

# **BASIC COMPUTER ENGINEERING**

## **BT – 205**

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# Computer

A programmable electronic device designed to accept data, perform prescribed mathematical and logical operations at high speed, and display the results of these operations. Mainframes, desktop and laptop computers, tablets, and smartphones are some of the different types of computers.

- A **computer** is a machine that can be instructed to carry out sequences of arithmetic or logical operations automatically via computer programming. Modern computers have the ability to follow generalized sets of operations, called *programs*. These programs enable computers to perform an extremely wide range of tasks. A "complete" computer including the hardware, the operating system (main software), and peripheral equipment required and used for "full" operation can be referred to as a **computer system**. This term may as well be used for a group of computers that are connected and work together, in particular a computer network

# Full form of Computer

- C= Commonly

- O= Operating

- M= Machine

- P = Particularly

- U = Used

- T = Training

- E = Education

- R= Research

# Computer

- The term computer has taken from the computing. A computer can be defined as an electronic device that takes data and instruction from the user as input perform computing and give information as output to the user.
- The electronic device is known as hardware & the set of instruction is known as software.

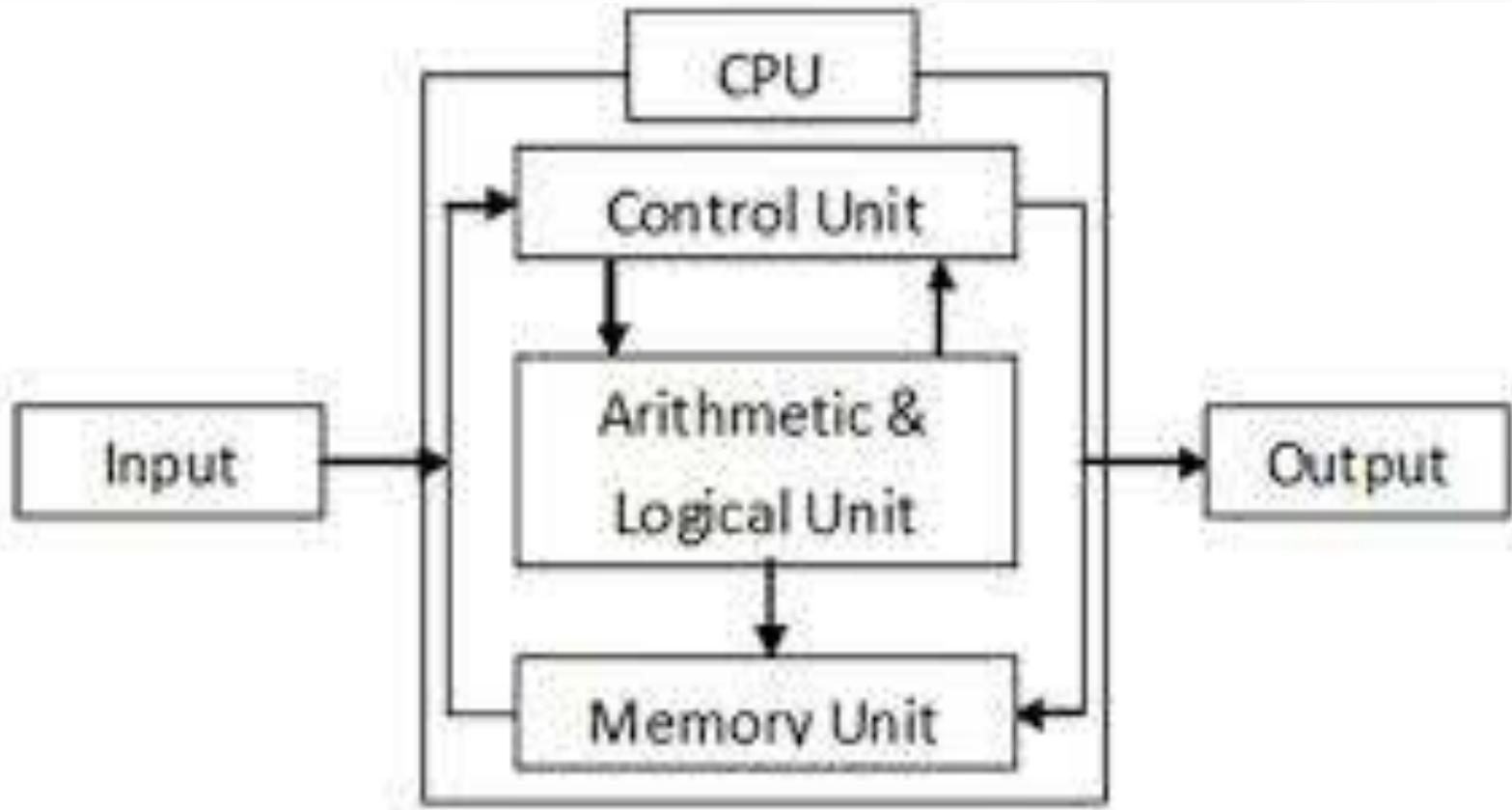


Fig. Block Diagram of Computer

# Basic Computer Operation

## ● Basic Operations of a Computer System:

- Inputting
- Processing
- Outputting
- Storing
- Controlling

**Inputting** : Inputting is a basic operation of a computer system. This is the act of feeding in the data and instruction to the computer.

- Information and programs are entered into the computer through Input devices such as the keyboard, disks, or through other computers via network connections or modems connected to the Internet.
  
- **Processing** : The task of performing calculations and comparisons are known as processing. it performs the action as per the instruction issued and process the given data.

- The unit in Computer System that is responsible for processing is ALU (Arithmetic and Logical Unit). ALU is the place where actual execution of the instructions takes place during the processing operations. All calculations & comparisons are made in the ALU. The data and instructions stored in the primary storage are transferred to it as when required. ALU may produce Intermediate results and store it in the memory which is also transferred back to the ALU for the final processing. After completion of processing the final results are send to storage units from ALU

**Outputting :** This unit takes care of receiving processed information from processing unit and present it to the user in the suitable form.

**Storage Unit :** Before actual processing start, data & instructions entered to the computer must be stored somewhere inside the computer. Similarly, results produced by the computer are required to be stored before it is passed to the output unit. The intermediate result produced by the computer must also be stored for further processing.

