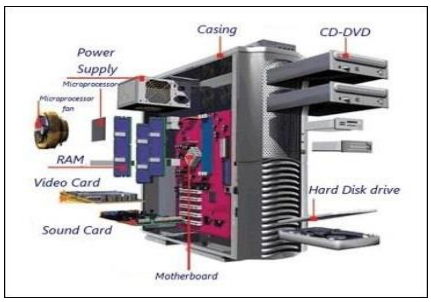
BCA1B01– COMPUTER FUNDAMENTALS AND HTML
MODULE 1

Concepts of Hardware and Software

Computer Hardware:

The term hardware refers to mechanical device that makes up computer. Computer Hardware is any part of the computer that we can touch these parts. Computer hardware consists of interconnected electronic devices that we can use to control computer's operation, input and output. Examples of hardware are CPU, keyboard, mouse, hard disk, etc.



Computer Software:

Software is a collection of instructions, procedures, documentation that performs different tasks on a computer system. We can say also Computer Software is a programming code executed on a computer processor. The code can be machine-level code or the code written for an operating system. Examples of software are Ms Word, Excel, Power Point, Google Chrome, Photoshop, MySQL etc.

- System software
- Application software

System software

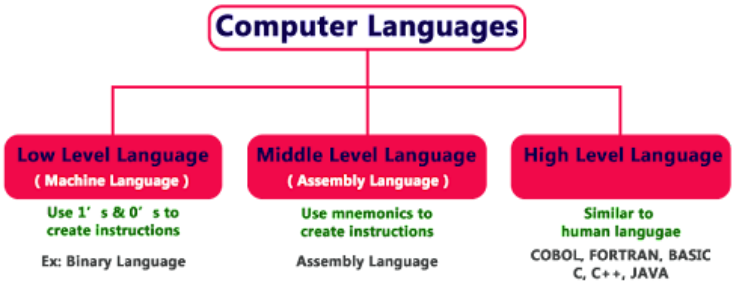
Application software

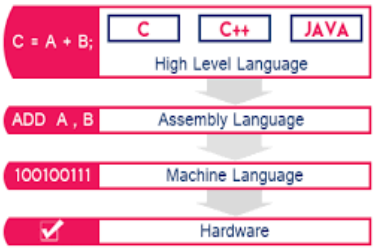
1) System Software

System software operates directly on hardware devices of computer. It provides a platform to run an application. It provides and supports user functionality. Examples of system software include operating systems such as Windows, Linux, UNIX, etc.

2) Application Software

An application software is designed for benefit of users to perform one or more tasks. Examples of application software include Microsoft Word, Excel, PowerPoint, Oracle, etc.





Computer Languages

The user of a computer must be able to communicate with it. That means, he must be able to give the computer commands and understand the output that the computer generates. This is possible due to the invention of computer languages.

1] Low Level Languages

The main function of low level languages is to interact with the hardware of the computer. They help in operating, syncing and managing all the hardware and system components of the computer.

Machine Language: This is one of the most basic low level languages. The language was first developed to interact with the first generation computers. It is written in binary code or machine code, which means it basically comprises of only two digits – 1 and 0.

Example of machine-language

Here's what a program-fragment looks like:

```
10100001 10111100 10010011 00000100
00001000 00000011 00000101 11000000
10010011 00000100 00001000 10100011
11000000 10010100 00000100 00001000
```

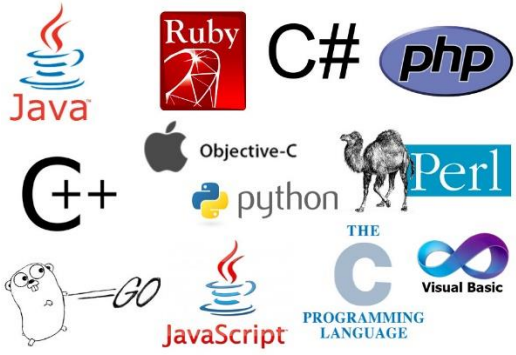
It means: z = x + y;

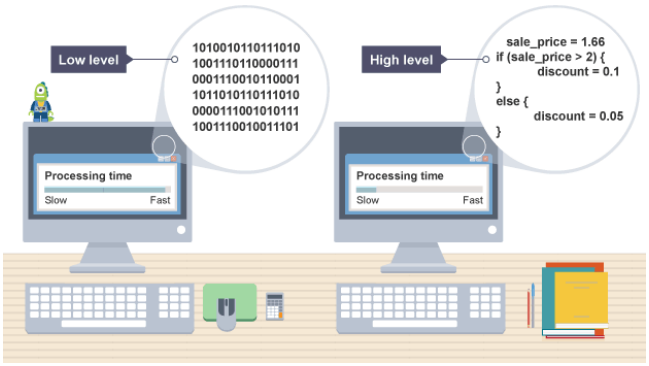
Assembly Language: This is the second generation programming language. It is a development on the machine language, where instead of using only numbers, we use English words, names, and symbols. It is the most basic computer language necessary for any processor.

```
01 .MODEL SMALL
02 .STACK 100H
03 .CODE
04
05 MOV AX, 0x3C
06 MOV BX, 0000000000001010B
07 ADD AX, BX
08 MOV BX, 14
09 SUB AX, BX
10
11 MOV AH, 04CH
12 INT 21H
```

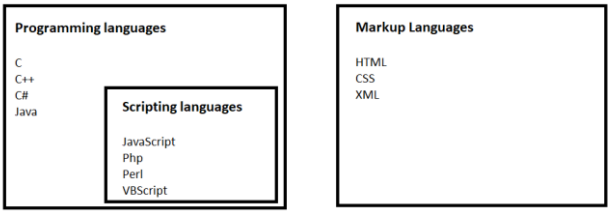
2] High Level Language

The important feature about such high level languages is that they allow the programmer to write programs for all types of computers and systems. Every instruction in high level language is converted to machine language for the computer to comprehend.

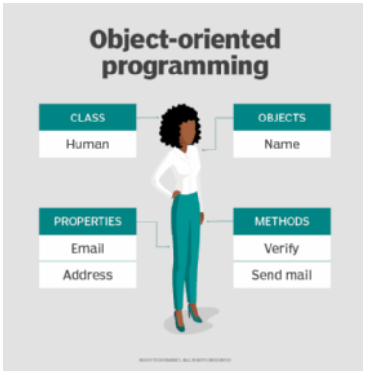


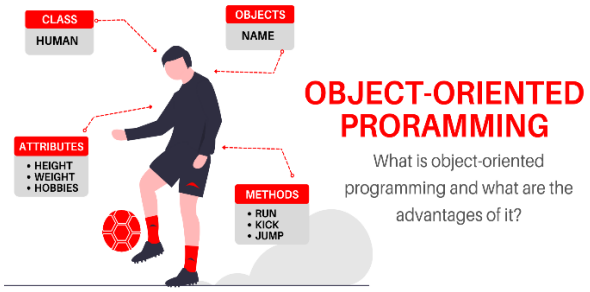


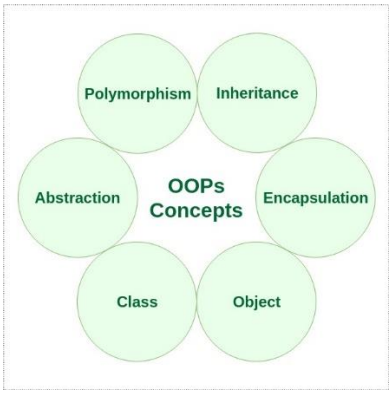
Scripting Languages: Scripting languages, as the name suggests, is a programming language that supports scripts. A scripting language binds a set of software components that collaborate to solve a particular problem. Scripting assumes the existence of powerful components and provides the means to connect them together. These languages employ a high level construct which allows it to interpret and execute one command at a time. Some examples are AppleScript, JavaScript, and Pearl etc.



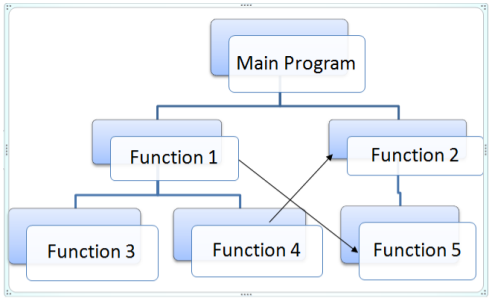
Object-Oriented Languages: The reasoning behind is that the programmers really cares about the object they wish to manipulate rather than the logic needed to manipulate them. Some examples include Java, C+, C++, Python, and Swift etc.

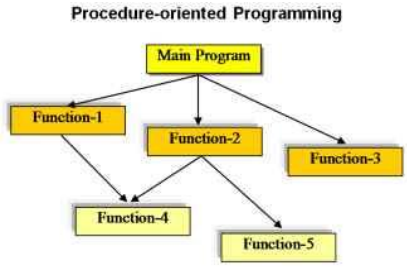


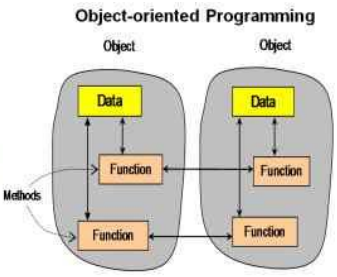




Procedural Programming Language: This is a type of programming language that has well-structured steps and complex procedures within its programming to compose a complete program. It has a systematic order functions and commands to complete a task or a program. FORTRAN, ALGOL, BASIC, COBOL are some examples.

