Computer Science

Grade: XI

UNIT-1: Computer System

- Introduction of Computer
- Computer System and I/O devices

Reference Note

Unit Wise Important Questions for Computer Science XI

Unit 1 Computer System

1. ***What is Generation of computer? Explain briefly about different generation of computer.***
2. What is computer? Explain characteristics of computer.
3. What are the application fields of computer? Explain in brief.
4. Why computer in known as versatile and accurate machine? Explain
5. ***Differentiate between 3G and 4G computer.***
6. ***Explain the application areas of computers.***
7. List out the merits and demerits of computer.
8. ***Differentiate between Analog and digital computer.***
9. ***Differentiate between Micro and Super Computer.***
10. ***Differentiate between IBM Compatible and IBM Computer.***
11. What is super computer? Explain its application in real time situations.
12. Differentiate between RAM and ROM.
13. ***Differentiate between impact and Non-impact printer.***
14. Differentiate between primary memory and Secondary memory.
15. ***Differentiate between CRT and LCD***
16. Differentiate between CD and DVD.

17.) Define software. Explain the different types of software in detail.

18.) Explain the functions of CPU.

19.) What is bus? Explain its types with clear diagram.

20.) What is virus? What are the symptoms of virus? Write its examples.

21.) Write Short notes on:

a. Cache Memory **b*) Virtual Memory*** **C**) Buffer **d) *Microprocessor***
e) Hard disk ***f) Input device*** ***g) Dot-Matrix printer*** h) interface or Port
i) ***Charles Babbage*** j) Lady Augusta Ada k) ***J.V. Neumann***
l) Mark I m) ***Napier's bone*** n) ABC **o) *UNIVAC*** p) EDVAC q) Howard Aiken
r) Hybrid computer s) ***Personal computer*** t) Mainframe computer

Concept of computer

The word computer is derived from the Latin word 'computare' which means to calculate or the word computer is comes from the English word 'compute' which means to calculate. So that computer is a calculating device.

Introduction of Computer

The word "Computer" is derived from the Latin word "Computare" which means 'to calculate'. Nowadays, computer has become an indispensable part of our life. Computer is used in various places like: home, school, college, offices etc. Computer can perform complex mathematical calculations accurately in a short period of time. The modern computer has lots of capabilities like creating documents, videos, games, music presentation, etc. It can use AI (Artificial Intelligence) for understanding natural language, taking self-decision capabilities, analyzing graphs and patterns, etc.

- *A computer is an electronic device that accepts raw data and instructions from users; processes it according to the given set of instructions, stores and gives meaningful information.*

- Computer is an electronic device that accepts raw data and instruction, store it, process it and produce meaningful information.
- Computer is an electronic device that receives raw data and instruction, store it, process it according to the given set of predefined instructions and them gives the meaningful information as a result.
- A computer can be defined as a multipurpose, programmable, electronic data processing device that is capable of accepting input (data), processing it and producing a refined data (information) output at high speed.
- Computer is an electronic device which can perform computation as well as logical action at high speed.
- Computer is a high speed electronic digital data processing device.
- Computer is a multi-tasking programmable electronic machine which performs the calculations and processes information with very high speed.

Computer Means

- ✓ *C*= Commonly
- ✓ *O*= Operating
- ✓ *M*= Machine
- ✓ *P*= Purposed by
- ✓ ***U*=** Unlimited
- ✓ ***T*=** Technology for
- ✓ ***E*=** Education and
- ✓ ***R*=** Research

Working of a computer/General function or Basic Operation of Computer

1. ***Inputting:*** It is the process of entering data and instruction into computer system.
2. ***Processing:*** It is the process of performing arithmetic and logical operation.
3. ***Storing:*** It is the process of saving or holding data, information and programs for future use.
4. ***Outputting:*** It is the process of producing useful information as a result.

Some basic terms

1. **Data:** It is the collection of raw facts and figures about a person, place, and things etc. which can be recorded in the form of text, number, sound or image. Example, ram, 102, male etc.
2. **Instruction:** It is a command given to the computer to do s specific task.
3. **Information:** It is the processed form of data which we get in the required form. So it is very meaningful and useful to us.
4. **Process:** Processing is the conversion of inputted data into output (information) which is done by the processing unit of the computer.
5. **Program:** Program is set of instructions to perform specific task in a computer, a component of software.
6. **Software:** Software is the collection of computer programs to perform special work in a computer. Software tells the computer how to do and what to do.
7. **Hardware:** It is the physical parts of computer system which can be touch, felt and seen.
8. **Input:** It is data and instruction entered into computer for processing.
9. **Output:** It is called result or information.
10. **Memory device:** The device which is used to store data, instruction and information (temporarily or permanently) is called memory device. Examples are RAM, ROM, Hard Disk, Pen drive etc.

Characteristics of a Computer / Features of Computer

A computer is powerful and useful in all areas. The use of computer is increasing with time. The main features or characteristics of computer are described below:

1. Automatic

A computer is an automatic device. It can do tasks automatically as instructed by software. It can automatically control various devices attached with computer system.

2. Speed

The calculation in the computer is at very high speeds. For example, a micro-computer can perform millions of instructions per second as many times without any mistake. The speed increases, as the power of computer increase. For example, a super computer can operate at speed measures on nanoseconds and even picosecond.

A computer performs tasks accurately. The operations on data in computer are performed through electronic circuit according to given instructions. Computer can perform millions and billions of operations on data within a second. The speed of computer is measured in MegaHertz (MHz) or GigaHertz (GHz). The time taken to perform a task is measured in fraction of second.

Unit of Time	Meaning	Part of Second	Power of 10
Millisecond (ms)	One thousandth of second	1/1000	10^{-3}sec.
Microsecond(us)	One millionth of second	1/1,000,000	10^{-6}sec.
Nanosecond(ns)	One billionth of second	1/1,000,000,000	10^{-9}sec.
Picosecond (ps)	One trillionth of second	1/1,000,000,000,000	10^{-12}sec.
Femtosecond (fs)	One quadrillionth of second	1/1,000,000,000,000,000	10^{-15}sec.

3. Accuracy

A computer performs tasks accurately. If data and instructions given to the computer are correct then it gives an accurate output. It means output totally depends on the given instructions and input data. If input data is incorrect then the output will be incorrect which is called GIGO (Garbage in Garbage out).

4. Storage:

Computer system consists of data storage unit. A computer has main storage and secondary storage. A large amount of data can be stored in secondary storage like hard disk, pen drive, CD/DVD, etc. for future use. The main memory (RAM) stores currently used data. Computer stores data in term of 0 and 1.

0 or 1	1 Bit
4 bits	1 Nibble
8 bits	1 Byte
1024 bytes	1 Kilobytes (KB)
1024 Kilobytes	1 Megabyte (MB)
1024 Megabytes	1 Gigabytes (GB)
1024 Gigabytes	1 Terabytes (TB)
1024 Terabytes	1 Petabyte (PB)
1024 Petabytes	1 Exabyte (EB)
1024 Exabyte	1 Zetta byte (ZB)
1024 Zetta byte	1 Yotta byte (YB)
1024 Yotta byte	1 bronto byte (BB)

5. Diligence

A computer can continuously work for a long time without losing its speed and accuracy. So it is called diligent device. It doesn't get tired or bored or lazy while working.

6. Versatile

A computer is a versatile device which means it is flexible. It has capability of performing different types of tasks like drawing paints, playing games, music, calculations, sending an e-mail, desktop publishing work, etc. in different field efficiently. So it is used in different fields to perform varieties of tasks.

7. Reliability

Computers are used widely as they are reliable. The computer never gives the wrong result as long as the input is given correctly. The probability of error in the computer is negligible. A Huge amount of verities of data like monetary transaction, banking account, personal information is stored in a computer with the strong reliability to the computer.

Advantages and disadvantages of computer

Advantages/ Capabilities/ Benefits/ Merits

1. The computer can perform a complex operation in a short time.
2. The computer can process a large volume of data.
3. Computer can work continuously for a long time
4. A single computer can perform multiple tasks such as watching a movie, playing games, listening song and others.
5. The computer does not make a mistake.
6. Computer increases the curricular performance of the student.

Disadvantages/Limitations/ Drawbacks/ De-merits

1. The computer does not have a brain and cannot decide itself.
2. It does not have its own intelligence.
3. The computer does not have emotion and feelings.
4. It needs electricity to operate.
5. It cannot operate itself, unless, a human command is given.

Application of computer

A computer is given great importance in every field of work. Nowadays, it is impossible to find where computer are not used. Computer and its technology are used in education, agriculture, industries, banking, engineering, scientific research and many more. The main applications of computer are described below.

1. Home
2. Education
3. Industry
4. Business
5. Bank
6. Communication
7. Health and Medical Field

8. Computer In Graphics
9. Desktop publishing
10. Scientific Research
11. Defense
12. Entertainment

Application of computer

Computers at Home

Computers have already changed our lives at home. New gadgets such as automatic washing machines, dishwashers and microwaves have made our lives easier. Many of the educational software programs are used by children at homes. These programs enrich students' knowledge and skills. Encyclopedia, dictionaries, telephone directories and medical references are now available in optical disk which contains multimedia capabilities. Internet connections also provide electronic mail, discussion groups, and other communication options for home users. Apart from learning, computers also offer a new form of entertainment. They are used for playing computer games.

Computers in Education

Computers are used as teaching aids, research tools and analyzing systems in educational institutions. Teachers use computers to organize and prepare course materials. Teachers may use pictures, graphs and graphical presentations to easily illustrate a difficult concepts. Nowadays more and more educational institutions are using computer-assisted instruction systems. It offers interactive instruction on a one-to-one basis and can be automatically modified to suit the user's level of ability. Educational software has become a major influence at all levels from elementary schools to universities. Elementary and secondary schools are using computers to play multimedia educational programs and to teach kids to explore the Web for information. A computer's voice recognition capabilities and its connection to the Internet makes it possible for distance learning.

Computers in Medicine

Computers have played very important roles in the growth and improvement of health care. They are used in medicine to keep the records of patients' case-histories, diagnosis and treatment of diseases. They are also used to monitor vital data during surgery in the operating theatre. They provide a complete, accurate, up-to-date and readily available source of information about patients' health. Many medical scanners for exploring inside the body only work because of computer power. They are also used to monitor the availability of bed, staff payroll, hospital accounting, patient billing, drug inventory and location of doctors and patients in large hospitals. They have reduced the barriers of distance and time via telemedicine and
on-line access to laboratory test results and medical researches.

Computers in Government

Computer is also used by the government to collect, process and store vast amounts of information. The web sites of the different government departments provide information to the users. It is used for the filing of income tax return, paying taxes, online submission of water and electricity bills, for the access of land record details, etc.

Computers in Industry

Modern factories and industries cannot work without computers. They control huge numbers of machines, especially robot-type devices for creating, assembling and testing products and their components. Computers also help humans to control complex machines, such as power stations, ships and space crafts. Rows of levers and switches can be replaced with computers that take care of routine tasks automatically. This leaves the human operator free for more important decisions. Many industries now use Computer Aided Design (CAD) to develop products and Computer Aided Manufacturing (CAM) to produce them. Computers are used for inventory control, planning and process control.

Computers in Law and Order

Computers are used by lawyers to research and store volumes of cases and judicial proceedings in the computer. Law enforcement agencies from local police to international organizations use computers to store information about criminals and suspected criminals. Minute details of speech intonation, physical characteristics, criminal habits and finger prints can be matched for accurate detection through computers.

Computer systems are used in conjunction with video cameras to provide internal surveillance and to ensure the safety of prisoners and officers.

Computers in Entertainment

Computers have now become an important part of the entertainment industry. They are widely used to create special effects in movies. They are used in editing movies and multimedia presentations. They help in composing, editing, recording and reproducing music and sound effects. They are used in sports to analyze the movements of sports persons and to find faults in the movements and optimize the movements so that maximum efficiency is achieved. They are used by sports professionals to analyze their techniques to find their strengths and weaknesses. They are used to simulate games and to try out different game strategies.

Computers in Banks

The banking business has been revolutionized by computer technology. They are used for various tasks such as online enquiry of customer's balance, cheque verification, updating the balance, calculating interests and printing customer statements. Many leading banks have installed Automated Teller Machines (ATMs). These enable the customers to draw money from accounts, transfer money, obtain bank statements, etc. All these can be done using a special plastic card which is inserted into the input device of a computer. This also eliminates the need for a clerk. The list of applications of computers is so long that it is not possible to discuss all of them here. In addition to the applications of the computers discussed above, computers have also proliferated into areas like investments, stock trading, accounting, ticket reservation, military operations, meteorological predictions, social networking, business organization, police department, video conferencing and book publishing.

Evolution of computer

Evolution of computer is a study of past development of computer i.e. it is meant by the gradual improvements of accuracy, speed and efficiency of computers through generations, whereas generations of computers may be defined as the development of computer in an average period of time in which old computer technology may be replaced by newer technology.

Ancient people lived on the earth for centuries without counting. Then, they started to count their ten figures. It became so difficult to live and to remember anything. These phenomena were gradually replaced by the use of stones, counting notches on sticks or marks on walls. The different generations are described below which has helped the humans for keeping records with the passing of time.