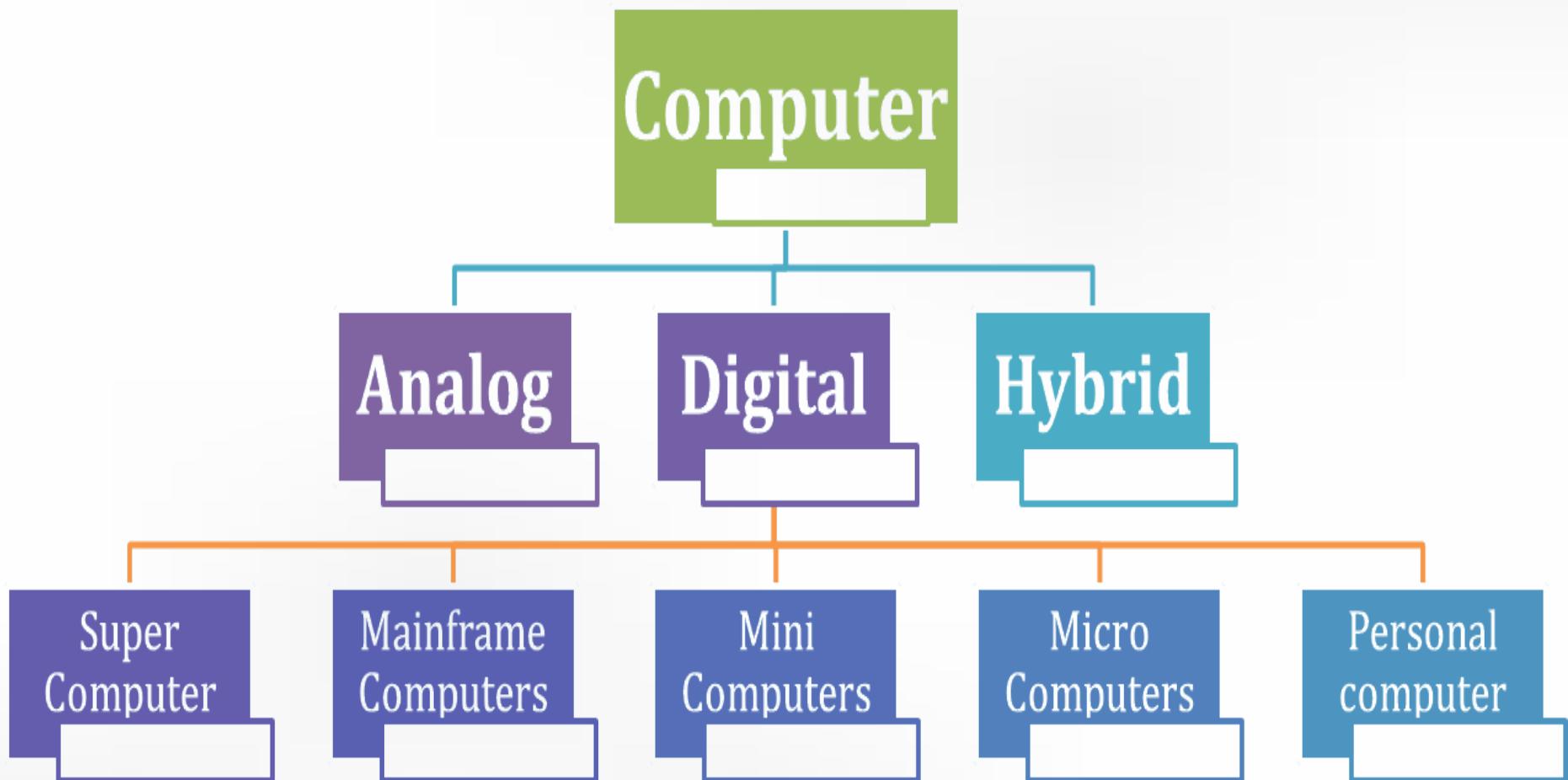
- Based on whether the storage device is inside the main machine or not, it can be internal or external storage. Similarly, looking at whether the storage device works close with CPU or works as backup media, they can be primary storage or secondary storage. Primary storage is also called primary memory. Secondary storage is known by other names such as backup storage or secondary memory. For the storage purpose, a computer system may have different devices such as registers, cache, RAM/ROM, flash, magnetic disks, optical disks and so on.

- **Control Unit :** ALU dose does not know what should be done with the data likewise, output unit dose not know when the result should be displayed. By selecting, interning and seeing to the execution of the program the CU is able to maintain order and direct the operations of the entire system. CU doesn't perform any actual processing on data yet it is known as a central nervous system for the comforts of the computer.

# Advantages of Computer

- **ACCURACY** Computer performs complex and repetitive calculation with accurate results.
- **MEMORY** Store large amount of data and information
- **USER-FRIENDLY** Provide information to the user in many different forms.
- **FAST** Perform fast execution or processing.
- **LESS MAN POWER** Manual requirement is less.
- **BEST RESULTS** Artificial intelligence, Decision-making best results

# CLASSIFICATION OF COMPUTER



# Analog Computer

- **Analog computer** is a form of computer that uses the continuously changeable aspects of physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved.



# Digital Computer

- The digital computer works on discontinuous data. They convert the data into digits (binary digits 0 and 1)and all operations are carried out on these digits at extremely fast rates.
- A digital computer basically knows how to count the digits and add the digits. Digital computers are much faster than an analog computer and far more accurate.

# Supercomputer

- A supercomputer contains many CPUs which operate in parallel to make it faster. They are used for massive data processing and solving very sophisticated problems. They are used for weather forecasting, weapons research and development, rocketing, aerodynamics, seismology, atomic, nuclear etc.
- **Seymour Cray invent the first super computer in 1964.**
- **PARAM 8000, India's 1st Giga-scale supercomputer in 1990.**
- **Fugaku** in Kobe, Japan is the the world's fastest supercomputer as of November 2020.

- Top 6 supercomputers in India :
  - 1) Pratyush [Cray XC40\*]
  - 2) SahasraT (Cray XC40)
  - 3) Aaditya (IBM/Lenovo System)
  - 4) TIFR Colour Boson
  - 5) IIT Delhi HPC
  - 6) Param Yuva 2.
- 
- Most modern supercomputers use the **Linux operating system**

# MAINFRAME COMPUTERS:

- Mainframe computers are very powerful, large general-purpose computers. They are used where a large amount of data is to be processed or very complex calculations are to be made and these tasks are beyond the computing capacity of minicomputers. They are used in research organizations, large industries, large business, and government organizations, bank, and airline reservations where a large database is required.

# Microcomputers:

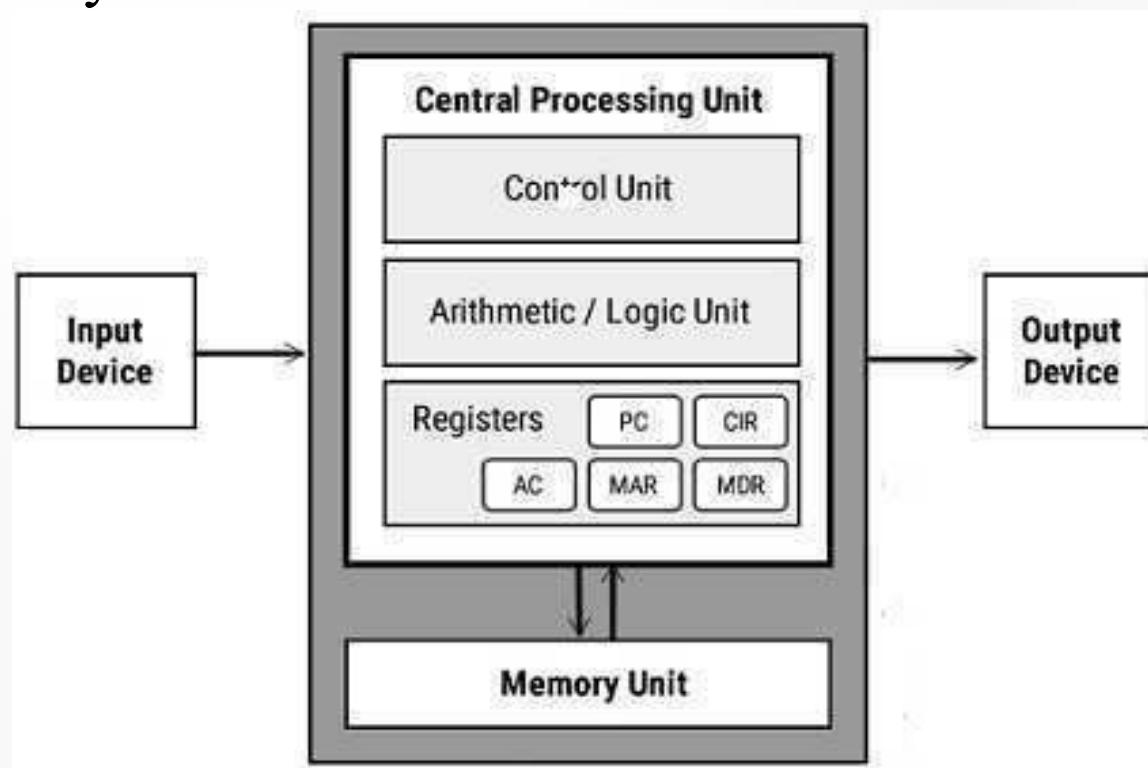
- A Microcomputer is a low-cost, small, digital computer. It contains the microprocessor as its CPU, a memory unit, an input device, and an output device. Microcomputers have a wide range of applications like general purpose calculations, industrial control, home application; Microcomputers are also called personal computers .
- Laptop, desktop, Palmtop are the examples of Microcomputer.

