# FUNDAMENTALS OF COMPUTERS

By

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**What is Computer: -** The computer is defined as an electronic device that performs computation, manipulation and processing on data in order to generate information. The word computer is derived from the "compute" which means to calculate. Initially, the computer was aimed to be fast calculating machine which could relieve the human beings of tedious computations on numerical problems. With the passage of time and various advancements, the computer was able to perform a number of other functions besides mere arithmetic operations. It can store, process and retrieve the data as and when desired. Computer can input raw data or meaningless facts and figures, processes them and generates meaningful information. Today the computers have revolutionized the world in every walk of life.

## CHARACTERISTICS OF COMPUTERS

The popularity of the computers as a powerful tool in every field is generally due to the following characteristics:-

A) **Automatic:-** The computer is considered to be automatic machine in the sense that it performs the given task until end without any human intervention or assistance. The computer works as per given instructions that specify exactly how a particular job is to be done. As soon as one instruction in completed, the next is obeyed automatically. Hence we can say that the computers are automatic and work on a given problem without human intervention.

B) **Speed:-** The processing speed of the computers is so high that they perform a task in nanoseconds($10^{-9}$) or picoseconds($10^{-12}$) which the human beings take days or months to complete.

C) **Accuracy:-** Besides being very fast, the computers are very accurate. They perform each and every calculation with the same accuracy. The electronic circuits in the computer having no mechanical malfunctions can perform the errorless operations continuously.

D) **Diligence:-** Computers can work for hours together without any tiredness or lack of concentration without creating any error.Due to this property, the computers score over human beings in doing routine jobs which require great accuracy.

E) **Versatility:**- The computers are versatile in performing the task as they can switch from one job to another according the need of the users.

F) **Memory:-** The computers can store and recall any amount of information because of its secondary storage. Every piece of information can be retained as long as desired by the user and recalled as and when needed.

G)**No I.Q:-** Computer is not a magical device. It can perform the tasks that a human being can. The difference is that it performs these tasks with speed and accuracy without having decision making capability. But with the advent of Artificial Intelligence and neuron technology, it would become a reality.

H) **No Feelings:-** Computers have no feelings or emotions. They have memory but no equivalent of human heart and soul.

**Types of Computers**

✓ On the basis of functionality, computers are classified as :

1. **Analog Computer** An analog computer is a form of computer that uses *continuous* physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved
2. **Digital Computer** A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system
3. **Hybrid Computer (Analog + Digital)** A combination of computers those are capable of inputting and outputting in both digital and analog signals. A hybrid computer system setup offers a cost effective method of performing complex simulations.

✓ **On the basis of Size**

1. **Super Computer** The fastest and most powerful type of computer Supercomputers are very expensive and are employed for specialized applications that require immense amounts of mathematical calculations. For example, weather forecasting requires a supercomputer. Other uses of supercomputers include animated graphics, fluid dynamic calculations, nuclear energy research, and petroleum exploration. The chief difference between a supercomputer and a mainframe is that a supercomputer channels all its power into executing a few programs as fast as possible, whereas a mainframe uses its power to execute many programs concurrently.
2. **Mainframe Computer** A very large and expensive computer capable of supporting hundreds, or even thousands, of users simultaneously. In the hierarchy that starts with a simple microprocessor (in watches, for example) at the bottom and moves to supercomputers at the top, mainframes are just below supercomputers. In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.
3. **Mini Computer** A midsized computer. In size and power, minicomputers lie between *workstations* and *mainframes*. In the past decade, the distinction between large minicomputers and small mainframes has blurred, however, as has the distinction between small minicomputers and workstations. But in general, a minicomputer is a multiprocessing system capable of supporting from 4 to about 200 users simultaneously.
4. **Micro Computer or Personal Computer**

- **Desktop Computer:** a personal or micro-mini computer sufficient to fit on a desk.

- **Laptop Computer:** a portable computer complete with an integrated screen and keyboard. It is generally smaller in size than a desktop computer and larger than a notebook computer.
- **Palmtop Computer/Digital Diary /Notebook /PDAs:** a hand-sized computer. Palmtops have no keyboard but the screen serves both as an input and output device.
- **Workstations** A terminal or desktop computer in a network. In this context, workstation is just a generic term for a user's machine (client machine) in contrast to a "server" or "mainframe."

## Generations of Computers

A generation refers to the state of improvement in the product development process. This term is also used in the different advancements of new computer technology. With each new generation, the circuitry has gotten smaller and more advanced than the previous generation before it. As a result of the miniaturization, speed, power, and computer memory has proportionally increased. Each generation of computers is characterized by major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful and more efficient and reliable devices.