1.) The Mechanical Era (Zeroth generation)

The calculator of this age was developed by using mechanical components like wood, metal, stone, bone, etc. It was used for simple mathematical calculations. Some of the popular calculations used in this ages are:

- **Abacus**

In ancient period, it was used to calculate mathematical calculation. Abacus is considered as the **first calculating device.** It was developed by Chinese and Egyptians around 3000 BC. It was used for performing simple calculation like counting, addition, subtraction and multiplication of number. An abacus consists of a rectangular frame carrying a number of wooden rods. Mid-bar divides each of these rods in top unequal -upper and lower parts.

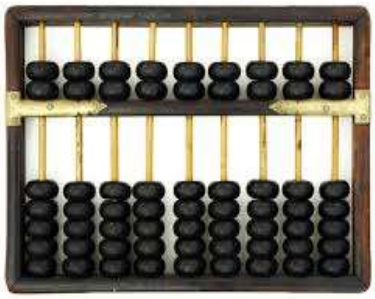


Fig: Abacus

The upper part is called heaven, whereas lower part is called earth. The heaven consists of two beads, whereas the earth part consists of five beads to each rod. The value of bead on heaven part is five and earth is one. Each abacus consists of nine or eleven or thirteen rods.

- **John Napier (1550-1617 AD)**

THE SCOTTISH mathematician John Napier first published the table of logarithms in 1614 AD. It was very used and consists of a large number of calculations.

He invented bone rods and used bones to demonstrate by subtracting and multiplication by addition according to his principle. These are made of strips of bones on which numbers were carved and painted that`s why it is also called **Napier's bone.**

Fig: Napier bone

- **William Oughtred (1575-1660AD)**

Slide Rule was developed by an English mathematician William Ought red in 1620 AD. It is considered as the **first analog device.** It consists of two sets of scales overlapping together with marginal space between them. The rules were slide together for calculating. It is used for performing multiplication and division using the method of addition and subtraction.
It is a rectangular device-**slide-rule.** It was a calculating device based on the principle of a log. A rule consists of two graduated scales, one of which slips upon other. It is devised in such a way that suitable alignment of one scale against the other makes it possible to find products and quotient of any numbers.

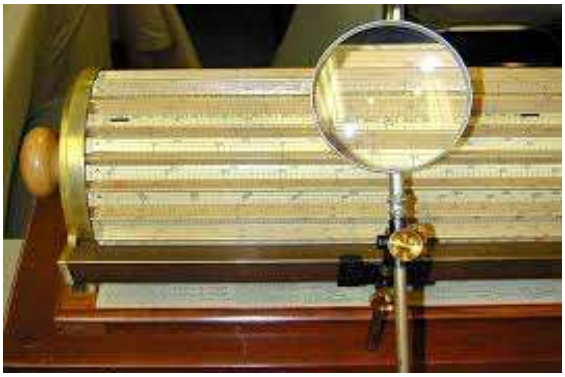


Fig: Oughtred ruler

- **Blaise Pascal (1623-1662AD)**

The man name Blaise Pascal, was a brilliant mathematician and religious thinker. Pascal made a mercury barometer and measured atmospheric pressure to assist his father in his work accounting. Pascal invented the **first mechanical calculation machine** in Paris. It could only do addition and subtraction with numbers being entered by manipulating its dials.

Fig: Pascal Calculator

It has a complex arrangement of wheels, gears and dials. It was operated by a series of dials attached to the wheels that had the numbers zero to nine on their circumference. One once complete turn of a wheel, it was advanced to the wheel to the left of it. It is also known as **Arithmetic Machine** or **Adding Machine**.

- **Baron Gottfried Wilhelm Von Leibniz (1646-1716AD)**

He develops a new method of calculation called **'Calculus'**. The concept of Pascaline was used for developing this machine. So Stepped Reckoner is considered as the advance version of pascaline. This machine was able to perform addition, subtraction, multiplication and division. But could find out square root. Each with nine teeth of varying lengths instead of wheels it was called **'Leibniz Calculator'** or **'Stepped Reckoner'.**

Fig : Leibniz Calculator

- **Joseph Marie Jacquard (1752-1834 AD)**

The french man, Joseph Marie Jacquard, was a textile manufacturer who invented a mechanism for automated weaving clothes for the textile industry at Lyon, in 1802 AD. This machine was used to automatically control weaving looms to facilitate the production of weaving cloth with complex patterns.

Fig: Jacquard loom

This was an automatic weaving machine. This machine was useful for weaving the patterns on the textiles. Punched cards were used to intricate design and produce the pattern in woven clothes.

- **Charles Babbage (1791-1871 AD)**

The English Professor and Mathematician, Charles Babbage, invented the **Different Engine** at Cambridge University, in 1822 AD. This machine can solve differential equations and calculate various mathematical functions. Charles Babbage contribution was one of the most significant milestones in the development of the modern digital computers. He developed the first mechanical computer called **difference engine.** It is capable of computing several sets of numbers and making hard copies of the results. Due to a lack of funding, he was never able to complete a full-scale functional version of this machine. It is also called **"Analytical Engine ".**

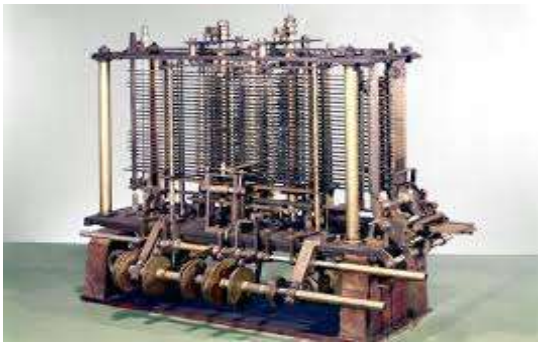


Fig: Analytical engine

Charles Babbage designed another machine named analytical engine that could be programmed to solve particular problems. The Analytical Engine was to be a general-purpose, **fully program-controlled, automatic mechanical digital computer.** It would be able to perform any calculation set before it. The

machine was designed to consist of four components: the mill, the store, the reader, and the printer. These components are the essential components of every computer today. The mill was the calculating unit, analogous to the central processing unit (CPU) in a modern computer; the store was where data were held prior to processing, exactly analogous to memory and storage in today's computers; and the reader and printer were the input and output devices. So, Charles Babbage is considered as **Father of Modern computer.**

- **Lady Augusta Ada Byron Lovelace (1515-1852 AD)**

The English intelligent and independent-minded woman, Lady Augusta, was a daughter of English poet Lord Byron and a very Great follower, assistant of Charles Babbage. Lady documents Babbage`s work and writes programs for Babbage.

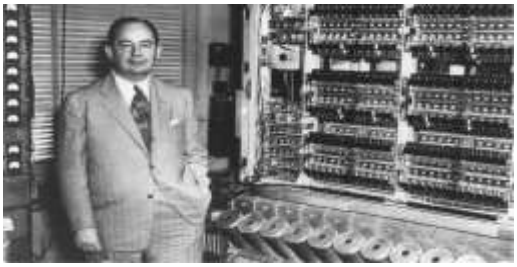
This plan is now regarded as the **first computer program.** That`s why, she was considered the first computer programmer and a software language developed by the US Defense Department, was named **Ada** in her honor.

- **Herman Hollerith (1860-1929 AD)**

An American Inventor, Herman Hollerith, also applied the Jacquard loom concept in computing and applies for patents for an automatic punch-card tabulating machine. He invented a machine knows as " **Tabulating Machine ".** This device could process on the punch cards and perform **census calculating faster** than ever before.

- **John Von Neumann (1903-1975 AD)**

The Hungarian Mathematician, John gave an idea of stored program computer in the sense that program is stored internally in the main memory of the computer along with its associated data, in 1945. So, he is called the **"Father of Stored Program".** Before that, program required for the computer were integrated and written permanently in chips. So, modification of program was not possible. But, after Neumann, such programs were stored on a computer in some storage media, so modification was easy and flexible.



2.) **The Electro-Mechanical Era**

The calculator of this age was developed by using mechanical and electronic component **vacuum tube**. Successful **general purpose mechanical computers** were built, in the 1930s. Konrad Zuse developed mechanical computer, the Z1, in 1983 in Germany.

- **The Mark I Computer (1937 - 1944)**

A Professor of Physics, Howard H. Aiken designed a **general purpose mechanical computer** at Harvard University and IBM Automatic Sequence Controlled Calculator (IBM ASCC). It was the **first fully automatic calculating machine** and later as Harvard Mark I.

It used binary numbers for its operation. Later, Mark II was invented by Aiken and his colleagues that were working electromechanical relays for its operation. Mark I used 18000 valves.

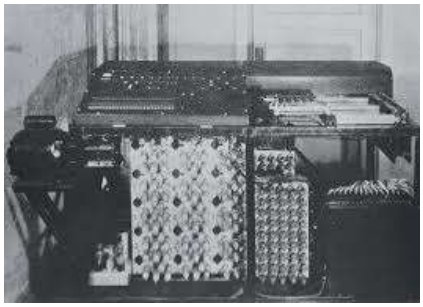
The Harvard Mark I could perform four arithmetic operations and had built-in programs for processing logarithms and trigonometric functions. The Mark I received instructions on paper tape and loaded data output on punch cards.

- **The Mark II Computer**

It used about 18 thousand vacuum tubes as the main memory device with 7 lakes 50 thousand parts. It is 51 feet long, 8 feet height and 3 feet wide as bulky in size. It was capable of performing five basic arithmetic operations; additions, subtraction, multiplication, division and table reference. **The result was printed at the rate of one result per five seconds.**

- **The Atanasoff-Berry Computer (1939 - 1942)**

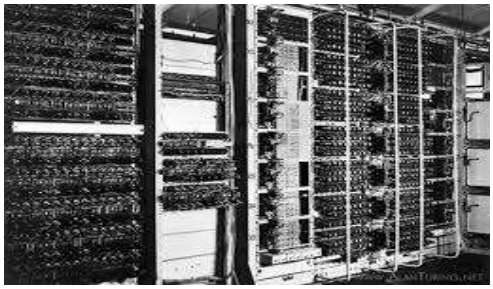
In 1939, John Vincent Atanasoff and Clifford Berry designed Atanasoff-Berry computer or ABC solving systems of mathematical simultaneous equation. This computer was **first electronic digital computer** and was the **first machine to use vacuum tubes.** It used 18000 valves and other 45 valves for internal logic and capacitors for storage.



It used punch cards as input and output operation i.e secondary. It is considered as the first computing machine which introduced the **idea of binary arithmetic**, **regenerative memory and logic circuits.**

- **The Colossus (1941 - 1944)**

In 1944, Colossus computer is designed by Alan M. Turing and build by British mathematician Alan Mathison Neuman, Alan with some colleagues, creates a computer named colossus at the University of Manchester, England, which comprised 1800 vacuum tubes.



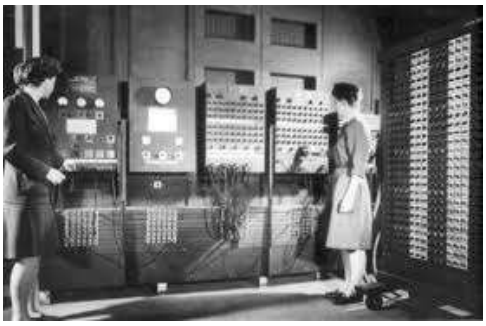
It was one of the world's earliest working **programmable electronic digital computers.** Colossus was a special purpose machine that suited a narrow range of tax (for example, it was capable of performing **decimal multiplication**).

- **The Electronic Computer Era**

The computers of this age are developed by using electronic components like a vacuum tube, transistors IC, VLSI, etc. These computers are smaller, faster and more reliable.

- **The ENIAC (1943-1946)**

In 1946, John W. Mauchly and J.presper Eckert constructed ENIAC (Electronic Numerical Integrated and Calculator), at the Moore School of Engineering of the University of Pennsylvania. USA ENIAC was the first popular **general purpose all electronic digital computers**. John Von Neumann was the consultant of the ENIAC project.



It was a very large machine weighing about 30 tons and containing about 17,468 vacuum tubes, 70,000 resistors, 5 million soldered joints and it consumed 160 kilowatts.

- **The EDVAC (1946-1952)**

EDVAC (Electronic Discrete Variable Automatic Computer) was developed by Dr.John Von Neumann,and a member of the Moore School of Engineering of the Unversity of Pennslyvania,J.P Eckert, and J.W Mauchly. The EDVAC is used for more school personnel and the Ballistics Research Laboratory of the US Army,which was based on **John Von Neumann`s ideas of Stored Program".**

- **EDSAC (Electronic Delay Storage Automatic Calculator):**

EDSAC was the **first full sized stored program computer** built at the University of Cambridge by the group of scientist. It was build according to the John Von Neumann principles of stored program. The input and output were provided by the paper tapes. It could do about 700 addition and multiplication per second. The machine occupied a room with 5/4 meters.

- **The UNIVAC (1951)**

UNIVAC (Universal Automatic Computer) was developed by J.P.Eckert and J. Mauchly in 1951. It was the **first computer manufactured for commercial use and general purpose digital computer**. It was designed to handle both numeric and textual information. Before this, all the computers were either used for defense or census was by General Electrical Corporation in 1954.

Generation of Computers

Computer generation is the classification of computers into different groups according to their manufacturing date, memory device, and other hardware and software technology used inside those computers. Generation of computer is a step in developing (advancing) technology.

