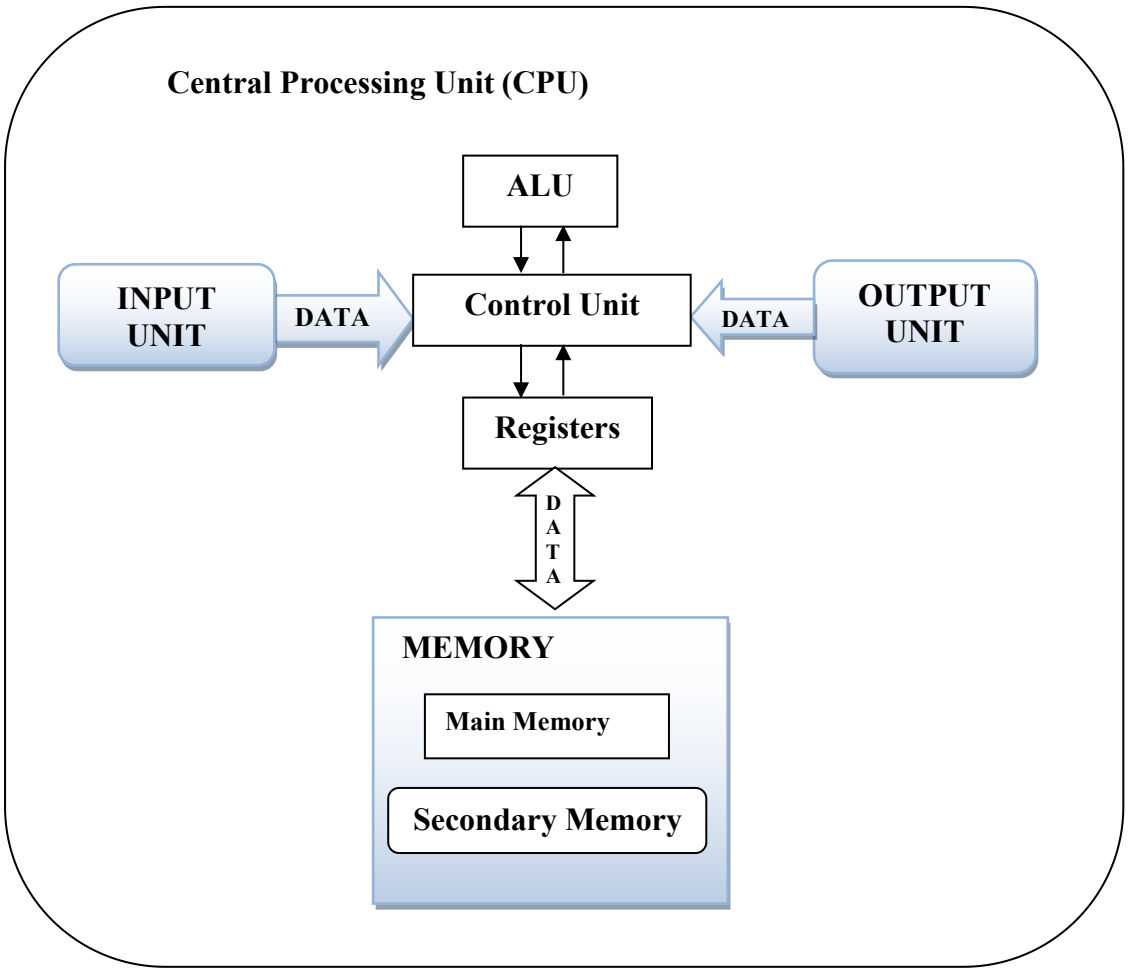
Overview of Computer

COMPUTER:A Computer is an electronic machine that process raw data and generate meaningful information under the control of set instructions with speed and accuracy

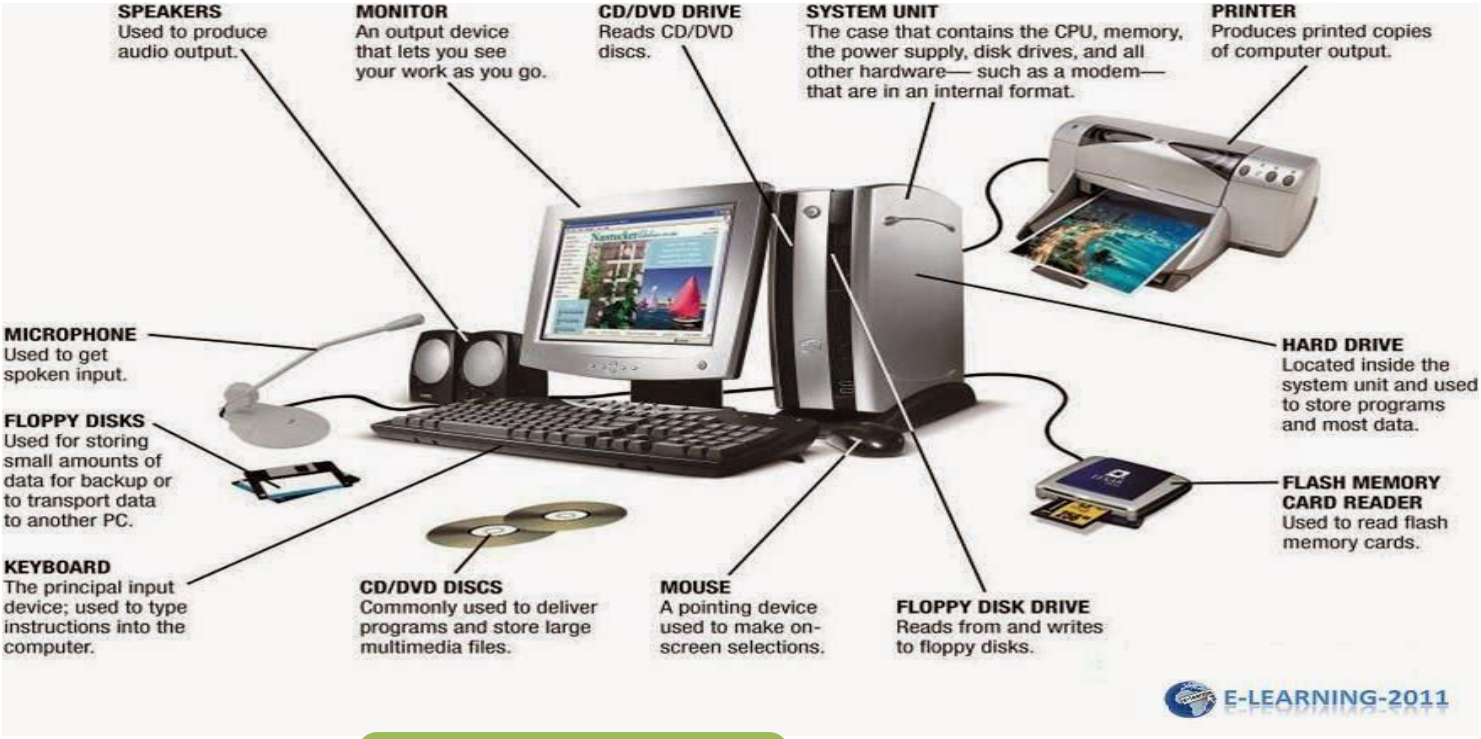
Hardware: The term hardware refers to the physical components of your computer such as the unit, Mouse, Keyboard, monitor etc.

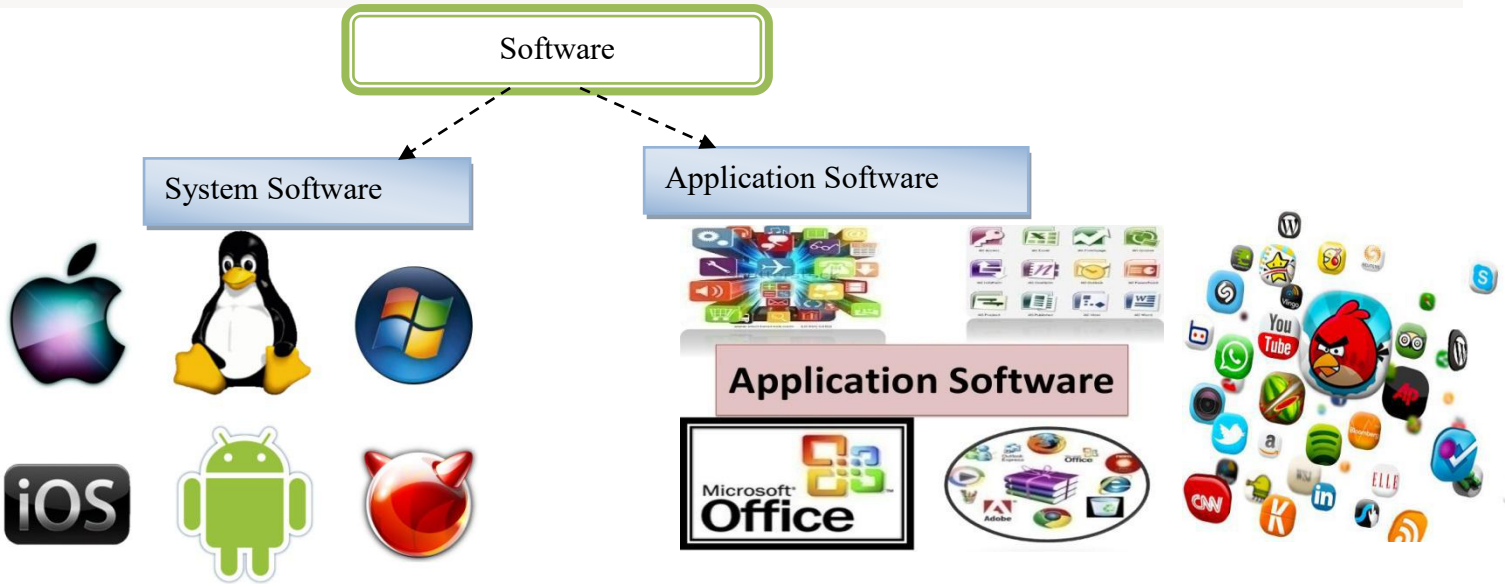
Software: is the instructions or program that makes computer work.
Programs: consists of the step-by-step instructions that tell the computer how to do its work.

Block diagram of computer.(Functional Components of Computer)



1) **Input Device:**
2) **Central Processing Unit(CPU)**
   a) Arithmetic Logic Unit**(ALU)**
   b) Registers(Internal Memory)
   c) Control Unit**(CU)**
3) **Memory Unit**
4) **Output Unit**:





System Software: System software is the interface between the hardware and user applications.

Application Software:is a computer program designed to perform a group of coordinated functions, tasks, or activities for the benefit of the user. Examples of an application include a word processor, a spreadsheet, an accounting application, a web browser, amedia player, an aeronautical flight simulator, a console game or a photo editor.

Characteristics of computers.