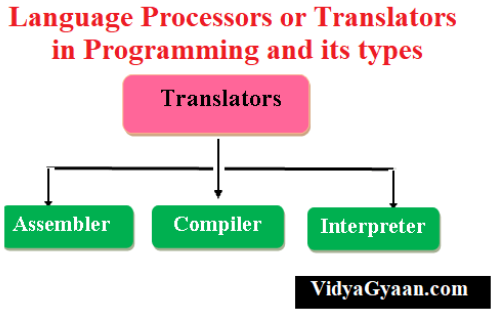


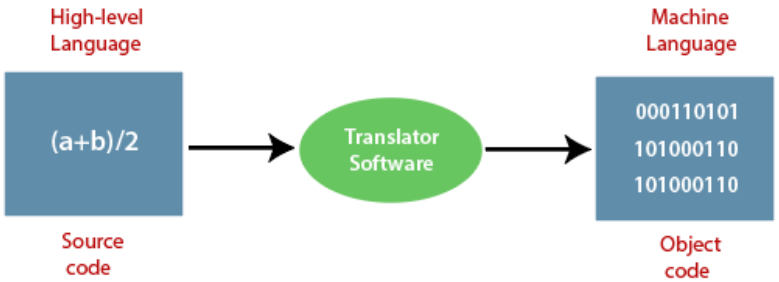




Language Translators

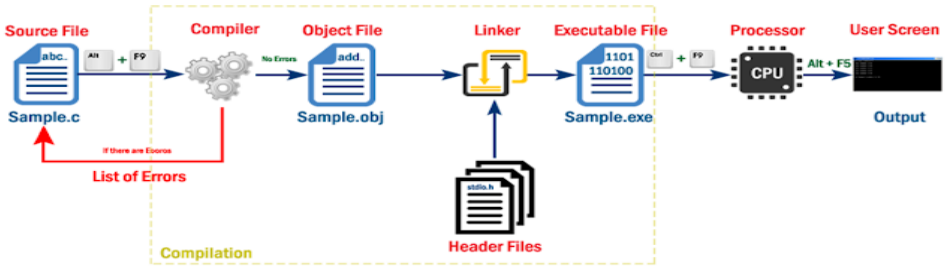
A translator is a programming language processor that converts a computer program from one language to another. It takes a program written in source code and converts it into machine code. It discovers and identifies the error during translation. There are 3 different types of translators as follows:





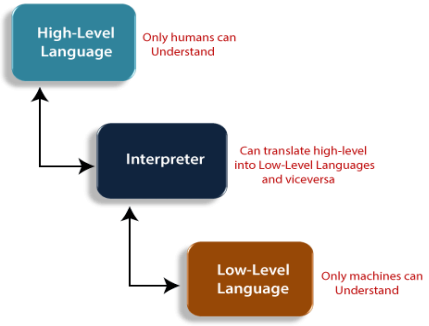
1) Compiler

A compiler is a translator used to convert high-level programming language to low-level programming language. It converts the whole program in one session and reports errors detected after the conversion. Compiler takes time to do its work as it translates high-level code to lower-level code all at once and then saves it to memory. A compiler is processor-dependent and platform-dependent. But it has been addressed by a special compiler, a cross-compiler and a source-to-source compiler. Ex: Microsoft Visual Studio, GCC, COBOL



2) Interpreter

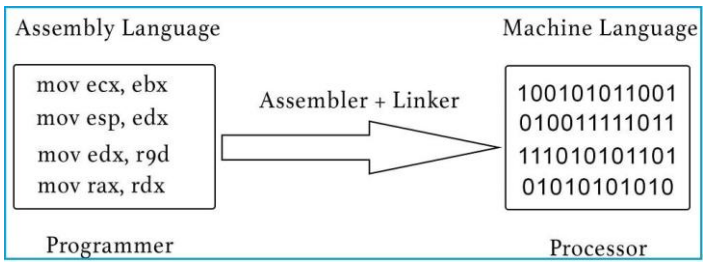
Just like a compiler, is a translator used to convert high-level programming language to low-level programming language. It converts the program one at a time and reports errors detected at once, while doing the conversion. With this, it is easier to detect errors than in a compiler. An interpreter is faster than a compiler as it immediately executes the code upon reading the code.It is often used as a debugging tool for software development as it can execute a single line of code at a time.An interpreter is also more portable than a compiler as it is not processor-dependent, you can work between hardware architectures. EX : OCaml,LISP,Python

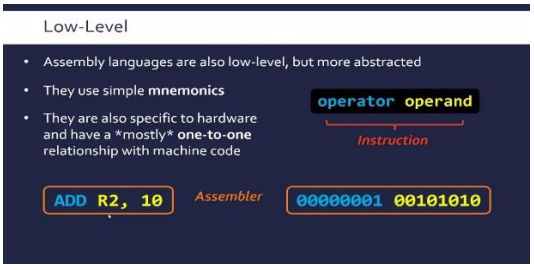


3) Assembler

An assembler is is a translator used to translate assembly language to machine language. It is like a compiler for the assembly language but interactive like an interpreter. Assembly language is difficult to understand as it is a low-level programming language. An assembler translates a low-level language, an assembly language to an even lower-level language, which is the machine code. The machine code can be directly understood by the CPU.

Ex: FAP, MAP, SOAP





Interpreter, compiler & assembler

Translator	Compiler	Assembler
Translates high-level language into machine code	Translates high-level language into machine code	Translates assembly language into machine code
Translates source one line at a time	Translates all code at the same time	Uses the processors instruction set to convert
Needed every time you run the program	Only needed once to create an executable file	Runs quickly as conversation between two low level languages is just reliant on the processors instructions set
Returns a list of errors found and on which lines	Will only inform you of the first error it finds	
Runs more slowly as it is being translated every time the code is run	Once compiled runs quickly but compiling can take a long time	

Features of good language

- A programming language must be simple, easy to learn and use, have good readability and human recognizable.
- Abstraction is a must-have Characteristics for a programming language in which ability to define the complex structure and then its degree of usability comes.
- A portable programming language is always preferred.
- Programming language's efficiency must be high so that it can be easily converted into a machine code and executed consumes little space in memory.
- A programming language should be well structured and documented so that it is suitable for application development.
- Necessary tools for development, debugging, testing, and maintenance of a program must be provided by a programming language.
- A programming language should provide single environment known as Integrated Development Environment (IDE).
- A programming language must be consistent in terms of syntax and semantics.

Basics Computer Organization:

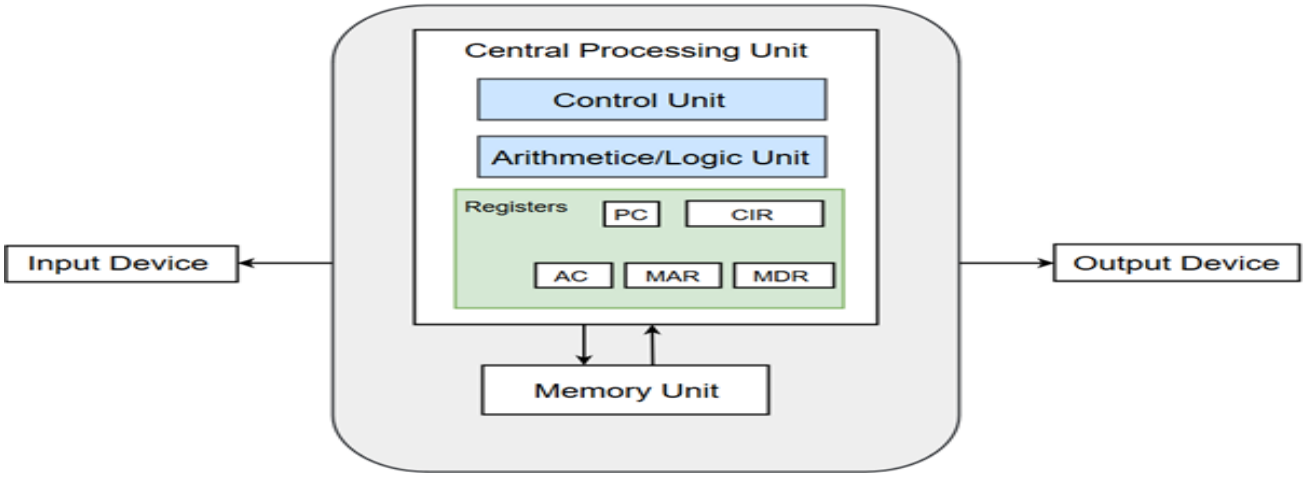
Von Neumann Model:

Von-Neumann proposed his computer architecture design in 1945 which was later known as Von-Neumann Architecture. It consisted of a Control Unit, Arithmetic, and Logical Memory Unit (ALU), Registers and Inputs/Outputs. On Neumann architecture is based on the stored-program computer concept, where instruction data and program data are stored in the same memory. This design is still used in most computers produced today.

A Von Neumann-based computer:

- Uses a single processor
- Uses one memory for both instructions and data.
- Executes programs following the fetch-decode-execute cycle

Von-Neumann Basic Structure:



Central Processing Unit

The part of the Computer that performs the bulk of data processing operations is called the Central Processing Unit and is referred to as the CPU. The Central Processing Unit can also be defined as an electric circuit responsible for executing the instructions of a computer program.

The CPU performs a variety of functions dictated by the type of instructions that are incorporated in the computer.

The major components of CPU are Arithmetic and Logic Unit (ALU), Control Unit (CU) and a variety of registers.

Arithmetic and Logic Unit (ALU)

The Arithmetic and Logic Unit (ALU) performs the required micro-operations for executing the instructions. In simple words, ALU allows arithmetic (add, subtract, etc.) and logic (AND, OR, NOT, etc.) operations to be carried out.

Control Unit

The Control Unit of a computer system controls the operations of components like ALU, memory and input/output devices.The Control Unit consists of a program counter that contains the address of the instructions to be fetched and an instruction register into which instructions are fetched from memory for execution.