The classification, time periods and main device are given below:

Generation	***Time Duration***	***Memory device used***
First	1945-1955	Vacuum tubes and valves
Second	1957-1963	Transistor
Third	1964-1971	ICs
Fourth	1972 onward	VLSI or Microprocessor
Fifth	Present and future	Bio- chips

Summary table of computer generation:

Features	**First**	**Second**	**Third**	**Fourth**	**Fifth**
Electronic Device	Valve/ Vacuum tube	Transistor	IC	Microprocessor	Bio-Chips
Speed	Milli Second	Micro Second	Nano Second	Pico Second	More than femto second
Internal Memory	Valve	Magnetic core	Semi Conductor	Semi Conductor	Super conductor
Permanent Storage	Punched Cards	Magnetic Tapes	Magnetic Disk(FDD)	Magnetic and Optical Disks (HD,CD,DVD, Pen Drive)	New Technology for storage
Computer Language	Fully Machine	Assembly and little bit of High	Fully High Level	High Level and 4GL	Natural Language
Cost, Size, Electrical consume, Heat generate	Very High	High	Low	Very Low	Not Known
Speed, Capability	Very less	Less	Moderate	High	Much higher
Examples	ENIAC, EDVAC, EDSAC, UNIVAC	IBM 7000, IBM 1401, IBM 1620, NCR 304, MARK III, ATLAS	PDP-8, PDP-11, ICL 2900 series, IBM 360, IBM 370	Apple Macintosh, IBM PC	Robert

1.) First Generation Computer (1945-1955)

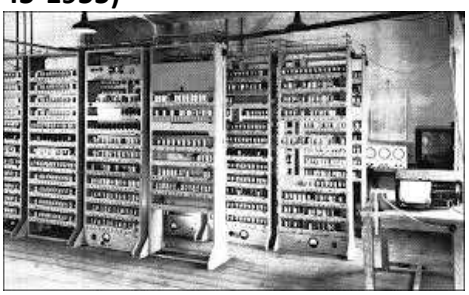


Fig: First Generation Computer

Features of first generation computers:

- Technology used: vacuum tube
- Machines languages were used to instruct the computer.
- Magnetic core memory was used as primary memory.
- Electrostatic tubes, Paper tape, punch card, magnetic tape
- Punched card, printing devices were used for input/output operations and store the result.
- It occupies very large space, slow processing, inefficient and unreliable due to low accuracy.
- Power consumption was very high and it generated much heat.
- It could only perform straight forward simple numerical calculation.
- Computer used to be much expensive.

The example of first generation computers is ENIAC, UNIVAC, EDVAC, and EDSAC.

2.) Second Generation Computer (1957-1963)

Fig: Second Generation Computer

Some of its features are:

- Technology used: Transistor
- Operating speed was in terms of a microsecond.
- Assembly language and machines independent language such as COBOL (Common Business Oriented Language) and FORTRAN (Formula Translation) were introduced the size of the computer.
- Magnetic core memory was used as primary memory.
- Magnetic drum and magnetic tape were used as secondary memory.
- Power required to operate them was low.
- It could perform scientific calculation such as solving differential equations.
- Storage capacity and use of computers are increased.

3.) Third Generation Computer (1964-1971)

Fig: Third Generation Computer

Features of the third generation computers are:

- The technology used: IC (Integrated Circuit).
- Transistors were replaced by IC in their electronic circuitry.
- High-level languages like FORTAN, BASIC and other are used to develop programs.
- Semiconductor memory like RAM and ROM were used as primary memory.
- Monitor and keyboard were introduced for data input and output respectively.
- Multiprogramming facility was developed.
- The computer was used in census calculation, military, banks and industries.
- Size, cost, power requirement and heat generation decreased.
- Processing speed and storage capacity used of computer increased.

4.) Fourth Generation Computer (1972 onward)

Fig: Fourth Generation Computer

The invention of microprocessor chip marked the beginning of the fourth generation computers. Semiconductor memories replaced magnetic core memories. The invention of microprocessors led to the development of microcomputer or the personal computer.

The first microprocessor called ***Intel 4004*** was developed by American Intel Corporation 1971.

Features of the fourth generation computer are:

- Technology in use: VLSI is introduced and used Microprocessor-based technology.
- Problem-oriented fourth generation language (4GL) is used to develop the program.
- Semiconductor like RAM, ROM and cache memory is used as a primary memory.
- Magnetic disks like hard disk, optical disk (CD, DVD), Blue-ray disk, flashes memory (memory chip, pen drive) are used as secondary memory.
- E-mail, Internet and mobile communication are developed.
- Advanced, user-friendly, web page software are developed.
- Size, cost, power requirement, heat generation decreased compared to the previous generation.
- Operating speed, storage capacity ,use of computer increased compared to the previous generation

The example of the fourth generation computer is IBM-PC, HP laptops, Mac notebook etc.

5.) Fifth Generation Computer (Present and future)

Fig: Fifth generation Computer

The aim is to bring machines with genuine IQ, the ability to reason logically and with real knowledge of the word. Thus, this computer will be totally different, totally novel and totally new than last four generations of computer.

Fifth generation computer was based on Artificial Intelligence (AI) and that is still developing process, but not yet a reality i.e this computer is incomplete. The scientists are working on it still.

These computers will be able to converse with people and will be able to mimic human sense, manual skills, and intelligence.

Features of the fifth generation computers are:

- Technology to be used: These machines will incorporate Bio-chip and VVLSI (Very Very Large Scale Integration) or Ultra-Large Scale Integration (ULSI)
- The computer will have Artificial Intelligence (AI).
- Natural language will be used to develop programs.
- The computer will have parallel processing in full fledge.
- The operating speed will be in terms of LIPS(Logical Inference per Second)
- This aim is to solve highly complex problems, which require great intelligence and expertise when solved by people.
- Quantum computation, molecular and nanotechnology will be used completely.

AI (Artificial Intelligence):

- It is a branch of computer science which concerned with programs that solves and analyze problems intelligently.
- Artificial intelligence is the science of making machines imitates human thinking and behavior.

Measurement unit processing speed and storage unit

Computer Speed

A computer is a very fast device. Inside the system unit, operations occur through electronic circuits. When data, instructions and information flow along these circuits, they travel at the speed of light. It can perform a task in a minute that may take days if performed manually. A modern computer can execute millions of instructions in one second.

Unit of Time	Meaning	Part of Second	Power of 10
Millisecond (ms)	One thousandth of second	1/1000	10^{-3}sec.
Microsecond(us)	One millionth of second	1/1,000,000	10^{-6}sec.
Nanosecond(ns)	One billionth of second	1/1,000,000,000	10^{-9}sec.
Picosecond (ps)	One trillionth of second	1/1,000,000,000,000	10^{-12}sec.
Femtosecond (fs)	One quadrillionth of second	1/1,000,000,000,000,000	10^{-15}sec.

Measurement Unit

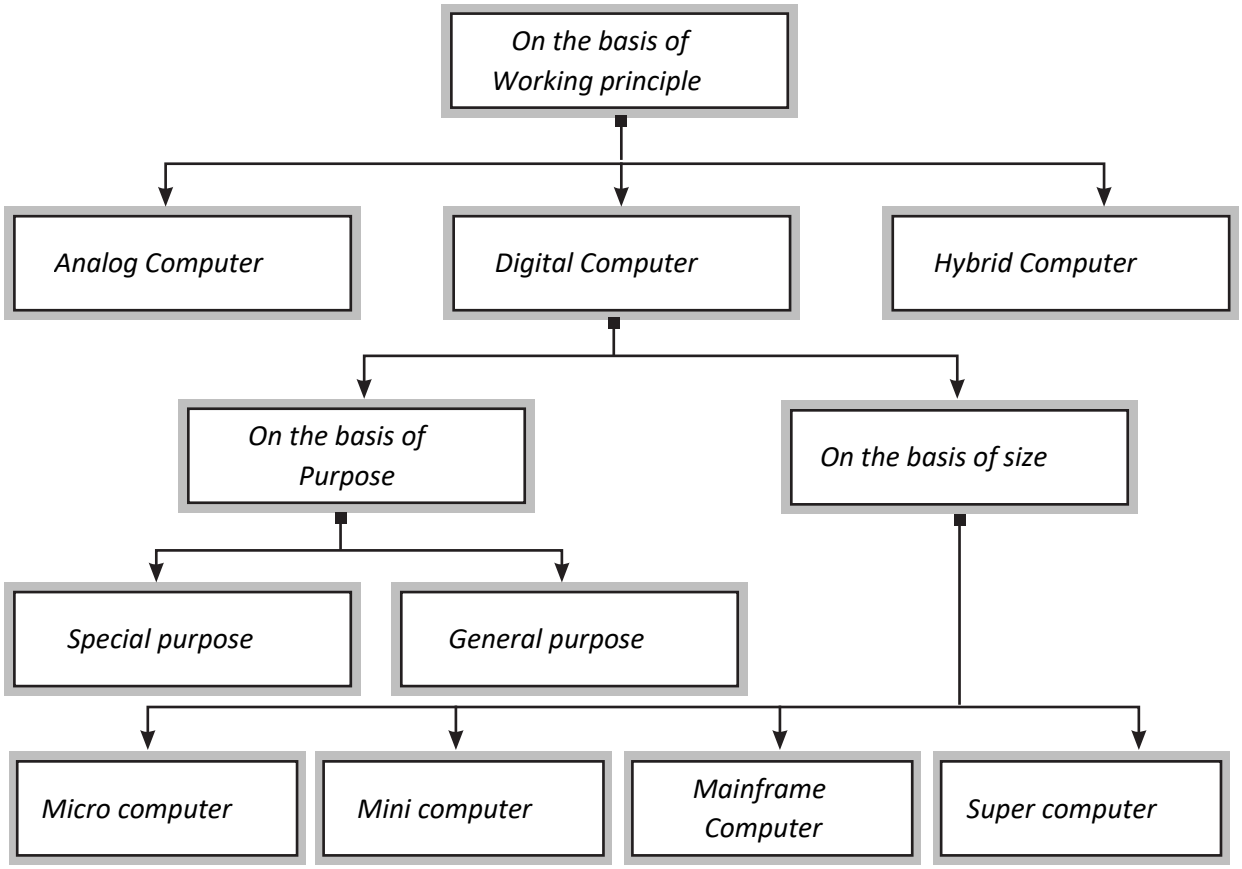
The memory of a computer is divided into section, or cells, that each holds an equal amount of data. Each of these cells contain one bit of information, i.e., each cell contains a 0 or a 1. The symbols 0 and 1 are together called binary digits or BITS. It is the smallest unit of information handled by a computer. A combination of bits is used to store instructions and data in the computer memory. They are called nibbles, bytes, words depending on the number of bits they have.

Data Storage Units Chart: From Smallest to Largest

Unit	Shortened	Capacity
1 Bit	B	1 or 0 (on or off)
1 Nibble	-	4 bits
1 Byte	B	8 bits
1 Kilobyte	KB	1024 bytes
1 Megabyte	MB	1024 KB
1 Gigabyte	GB	1024 MB
1 Terabyte	TB	1024 GB
1 Petabyte	PB	1024 TB
1 Exabyte	EB	1024 PB
1 Zettabyte	ZB	1024 EB
1 Yottabyte	YB	1024 ZB

1.4 Classification of Computer

Classification of Computer	
On the basis of Purpose	***On the basis of Size***
➢ *General Purpose Computer*	➢ *Super Computer*
➢ *Special Purpose Computer*	➢ *Mainframe Computer*
On the basis of Working principles	➢ *Mini Computer*
➢ *Analog Computer*	➢ *Micro Computer*
➢ *Digital Computer*	✓ *Desktop*
➢ *Hybrid Computer*	✓ *Laptop*
On the basis of Brand	✓ *Handheld*
➢ *IBM PC*	***On the basis of Model***
➢ *IBM Compatible PC*	➢ *XT Computer*
➢ *Apple/Macintosh Computer*	➢ *AT Computer*
	➢ *PS/2 Computer*



Classification of Computer

On the basis of purpose

1. **General Purpose computer**
   A **general-purpose computer** is a description of a computer capable of performing many different tasks rather than a specific one like a special-purpose computer. For example, the computer you're using now to read this web page is a general-purpose computer. In addition to browsing the Internet, you can play a game, write a letter in a word processor, and other tasks.
2. **Special Purpose computer**
   A special-purpose computer is embedded in almost all electronic devices and is the most widely-used computer. This computer is designed for a specific task and is found in ATMs, cars,

microwaves, TVs, the VCR, and other home electronics. See our special-purpose computer page for further information and examples.

S.N.	Special Purpose Computer	S.N.	General Purpose computer
1	They are called single task.	1	They are also called multi task computer
2	The program is installed at the time of manufacturing in it.	2	Programs are installed later on as per the requirement of user.
3	A user cannot install program in it.	3	A user can install different programs according to their needs.
4	Programs are permanently stored.	4	Programs are temporary in the memory.
5	It is comparatively faster than general purpose computer.	5	It is comparatively slower than special purpose computer.
6	Example: Washing machine	6	Example: Microcomputer.

On the basis of Work:

1) Analog Computer:- Analog computer is one which operates on continuous data, usually of a physical nature such as length, voltage or current, etc. An analog machine is usually a special purpose device dedicated to a single task. Analog computers are based on analog signals that are continuous signals. These types of computers were widely used in scientific and industrial applications. These are used in a hospital to measure the size of the stone in kidney and mental diseases diagnostics.