- ❖ Speed
- ❖ Memory
- ❖ Accuracy
- ❖ Reliability
- ❖ Storage capability
- ❖ Reduced cost
- ❖ Intangible Benefits
- ❖ Versatility
- ❖ Automation
- ❖ Diligence

Speed:Current computer system can manipulate and provide data in fraction of second. Computers take a minute to complete a task that would take person years to complete. The speed of a computer is closely related to the amount of data it most process.

Accuracy: The computer most processes the data accuracy as well as quickly. Accuracy is a prime consideration insisting computers

Reliability : Computer systems are particularly adept and repaired task

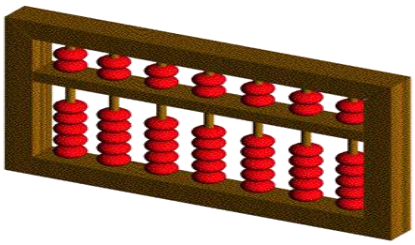
Storage capability: Computer systems have total and insistent recoil of data and almost unlimited capacity to store this data.

- **Reduced cost** : A cost of computer equipment has dropped drastically over the years

Explain the evolution of computer.

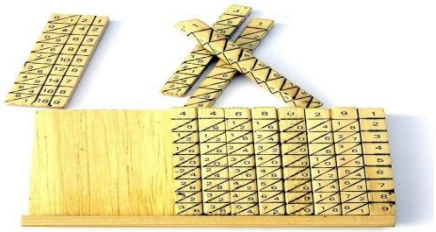
3000- BC: THE ABACUS: ( )

Abacus is the first known calculating machine used for counting .This devise allows user to make computation using a system of sliding beads arranged on a frame .Abacus was mainly used for addition and subtraction and later for division and multiplication.



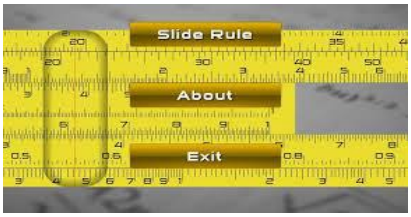
1614-AD : NAPIERS BONES: ( )

The **Napier's** bones was invented by john Napier ,a Scottish mathematician as an aid to multiplication .A set of bones consisted of nine rods ,one for each digit 1 to 9 and a constant rod for the digit 0. rod is similar to one column of multiplication table.



1633-AD : SLIDE RULE :

The slide rule was based on Napier's ideas about logarithms to do multiplication quickly and easily .The slide rule is embodied by the two sets of scales that are joined together to perform multiplication and division by the method of addition and subtraction



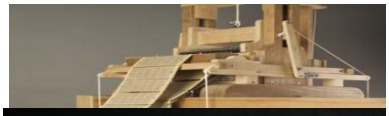
1642-AD : ADDING MACHIN PASCALINE:

First mechanical adding calculator was invented by ***Braise Pascal*** in 1641. It could add, subtract, divide and multiply the numbers as big as thousands.

1650: LEIBNIZ CALCULATOR:

Leibniz improved the pascaline by creating a machine that could add, subtract multiply and divide the number. Leibniz's mechanical multiplier worked by a system of gears and dials.

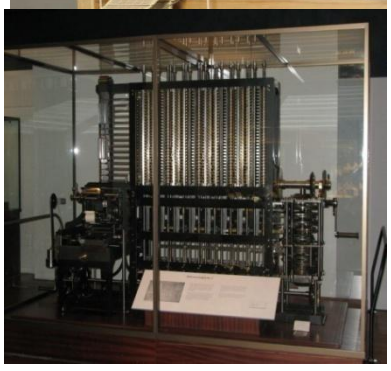
1801-JACQUARDS LOOM: Joseph Mary jacquard invented a powered that used punched wooden cards to automatically weave incredibly detailed patterns including picture and text .This can taken as the first "**read only memory**" device



1822-CHARLES BABBAGE:THE DIFFERENCE ENGINE:

Babbage developed a machine to perform differential equations called difference Engine .It was powered by steam and large as a locomotive could perform calculations and print the result automatically .Later he thought of a mechanical construction which was known as mechanical digital computer .Babbage called this analytical Engine .This analytical engine consisted five units, which became the basic principles for the development for modern computers .

Hence ***Charles Babbage*** is rightly called the "***FATHER OF COMPUTERS***".



1833AD-FIRST PROGRAMMER:

Lady Ada Lovelace, her mathematical genius came to light most strikingly in her work her work on Charles Babbage. Babbage was pathway into the process designing the mechanical computer(Analytical Engine) .She started writing the first *computer algorithm* and she predicted that later computers will have the abilities to do more mathematical calculation.

1890AD –HOLLERITH TABULATING MACHINE: In 1889, An American name Herman Hollerith invented a counting machine to count the population of USA. This electronic machine is able to read the information on the punched cards and process it electronically. It was one of the main electronic counting devise .It was on punched cards .Hollerith was the

founder of the company that became famous as IBM (international business machine)

Generations computer

1. First Generations computer(1940-1956)

The importance features of the 1st Generation systems are:

- **Magnetic drums** device were used for memory
- Punched cards was used for input & output
- Low level language for programming were used
- Processing speed for very slow
- It was very expensive
- System was not very powerful
- The system was huge and non portable.
- It did not have much memory.

Example:
ENIAC(Electronic Numerical integrator and Automatic computer)
UNIVAC(Universal Automatic Computer)
EDSAC(Electronic delay storage automatic calculator)
EDVAC(Electronic Discrete Variable automatic computer) etc

2. Second Generations computer (1956-1963)

The importance features of the 2nd generation system are:-

- **Transistors** were used for internal operation.
- Magnetic ore for main memory was used.
- Magnetic tapes and disks were used for secondary memory
- High level languages were used for developing programmers.
  Ex: COBOL, FORTAN
- The system was faster compare to 1st generation, more powerful, more reliable,
- Cheaper, smaller in overall size and more memory.

Ex: IBM -1401
Cyber – 175
UNIVAC – 1108/9000
} Used for commercial applications

3. Third Generations computer(1964-1971)

The important features of the 3rd generation system are:

- **Integrated circuits**(IC's) on silicon chips were used for internal operations
- Minicomputer were introduced
- Computer were able to reduce computational task for mile seconds to micro sec
- Maintenance cost was low as hardware failure was rare.
- A system were totally general purpose and could be used for a number of "*Commercial application*"

Ex. IBM – 3033, Hp 3000 (Mini computer), POP 11, CYBER 205

4. Fourth Generations computer(1971-tll date)

The important features of **4th Generation** system are:

- More circuits on chips, **LSI** and **ULSI**
- Induction of **Micro processer**
- Micro computer and personal computer with were affordable was available to the common man.
- The cost of assembly reduced to great extent.
- Easily portable because of there is small size
- Hardware failures were negligible.
- The system were faster, more powerful, more reliable, cheaper, smaller in overall size and more memory

  Ex**:** Intel 4004 Chip, Macintosh

5. Fifth Generations computer(Present -Beyond):-(Artificial intelligence(ROBOTICS)

The important features of **5th Generation** system are: -

- Major Innovations - ULSIC (Ultra large scale integrated circuit)
- Main Memory - EEPROM, SIMM and DIMM.
- A development of *storage technology*
- Advancement in *Network in technology*
- Systems are more reliable and cheaper
- Development of *Robots to assist human beings*.

  Ex: Robotics

- ✓ **Charles Babbage is the father of computer**
- ✓ **Alan Turing is know as the father of modern computer**
- ✓ **Lady Ada Lovelace - first programmer**
- ✓ **World fastest super computer:As of June 2016**, the fastest supercomputer in the world is the ***Sunway TaihuLight,*** in mainland China,
- ✓ **Microprocessor** is the main concept of fourth generation computer in 1971 . invented by Ted Hoff.
- ✓ **Intel -4004 -The first microprocessor**
- ✓ **Integrated circuits**(IC's) was invented by Jack kilby in 1958
- ✓ **Evaluation of microprocessors**

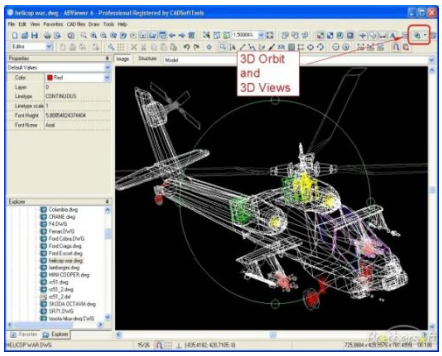
NAME	YEAR	Bit Size
4004	1971	4
8008	1972	8
8080	1974	8
8085	1977	8
8086	1978	16
8089	1979	16
80286	1982	32
80386	1985	32
80486	1989	32
80856(Pentium)	1993	32
Pentium Pro	1995	32
PentiumII	1997	32
Pentium III	1999	32
Pentium IV	2000	32
Intanium	2001	64
Pentium M processors	2003	64
Pentium m IV and Xeon	2005	64
Pentium D 900	2006	64
Dual core	2007	64
core 2 Duo	2008	64
Quad core	2009	64
core i3	2010	64
core i5	2012	64
core i7	2016	64

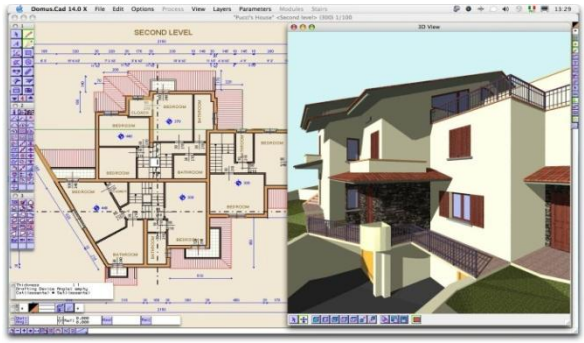
Application of Computer:

- **Computers in Education.**
  Ex: School, colleges, Universities etc

- **Computers in industry.**

  CAD(***Computers Aided Design)*** is used to design/develop products and CAM(***Computer Aided Manufacturing)***is used to produce them.
  CIM **(Computer integrated Manufacturing)**
  CAE**(*Computer Aided* Engineering),**





- **Computers in Business.**

  It is used Marketing , stock exchange ,Banks
  It is used in on-line shopping (*E-commerce*)

- **Computers in communication**

  - Used in teleconferencing /Video conferencing.
  - Used to send and receive E-mail/voice mail.
  - Used as switching element in telephone exchange.
  - Used in satellite communications.