# Minicomputers:

- Minicomputers are faster and more powerful than microcomputers. Minicomputers are general purpose computers, smaller than mainframe and give computing power without adding the prohibitive expenses associated with large systems. They are used in accounting, word processing, database management, statistical packages for social sciences, CAD, and numerical analysis.
- They are costly than microcomputer.

# Central Processing Unit

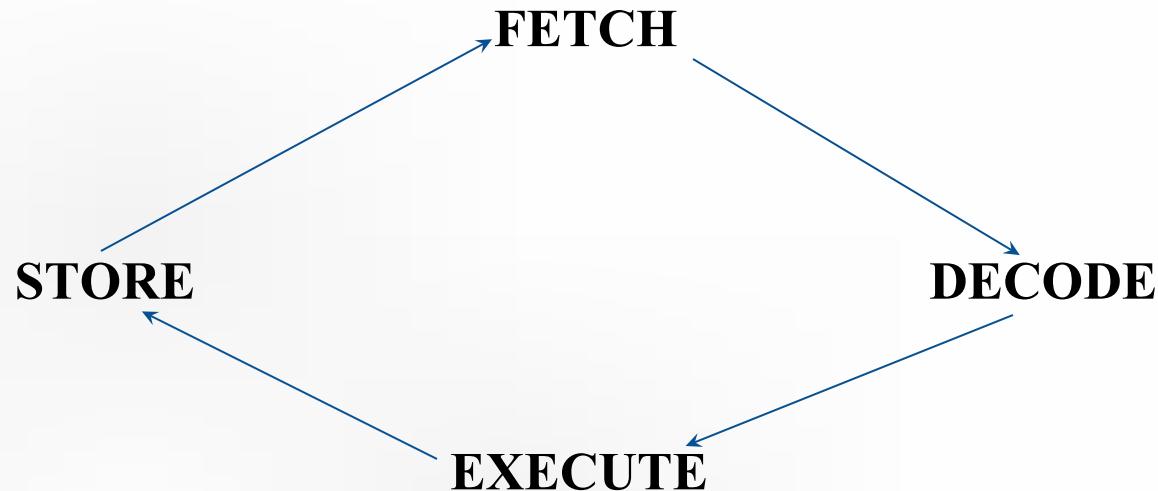
- The CPU which is referred to as the brain of a computer is responsible for processing the data inside the computer system. It is also responsible for controlling all other components of computer system.



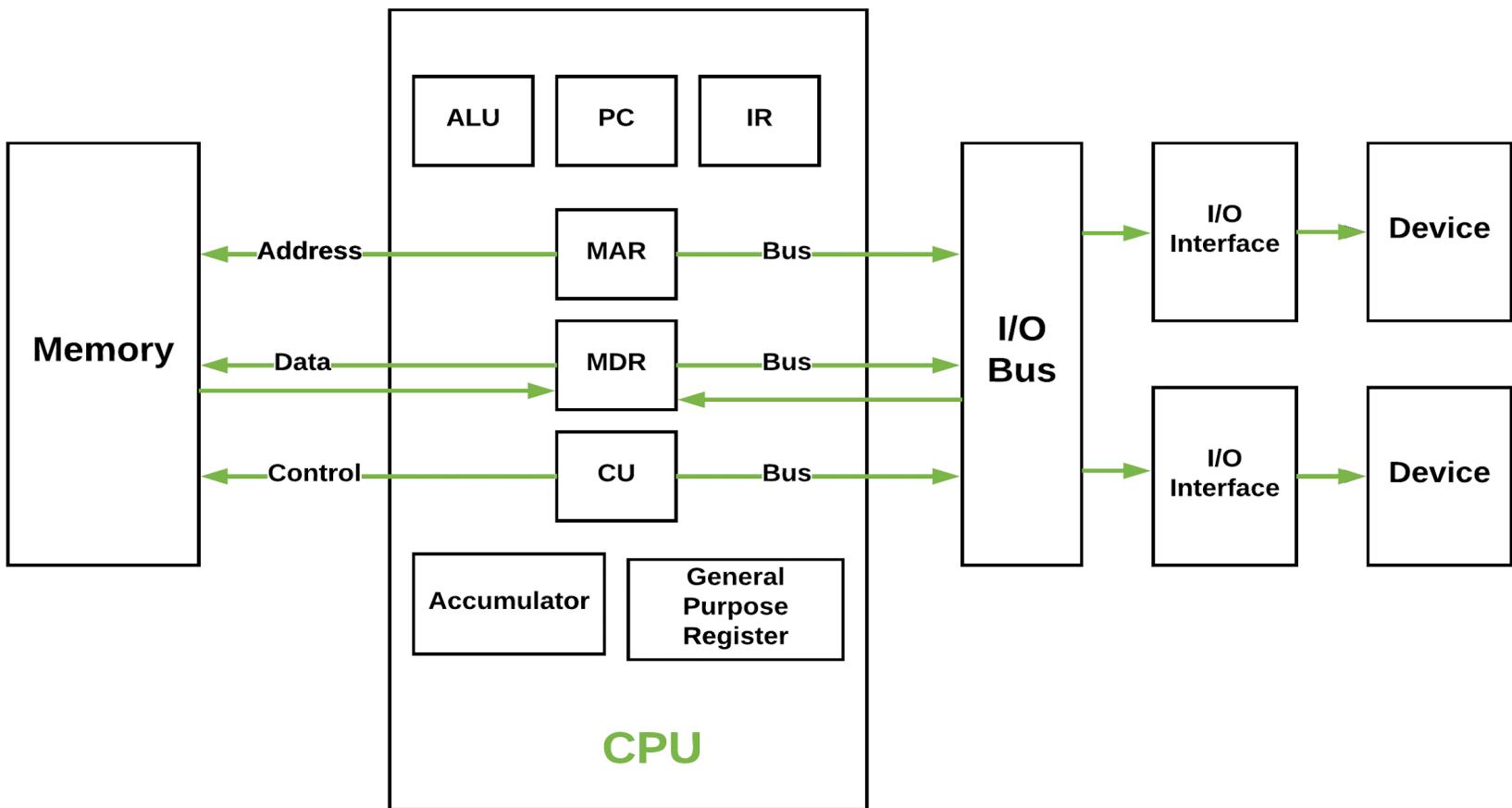
- Central processing unit (CPU) is the central component of the PC. Sometimes it is called as a processor. It is the brain that runs the show inside the Pc. All work that is done on a computer is performed directly or indirectly by the processor. Obviously, it is one of the most important components of the Pc. It is also, scientifically, not only one of the most amazing parts of the PC but one of the most amazing devices in the world of technology. The processor plays a significant role in the following important aspects of your computer system.

# Main Operation of the CPU Includes

- - **FETCH**: Fetching instruction from the memory issued by the user.
  - **DECODE**: Decoding the instruction to decide what operation to be performed.
  - **EXECUTE**: Execute the instruction.
  - **STORE**: Store the result in the memory.



# The structure of CPU:



# Register

- **The register** is used to quickly accept, store, and transfer data and instructions that are being used immediately by the CPU, there are various types of Registers those are used for various purposes. Register are special purpose high-speed temporary storage area for holding data, address, and instruction during processing of the instruction. The register is always on the CPU.