Registers

Registers refer to high-speed storage areas in the CPU. The data processed by the CPU are fetched from the registers. Following is the list of registers that plays a crucial role in data processing.

MAR (Memory Address Register)-This register holds the memory location of the data that needs to be accessed.

MDR (Memory Data Register)-This register holds the data that is being transferred to or from memory.

AC (Accumulator)-This register holds the intermediate arithmetic and logic results.

PC (Program Counter)-This register contains the address of the next instruction to be executed.

CIR (Current Instruction Register)-This register contains the current instruction during processing.

Buses

Buses are the means by which information is shared between the registers in a multiple-register configuration system.A bus structure consists of a set of common lines, one for each bit of a register, through which binary information is transferred one at a time. Control signals determine which register is selected by the bus during each particular register transfer.

Address Bus-Address Bus carries the address of data (but not the data) between the processor and the memory.

Data Bus-Data Bus carries data between the processor, the memory unit and the input/output devices.

Control Bus-Control Bus carries signals/commands from the CPU.

Memory Unit

A memory unit is a collection of storage cells together with associated circuits needed to transfer information in and out of the storage. The memory stores binary information in groups of bits called words. The internal structure of a memory unit is specified by the number of words it contains and the number of bits in each word.

Two major types of memories are used in computer systems:

1. RAM (Random Access Memory)
2. ROM (Read-Only Memory)

INPUT UNIT - INPUT DEVICES

Input device enables the user to send data, information, or control signals to a computer. The Central Processing Unit (CPU) of a computer receives the input and processes it to produce the output.

1) Keyboard

The keyboard is a basic input device that is used to enter data into a computer or any other electronic device by pressing keys. It has different sets of keys for letters, numbers, characters, and functions. Keyboards are connected to a computer through USB or a Bluetooth device for wireless communication.

2) Mouse

Mouse is the most popular pointing device. It is a very famous cursor-control device having a small palm size box with a round ball at its base, which senses the movement of the mouse and sends corresponding signals to the CPU when the mouse buttons are pressed.Generally, it has two buttons called the left and the right button and a wheel is present between the buttons. A mouse can be used to control the position of the cursor on the screen, but it cannot be used to enter text into the computer.

3) Joystick

Joystick is also a pointing device, which is used to move the cursor position on a monitor screen. It is a stick having a spherical ball at its both lower and upper ends. The lower spherical ball moves in a socket. The joystick can be moved in all four directions.

4)Scanner

Scanner is an input device, which works more like a photocopy machine. It is used when some information is available on paper and it is to be transferred to the hard disk of the computer for further manipulation. Scanner captures images from the source which are then converted into a digital form that can be stored on the disk. These images can be edited before they are printed.

5)Digitizer

Digitizer is an input device which converts analog information into digital form. Digitizer can convert a signal from the television or camera into a series of numbers that could be stored in a computer. They can be used by the computer to create a picture of whatever the camera had been pointed at.

Digitizer is also known as Tablet or Graphics Tablet as it converts graphics and pictorial data into binary inputs. A graphic tablet as digitizer is used for fine works of drawing and image manipulation applications.

6)Microphone

The microphone is a computer input device that is used to input the sound. It receives the sound vibrations and converts them into audio signals or sends to a recording medium. The audio signals are converted into digital data and stored in the computer. The microphone also enables the user to telecommunicate with others. It is also used to

add sound to presentations and with webcams for video conferencing. The microphone is used for various applications such as adding sound to a multimedia presentation or for mixing music.

7)Magnetic Ink Card Reader (MICR)

MICR input device is generally used in banks as there are large number of cheques to be processed every day. The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable.

This reading process is called Magnetic Ink Character Recognition (MICR). The main advantages of MICR is that it is fast and less error prone.

8)Optical Character Reader (OCR)

OCR computer input device is designed to convert the scanned images of handwritten, typed or printed text into digital text. It is widely used in offices and libraries to convert documents and books into electronic files.

OCR scans the text optically, character by character, converts them into a machine readable code, and stores the text on the system memory.

9)Bar Code Readers

Bar Code Reader is a device used for reading bar coded data (data in the form of light and dark lines). Bar coded data is generally used in labelling goods, numbering the books, etc. It may be a handheld scanner or may be embedded in a stationary scanner.

Bar Code Reader scans a bar code image, converts it into an alphanumeric value, which is then fed to the computer that the bar code reader is connected to.

10)Optical Mark Reader (OMR)

OMR is a special type of optical scanner used to recognize the type of mark made by pen or pencil. It is used where one out of a few alternatives is to be selected and marked.

It is specially used for checking the answer sheets of examinations having multiple choice questions.

OUTPUT UNIT - OUTPUT DEVICES

The output device displays the result of the processing of raw data that is entered in the computer through an input device. There are a number of output devices that display output in different ways such as text, images, hard copies, and audio or video.

Some of the popular output devices are:

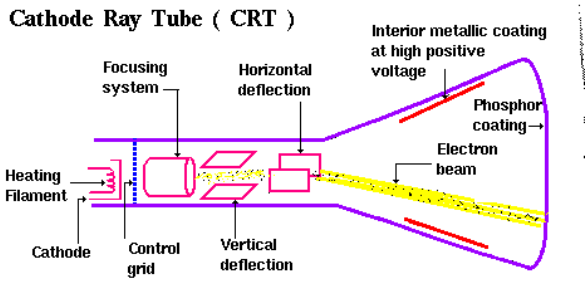
1. Monitor
    - CRT Monitor
    - LCD Monitor
    - LED Monitor
    - Plasma Monitor
2. Printer
    - Impact Printers
        A. Character Printers
            i. Dot Matrix printers
            ii. Daisy Wheel printers
        B. Line printers
            i. Drum printers
            ii. Chain printers
    - Non-impact printers
        A. Laser printers
        B. Inkjet printers
3. Projector

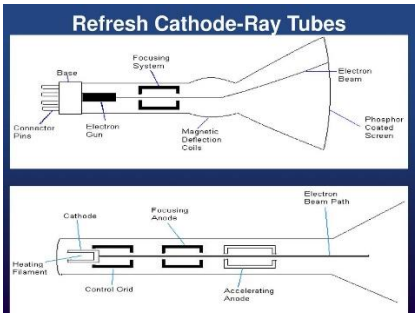
1) Monitor

The monitor is the display unit or screen of the computer. It is the main output device that displays the processed data or information as text, images, audio or video.

The types of monitors are given below.

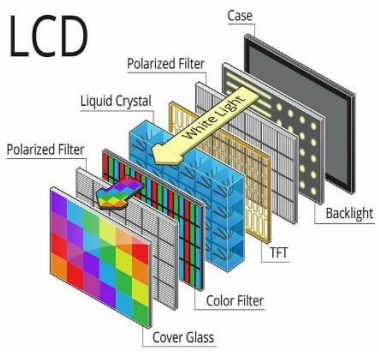
i) CRT Monitor

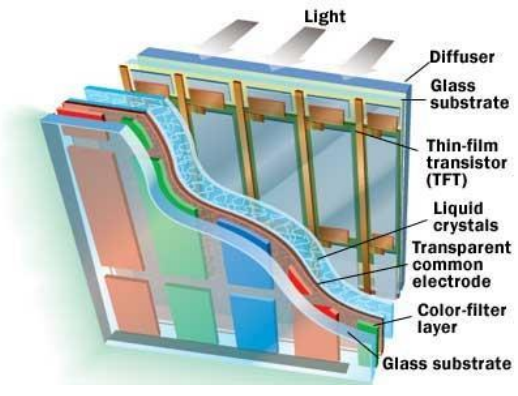




CRT monitors are based on the cathode ray tubes. They are like vacuum tubes which produce images in the form of video signals. Cathode rays tube produces a beam of electrons through electron guns that strike on the inner phosphorescent surface of the screen to produce images on the screen. The monitor contains millions of phosphorus dots of red, green and blue color. These dots start to glow when struck by electron beams and this phenomenon is called cathodoluminescence.The main components of a CRT monitor include the electron gun assembly, deflection plate assembly, fluorescent screen, glass envelope, and base.The front (outer surface) of the screen onto which images are produced is called the face plate. It is made up of fiber optics.

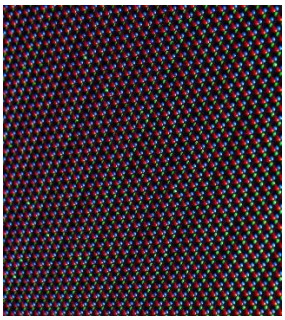
ii) LCD Monitor





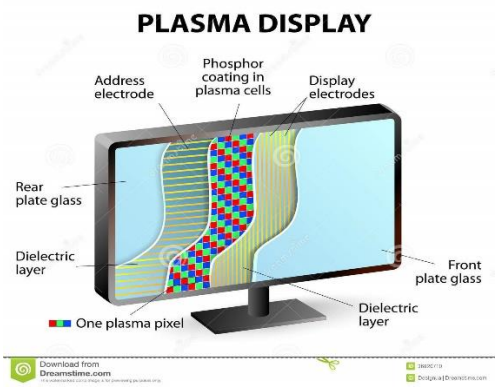
The LCD monitor is a flat panel screen that is compact and light-weight as compared to CRT monitors. It is based on liquid crystal display technology which is used in the screens of laptops, tablets, smart phones, etc. An LCD screen comprises two layers of polarized glass with a liquid crystal solution between them. When the light passes through the first layer, an electric current aligns the liquids crystals. The aligned liquid crystals allow a varying level of light to pass through the second layer to create images on the screen.

iii) LED monitor



The LED monitor is an improved version of an LCD monitor. It also has a flat panel display and uses liquid crystal display technology like the LCD monitors. The difference between them lies in the source of light to backlight the display. The LED monitor has many LED panels, and each panel has several LEDsto backlight the display, whereas the LCD monitors use cold cathode fluorescent light to backlight the display.Modern electronic devices such as mobile phones, LED TVs, laptop and computer screens, etc., use a LED display as it not only produces more brilliance and greater light intensity but also consumes less power.

iv) Plasma Monitor



The plasma monitor is also a flat panel display that is based on plasma display technology. It has small tiny cells between two glass panels. These cells contain mixtures of noble gases and a small amount of mercury. When voltage is applied, the gas in the cells turns into a plasma and emits ultraviolet light that creates images on the screen, i.e., the screen is illuminated by a tiny bit of plasma, a charged gas. Plasma displays are brighter than liquid crystal displays (LCD) and also offer a wide viewing angle than an LCD.