- **Computer in Science and Engineering**

- **Computer in Entertainment and Multimedia**

- **Publishing:** The process of making works available to the public. The work includes books, magazines, newspaper, music, film etc

- **Travel:** Uses of computers in the field of traveling are given below;

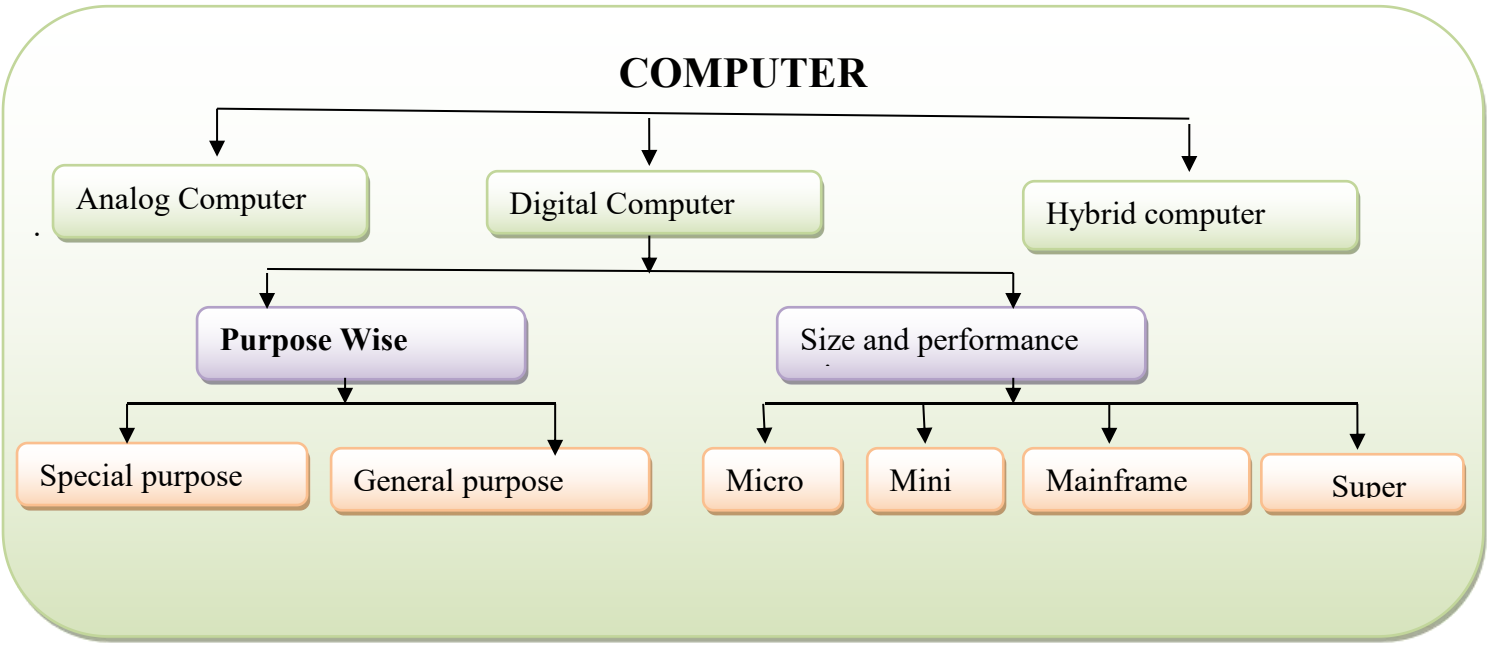
  - Computers are used in traveling for scheduling the railways & air flights.
  - We can book our air tickets or railways by using computer.
  - We can make our hotel reservation online.
  - Pilots train on a software, which simulate flying.
  - Whenever we travel by air, we can easily analyze & predict weather conditions by computer.
  - We can easily determine the distance between two cities or countries before traveling.

- **Hospitals:** The patients ID card details help in diagnosing like scanning, ECG etc, medication and history of patients are maintained etc by a computer.

- ***Satellite communications***:-Satellite is basically a self-contained communications system throughout the world. This have led to the growth of the information and technological globally. The usage of this we can browse the data, Surfing, chatting, email messaging etc are the area of communication.

- **Classification of computer.**

Classification of the electronic computers may be based on either their principles of operation or their configuration means size, speed of doing computation and storage capacity of a computer. Classification based on Principles of Operation:The computer can be classified in various three categories,



1. **Analog computers**,
2. **Digital computers**,
3. **Hybrid computers**

Analog computer is a computing device that works on continuous range of values.
The computations are carried out with physical quantities such as *voltage, length, current, temperature* etc.

Digital computers: Digital computer represents physical quantities with the help of digits or numbers(0 and 1) . These numbers are used to perform Arithmetic calculations and also make logical decision Digitals computers are much faster than analog computers and also more accurate.

Digital computers are classified into 2 ways

1. Purpose wise
2. Size and performance wise
Purpose wise digital computers are classified into two types:

1. Purpose wise:

A. special purpose computerB. General purpose computer

***A. Special purpose computers*:**is the one that is designed to perform a specific task. The instructions are carry out the task are permanently stored in the machine. These computers are not versatile. **For example**: **Blood pressure monitoring system**.

B.*General purpose computers*: is the one that can work on different types of program input to it and thus be used in countless applications.

2. Size and performance wise

- **a)** Micro computer
- **b)** Mini computer
- **c)** Mainframe computer
- **d)** Super computer

a) Micro computer:

Micro computer is also called Personal computer. It was introduced in 1970.The number of processors in micro computers will be one or two processors.
It contains input/output devices, storage device, memory and processor.
This kind of computer can be used by one person at a time
The major types of personal computers are *desktop* computers and
Portable computers

Desktop computers:*Desktop computers are designed for use at a desk or table.* *T*hey are typically larger and more powerful than other types of personal computers. Desktop computers are made up of separate components. The main components called a system unit, is usually a rectangular case that sits on or underneath a desk. Other *components, such as the monitor, mouse, and keyboard, connect to the system unit.*

Portable computers: Portable is a personal computer that can be carried from one place to another easily. Examples for portable computers**areLaptop, Notebook,***etc.*
Handheld computer*: This kind of computers can portable. Handheld computer* is also known as palmtop computers. It is easily fits in the hand of the user.

b) Mini computers: were introduced in 1960.Mini computers is larger and more powerful computer than personal computer. It can execute 5 million instructions per second (MIPS).It generally consists of 2 or more processors. This computer can serve up to 4000 connected users simultaneously. Minicomputer has a device with a monitor and keyboard is called terminal. It is also known as dumb terminal. It has no processing power and cannot work as stand-alone computer.

Mini computers are often used by small and medium-sized companies to provide centralized to store the information.

Ex:-VAX-8800, AS 400 , IBM-370,IBM-S/390,UNIVAC-1110 etc.

c) Mainframe computers were introduced in 1975. A mainframe computer is a very large computer in size. It consists of multiple processors and it performs multiple users at the same time. This type of computer can execute 16 MIPS.

Ex:-IBM-17,DEC.PDP-11,HP-9000, NEC610, DEC 1

Uses of mainframe computer: are used in large organization like airlines, ticket reservation and also used to primarily by corporate and governmental organization for critical application.

d) Super Computer: Super computers were introduced in 1980.These computers are fastest, biggest in size and most expensive price than other computer. The super computer can process trillions of instruction in one second. This is mainly used to highly complex calculations and also used for scientists. The speed of supercomputers are measured in FLOPS (Floating Point operations Per second).

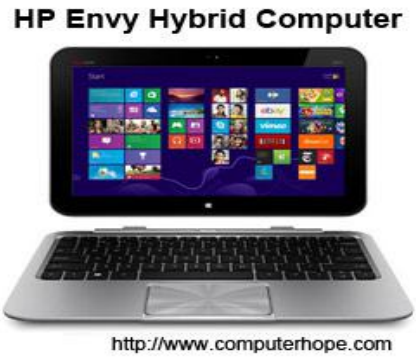
Uses of super computer:

- Weather forecasting,
- Animated graphics like Hollywood movies
- Fluid dynamic calculations.
- Nuclear energy research
- Space science
- Weapon and missile design
- Petroleum exploration etc.

Example:
CRAY-XP, ETA-10, Siddhartha , CRAY-1 ,PARAM, PRAM YUVA-II,Tianhe-2 etc.

Hybrid Computers:

i. These computers use the principles of both analog and digital computers.
ii. In these computers some calculations take place in analog manner and rest of them take place in digital manner.
iii. They too have high memory capacity and are *used in intensive care units of hospitals as well as space research etc.*



- ✓ **World first super computer** :The first Atlas was officially commissioned on *7 December 1962*, nearly three years after the **Cray -CDC 6600** supercomputer was introduced, as one of the world's first supercomputers

- ✓ **World fastest super computer**:**As of June 2016**, the fastest supercomputer in the world is the ***Sunway TaihuLight,*** in mainland China, with a **Linpack** benchmark of 93 PFLOPS, exceeding the previous record holder, **Tianhe-2,** by around 59 PFLOPS.

- ✓ **Indian first super computer :**PARAM 8000is considered **India's first supercomputer**. It was indigenously built in 1990 by **C**entre for **D**evelopment of **A**dvanced **C**omputing(**C-DAC**)_PUNE.

- ✓ **Indian latest super computer:**

INDIA's Rank in Top500

Rank	Site	Name
139	Indian Institute of Tropical Meteorology	Aaditya (iDataPlex DX360M4)
186	Tata Institute of Fundamental Research	**TIFR - Cray XC30**
217	Indian Institute of Technology Delhi	HP Apollo 6000 Xl230/250
337	Centre for Development of Advanced Computing	PARAM Yuva - II

Chapter-2
Input, Output and Memory Devices

Input devices: An input device is used to feed data into a computer. The human understandable form (usually English/Kannada or any other language) is converted into machine understandable form **0's and 1's .**

Output devices: An **output device** is any **device** used to send data from a computer to another **device** or user. Most computer data **output** that is meant for humans is in the form of audio or video.

A computer can have several input/output devices are.

Input Devices:

INPUT PUT DEVICES:

- Graphics Tablets
- Cameras
- Video Capture Hardware
- Trackballs
- Barcode reader
- Digital Camera
- Gamepad
- Joystick
- Keyboard
- Microphone
- MIDI keyboard
- Mouse (pointing device)
- Scanner
- Webcam
- Touch pads
- Pen Input
- Microphone
- Electronic Whiteboard
- OMR
- OCR
- Punch Card Reader
- MICR (Magnetic Ink character

Output Devices:

OUTPUT DEVICES:

- Monitor (LED, LCD, CRT etc)
- Printers (all types)
- Plotters
- Projector
- LCD Projection Panels
- Computer Output Microfilm (COM)
- Speaker(s)
- Head Phone
- Visual Display Unit
- Film Recorder
- Microfiche

1. Remote control :

These devices are very common. They send data signals each time a button is pressed using infrared light or radio signals . The signals can control a computer (or a system that contains a smaller computer such as a DVD player) from some distance often used to control a presentation slideshow.

2. Biometrics:

When referring to computers and security, **biometrics** is the identification of a person by the measurement of their biological features.

For example, a user identifying themselves to a computer or building by their finger print or voice is considered a biometrics identification. When compared to a password, this type of system is much more difficult to fake since it is unique to the person. Below is a listing of all known biometric devices.Other common methods of a biometrics scan are a person's face, hand, iris, and retina.

