Unit 2

Computer Hardware

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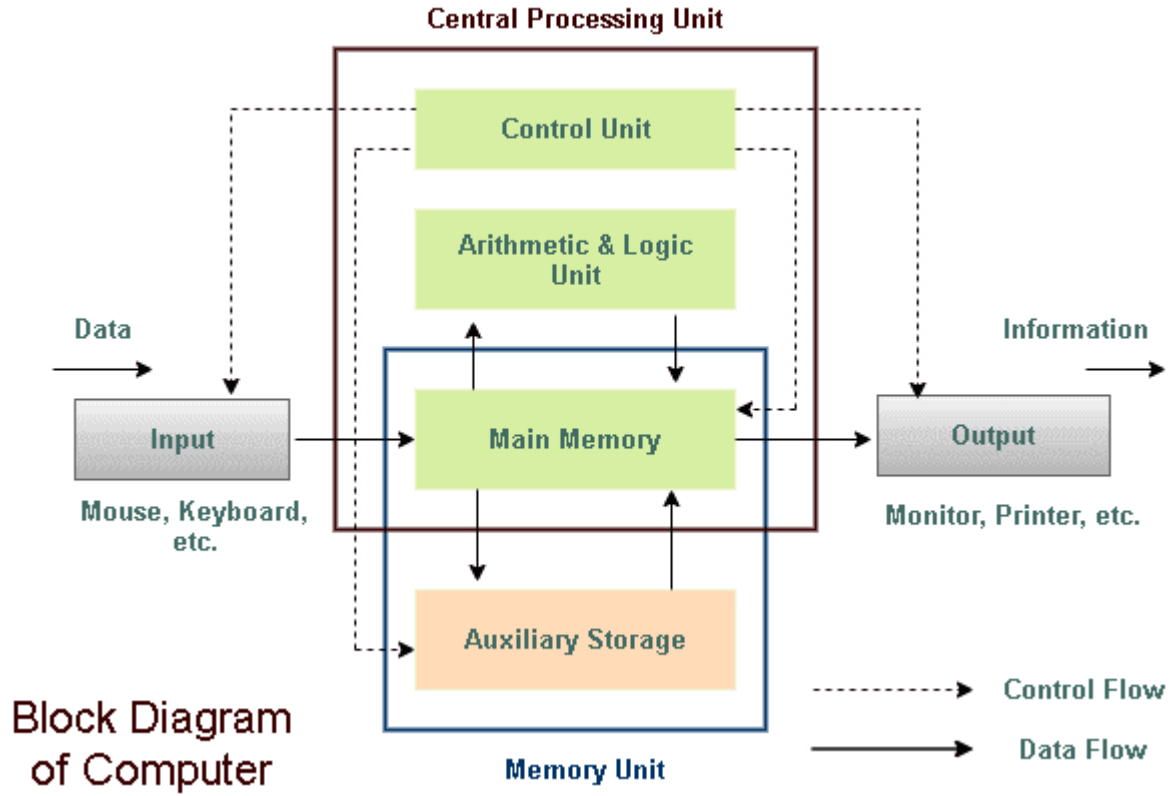
Introduction

- ✓ The system which is a combination of **hardware and software** is called computer system.
- ✓ Computer system consists of **Input devices, Processing devices, Storage devices and Output devices**.
- ✓ Thus computer system is a collection of different components which are combined each other to get certain objective.
- ✓ In other words, it is defined as **combination of Input unit, Central Processing Unit (CPU), Output unit and other parts**.

Introduction

Figure: The Elements of a Computer System showing Its Logical Structure.



Working Process/ How Data Flows

- ✓ Data flows from **input device (or backing storage) to main memory** and from **main memory to output devices (or backing storage**).
- ✓ The processor performs operations on data from the memory and returns the results of processing to the memory.
- ✓ Arithmetic-Logic Unit(ALU) and Control Unit(CU) forms a processor.
- ✓ Processor is also kown as Central Processing Unit (CPU) or Central Processor (CP).
- ✓ Data held in Auxillary Storage/ Backing Storage maybe input to main memory during processing which after processed with the input data is returned back to backing storage or Output devices as well.

Functional Components of Computer

1. Input Unit
2. Central Processing Unit (CPU)
3. Output Unit
4. Memory Unit (Main Memory, Auxilliary Storage)

Functional Components of Computer

1. **Input Unit**

- ✓ Interface between User and Machine for inputting data and instruction into the computer memory.
- ✓ input Unit accepts input, converts it into a computer-readable format, and provides it for processing and storage.

For example, Keyboard, Mouse, Microphone, Barcode reader, Scanners etc.

Functional Components of Computer

2. Central Processing Unit

- ✓ Responsible for processing inputs/ data and controlling all the operations of the computer.

Composed of three sub-units:

a. **Arithmetic Logic Unit (ALU):** Performs arithmetic calculations and logical operations.
b. **Control Unit (CU):** Directs the flow of data and controls the operations of other components.
c. **Register Array:** Responsible for storing data and instructions temporarily during processing.

Functional Components of Computer

3. Memory Unit

✓ Stores data and instructions temporarily or permanently .

Types of memory:

❑ **Primary Memory (Random Access Memory):**

✓ Temporarily holds data for active processes.
✓ Only the memory directly accessible by CPU.
✓ For example, RAM, Cache Memory.

❑ **Secondary Storage (Hard Drives, SSDs):**

✓ Permanently stores data and files.
✓ It is not directly accessible by CPU which requires primary memory for its operations.
✓ For example, Hard Disk, DVD, Pendrive, etc.

Functional Components of Computer

4. Output Unit

- ✓ It provides the result after processing to the users.
- ✓ It converts the output into a user understandable format before providing it to the users.

Types of output:

a. Softcopy Output

- ✓ Output generated by monitor, speaker, and projectors.
- ✓ Modification Possible.

b. Hardcopy Output

- ✓ Output generated by printers and plotters.
- ✓ Modification not possible.

Central Processing Unit (CPU)

- ✓ Performs different types of mathematical and logical operations and which control all the devices connected with it.
- ✓ The processor is also called Brain of computer system which is a special kind of Integrated Circuit(IC) and which may be programmed and applied to wide range of applications.
- ✓ The CPU is linked with different peripherals equipment, including input and output devices and auxiliary storage and primary storage.

Functions:

- ✓ Carry out processing and give commands to all parts of computer.
- ✓ Control of sequence of operations.
- ✓ Control of storage of data or instructions.
- ✓ Perform simple to complex calculations.

Arithmetic Logic Unit (ALU)

- ✓ Performs logic and mathematical computations and control the speed of those operations as directed by Control Unit (CU).
- ✓ It executes **logical** and **Comparison** testing.
- ✓ ALU performs following calculations as,

a. Addition, Subtraction, Multiplication and Division.
b. Logical AND, Logical OR, Logical Exclusive – OR and Logical NOT (Complement)
c. Increment (Addition of 1) and decement (Subtraction of 1).
d. Act as gateway between primary memory and secondary memory.
e. Clear, Left or Right Shift Operations.

Control Unit (CU)

- ✓ Directs the movement of electronic signals between main memory , ALU and IO devices.
- ✓ Control unit acts as a nerve system of Computer.
- ✓ The control unit has a electronic clock that transmits electronic pulse at an equal interval of time **which gives instruction to other devices based on these pulses.**
- ✓ Consists of components like decoder, flag, quartz crystal and control logic circuits.

Functions of Control Unit (CU)

- ✓ Controls and coordinates the sequence of data movements around ALU, registers, memories, IO devices.
- ✓ Analyses and interprets each instructions in the program and sends the relevant control signals to other devices.
- ✓ Provides status of each and every device connected to computer to know its functionality.
- ✓ Handle multiple task like fetching (Retriving instructions from memory), decoding (Interpreting the instructions), execution handling, and storing results.

Working Procedure of Control Unit (CU)

- ✓ Fetcher receives commands from an application .
- ✓ Decoder interprets the instructions and take actions.
- ✓ It sends signals to the ALU or directs registers to perform specific tasks.
- ✓ The control unit transmits signals to different sections of the microprocessor and registers, which inform these componenets to execute actions.
- ✓ CU sends signals that synchronize and ensure the timely execution of commands and processes.

Classwork:

1. Explain the different components of Computer with its logical diagram.

Registers

- ✓ A register in computer hardware refers to a **small, fast storage location within a processor (CPU) that holds data temporarily during processing**.
- ✓ Registers are used for various operations, such as **holding intermediate results of computations or controlling the execution of instructions**.
- ✓ Registers allow the CPU to quickly access data for arithmetic and logic operations.

Registers are commonly required during processing such as,

- The address of next instruction to be executed.
- The current instruction being decoded.
- The results of frequently used calulations in small amounts of data.

Common Types of Registers

- **Memory Address Register (MAR):**
- Holds the address of the memory location for data that is about to be accessed (read from or written to) in the memory.
- Its role is to point to the location in memory where data is stored or retrieved.
- **Memory Buffer Register (MBR):**
- Holds the data being transferred to or from memory.
- Temporarily stores data that is read from or written to the memory.
- When data is fetched from memory, it's stored in the MBR before being processed.
- When data is written to memory, it is loaded from the MBR.