- **PC:** - The **program counter (PC)** just part of the instruction sequencer in some computers is a processor register. It keeps track of the **next memory address** of the instruction that is to be executed once the execution of the current instruction is completed. **In other words, it holds the address of the memory location of the next instruction when the current instruction is executed.**
- **AC:** -**Accumulator:** This Register is used for storing the Results those are produced by the System. When the CPU will generate Some Results after the Processing then all the Results will be Stored into the **AC Register.**
- **IR:** - Instruction Register: store the instruction currently being executed.

- **MAR:** - (Memory address register) this register holds the memory addresses of data and instructions. This register is used to access data and instructions from memory during the execution phase of an instruction. Suppose CPU wants to store some data in the memory or to read the data from the memory. It places the address of the required memory location in the MAR.
- **MBR** stands for Memory Buffer Register. This register holds the contents of data or instruction read from, or written in the memory. It means that this register is used to store data/instruction coming from the memory or going to the memory.
- **MDR:** - (**Memory Data register**) MDR is the register of a computer's control unit that contains the **data to be stored in the computer storage** (e.g. RAM), or the **data after a fetch from the computer storage**. It acts **as a buffer** and holds anything that is copied from the memory ready for the processor to use it.

# Bus Architecture

- A bus is a set of wire that is used to connect the different internal components of a computer system for transferring data, address, and control. A **bus** can be 8 bit, 16 bit, 32 bit and 64 bit. A 32 bit **bus** can transmit 32 bit information at a time.
- **There may be several buses in a computer system broadly divided into categories.**
- Serial Bus.
- Parallel Bus.

- In **Serial Bus** only one bit of data is transferred at a time, amongst the various hardware components.
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- In **Parallel Bus** : Several bits of data can be transferred at a time, amongst the various hardware components.
- The speed of any type of bus is measured in terms of the number of bits transferred per second, between two components.

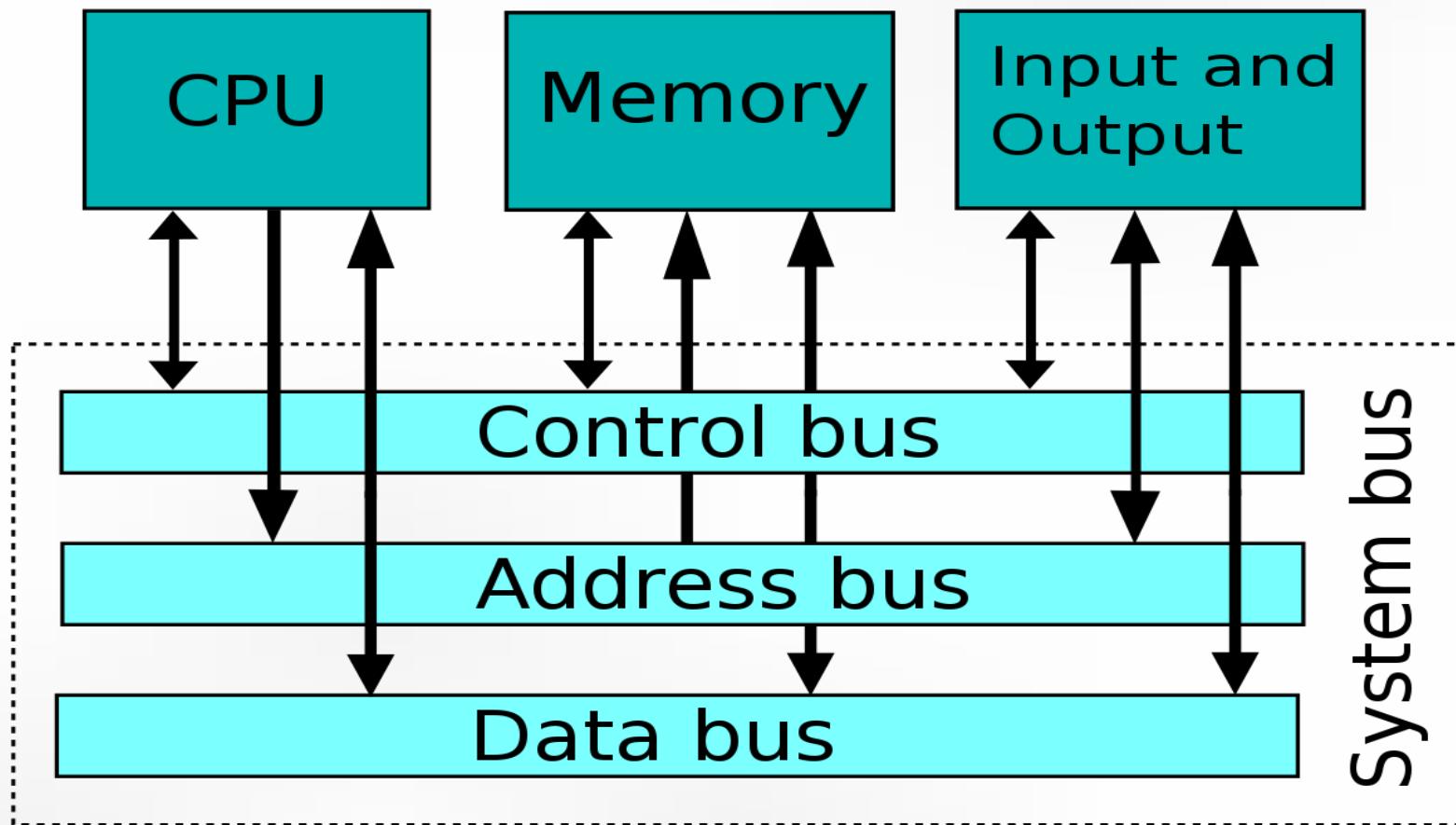
## ● Type of Bus Based on data it carries:

- 1) CONTROL BUS
- 2) DATA BUS
- 3) ADDRESS BUS

**Control Bus :** Control bus manages the transfer of data and address among various components by transferring appropriate control signals.

- **DATA BUS:** - The Databus in a computer system is used to transfer data amongst the different internal components. The speed of the data bus also affects the overall processing power of a computer system. The modern computer system uses 32-bit data buses for data transfer. This means that these buses can transfer 32 bits of data at a time.
- The data bus implemented between the main memory and the processor of a computer system.