Types of biometric devices

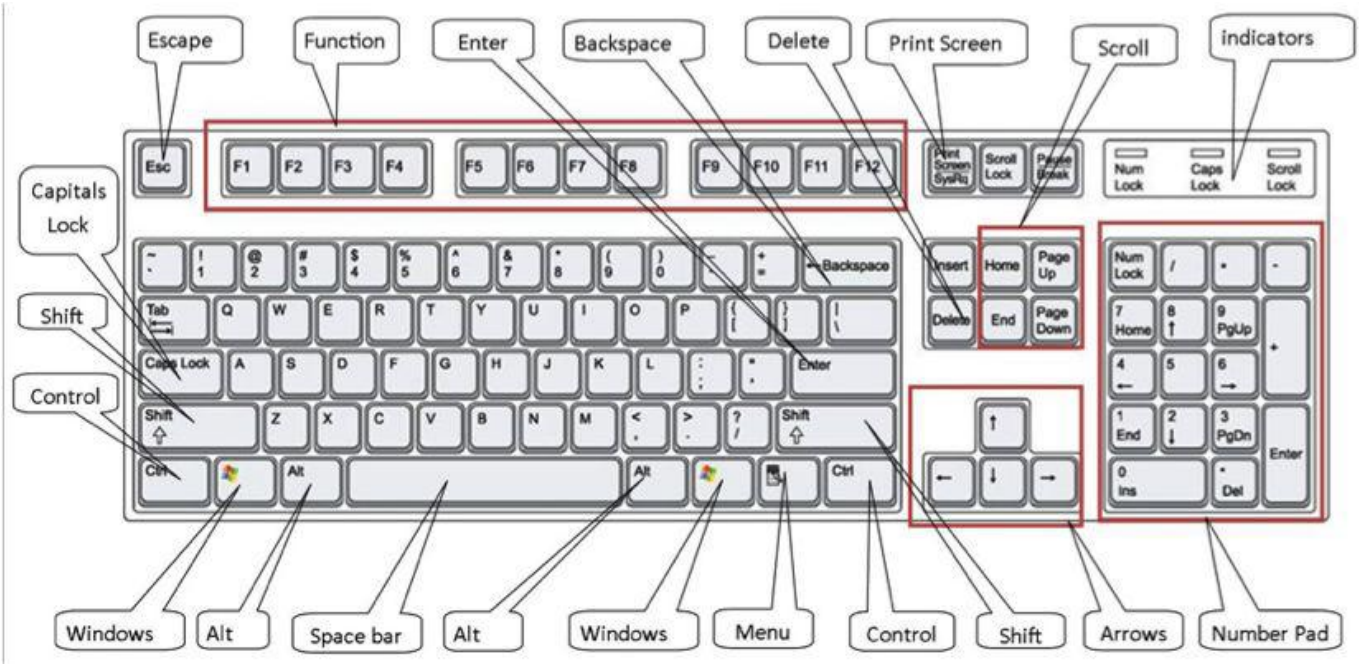
a) **Face scanner**
b) **Hand scanner**
c) **Retina or iris scanner -**
d) **Voice scanner**

3. Joystick:

joystick is an input device that allows the user to control a character **or** machine in a computer program, such as a plane in a flight simulator. They look similar to the control device you would find on an arcade game, but nearly always include extra buttons for additional functionality. The picture shows the LogitechFreedom 2.4, an example of a joystick.

The first joystick was invented at the U.S. Naval Research Laboratory by C. B. Mirick and patented in 1926.

4. Keyboard:



A computer **keyboard** is one of the primary input devices used with a computer that looks similar to those found on electric typewriters, but with some additional keys. The modern keyboard is based on the typewriter, a typing device that was first developed and patented in **1868** by **Christopher Sholes.** Keyboards allow you to input letters, numbers, and other symbols into a computer that often function as commands. The following image shows a 104-key Saitek keyboard with indicators pointing to each of the major key sections of a keyboard including the control keys, function keys, LED indicators, wrist pad, arrow keys, and keypad.

5. Mouse:

Originally referred to as an **X-Y Position Indicator** for a Display System, a **mouse** is a hardware input device that was invented byDouglas Engelbart in 1963 while working at Xerox PARC. The mouse allows an individual to control apointer in a graphical user interface (GUI) and manipulate on-screen objects such as icons, files, and folders.

Types of computer mice

- Cordless (Wireless)
- Foot mouse
- IntelliMouse (Wheel mouse)
- J mouse
- Joystick
- Mechanical
- Optical
- Touchpad (Glide point)
- Trackball
- Track Point

Computer mouse ports

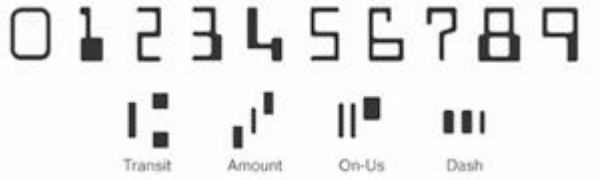
Today, most computer mice connect to a computer using a USB port. Below is a listing of all of the type of ports and wireless connections that a mouse has used.

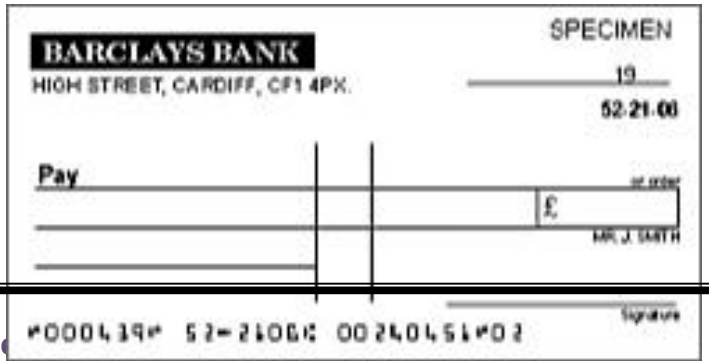
- Bluetooth
- Infrared
- PS/2 Port
- Serial Port
- USB

6. MICR Reader

Magnetic Ink Character Recognition (**MICR**) is a technology that allows details from **bank cheques** to be read into a computer **quickly**and **accurately**.

The **cheque number** and **bank account** number are printed at the bottom of each bank cheque in **special magnetic ink** using a **special font**. These numbers can be detected by an **MICR reader**.





7. OMR Scanner:

Optical Mark Recognition (**OMR**) is a technology that allows the data from a **multiple-choice** type form to be read **quickly** and **accurately** into a computer.

Special OMR forms are used which have spaces that can be **colored in** (usually using a pencil). These **marks** can then be **detected** by an **OMR scanner**.

Common uses of OMR are **multiple-choice exam** answer sheets and **lottery number** forms.

8. OCR Scanner:

Optical Character Recognition (**OCR**) is a software technology that can **convert images of text into an actual text file** that can then be edited (e.g. using word-processing software). The result is just as if the text had been typed in by hand.

OCR is typically used after a page of a book has been **scanned**. The scanned **image** of the page is then **analyzed** by the **OCR software** which looks for recognizable **letter shapes** and generates a matching text file.

Advanced OCR software can recognize normal **handwriting** as well as printed text - this is usually called **handwriting recognition**.

9. Barcode Reader / Scanner:

A barcode is simply a **numeric code** represented as a series of **lines**.

These lines can be read by a **barcode reader/scanner**.

The most common use of barcode readers is at **Point-of-Sale** (**POS**) in a shop. The **code** for each item to be purchased needs to be entered into the computer. Reading the **barcode** is far **quicker** and more **accurate** than **typing** in each code using a keypad.

Bar code can be found on many other items that have numeric codes which have to be read quickly and accurately - for example ID cards.

OUTPUT DEIVICES

1. CRT Monitor

A monitor displays **text** and **image** data passed to it by the computer.

A **cathode-ray tube** (CRT) monitor is the type that has been around for years and is **large** and **boxy**. CRT monitors are **heavy** and they take up a **lot of desk space**. They have largely been **replaced** by flat-screen monitors. However some are still used in the design industry since the **color accuracy** and **brightness** of CRT monitors is excellent, and designers need to see true-to-life colors.

Also, CRT monitors are generally **cheaper** than flat-screen monitors.

Flat-Screen Monitor (TFT or LCD)

Over the past few years, as they have come down in price, flat-screen displays have **replaced** CRT monitors.

Flat-screen monitors are **light in weight** and they take up very **little desk space**.

Modern flat-screen monitors have a **picture quality** that is as good as CRT monitors.

*TFT and LCD are two of the technologies used in flat-screen monitors: **TFT** is Thin-Film-Transistor, and **LCD** is Liquid-Crystal Display.*

*Another technology that may replace these is **OLED**, or Organic Light-Emitting Diodes.*

Digital / Multimedia Projector

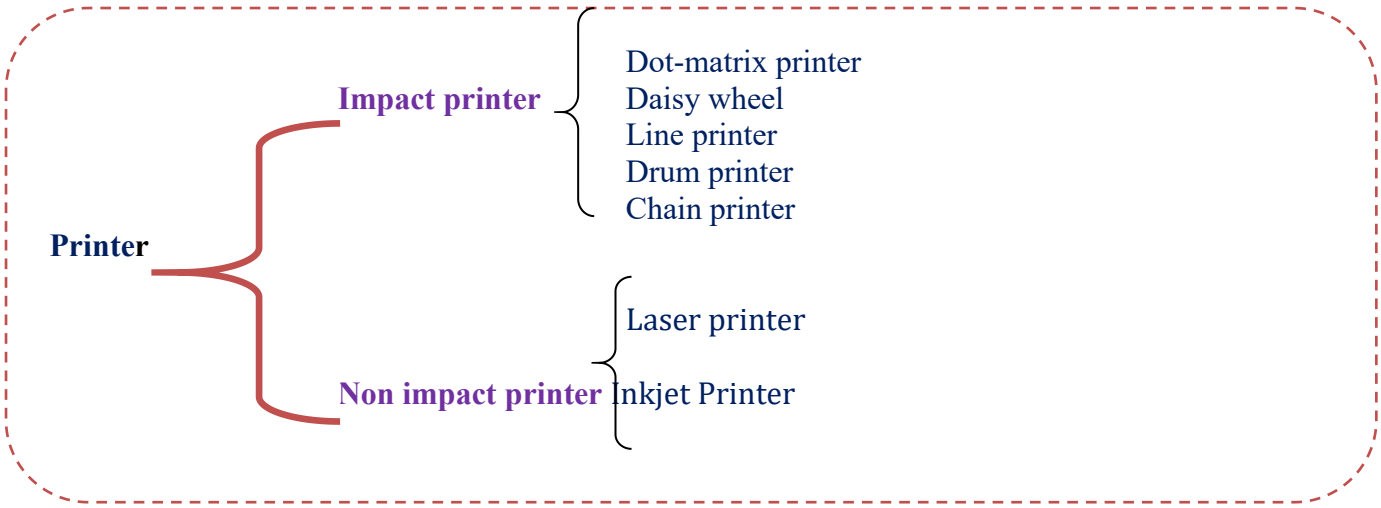
Digital projectors are used in situations when a **very large viewing area** is required, for example during **presentations**, for **advertising**, or in your home for **watching movies**.
A projector connects to a **computer**, a **DVD player** or a **satellite receiver** just like a ordinary monitor.

The image is produced inside the device and then projected out through a large lens, using a **powerful light source**.