Common Types of Registers

- **Program Counter Register (PCR)**
- Holds the address of the next instruction to be fetched and executed.
- Keeps track of the instruction sequence in a program.
- Automatically increments after each instruction fetch to point to the next one.
- Plays a critical role in instruction flow.

- **Accumulator Register (AR)**
- Holds the intermediate results of arithmetic and logic operations.
- Stores the result of operations such as addition, subtraction, etc., before they are moved to memory or used in further operations.
- Frequently involved in data processing tasks.

Common Types of Registers

- **Instruction Register (IR)**
- Stores the instruction that has been fetched from memory.
- Decodes and executes the instruction by passing it to the appropriate part of the CPU.

- **Input/Output Register (IO Register)**
- Facilitates data transfer between peripheral devices (e.g., keyboard, display, hard drive) and the CPU.
- I/O registers hold data being received from or sent to peripherals.

Clock Speed

- ✓ Clock speed (also known as clock rate) refers to the speed at which a processor can execute instructions.
- ✓ It is measured in **Hertz (Hz), Megahertz (MHz) and Gigahertz (GHz)** which represents the number of cycles per second.
- ✓ Higher clock speed means the processor can complete more cycles per second, which generally results in faster execution of tasks.
- ✓ For example, a processor with a clock speed of 3 GHz can perform 3 billion cycles per second.

Word Length

Word length refers to the number of bits that a computer's processor can handle or process in one cycle or operation.
It's typically measured in bits, such as 16-bit, 32-bit, or 64-bit.

Case Study:
A 16-bit system can process 16 bits of data at a time, while a 64-bit system can process 64 bits at once. A longer word length enables a system to handle more data at once, which can improve performance, especially with large datasets or complex computations.

Classwork:

Q1. Do research on special purpose registers like Stack Pointer, Status Register and Index Register and write it.
Q2. Do you think Clock speed and word length are interrelated? Explain why?

Interconnecting the Units of a Computer

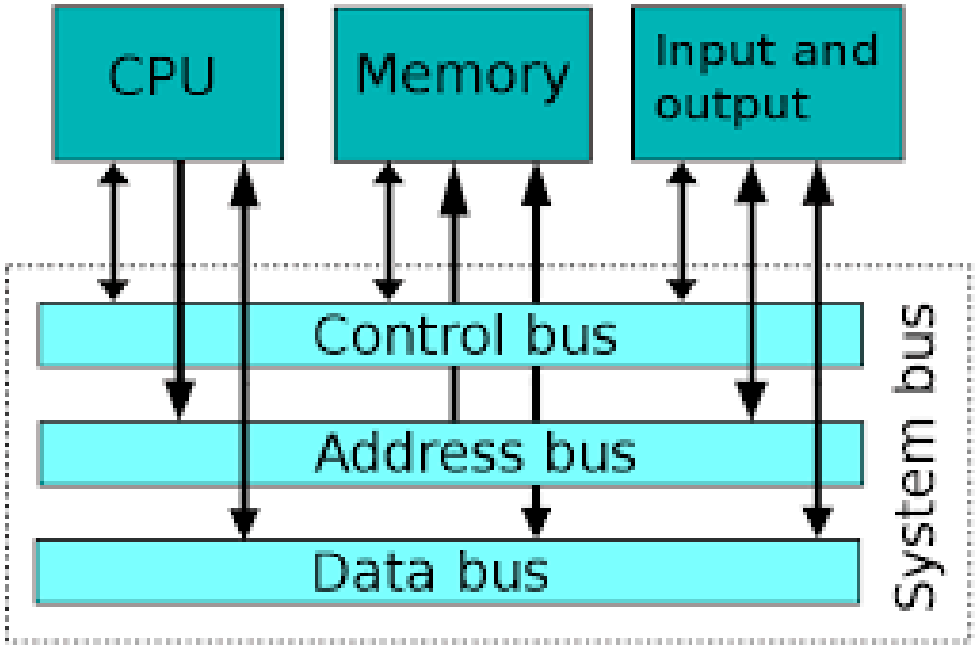
- ✓ In computer architecture, different units of the computer are connected by bus.
- ✓ A **Bus** is a **collection of wires, chips, and slots** inside the computer that **connects different components of the computer**.
- ✓ Data and instructions are transmitted from one part of computer to another, in and out from peripheral devices through the bus.
- ✓ It connects all the internal components to CPU and main memory.

The bus consists of three main parts as,

- ✓ Control Bus
- ✓ Address Bus
- ✓ Data Bus

Interconnecting the Units of a Computer

Figure: Bus Architecture



Interconnecting the Units of a Computer

- ❑ Control Bus
- ✓ It carries the control signal which is used for controlling and coordinating different activities across the computer.
- ✓ It generation is from the Control Unit of the CPU.
- ✓ The control bus ensures that data is transferred correctly and that the operations between the CPU and peripherals are synchronized.
- ✓ It helps in managing access to shared resources, like memory or I/O devices.

The control bus transmits various types of signals like Read/ Write Signals, Clock Signals, Interrupt Signals, Status Signal, Reset Signals and many more.

Interconnecting the Units of a Computer

- ❑ Address Bus
- ✓ It carry the memory address and allows the CPU to reference memory locations within the device.
- ✓ It connects the CPU and other peripherals and carries only memory addresses.
- ✓ The address Bus is unidirectional, bits flows in one direction, from processor to perpherals.

For instance, If the address bus could carry 8 bit at a time, the CPU could address only 2^8 = 256 bytes of RAM.

- ✓ Wider the bus path, more information can be processed at a time, which overall also afftects the processing speed of a computer.

Interconnecting the Units of a Computer

- ❑ Data Bus
- ✓ Data bus transfers data from one location to another across the computer.
- ✓ The CPU uses a data bus to transfer a data.
- ✓ It is an electrical path that connects the CPU, memory, and hardware devices on the motherboard.
- ✓ These lines are bidirectional, data flow in both directions between the processor and memory and peripheral devices.
- ✓ Normally used data bus are 16-bit or 32-bit.
- ✓ Each wire can transfer 1 bit of data at a time.
- ✓ An 8 wire bus can move 8-bit of data at a time, which is 1 Byte of data at a time.
- ✓ So, data transfer rate also depends on the width of data bus.

Inside a Computer Cabinet

Components that are required to operate a computer.
Major components inside the computer cabinet are: **Motherboard, hard disk or SSDs (Solid State Disk), RAM, CPU/ Processor, Cooling Fan, and SMPS (Switch Mode Power Supply).**

Power Supply

RAM

CPU Fan

Motherboard

CPU

DVD ROM Drive

Hard Disk

Inside a Computer Cabinet

1. **Motherboard:** It holds and control all the electronic components together like CPU, RAM, Hard disk, BIOS, CMOS, expansion slots, etc.
2. **Hard disk/ or SSD:** It is used for permanent storage of data. SSD is comparitvely faster but expensive than normal hard disk.
3. **RAM:** it is a volatile memory that can hold data only till the computer is in ON state. It is used to store data instructions required by CPU for processing.
4. **CPU/ Processor:** It is responsible for processing the input and controlling all the operation of the computer. CPU of micro computer is known as micro processor.
5. **Cooling Fan**: It is used to control the temperature produced by the heating of the microprocessor.
6. **SMPS (Switch Mode Power Supply):** It is the power controller of the computer. It is used to provide electrical current to all the components of the computer. It also convert AC current to DC.

Computer Memory

- ✓ Memory is the part of computer system that is used to storage data or instruction (Program) temporarily and permanently.

- ✓ The digital computer contains **Primary Memory** and **Secondary Memory**.

- ✓ Primary Memory (RAM) stores programs along with data temporarily which is to be executed, and it also stores essential programs for the operation of the computer.
- ✓ Secondary memory stores Operating system, data and application programs permanently.
- ✓ Hard disk, Tape Drives, CD, DVD, pen drives are secondary storage devices.

Computer Memory

- ✓ CPU contains necessary circuitry for data processing and controlling other components of the computer.
- ✓ However, it doesnot have a place to store programs and data needed during data processing.
- ✓ We also knew that the CPU contains several Registers for storing data and instructions but they can store only a few bytes at a time.
- ✓ They are just sufficient to hold only one or two instructions with corresponding data.
- ✓ If the instructions and data of a program being executed by a CPU were to reside in secondary storage like a hard disk which is fetched and loaded one by one into CPU Registers as the program execution proceeded, this could lead to the CPU being idle most of the time.

Computer Memory

- ✓ This is because there is a large **speed difference between the rate at which CPU can process data** and the **rate at which data can be transferred from disk to CPU registers**.

For example,
Problem Statement: A CPU can process data at the rate of about 5ns /byte and a disk reader can read data at a speed of about 5 µs /byte. Hence within the time in which a disk can supply one byte of data, a CPU can process 1000 bytes. This could guide to a very slow overall performance even if a computer used a very fast CPU.