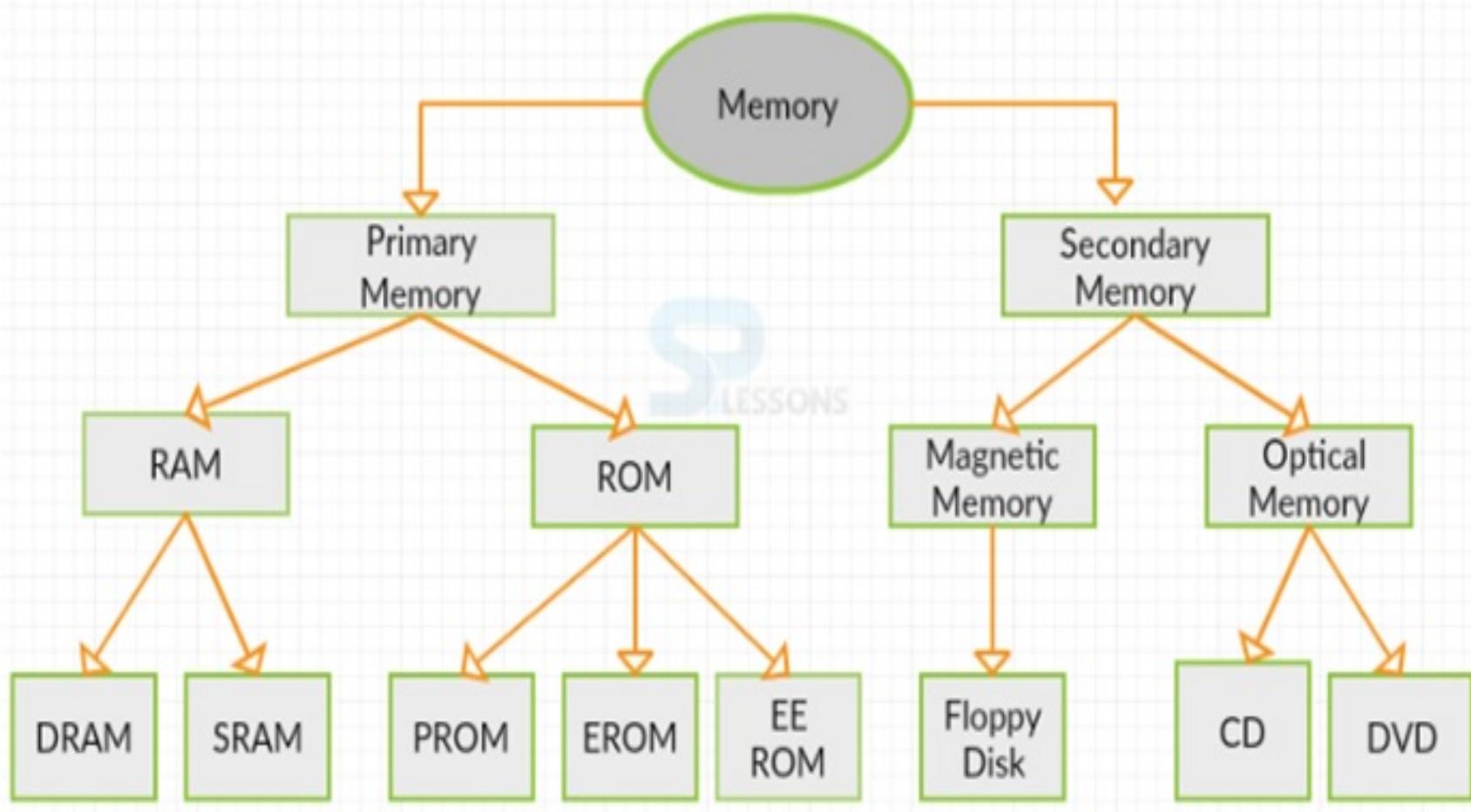
- **ADDRESS BUS:** - The address bus is also known as the memory bus. It transfers the memory address for reading and writes memory operations. It contains many address lines that determine the range of memory addresses that can be referenced using the address bus.
- For Example-a 32-bit address bus can be used to reference 2 Memory locations. Like data bus, the address bus can also be a serial or a parallel bus.



# MEMORY AND STORAGE DEVICES

- The memory unit of a computer is used to store data, instructions for processing data, intermediate results of processing and the final processed information. The memory unit of a computer is classified as primary ,secondary and cache memory.

## Memory Management



# **PRIMARY MEMORY: -**

- Primary memory is computer memory that is accessed directly by the CPU. Primary memory is also called Main memory.
- There are two types of memory in primary memory.
- RAM(Random Access Memory)
- ROM ( Read Only Memory)

- RAM is Random Access Memory which loses its contents when the computer is switched off (it is volatile ). This memory can be written to, instructions and data can be loaded into it.
- ROM , or Read Only Memory is non-volatile and is used to store programs permanently (the start-up or " boot " instructions, for example), the computer cannot store anything in this type of memory.

# Random Access Memory

- This is the primary memory from where data & instructions can be received in a random manner (RAM). It is a volatile memory in which the contents are lost once the power is turned off. The kind of memory is used to store the data temporarily during the computer operations.



- RAM can be divided into 2 types:

- 1) SRAM( Static Random Access Memory).
- 2) DRAM ( Dynamic Random Access Memory).

**SRAM:** It is a volatile memory based on traditional transistors using flip-flop gates to hold data if the power is on. The contents are lost once the power is turned off. It is very fast and that's why used in the cache memory. The SRAM takes more space and is expensive too, but it is easy to use. It does not need to be refreshed periodically and synchronizes itself with the timing of CPU.

- **Dynamic random-access memory (DRAM):** It is a volatile memory based on the capacitors that hold data if the power is on. Due to discharging capacitors, the DRAM is refreshed periodically. This refreshing is done automatically, and due to the time consumed in refreshing. The DRAM is slow. It is inexpensive and takes less space; therefore, DRAM is used as the main memory.

<b><u>SRAM</u></b>	<b><u>DRAM</u></b>
1. SRAM has lower access time, so it is faster compared to DRAM.	1. DRAM has higher access time, so it is slower than SRAM.
2. SRAM is costlier than DRAM.	2. DRAM costs less compared to SRAM.
3. SRAM requires constant power supply, which means this type of memory consumes more power.	3. DRAM offers reduced power consumption, due to the fact that the information is stored in the capacitor.
4. Due to complex internal circuitry, less storage capacity is available compared to the same physical size of DRAM memory chip.	4. Due to the small internal circuitry in the one-bit memory cell of DRAM, the large storage capacity is available.
5. SRAM has low packaging density.	5. DRAM has high packaging density.

# ROM(Read Only Memory)

- ROM is a special type of memory which can only be read and contents of which are not lost even when the computer is switched off. ROM chips are used not only in computers but in most other electronic items such as washing machines, microwave ovens, calculators, laser printers, media players etc. It is not limited to electronic chips, CDROM and DVD ROM.

- **Programmable read-only memory (PROM):** This is a kind of ROM has not been pre-recorded by the manufacturer but is supplied empty. The user of this ROM can store programs on it using a special tool. Once the empty ROM is programmed, it behaves like any other ROM, that is, it cannot be rewritten.

## ● **Erasable programmable read-only memory (EPROM):**

This is a ROM which has not been pre-recorded by the manufacturer, but it is supplied empty. The user of this ROM can store programs on it using a special tool. Once the empty ROM is programmed, it can be rewritten repeatedly after erasing the previously written entire contents using the ultraviolet light of specific frequency. EPROM is more expensive than PROM.

## ● **Electrically erasable programmable read-only memory (EEPROM):**

This is a ROM which has not been pre-recorded by the manufacturer, but it supplied empty. The user of this ROM can store programs on it using a special tool. Once the empty ROM is programmed, it can be rewritten repeatedly after erasing the previously written contents using electric charge. This kind of ROM requires erasing the entire previously written content, but it allows erasing one byte at a time before writing the new content onto it. The EEPROM is more expensive than PROM, but it need not be removed from the computer for rewriting. This is the most flexible type of ROM, which is now commonly used for storing BIOS programs.

# SECONDARY MEMORY: -

- The secondary memory is the storage devices in which the data can be stored for a longer duration, and it is not lost even when the power is turned off. The hard disks, flash drive, floppy disks, CD-ROMs, and DVDs, etc., are examples of secondary memory. This memory has greater storage capacity than the primary memory. Also, it is inexpensive but slow.

## The secondary storage device can be classified as:

- **Magnetic Storage device:** The magnetic storage devices store information that can be read, erased and rewritten many times. These include a floppy disk, hard disk, and magnetic tapes.



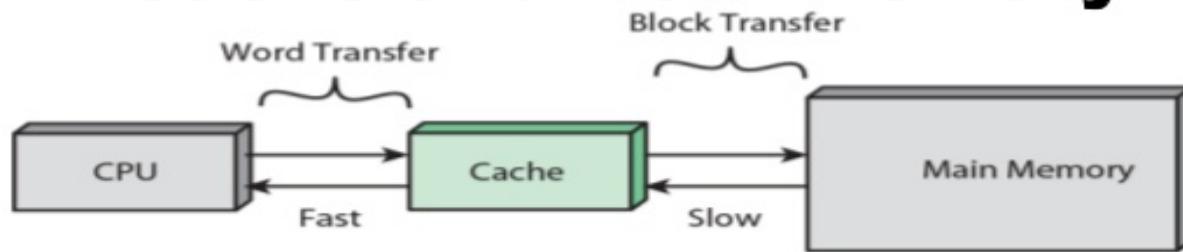
- **Optical storage device:** - The optical storage devices are secondary storage devices that use laser beams to read the stored data. These include CD-ROM, rewritable compact disk (CD-RW). Digital video disks with read-only memory, etc.



