned" into the surface of the disc.
- The holes are interpreted as 1s. The absence of holes are interpreted as 0s.
- Secondary Memory Input Devices
- These input devices are used by a computer to store information and then to retrieve that information as needed.
- External to the computer.
- Commonly consists of floppy disks, hard disk drives, or CD-ROMs.

- Secondary memory uses binary.
- The usual measurement is the byte.
- A byte consists of 8 binary digits (bits). The byte is a standard unit.
- The four most important characteristics of storage devices:
- Speed and access time
- Cost / Removable versus non-removable
- Capacity
- Type of access
- **Speed** (Access time) - How fast information can be taken from or stored onto the computer memory device's medium.
- Electronic circuits: Fastest to access.
- 40 billionths of a second.
- Floppy disks: Very slow in comparison.
- Takes up to 1/2 second to reach full speed before access is even possible.
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- **Cost**
- **Megabyte**: A Million bytes.
- **Gigabyte**: A billion bytes.
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- Two parts to a removable secondary storage device:
- The cost of the medium. (*Cheaper if bought in quantity*)
- The cost of the drive.

Cost for medium	Cost for drive	Examples:	
.50	59.00	Floppy drive (1.4MB)	•
10.00	99.00	Zip 100 (100 MB)	•
1.00	360.00 and up	CD-WR (650 MB)	•

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- **Type of Access**
- **Sequential** - Obtained by proceeding through the storage medium from the beginning until the designated area is reached (as in magnetic tape).
- **Random Access** - Direct access (as in floppy and hard disks).
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- **Primary storage** or **memory**: Is where the data and program that are currently in operation or being accessed are stored during use.
- Consists of electronic circuits: Extremely fast and expensive.
- Two types:
- **RAM** (non-permanent)
- Programs and data can be stored here for the computer's use.
- Volatile: All information will be lost once the computer shuts down.
- **ROM** (permanent)
- Contents do not change.
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- The Central Processing Unit (CPU)
- Often referred to as the "brain" of the computer.
- Responsible for controlling all activities of the computer system.
- The three major components of the CPU are:

1. **Arithmetic Unit** (Computations performed)   •
Accumulator (Results of computations kept here)   •
2. **Control Unit** (Has two locations where numbers are kept)   •
Instruction Register (Instruction placed here for analysis)   •
Program Counter (Which instruction will be performed next?)   •
3. **Instruction Decoding Unit** (Decodes the instruction)   •
Motherboard: The place where most of the electronics including the   •
CPU are mounted.
Output units store and display information (calculated results and other   •
messages) for us to see and use.
Floppy disk drives and Hard disk drives.   •
Display monitors: Hi-resolution monitors come in two types: •
Cathode ray tube (CRT) - Streams of electrons make phosphors glow   •
on a large vacuum tube.
Liquid crystal display (LCD) - A flat panel display that uses crystals   •
to let varying amounts of different colored light to pass through it.
Developed primarily for portable computers.   •
Audio Output Devices   •
Windows machines need special audio card for audio output.   •
Macintosh has audio playback built in.   •
Audio output is useful for: •
Music   •
CD player is a computer.   •
Most personal computers have CD players that can access both music   •
CDs and CD-ROMs.
Voice synthesis (becoming more human sounding.)   •
Multimedia   •
Specialized tasks (i.e.: elevator's floor announcements)   •
     •
     •
Optical Disks: CD-ROM and DVD   •
CD-ROM (Compact Disk - Read Only Memory)   •
By its definition, CD-ROM is Read Only.   •
Special CD drives "burn" information into blank CDs.   •
Burn: A laser is used to "burn" craters into the surface to represent a   •
binary 1.
Two main types of CDs: •
CD-R (Compact Disk - Recordable)   •
CD-WR (Compact Disk - ReWritable)   •
It takes longer to write to a CD-R than a hard drive.   •
Special software is needed to record.   •
     •
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- CD-WR (Compact Disk - ReWritable)
- It takes longer to write to a CD-R than a hard drive.
- Special software is needed to record.
- Output Devices
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- DVD (Digital Versatile Disk)
- Allows up to 17 gigabytes of storage (from 4.7 GB to 17 GB).
- Compatible with older CD-ROM technology.
- The four versions of the DVD:
- Storage Requirements: How much storage capacity is needed for…
- 1 byte (8 bits)One keystroke on a keyboard.
- 4.0 K   One page single-spaced document.
- 75 K   Nineteen pages formatted text.
- 95-110 K   One second of high-fidelity sound.
- 8.4 MG Complete word processing program.
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- Storage Capacity: How much data can be stored on…
- 4 K   One inch of 1/2 in. wide magnetic tape.
- 1.4 MG One 3 1/2" floppy disk, high density.
- 650 MG   One Compact Disk.
- up to 17 GB   One DVD.
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