2. Loudspeaker:

If you want to hear music or songs from your computer you will have to attach loudspeakers. They convert electrical signals into sound waves. Loudspeakers are essential for applications such as music editing , video conferencing watching movies etc.
If you want a physical copy of some data on **paper** (a '**hardcopy**') you will need a device that can make **marks** on paper - a printer or a plotter...

3. Printers :-



I. Impact printer :

The impact printers print the characters by striking them on the ribbon which is then pressed on the paper.
Characteristics of Impact Printers are the following:

- Very low consumable costs
- Very noisy
- Useful for bulk printing due to low cost
- There is physical contact with the paper to produce an image

These printers are of two types

- Character printers
- Line printers

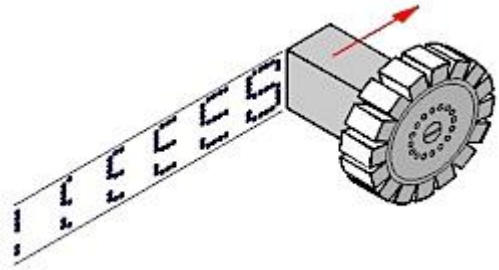
Character Printers

Character printers are the printers which print one character at a time.
These are further divided into two types:

- Dot Matrix Printer(DMP)
- Daisy Wheel

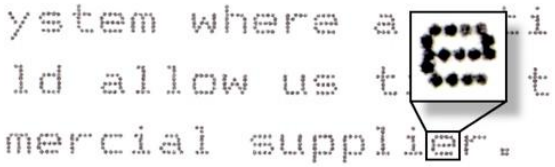
1. Dot Matrix Printer(DMP)

A dot-matrix printer is named after the pattern (a grid or 'matrix') of dots used when creating the paper printout.
These dots are formed by tiny **pins** in the printer's print head that **hit**an inked ribbon against the paper leaving marks. As the print head moves along it leaves a pattern of **dots** behind it which can form letters, images, etc.



Dot matrix printers often use **continuous stationary**: long, continuous strips of paper (rather than separate sheets of A4 like ink-jet and laser printers use).

After printing, the printout is torn off from the long strip.



Dot-matrix print **quality is poor**, the printers are **noisy**, and there are much better printing systems available today. However, the dot-matrix printers are still used in certain situations:

- Since the pins actually hit the paper, several '**carbon-copies**' can be printed in one go. An example of this is **airline tickets**which have several **duplicate pages**, all printed in **one go**
- The print mechanism is **very cheap**, and the inked ribbons last for a **long time**. So, where cheap, low-quality printouts are required, dot-matrix printers are used. An example is **shop receipts**.

2. DAISY WHEEL

Head is lying on a wheel and pins corresponding to characters are like petals of Daisy (flower name) that is why it is called Daisy Wheel Printer. These printers are generally used for word-processing in offices which require a few letters to be sent here and there with very nice quality.

Advantages

- More reliable than DMP
- Better quality
- The fonts of character can be easily changed

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

3. Line Printers

Line printers are the printers which print one line at a time.

These are of further two types

- Drum Printer
- Chain Printer

4. DRUM PRINTER

This printer is like a drum in shape so it is called drum printer. The surface of drum is divided into number of tracks. Total tracks are equal to size of paper i.e. for a paper width of 132 characters, drum will have 132 tracks. A character set is embossed on track. The different character sets available in the market are 48 character set, 64 and 96 characters set. One rotation of drum prints one line. Drum printers are fast in speed and can print 300 to 2000 lines per minute.

Advantages

- Very high speed

Disadvantages

- Very expensive
- Characters fonts cannot be changed

5. CHAIN PRINTER

In this printer, chain of character sets are used so it is called Chain Printer. A standard character set may have 48, 64, or 96 characters.

Advantages

- Character fonts can easily be changed.
- Different languages can be used with the same printer.

DisadvantagesNoisy

II. Non-impact Printers

Non-impact printers print the characters without using ribbon. These printers print a complete page at a time so they are also called as Page Printers.
These printers are of two types

- Laser Printers
- Inkjet Printers

Characteristics of Non-impact Printers

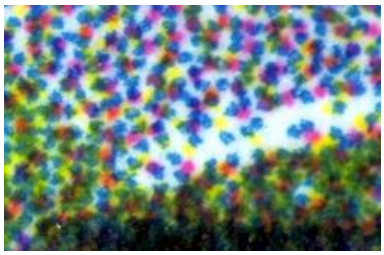
- Faster than impact printers.
- They are not noisy.
- High quality.
- Support many fonts and different character size.

6. Inkjet Printer

Cheap, **high-quality**, **full-color** printing became available during the 1980s due to the development of ink-jet printers.
These printers have a similar print-head mechanism to a dot-matrix printer. The print-head passes left and right across the paper. However, instead of using pins to hit inky marks onto the paper, the ink-jet **squirts** tiny **droplets** of ink onto the surface of the paper. Several colored inks can be used to produce **full-color** printouts.

The droplets of ink come from tiny holes (the **jets**) which are less than the width of a human hair in size. Each droplet creates a tiny dot on the paper. Since the dots are so small, the quality of the printout is excellent (1200 dots-per-inch are possible). This is perfect for **photographs**.

Ink-jet printers are **very quiet** in use. Since they have so few moving parts they are also **cheap** to manufacture and thus cheap to purchase. However, the **ink** is very **expensive** to buy (this is how the printer companies make their profits!) so the printers are **expensive to use**.



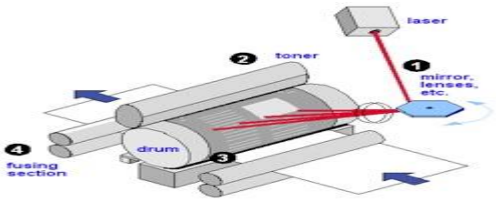
This is a close-up of the tiny ink dots on a page. The dots combine to form light and dark areas.

7. Laser Printer

Laser printers are very **complex** devices, and thus **expensive to buy**. However they are very **cheap to use**. This is because they produce marks on paper using a fine dust called **toner** which is relatively cheap to buy. A single toner cartridge will often last for 5,000-10,000 pages of printing.

The laser printer uses a complex system, involving a **laser**, to make the toner stick to the required parts of the paper. (This system is very different to a dot-matrix or ink-jet, and you don't need to know the details.)
The laser and toner system allows **very fast printing** compared to other printers (just a few seconds per page).

Laser printers are very common in **offices** since they print very quickly, are cheap to use and are reasonably quiet.



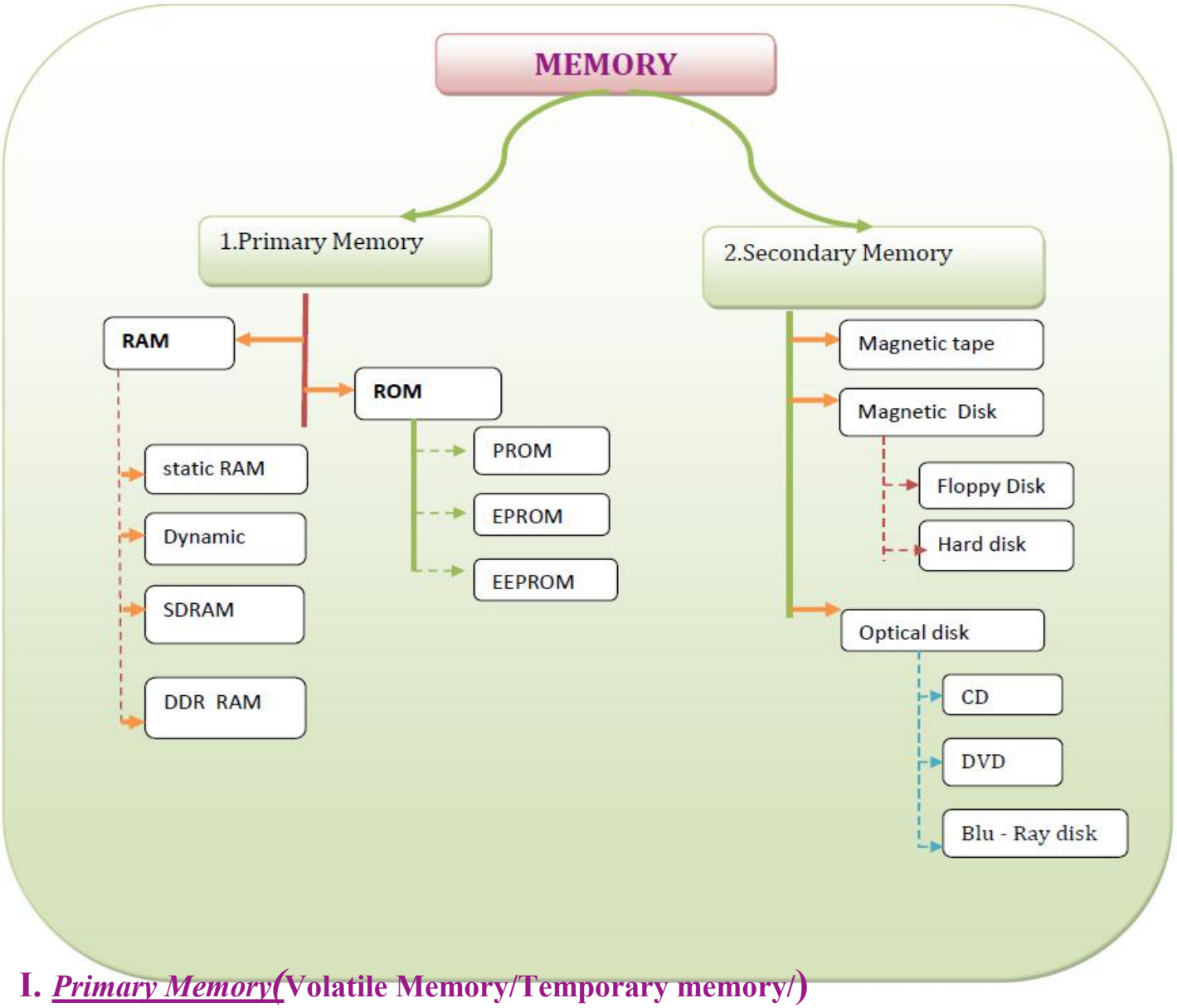
8. Plotter

Plotters create hard-copy in a very different way to printers. Instead of building up text and images from tiny dots, plotters **draw** on the paper using a **pen**.

The pens are held in an arm which can lift the pen up or down, and which can move across the paper. The arm and pen create a drawing just like a human could, but much more **accurately** and more **quickly**. Different **colored pens** can be used to produce colored line drawings. Plotters are often used by **designers** and **architects** since they work with **huge pieces of paper**, far bigger than anything a normal printer could work with...