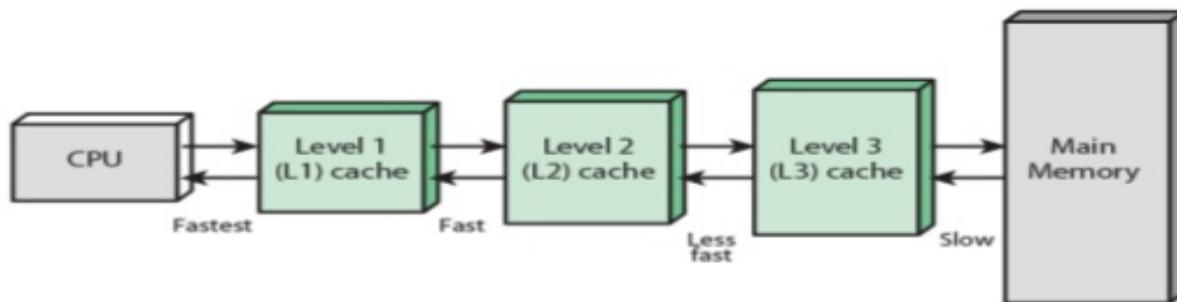
# **CACHE MEMORY: -**

- The cache memory is slower than the CPU registers and faster than the main or primary memory. It is a SRAM placed between the CPU and the main memory, and when CPU needs any data or instruction is found in the cache memory, it is retrieved by the CPU for processing. Otherwise, the main memory is searched for the same information. The most frequently used instructions and data are placed in the cache memory; therefore, the overall speed of the computer is increased.

## Cache and Main Memory

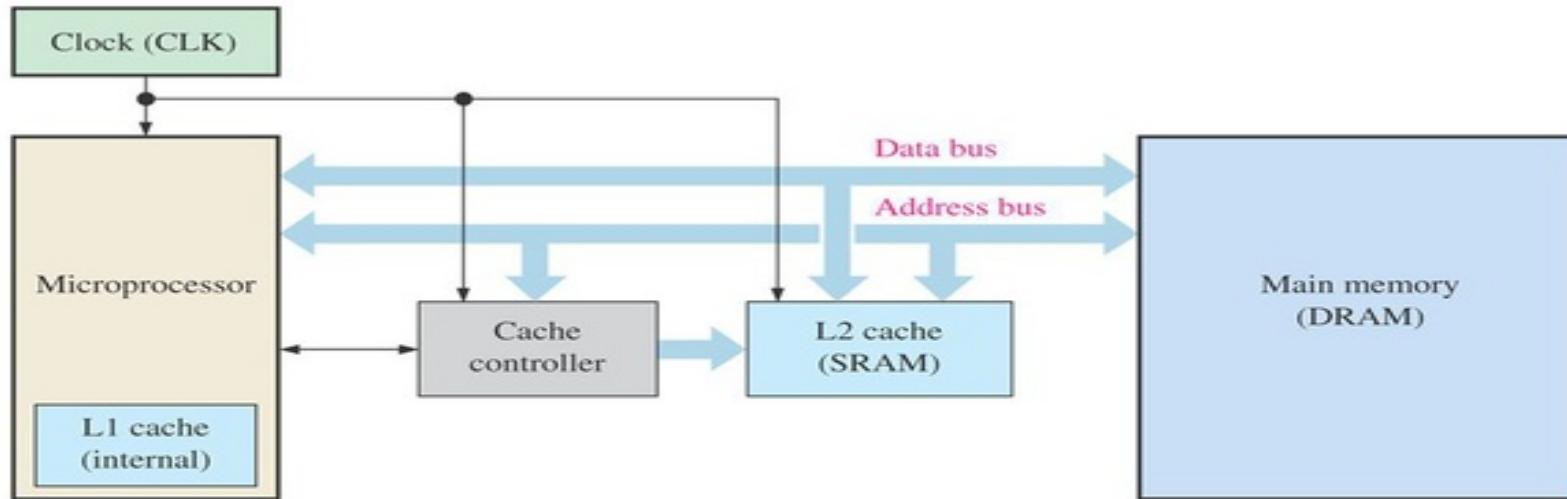


(a) Single cache



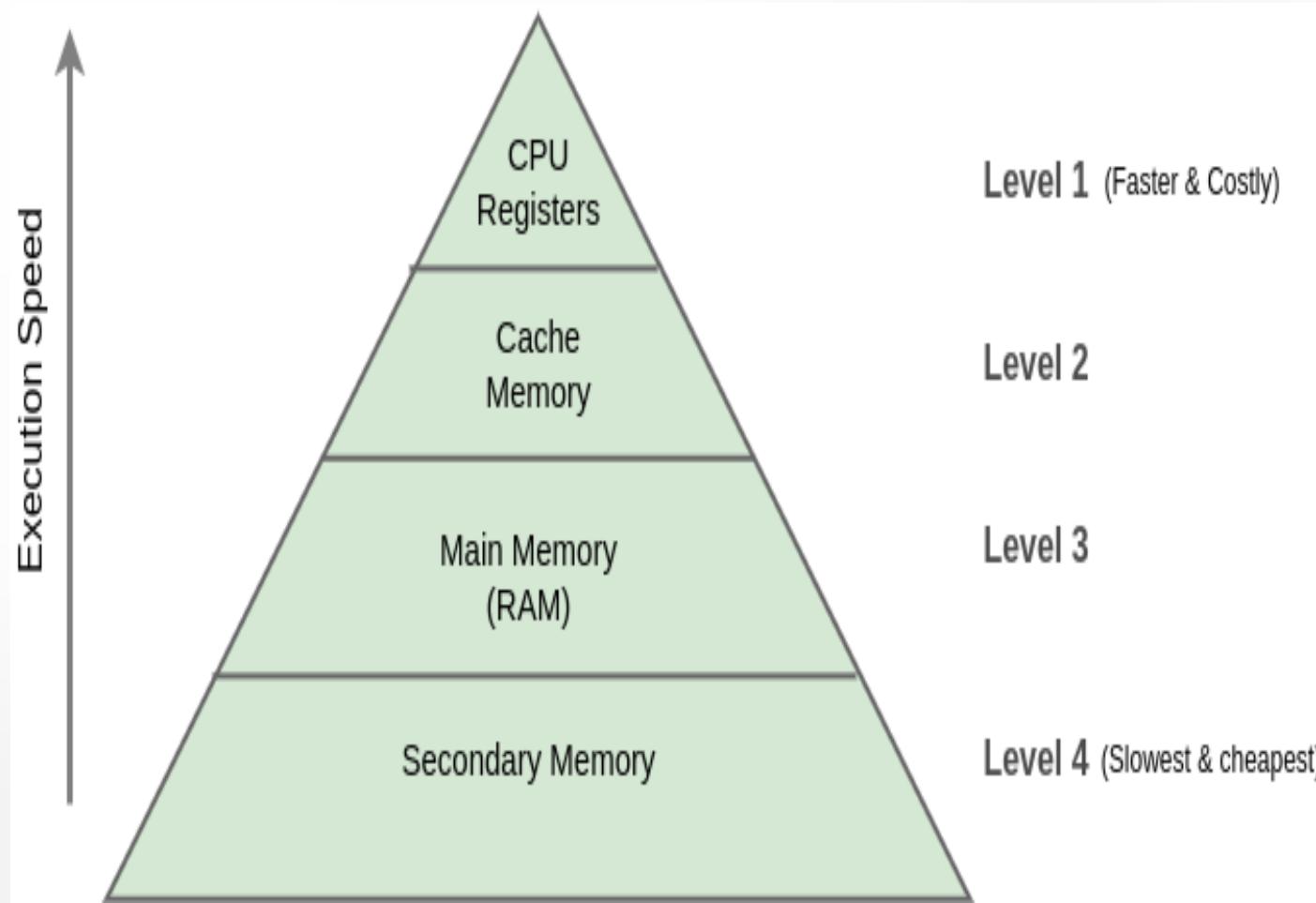
(b) Three-level cache organization

# Cache Memory



Block diagram showing L1 and L2 cache memories in a computer system.