Analog computer works by measuring rather than counting. It is usually used for scientific work rather than personal purpose and commercial use so it is special purpose computer. It is powerful in solving differential equations.

Characteristics of analog computer

- Based on continuous varying data.
- Measure only natural or physical values.
- Used for special purpose.
- Generally, no storage facility is available because they work on real time basis. If provided, then only a little amount of storage is available in it.
- Accuracy of these types of computer is very less because of noise and filtering facility.

Examples: - ohmmeter, speed meter, tetrameter, seismograph etc.

2) Digital Computer:-

The computer which works on discrete data or discontinuous data is known as a digital computer. It works on a binary system where 0 represent off and 1 represents on. It is based on digital signals i.e discrete signals.

So, the basic principle of these computers is either present or absence of an electric pulse in the signals. It is a multipurpose and programmable computer. It is fast processing, more accurate and has large memory capacity. It is usually general purpose computer. Some examples of a digital computer are IBM PC, Apple/Macintosh computer, etc.

Characteristics of digital computer

- Based on discrete data which are not continuous with time.
- Based on principle of logic 1 and 0 or high and low voltage.
- Used for general purpose.
- They are more reliable because of less noise and filtering facility.
- It has large memory capacity because the calculations are to be stored internally for future use and re-programming.
- It is multipurpose and programmable so, it is of high cost and faster processing.
- Signal representation of digital pulse is as follows.

Example: - IBM PC, Apple/Macintosh etc.

3) Hybrid Computer:-

A computer, which has a combination best feature of both analog and digital computers, is called a hybrid computer. It helps the user to process discrete and continuous data. The hybrid computer can convert the analog signal into digital signals and digital signal into analog signal. Hybrid computers are used mainly in specialized applications where both kinds of data need to be processed. Therefore, they help the user to process both continuous and discrete data.

Characteristics of Hybrid computer are as follows.

- It is the combination of qualities of analog as well as a digital computer.
- It can process both continuous and discrete data.
- It is special purpose computer.
- It can convert one type of data into another.
- It is mostly used in radar communication, rocket launching, weather forecasting and in other fields.
- It usually high cost compared to analog and digital computer.
- Hybrid Machines are generally used in scientific applications or in controlling industrial processes.

S.N.	Digital Computer	S.N.	Analog Computer
1	These computers work with digits.	1	These computers work with natural or physical value.
2	It works upon discrete data.	2	It works upon continuous data.
3	It operates by counting and adding, i.e. it calculates.	3	It operates by measuring and comparing.
4	Its accuracy is high.	4	Its accuracy is low.
5	Results are obtained after complete computation.	5	Output is continuous.
6	It is general purpose in nature.	6	It is special purpose computer.
7	Larger storage capacity (memory).	7	No any or smaller storage capacity.
8	Higher cost then analog computer.	8	Lower cost than Digital computer.
9	It can be reprogrammed.	9	Normally, it cannot be reprogrammed.
10	Example: IBM PC, Apple etc.	10	Example: Presley, Speedometer etc.

2.) On the basis of Size:

1) Micro Computer:-

These are the smallest computer systems on the basis of size. These computers are based on micro chips because microprocessor is used as memory device and they are very small. These computers

are also called PC (personal computer) or home computers. The smallest of this category are laptop, notebook and palmtop computers. This size is reducing day- by-day.

Characteristics of micro computer

- Smallest in terms of size can be kept on top of a desk (desktop), on top of laptop and like a notebook.
- Speed and cost is also smaller.
- Since a single user system is used, storage devices and memory are smaller sized.

Example: IBM Pentium Pc, Apple/ Macintosh etc.

Types of Micro Computer

1. ***Desktop Computer:*** A Desktop computer is a personal computer that is designed to fit on top of a typical office desk.
2. ***Laptop Computer:*** A Laptop computer is a portable personal computer light and small enough to sit on a person's lap.
3. ***Handheld computer:*** It can fit one hand and we can operate it with the other hand. Because of its reduced size, the screen of handheld computer is quite small. Similarly, it also has small keyboard.

   - ***Notebook:*** Notebook is also designed for the people in move. But it is smaller in size compared to laptop. It is device with a reduced keyboard, screen, functionality, and software support than laptop.

   - *Palm top:* A small computer that literally fits in your palm. Compared to full size computers, palmtops are severely limited, but they are practical for certain function such as phone books and calendars.

   - ***Tablet Pc:*** A tablet PC is a wireless, portable personal computer with a touch screen interface. The tablet is typically smaller than a notebook computer but larger than a smart phone

   - ***Smart phone/ PDA:*** A smart phone is a mobile phone that includes advanced functionality beyond making phone calls and sending text messages.

2) Mini Computer:-

Minicomputer is medium in size it is bigger than micro and smaller than mainframe computer. A centrally located server or CPU is connected with more than 50 terminals. At a time 50 people can work with single minicomputer for data processing, Desktop publishing etc. It is linked with network and used for Bank, Business field.

Characteristics of mini computer

- Medium sized computer occupying approximately 10 sq. feet of area.
- More than 50 terminals and large capacity storage devices than micro computer.
- But minicomputer is smaller than mainframe computer.
- Used for general purpose.
- Used in medium sized organizations and corporations for their database administration.

Examples: - Prime 9755, vax 36 etc.

3) Mainframe Computer:-

These are the largest computer on the basis of the size. It has more storage capacity and fast processing speed. It takes about 100 sq. feet. At least 100 people can work at a time. A centrally located server or CPU is connected with more than 100 terminals.

Fig. Mainframe computer

Characteristics of mainframe computer

- Largest in size with approximately 10000 sq. feet area.
- Central processor, central administration
- More than 100 terminals, large capacity storage devices used.
- Fastest and very expensive system.
- General purpose computer.
- Used by large agencies and government for large scale data processing.

Examples: - IBM 1401, ICL 2950/10 etc.

4) Supper Computer:-Super computer is very large machine which works in MIPS. They are most powerful and expensive computers. They have extremely large storage capacities and processing speed is at least 10 times faster than other computer.

Characteristics of super computer

- It is very large and powerful computer.
- It is large storage capacities and work is done by very fast.
- It can calculate about 400 million numbers every second.
- It can result is always exactly correct.
- Super computers are used in weather forecasting petroleum engineering and medicine and for creating computer graphics.
- It is used in weather research and scientific research.

Some examples of the super computers are CRAY, NEC Super SX11, and CYBER 205 etc.

Micro Computer	**Super Computer**
1. It is less powerful.	3. It is more powerful.
2. It is the smallest computer on the basis of size.	2. It is larger in size.
3. It is cheaper.	3. It is the most expensive computer.
4. It can be handled by only one person.	4. It required numbers of experts to operate.
5. It is used in office, house.	5. It is used in weather forecasting, Scientific research.
6. Example are IBM PC, Apple/ Macintosh etc.	6. Example are CRAY I, CYBER 205 etc.

1) IBM Computer (IBM PC):-

IBM, which established by Dr. Herman Hollerith in 1923 AD, is the largest computer manufacturing company in the world till today. It is leading the market of mainframe and PCs. It uses the processors multimedia devices and some other hardware parts developed by some

other Companies like Intel but use the principle of its own. So, all the computers developed by IBM Company are called IBM computers. Example: - IBM PC and IBM Compatible.

2) Apple / Macintosh Computer:-

Apple Corporation was established in 1970 AD is USA. Within these 3 decades. It has gone much forward and produced PCs with good qualities and user friendly. So, the entire computers that are developed by Apple Corporation are called Apple/Macintosh (Mac) computers. These computers are architecturally totally different than that of IBM's. Not only hardware part, but their software architecture is also totally different. Software made for IBM PC can't be run in Macintosh or vice versa. Floppy disks or hard disks formatted in one can't be recognized by on other.

3) On the basis of Brand:

1) IBM Compatible:-

The computers developed by IBM company is itself are called branded or IBM PC computer which are developed or assembled by other companies using the parts and principle of IBM PCs are called IBM compatibles. So, IBM compatibles are also called duplicate of IBM PCs.

IBM PC	IBM Compatible
1. These computers are developed by IBM Company itself.	1. These computer are developed by the companies other than IBM Company
2. These computer are also called branded or original PCs.	2. These computer are generally called assembled or duplicate of PCs.
3. Generally Expensive	3. Comparatively cheaper.
4. It is more reliable.	4. It is less reliable.
5. These computer are reliable, durable and have better quality than IBM Compatible.	5. These computers are less reliable, less durable, have low quality.

4) On the basis of Model:

1) XT Computer:-

XT (Extra technology) computer are the old technology computers with much slower processing speed (not more than 4.77 MHz.). Advanced GUI (Graphical user interface) based Software like (Windows) can't be run in these computers. Everything was based on text based system.

2) AT Computer:-

AT (Advanced Technology) computers are the new technology computers. They are faster in processing (more than 2 GHZ) and can run any type of software whether that is text based or GUI based.

3) PS/2 Computer:-

PS (personal system)/2 computers actually, these are not totally different models of computers but are refinement of AT computers. These models were built 1990 and mostly used in laptop computers. Rechargeable and battery operated systems with faster and flexible.

MOBILE COMPUTING

Mobile computing is the form of human-computer interaction by which a computer is expected to be transported during normal usages. Mobile computing has three aspects: mobile communication, mobile hardware and mobile software.

The first aspect addresses communication issues in ad-hoc and infrastructure networks as well as communication properties, protocol, data format and concrete technologies. The second aspect is on hardware, e.g., mobile device or device components. The third aspect deals with the characteristics and requirements of mobile applications.

Fig: Mobile Computing

Mobile computing is a generic term describing one's ability to use technology while moving, as opposed to portable which is the only particle for use while deployed in a stationary configuration. A mobile computing device is created using mobile components, such as mobile hardware and software.

Mobile computing devices are portable devices capable of operating, executing, providing services and applications to a computing device. It is a computing device used in transit. Users can access data and information from wherever they are. Here's the example view of how does the mobile computing works on a server and mobile networks.

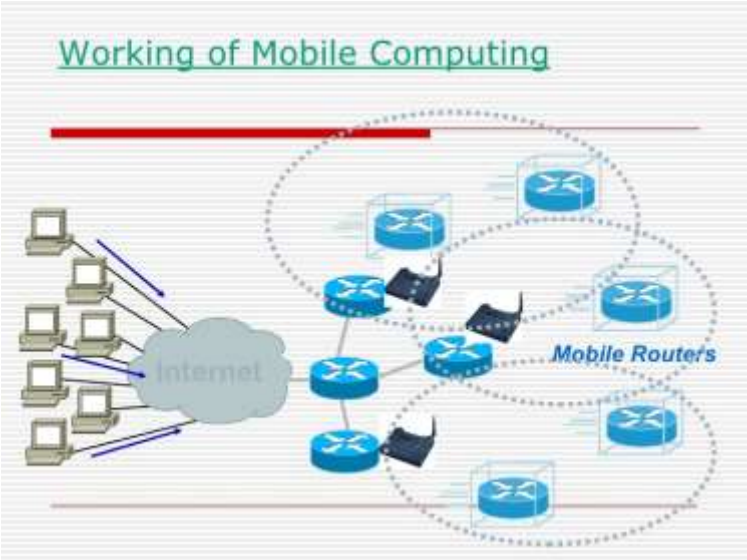


Fig: Working of Mobile Computing

Mobile computing is the process of computation on a mobile device. In mobile computing, a set of distributed computing systems or service provider servers participate, connect, and synchronize through mobile communication protocols.

Mobile computing provides decentralized (distributed) computations on diversified devices, systems, and networks, which are mobile, synchronized, and interconnected via mobile communication standards and protocols.

Many types of mobile computers have been introduced since the 1990's including wearable computer, PDA, enterprise digital assistant, smart phone, UMPC (Ultra-mobile PC), Tablet PC.

CHARACTERISTICS OF MOBILE COMPUTING

- It is a portable device that you can carry during mobility.
- It has limited processing and storage capability.
- It includes mobile communication, mobile hardware, and mobile software.
- It usually contains touch screen for providing input.
- It contains on-screen or virtual keyboard for proving text inputs. However, an external keyboard can be connected by using USB port, infrared or Bluetooth.
- It contains the camera, speaker, and microphone etc.
- It contains handwriting recognizing software.
- Most of the mobile computing devices contain memory card slot to expand the storage capacity.
- It has wireless connectivity such as Bluetooth, Wi-Fi, to connect the Internet or with other computing devices as well as the wired connection through the USB port.
- The most mobile computing device can synchronize their data with the applications on a user's computer.
- It can be used for cloud computing and remote access.

- It uses the mobile computing operating system such as Android, iOS, Windows Mobile OS, Plam OS.
- It can include GPS (Global Positioning System) receiver for navigation.

Fig: Mobile Computing

1.2. Computer System and I/O devices

Concept of Computer Architecture and Organization

Computer architecture

Computer architecture is a specification detailing how a set of software and hardware technology standards interact to form a computer system or platform. In short, computer architecture refers to how a computer system is designed and what technologies it is compatible with.

- Computer Architecture is the conceptual design and fundamental operational structure of computer system.
- It is the coordination of abstract levels of a processor under changing forces, involving design, measurement and evaluation.
- It also includes the overall fundamental working principle of the internal logical structure of a computer system.
- The computer architecture is the theory behind the design of a computer.
- Computer Architecture sets the design requirement or specification of computer system.
- It is the design of the task performing part of computers.
- It is the science and art of selecting and interconnecting hardware components to create computer system.