*Plotters are only suitable for producing **line drawings**. They cannot produce the kind of text and images that an ink-jet or laser printer could. (So you cannot use a plotter to produce photos for example)*

- **DPI**-Dots per Inch
- **CPS**-Character per Second
- **PPM**-Pages Per-Minute
- **DMP**-Dot Matrix Printer
- **CRT**-Cathode Ray Tube
- **LCD**-Liquid crystal Display
- **LED**-Light Emitting diode
- **TFT**-Thin film transistors.
- ***OLED***-*Organic Light-Emitting Diodes.*
- **MICR**-Magnetic Ink Character Recognition\
- **OCR**-Optical Character Reader
- **OMR**-Optical Mark Recognition
- **POS**- Point-of-Sale
- ***Joystick***-*The first joystick was invented at the U.S. Naval Research Laboratory by C. B. Mirick and patented in 1926.*
- **MOUSE:** (Mechanically Operated User Serial Engine) is a hardware input device that was invented by Douglas Engelbart in 1963
- **Keyboard:** A typing device that was first developed and patented in **1868** by **Christopher Sholes**.



I. *Primary Memory*(Volatile Memory/Temporary memory/)

1.RAM

➢ **RAM: - [Random access memory]**

RAM is also called as a main memory. It is the ream and write memory. It is just like a page of note book where you can write something or read something. The data and instruction entered by user or stored in this memory.

Types of RAM:

- Static RAM
- Dynamic RAM

- ***Static RAM:*** -

  Static RAM related stored information as long as the power supplying is on. Static RAM is costlier compared to dynamic RAM and consumed more power. They have higher speed than dynamic RAM.

- ***Dynamic RAM*:-**

  Dynamic RAM in cheaper and they consume less power. They are used where large capacity of memory is needed.

2.ROM

ROM(Read only Memory) is a permanent memory that is the information stored in it will not be lost even if the power goes off.

Types of ROM:

- **PROM**
- **EPROM**
- **EEPROM**

- **PROM:-[Programmable read only memory]**

  It is a variation of ROM, the contents of this memory by the user. It is initially empty later the user can store program, data or any other information permanently in this memory. However these programs cannot be erased once they are written on it.

- **EPROM:- [Erasable program read only memory]**

  It is a modification of PROM, the content stored in this can be erased by exposing it to an ultraviolet light for about 10 to 20 minutes.

- **EEPROM:- [Eclectically Erasable program read only memory]**

  Memory and also referred to as E^2PROM. As the name suggest, an EEPROM can be both erased and programmed with electrical pulses.

  EEPROM is also called a non-volatile memory because when power is turned off the stored data in the EEPROM will not be erased or intact.

II. Secondary Memory (permanent memory/secondary storage device/non-volatile memory)

Secondary storage device:-[secondary memory]

The storage capacity of the primary memory is not very large. It cannot hold large amount of data including programmed which may be needed for processing disk, secondary storage device are necessary. Any additional storage used in a computer other than primary memory classified as secondary memory or storage devices.

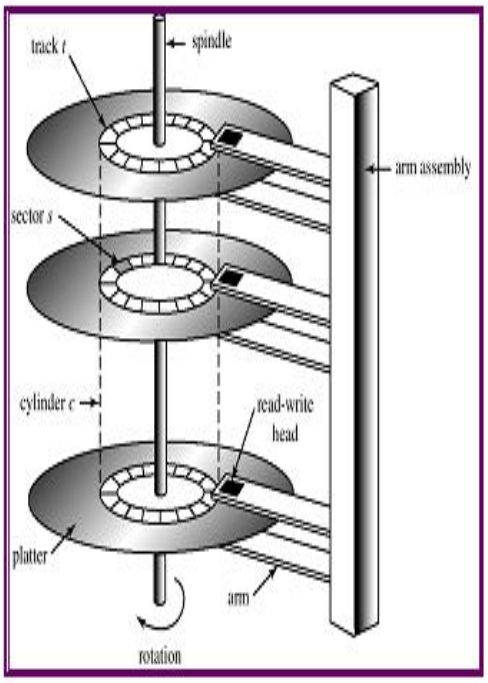
The commonly used in secondary memory device are:-

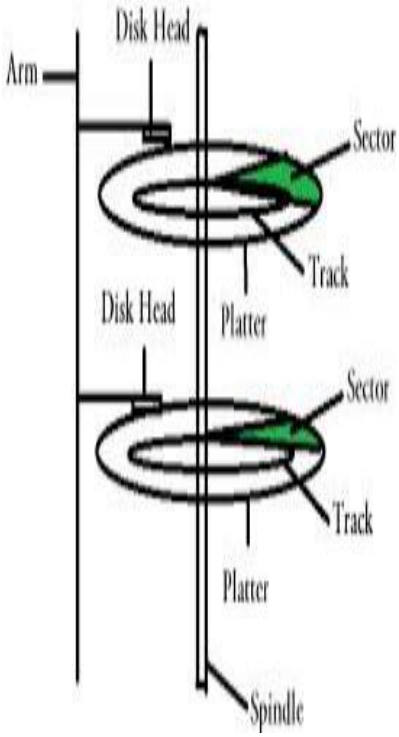
- Floppy disk
- Hard Disk
- Magnetic tapes
- Magnetic drum, CD-ROM

1. Magnetic tape:

Magnetic tape is a large capacity, ***serial access medium***. Because it is a serial access medium , accessing individual files on a tape is slow. Tapes are used where large amounts of data need to be stored ,but where quick access to individual files is not required .A typical use is for data back-up (lots of data , but rarely only accessed in an emergency) Tapes are also used and in some batch processing applications.
(E.g.: to hold the list of data that will be processed)

2. Hard disk.





The Size of the floppy disk is limited. If the application require more secondary memory than hard disk are used. Hard disk in a group of round flat metal plated which are coated with magnetic metal. Because of the use of metal in place of thin plastic they are called “Hard disk”

The data is recorded as both the surface of the disk the read and write head mechanism consists of one magnetic head per surface [to per disk] that are mounted on common Arm that is driven by a *serve controller* motor so that the centre of disk. This disk is rotated as a result of rotation of the central hub at a high speed. The speed in generally in the range *of 2400-4700 RPM [Revolution per minute]*

Advantage of Hard disk:-

Random access: Data is located and accessed directly for reading and writing

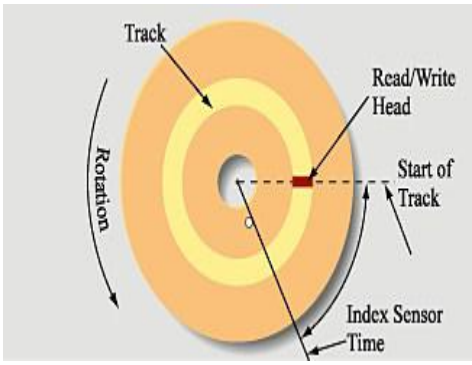
Reliability: Data stored on thin disk can be used repeatedly. That is the data can be represented whenever it is required.

Durability: There are less prone to damage.

Disadvantages:-

- Costlier as compared to magnetic tape
- Hard disk or off heavy weight as compared to magnetic tapes

3.Floppy Disk :

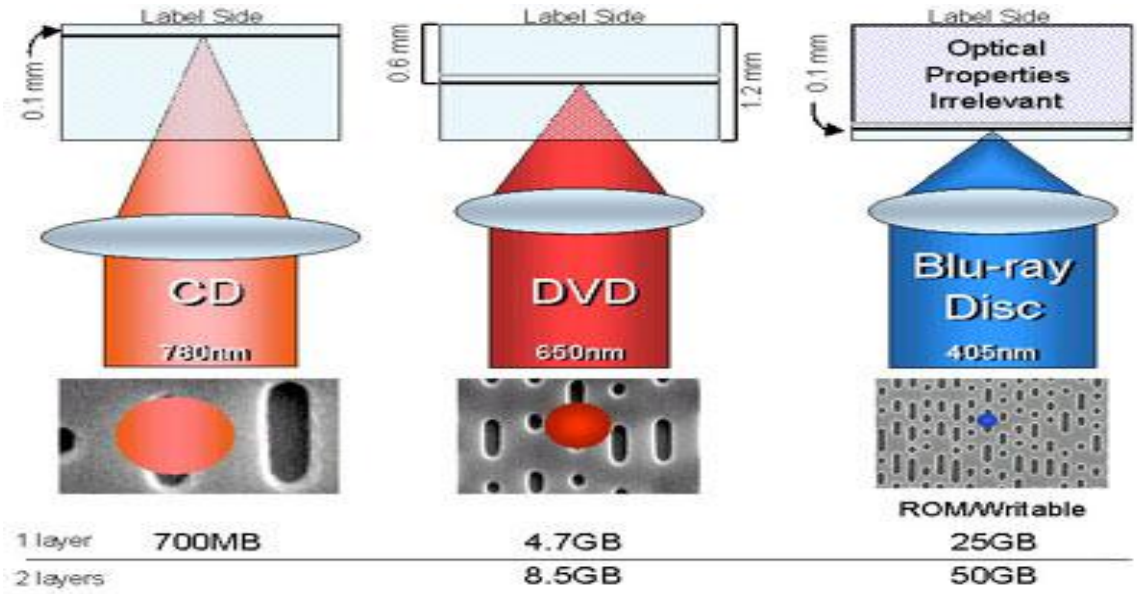


Floppy disk is a secondary memory device. It is also called floppy diskette. The dictionary meaning of Floppy is "soft and flexible" and disk means circular thing. Hence a floppy disk is a thin flexible, circular plastic plate, coated with magnetic oxide. The data on the floppy disk in terms of magnitude sports. The data on the spots particularly floppy magnetized due to a magnetic flux induced which current padded through the read and write head.

*The surface of a floppy disk us divided into number of constrict circle are called **"tracks"** and thin tracks are further divided into **"Sector".** Sectors are conical position. It is shown in a diagram. The area bounded by the track and sector is called a data **"segment"** where the data and instruction were stored.*

Example: 5.25 inches (360 KB)
3.5 inches (1.44 MB)

4.Optical Disk.



a) CD ROM:

CD-ROM to holds large quantity of data (650-700 MB) In the form of program text, video clips, picture, CD ROM also know as optical disk because the data read by a laser beam reflecting or not reflecting from the disk surface.
CD's are available in 3 formats:
CD ROM
CD-R
CD-RW

b) DVD [Digital versatile Disk]:-

DVD device are replacing CD drives in computers due to the memory capacity of the disk and high quality of stored images and data multilayer and double sided DVD can hold up to 17 GB of data. Example: A single DVD holds 4.7 GB data.

c) BD [Blu -ray] ROM: BD ROM is high –capacity storage technology with a 25 GB to 50 GB capacity to store high definition movies and data. The name blue-ray is derived from the blue –violet color laser to read data stored on Blu-ray discs.

d) 'Solid-State'?

The term 'solid-state' essentially means 'no moving parts'.

Solid-state storage devices are based on **electronic circuits** with **no moving parts** (no reels of tape, no spinning discs, no laser beams, etc.)

Solid-state storage devices store data using a special type of **memory** called **flash memory**...