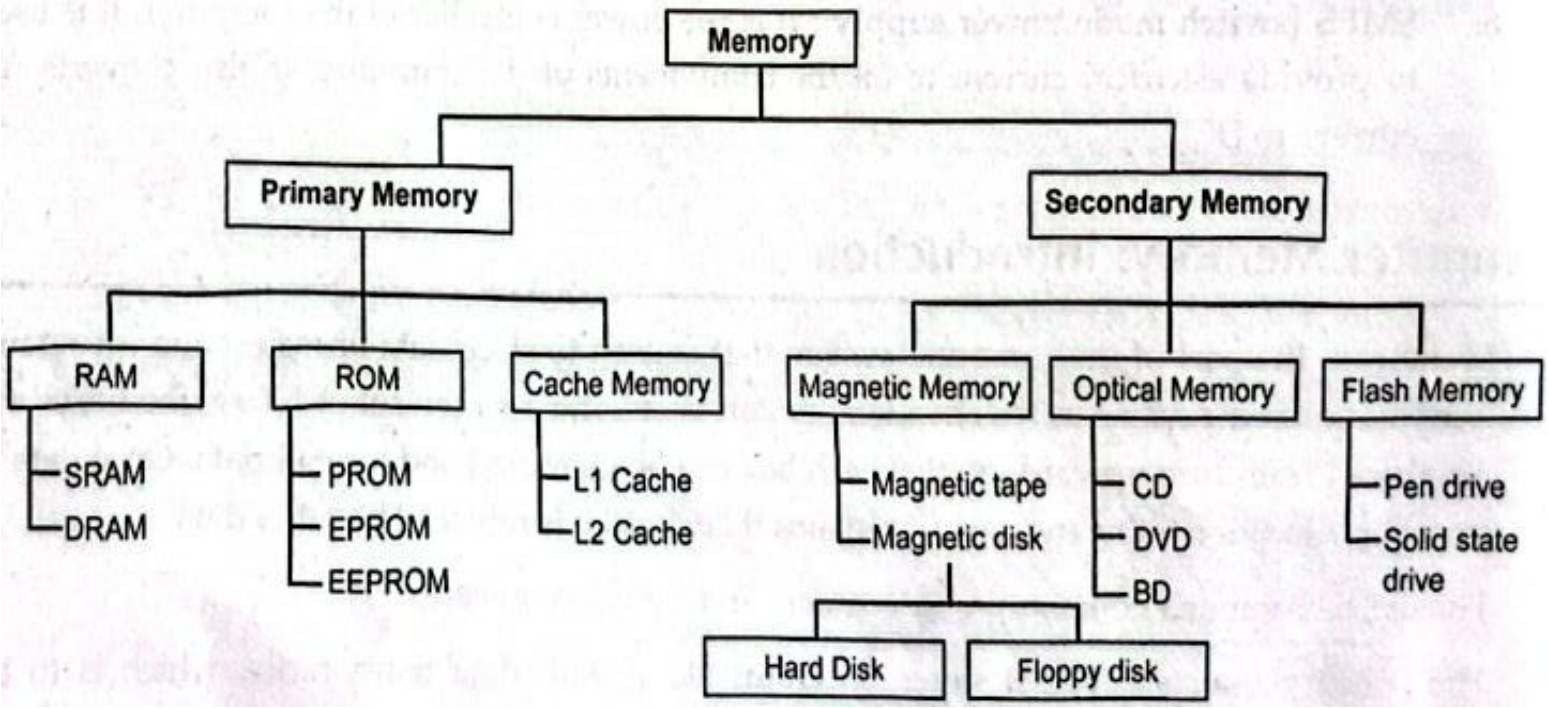
Computer Memory

Solution: In order to resolve this issue, main memory is introduced to eliminate the issue of speed mismatch problem with CPU speed. These are the temporary storage that reside nearby CPU which comprises of Integrated Circuits (IC). So it helps to resolve the issue of speed mismatch.

Classwork:

1. How can we resolve speed mismatch issues inside a computer?
2. What is a Bus? Explain different types of Bus used in Computer System?

Figure: Hierarchical classification of computer memory



Classification of memory based on Technological View

1. Semiconductor Memory

- ✓ Memory built using semiconductor components like transistors, IC, etc.
- ✓ Faster and has smaller storage capacity and consumes less power.
- ✓ Used as a main memory in computer.
- ✓ Example, RAM, Cache memory, etc.

2. Magnetic Memory

- ✓ Uses magnetic property for storage of data.
- ✓ Stores data in the form of magnetized dots.
- ✓ Slower to read/write operation however cheaper than Semiconductor memory.
- ✓ For example, Hard disk, Pen drive, etc.

Classification of memory based on Technological View

3. Optical Memory

- ✓ It uses optical property (Reflection of Light) to read/write operation of the data.
- ✓ Slower and cheaper than semiconductor memory.
- ✓ For example, CD, DVD, etc.

Memory Representation

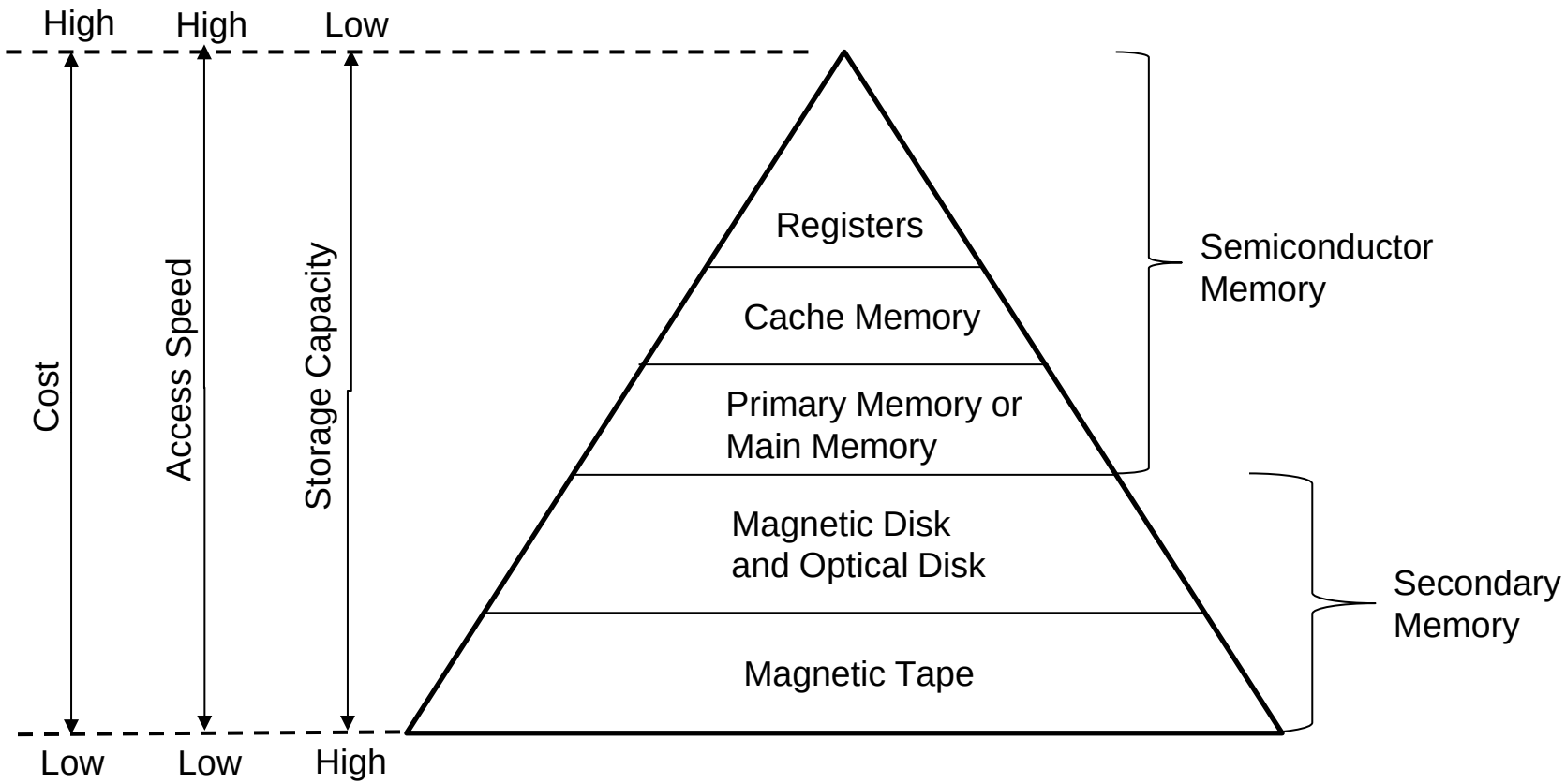
- ✓ Computer memory stores data in the form of machine codes. i.e. 0 and 1.
- ✓ A bit is the smallest unit of memory.
- ✓ The **storing capacity** of computer is measured in terms of **byte, kilobyte, megabyte, gigabyte, and terabyte.**

Memory Capacity Representation
4 Bits = 1 Nibble
8 Bits = 1 Byte (B)
1024 Bytes = 1 Kilobytes (KB)
1024 Kilobytes = 1 Megabytes (MB)
1024 Megabytes = 1 Gigabytes (GB)

Memory Hierarchy

- ✓ The memory is characterised based on two key factors: **Capacity and Access Time**.
- ✓ **Capacity** is the amount of information (in bits) that a memory can store.
- ✓ **Access time** is the time interval between the Read/Write, Request and the availability of data.
- ✓ The **lesser the access time**, the **faster is the speed of memory**.
- ✓ We want the memory with fastest speed and largest capacity, however the cost of fast memory is very high.
- ✓ The computer uses a hierarchy of memory that is organized in a manner to enable the fastest speed and largest capacity of memory.