# MEMORY HIERARCHY:



# MEMORY HIERARCHY:

- The computer requires different kinds of memory for its proper functioning. Since the fast memories are very expensive, therefore they cannot be used in excess. There is a hierarchy of memories considering their speed and cost. The registers are the fastest storage devices; even faster than the cache memory (SRAM), which is faster than the main memory.

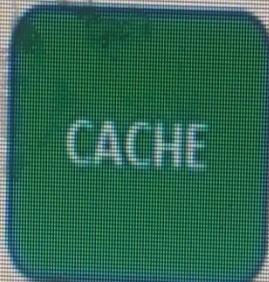
**Hard Disk**



**RAM**



**CACHE**



**CPU**  
Central Processing Unit



**Secondary Memory**

**Primary Memory**

**Cache Memory**

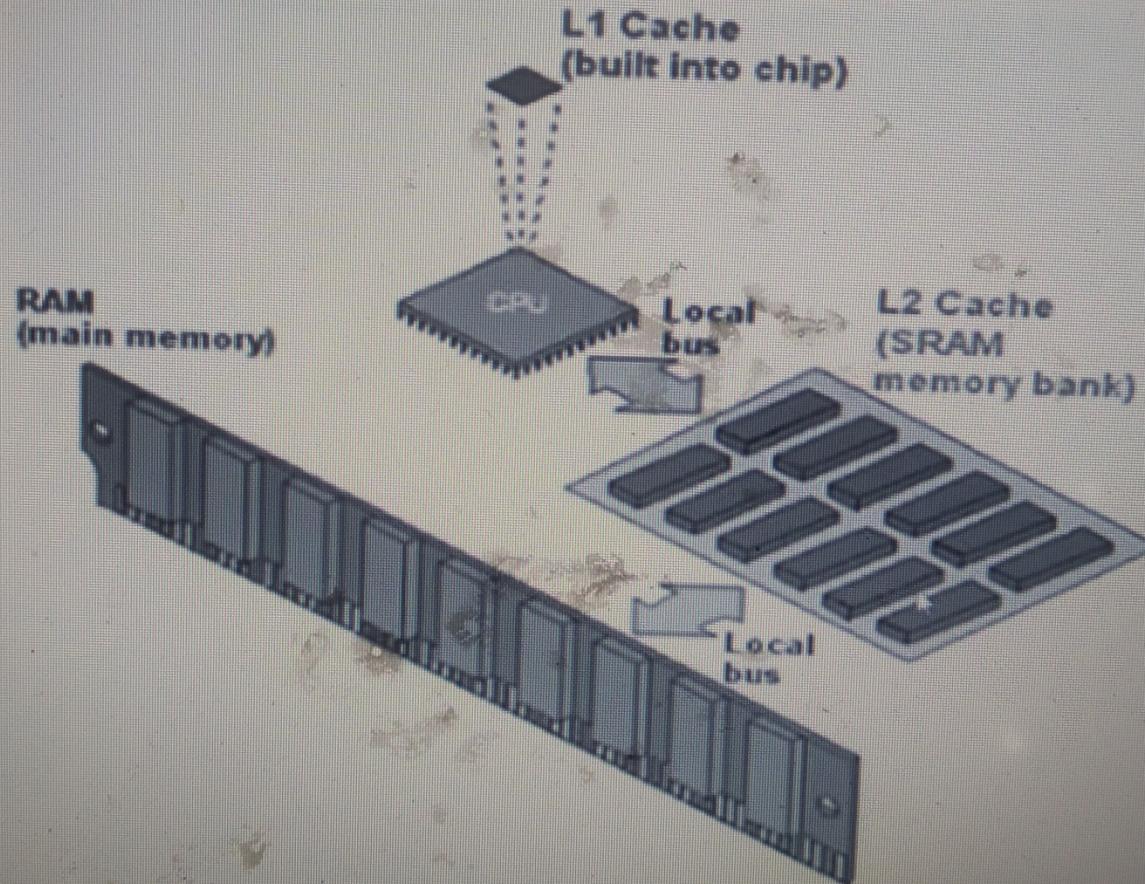
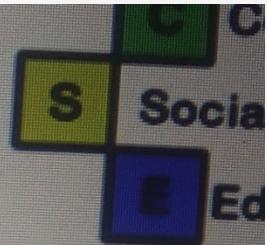
**CPU - Processor**



C Computer  
S Social  
E Education



# SRAM → Static Random Access Memory



# **SOFTWARE**

The software is defined as a computer program or collection of programs which are designed to solve any task.

## **TYPES OF SOFTWARE: -**

1. System software
2. Application software

# **SYSTEM SOFTWARE**

System software refers to a computer program that manages and controls hardware component of a computer system. The system software is responsible for handling the function of computer hardware. It is also responsible for the proper function of application software on a computer.

## **EXAMPLE: -**

- 1. OPERATING SYSTEM SOFTWARE:** - An operating system is a program which acts as an interface between user and hardware.
- 2. LANGUAGE PROCESSOR:** - These are system software which is used to translate the instruction of any programmable language in the form that can be executed by the computer system, Example: - Computer, Interpreter, Assembler.

# **APPLICATION SOFTWARE**

Application software is a computer program that executes on system software it is designed and develops for performing a specific task for a specific application.

It can be of two types

- 1. Special purpose Application Software**
- 2. General purpose Application Software**

**Special-purpose computers** refer to **computers** that are built to perform **specific** tasks, such as automatic teller machines or washing machines. ... Other **examples of special purpose computers** include traffic-light control systems, weather-forecasting simulators, oil-exploration systems and traffic-control **computers**.

A **general purpose** application, sometimes known as 'off-the-shelf' is the sort of **software** that you use at home and school. **Examples** include word processors, spreadsheets, databases, desktop publishing packages, graphics packages etc.

# Application of Computer

## **Computer Application in e-Business: -**

E-Business (e-Business), or Electronic Business, is the administration of conducting business via the internet. This would include the buying and selling of goods and services, along with providing technical or customer support through the Internet. E-Business is a term often used in conjunction with e-commerce but includes services in addition to the sale of goods.

## **Bio-Informatics: -**

Bioinformatics is the field of science which applies computer-based tools and technologies on biological research and development. It primarily involves collection and storage of biological and genetic data on which statistical techniques are applied to arrive at the required solution.

## **Health Care: -**

Now a day, computers are being used to cater to several different aspects of healthcare. The use of a computer is evident right from the beginning when a patient approaches healthcare facility.

Health care (or healthcare) is the diagnosis, treatment, and prevention of disease, illness, injury, and other physical and mental impairments in humans. Health care is delivered by practitioners in medicine, chiropractic, dentistry, nursing, pharmacy, allied health, and other care providers. It refers to the work done in providing primary care, secondary care, and tertiary care, as well as in public health

## **Remote sensing :**

Remote sensing is the technique of acquiring information about a subject (material or spatial) without coming in direct contact with it. Since there are no direct contact involved, wireless devices are used for performing remote sensing task. Such devices are typically real-time systems that continuously gather and store data related to the subject under observation. A **RADAR** system can be considered as a good example of remote sensing device that measures the time delay between sending and receiving of signals to detect information related to the objects.

## **GIS (Geographic information system) :-**

Geographic information system (GIS) is a system that gathers location-specific data present it is various meaningful forms. It is basically a computer-based information system that captures and stores location- specific data against different parameters.