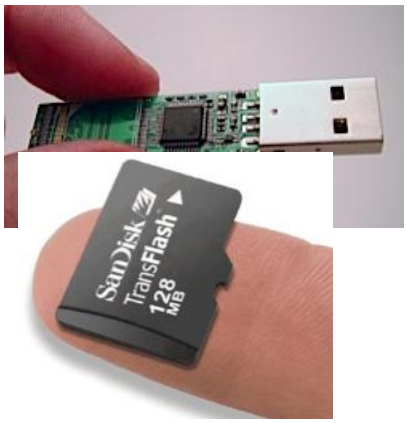
e) Flash Memory

Flash memory is a type of Electronically-Erasable Programmable Read-Only Memory (**EEPROM**).
Flash memory is **non-volatile** (like ROM) but the data stored in it can also be **erased** or **changed** (like RAM).

f) USB Memory Sticks

Memory sticks are **non-volatile**, **random-access** storage devices.
Each of these small devices has some **flash memory** connected to a**USB interface**. Plug it into your computer and it appears as a drive. You can then add files, erase files, etc. You can use it to **move any type of file** between computers.
Flash memory used to be very expensive, but in recent years it has become much **cheaper** and you can now buy a 16GB memory stick for just a few dollars.

g) Memory cards



Many of our digital devices (**cameras**, **mobile phones**, **MP3 players**, etc.) require **compact**, **non-volatile** data storage. Flash memory cards provide this and come in a variety of shapes and sizes.

One of the most common formats used by digital cameras is the SD Card. The cards store the digital images taken by the camera.

Mobile phones contain a **Subscriber Identity Module** (**SIM**) card that contains the phone's number, the phonebook numbers, text messages, etc.

Many phones also have extra memory cards to store music, video, photos, etc. (e.g Tiny Micro-SD cards).

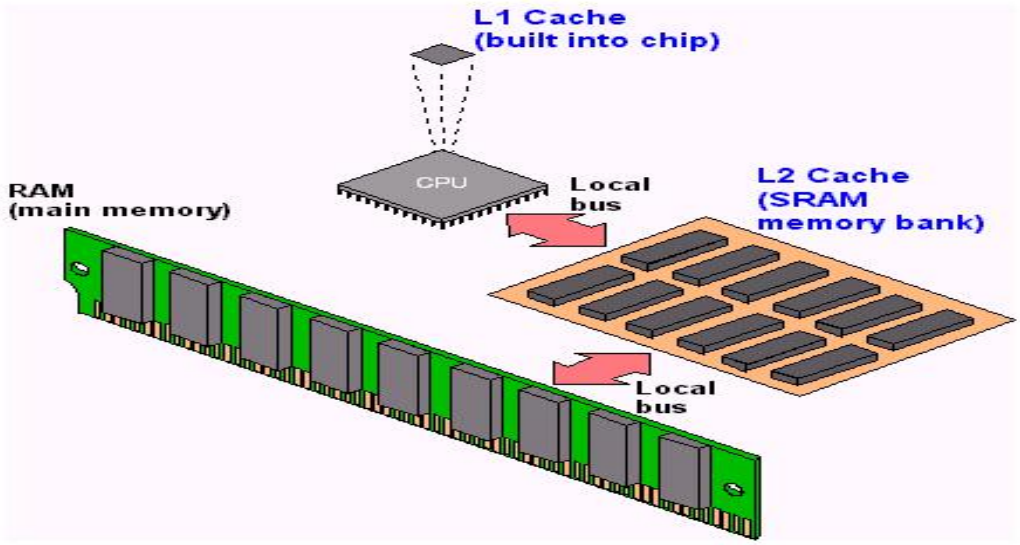
5. Cache memory

Cache Memory: *Cache memory is high speed memory that locates or resides between the CPU and RAM in computer.* It much faster than main memory. Its access time is much less compared to that of the main memory.

The cache memory increases the operating speed of the system. But it is much costlier than main memory. Cache memory today is usually internal cache (built with right into the CPU chip), In the past, some cache memory was external (located close to but not inside the CPU).

Types of cache memory

- L1 cache (level-1)
- L2 cache (level-2)
- L3 cache (level-3)



Memory Measurement:

8 bits make a byte . 2*2*2*2*2*2*2*2*2*2=1024 -2^{10}

	4 bit	1 nibble
	1 Bit	Binary Digit
	8 Bits	1 Byte
2^{10} bytes	1024 Byte	1 KB(**Kilo byte**)
2^{20}bytes	1024 KB	1 MB (**Mega Byte**)
2^{30} bytes	1024 MB	1 GB(**Giga Byte**)
2^{40} bytes	1024 GB	1 TB(**Terra Byte**)
2^{50} bytes	1024 TB	1 PB(**Peta Byte**)
2^{60} bytes	1024 PB	1 EB(**Exa Byte**)
2^{70} bytes	1024 EB	1 ZB(**Zetta Byte**)
2^{80} bytes	1024 ZB	1 ZB(**Zetta Byte**)
2^{90} bytes	1024 ZB	1 (**Bronto Byte**)
2^{100} bytes	1024 Bronto byte	1 (**Geop Byte**)

- **4 bit** = 1 nibble
- **Bit**is the smallest memory measurement Unit.
- **Geop Byte**is The Highest Memory Measurement Unit!!!
- **Tracks-** *The surface of a floppy disk us divided into number of constrict circle are called "**tracks**"*
- **Sectors** - *Thin tracks are further divided into "**Sector**". Sectors are conical position.*
- ***SRAM:-*** *static Random Access Memory*
- *DRAM- Dynamic Random Access Memory*
- ***SD-RAM*** *-Synchronous Dynamic Random Access Memory*
- ***DDR-RAM*** *-Double Data Rate Random Access Memory*
- ***EDO-RAM*** *- eXtended Data Output Random Access Memory*
- ***DDR-SD-RAM*** *-Double Data Rate synchronous Dynamic Random Access Memory*
- **Cache Memory:** *Cache memory is high speed memory that locates or resides between the CPU and RAM in computer.*

CHAPTER -4
DATA REPRESENTAION

Introduction:

In digital computers , data and instructions are stored in the computer's memory using binary code(or machine code) represented by Binary digits **1** and **0** called **B**its.

Number systems are basically classified into two types. They are,

1. Non-positional number system
2. Positional number system

Non-Positional number system:

Roman number system is an example of the non-positional number system.

I.e., I=1, V=5, X=10, L=50.

Positional Number system:

Decimal, binary, octal and hexadecimal number systems are some of the example of these type numbers systems.

The base or radix of number system is the total number of digits present in that

1. DECIMAL NUMBER SYSTEM:

The base or radix of number system in our daily life. It has 10 numbers from 0 to 9; hence its radix is 10.

The positional values are expressed in powers of 10.

Example: consider a decimal number $542.76_{(10)}$ which can be represented equivalent value as:

$\mathbf{5x10^2+4x10^2+2x10^0+7x10^{-1}+6x10^{-2}}$

The following table shows the weitage of the positional values of the decimal number.

2. BINARY NUMBER SYSTEM:

*The digital computers cannot process decimal numbers, hence it has be converted binary digits 0(low) and 1(High), which is suitable to represent the two states of electronics. Th*e representation of the data in a computer is usually in binary digits 0 and 1. Hence the base is 2. The positional values are expressed in **power of 2.**

Example:-consider a binary number 11011.101(2) which can be represented in equivalent values.

$\mathbf{1x2^4+1x2^3+0x2^2+1x2^1+1x2^0+1X2^{-1}+0x2^{-2}+1x2^{-3}}$

3. OCTAL NUMBER SYSTEM:

The octal number system has 8 digits, 0,1,2,3,4,5,6 and 7. Its radix is 8. The positional values are expressed in power of 8.

Example: - consider an octal number 234.56(8) which can be represented in equivalent value as**:**

$\mathbf{2X8^2+3X8^1+4X8^0+5X8^{-1}+6X8^{-2}}$

4. HEXADECIMAL NUMBER SYSTEM:

This number system has 16 digits,0,1,2,3,4,5,6,7,8,9,A,B,C,D,E and E. The radix is 16. The positional values are expressed in powers of 16. The digits A, B, C, D, E and F have the decimal equivalents 10, 11, 12, 13, 14 and 15 respectively.

Example: - consider a hexadecimal number $5AF.D_{(16)}$ which can be represented in equivalent value as:

$$\mathbf{5X16^2+AX16^1+FX16^0+DX16^{-1}}$$

NUMBER SYSTEMS CONVERSIONS (ALL TYPES)

1. Decimal to Binary conversion
2. Decimal fraction to Binary conversion
3. Binary to Decimal conversion
4. Decimal to Octal Conversion
5. Octal to Decimal conversion
6. Decimal to Hexadecimal conversion
7. Binary to Octal conversion
8. Octal to Binary conversion
9. Binary to Hexadecimal Conversion
10. Hexadecimal to Binary Conversion
11. Octal to Hexadecimal conversion
12. Hexadecimal to octal conversion

1.Decimal to Binary Conversion:

Normally, the **Repeated-Division by-2** method is used to convert a given decimal into its equivalent binary number. The steps involved in decimal-to-binary conversion are given below.

Stept 1 : Divide the given decimal number by 2

Stept 2 : Note the quotient and remainder.

Stept 3 : Repeat the step1 and step2 until the quotient becomes zero.

Stept 4 : The first remainder will be the **LSB** and the last remainder is the **MSB**. The equivalent binary number is then written from left to right i.e., from **MSB** to **LSB.**

Example: - consider the decimal number **53**$_{(10)}$ which can be represented in binary as:

2	**53**		
2	26-remainder	1	~~LSB~~▶
2	13-remainder	0	
2	6-remainder	1	
2	3-remainder	0	

2	1-remainder	1	
2	0-remainder	1	~~MSB~~

Therefore $53_{(10)} = 110101_{(2)}$

2. Decimal fraction to Binary conversion:

Either uses the **sum-of-weights** method or the ***repeated-multiplication-by-2*** method. In the multiplication-by-2 method, *we repeated multiply the fraction bytwo, and record the carry, until the fraction product is zero*. The first carry produced will be the MSB, while the last carry the LSB. Remainder that the binary precedes the MSB.

Example (1): Let us consider the conversion of **$0.3125_{(10)}$** to binary

Multiplication	Result	Carry
0.3125 **X** 2	0.625	0(MSB)
0.625 X 2	1.25	1
0.25 X2	0.50	0
0.50 X 2	1.00	1(LSB)
0.00		

Reading the carry from top to the bottom

Therefore, $0.3125_{(10)} = 0.0101_{(2)}$

Example (2): Let us consider the conversion of **$25.828125_{(10)}$**

Here, first we have to convert the whole number 25 into binary and then the fraction **0.828125**

a. Converting **$25_{(10)}$**to binary:

2	**25**		
2	12-remainder	1	~~LSB~~
2	6-remainder	0	
2	3-remainder	0	
2	1-remainder	1	
2	0-remainder	1	~~MSB~~

b. Converting **0.828125** to binary:

Multiplication	Result	Carry
0.828125 X 2	1.65625	1(MSB)

Reading the carry from top to the bottom

0. 65625 X 2	1.3125	1
0. 625 X2	0.625	0
0.625 X 2	1.25	1
0.25 X2	0.5	0
0.5X2	1.0	1(LSB)

Therefore, $0.828125_{(10)} = 1101019_{(2)}$

Now, the given decimal number 25.828125 is represented in binary as 11001.110101.