6. Application Layer	SOFTWARE LEVEL
5. System Software Layer	

4. Machine Layer	HARDWARE LEVEL
3. Micro Programmed Layer	
2. Digital Logic Layer	
1. Electrical and electronic component Layer	

Fig. Layers of computer Architecture

1. Electrical and electronic component layer

This layer is also referred as physical device layer,

- Transistor
- Capacitors
- Registers
- Diode
- ICS etc.

2. Digital Logic Layer

All most basic operations of the machine are provided at this level. The basic elements at this level can store, manipulate & transmit data in the form of simple binary representations. These digital logic elements are called gates.

3. Micro program Layer:-

A sequence of micro instruction constitutes the micro program is called firmware. It is permanently stored in ROM.

4. Machine Layer

Several Hardware Levels are presented in machine level. These are the basic elements of computer.

They are – processor, input/output devices,

Main memory, Auxiliary memory, Translator

Program (Compiler, Assembler, Interpreter).

5. System Layer:-

- System software control overall operation of the computer.
- Functions Like
  - File editing, Storage Management, resource accounting, I/O Management, Database Management etc.
  - Example, MS-windows, Linux, Unix, Ms-DOS,

  Language Processor, Utility software.

6. Application Layer:-

- Application software is the software which is used to perform the specific task needed by the user.
- Example, Auto CAD, MS-office Package, Adobe Photoshop, Tally etc.

Computer Organization

- Basic different parts are constructed and organized in a computer they are CPU, Memory, Input and output system that combination is called computer organization.
- Computer organization refers to the operational units and their interconnection that realize the architecture specification. Computer organization deals with physical aspects of computer design, memory and their types and microprocessors design.
- Whereas computer architecture deals with design aspects of computer that assembly programmer needs to know like instruction set (i.e. instruction supported), instruction format (i.e. how instruction will be specified), addressing modes, data types supported, etc.
-
-

Computer Architecture	**Computer Organization**
Computer architecture is concerned with the structure and behavior of computer system as seen by the user.	Computer organization is concerned with the way the hardware components operate and the way they are connected together to form a computer system.
It includes information, formats, instruction set, and techniques for addressing memory.	It includes Hardware details transparent to the programmer such as control signal and peripheral.
It describes what the computer does.	It describes how the computer performs.Ex, circuit design, control signals, memory types and etc.

Computer System

A computer system refers to the fully function able system that is integration of both hardware and software. The hardware components of a computer of a computer system are physical components that are tangible such as keyboard, mouse, processor, mother board, main memory, secondary memory, monitor, printer, etc. whereas the software components are logical components that make physical component work such as data, information, computer instructions etc.

The computer is a device that operated upon information or data. It is an electronic device which accepts inputs data, stores the data, does arithmetic and logic operations and provides

the outputs in the desired format. The computer receives data, process it, produces output and stores it for further references. So, a computer should have at least four major components to perform these tasks. A block diagram of the basic computer organization has the following functional units.

Computer system is the integration of main processing unit with the supporting chips or processors and the devices attached with it.
- It is the combination of input unit, central processing unit and output unit.
- Computer system is just like the system of our body.

Component of computer System

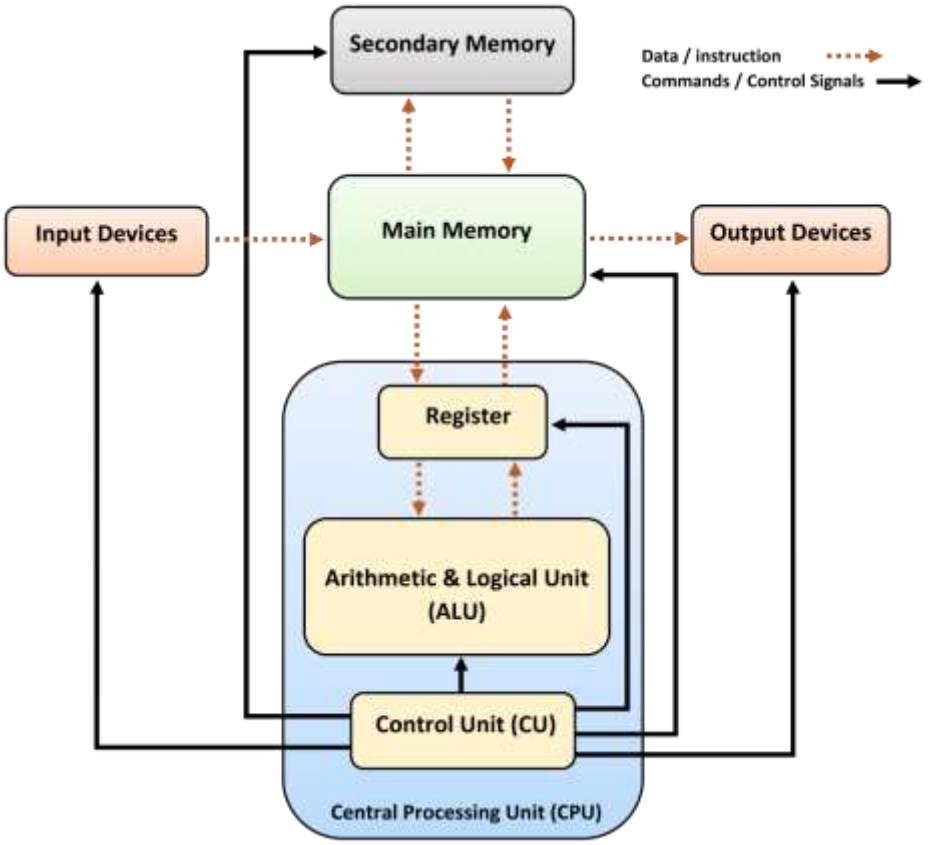


Fig: Block diagram of computer architecture

a. **Input unit:** it accepts the data or instructions given by the user and it converts the data and instructions from man readable to machine readable code. Some common input devices are keyboard, mouse, scanner punched cards etc.

b. **Processor/CPU:** CPU is the portion of a computer system that carries out the instructions of a computer program, and is the primary element carrying out the computer's functions. Some of the primary components of a CPU are:
   i. **Registers:** These are the primary memory of computer system. They are mainly used to store data during the time of processing inside ALU. The registers within CPU are special purpose temporary storage locations.
   ii. **Control unit:** The control unit is the brain of the CPU itself. It controls overall operations and devices of computer.
   iii. **Arithmetic Logic Unit:** ALU carries out the arithmetic and logical operations on the data made available to it.
c. **Primary/ Main Memory:** It is a volatile memory of computer. As soon as a computer starts, primary memory stores all running applications, operating system, user interface and any others. Its storage capacity is smaller but faster.
d. **Secondary/ Auxiliary storage**: It is the secondary memory of computer. They have slower access rates but greater storage capacity and data stability. Auxiliary memory holds programs and data for future use because it is non-volatile.

e. Output Unit: When the computer its processing task, the results must be conveyed back to the user. Information from the CPU is converted into an understandable form through output devices.

I/O (Input/Output) devices

Input Unit

The input unit is formed by the input devices attached to the computer. Input devices are used to interact with a computer system or used enter data and instructions to the computer. These devices convert input data and instructions into a suitable binary form such as ASCII, which can be acceptable by the computer. In brief, an input unit performs the following function:

- It accepts data and instruction from the outside worlds.
- It converts these data and instruction into computer understandable from a binary form.
- It supplied the converted data and instruction to the computer system for further processing.

Example of input devices are keyboard, mouse, scanner etc.

COMMONLY USED INPUT DEVICES

- Keyboard

A keyboard is the primary input device through which instructions and data are entered into the computer. It was first invented, in 1868 A.D, in America by Christopher Latham Sholes.

This commonly used input device mostly uses a Qwerty layout. The layout is called "Qwerty layout" because such keyboard has those keys as the first 6 letters on top of an alphabetic line of a keyboard.


Fig: Keyboard

A keyboard is connected to the CPU with a cable. When a key is pressed, an electronic signal is produced which is then detected by an electronic circuit called keyboard encoder. The main function of an encoder is to detect which key has been pressed and to send a binary code that is correspondent to the pressed key of a computer. This binary code may be ASCII, EBDIC or HEX code.

Earlier, keyboard with serial port containing 9 pins was in use. These days, we have USB (Universal Serial Bus) port keyboard and some even wireless. Keyboard with navigation keys like play, pause, next, previous, etc. with multimedia functions is also available. There are 4 types of keyboards for PCs now available. The first 3 were invented by IBM while, the latter is the result of changes made when Microsoft Windows 95 was released. They are:

1. The 83-key keyboard (PC/XT)
2. The 84-key keyboard (PC/AT)
3. The 102-key keyboard (called the extended keyboard)
4. The 105-key Microsoft Windows 95-compatible keyboard)

- **Mouse**

A mouse is a small input device which is used to point, draw and select items that are displayed on the computer screen. The pointer of the mouse is called a cursor. As we move the mouse across the screen, the cursor moves according to the movement of the mouse. It was invented in 1960 A.D by Douglas Englebart.

Fig:Mouse

A mouse is one of the most important and popular input devices. Its movement and the direction of movement are detected by 2 rotating wheels on the underside of the mouse. These wheels have their axes at right angles where, in each wheel is connected to a shaft encoder which emits electrical pulses for everyday increment movement of the wheel. The pulses transmitted by the mouse determine the distance moved.

There are 3 types of mouse found in a market.They are:

a.) **Scroll mouse**: It is a type of mouse which comes with a scroll wheel perpendicular to its surface. This scroll wheel or a mouse wheel is made up of a rubbery disc or hard plastic on the computer mouse. It is generally located between the right and left mouse buttons.

Fig: Scroll Mouse

b.) Optical mouse: It is a more advanced mouse which uses a light source, typically LED (Light Emitting Diode), a DSP (Digital processing) and an optical sensor instead of the regular mouse ball. It uses a light detector such as an image sensor or an array of photodiodes to detect any relative movement to a surface.

Fig: Optical Mouse

c.) Laser mouse: It is an even more advanced mouse which uses laser to detect movements on a surface. It can track more than 2,000 DPI (Dots Per Inch) whereas, a typical optical mouse can track between 400 and 800 DPI only. This mouse emits light to the surface where it is put on. The emitted light is reflected back which tells the computer to control the pointer on the screen. Generally, laser mouse available nowadays is connected to the USB (Universal Serial Bus) port.

Fig:Laser Mouse

- Joystick

The joystick was invented, in 1944 A.D., in Germany but the video game joystick was invented in, 1967 A.D. A joystick is a stick which is mounted on a spherical ball which moves in a socket. It allows the user to navigate easily around the display on the screen. A user may move the stick on the device in different directions. This is particularly useful at homes for playing video games and for indicating positions in graphic systems.

Fig:Joystick

- **Touch Pad**

A touch pad is a small touch-sensitive pad that is used as a pointing device in portable computers. It can be used in place of an external mouse. It uses pressure sensors to track the position of a device on its surface. Each position on the touch pad is translated to the specific location on the screen. A touchpad is operated by using your finger.

Fig: Touch Pad

- **Track Ball**

A track ball is an upside down of a roller mouse. It was used to be a basic input device in laptops earlier. It is similar to the mouse but with a mouse, the ball is rolled by moving the entire unit over the surface whereas, with track ball, the ball itself is rolled with fingers.

Fig: Trackball

- **Scanner**

The scanner is an input device that needs images or text and converts the data into digital signals. The image is scanned and converted into a format that the PC can interpret. It was invented by Rudolph Hell, in 1963 A.D, in Germany.

Fig: Scanner

A scanner works by digitizing an image, dividing it into a grid of small dots called pixel and representing each dot with RGB value for that pixel value by binary bits. The resulting matrix of bits is called a bitmap, which can be stored in a file and can be displayed on a screen.

- **Bar Code Reader**

The Bar Code Reader is a device which is used to read a barcode field. Bar Code is a technology that uses white spaces and black bars to represent encoded information. This encoded information can be read with an optical device that converts the bars and spaces into an electrical signal which is then decoded into the original characters. The bar code was invented by Woodland.

Fig: Barcode reader

The bar code reader is used in labeling consumer products and books. It is detected as ten digits. The first 5 digits identify the supplier or manufacturer of the item whereas, the second 5 digits identify an individual product. The code also contains a check digit to ensure that the information read is correct.

- **Light Pen**

A light pen is a pencil shaped device which is used to select screen positions by detecting the light coming from points on a screen. It was 1stinvented in 1952 A.D, in MIT (Massachusetts Institute of Technology). A light pen is sensitive to the short burst of light emitted from the phosphor coating at the instant the electron beam strikes on a particular point.

Fig: Light pen

Though the light pens are still in use, they are not as popular as they used to be as they have several disadvantages comparing to other input devices.

- **OCR (Optical Character Reader)**

Optical Character Reader (OCR) is the device that helps in the recognition of printed or written text characters by a computer. OCR is used for reading text from paper and translating it into a form that the computer can manipulate. An OCR reader scans the document using the photoelectric device to convert it into electric signals. These patterns are then compared with the stored patterns of the characters which the reader can recognize. If a match is found, the character scanned is identified otherwise, it is rejected by the reader. This device is widely used in airlines, banks, postal offices (for reading postal code), etc.