## **Computer Gaming: -**

Computers are widely used for playing games that are like video or console-based games. A computer must process graphics and animations support for ensuring rich gaming experience to the user. The computer gaming industry has evolved tremendously over the experience over the past decade.

Computer and video games are a maturing medium and industry and have caught the attention of scholars across a variety of disciplines. By and large, computer and video games have been ignored by educators.

## **Multimedia: -**

Multimedia is media and content that uses a combination of different content forms. This contrasts with media that use only rudimentary computer displays such as text-only or traditional forms of printed or hand-produced material. Multimedia includes a combination of text, audio, still images, animation, video, or interactivity content forms.

Multimedia is usually recorded and played, displayed, or accessed by information content processing devices, such as computerized and electronic devices, but can also be part of a live performance. Multimedia devices are electronic media devices used to store and experience multimedia content.

## **Animation:-**

**The animation** is the rapid display of a sequence of images to create an illusion of movement. The most common method of presenting animation is as a motion picture or video program, although there are other methods. This type of presentation is usually accomplished with a camera and a projector or a computer viewing screen which can rapidly cycle through images in a sequence. Animation can be made with either hand rendered art, computer-generated imagery, or three-dimensional objects, e.g. puppets or clay figures, or a combination of techniques.

# **Fundamental Components of Computer**

**INPUT UNIT:** Input unit is formed by the input devices attached to the computer. Input devices take the raw data from the user to the computer for processing.

- 1) KEYBOARD**
- 2) MOUSE**
- 3) LIGHT PEN**
- 4) TOUCH SCREEN**
- 5) JOYSTICK**
- 6) SCANNER**
- 7) SMART CARD READER**
- 8) OPTICAL MARK READER**
- 9) BARCODE READER**
- 10) WEBCAM**

# **OUTPUT UNIT**

The output generated by the computer is sent to the output device.

- 1) MONITOR**
- 2) PRINTER**
- 3) SPEAKER**
- 4) PLOTTER**

# **Operating System**

Operating System is software that works as an interface between a user and the computer hardware. The primary objective of an operating system is to make computer system convenient to use and to utilize computer hardware in an efficient manner.

Various types of operating systems are  
UNIX/LINUX/REDHAT/UBUNTU, MS-DOS, MS-Windows -  
98/XP/Vista/windows7/windows8/windows10, Windows-  
NT/2000/2003/2005, OS/2 and Mac OS.

The first, it manages the hardware and software resources of the computer system. These resources include the processor, memory, disk space, etc.

The second, it provides a stable, consistent way for applications to deal with the hardware without having to know all the details of the hardware.

## **Types of Operating System**

There are Many Operating Systems those have been developed for performing the operations those are requested by the user. There are many Operating Systems which have the capability to perform the requests those are received from the System. There are many types of Operating systems those are organized by using their Working Techniques.

- 1) Serial Processing.**
- 2) Batch Processing.**
- 3) Multi-Programming.**
- 4) Real-Time System.**
- 5) Distributed Operating System.**
- 6) Multiprocessing.**

**1) Serial Processing:** The Serial Processing Operating Systems are those which Performs all the instructions into a **Sequence Manner** or the Instructions those are given by the user will be **executed by using the FIFO Manner** means First in First Out. All the Instructions those are Entered First in the System will be Executed First and the Instructions those are Entered Later Will be Executed Later.

**Main Problem is that a user doesn't interact with the System** while he is working on the System, means the user can't be able to enter the data for Execution.

**2) Batch Processing:** The Batch Processing is **same as the Serial Processing Technique**. But in the Batch Processing **Similar Types of jobs are Firstly Prepared** and they are Stored on the Card. and that card will be Submit to the System for the Processing. The System then Perform all the Operations on the Instructions one by one. And a **user can't be Able to specify any input**. And **Operating System** will increments his Program Counter for Executing the Next Instruction.

**Main Problem is that the Jobs those are prepared for Execution must be the Same Type.**

**second there will be the wastage of the Time when we are preparing the batch and the CPU will remain idle at that Time.**

**Multi-Programming :** The Multi-programming Operating Systems never use any cards because the Process is entered on the Spot by the user. But the **Operating System also uses the Process of Allocation and De-allocation of the Memory** Means he will provide the Memory Space to all the Running and all the Waiting Processes. There must be the Proper Management of all the Running Jobs.

**4) Real Time System:** There is also an Operating System which is known as Real Time Processing System. In this Response Time is already fixed. Means time to Display the Results after Possessing has fixed by the Processor or CPU. Real Time System is used at those Places in which we **Requires higher and Timely Response.**

There are two Types of Real Time System.

- 1) Hard Real Time System.**
- 2) Soft Real Time System**

- 1) **Hard Real Time System**: In the Hard Real Time System, Time is fixed and we can't Change any Moments of the Time of Processing. Means CPU will Process the data as we Enters the Data.
- 2) **Soft Real Time System**: In the Soft Real Time System, some Moments can be Change. Means after giving the Command to the CPU, CPU Performs the Operation after a **Microsecond**.

**5) Distributed Operating System.** – Distributed Means Data is Stored and Processed on Multiple Locations. When a Data is stored on to the Multiple Computers, those are placed in Different Locations. Distributed means In the Network, Network Collections of Computers are connected with Each other.

**Multiprocessing:** In the Multi Processing there are two or More CPU in a Single Operating System if one CPU will fail, then other CPU is used for providing backup to the first CPU. With the help of Multi-processing, we can Execute Many Jobs at a Time. All the Operations are divided into the Number of CPU's. if first CPU Completed his Work before the Second CPU, then the Work of Second CPU will be divided into the First and Second.

# File System

A file can be "free formed", indexed or a structured collection of related bytes having meaning only to the one who created it. Or in other words, an entry in a directory is the file. The file may have attributes like name, creator, date, type, permissions etc.

# **File Structure**

A file has various kinds of structure. Some of them can be:

- 1) **Simple Record Structure** with lines of fixed or variable lengths.
- 2) **Complex Structures** like a formatted document or reloadable load files.
- 3) **No Definite Structure** like a sequence of words and bytes etc.

# **Attributes of a File**

Following are some of the attributes of a file:

- 1) **Name.** It is the only information which is in human-readable form.
- 2) **Identifier.** The file is identified by a unique tag(number) within the file system.
- 3) **Type.** It is needed for systems that support different types of files.
- 4) **Location.** Pointer to file location on device.
- 5) **Size.** The current size of the file.
- 6) **Protection.** This controls and assigns the power of reading, writing, executing.
- 7) **Time, date, and user identification.** This is the data for protection, security, and usage monitoring.

# File Access Methods

The way that files are accessed and read into memory is determined by Access methods. Usually, a single access method is supported by systems while there are OS's that support multiple access methods.

- 1) Sequential Access**
- 2) Direct Access**
- 3) Indexed Sequential Access**

# What is a Directory

Information about files is maintained by Directories. A directory can contain multiple files. It can even have directories inside of them. In Windows, we also call these directories as folders.

## **Following is the information maintained in a directory:**

- 1) Name : The name visible to the user.
- 2) Type: Type of the directory.
- 3) Location: Device and location on the device where the file header is located.
- 4) Size: Number of bytes/words/blocks in the file.
- 5) Position: Current next-read/next-write pointers.
- 6) Protection: Access control on read/write/execute/delete.
- 7) Usage: Time of creation, access, modification etc.
- 8) Mounting: When the root of one file system is "grafted" into the existing tree of another file system it's called Mounting.

# File Systems

Provide a means to store data organized as files as well as a collection of functions that can be performed on files.

Maintain a set of attributes associated with the file.

**Typical operations include:**

- 1) Create**
- 2) Delete**
- 3) Open**
- 4) Close**
- 5) Read**
- 6) Write**