3. Binary to Decimal conversion:

Thesteps involved in converting a binary number into its equivalent decimal number are as follows.

Step 1: write down the binary number

Step 2: write down the weight (power 2) corresponding to each position in the binary number

Step3: Multiply each digit by its weight

Step4: Add all products

Example: consider the binary number $\mathbf{11011.101_{(2)}}$ which can be represented in decimal value.

$$\mathbf{1X2^4+0X2^3+1X2^2+1X2^{-1}+0X2^{-2}+1X2^{-3}}$$

Ans:

4.Decimal to Octal Conversion:

Thesteps involved in converting a Decimal into its equivalent octal number are as follows.

Step 1: Divide the given decimal number by 8

Step 2: Note the quotient and remainder.

Step 3: Repeat the step 1 and step2 until the quotient becomes zero.

Step 4: The first remainder will be the LSB and the last remainder is the MSB. The equivalent number is then written from left to right i.e., MSB to LSB.

Example: -Consider the decimal number $\mathbf{459_{(10)}}$

8	459		
8	57-remainder	1	~~LSD~~
8	7-remainder	0	
8	0-remainder	0	~~MSD~~

Therefore, $\mathbf{459_{(10)} = 713_{(8)}}$

5. Octal to Decimal Conversion:

Thesteps involved in converting an octal into its equivalentDecimal number are as follows.

Step1: write down an octal number

Step2: write down the weight (power of 8) corresponding to each position in the octal number

Step3: Multiply each digit by its weight

Step4: Add all products

Example: Find the decimal equivalent of **345**$_{(8)}$

$2X8^2+3X8^1+4X8^O+8^{-1}+6X8^{-2}$

The following table shows the weight age of the positional values of the octal number

Ans:

Therefore, $234.56_{(8)} = 156.71875_{(10)}$

6. Decimal to Hexadecimal conversion:

Thesteps involved in converting a Decimal into its equivalentHexadecimal number are as follows.

Step1: Divide the given decimal number by 16

Step 2: Note the quotient and remainder

Step 3: Repeat the above step 1 and step 2 until the quotient is becomes zero.

Step 4: The first remainder is the LSB and the remainder is the MSB. The hexadecimal number is written from left to right with MSB occurring first.

Example: - consider a decimal number $559_{(10)}$

16	559		
16	34 remainder	15	~~LSD~~▸
16	2 remainder	2	
16	0 remainder	2	~~MSD~~

Ans: Therefore **$559_{(10)}$ =22F $_{(16)}$**

7. Hexadecimal to Decimal Conversion:

Step1: Multiplyeach digit of the hexadecimal number by its positional weight.

Step2: Add all the products.

Example:-Consider a hexadecimal number **5AF.D $_{(16)}$** which can be represented in decimal values as:

$5X16^2+AX16^1+FX16^0+DX16^{-1}$

The following table shows the weight age of the positional values of the hexadecimal number:

Weights	16^2	16^1	16^0	16^{-1}
Digits	5	A	F	D
Values	256	16	1	0.0625

Therefore,

$5AF.D_{(16)} = 1455.8125_{(10)}$

8. Binary to Octal Conversion:

Binary to octal conversion is also simple process. *Here we have to break the binary digits into groups of three bits starting from the binary point and convert each group into its appropriate octal digit.* For whole numbers, it may be necessary to add zero as the **MSB** in order to complete a grouping of three bits.

(*Note that this does not change the value of the binary number, similarly when representing fractions. It may be necessary to add a trailing zero in the LSB in order to form a complete grouping of three).*

Example (1): Find the octal equivalent of **$010101_{(2)}$**

010 101

↓ ↓

2 5

Therefore**$010101_{(2)} = 25_{(8)}$**

Example (2): converting **$010111_{(2)}$** to octal

010=6 (MSB)

111=5 (LSB)

Thus, **$0.110101_{(2)} = 0.65_{(2)}$**

9. Octal to Binary Conversion:

The application of octal numbers is to represent binary numbers, as it is easier to read large numbers in octal form than in binary form. Each octal digit is represented by a three-bit binary number. Hence it is easy to convert form octal to binary.

Octal digit	**Binary digit.**
0	000
1	001

2	010
3	011
4	100
5	101
6	110
7	111

Example1: Consider the octal number $456_{(8)}$

4 ⟶ 100

5 ⟶ 101

6 ⟶ 110 Therefore $456_{(8)}$ **$=100101110_{(2)}$**

Example2: Consider the octal number $73.16_{(8)}$

7⟶ 111

3⟶ 011

1⟶ 001

6⟶ 110 Therefore **$73.16_{(8)} =111011001110_{(2)}$**

10. Binary to Hexadecimal Conversion:

The binary bits are grouped into four bits starting from the binary point and replace each group by a hexadecimal digit. For whole numbers, it may be required to add zero as the MSB to complete a group of four bits. Similarly, when representing fractions, it may be required to add a trailing zero as the LSB to complete a group of four bits. ***This addition of zeros will not change the value of the binary number.***

Octal digit	Binary digit.	Hexadecimal
0	**0000**	**0**
1	**0001**	**1**
2	**0010**	**2**
3	**0011**	**3**
4	**0100**	**4**
5	**0101**	**5**
6	**0110**	**6**
7	**0111**	**7**
8	**1000**	**8**
9	**1001**	**9**

The following table shows each hexadecimal number may be represented as a 4-digit number.

10	**1010**	**A**
11	**1011**	**B**
12	**1100**	**C**
13	**1101**	**D**
14	**1110**	**E**
15	**1111**	**F**

Example: *consider a binary number* $1011001_{(2)}$

$$\underbrace{0101}_{5} \qquad \underbrace{1001}_{9}$$

Therefore, $\mathbf{1011001_{(2)} = 59_{(16)}}$

Example: *consider a binary number* $\mathbf{0.11010111_{(2)}}$

$$\underbrace{1101}_{D} \qquad \underbrace{0111}_{7}$$

Therefore $\mathbf{0.11010111_{(2)} = 0.D7_{(16)}}$

11. Hexadecimal to Binary Conversion:

Each digit of a hexadecimal number is replaced by a 4-bit binary number.

Example: consider a hexadecimal number **CEBA** $_{(16)}$

C-----→12-----→1100

E-----→14----→1110

B-----→11----→1011

A-----→10---→1010 Therefore, **CEBA** $_{(16)}$ **=1100111010111010**$_{(2)}$

12. Octal to Hexadecimal conversion:

Using binary system, we can easily convert octal numbers to hexadecimal numbers and vice-versa.

Step 1: write the binary equivalent of each digit.

Step 2: Regroup into 4bits from the right side with zeroes added, if necessary.

Step 3: convert each group into its equivalent hexadecimal digit.

Example: Consider an octal number **274**$_{(8)}$

2----→010

7---→111

4---→100

Therefore, $274_{(8)}=010111100_{(2)}$

Group the bits groups of 4-bits as 010111100

0	1011	1100
0	B	C

Therefore, **$274_{(8)}$ =BC $_{(16)}$**

13. Hexadecimal to Octal conversion:

Step 1: Write the binary equivalent of each hexadecimal digit.

Step 2: Regroup them into 3-bits from the right side with zeroes added, if necessary.

Step 3: Convert each group into octal equivalent.

Example: Consider a hexadecimal number **FADE**$_{(16)}$

F----→15---→1111

A ---→10---→1010

D ---→13---→1101

E ---→14---→1110

Therefore**, FADE** $_{(16)}$=111101011011110$_{(2)}$

001	111	101	011	011	110
1	7	5	3	3	6

Therefore, **FADE $_{(16)}$ =175336$_{(8)}$**

BINARY ARITHMETIC AND BINARY SUBSTRACTION

Binary arithmetic addition rules:

Additional rules		
A+B	**Sum**	**Carry**
0+0	0	0
0+1	1	0
1+0	1	0
1+1	0	1

Examples of binary addition

1001010	**74**
+10011	**+19**
---------	**-------**
101101	**93**

101	5
+011	+3
1000	8
(Binary)	
(Decimal)	

1110	14
+1001	+09
10111	23
(Binary)	(Decimal)

Binary Subtraction:

Subtraction rules		
A-B	**Sum**	**Carry**
0-0	0	0
1-0	1	0
1-1	0	0
0-1	1	1

When we subtract a 1 from a 0, it is necessary to barrow 1 from the next left column.

Examples of binary subtraction:

101	5
-011	-3
010	2
(Binary)	(Decimal)

1110	14
-1001	-09
0101	05
(Binary)	(Decimal)

1001010	74
-10011	-19
0110101	53
(Binary)	(Decimal)

1's complement and 2's complement:

1's complement: The 1's complement of binary number is found by changing all the 1's to 0's and 0's to 1's.

Example (1): Find the 1's complement of 1100.

Given binary number=1100

1's complement of 1001=0011 (replacing all 0's by 1's and 1's by 0's)

Example (2): Find the 1's complement of 11111.

Given binary =11111

1's complement of 11111=00000

(Replacing all 0's by 1's and 1's by 0's)

2's complement: The 2's complement of a binary number is found by adding 1 to the 1's complement representation of that number. It is illustrated by the examples. Below.

Example (1): Find the 1's complement and 2's complement of 1001

Given binary number =1001

1's complement of 1001 =0110 (replacing all 0's by 1's and 1's by 0s)

2's complement of 1001 =0110

+1

0111

Therefore, 2's complement of 1001=0111

Example (2): Find the 1's complement and 2's complement of 101001.

Given binary number =101001

1's complement of 101001 =010110 (replacing all 0s by 1's and 1s by 0s)

2's complement of 101001=010110

+1 (add 1 to 1's complement)

010111

Therefore, 2's complement of 101001 =010111

Computer codes:

Computer Codes: Computer codes help us to represent characters in a coded form in the memory of the computer. These codes represents specific formats which are used to record data. Coding techniques are:

- BCD
- EBCDIC
  ASCII
- Excess-3

BCD Code:BCD(**Binary code decimal**) was an early and widely used code. In this each digit of a decimal number is independently converted to *4-bit binary number*.

ASCII Code:ASCII(American Standard Code for Information Interchange)

Computer handles numeric and alphanumeric data, alphanumeric data is a combination of numeric and the text values. To represent alphanumeric data in the computer, *ASCII is used in most microcomputers and minicomputer*. ASCII code is 7-bit code which means it can store $2^7 = 128$ code groups, which is sufficient to represent all the characters on keyboard.

EBCDIC Code:(Extended Binary Coded Decimal Interchange Code)
ASCII can represent 128 characters. So to represent **256 characters** in the keyboard EBCDIC is used. This coding scheme was developed by IBM, used in main frames. This coding scheme follows 8-bit code.

Excess-3 Code: Excess-3, also called XS3, is a non-weighted code used to express decimal numbers. It is another important binary code. The name excess-3 code derived from the fact that each binary code is the corresponding BCD code plus $0011_{(2)}$(i.e., decimal3).It is particularly significant for arithmetic operations as it overcomes the short comings encountered while using the 4-bit BCD code to add 2 decimal digits whose sum exceeds 9. *This code used in some old computers.*