## First Generation - 1940-1956:

The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. A magnetic drum, also referred to as drum, is a metal cylinder coated with magnetic iron-oxide material on which data and programs can be stored. Magnetic drums were once used as a primary storage device but have since been implemented as auxiliary storage devices.The tracks on a magnetic drum are assigned to channels located around the circumference of the drum, forming adjacent circular bands that wind around the drum. A single drum can have up to 200 tracks. As the drum rotates at a speed of up to 3,000 rpm, the device's read/write heads deposit magnetized spots on the drum during the write operation and sense these spots during a read operation. This action is similar to that of a magnetic tape or disk drive.They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions. First generation computers relied on machine language to perform operations, and they could only solve one problem at a time. Machine languages are the only languages understood by computers. While easily understood by computers, machine languages are almost impossible for humans to use because they consist entirely of numbers. Computer Programmers, therefore, use either **high level programming languages** or an assembly language programming. An

assembly language contains the same instructions as a machine language, but the instructions and variables have names instead of being just numbers.Programs written in **high level programming languages** retranslated into assembly language or machine language by a compiler. Assembly language program retranslated into machine language by a program called an assembler (assembly language compiler).Every CPU has its own unique machine language. Programs must be rewritten or recompiled, therefore, to run on different types of computers. Input was based on punch card and paper tapes, and output was displayed on printouts.The UNIVAC and ENIAC computers are examples of first-generation computing devices.

**Second Generation - 1956-1963:**

Transistors replaced vacuum tubes and ushered in the second generation computer. Transistor is a device composed of semiconductor material that amplifies a signal or opens or closes a circuit. Invented in 1947 at Bell Labs, transistors have become the key ingredient of all digital circuits, including computers. Today's **latest microprocessor** contains tens of millions of microscopic transistors. The transistor was far superior to the vacuum tube, allowing computers to become smaller, faster, cheaper,more energy-efficient and more reliable than their first-generation predecessors. Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output. Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as COBOL and FORTRAN. The first computers of this generation were developed for the atomic energy industry.

**Third Generation - 1964-1971:**

The development of the integrated circuit was the hallmark of the third generation of computers. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers. Silicon is the basic material used to make computer chips, transistors, silicon diodes and other electronic circuits and switching devices because its atomic structure makes the element an ideal semiconductor. A chip is a small piece of semi conducting material(usually silicon) on which an integrated circuit is embedded. A typical chip is less than ¼-square inches and can contain millions of electronic components(transistors). Computers consist of many chips placed on electronic boards called printed circuit boards. There are different types of chips. For example, CPU chips (also called

microprocessors) contain an entire processing unit, whereas memory chips contain blank memory. Not only does miniaturization mean that the components take up less space, it also means that they are faster and require less energy. Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors.

**Fourth Generation - 1971-Present:**

The microprocessor brought the fourth generation of computers, as thousands of integrated circuits we rebuilt onto a single silicon chip. At the heart of all personal computers and most workstations sits a microprocessor. Microprocessors also control the logic of almost all digital devices, from clock radios to fuel-injection systems for automobiles. Three basic characteristics differentiate microprocessors:

- **Instruction Set**: The set of instructions that the microprocessor can execute.
- **Bandwidth**: The number of bits processed in a single instruction.
- **Clock Speed**: Given in megahertz (MHz), the clock speed determines how many instructions per second the processor can execute.In 1981 IBM introduced its first computer for the home users, and in 1984 Apple introduced the Macintosh.As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUI's, the mouse and handheld devices

**Fifth Generation - Present and Beyond:**

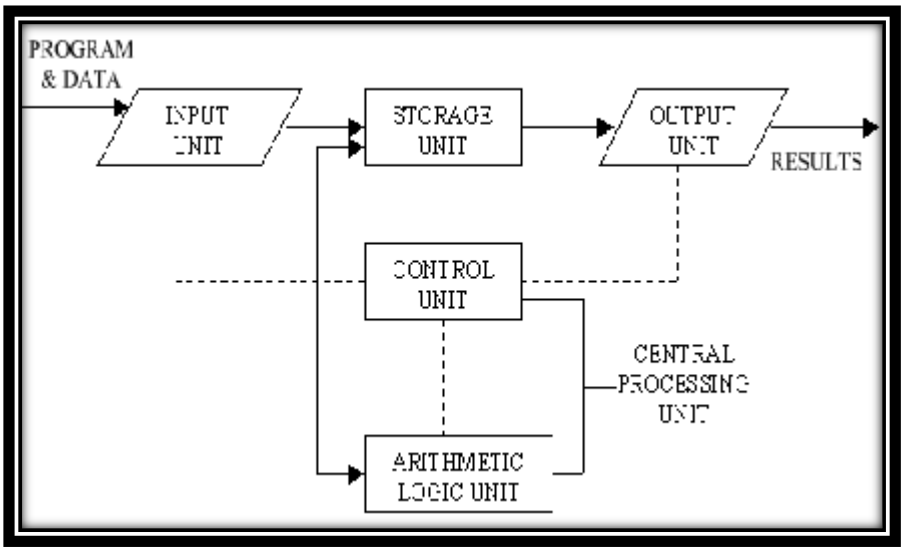
Fifth generation computing devices, based on artificial intelligence, are still in development,though there are some applications, such as voice recognition, that are being used today.