Memory Hierarchy



Memory Hierarchy

- ✓ The internal memory consists of the CPU registers, cache memory and Primary memory.
- ✓ The internal memory is used by the CPU to perform the computing tasks.
- ✓ The external memory is also called secondary memory.
- ✓ The secondary memory is used to store the large amount of amount of data and the software.

Memory Hierarchy

With respect to CPU, memory is organized as,

1. Registers:

- ✓ Small, fast storage inside the CPU. Stores data actively being processed. The access time is measured in nanoseconds (ns) and is extremely fast.

2. Cache Memory:

- ✓ High-speed memory close to the CPU. Stores frequently used data to speed up processing.
- ✓ Divided into L1, L2, and L3 caches (L1 is fastest, L3 is largest).
- ✓ Cache memory has low access time, typically around 1 to 10 ns.
- ✓ It’s faster than main memory but slower than registers.

Memory Hierarchy

With respect to CPU, memory is organized as,

3. Primary Memory (RAM):

- ✓ Temporary storage for data and instructions in use.
- ✓ Slower than cache, but larger in size.
- ✓ Access times for RAM are typically in the range of 50 to 100 ns.

4. Secondary Storage:

- ✓ Permanent storage for data and instructions in use.
- ✓ Slower than RAM, used for long-term data storage.
- ✓ Access times for secondary storage is measured in milliseconds (ms).

Example:- HDD, SSD.

Classwork:

1. Explain memory hierarchy with suitable diagram.

Primary Memory

- ✓ Primary Memory refers to the main memory of a computer system that stores data and instructions that are actively being processed by the CPU.
- ✓ It is volatile, meaning it loses all data when the system is powered off.
- ✓ Primary memory enables quick access to data, ensuring efficient execution of programs and processes.

Features of Primary Memory

- ✓ **Volatility:** Data is lost when power is turned off (e.g., RAM).
- ✓ **High-Speed Access:** Provides fast data retrieval for processing, much faster than secondary storage devices like hard drives or SSDs.
- ✓ **Temporary Storage:** Used to temporarily store data and instructions that are in use or being processed.
- ✓ **Direct Access by CPU:** CPU can directly access the data stored in primary memory, enabling efficient computation and program execution.
- ✓ **Capacity:** Relatively smaller capacity compared to secondary storage but is crucial for fast execution of tasks.

Types of Primary Memory

1. RAM (Random Access Memory):
A type of memory that stores data and instructions that are actively being used or processed by the CPU.

Types of RAM
a. Dynamic RAM (DRAM):
- ✓ Requires constant refreshing of data.
- ✓ Slower and less expensive.

b. Static RAM (SRAM):
- ✓ Does not need to be refreshed, faster than DRAM but more expensive.
- ✓ Expensive however faster to read/ write than DRAM.

Difference between SRAM and DRAM (Important)

Feature	SRAM (Static RAM)	DRAM (Dynamic RAM)
Data Storage Mechanism	Stores data using flip-flops (transistor circuits)	Stores data in capacitors that require refreshing
Speed	Faster due to simpler architecture and no refreshing	Slower because of periodic refreshing requirement
Complexity and Size	More complex and larger in size due to more transistors	Simpler and smaller in size due to fewer components
Cost	More expensive to manufacture	Cheaper to produce due to simpler design
Power Consumption	Consumes less power during operation	Consumes more power due to the need for refreshing

Read Only Memory (ROM)

- ✓ ROM is a type of non-volatile memory that is used primarily for storing firmware or software that is permanently programmed during manufacturing.
- ✓ It retains its data even when the system is powered off.
- ✓ Typically, data is written during manufacturing and cannot be modified (or can only be modified under certain conditions).

Difference between RAM and ROM (Important)

Feature	RAM (Random Access Memory)	ROM (Read-Only Memory)
Definition	Volatile memory used for temporary data storage during system operation.	Non-volatile memory used for storing permanent instructions or firmware.
Volatility	Volatile: Data is lost when the system is powered off.	Non-volatile: Data is retained even when the system is powered off.
Read/Write Operations	Both read and write operations are possible.	Primarily read-only; data can only be written during manufacturing or under specific conditions.
Usage	Stores data actively being used by the CPU (e.g., program data, system processes).	Stores system firmware, boot instructions, or permanent data (e.g., BIOS).
Speed	Faster than ROM, allowing quick access to data for processing.	Slower than RAM as it is mainly designed for permanent storage rather than active data access.
Capacity	Larger capacity (in the range of gigabytes in modern systems).	Smaller capacity compared to RAM, as it stores limited and fixed data.

Types of Read Only Memory (ROM)

1. PROM (Programmable Read-Only Memory):

- ✓ A type of ROM that can be programmed by the user after manufacturing using a special device.
- ✓ Once programmed, data is permanent (cannot be changed or erased).
- ✓ Used for storing firmware or configuration data.

2. EPROM (Erasable Programmable Read-Only Memory):

- ✓ A type of ROM that can be erased and reprogrammed.
- ✓ Erased using ultraviolet (UV) light, allowing the memory to be reprogrammed.
- ✓ Typically used in situations where updates to firmware or software are required.

Types of Read Only Memory (ROM)

3. EEPROM (Electrically Erasable Programmable Read-Only Memory):

- ✓ A type of ROM that can be electrically erased and reprogrammed.
- ✓ Can be rewritten multiple times by applying electrical voltage.
- ✓ Allows individual bytes of data to be rewritten, unlike EPROM that erases the entire chip.
- ✓ Used in applications like BIOS, firmware updates, and embedded systems.

Classwork:

1. **What are the differences between Primary Memory vs. Secondary Memory?**
2. **Explain types of RAM and ROM.**
3. **Do research and write full form for following: BIOS, CD, DVD, USB, HDMI, PROM, EPROM, EEPROM.**

Cache Memory

- ✓ Cache memory is a small, high-speed storage area located inside or near the central processing unit (CPU) of a computer.
- ✓ Its primary purpose is to **store frequently accessed data and instructions, reducing the time the CPU takes to fetch this information from slower main memory (RAM).**
- ✓ Cache memory significantly improves the performance of a computer system by speeding up data access.

Cache Memory

Types of Cache Memory: Internal (Present inside CPU) and External Cache (Present outside CPU).

Levels of Cache:

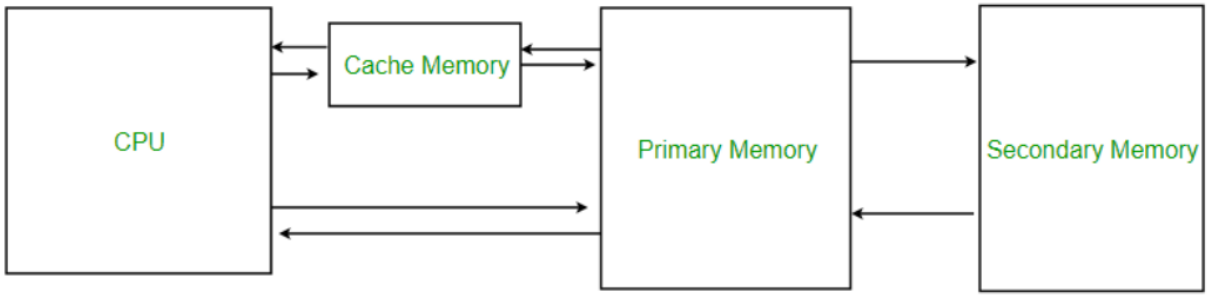
L1 Cache:

- ✓ This is the primary and smallest cache, located directly inside the CPU.
- ✓ It is extremely fast but limited in size (typically 32KB to 128KB).

L2 Cache:

- ✓ Slightly larger and slower than L1.
- ✓ L2 cache is also located close to the CPU, often on the same chip, but may be separate in some designs (typically ranging from 128KB to several MB).