Fig: Optical Character Reader

- **OMR (Optical Mark Reader)**

Optical Mark Reader is widely used device for scoring answers for multiple choice questions. It can sense the presence of a pen or pencil mark. Special marks such as squares or bubbles are prepared on examination answer sheets or questionnaires .The user fills in these squares or bubbles with soft pencil or ink to indicate their choice. These marks are detected by the Optical Mark Reader and the corresponding signals are sent to the processor.

Fig: Optical Mark Reader

- **MICR (Magnetic Ink Character Reader)**

Magnetic Ink Character Reader has been used to read documents that are written by a special ink made of a magnetic material called magnetic ink. MICR is capable of reading characters on a paper written with the magnetic ink which is magnetized during the input process. The MICR reads the magnetic pattern of the written characters. To identify the characters, these patterns are compared with a special pattern stored in the memory. It is mostly used in banks and postal services.

Fig: Magnetic Ink Character Reader

- **Touch Screen**

Touch screen is a kind of screen which is sensitive to user's touch. One can use a finger to point the command or menu displayed on the screen. Touch screen was invented in 2009 A.D, in Apple store. It is widely popular on laptops.

Fig: Touchscreen

- **QR Code Scanner**

It stands for Quick Response Code. The advanced form of Bar Code Reader is QR Code Scanner. A QR code is a pattern of black and white squares. The QR code of any product gives information about the website address. A QR code can be read and processed by a smartphone *QR Code* or a cell phone with the help of Apps or Applications.

- **Voice Input System**

The input system which is used to give the instruction to the computer invoice, without using the keyboard i.e. without typing is called Voice Input System. In Voice Input System, the speech is converted into electrical signals employing a microphone. The signals are sent to a processor for processing. Then, the signal pattern is compared with the pattern already stored in the memory .A word is recognized only when a choice is found, and then, the computer gives a corresponding output.

Fig: Voice Input System

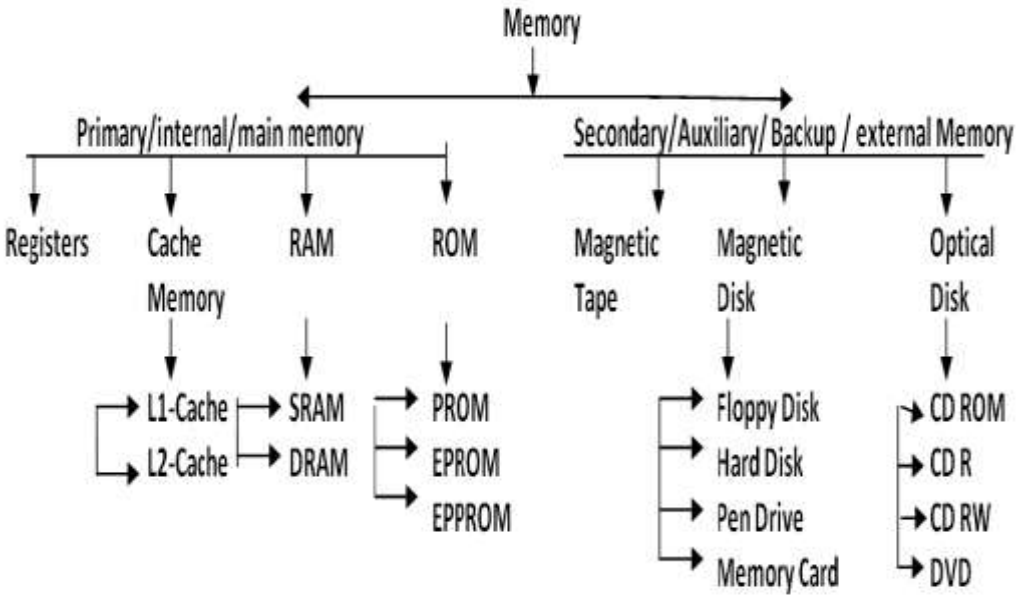
A voice recognition system can be used in factories at places where both hands of workers are engaged in the job like if he is doing some handful of work and he wants to input some data into the computer. It can also be used to assist handicapped people or for identification purposes in banks, etc.

Memory Unit

This unit is also called storage unit. The data and instructions, which are entered through an input unit must be stored on the computer before the actual processing starts. The result produces by the computer after processing is also kept somewhere before passed to the output units. If intermediate results are produced during processing, it should be stored in somewhere in memory. The storage unit of a computer performs all these needs. In brief, the specific functions performed by the storage unit are as follow:

- It stored data and instructions, which are entered through input devices.
- It stores an intermediate result of processing.
- It stores the final result of processing before these results are passed to an output device.

The storage unit of computers consists of two types of memory or storage: primary and secondary storage:



i. Primary / Main / Internal Storage

Memory storage that communicates directly with CPU is called main memory. It enables the computer to store, at least temporarily data and instruction. It is mainly used to hold data and instructions and as well as the intermediate result of processing which the computer system is currently working on. Primary memory is volatile, that is, it lose its content when

power supply is off. The Random access memory (RAM) is an example of a primary to main memory.

Here are some of them that comes under the primary memory

- **RAM (Random Access Memory)**

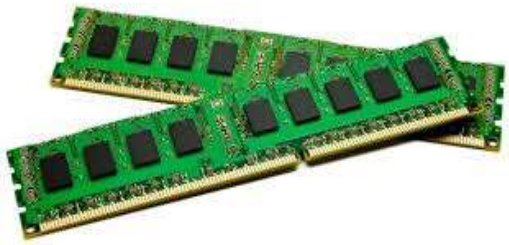


Fig: Random Access Memory

RAM is the read/write memory of the computer. It is used for both purpose read and write. It possesses random access property that means CPU can access any memory location in a random sequence form.

It is a volatile memory. It stores data or information as long as power supply is on. But, after power supply is off, data will be gone. There are two types of RAM.

Types of RAM

- **Static RAM (SRAM)**

SRAM stores data and programs as long as the computer is in ON state. It is expensive but faster for read/write than DRAM.it is typically used for CPU cache while DRAM is used for a computer's main memory.

Fig: Static RAM

- **Dynamic RAM (DRAM)**

The data stored in DRAM will be lost after a few milliseconds even if the computer is on. It is cheap but slow for read/write than SRAM.

Fig: Dynamic RAM

- **Read Only Memory (ROM)**

ROM stands for Read only memory. It can be used only to perform the read operations. It does not have write access. It is non-volatile memory i.e, the information stored in it is permanent and is not lost even if the power supply is cut down.

Fig: **Read Only** ***Memory***

It is used for permanent storage of programs. It is cheaper than RAM on per unit basis but while compared to storage ROM is expensive than RAM.

Types of ROM

- **PROM (Programmable Read Only Memory)**

It is a programmable memory that users can write data at once only. The user can store permanent programs, data or any kind of information in PROM.

Fig: Programmable Read only Memory

- **EEPROM (Electrical erasable programmable read only memory)**

It is a memory that can also be erasable via electric. It can be erased and reprogrammed on the byte by byte basis single data or the entire chip can be erased.

Fig: Electrical erasable programmable read only memory

- **EPROM (Erasable Programmable Read Only Memory)**

It is an erasable memory. Data stored on it can be erasable via passing the Ultra-Violet light so that entire data will be erased.

Fig: Erasable *Programmable Read Only Memory*

1. RAM is a volatile memory.	1. ROM is a non-volatile memory.
2. RAM is a read and write memory.	2. ROM is a read only memory.
3. RAM holds the program and data the CPU is presently processing.	3. ROM contains special instructions for detailed computer operations.
4. It is used for buffering purpose.	4. It is not used for buffering purpose.
5. It is higher memory space.	5. It is less memory space.
6. Data are lost when the power supply is switched off.	6. Data are store permanently.
7. Types are SRAM and DRAM	7. Types are PROM, EPROM and EEPROM

Secondary / Auxiliary / External Storage

Secondary memory is non-volatile and has a lower cost per bit. It generally has an operating speed far slower than that of primary memory. Secondary memory is also called as "Auxiliary Memory". It is primarily used to store a large volume of data on the permanent basis that can be partially transferred to primary storage.

Secondary storage is the storage device that is designed to store data and instructions (programs) in a computer relatively in permanent form. It is non-volatile storage.ie. Stored data and instructions can be retained even if the power supply is cut off. It is also known as backup memory. It is mainly used to transfer data to program from one computer to another computer. There is high capacity storage devices used to store data and program permanently. These are also used as backup devices which allows to store the valuable information as backup on which you are working on. The examples of secondary memory are Magnetic Disk, Optical disk, etc.

Features of secondary memory

1. It is not directly accessible to CPU;
2. It requires primary memory for its operation.
3. It is usually non-volatile memory.
4. It is usually cheaper and slower for read /write operation than primary memory.

Secondary memory is also called auxiliary memory or backup memory. These memories are used to store data and instructions permanently for future use. CD/DVD, pen drive, hard disk, etc. store data and instruction for future. The various types of secondary memory are Magnetic Tape, Hard disk, SSD (Solid State Drive), Optical Storage Disc, Pen drive, etc.

a. Magnetic Storage

Computer systems need to store data in digital format. One of the most widely used types of digital data storage is magnetic storage. This refers to any type of data storage using a magnetized medium. Several types of magnetized media are used in computer systems, including magnetic tape, floppy disks, Super disks, hard disks, etc.

Magnetic Tape

Magnetic Tape is a usable secondary storage device to store and retain a large volume of data. It is made up of a plastic strip of which one surface is coated with magnetic ink. Analog and digital data are stored in magnetic tape. Normally, minicomputer, mainframe computer, large scale business organization server, etc. uses magnetic tape for backup data and information. Magnetic tape driver are used to store and retrieve the data and information from magnetic tape. The main important function of magnetic tape is to store data safely for a long period of time.

Magnetic Tape and Tape Drive

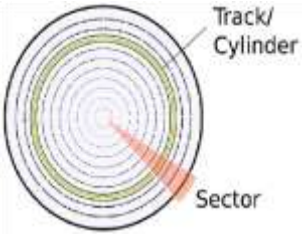
Hard Disk

Hard disk is commonly used storage device. It stores large amount of data and information permanently. It is also called fixed disk. It is made of aluminum materials and the surface is coated with the ferromagnetic element. Circular metal discs also called platters to rotate while writing or reading the data and information into them. It stores a large amount of data on hard disk. The speed of the hard disk is measured in rpm (revolutions per minute). The hard disks with 5400 rpm or 7200 rpm are generally used in present-day computer system.

Hard disk capacity

Hard disk must be formatted before use. There are thousands of track on the surface of hard disk. So, each track is divided into various sectors. Each sector stores 512 bytes. Header is used to read and write on hard disk. The storage capacity of hard disk is determined from number of disk or platter it contains and their density.

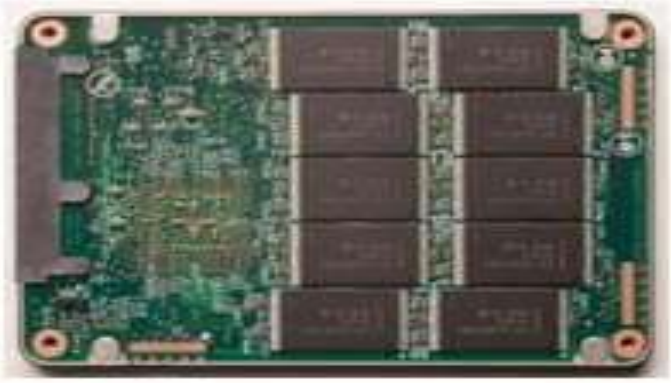
Hard Disk



Track and Sector

SSD (Solid State Drive)

Hard disk can be replaced and upgraded by SSD (Solid State Drive) as new technology. Semiconductor chips are used to store data in SSD. The speed to read and write data is greater than hard disk. So its price is more expensive than hard disk. Laptop, notebook, ultra-book, etc. uses SSD as storage device. Its storage capacity is about 4 TB but various companies are trying to develop SSD with high storage capacity. It is more costly than HDD (Hard Disk Drive).



Solid State Drive

Differences between SSD and Hard disk

S.N.	Hard disk	SSD
1	It is heavier than SSD.	It is lighter than hard disk.
2	Its storage capacity is 500 GB to 100 TB.	Its storage capacity is 1 TB to 4 TB.
3	It is cheaper than SSD.	It is more expensive than hard disk.
4	It takes 6-7 watt electricity.	It takes 2-3 watt electricity.
5	The file writing speed is 50-120 MB/S (megabyte per second)	The file writing speed is 200-550 MB/S (megabyte per second)
6	It is made up of aluminum material.	It is made up of semiconductor microchip.

External Hard Drive

The working principle of hard disk is similar to that of internal hard drive but it is not placed inside CPU casing. It can be externally connected with a USB (Universal Serial Bus) port. It is portable and easy to carry. It is used to transfer data, information and software from one computer to another.

External Hard Drive

Pen drive

Pen drive is a popular flash storage device. It is also called flash memory. It is connected through the USB ports. It is a small size and portable device. It can be carried in a pocket like pen. So it got its name as a pen drive. It is used to transfer data, information and software from one computer to another. It is made up of semiconductor chip which is EEPROM technology. The writing speed of pen drive of USB 3.0 is up to 60 MB/S and data reading speed up to 120 MB/S.