2) Printer

A printer produces hard copies of the processed data. It enables the user, to print images, text or any other information onto the paper.

Based on the printing mechanism, the printers are of two types: Impact Printers and Non-impact Printers.

- **Impact Printers: They are of two types:**
  - A. Character Printers
    - i. Dot Matrix printers
    - ii. Daisy Wheel printers
  - B. Line printers
    - i. Drum printers
    - ii. Chain printers
- **Non-impact printers: They are of two types:**
  - A. Laser printers
  - B. Inkjet printers

Impact Printer

The impact printer uses a hammer or print head to print the character or images onto the paper. The hammer or print head strikes or presses an ink ribbon against the paper to print characters and images.

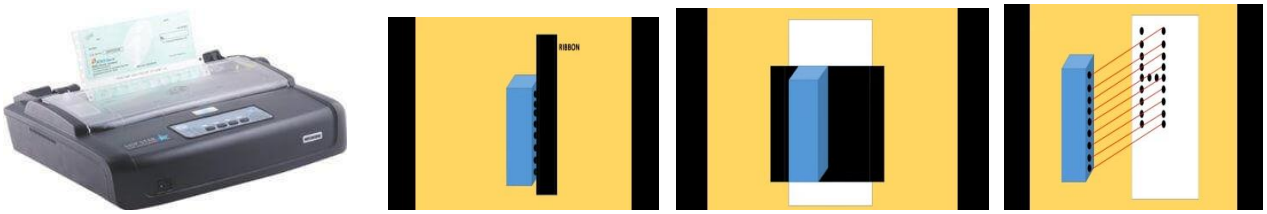
Impact printers are further divided into two types.

A. Character Printers
B. Line printers

A) Character Printers

Character printer prints a single character at a time or with a single stroke of the print head or hammer. It does not print one line at a time. Dot Matrix printer and Daisy Wheel printer are character printers. Today, these printers are not in much use due to their low speed and because only the text can be printed. The character printers are of two types, which are as follows:

i) Dot Matrix Printer



Dot Matrix Printer is an impact printer. The characters and images printed by it are the patterns of dots. These patterns are produced by striking the ink soaked ribbon against the paper with a print head. The print head contains pins that produce a pattern of dots on the paper to form the individual characters. The print head of a 24 pin dot matrix contains more pins than a 9 pin dot matrix printer, so it produces more dots which results in better printing of characters. To produce color output, the black ribbon can be changed with color stripes. The speed of Dot Matrix printers is around 200-500 characters per second.

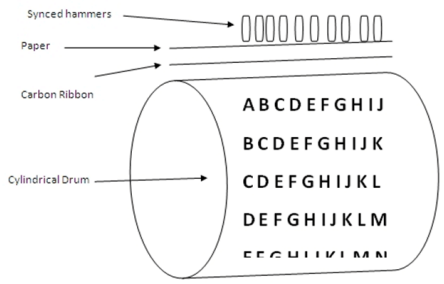
ii) Daisy Wheel Printer

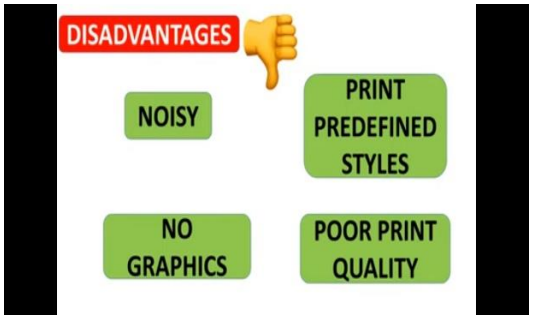
Daisy Wheel Printer was invented by David S. Lee at Diablo Data Systems.It consists of a wheel or disk that has spokes or extensions and looks like a daisy, so it is named Daisy Wheel printer. At the end of extensions, molded metal characters are mounted. To print a character the printer rotates the wheel, and when the desired character is on the print location the hammer hits disk and the extension hits the ink ribbon against the paper to create the impression. It cannot be used to print graphics and is often noisy and slow, i.e., the speed is very low around 25-50 characters per second. Due to these drawbacks,these printers have become obsolete.

B) Line Printers:

Line printer, which is also as a bar printer, prints one line at a time. It is a high-speed impact printer as it can print 500 to 3000 lines per minute. Drum printer and chain printer are examples of line printers.

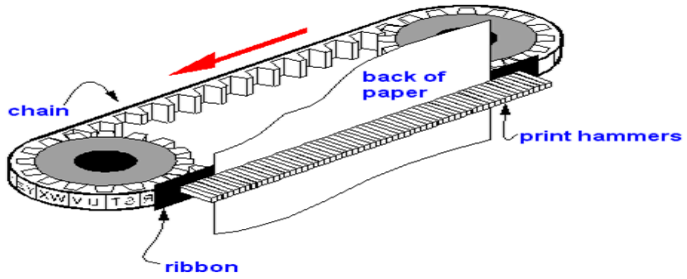
i) Drum Printer:





Drum printer is a line printer that is made of a rotating drum to print characters. The drum has circular bands of characters on its surface. It has a separate hammer for each band of characters. When you print, the drum rotates, and when the desired character comes under the hammer, the hammer strikes the ink ribbon against the paper to print characters. The drum rotates at a very high speed and characters are printed by activating the appropriate hammers. Although all the characters are not printed at a time, they are printed at a very high speed. These printers are known to be very noisy due to the use of hammering techniques.

ii) Chain Printer:



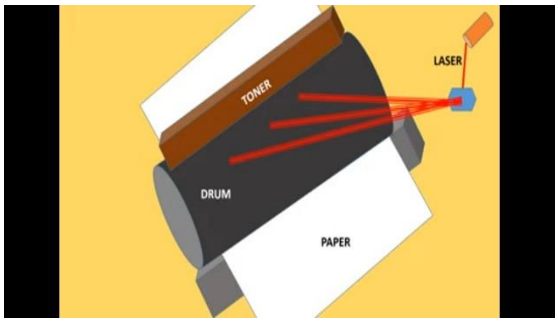
Chain printer is a line printer that uses a rotating chain to print characters. The characters are embossed on the surface of the chain. The chain rotates horizontally around a set of hammers, for each print location one hammer is provided, i.e., the total number of hammers is equal to the total number of print positions.

The chain rotates at a very high speed and when the desired character comes at the print location, the corresponding hammer strikes the page against the ribbon and character on the chain.They can type 500 to 3000 lines per minute. They are also noisy due to the hammering action.

Non-Impact Printer:

Non-impact printers don't print characters or images by striking a print head or hammer on the ink ribbon placed against the paper. They print characters and images without direct physical contact between the paper and the printing machinery. These printers can print a complete page at a time, so they are also known as page printers. The common types of non-impact printers are Laser printer and Inkjet printer:

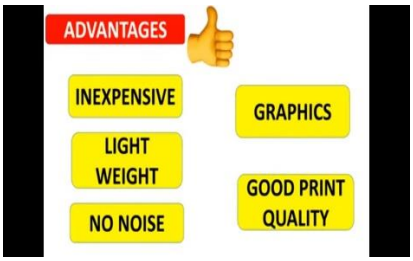
i) Laser Printer:



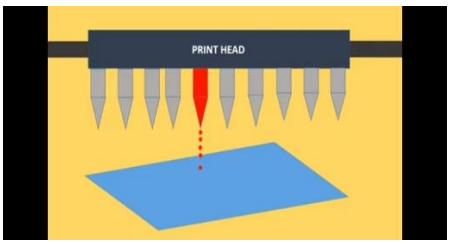
A laser printer is a non-impact printer that uses a laser beam to print the characters. The laser beam hits the drum, which is a photoreceptor and draws the image on the drum by altering electrical charges on the drum. The drum then rolls in toner, and the charged image on the drum picks the toner. The toner is then printed on the paper using heat and pressure. Once the document is printed, the drum loses the electric charge,and the remaining toner is collected. The laser printers use powdered toner for printing instead of liquid ink and produce quality print objects with a resolution of 600 dots per inch (dpi) or more.

ii) Inkjet Printer:

The inkjet printer is a non-impact printer that prints images and characters by spraying fine,ionized drops of ink. The print head has tiny nozzles to spray the ink. The printer head moves back and forth and sprays ionized drops of ink on the paper, which is fed through the printer. These drops pass through an electric field that guides the ink onto the paper to print correct images and characters.



An inkjet printer has cartridges that contain ink. Modern inkjet printers are color printers that have four cartridges containing different colors: Cyan, Magenta, Yellow, and Black. It is capable of printing high-quality images with different colors. It can produce print objects with a resolution of at least 300 dots per inch (dpi).