Artificial Intelligence is the branch of computer science concerned with making computers behave like humans. The term was coined in 1956 by John McCarthy at the Massachusetts Institute of Technology. Artificial intelligence includes:

- **Games Playing**: programming computers to play games such as chess and checkers
- **Expert Systems**: programming computers to make decisions in real-life situations (for example, some expert systems help doctors diagnose diseases based on symptoms)

- **Natural Language**: programming computers to understand natural human languages
- **Neural Networks**: Systems that simulate intelligence by attempting to reproduce the types of physical connections that occur in animal brains
- **Robotics**: programming computers to see and hear and react to other sensory stimuli

## Basic Components of Computer system




## FUNCTIONAL UNITS(COMPONENTS)

- In order to carry out the operations like input, processing, control and output, the computer allocates the task between its various functional units. The computer system is divided into the following separate units for its operation. They are
- 1) Input /Output Unit (I/O Devices)
- 2) Memory Unit
- 3) Central Processing Unit

**Input /Output Unit (I/O Devices)** :-The computer will be of no use unless it is able to communicate with the outside world. Input/Output devices are required for users to communicate with the computer. In simple terms, input devices bring information INTO the computer and output devices bring information OUT of a computer system. These input/output devices are also known as peripherals since they surround the CPU and memory of a computer system. Some commonly used Input/Output devices are listed below.

**I. Input Devices**

**(a) Keyboard**

It is a text base input device that allows the user to input alphabets, numbers and

Other characters. It consists of a set of keys mounted on a board.
Alphanumeric Keypad:- It consists of keys for English alphabets, 0 to 9 numbers, and special characters like +−/ * ( ) etc.
Function Keys:- There are twelve function keys labeled F1, F2, F3… F12. The functions assigned to these keys differ from one software package to another. These keys are also user programmable keys.
Special-function Keys:- These keys have special functions assigned to them and can be used only for those specific purposes. Functions of some of the important keys are defined below.
Enter:- It is similar to the 'return' key of the typewriter and is used to execute a command or program.
Spacebar:- It is used to enter a space at the current cursor location.
Backspace:-This key is used to move the cursor one position to the left and also delete the character in that position.
Numeric Keypad:- Numeric keypad is located on the right side of the keyboard and consists of keys having numbers (0 to 9) and mathematical operators (+ −* /) defined on them. This keypad is provided to support quick entry for numeric data.

**(b) Mouse**

The mouse is a small device used to point to a particular place on the screen and select in order to perform one or more actions. It can be used to select menu commands, size windows, start programs etc.
The most conventional kind of mouse has two buttons on top: the left one being used most frequently.
Mouse Actions
Left Click : Used to select an item.
Double Click : Used to start a program or open a file.
Right Click : Usually used to display a set of commands.
Drag and Drop : It allows you to select and move an item from one location to another.
(c) Joystick
The joystick is a vertical stick which moves the graphic cursor in a direction the stick is moved. It typically has a button on top that is used to select the option pointed by the cursor. Joystick is used as an input device primarily used with video games, training simulators and controlling robots

**(d)Scanner**

Scanner is an input device used for direct data entry from the source document into the computer system. It converts the document image into digital form so that it can be fed into the computer. Capturing information like this reduces the possibility of errors typically experienced during large data entry. Hand-held scanners are commonly seen in big

stores to scan codes and price information for each of the items. They are also termed the bar code readers.

**(e) Bar code Reader**

A bar code is a set of lines of different thicknesses that represent a number. Bar Code Readers are used to input data from bar codes. Most products in shops have bar codes on them. Bar code readers work by shining a beam of light on the lines that make up the bar code and detecting the amount of light that is reflected back

**(f) Light Pen**

It is a pen shaped device used to select objects on a display screen. It is quite like the mouse (in its functionality) but uses a light pen to move the pointer and select any object on the screen by pointing to the object.Users of Computer Aided Design (CAD) applications commonly use the light pens to directly draw on screen.

**(g) Touch Screen**

It allows the user to operate/make selections by simply touching the display screen. Common examples of touch screen include information kiosks, and bank ATMs.

**(h)Digital camera**

A digital camera can store many more pictures than an ordinary camera. Pictures taken using a digital camera are stored inside its memory and can be transferred to a computer by connecting the camera to it. A digital camera takes pictures by converting the light passing through the lens at the front into a digital image.

**(i) The Speech Input Device**

The “Microphones - Speech Recognition” is a speech Input device. To operate it we require using a microphone to talk to the computer. Also we need to add a sound card to the computer. The Sound card digitizes audio input into 0/1s .A speech recognition program can process the input and convert it into machine-recognized commands or input.

**(j) Optical Character Recognition (OCR)** refers to the technology that involves reading text from paper and translating the images into a form that the computer can manipulate (for example, into ASCII codes). An OCR system enables you to take a book or a magazine article, and feed it directly into an electronic computer file.

**(k) Magnetic Ink Character Recognition(MICR)** is a technique that enables special characters printed in magnetic ink to be read and input rapidly to a computer. When a document that contains this ink needs to be read, it passes through a machine, which magnetizes the ink and then translates the magnetic information into characters.

MICR is used to verify the legitimacy or originality of paper documents, especially checks. MICR is used extensively in banking because magnetic-ink characters are difficult to forge and are therefore ideal for marking and identifying cheques

**(l) Optical Mark Recognition (OMR)** is the technology of electronically extracting intended data from marked fields, such as checkboxes and fill-in fields, on printed forms.

It is generally distinguished from OCR by the fact that a recognition engine is not required. This requires the image to have high contrast and an easily-recognizable or irrelevant shape. OMR technology scans a printed form and reads predefined positions and records where marks are made on the form. This technology is useful for applications in which large numbers of hand-filled forms need to be processed quickly and with great accuracy, such as surveys, reply cards, questionnaires,academic testing and ballots.