Pen drive

b. Optical Storage Disc

The disc that uses laser light technology to store and retrieve data is called optical storage disc. The most commonly used optical storage discs are CD, DVD, Blu-ray disk, etc.

CD (Compact Disc)

In 1980, Philips Company of Netherland developed first CD or optical disk which was 12cm in diameter and had 72 minutes audio/video storage capacity. The laser ray technology is used to retrieve and store the data. The information on the optical disk is stored in the form of pits. The pits are tiny reflective bump.

CD has the diameter of 12 cm. It's weight is 18gm and width 1mm (millimeter). The data can be written on a CD only once. CD is made up of poly carbon and both surfaces are coated with aluminum. Nowadays, CDs are commonly used in microcomputer. It can be used to transfer data from one computer to another. The storage capacity of a CD is 700MB.

The three types of optical storage devices are:

- CD-ROM → Compact Disc – Read Only Memory
- WORM → Write Once Read Many
- CD-RW → Compact Disc – Rewritable

a. CD-ROM stores data or programs like video, music, software, etc. for selling purpose developed by different company. The information stored on it is read-only.

b. WORM is an optical storage media which is purchased as blank media and data can be written only once but can be read many times.

c. CD-RW (Compact Disc - Rewritable) means read and write in it multiple time. It is similar to pen drive as information can be read from and written to the disk many times.

CD (Compact Disk)

DVD (Digital Versatile Disc)

DVD stands for Digital Versatile Disc or Digital Video Disc. Its storage capacity is higher than CD. It stores multiple layers of data. The various DVD storage capacities are

- Single Side Layer- 4.7 GB
- Single Side Double Layer-8.5 GB
- Double Layer Single Side- 9.4 GB
- Double Layer Double Side-17.08 GB

Philips, Sony, Toshiba/ Panasonic companies developed first DVD in 1995. DVD Drive is used to read/write the data on DVD.

Differences between CD and DVD

S.N.	CD	DVD
1	Its storage capacity is 700MB.	Its storage capacity is up to 20GB.
2	It is cheaper.	It is more expensive.
3	It is used to store audio and software.	It is used to store video and software.
4	Its types are CD-R, CD-RW, etc.	Its types are: DVD-RW, DVD+RW, etc.
5	It was developed by Philips and Sony.	It was developed by Philips, Sony, Toshiba, Panasonic etc.

Blue-ray Disc

It is an optical data storage device. Its storage capacity is up to 200GB. It is mainly used to store high-quality audio and movie data. It is scratch resistant discs.

Differences between Primary memory and Secondary memory:

S.N.	Primary memory	Secondary memory
1	It is also called main memory or internal memory.	It is also called auxiliary memory or backup memory.
2	It is volatile and non-volatile memory.	It is non-volatile memory.
3	The storage capacity is less.	The storage capacity is more.
4	Its types are RAM, ROM, etc.	Its types are: Hard disk, CD/DVD, etc.

5	It is made up of semiconductor.	It is made up of magnetic materials, poly carbon, etc.
6	The data is directly accessed by the processing unit.	The data cannot be directly accessed by the processing unit.

S.N.	Hard disk Drive-HDD	S.N.	Solid State Drive-SSD
1	Its storage ranges 500 GB to 100 TB	1	Its storage ranges from 1 TB to 4 TB.
2	It is cheap.	2	It is expensive
3	It consumes more electricity. (6/7w)	3	It consumes very less electricity. (2/3w).
4	It has rotating disk platters.	4	It does not have rotating disks.
5	Produces sound while move.	5	It does not produce sound while working.
6	R/W speed is 50-120 MB/s.	6	It is made of semiconductor memory chips.
7	Platters are made of aluminum.	7	It is made of semiconductor Memory chips.

Cache Memory

Cache memory pronounced as cash, is a special high speed and expensive memory used in CPU, so that CPU doesn`t have to wait for data to be delivered. The most frequently used instructions are kept in the cache memory.

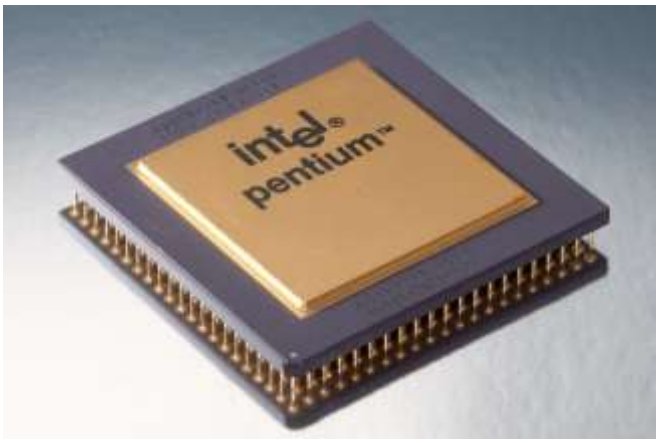
Cache memory computer runs fast and smoothly. It doesn`t have to swap instruction in and out of RAM. Hence, the cache memory is placed in between CPU and RAM so that the speed of operation of main memory and cache memory together can meet speed requirements.

Central Processing Unit (CPU) or Microprocessor

CPU is the component that actually responsible for interpreting and executing most of the commands from the computer hardware and software and also controls the operation of all other components such as memory unit, input and output devices. It simply accepts binary data as input and processes data according to those instructions and provides the result as output. It is the logic machine. So, its main function is run the program by fetching instructions

from the RAM, evaluating and executing them in sequence. In summary, the function of CPU or Microprocessor are as follow:

- Read instruction from memory
- Communicate with all peripherals using the system bus.
- It controls the sequence of instructions.
- It controls the flow of data from one component to another component.
- Performs the computing task specified in the program.
- Fetch-decode-execute.



The CPU has three components responsible for different function, these components are Control units, arithmetic-logical unit (ALU) and Register.

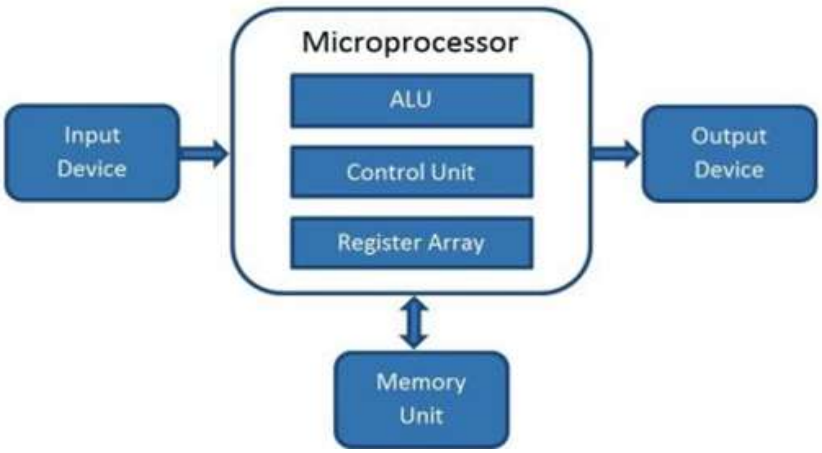


Fig: Components of CPU or Microprocessor

Control Unit

Control Unit is a part of the CPU that controls and coordinates activities of other units of computer system. It acts as a nervous system of computer. It controls the execution of instructions given to system. It coordinates the flow of data in or out of ALU, memory and various input or output devices.

- It performs the data processing operations with the aid of program prepared by the user and send control signals to various parts of the computer system.

- It gives commands to transfer data from the input devices to the memory to an arithmetic logic unit.
- It also transfers the results from ALU to the memory and then to the output devices.
- It stores a program in the memory.
- It fetches the required instruction from the main storage and decode each instruction and hence execute them in sequence.

Arithmetic Logic Unit

Arithmetic logic unit is a part of CPU that can perform arithmetic operation like addition, subtraction, multiplication and division. Logical operation such as comparison AND, OR and Exclusive OR. It also performs logical comparison like equal to, greater than, less than, etc. to compare between two numbers.

- It accepts operands from registers.
- It performs arithmetic and logic operations.
- It returns a result to register or a memory
- The logical operations of ALU give the computer the decision-making ability.

MU (Memory Unit- Register Array)

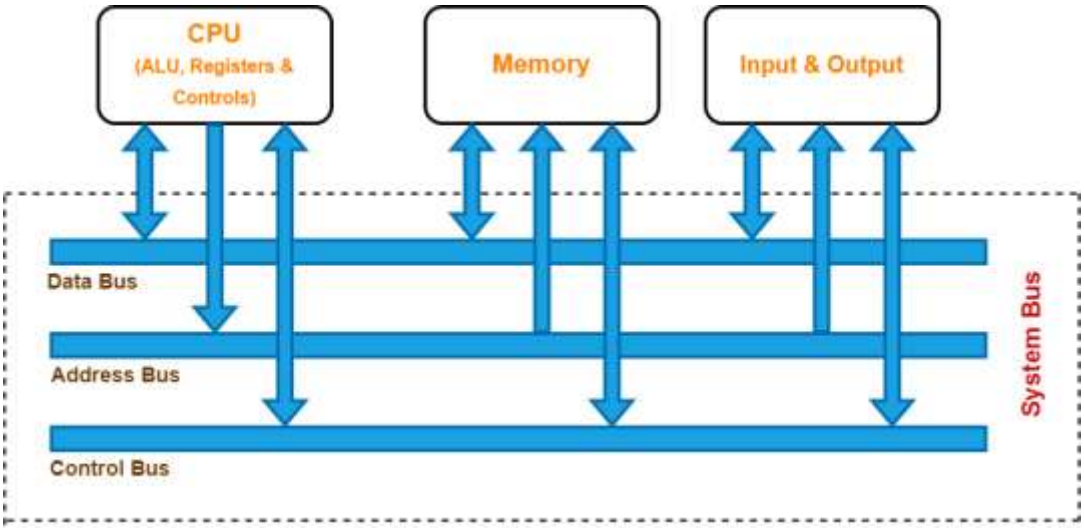
Memory unit is also a part of CPU but not the part of main memory that store currently executing task. It is located inside the microprocessor and has very limited storage. It is used to store very active data and instructions temporarily during processing. Register are primarily used to store data temporarily during the execution of a program and are accessible to the user through instructions.

BUS System

- Bus refers to the path between the components of a computer. Actually bus is set of hardware line(conductor) which lies inside the computer through which data is transmitted from one part of computer to the another part.
- The bus is a medium used to transfer data, memory address and control signal from one part to other part of computers.

There are three types of bus which are described below:

a. **Address Bus:** It is a group of wires or lines that are used to transfer the addresses of memory or I/O devices. It is unidirectional.
b. **Data Bus:** It is used to transfer data within microprocessor and memory/input or output devices. It is bidirectional as microprocessor requires sending or receiving data.
c. **Control Bus:** A control bus is a computer bus used by the CPU to communicate with devices that are contained within the computer. This occurs through physical connections such as cables or printed circuits.



Virtual Memory

- This is the hypothetical memory into the computer system. Exactly this is logical memory or not real memory exist into the computer system likewise physical memory (RAM).

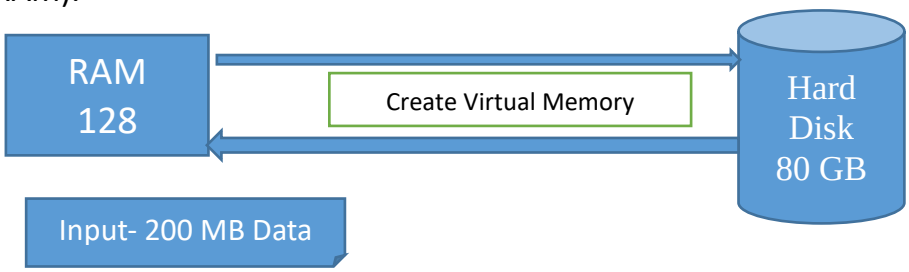


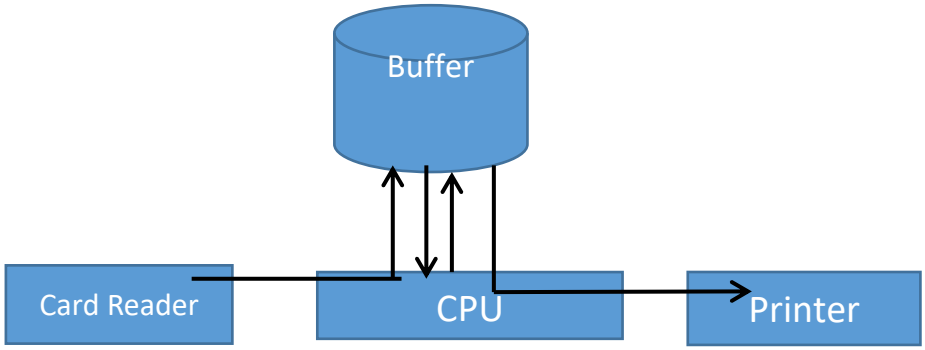
Fig.:- Mechanism of Create virtual Memory

Memory that no longer physically exists within computer system is called virtual memory. Virtual memory is a technique that allows the execution of process that may not be completely in memory. Virtual memory automatically managers two levels of the memory hierarchy representing the main memory (RAM & ROM) and secondary storage (Hard disk). The operating system automatically manages the required space from secondary storage in the case of main memory is not sufficient to run particular program.

Buffer

Buffer is the temporary memory which stores the data from disk to RAM. The behavior of buffer is same as RAM but defined in disk.