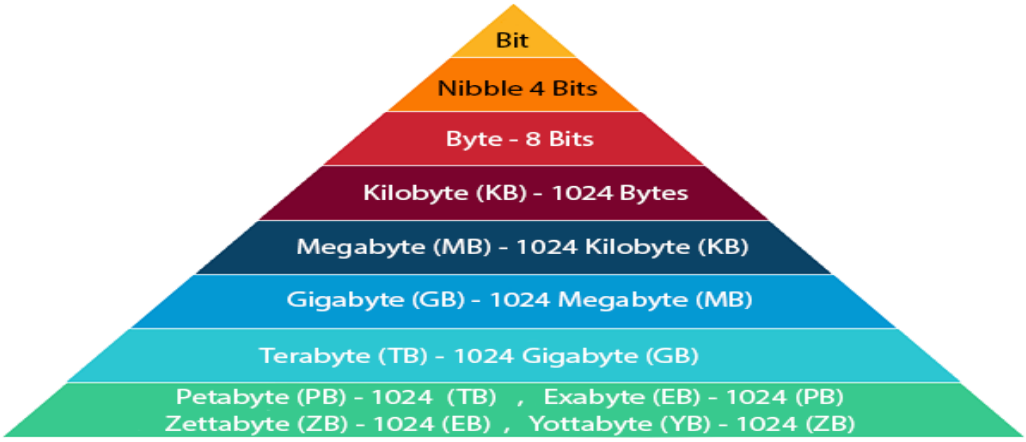


3) Projector

A projector is an output device that enables the user to project the output onto a large surface such as a big screen or wall. It can be connected to a computer and similar devices to project their output onto a screen. It uses light and lenses to produce magnified texts, images, and videos. So, it is an ideal output device to give presentations or to teach a large number of people.

Modern projects (digital projectors) come with multiple input sources such as HDMI ports for newer equipment and VGA ports that support older devices. Some projectors are designed to support Wi-Fi and Bluetooth as well. They can be fixed onto the ceiling, placed on a stand, and more and are frequently used for classroom teaching, giving presentations, home cinemas, etc.

Memory Units



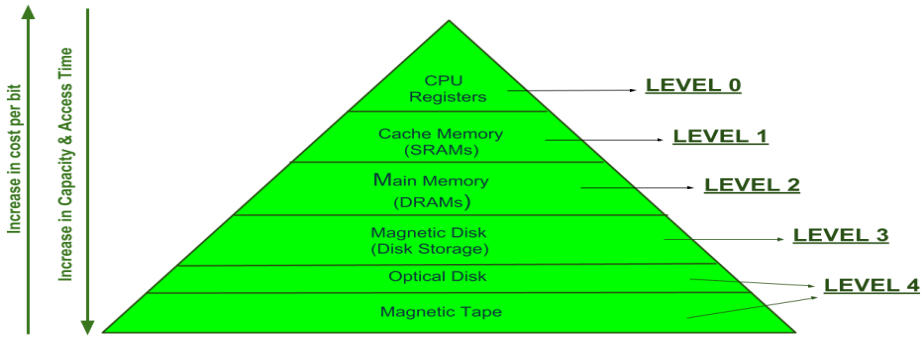
A memory unit is the collection of storage units or devices together. The memory unit stores the binary information in the form of bits. Generally, memory/storage is classified into 2 categories:

- **Volatile Memory**: This loses its data, when power is switched off.
- **Non-Volatile Memory**: This is a permanent storage and does not lose any data when power is switched off.

Memory units are used to measure and represent data. Some of the commonly used memory units are:
1) **Bit:** The computer memory units start from bit. A bit is the smallest memory unit to measure data stored in main memory and storage devices. A bit can have only one binary value out of 0 and 1.
2) **Byte:** It is the fundamental unit to measure data. It contains 8 bits or is equal to 8 bits. Thus a byte can represent 2*8 or 256 values.
3) **Kilobyte:** A kilobyte contains 1024 bytes.
4) **Megabyte:** A megabyte contains 1024 kilobytes.
5) **Gigabyte:** A gigabyte contains 1024 megabyte.
6) **Terabyte:** A terabyte contains 1024 gigabytes.

Memory Hierarchy

Memory is a necessary part of the computer. Memory is the storage section of the computer's functioning. In the Computer System Design, Memory Hierarchy is an enhancement to organize the memory such that it can minimize the access time. The Memory Hierarchy was developed based on a program behaviour known as locality of references.



MEMORY HIERARCHY DESIGN

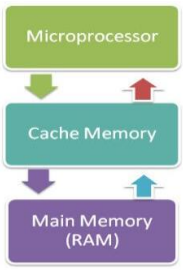
CPU Registers :

Registers are a type of computer memory used to quickly accept, store, and transfer data and instructions that are being used immediately by the CPU. The registers used by the CPU are often termed as Processor registers.
Following is the list of some of the most common registers used in a basic computer:

Register	Symbol	Number of bits	Function
Data register	DR	16	Holds memory operand
Address register	AR	12	Holds address for the memory
Accumulator	AC	16	Processor register
Instruction register	IR	16	Holds instruction code
Program counter	PC	12	Holds address of the instruction
Temporary register	TR	16	Holds temporary data
Input register	INPR	8	Carries input character
Output register	OUTR	8	Carries output character

Cache Memory :

The data or contents of the main memory that are used frequently by CPU are stored in the cache memory so that the processor can easily access that data in a shorter time. Whenever the CPU needs to access memory, it first checks the cache memory. If the data is not found in cache memory, then the CPU moves into the main memory.

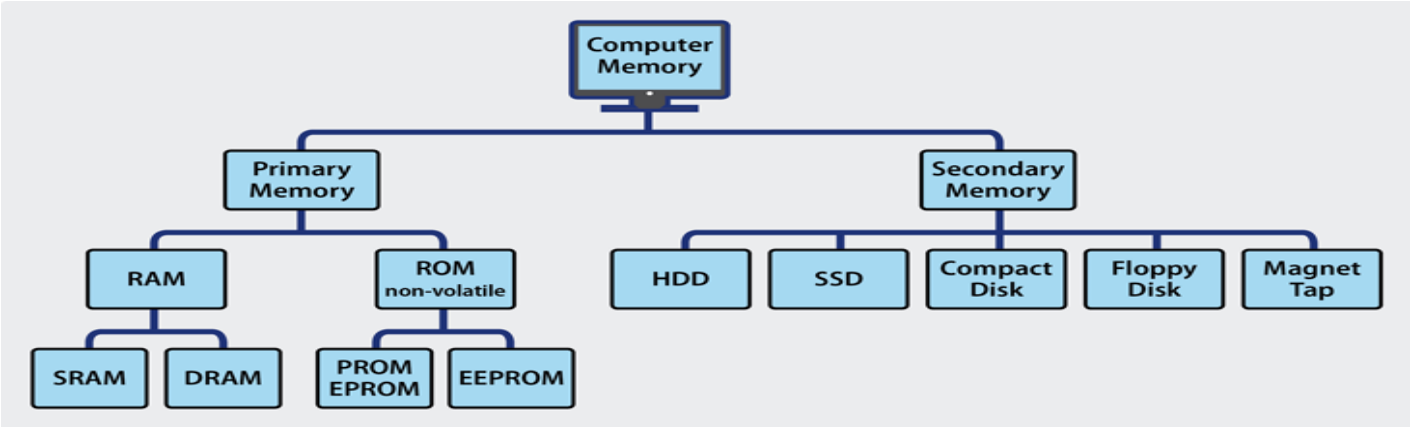


Types of Cache Memory:

L1: It is the first level of cache memory, which is called Level 1 cache or L1 cache. In this type of cache memory, a small amount of memory is present inside the CPU itself.

L2: This cache is known as Level 2 cache or L2 cache. This level 2 cache may be inside the CPU or outside the CPU.

L3: It is known as Level 3 cache or L3 cache. This cache is not present in all the processors; some high-end processors may have this type of cache. This cache is used to enhance the performance of Level 1 and Level 2 cache. It is located outside the CPU and is shared by all the cores of a CPU. Its memory size ranges from 1 MB to 8 MB. Although it is slower than L1 and L2 cache, it is faster than Random Access Memory (RAM).



Primary Memory Types: RAM and ROM

There are two key types of primary memory:

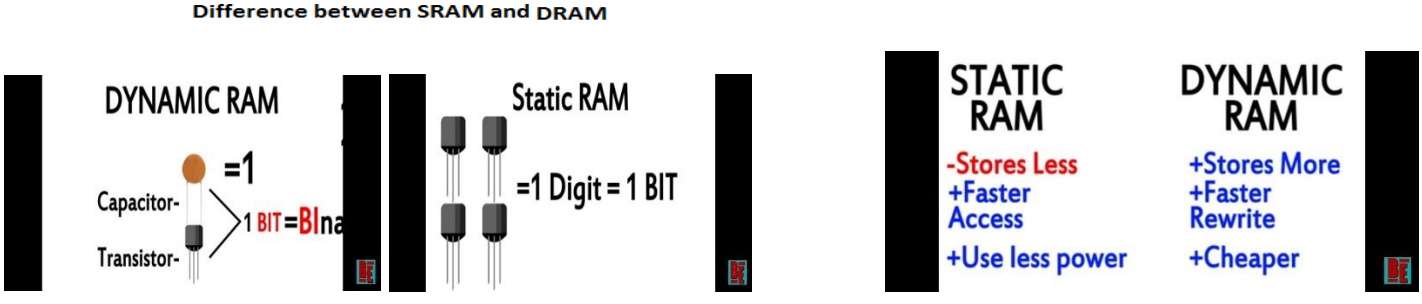
RAM, or random access memory

ROM, or read-only memory

1. Random Access Memory (RAM) –

- It is also called as *read write memory* or the *main memory* or the *primary memory*.
- The programs and data that the CPU requires during execution of a program are stored in this memory.
- It is a volatile memory as the data loses when the power is turned off.
- RAM is further classified into two types- *SRAM (Static Random Access Memory)* and *DRAM (Dynamic Random Access Memory)*.