**Output Devices**

**(a) Monitor**

Monitor is an output device that resembles the television screen and uses a Cathode Ray Tube (CRT) to display information. The monitor is associated with a keyboard for manual input of characters and displays the information as it is keyed in. It also displays the program or application output. Like the television, monitors are also available in different sizes.

**(b) Liquid Crystal Display (LCD)**

LCD was introduced in the 1970s and is now applied to display terminals also. Its advantages like low energy consumption, smaller and lighter have paved its way for usage in portable computers (laptops).

**(c) Printer**

Printers are used to produce paper (commonly known as hardcopy) output. Based on the technology used, they can be classified as Impact or Non-impact printers.

Impact printers use the typewriting printing mechanism wherein a hammer strikes the paper through a ribbon in order to produce output. Dot-matrix and Character printers fall under this category.

Non-impact printers do not touch the paper while printing. They use chemical, heat or electrical signals to etch the symbols on paper. Inkjet, Deskjet, Laser, Thermal printers fall under this category of printers.

When we talk about printers we refer to two basic qualities associated with printers: resolution, and speed. Print resolution is measured in terms of number of dots per inch (dpi). Print speed is measured in terms of number of characters printed in a unit of time and is represented as characters-per-second (cps), lines-per-minute (lpm), or pages-per-minute (ppm).

**(d) Plotter**

Plotters are used to print graphical output on paper. It interprets computer commands and makes line drawings on paper using multi colour automated pens. It is capable of producing graphs, drawings, charts, maps etc. Computer Aided Engineering (CAE) applications like CAD (Computer Aided Design) and CAM (Computer Aided Manufacturing) are typical usage areas for plotters.

**(e) Audio Output: Sound Cards and Speakers:**

The Audio output is the ability of the computer to output sound. Two components are needed: Sound card – Plays contents of digitized recordings, Speakers – Attached to sound card.

**Memory/Storage Unit:-**Storage device is a device for recording (storing) information (data). There are two types of storage devices used in computers;

**1.Primary/Main Storage**: - Primary storage is a storage that holds data for short periods of times while the computer is on. This type of storage is the fastest type of memory in the computer and is used to store data while it's being used. For example, when you open a program data is moved from the secondary storage into the primary storage. It is also known as internal memory and main memory.

A→**Random Access Memory (RAM)** is the best known form of computer memory. The Read and write (R/W) memory of a computer is called RAM. The User can write information to it and read information from it. With Ram any location can be reached in a fixed ( and short) amount of time after specifying its address. The RAM is a volatile memory; it means information written to it can be accessed as long as power is on. As soon as the power is off, it cannot be accessed.
RAM is considered "random access" because you can access any memory cell directly if you know the row and column that intersect at that cell. RAM is made in electronic chips made of so called semiconductor material, just like processors and many other types of chips. In RAM, transistors make up the individual storage cells which can each "remember" an amount of data, for example, 1 or 4 bits – as long as the PC is switched on. Physically, RAM consists of small electronic chips which are mounted in modules (small printed circuit boards). The modules are installed in the PC's motherboard using sockets –**There are two basic types of RAM :**

(i) Dynamic R
(ii) Static RAM

**Dynamic RAM :** loses its stored information in a very short time (for milli sec.) even when power supply is on. D-RAM is an Integrated Circuit (IC) made of millions of transistors and capacitors. Dynamic Memory Cell, represents a single bit of data. The capacitor holds the bit of information – a 0 or a 1. The transistor acts as a switch that lets the control circuitry on the memory chip read the capacitor or change its state. A capacitor is like a small bucket that is able to store electrons. To store a 1 in the memory cell, the bucket is filled with electrons. To store a 0, it is emptied. The problem with the capacitor's bucket is that it has a leak. Therefore, for dynamic memory to work, either the CPU or the Memory Controller has to come along and recharge all of the capacitors holding it before they discharge. Dynamic RAM has to be dynamically refreshed all of the time or it forgets what it is holding. This refreshing slows down the memory.

**Static RAM** uses a completely different technology. S-RAM retains stored information only as long as the power supply is on. Static RAM's are costlier and consume more

power. They have higher speed than D-RAMs. They store information in Hip-Hope.In static RAM, a form of flipflop holds each bit of memory. A flip-flop for a memory cell takes four or six transistors along with some wiring, but never has to be refreshed. This makes static RAM significantly faster than dynamic RAM. However, because it has more parts, a static memory cell takes up a lot more space on a chip than a dynamic memory cell.