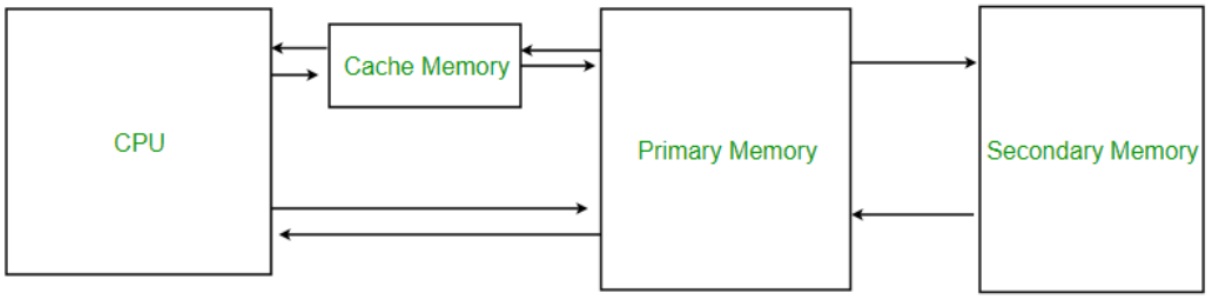
Relationship among Cache Memory, Primary Memory and Secondary Memory



Working Procedure: Cache → Primary Memory:

- ✓ Cache memory stores frequently accessed data that is typically retrieved from primary memory.
- ✓ If the data the CPU needs is in the cache, it is processed quickly called *cache hit*.
- ✓ If not, it is fetched from primary memory (RAM). Also known as *cache miss.*

Relationship among Cache Memory, Primary Memory and Secondary Memory



Primary Memory → Secondary Memory:

- ✓ Data and programs that are not in use can be stored in secondary memory (hard drive or SSD).
- ✓ When the CPU needs data that is not in RAM, it is retrieved from secondary storage, which takes more time compared to accessing RAM.

Video memory (also called VRAM for Video RAM)

- ✓ Specialized type of memory used to store image data and frame buffers, primarily for the display and processing of visual information by the computer's graphics processing unit (GPU).
- ✓ It plays a crucial role in rendering graphics, especially for tasks that require intensive visual computation, such as video games, 3D modeling, and video editing.

Buffer

- ✓ Buffers hold data temporarily before it is processed or transferred.
- ✓ The data can be written into the buffer from one device or component and read out by another.
- ✓ Buffer usually use a First In – First Out (FIFO) arrangement.
- ✓ Buffers are primarily **used to manage differences in data transfer rates or processing speeds between devices or components, ensuring smooth data flow without data loss or delays**.

Example of Buffer Usage in Printing (Spooling)

1. **User sends a print job:** The computer sends data to the printer through a USB or wireless connection.
2. **Printer buffer receives data:** The printer buffer stores the incoming print job data.
3. **Printer processes and prints:** As the printer prints the first set of pages, it simultaneously pulls the next set of data from the buffer.
4. **If printer is slow or busy:** The printer can keep pulling data from the buffer while it processes and prints, ensuring that the printing job continues seamlessly.

Secondary Memory

- ✓ Also Known as **Secondary storage or Auxilliary memory**.
- ✓ Non-volatile storage used to store data permanently or for extended periods.
- ✓ Unlike primary memory (RAM), which is temporary and loses its content when the computer is turned off, secondary memory retains data even when the system is powered down.
- ✓ It is used to store operating systems, applications, files, and other data that don't need to be immediately accessed by the CPU.

Features of Secondary Memory

- ✓ **Non-Volatile:** Retains data even when powered off.
- ✓ **Large Capacity:** Offers much larger storage (GB to TB) than primary memory.
- ✓ **Slower Access:** Slower data access compared to RAM.
- ✓ **Cost-Effective:** More affordable per GB than primary memory.
- ✓ **Variety of Devices:** Includes HDDs, SSDs, optical discs, flash drives, and cloud storage.
- ✓ **Removable or Non-Removable:** Some devices are portable (USB drives), others are fixed (internal HDDs/SSDs).
- ✓ **Data Backup:** Used for long-term storage, backup, and archiving.
- ✓ **Random Access:** Allows random access to stored data (except sequential devices like tapes).

Magnetic Memory

- ✓ Magnetic memory refers to a type of storage that **uses magnetic fields to record and retrieve data**.
- ✓ It is primarily used in devices such as **hard disk drives (HDDs), magnetic tapes, and floppy disks**.
- ✓ Magnetic memory is a form of **non-volatile** storage, meaning it retains data even when the power is turned off.

Components of Magnetic Memory:

- ✓ **Structure:** Consists of flat, circular plates made of aluminum or glass, coated with a magnetic material.
- ✓ **Data Organization:** Data is stored on the disk in concentric tracks.
- ✓ **Magnetic Head:**
- **Write:** Writes binary data (1s and 0s) by magnetizing tiny spots on the spinning disk in different directions.
- **Read:** Reads data by detecting the magnetization direction of the spots.
- ✓ **Hard Drive Components:** Includes several hard disks, read/write heads, a drive motor, and protective circuitry, all sealed in a metal case.

Lets Explore how Magnetic Memory works by watching this video:
https://www.youtube.com/watch?v=owlxKEMgB_M

Classwork:
Q. What did you learn after watching this video? Please write down how magnetic memory works?

Access types of Storage Devices

1. **Sequential Access**

- ✓ Data is stored in a **predefined order**, and to access a particular piece of data, you must read through the data in the sequence it was written until you reach the desired location.
- ✓ You cannot skip directly to a specific part.
- ✓ For example, Magnetic Tapes, Optical Discs (CD/DVD), some types of backup systems, and older storage media.

Access types of Storage Devices

2. Direct Access

- ✓ Data can be retrieved directly from any location on the storage device, without having to read through other data.
- ✓ This allows the device to access any part of the storage independently and immediately.
- ✓ For Example, Hard Disk Drives (HDDs), Solid-State Drives (SSDs), USB Flash Drives, RAM, Optical Discs (with random access modes).

Difference between Direct Access vs. Sequential Access

Feature	Direct Access	Sequential Access
Data Retrieval	Can access any part of the data directly, in any order.	Must access data in the order it was stored.
Efficiency	Fast when accessing specific data points.	Efficient for large, continuous data processing.
Access Time	Consistent and fast, regardless of data location.	Slower when accessing random locations, fast for sequential access.
Devices	HDDs, SSDs, USB Flash Drives, RAM, Optical Discs (random access).	Magnetic Tapes, Optical Discs (sequential use).
Typical Use Cases	Personal computing, databases, gaming, file access.	Backup, archival storage, video/audio streaming.

Magnetic tape

- ✓ Magnetic tape is a type of storage medium that uses a magnetic material to store data in a linear (sequential) format.
- ✓ It is a well-established storage technology, primarily **used for backup, archival storage, and data transfer** in various industries.

Advantages

- ✓ **Cost-Efficient:** Magnetic tape offers the lowest cost per unit of storage compared to most modern disk-based storage options.
- ✓ **High Capacity:** Tape cartridges can store vast amounts of data in a relatively small physical space.
- ✓ **Long-Term Reliability:** Tapes can retain data for decades when properly stored and are less likely to degrade quickly compared to hard drives.
- ✓ **Portability:** Tapes are small, lightweight, and easy to transport, making them ideal for offsite storage.

Magnetic tape

Limitations:

- ✓ **Slow Access Time:** The primary drawback of magnetic tape is the slower access time due to its sequential nature.
- ✓ **Wear and Tear:** While magnetic tapes are durable, they can degrade with repeated use, and improper handling can damage them.
- ✓ **Prone to dust:** Dusty environment can cause tape reading errors.

Floppy disk (Also called Diskette)

- ✓ A floppy disk is a type of magnetic storage medium that was widely used in the late 20th century for data storage and transfer.
- ✓ It consists of a **thin, flexible disk coated with a magnetic material and enclosed in a plastic casing**.
- ✓ Data is stored as electromagnetic charges on iron oxide film that coats the Mylar Pastic.
- ✓ Data is stored and retrieved using a read/write head, similar to other magnetic storage devices like hard disks.

Hard Disk Drive vs. Floppy Disk

Feature	Hard Disk Drive (HDD)	Floppy Disk
Storage Capacity	GBs to TBs (hundreds of GBs to several TBs)	1.44 MB to 2.88 MB
Data Transfer Speed	Fast (100-200 MB/s)	Slow (500 KB/s to 1 MB/s)
Size	Larger (3.5-inch or 2.5-inch for internal, portable)	Small (3.5-inch, 5.25-inch, or 8-inch)
Durability	More durable, but sensitive to physical shock	Prone to physical damage, easy to wear out
Technology	Rigid platters, random access, spinning at high RPMs	Flexible disk, sequential access, slower rotation

Optical Disk Memory

- ✓ Data storage that **uses laser technology** to read and write data on the surface of an optical disc.
- ✓ Unlike magnetic storage devices like hard disks or floppy disks, optical discs **use light (laser beams) to detect and modify data** stored as tiny marks (pits) on the disc's surface.
- ✓ The two most common types of optical disks are **CDs (Compact Discs) and DVDs (Digital Versatile Discs)**, although there are other formats such as Blu-ray Discs.

Advantages of Optical Disk Memory

- ✓ **Portability:** Optical discs are lightweight and easy to carry, making them convenient for transferring data or storing data off-site.
- ✓ **Durability:** Optical discs are relatively durable compared to other media like floppy disks or magnetic tapes. They are resistant to damage from magnetic fields.
- ✓ **Low Cost:** Blank optical discs (e.g., CD-R, DVD-R) are inexpensive, especially in bulk, making them an affordable solution for storing small to medium amounts of data.
- ✓ **Long Shelf Life:** When stored properly, optical discs have a long lifespan, often 20+ years or more, making them suitable for archival storage.