DRAM	SRAM
1. Constructed of tiny capacitors that leak electricity.	1.Constructed of circuits similar to D flip-flops.
2.Requires a recharge every few milliseconds to maintain its data.	2.Holds its contents as long as power is available.
3.Inexpensive.	3.Expensive.
4. Slower than SRAM.	4. Faster than DRAM.
5. Can store many bits per chip.	5. Can not store many bits per chip.
6. Uses less power.	6.Uses more power.
7.Generates less heat.	7.Generates more heat.
8. Used for main memory.	8. Used for cache.

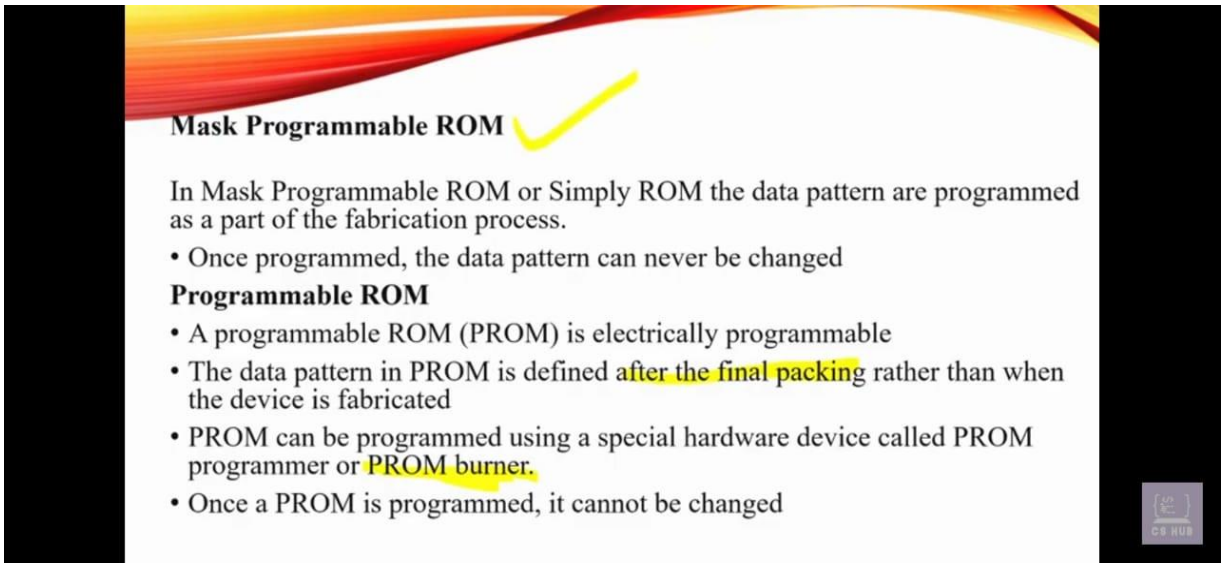


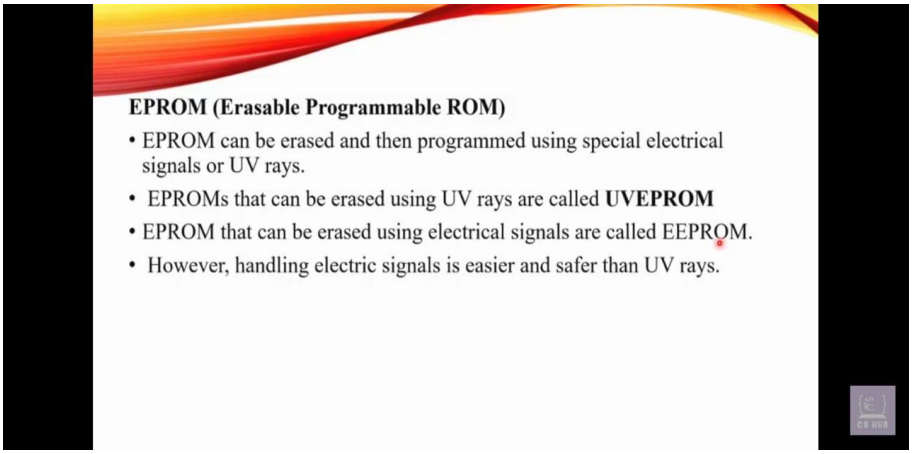
2. Read Only Memory (ROM) –

- Stores crucial information essential to operate the system, like the program essential to boot the computer.
- It is not volatile.
- Always retains its data.
- Used in embedded systems or where the programming needs no change.
- Used in calculators and peripheral devices.
- ROM is further classified into 4 types- *ROM*, *PROM*, *EPROM*, and *EEPROM*.

Types of Read Only Memory (ROM) –

1. **PROM (Programmable read-only memory)** – It can be programmed by user. Once programmed, the data and instructions in it cannot be changed.
2. **EPROM (Erasable Programmable read only memory)** – It can be reprogrammed. To erase data from it, expose it to ultra violet light. To reprogram it, erase all the previous data.
3. **EEPROM (Electrically erasable programmable read only memory)** – The data can be erased by applying electric field, no need of ultra violet light. We can erase only portions of the chip.





RAM	ROM
1. Temporary Storage.	1. Permanent storage.
2. Store data in MBs.	2. Store data in GBs.
3. Volatile.	3. Non-volatile.
4.Used in normal operations.	4. Used for startup process of computer.
5. Writing data is faster.	5. Writing data is slower.

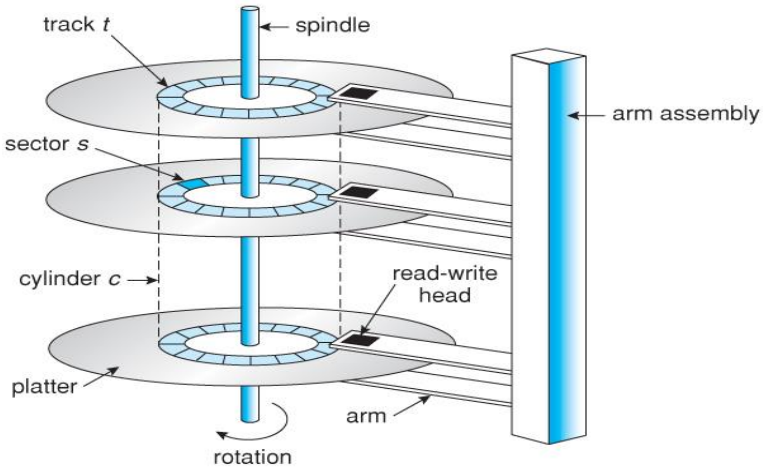
Difference between RAM and ROM

Secondary storage Devices

Alternatively referred to as external memory, secondary memory, and auxiliary storage, a secondary storage device is a non-volatile device that holds data until it is deleted or overwritten.

Hard Disk Drive :

Hard disk drive is made up of a series of circular disks called platters arranged one over the other almost ½ inches apart around a spindle. Disks are made of non-magnetic material like aluminum alloy and coated with 10-20 nm of magnetic material.



CD Drive :

CD stands for **Compact Disk**. CDs are circular disks that use optical rays, usually lasers, to read and write data. They are very cheap as you can get 700 MB of storage space for less than a dollar. CDs are inserted in CD drives built into CPU cabinet. They are portable as you can eject the drive, remove the CD and carry it with you. There are three types of CDs −

- **CD-ROM (Compact Disk – Read Only Memory)** − The data on these CDs are recorded by the manufacturer. Proprietary Software, audio or video are released on CD-ROMs.
- **CD-R (Compact Disk – Recordable)** − Data can be written by the user once on the CD-R. It cannot be deleted or modified later.
- **CD-RW (Compact Disk – Rewritable)** − Data can be written and deleted on these optical disks again and again.

DVD Drive :

DVD stands for **Digital Video Display**. DVD are optical devices that can store 15 times the data held by CDs. They are usually used to store rich multimedia files that need high storage capacity. DVDs also come in three varieties – read only, recordable and rewritable.

Pen Drive :

Pen drive is a portable memory device that uses solid state memory rather than magnetic fields or lasers to record data. It uses a technology similar to RAM, except that it is nonvolatile. It is also called USB drive, key drive or flash memory.

Blu Ray Disk :

Blu Ray Disk (BD) is an optical storage media used to store high definition (HD) video and other multimedia filed. BD uses shorter wavelength laser as compared to CD/DVD. This enables writing arm to focus more tightly on the disk and hence pack in more data. BDs can store up to 128 GB data.

SSD :

Short for solid-state drive, an SSD is a storage medium that uses non-volatile memory to hold and access data. Unlike a hard drive, an SSD has no moving parts, which gives it advantages, such as faster access time, noiseless operation, higher reliability, and lower power consumption.

SD card :

Short for Secure Digital card, the SD card is one of the more common types of memory cards used with electronics. he three versions of the SD card, along with their physical dimensions, are shown below.

- **SD** - 32mm x 24mm x 2.1mm.
- **MiniSD** - 21.5mm x 20mm x 1.4mm.
- **MicroSD** - 15mm x 11mm x 1.0mm.

Floppy disk :

A floppy diskette is a type of storage media capable of storing electronic data, like a computer file. an example of a 3.5" floppy diskette, one of the most commonly used floppy diskettes, capable of storing 1.44 MB of data. To read and write to this diskette it would be inserted into a floppy drive.

Tertiary Storages

Magnetic Tape memory :

In magnetic tape only one side of the ribbon is used for storing data. It is sequential memory which contains thin plastic ribbon to store data and coated by magnetic oxide. Data read/write speed is slower because of sequential access. It is highly reliable which requires magnetic tape drive writing and reading data. The width of the ribbon varies from 4mm to 1 Inch and it has storage capacity 100 MB to 200 GB.