**Some other RAMS are :**

(a) EDO (Extended Data Output) RAM

(b) SDRAM (Synchronous DRAMS)**,**

(c) DDR-SDRAM (Double Data Rate – SDRAM)

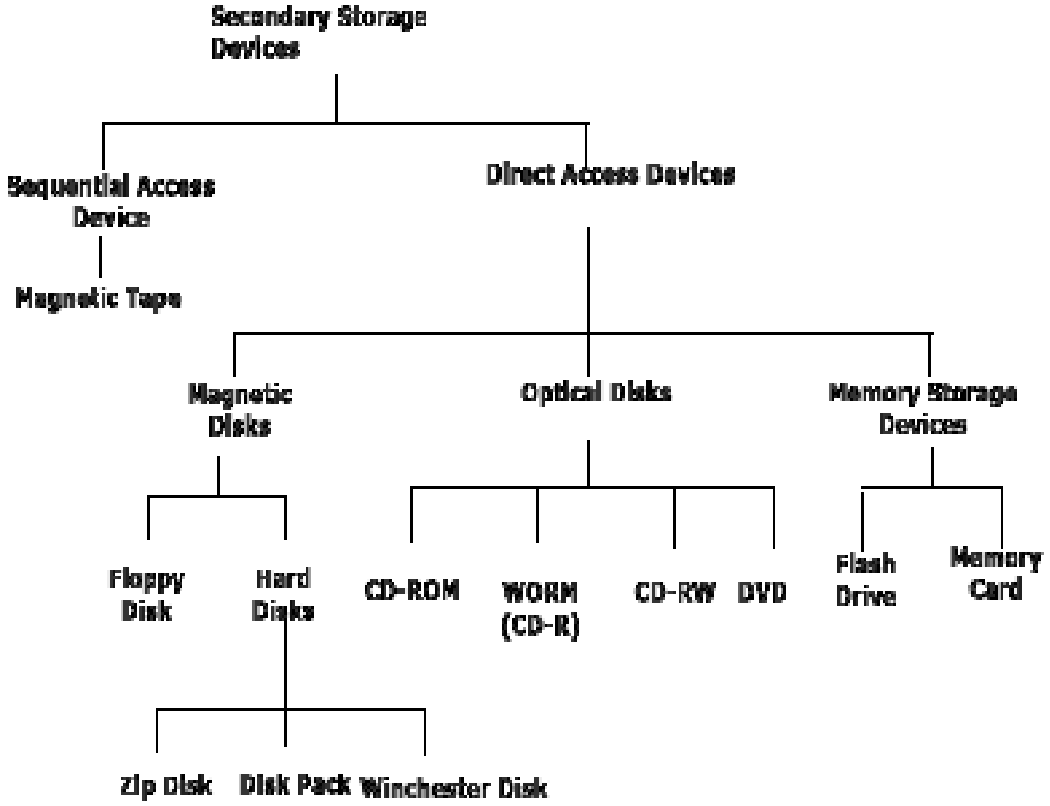
**B→ROM :** Read only Memory: It is non volatile memory, ie, the information stored in it, is not lost even if the power supply goes off. It's used for the permanent storage of information. It also posses random access property. Information can not be written into a ROM by the users/programmers. In other words the contents of ROMs are decided by the manufactures.**The following types of ROMs are listed below :**

**(i) PROM :** It's programmable ROM. Its contents are decided by the user. The user can store permanent programs, data etc in a PROM. The data is fed into it using a PROM programs.

**(ii) EPROM :** An EPROM is an erasable PROM. The stored data in EPROM's can be erased by exposing it to UV light for about 20 min. It's not easy to erase it because the EPROM IC has to be removed from the computer and exposed to UV light. The entire data is erased and not selected portions by the user. EPROM's are cheap and reliable.

**(iii) EEPROM (Electrically Erasable PROM) :** The chip can be erased & reprogrammed on the board easily byte by byte. It can be erased with in a few milliseconds. There is a limit on the number of times the EEPROM's can be reprogrammed, i.e.; usually around 10,000 times.

**Secondary Storage:** - Secondary storage is a storage medium that holds information until it is deleted or overwritten regardless if the computer has power. Some Major Secondary Storage devices are detailed as under:-




Secondary storage devices and their classification

**A→Magnetic Tape: Magnetic Tape** can be used to perform both functions -input and output. Magnetic Tape is a **secondary storage medium.** Magnetic tapes are used for large computers like mainframe computers where large volume of data is stored for a longer time. In PC also you can use tapes in the form of cassettes. The cost of storing data in tapes is inexpensive. Tapes consist of magnetic materials that store data permanently. It can be 12.5 mm to 25 mm wide plastic film-type and 500 meter to 1200 meter long which is coated with magnetic material. The deck is connected to the central processor and information is fed into or read from the tape through the processor. It is similar to cassette tape recorder. ***Advantages of Magnetic Tape****:*

**Compact:** A 10-inch diameter reel of tape is 2400 feet long and is able to hold 800, 1600 or 6250 characters in each inch of its length. T he maximum capacity of such tape is 180 million characters. Thus data are stored much more compactly on tape.

**Economical**: The cost of storing characters is very less as compared to other storage devices.

**Fast**: Copying of data is easier and fast. **Long term Storage and Re-usability**: Magnetic tapes can be used for long term storage and a tape can be used repeatedly with out loss of data

**B→ Direct Access Storage Devices**

- **Magnetic Disk:** You might have seen the gramophone record, which is circular like a disk and coated with magnetic material. Magnetic disks used in computer are made on the same principle. It rotates with very high speed inside the computer drive. Data is stored on both the surface of the disk. Magnetic disks are most popular for *direct access* storage device. Each disk consists of a number of invisible *concentric circles* called *tracks*. Information is recorded on tracks of a disk surface in the form of tiny magnetic spots. The presence of a magnetic spot represents *one bit* and its absence represents zero bit. The information stored in a disk can be read many times without affecting the stored data. So the reading operation is non-destructive. But if you want to write a new data, then the existing data is erased from the disk and new data is recorded.
- **Hard Disk :** Hard disks are made of aluminum or other metal alloys which are coated on both sides with magnetic material. Unlike floppy disks, hark disks are not removable from the computer. To remain the storing capacity several disks are packed together & mounted on a common drive to form a disk pack. A disk is also called a platter.
- **Seek Time: -** The Total Time which is Taken to Move on the Desired track is known as the seek Time. And time is always measured by using the Milliseconds.