Drawbacks of Optical Disk Memory

- ✓ **Fragility:** Optical discs are prone to scratches, fingerprints, and other surface damage, which can render them unreadable or cause data loss.
- ✓ **Limited Reusability:** While some discs are rewritable (e.g., CD-RW, DVD-RW), many optical discs are write-once (e.g., CD-R, DVD-R), limiting flexibility for long-term use.
- ✓ **Compatibility Issues**: Many modern laptops and desktops no longer come with optical drives, reducing compatibility and accessibility for users who still rely on optical media.
- ✓ **Limited Storage capacity.**

Magneto-Optical Disk

- ✓ Rewritable disk that makes the use of both magnetic disk and optical technologies.

Features:

- ✓ **Magnetic and Optical Combination:** Uses laser heating and a magnetic field for writing; laser alone for reading data by detecting changes in magnetization.
- ✓ **Data Write/Erase:** Rewritable; data can be written, erased, and rewritten multiple times, offering more flexibility than write-once media (e.g., CD-R, DVD-R).
- ✓ **Capacity:** Typically ranges from 128 MB to 9 GB, depending on the format and disk technology.
- ✓ **Durability:** More durable than traditional optical discs due to the magnetic layer, which protects against scratches and physical damage.

How the Computer Uses its Memory

Step 1: Power-On

- ✓ Press the power button to turn on the computer.
- ✓ The power supply is activated, sending power to the motherboard and other components.

Step 2: POST (Power-On Self Test)

- ✓ The BIOS or UEFI runs the POST, checking essential hardware components (CPU, RAM, storage, etc.) to ensure they are functioning correctly.
- ✓ If everything passes, it moves to the next step; otherwise, an error message is displayed.

Step 3: Loading the Bootloader

- ✓ BIOS/UEFI locates and loads the bootloader from the storage device (SSD or HDD).
- ✓ The bootloader is a small program responsible for starting the operating system.

Step 4: Operating System Initialization

- ✓ The operating system (OS) is loaded into RAM from the storage device.
- ✓ The OS starts essential background services and configures system devices.

Step 5: Memory Allocation

- ✓ The OS allocates RAM to running applications and processes.
- ✓ Cache memory is used to store frequently accessed data to speed up the process.

How the Computer Uses its Memory

Step 6: Running Programs

- ✓ The CPU fetches instructions from RAM and cache memory to execute tasks.
- ✓ The OS manages programs and multitasking, allocating system resources to each process.

Step 7: Input and Output Operations

- ✓ Input devices (e.g., keyboard, mouse) send data to the CPU for processing.
- ✓ The CPU processes data, and output is sent to devices like the monitor or printer.

Step 8: Data Storage

- ✓ Data used by running programs is temporarily stored in RAM.
- ✓ As needed, data is saved to permanent storage (HDD/SSD) when programs are closed or data needs to be retained.

How the Computer Uses its Memory

Step 9: Shutdown Initiation

- ✓ When the user chooses to shut down, the OS begins closing programs, saving any unsaved data to storage.
- ✓ Processes are terminated properly to avoid data corruption.

Step 10: Power Off

- ✓ The OS sends a signal to the power supply to turn off the computer.
- ✓ RAM is cleared, and all components stop functioning.

Step 11: Computer is Off

- ✓ The computer is completely powered down.
- ✓ All running processes cease, and data in RAM is lost, while data in permanent storage (e.g., HDD, SSD) remains safe.

Classwork

Q. Research the following topics CD-ROM, CD-R, CD-RW, DVD-ROM, DVD-R, DVD-RW, BD and write a brief description for each.

Input and Output Devices

- ✓ The unit which is used to supply data into a computer is called input devices.
- ✓ Those devices which are used to input data into computer and retrieve data from computer is called input/output (I/O) devices.
- ✓ These I/O devices provide the environment of communication between the computer and outer the world.
- ✓ These I/O devices are called peripheral devices.for example:- keyboard, mouse, scanner, monitor, printer etc are I/O devices.

Input Devices

1) Keyboard:

- ✓ Keyboard is an input device with various keys that enables you to enter data into computer.
- ✓ Computer keyboard are similar with electric typewriter except consisting extra additional keys.
- ✓ Keyboard consists following types of keys:

a. **Alpanumeric keys** :- Letters, and numbers
b. **Punctation keys:-**comma, period, semicolon and so on.
c. **Special keys:-**function keys, control keys, arrows keys cap lock key, and so on.

- ✓ There are different types of keyboard having different number of keys.

Input Devices

2) Mouse:

- ✓ The device that control the movements of cursor or pointer on a display screen is called mouse.
- ✓ As you move the mouse the pointer on the display screen moves in the same direction.
- ✓ Mouse consists one to three button which have different function as required.

There are three types of mouse:

A) Mechanical Mouse:

- ✓ This type of mouse has a rubber or metal ball on its underside that roll in all directions.
- ✓ Mechanical sensors within the mouse detect the direction the ball is rolling and move the screen pointer accordingly.

Input Devices

B) Opt mechanical Mouse:

- ✓ Same as mechanical mouse but it uses optical sensor to detect motion of the ball.

C) Optical mouse:

- ✓ This type of mouse uses laser beam (special light) to detect the mouse's movement.
- ✓ Optical mouse has no mechanical moving parts; optical mouse removes the drawback of mechanical mouse.
- ✓ So that they respond more quickly and precisely than mechanical and opt mechanical mice but they area also more expensive than other mice.

Input Devices

3) Trackball:

- ✓ Track ball is similar to mouse except that it requires less space than mice.
- ✓ When space is limited trackball is used to move the pointer you have to rotate the ball with your thumb, fingers or the palm of your hand.
- ✓ Due to limited space in LAPTOP computer, track ball is used instead of mouse. There are usually one to three buttons on trackball.
- ✓ Trackball is popular than mice because it is stationary so it does not require much space and we can place it into any type of surface.

Input Devices

4) Joystick:

- ✓ A joystick is a pointing device which is often used for playing compute games.
- ✓ The joystick has gearshift like lever that is used to move the pointer on the screen.
- ✓ On most joysticks a button on the top is used to select option.
- ✓ With a joystick the pointer continues moving in the direction the joystick pointing, to stop the pointer you must return the joystick to its upright position.

Input Devices

5) Digitizing tablet:

- ✓ This is an input device that enables you to enter drawing and sketches into a computer.
- ✓ A digiting tablet consists of an electronic tablet and a cursor or pen.
- ✓ The pen is also called a stylus and looks like a simple ballpoint pen but uses an electronic head instead of ink.
- ✓ The tablet contains electronics that enables it to detect the movement of the cursor or pen and translate the movements into digital signals that it sends to the computer.

Input Devices

5) Scanner:

- ✓ A scanner is an input device that can read text and transfer from a piece of paper into computer represent able.
- ✓ To do this the scanner sends a beam of light to the page and then measures the amount of light reflected back.
- ✓ A scanner works by digitizing an image –dividing it into a grid of boxes and representing each box with either zero or a one.
- ✓ Each box is represented by 24 bits, the resulting matrix of bits called a bit map, can stored in a file displayed on a screen and manipulated by programs.

Input Devices

6) Digital Camera

- ✓ Digital camera is used to input image into computer.
- ✓ Digital camera uses the digital photographic technology.
- ✓ Normal camera capture images on specially coated film whereas digital cameras capture images electronically.
- ✓ Then it sends images as digital data into computer.

Input Devices

7) Magnetic ink character Reader (MICR):

- ✓ MICR is that type of device which reads text printed using magnetic ink.
- ✓ MICR devices were developed to help the banking field in processing the large volumes of cheques.
- ✓ The MICR devices is used automatically to read cheque number, bank identification code and customer account number.
- ✓ MICR is used to read those number and character which are made with magnetic materials.

Input Devices

8) Optical Character Reader (OCR):

- ✓ OCR is the ability of machine to recognize characters.
- ✓ OCR is a type of optical scanner, which can detect alphanumeric characters printed on paper.
- ✓ The OCR uses special light, or optic to read text from a piece of paper.
- ✓ A special font standard is needed to recognize character.
- ✓ The OCR system consist combination of hardware and software to recognize characters.
- ✓ The advanced OCR system can read variety of fonts, but still have difficulty to read hand written text.

Input Devices

10) Bar Code Reader:

- ✓ Bar code Reader also called as bar code scanner is a input device that uses **laser beams to read bar codes** on products such as books, packages so it is used in supermarkets, bookshops etc.
- ✓ The bar code reader can identify the description of product items and latest price.

Input Devices

11) Touch Screen:

- ✓ This is easiest way to enter data using the finger touch.
- ✓ Touch screens enables the user to select an option by pressing a specific part of the screen.
- ✓ Touch screen is a type of display screen that has a touch sensitive transparent panel covering the screen.
- ✓ Touch screen enables us to directly select objects instead of using pointing devices such as mouse, light pens.
- ✓ Touch screen are commonly used in fast food restaurants and information centers.