Basics of Hardware Components

Hardware represents the physical and tangible components of a computer, i.e. the components that can be seen and touched.

Switched-Mode Power Supply (SMPS) :

A switched-mode power supply (SMPS) is an electronic circuit that converts power using switching devices that are turned on and off at high frequencies, and storage components such as inductors or capacitors to supply power when the switching device is in its non-conduction state.

Mother Board :

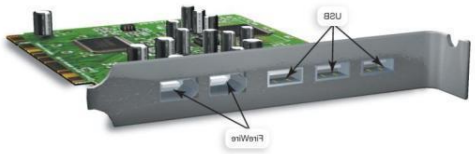
The motherboard serves as a single platform to connect all of the parts of a computer together. It connects the CPU, memory, hard drives, optical drives, video card, sound card, and other ports and expansion cards directly or via cables. It can be considered as the backbone of a computer.

A motherboard comes with following features −

- Motherboard varies greatly in supporting various types of components.
- Motherboard supports a single type of CPU and few types of memories.
- Video cards, hard disks, sound cards have to be compatible with the motherboard to function properly.
- Motherboards, cases, and power supplies must be compatible to work properly together.

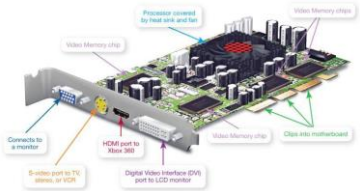
ADD-ON-CARDS or Expansion Cards :

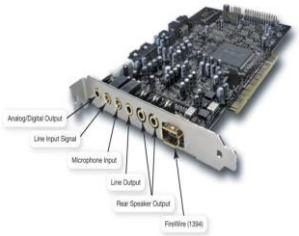
An expansion card is an electronic card/board that is used to add extra functionality to a computer. It is inserted into an expansion slot on the motherboard of a computer. Many different classes of expansion card are available, including sound cards, video graphics cards, network cards and so on.

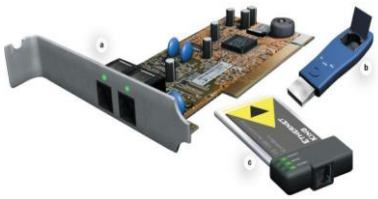


1) Video (Graphics) Card:

A dedicated video card (or video adapter) is an expansion card installed inside your system unit to translate binary data received from the CPU or GPU into the images you view on your monitor. It is an alternative to the integrated graphics chip.Modern video cards include ports allowing you to connect to different video equipment; also they contain their own RAM, called video memory.







Vedio Card Sound Card Network Card

2) Sound cards

It attached to the motherboard and enabled your computer to record and reproduce sounds.

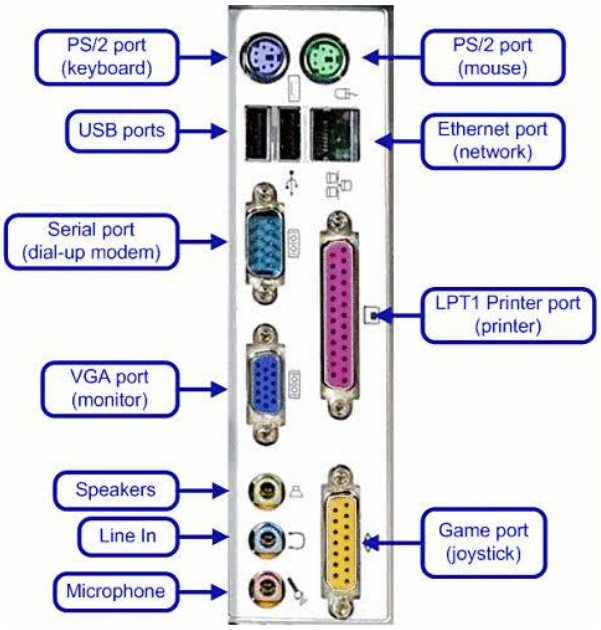
Most computers ship with a basic sound card, most often a 3D sound card. This tends to produce a fuller, richer sound than stereo sound.To set up surround sound on your computer, you need two things: a set of surround-sound speakers and a sound card that is Dolby Digital compatible. The ports on the sound card allow you to connect additional audio devices such as amplified speakers, headphones, microphones etc.

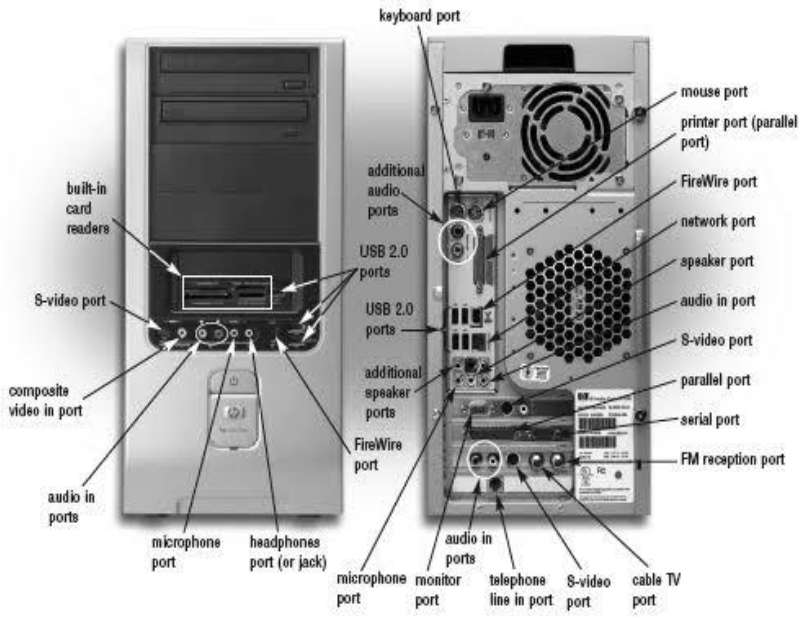
3)Network Cards

An Ethernet network requires that you install or attach network adapters to each computer or peripheral you want to connect to the network. Most computers come with Ethernet adapters preinstalled as network interface cards (NICs).

Computer Ports

A connection point that acts as interface between the computer and external devices like mouse, printer, modem, etc. is called **port**.





Ports are of two types −

- 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.

Serial Port: Serial ports transmit data sequentially one bit at a time. So they need only one wire to transmit 8 bits. However it also makes them slower. Serial ports are usually 9-pin or 25-pin male connectors.

Parallel Port: Parallel ports can send or receive 8 bits or 1 byte at a time. Parallel ports come in form of 25-pin female pins and are used to connect printer, scanner, external hard disk drive, etc.

USB Port :USB stands for Universal Serial Bus. It is the industry standard for short distance digital data connection. USB port is a standardized port to connect a variety of devices like printer, camera, keyboard, speaker, etc.

PS-2 Port :PS/2 stands for **Personal System/2**. It is a female 6-pin port standard that connects to the male mini-DIN cable. PS/2 was introduced by IBM to connect mouse and keyboard to personal computers. This port is now mostly obsolete, though some systems compatible with IBM may have this port.

VGA Port: A Video Graphics Array (VGA) connector is a standard connector used for computer video output. Originating with the 1987 IBM PS/2 and its VGA graphics system, the 15-pin connector went on to become ubiquitous on PCs, as well as many monitors, projectors and high definition television sets.

Power connector Port: From Wikipedia, the free encyclopedia. Power connector may refer to: AC power plugs and sockets, devices that allow electrically operated equipment to be connected to the primary alternating current (AC) power supply in a building.

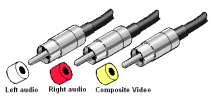
Audio Ports : computer's audio ports link the computer's sound hardware with your speakers, microphone, headsets or other audio equipment. Every computer motherboard has at least a few basic audio ports built in, allowing you to connect stereo speakers and a microphone.

DVI (Digital Visual Interface): it was developed by the industry body DDWG (the Data Display Working Group) to send digital information from a computer to a digital display, such as a flat-panel LCD monitor. HDMI took a step forward by integrating audio and video into a more compact interface.

Mini - DVI : The Mini-DVI connector is used on certain Apple computers as a digital alternative to the Mini-VGA connector. It s size is between the full-sized DVI and the tiny Micro-DVI.

Micro-DVI : The Micro-DVI port is a proprietary video output port found in the original MacBook Air. It is smaller than the Mini-DVI port used by its MacBook models. To use the port for displaying video on a standard monitor or television, an adapter must be used.

RCA Connector : An RCA connector,is a type of electrical connector commonly used to carry audio and video signals. The name RCA derives from the Radio Corporation of America, which introduced the design by the early 1940s for internal connection of the pickup to the chassis in home radio-phonograph consoles. It was originally a low-cost, simple design, intended only for mating and disconnection when servicing the console.



HDMI : HDMI (High-Definition Multimedia Interface) is a proprietary audio/video interface for transmitting uncompressed video data and compressed or uncompressed digital audio data from an HDMI-compliant source device, such as a display controller, to a compatible computer monitor, video projector, digital television, or digital audio device.HDMI is a digital replacement for analog video standards.

RJ-45 : RJ45 is a type of connector commonly used for Ethernet networking. It looks similar to a telephone jack, but is slightly wider. Since Ethernet cables have an RJ45 connector on each end, Ethernet cables are sometimes also called RJ45 cables.

Adapters

An adapter is a device that allows a specific type of hardware to work with another device that would otherwise be incompatible. Examples of adapters include electrical adapters, video adapters, audio adapters, and network adapters.