- **Latency Time**: The time required to Bring the Particular Track to the Desired Location Means the Total Time to bring the Correct the Sector for Reading or for the read and Write head. This is also called as the Average Time.
- **Data Transfer Time:** The Total Time which is required for Reading and Writing the data into the Disk is known as the Data transfer Time.
- **Floppy Disk** : It's a circular disk coated with magnetic oxide and enclosed within square plastic cover (Jacket). It's available in different size, but the most commonly used floppy is 3½. Data up to 1.44 MB can be stored in it. Data is written as tiny magnetic spots on the disk surface creating new data or by erasing data previously stored at that location. Floppies are available in 2 sizes, 3.5 inch & 5.25 inch. The 3.5 inch size floppy is mostly used. The 5.25 inch floppy is kept in a flexible cover & it's not safe. It can store about 1.2 MB data.
- **Optical Disk** : Information is written to or read from an optical disk or tape using laser beam. Optical disks are not suitable memory storage units because their access time is more than that of hard disks. Their advantage is that they have very high storage capacity. Types of optical memory are: CD –ROM, CD-R, CD-RW, DVD-ROM, DVD-R and DVD-RW. Information on a CD-ROM is written at the time of manufacture. CD-R/W of 700 MB are available. A DVD-ROM is similar to CD-ROM. It uses shorter wave length of laser beam and hence, stores more data than CD-ROM.
  With every new application and software there is greater demand for memory capacity. It is the necessity to store large volume of data that has led to the development of optical disk storage medium. Optical disks can be divided into the following categories:
- ***Compact Disk/ Read Only Memory (CD-ROM)***: CD-ROM disks are made of reflective metals. CD-ROM is written during the process of manufacturing by high power *laser beam.* Here the storage density is very high, storage cost is very low and access time is relatively fast. Each disk is approximately 4 1/2 inches in diameter and can hold over 600 MB of data. As the CD-ROM can be *read only* we cannot write or make changes into the data contained in it.
- ***Write Once Read Many (WORM)***: The inconvenience that we cannot write anything in to a CD-ROM is avoided in WORM. A WORM allows the user to write data permanently on to the disk. Once the data is written it can never be erased without physically damaging the disk. Here data can be recorded from keyboard, video scanner, OCR equipment and other devices. The advantage of WORM is that it can store vast amount of data amounting to gigabytes (109 bytes). Any document in a WORM can be accessed very fast, say less than 30 seconds.
- ***Erasable Optical Disk***: These are optical disks where data can be written, erased and re-written. This also applies a laser beam to write and re-write the data. These disks may be used as alternatives to traditional disks. Erasable optical disks are

based on a technology known as *magnetic optical* (MO). To write a data bit on to the erasable optical disk the MO drive's laser beam heats a tiny, precisely defined point on the disk's surface and magnetizes it.

- **Winchester Disk**:-Another term for hard disk drive. The term **Winchester** comes from an early type of disk drive developed by IBM that had 30MB of fixed storage and 30MB of removable storage; so its inventors called it a Winchester in honor of its 30/30 rifle. Although modern disk drives are faster and hold more data, the basic technology is the same, so Winchester has become synonymous with hard.
- **Central Processing Unit** :-CPU is also known as microprocessor or processor. A CPU is brain of a computer. It is responsible for all functions and processes. Regarding computing power, the CPU is the most important element of a computer system. The CPU is consisted of thin layers of thousands of transistors. Each transistor receives a set of inputs and produces output. Transistors hold a key role in functioning of CPU as they make computer able to count and perform logical operations which is called processing. It processes the instructions that it collects by decoding the code in programs.

  There are three important functions of CPU:-

  **Fetch**: The Fetch Operation is used for taking the instructions those are given by the user and the Instructions those are stored into the Main Memory will be fetch by using Registers.

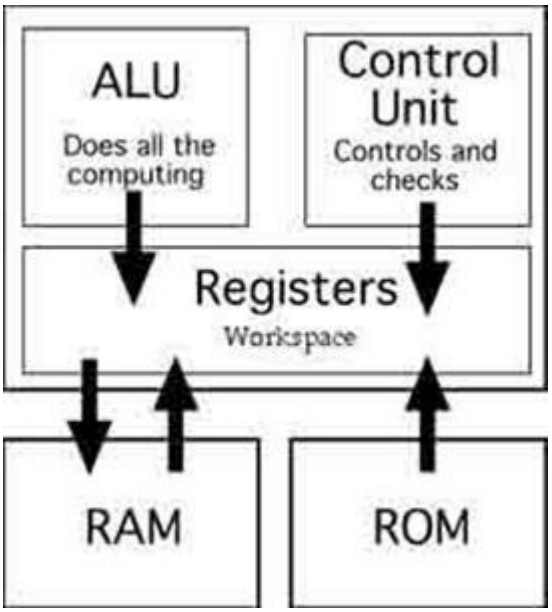
  **Decode**: The Decode Operation is used for interpreting the Instructions means the Instructions are decoded means the CPU will find out which Operation is to be performed on the Instructions.