It is a temporary holding area for data; unlike register it stores more than one piece of data. It is normally used between the CPU and the input/output devices. The purpose of a buffer is to hold data prior being used by CPU.



System Buffer

Buffering is a process of utilizing temporary storage such as memory one a file for temporary purpose whereas fastest acting devices. Such as CPU can store data that can by slowly operating devices.

- Buffer is a small, high speed memory
- It can be a reserved section of RAM or can be located in the input/ output devices.
- The technique which is used to keep both the CPU and input/output device busy all the time is called buffering.

OUTPUT UNIT

The output unit is formed by the output devices attached to the computer. Output devices are used to present result produced by the computer to the users. The output from the computer is in the form electric signals, which is then converted into human understandable form into human readable form.

The examples of output devices are the monitor, printer and speaker.

The main functions of the output unit are as follow:

- Accepts the result produced by the computer which is in electric binary signals.
- It then converts the result into human readable form.
- Finally, it supplied the converted results to the outside word.

Output devices

A computer peripheral is a device that is connected to a computer but is not part of the core computer architecture.

Hardcopy

These type of output are in print form on the paper or some material that can be touched and carried for being shown to other. It is permanent in nature. So that we can look after these output even there is no computer.

Unlike soft copy output, these type of output does not need continuous supply of power. For example, Output produce in paper or other material by printer or plotter is known as hard copy output and the device is known as hard copy output device. The commonly used hard copy output devices are printer and plotter.

Softcopy

Soft copy output refers to the data shown on display screen or produced by speaker. These type output is untouchable. It is temporary in nature that means, output cannot be carried for being shown to others. These types of output resides only when there is computer or continuous electric supply. It is non-portable compared to hard copy output. For example, Output produced on display screen or sound produced from speaker are soft copy output and whereas the device is known as soft copy output device. The commonly used soft copy output devices are speaker and monitor.

Output Device

The device which displays meaningful information from the computer is called an output device. So, an output is the result produced by processing unit. The common output devices are monitor and printer. Some other output devices are: plotter, speaker, headphone, etc.

Monitor

Monitor is the most common output device. It is also called VDU (Visual Display Unit) in computer system. The output displayed on monitor's screen in the form of text, videos and graphics is called soft copy output. On the basis of colour the monitors are of two types:

i. Monochrome monitor and ii. Colour Monitor

Monochrome monitor

The monitor which display output in one colour like green, white, black, blue, etc. is called monochrome monitor.

Colour monitor

The monitor which displays output in different colours more than sixteen is called colour monitor.

The information displayed on the screen is made of combination of small tiny dots. The small tiny dots are called pixel.

The clear screen consists of three terms as screen resolution, dot pitch and refreshes rate.

i. Screen Resolution

It represents the number of horizontal and vertical pixels. The clear screen is due to the high resolution of the monitor. The common resolution ranges are 640x480, 1024x768, 1600x1200 etc.

ii. Dot Pitch

The dot pitch is a measure of how close the pixels or dots are to create an image on the monitor. So, it is measured in millimeter. The clear screen is due to the low dot pitch of the monitor.

iii. Refresh Rate

The refresh rate is the rate due to each pixel on screen re-drawn. A low refresh rate results in a poor image on the screen. It is measured in hertz. So, the clear image is due to the high refresh rate.

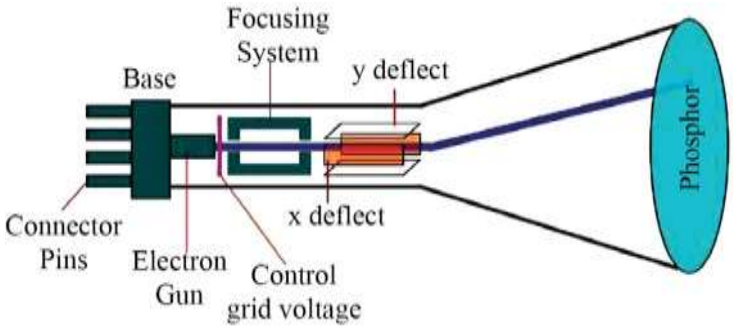
On the basis of technology, monitors are classified into three types as:

i. CRT Monitor

CRT stands for Cathode Ray Tube. It operates in the following ways:

- The electron gun emits a beam of electrons cathode rays.
- The electron beam passes through focusing and deflection systems that direct it towards specified positions on the phosphor-coated screen.
- When the beam hits the screen, the phosphor emits a small spot of light at each position contacted by the electron beam.
- It redraws the picture by directing the electron beam back over the same screen points quickly.

CRT Monitor



There are two ways Random scan and Raster scan by which we can display an object on to the screen.

ii. LCD Monitor

LCD stands for Liquid Crystal Display. It is very light, thin and consumes less power than CRT monitor. The two-layer in this monitor which consists of liquid crystal form an image. It is used in laptop, notebook, digital watch, desktop computer, etc. It is more expensive than CRT monitor and produces a high quality image on the screen. The fluorescent lamps are used for backlighting in LCD monitor for displaying image on the screen.

LCD Monitor

iii. LED Monitor

LED stands for Light Emitting Diode. It is very lighter and thinner than LCD and CRT monitors. It consumes less power than CRT and LCD monitors. Its working power is higher than others. So its lifetime is more and can be used for long-time-work. The quality of image on the screen is higher than that of other monitors. The diodes are used for backlighting in LED monitor for displaying the image on the screen. LCD and LED monitors are called flat panel displays.

LED Monitor

ii. Printer

Printer is a hard copy output device. It prints text & graphics on paper. There are many different types of printers available in market. Its speed is measured by CPS (Character per second), LPM (Line per minute) and PPM (Page per minute). The printers are classified in two types on the basis of printing quality. They are:

- Impact printer
- Non-impact printer

Impact Printer

An impact printer is a type of printer that operates by striking a metal or plastic head against an ink ribbon. Its structure is like a typewriter. It uses small pin-like objects or hammers that strike on the inked ribbon and characters are formed on the paper. These printers are slow and noisy. These printers use black or blue or red colour. The printing quality of impact printer is lower than non-impact printer.

The three main types of impact printer are following:

i. Dot Matrix Printer

Dot-matrix printer is a type of impact printer. The printer head contains a number of pins. The printer head strikes on the inked ribbon, the striking forms dotted characters on the paper. The speed of Dot-matrix printers ranges from 50 to 400 CPS (Character Per Second).

Dot Matrix Printer

ii. Daisy Wheel Printer

Daisy wheel printer is a type of impact printer. It uses hammer-like object to hit on the ink ribbon and a character is formed on the paper. The hammer contains letter face and is arranged in wheel like form and motor spins the wheel at a rapid rate. When desired characters spin to the correct position, a printer hammer strikes on the ribbon and output is formed on the paper. The speed of the daisy wheel printer ranges from 25 to 55 CPS (Character Per Second).

Print Head of Daisy Wheel

iii. Line Printer

Line printer is a type of impact printer. Its printing quality is better than that of Daisy wheel printer and Dot-matrix printer. It prints text line by line. So, it is called a line printer. The three types of line printer are:

Drum printer: In this type, there is a cylindrical drum which continuously rotates over the paper surface and causes characters rise and hits on the ribbon.

Chain Printer: In the chain printer, high-speed print chain is used. This chain contains different types of characters.

Drum Printer

Band Printer: In this line printer, steel print band is used to print one line printout on paper at a time.

Non-Impact Printer

The non-impact printer does not use the printing head to strike against ribbon and paper. Instead, small drops of ink are sprayed onto the paper. So non- impact printers are faster and are of high quality than impact printer. It does not produce sound while printing.

Inkjet printer, laser printer, 3D printer are the popular types of non- impact printer.

i. Ink-jet Printer

Inkjet printer prints text and graphics on paper by spraying small drops of ink into paper. The speed of inkjet printer is generally 1 to 4 pages per minute. It uses an A4 size paper. The liquid colour-filled cartridge is used instead of ink ribbon. Colour inkjet printer uses black colour. Four colour-CMYK (Cyan, Magenta, Yellow, Black) cartridges are used for colour printout.

Inkjet Printer

ii. Laser Printer

A laser printer is a type of printer which makes use of a laser beam to produce an image on the drum or you can say that it is a printer that makes use of a focused beam of light to transfer text and images onto paper. It was first developed by Gary Starkweather at Xerox PARC in 1971. Laser printer makes use of laser technology for the printing of copies onto the paper. Its printout technology is like a photocopy machine. It uses colour powdered toner to print text and graphics on paper. Its printing quality is high.

Laser Printer

iii. 3D – Three Dimensional Printer

Impact printer & non-impact printer prints text on paper but 3D printer prints an object. For example, any playing toys or any machinery parts are printed through the 3D printer. 3D printing builds parts out of plastic, metal and other materials directly from CAD (Computer-Aided Design) drawings that have been cross-sectioned into thousands of layers. This technology helps to build a 3D object by modelling. This technology is called additive manufacturing.

3D Printer

iii. Graphic Plotter

The graphic plotter is a hard copy output device which is used for good quality print or drawing like charts, map, engineering design, etc. Figures or maps are printed on graph paper placed on square board. The graphic plotter is used to print large size figure or map. It gets instruction from computer and draws a clear image by using pen. The different types of plotters are given below.

Pen plotter: Pen plotter contains one or more pen. It prints colour drawing with shade.

Electrostatic plotter: Electrostatic plotter does not contain any type of pen. It prints like laser printer.

Dot-matrix plotter: Dot matrix plotter prints drawing like impact printer. Print head strikes on ink ribbon and prints images on paper.

Graphic Plotter

Speaker

iv. Speaker

Speaker is a common audio output device. It is used to receive sound or music from computer system. It is used to covert digital data into audio analog data which user can understand. The quality of sound output depends on the speaker's quality. For example, loud speakers, sub woofers, in- wall/ceiling speaker, outdoor speaker, etc. are the different types of speakers.

Printer

Different types of printers are described below:

a. **Dot matrix**- printer: Dot matrix printer is an impact printer that produces text and graphics when tiny wire pins on the print head strike the ink ribbon. The print head runs back and forth on the paper like a typewriter. When the ink ribbon presses on the paper, it creates dots that form text and images.

Advantages :

i. Can print on multi-part forms or carbon copies.
ii. Low printing cost per page.
iii. Reliable, durable.

Disadvantages :

i. Noisy.
ii. Limited print quality.
iii. Low printing speed.
iv. Limited color printing.

b. **Inkjet printers:** These are non-impact printers which print text and images by spraying tiny droplets of liquid ink onto paper. They are the most popular printers for home use.

Advantages :

i. Low cost.
ii. High quality of output, fine and smooth printing.
iii. Good color printing
iv. Easy to use.
v. Faster in processing

Disadvantages :

i. Print head is less durable.
ii. Expensive replacement ink cartridges.
iii. Not good for high volume printing.
iv. Cannot use highlighter marker on inkjet printouts.

c. **Laser printers:** Laser printers are non-impact printers which can print text and images in high speed and high quality resolution, ranging from 600 to 1200 dpi.

Advantages :

i. High resolution.
ii. High print speed.
iii. No smearing.
iv. Cheap printing
v. Good for high volume printing.

Disadvantages :

i. They are more expensive than inkjet printers.
ii. Except for high end machines, laser printers are less capable of printing vivid colors and high quality images such as photos.
iii. They cost of toner replacement and drum replacement is high.
iv. Warm up time is needed.

Impact printer	**Non-Impact Printer**
1. It uses electro-mechanical mechanism that causes hammers or pins to strike against a ribbon and paper to print the text	1. It uses thermal, chemical, electrostatic, laser beam or ink jet technology for printing the text and images.
2. It is slow while printing.	2. It is fast while printing.
3. It uses force for printing and produces more sound while printing.	3. Since it doesn't use force for printing it produces less sound while printing.
4. It cannot print graphics perfectly.	4. It can print graphics perfectly.
5. It is usually single colored.	5. It can be single or multi-colored.
6. It is rarely used at present.	6. It is widely used at present.
examples: Dot matrix printer, Typewriter etc.	Examples: Ink jet printer, laser printer etc

Hardware Interface

Computer software

Computer software is the collection of computer programs, procedures and documentation that performs different tasks on a computer system. The types of software are system software and application software. They are as follows:

a. System software:
i. Operating system: Windows, Mac, DOS, etc.
ii. Utility software: antivirus software, backup software, etc.
iii. Language processor:
b. Application software:
i. Package software: word processing, database software, etc.
ii. Tailored software: JAVA, C++, etc.

a. **System software:** It is software designed to operate the computer hardware to provide a platform for running application software it helps in running the computer hardware and the computer software.
i. **Operating system:** It is the most important program that runs on a computer. Every general purpose computer must have an operating system to run other programs.
ii. **Utility software:** it helps to manage, maintain and control computer resources. Examples: virus scanning software, backup software, etc.
iii. **Language processor:** it is a special type of computer system software that can use to translate the programs written in one language into another language.

b. **Application software:** it enables the user to accomplish certain specific tasks. It can use to solve application type of problem.

i. **Package software:** it is mainly designed by software companies to generalize the tasks. They are general purpose software. For examples: word processing software, database software, spreadsheet software, multimedia software, etc.

ii. **Tailored software:** it is specific purpose software. It is also called small type of software. These types of software are developed for specific tasks. They are written in high level languages.