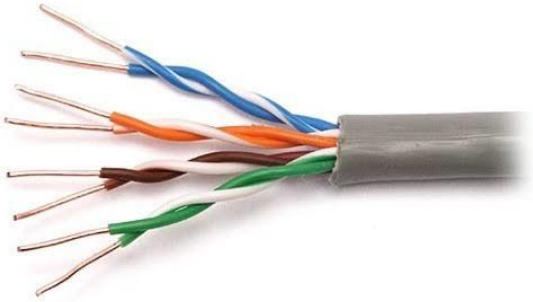
An electrical adapter, for instance, may convert the incoming voltage from 120V to 12V, which is suitable for a radio or other small electronic device. Video adapters and audio adapters adapt one type of interface to another type of connector. For example, a DVI to VGA adapter allows you to connect the DVI output of a laptop to the VGA input of a projector. Network cards, or NICs, are also called network adapters. These include Ethernet cards, internal Wi-Fi chips, and external wireless transmitters. While these devices don't convert connections like audio or video adapters, they enable computers to connect to network.

NETWORK CABLES

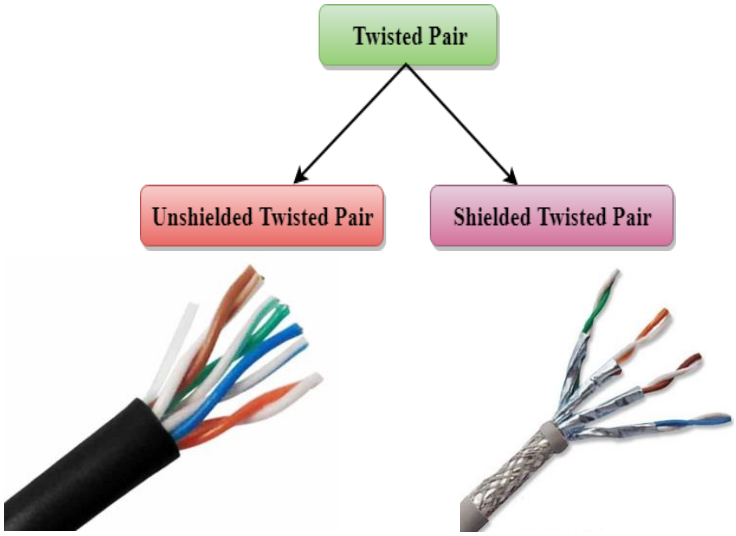
It is defined as the physical medium through which the signals are transmitted. It is also known as Bounded media.

1) Twisted pair:

Twisted pair is a physical media made up of a pair of cables twisted with each other. A twisted pair cable is cheap as compared to other transmission media. Installation of the twisted pair cable is easy, and it is a lightweight cable. The frequency range for twisted pair cable is from 0 to 3.5KHz. A twisted pair consists of two insulated copper wires arranged in a regular spiral pattern.The degree of reduction in noise interference is determined by the number of turns per foot. Increasing the number of turns per foot decreases noise interference.



Types of Twisted pair:



Unshielded Twisted Pair: An unshielded twisted pair is widely used in telecommunication. Following are the categories of the unshielded twisted pair cable:

- **Category 1:** Category 1 is used for telephone lines that have low-speed data.
- **Category 2:** It can support upto 4Mbps.
- **Category 3:** It can support upto 16Mbps.
- **Category 4:** It can support upto 20Mbps. Therefore, it can be used for long-distance communication.
- **Category 5:** It can support upto 200Mbps.

UTP Categories - Copper Cable

UTP Category	Data Rate	Max. Length	Cable Type	Application
CAT1	Up to 1Mbps	-	Twisted Pair	Old Telephone Cable
CAT2	Up to 4Mbps	-	Twisted Pair	Token Ring Networks
CAT3	Up to 10Mbps	100m	Twisted Pair	Token Rink & 10BASE-T Ethernet
CAT4	Up to 16Mbps	100m	Twisted Pair	Token Ring Networks
CAT5	Up to 100Mbps	100m	Twisted Pair	Ethernet, FastEthernet, Token Ring
CAT5e	Up to 1 Gbps	100m	Twisted Pair	Ethernet, FastEthernet, Gigabit Ethernet
CAT6	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT6a	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (55 meters)
CAT7	Up to 10Gbps	100m	Twisted Pair	GigabitEthernet, 10G Ethernet (100 meters)

Firewall.cx

Advantages of Unshielded Twisted Pair:

- It is cheap.
- Installation of the unshielded twisted pair is easy.
- It can be used for high-speed LAN.

Disadvantage:

- This cable can only be used for shorter distances because of attenuation.

Shielded Twisted Pair :A shielded twisted pair is a cable that contains the mesh surrounding the wire that allows the higher transmission rate.

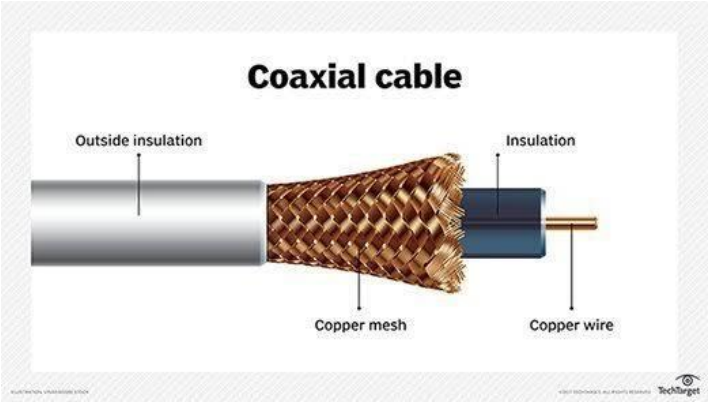
Characteristics of Shielded Twisted Pair:

- The cost of the shielded twisted pair cable is not very high and not very low.
- An installation of STP is easy.
- It has higher capacity as compared to unshielded twisted pair cable.
- It has a higher attenuation.
- It is shielded that provides the higher data transmission rate.

Disadvantages

- It is more expensive as compared to UTP and coaxial cable.
- It has a higher attenuation rate.

2) Coaxial Cable :



- Coaxial cable is very commonly used transmission media, for example, TV wire is usually a coaxial cable.
- The name of the cable is coaxial as it contains two conductors parallel to each other.
- It has a higher frequency as compared to Twisted pair cable.
- The inner conductor of the coaxial cable is made up of copper, and the outer conductor is made up of copper mesh. The middle core is made up of non-conductive cover that separates the inner conductor from the outer conductor.
- The middle core is responsible for the data transferring whereas the copper mesh prevents from the **EMI**(Electromagnetic interference).

Coaxial cable is of two types:

1. **Baseband transmission:** It is defined as the process of transmitting a single signal at high speed.
2. **Broadband transmission:** It is defined as the process of transmitting multiple signals simultaneously.

Advantages of Coaxial cable:

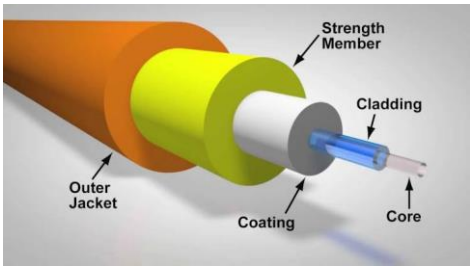
- The data can be transmitted at high speed.
- It has better shielding as compared to twisted pair cable.
- It provides higher bandwidth.

Disadvantages of Coaxial cable:

- It is more expensive as compared to twisted pair cable.
- If any fault occurs in the cable causes the failure in the entire network.

3)Fibre Optic :

- Fibre optic cable is a cable that uses electrical signals for communication.
- Fibre optic is a cable that holds the optical fibres coated in plastic that are used to send the data by pulses of light.
- The plastic coating protects the optical fibres from heat, cold, electromagnetic interference from other types of wiring.
- Fibre optics provide faster data transmission than copper wires.



Basic elements of Fibre optic cable:

- **Core:** The optical fibre consists of a narrow strand of glass or plastic known as a core. A core is a light transmission area of the fibre. The more the area of the core, the more light will be transmitted into the fibre.
- **Cladding:** The concentric layer of glass is known as cladding. The main functionality of the cladding is to provide the lower refractive index at the core interface as to cause the reflection within the core so that the light waves are transmitted through the fibre.
- **Jacket:** The protective coating consisting of plastic is known as a jacket. The main purpose of a jacket is to preserve the fibre strength, absorb shock and extra fibre protection.

Following are the advantages of fibre optic cable over copper:

- **Greater Bandwidth:** The fibre optic cable provides more bandwidth as compared copper. Therefore, the fibre optic carries more data as compared to copper cable.
- **Faster speed:** Fibre optic cable carries the data in the form of light. This allows the fibre optic cable to carry the signals at a higher speed.
- **Longer distances:** The fibre optic cable carries the data at a longer distance as compared to copper cable.
- **Better reliability:** The fibre optic cable is more reliable than the copper cable as it is immune to any temperature changes while it can cause obstruct in the connectivity of copper cable.
- **Thinner and Sturdier:** Fibre optic cable is thinner and lighter in weight so it can withstand more pull pressure than copper cable.

4) USB Cable :

The term USB stands for "Universal Serial Bus". USB cable assemblies are some of the most popular cable types available, used mostly to connect computers to peripheral devices such as cameras, camcorders, printers, scanners, and more. **Detail of USB Cable Construction**

The USB cable standard allows for these advantages over serial cable types:

- USB cables are **"Hot Pluggable"**, in other words you can connect and disconnect the cables while the computer is running without fear of freezing the computer
- USB cables are **fast**, transferring up to 480Mbps. Compare that to serial communication which transfers data at about 20Kbps
- USB cables **carry power** as well as signals. This allows for "USB powered" gadgets as well as recharging batteries in cameras and other USB peripherals.

****