  **Execute**: The Execute Operation is performed by the CPU and Results which are produced by the CPU are then Stored into the Memory and after that they are displayed on the user Screen.

  **Main Components of CPU:**

  The following are main components of the CPU:-

  **1.** Arithmetic Logic Unit
  **2.** Control Unit
  **3.** Registers




**Arithmetic Logic Unit (ALU)**:-There is electronic circuitry in arithmetic logic unit which executes all airthmetic and logical operations.Its function is obvious from its name.It performs arithmetic calculations like as addition, subtraction, multiplication and division as well as comparisons.The unit can compare numbers, letters, or special characters.There can be more than one Arithmetic logic unit in a CPU, and these ALUs can also be used for the purpose of maintaining timers that help run the computer.

**Control Unit(CU)**:-There is circuitry in the control unit which uses electrical signals to instruct the whole computer system for carrying out or executing,already stored program instructions.Its name clearly shows that it controls and co-ordinates computer components.It extracts instructions from memory and decodes and executes them.In fact it regulates the flow of information through the processor.In short,it can be said ,this component receives, decodes, stores results and manages execution of data that flows through the CPU. Its communication with both arithmetic unit and memory is inevitable.

**Registers**:-Registers are temporary storage areas which are responsible for holding the data that is to be processed.They store the instructions and data in a processor.This data is further used by Control Unit.

**Some major Registers in the CPU are as Followings:**

1) MAR stand for *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.

**2) Program Counter :**

The **program counter (PC)**, commonly called the **instruction pointer** (IP) in Intel x86 microprocessors, and sometimes called the **instruction address register**, keeps track of the the **next memory address** of the instruction that is to be executed once

the execution of the current instruction is completed. 3) **Accumulator Register**: 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**.

4) **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 **like a buffer** and holds anything that is copied from the memory ready for the processor to use it. **MDR hold the information before it goes to the decoder.**

5) **Index register**:-A hardware element which holds a number that can be added to (or, in some cases, subtracted from) the address portion of a computer instruction to form an effective address. Also known as **base register**. An index register in a computer's CPU is a processor register used for modifying operand addresses during the run of a program.

*6) Memory Buffer Register*

MBR stand for *Memory Buffer Register*. This register holds the contents of data or instruction read from, or written in memory. It means that this register is used to store data/instruction coming from the memory or going to the memory.

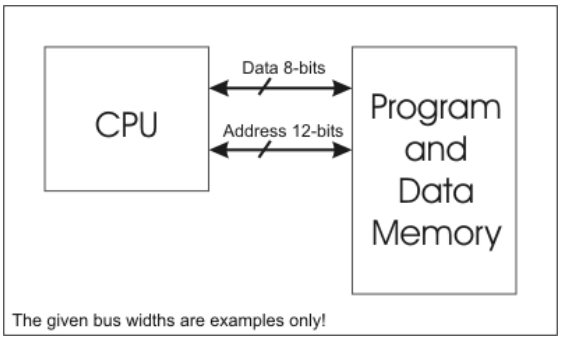
**7) Data Register**

A register used in microcomputers to temporarily store data being transmitted to or from a peripheral device.

## Von Neumann Architecture

In the von Neumann Architecture, the computer consists of a CPU, memory and I/O devices. The program is stored in the memory. The CPU fetches an instruction from the memory at a time and executes it.Thus, the instructions are executed sequentially which is a slow process. Neumann m/c are called control flow computer because instruction are executed sequentially as controlled by a program counter. To increase the speed, parallel processing of computer have been developed in which serial CPU's are connected in parallel to solve a problem. Even in parallel computers, the basic building blocks are Neumann processors.

- The von Neumann architecture is a design model for a stored-program digital computer that uses a processing unit and a single separate storage structure to hold both instructions and data. It is named after mathematician and early computer scientist John von Neumann. Such a computer implements a universal Turing machine, and the common "referential model" of specifying sequential architectures, in contrast with parallel architectures.




- One shared memory for instructions (program) and data with one data bus and one address bus between processor and memory. Instructions and data have to be fetched in sequential order (known as the Von Neuman Bottleneck), limiting the operation bandwidth. Its design is simpler than that of the Harvard architecture. It is mostly used to interface to external memory.
- Addressing modes are the method used to determine which part of memory is being referred to by a machine instruction. There are various types of addressing modes. Which addressing mode is used is dependent on what type of computer architecture is being used.
- Random access memory (RAM) is the primary area of memory for a computer. This is where any application must be loaded to if it is to be run. The central processing unit (CPU) reads machine instructions from the RAM and acts on those instructions. This is what happens whenever any application is run on a computer.
  The machine instructions given to the CPU often must refer to specific portions of the RAM. In order to do this, the CPU must have a way of knowing which portion of RAM the machine instruction is referring to. This is where addressing modes come into play.
  **Addressing Modes**
  Addressing modes are used to divide up the sections of RAM into individual portions that may be referenced individually. This is similar to how each house has an address. This address can then be used by a machine instruction to refer to a specific portion of memory. The CPU will then access that portion of memory and perform the action specified by the machine instruction.
  **Types of Addressing Modes:-**The most common addressing modes are:

  - Immediate addressing mode
  - Direct addressing mode
  - Indirect addressing mode
  - Register addressing mode
  - Register indirect addressing mode
  - Displacement addressing mode
  - Stack addressing mode

**Immediate Addressing:-**This is the simplest form of addressing. Here, the operand is given in the instruction itself. This mode is used to define constant or set initial values of variables. The advantage of this mode is that no memory reference other than instruction fetch is required to obtain operand. The disadvantage is that the size of the number is limited to the size of the address field, which most instruction sets is small compared to word length.

**Direct Addressing:**In direct addressing mode, effective address of the operand is given in the address field of the instruction. It requires one memory reference to read the operand from the given location and provides only a limited address space. Length of the address field is usually less than the word length.

**Indirect Addressing:**Indirect addressing mode, the address field of the instruction refers to the address of a word in memory, which in turn contains the full length address of the operand. The advantage of this mode is that for the word length of N, an address space of 2N can be addressed. He disadvantage is that instruction execution requires two memory reference to fetch the operand Multilevel or cascaded indirect addressing can also be used.

**Register Addressing:**

Register addressing mode is similar to direct addressing. The only difference is that the address field of the instruction refers to a register rather than a memory location 3 or 4 bits are used as address field to reference 8 to 16 generate purpose registers. The advantages of register addressing are Small address field is needed in the instruction.

**Register Indirect Addressing:** This mode is similar to indirect addressing. The address field of the instruction refers to a register. The register contains the effective address of the operand. This mode uses one memory reference to obtain the operand. The address space is limited to the width of the registers available to store the effective address.

**Displacement Addressing:** In displacement addressing mode there are 3 types of addressing mode. They are :

1) Relative addressing
2) Base register addressing
3) Indexing addressing.

This is a combination of direct addressing and register indirect addressing. The value contained in one address field. A is used directly and the other address refers to a register whose contents are added to A to produce the effective address.

**Stack Addressing:**Stack is a linear array of locations referred to as last-in first out queue. The stack is a reserved block of location, appended or deleted only at the top of the stack. Stack pointer is a register which stores the address of top of stack location. This mode of addressing is also known as implicit addressing.

## Applications/uses of Computers

- **Education :** Getting the right kind of information is a major challenge as is getting information to make sense.Research shows that computers can significantly enhance performance in learning. Students exposed to the internet say they think the web has helped them improve the quality of their academic research and of their written work. One revolution in education is the advent of distance learning. This offers a variety of internet and video-based online courses.
- **Health and Medicine :**Computer technology is radically changing the tools of medicine. All medical information can now be digitized. Software is now able to compute the risk of a disease. Mental health researchers are using computers to screen troubled teenagers in need of psychotherapy. A patient paralyzed by a stroke has received an implant that allows communication between his brain and a computer; as a result, he can move a cursor across a screen by brainpower and convey simple messages.
- **Science :** Scientists have long been users of it. A new adventure among scientists is the idea of a “collaboratory”, an internet based collaborative laboratory, in which researchers all over the world can work easily together even at a distance. An example is space physics where space physicists are allowed to band together to measure the earth’s ionosphere from instruments on four parts of the world.
- **Business :** Business clearly see the interest as a way to enhance productivity and competitiveness. Some areas of business that are undergoing rapid changes are sales and marketing, retailing, banking, stock trading, etc. Sales representatives not only need to be better educated and more knowledgeable about their customer’s businesses, but also must be comfortable with computer technology. The internet has become a popular marketing tool. The world of cybercash has come to banking – not only smart cards but internet banking, electronic deposit, bill paying, online stock and bond trading, etc.
- **Recreation and Entertainment:**Our entertainment and pleasure-time have also been affected by computerization. For example:

i) In movies, computer generated graphics give freedom to designers so that special effects and even imaginary characters can play a part in making movies, videos, and commercials.
ii) In sports, computers compile statistics, sell tickets, create training programs and diets for athletes, and suggest game plan strategies based on the competitor's past performance.
iii) In restaurants, almost everyone has eaten food where the clerk enters an order by indicating choices on a rather unusual looking cash register; the device directly enters the actual data into a computer, and calculates the cost and then prints a receipt.

- **Government:** Various departments of the Government use computer for their planning, control and law enforcement activities. To name a few – Traffic, Tourism, Information & Broadcasting, Education, Aviation and many others.
- **Defense**: There are many uses computers in Defense such as:
  1) Controlling UAV or unmanned air-crafts an example is Predator.
  2) They are also used on Intercontinental Ballistic Missiles (ICBMs) that uses GPS and Computers to help the missile get to the target.
  3) Computers are used to track incoming missiles and help slew weapons systems onto the incoming target to destroy them.
  4) Computers are used in helping the military find out where all their assets are (Situational Awareness) and in Communications/Battle Management Systems.
- **Sports:**
  In today's technologically growing society, computers are being used in nearly every ac**tivity.**