Input Devices

12) Touch Pad:

- ✓ Many Laptop computers use a touch pad in front of the keyboard.
- ✓ We can move our fingers on the pad to move the cursor on the screen.
- ✓ When we want to click, we can tap pad or use the buttons front of the pad, which works like mouse buttons.

Classwork:

Q. Explain different types of input devices in brief.

Output Devices

An output device is a machines which accept data from a computer and translates as a result or information which is suitable for use by the outside the world (users).

There are two types of output generated by output devices:

a) **Soft-Copy Output:** A soft-copy output is an output, which is not produced on paper or some materials rather displayed on monitor or screen. So it can't be touched and carried for being shown to others. for example: output seen on display screen.
b) **Hard-Copy Output:** A hard copy output is an output which is produced on paper or some materials, which can be touched and carried for beings shown to others. These types of output are **permanent** in nature and can be kept in paper files, or can be looked later when the person is not using the computer. For examples output produced by printers or plotters are hard copy output.

Types of Output Devices

1) Monitor:

- ✓ Monitor is called **visual display unit (VDU)** and it is also called display screen.
- ✓ The user can sees their result on the monitor screen.
- ✓ Monitor gives soft copy output.
- ✓ Computer monitor are similar with television screens except that monitor are extremely flexible and reliable devices.

Types of monitors: Cathode Ray Tube (CRT) and LCD(Liquid Crystal Display).

- ✓ The CRT monitor look much like television and are used with non-portable computer system.
- ✓ LCD monitor are thinner and lighter are commonly used with portable computer systems like laptop and notebook computers.

Classification of monitor Based on Signals

Monitors accept either analog or digital signal from video adapter.
There are two types of monitor based on signals.

A) Digital Monitor:-

- ✓ A digital monitor accepts digital signals rather than analog signals.
- ✓ All monitors (except LCD) use CRT technology, which is essentially analog.
- ✓ The term digital therefore refers only to the type of input received from the video adapter.
- ✓ Then digital monitor then translates the digital signals into analog signals that control the actual display.
- ✓ Thus digital monitors are fast and produce clear images.

Classification of monitor Based on Signals

Monitors accept either analog or digital signal from video adapter.
There are two types of monitor based on signals.

B) Analog Monitor:

- ✓ This is the traditional type of color display screen that has been used for years in televisions.
- ✓ So in reality all monitors based on CRT technology (that is all monitors except LCD) are analog.

Classification of monitor Based on Colors Displayed

A) Monochrome Monitor:

- ✓ These monitors display only one color on the screen, usually white or green, against a black background.
- ✓ Often used in early computers or specific applications like data entry, point-of-sale systems, or text-based work where color isn't necessary.

B) Grayscale Monitor:

- ✓ Grayscale monitors are a type of display that shows images in varying shades of gray, ranging from black to white, against a white or non-white background.

Classification of monitor Based on Colors Displayed

C) Color Monitor:

- ✓ These monitors can display a wide range of colors, typically supporting millions of colors for detailed and vibrant visuals.

Classification of monitor Based on Display Technique

A) Cathode Ray Tube (CRT) Monitor:

- ✓ These monitors use a cathode ray tube to project electron beams onto a phosphor-coated screen, which glows to produce images.

B) Flat Panel Monitor:

a. **Liquid Crystal Display (LCD) Monitor:**

- ✓ LCDs use liquid crystals sandwiched between two transparent layers, controlled by electric currents to modulate light and create images.
- ✓ Uses fluorescent (CCFL) or LED backlights to illuminate the liquid crystals.
- ✓ Compared to CRTs, LCDs are much more compact and portable.

Classification of monitor Based on Display Technique

B) Flat Panel Monitor:

b. Light Emitting Diode (LED) Monitor:

- ✓ An advanced version of LCD monitors, LED monitors use Light Emitting Diodes (LEDs) for backlighting instead of fluorescent lamps.
- ✓ LEDs are placed around the edges of the screen.

c. Gas Plasma Display:

- ✓ Gas-plasma monitors use tiny cells filled with electrically charged gases (plasma) to produce light when excited by electricity.
- ✓ Each pixel emits its own light, eliminating the need for backlighting.

Characteristics of a monitor:

A) Size:

- ✓ The size shows type of screen based on size example 14 inch, 17 inch etc.

B) Resolution:

- ✓ The resolution of monitor is expressed by the number of pixels on the screen, expressed as a matrix.
- ✓ The resolution refers to the number of dots displayed in the x (across) and y (down) co-ordinates.
- ✓ The resolution of a monitor indicates how densely the pixels are packed.
- ✓ Pixel is short for **Picture Element**; a pixel is a single point in graphic image.
- ✓ The quality of display monitor largely depends on its resolution, for example a resolution of 800×600 means that there are 800 pixels in horizontally and 600 pixels in vertically.

Characteristics of a monitor:

C) Band Width:

- ✓ The Bandwidth refers the **amount of data that can be transmitted in a fixed amount of time**.
- ✓ Thus this determines how much data it can process and therefore how fast it can refresh at higher resolution.
- ✓ For digital computer it is expressed in **bits or byte per second (bps)** and for analog it uses **hertz (HZ)**.

D) Refresh Rate:

- ✓ Refresh rate refers to the number of times per second that the image is re-drawn on the monitor screen.
- ✓ i.e. Refresh rate means how many times per second the screen is refreshed (re drawn).
- ✓ The refresh rate for a monitor measured in hertz(Hz).
- ✓ The faster the refresh rate ,the less monitor flickers.

Hard Copy Output Devices

1. Printers:

- ✓ Printers are one of the main output devices.
- ✓ It gives hard copy output. **i.e. Permanent readable form**.
- ✓ The output we get through this device is called as hardcopy or hard output.

Types of Printers:

a. Impact Printer:

- ✓ Produces characters and graphics on a piece of paper by striking it is called Impact Printer.
- ✓ It prints by hammering a set of metal pin or character set by using electromechanical devices.

For example, Daisy wheel printer, Dot Matrix Printer, Line Printer, etc.

Hard Copy Output Devices

Types of Printers:

b. Non-Impact Printer:

- ✓ A type of printer that produces characters and graphics on a piece of paper without striking.
- ✓ Printing is done by depositing ink in any form which does not use electromechanical devices.

For example, Inkjet printers, photo printers, laser printers are examples.

Hard Copy Output Devices

Types of Impact Printer:

a. **Daisy-wheel Printer**

- ✓ Daisy-wheel printer has a plastic or metal wheel on which the shape of each character stands out in relief.
- ✓ A hammer presses the wheel against a ribbon, which in turn makes an ink stain in the shape of the character on the paper.
- ✓ Daisy-wheel printer produces letter-quality type.
- ✓ Daisy –wheel printers are noisy in operation.
- ✓ This type of printers can not print graphics.

Hard Copy Output Devices

Types of Impact Printer:

b. Dot-matrix Printer:

- ✓ Dot-matrix printer produces character by striking pins against an ink ribbon.
- ✓ Each pin makes a dots and combination of dots form characters.
- ✓ Print head is a type of these printers which consists of a matrix of tiny needles,typically seven rows with nine needles in each (9*7 matrix).

Hard Copy Output Devices

Types of Non-Impact Printer:

a. **Ink-jet Printer:**

- ✓ Prints by spraying ink on paper and, which print characters by spraying small drops of ink at a sheet of paper.
- ✓ The ink is different from normal ink having a **high iron content**.
- ✓ There are magnetized plates in the ink's path which direct the ink onto the paper in the desired shapes.
- ✓ Ink-jet printers can also print in high color, which makes them popular for home users.
- ✓ Although ink-jet printers are inexpensive and produce excellent output, they are slow.
- ✓ But it can not be used to produce multiple copies of a document in a single printing.

Hard Copy Output Devices

Types of Non-Impact Printer:

b. Laser Printer:

- ✓ Laser printers work like photo copy machines.
- ✓ Laser printer uses laser beam to produce image.
- ✓ Laser printer can produce very high quality print and are capable of printing an almost unlimited variety of fonts.
- ✓ Laser printer are faster and more expensive than others.
- ✓ The Laser print quality is measured in number of **dots per inch(dpi).**

i.e. The Best laser printer can produce 600dpi or more.

Difference between Impact Printer Vs. Non-Impact Printer

Impact Printer	Non - Impact Printer
1. Impact Printer uses electromechanical mechanism that causes hammer (or pins) to strike against ribbon and paper to print the text.	1. It uses the thermal, chemical, electrostatic, laser beam or ink jet technology for printing the text and images.
2. Less efficient in comparison to Non – Impact printer because it uses electrical energy which is further converted into heat and sound.	2. Higher efficiency since electrical energy is not wasted.
3. Slow Printing	3. Fast Printing
4. Noisy while printing because of the force while printing.	4. Less noisy in comparsion to Impact Printer.
5. Example: Dot Matrix Printer, Daisy Wheel Printer, Line Printer, etc.	5. Example: Ink Jet Printer, Laser Printer, etc.

Classwork:

Q. Research on Line Printer and Thermal Printer and write it down.

I/O Ports

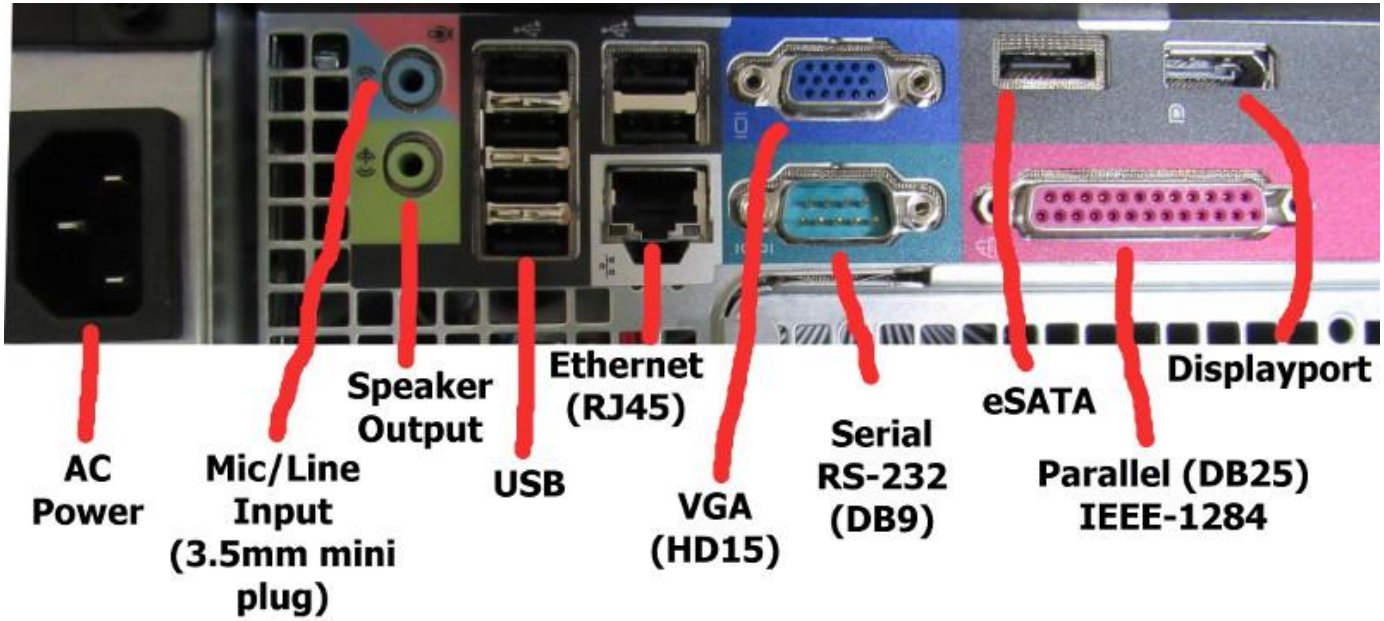
Port: A connection point that acts as interface between the computer and devices like mouse, printer, modem, hard disk etc. is called port.

Types of Port:

- **Internal Port:** It connects the **motherboard to internal devices** like hard disk drive, CD drive, internal modem, etc.
- **External Port:** It connects the **motherboard to external devices** like modem, mouse, printer, flash drives, etc.

- ✓ I/O (Input/Output) ports are interfaces between the computer system and external devices.
- ✓ They are used to send and receive data between the CPU and peripheral devices like keyboards, printers, or storage.

Figure: Commonly used Ports
In Computer System



Functions of Hardware Interface

- ✓ It is used for connecting peripheral devices.
- ✓ It is used for transmitting data to and from peripheral devices.
- ✓ It handles the initialization, configuration and shutdown of hardware components.
- ✓ It converts signals between different formats.

Types of Ports

1. Serial Port

- ✓ Transfers data one bit at a time (e.g., Communication ports).
- ✓ Used for devices like modems and older mice.
- ✓ Slower but requires fewer wires.

2. Parallel Port

- ✓ Transfers multiple bits (8 bits) simultaneously.
- ✓ Used for printers and scanners.
- ✓ Faster than serial but requires more wires.

Types of Ports

3. Universal Serial Bus (USB)

- ✓ A widely-used interface for connecting peripherals to a computer.
- ✓ Supports data transfer, device communication, and power delivery.
- ✓ Hot-swappable (devices can be plugged in or removed without restarting the system).
- ✓ USB have different types like Type A, Type B, Mini, etc. and its processing speed increases based on new versions.

Types of Ports

4. IEEE 1394 Interface (Fire wire port)

- ✓ Serial bus interface standard for high-speed communication used for data transfer, digital audio and digital video as well as aeronotics applications.
- ✓ It replaced parallel SCSI due to lower implementation cost and more adaptable cabling system.

5. SCSI (Small Computer System Interface) Port

- ✓ Used basically for transferring data at high speed in multiple devices.

Types of Ports

6. Peripheral Component Interconnect (PCI) Slot

- ✓ Used for expansion cards like graphics cards, network cards, sound cards, etc.
- ✓ Located away from the CPU, typically in a horizontal arrangement. Allows devices to communicate with the motherboard and CPU.

Types of Ports

7. HDMI (High Definition Multimedia Access)

- ✓ HDMI is a standard interface for transmitting high-definition audio and video between devices.
- ✓ It was introduced in 2003 and is widely used in consumer electronics.
- ✓ A single cable supports both video and audio signals, simplifying connections.

Types of Ports

Types of HDMI Connectors

- ✓ HDMI Type A: Standard connector for TVs, Projectors and PCs.
- ✓ HDMI Type C: Mini HDMI for tablets and cameras.

8. Expansion Slots

- ✓ Expansion slots are sockets on a computer's motherboard used to install expansion cards to enhance or add new functionalities.
- ✓ Commonly used for graphics, sound, network, and storage upgrades.

Working of I/O System

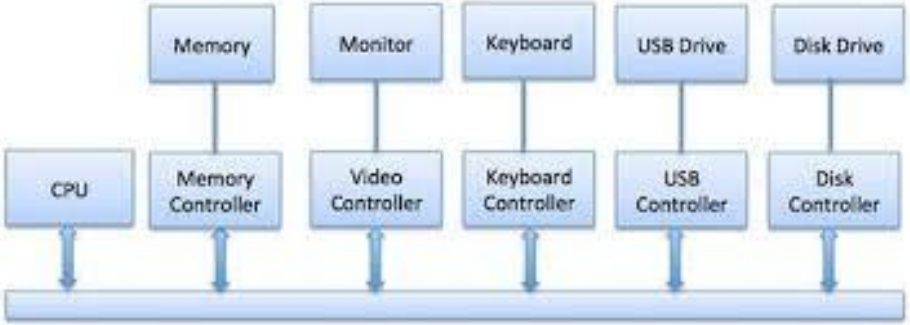


Fig: Device Controller and their Connections

1. Data Transfer Request: An I/O device sends a request to the I/O controller for data transfer.

2. I/O Controller: The controller processes the request and manages the data transfer between the device and the CPU.

3. Interrupts: The device sends an interrupt signal to the CPU when it needs attention, prompting the CPU to handle the request.

Working of I/O System

4. Data Transfer: Data is transferred using methods like programmed I/O, interrupt-driven I/O, or Direct Memory Access (DMA).
5. Communication via Buses: The system uses buses (data, address, control) to transfer data between the CPU, memory, and I/O devices.
6. Data Processing: The I/O controller ensures the data is in the correct format for the CPU and the peripheral device.
7. Completion: After the transfer, the CPU is notified (via interrupt) that the operation is complete, and the data is available for use.

Classwork:

Q. Explain different Communication ports.

Quiz:

1. Which component is known as the brain of the computer?
A) RAM B) CPU C) Monitor D) Keyboard
2. Which CPU unit performs arithmetic and logical operations?
A) Control Unit B) ALU C) Register D) Cache
3. Which memory is **volatile** and loses data when power is turned off?
A) ROM B) RAM C) Hard Disk D) SSD
4. What does BIOS do when the computer is powered on?
A) Stores user files B) Performs POST and boots OS C) Runs applications D) Encrypts disk
5. Which device converts AC mains to DC for computer components?
A) CMOS B) SMPS C) BIOS D) CPU fan
6. Which is an example of **secondary storage**?
A) Registers B) Cache C) Hard Disk D) RAM
7. Which on-board component holds the processor, RAM slots and expansion slots?
A) Power supply B) Motherboard C) Heat sink D) Monitor
8. What is stored in CMOS?
A) User documents B) BIOS settings and system time/date C) Operating system files D) Applications
9. Which is the fastest (lowest latency) memory type listed?
A) Hard Disk B) RAM C) Cache D) Registers
10. The full form of ALU is:
A) Arithmetic and Logical Unit B) Automatic Logic Unit C) Arithmetic Latency Unit D) Access Logic Unit
11. Which of these is a **port** used for external display?
A) SATA B) PCIe C) HDMI D) DIMM
12. Which component temporarily holds instructions and data for the CPU during execution?
A) Secondary storage B) Registers/Cache/RAM C) BIOS D) SMPS