Unit-1

Computer Basics

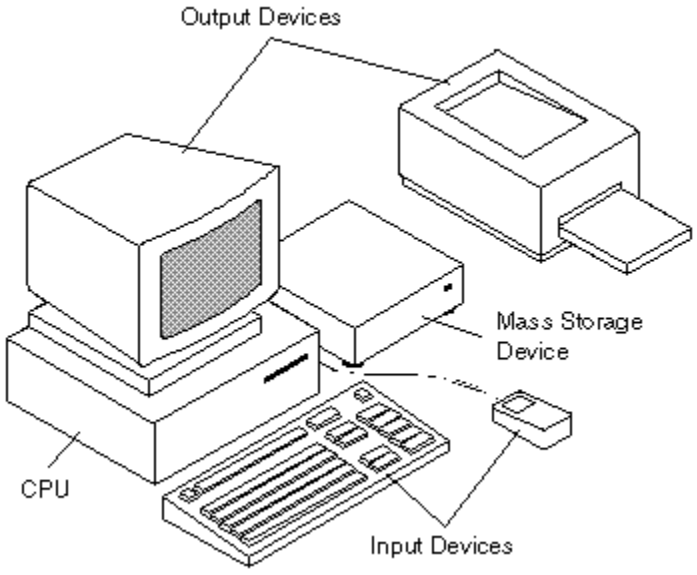
1.1 Computer:

Computer is an electronic device, which is used for manipulating data according to a list of instructions. A list of computer instructions designed to perform some task is known as a program. It is a complete collection of hardware, software and peripherals designed to work together. Computers take numerous physical forms. Early electronic computers were the size of a large room, consuming as much power as several hundred modern personal computers. Today, computers can be made small enough to fit into a wrist watch and powered from a watch battery. the most common form of computer in use today is by far the embedded computer. Embedded computers are mostly small and simple and they are often used to control other devices. They are used to control machines from fighter aircraft to industrial robots, digital cameras, and even children's toys.
The defining feature of modern computers which distinguishes them from all other machines is that they can be programmed. That is to say that a list of instructions can be given to the computer and it will store them and carry them out at some time in the future. Instruction is a command given to a computer to perform specified task. Some computer instructions are simple: add one number to another, move some data from one location to another, send a message to some external device, etc. These instructions are read from the computer's memory and are generally executed in the order they were given.

Computer works mostly on data and information. Data is a collection of raw facts. Data may be valuable or non-valuable. When these data has been converted and processed, so that it gets definite form and shape which becomes useful and act as a base for making any decision. Then it becomes an information, in simple we can say that information is the processed data. The two principal characteristics of a computer are:

- It responds to a specific set of instructions in a well-defined manner.
- It can execute a prerecorded list of instructions.

Modern computers are electronic and digital. The actual machinery i.e. wires, transistors, and circuit is called hardware. The instructions and data are called software. All general-purpose computers require the following hardware components as shown in the diag:



- **memory**: Enables a computer to store, at least temporarily, data and programs.
- **mass storage device :** Allows a computer to permanently retain large amounts of data. Common mass storage devices include disk drives and tape drives.
- **input device :** Usually a keyboard and mouse, the input device is the way through which data and instructions enter a computer.
- **output device :** A display screen, printer, or other device that lets you see what the computer has accomplished.
- **central processing unit (CPU):** The heart of the computer, this is the component that actually executes instructions.

Computer System mainly consists of two things:

Hardware: The term hardware covers all of those parts of a computer that are tangible objects. Circuits, displays, power supplies, cables, keyboards, printers and mice are all hardware.

Software: Software refers to parts of the computer that have no material form; programs, data, protocols, etc are all software. When software is stored in hardware that cannot easily be modified (such as BIOS ROM in an IBM PC compatible), it is sometimes termed firmware to indicate that it falls into an area of uncertainty between hardware and software.

1.2 Characteristics Of Computer

Speed: The smallest unit of time that we know is second, But the measurement of operations in computers are in microsecond, nanosecond and pico second. The speed of computer is closely related to the amount of data it process. The term volume and frequency are often used to describe the amount of data. Volume represent the overall quantity of the data to be processed. Frequency specifies how often a specific data item is used in processing.

Accuracy: Human Beings make certain mistakes while doing certain computation. But the computer system computes the data accurately and quickly.

Reliability: Computer systems are widely accepted because of their exceptional reliability. Unlike, most humans, they are capable of doing the work under the most adverse condition without showing any sign of fatique. Computer provides the accurate result under all the operating conditions.

Storage Capability: Computer system has a storage area which is known as memory to hold a large amount of data. The installation of computer has meant economic survival for many companies.

Versatility: Computers are versatile. They can do a variety of jobs depending on the instruction fed to them and their hardware characteristics. Modern computers are capable of handling not only complex arithmetic problems but also a lots of job unrelated to numbers, like railways and airline ticket reservation. Computers can be attached with several kinds of peripheral devices to accomplish variety of jobs.

Even computer system has got thousand of advantages but there are some disadvantages also that it does not take any decision o their own because it is working on the basis of what are feed in it. It's Iq is completely zero.

Beside many advantages the computer has also some of the disadvantages they are:

- Computer does no work by itself. It works on the basis of the list of instruction given to it.
- Computer does not have any I.Q it works on the basis of what has been instructed.
- Computer does not take decision of its own.
- Computer does not learn by experience.

1.3 History Of Computer:

The history of computers dates back to 500 BC, when the Chinese invented a calculating machine called Abacus. Some of these types of inventions discussed below are:

- Abacus
- Jacquard Loom

- Charles Babbage's Difference Engine
- Hollerith Census Tabulator
- Aiken & Mark1
- Von Neumann

A. Abacus

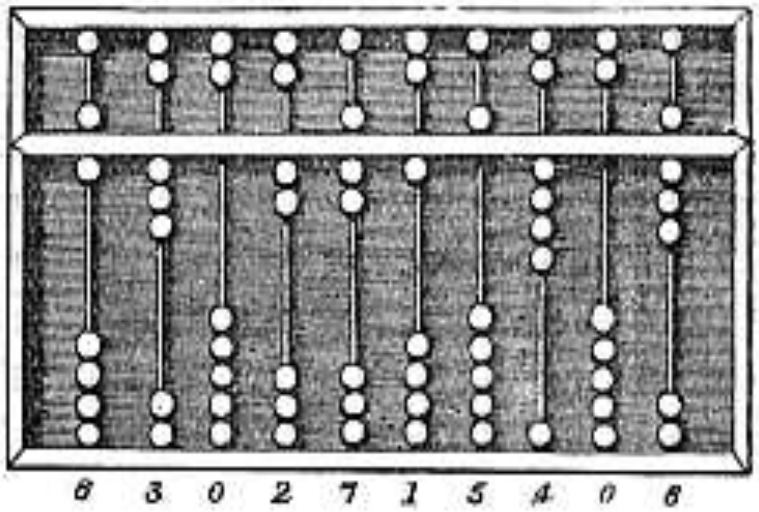
An **abacus** is a calculation tool, often constructed as a wooden frame with beads sliding on wires. It was in use centuries before the adoption of the written Hindu-Arabic numeral system and is still widely used by merchants and clerks in the People's Republic of China, Japan, Africa, and elsewhere.

The Chinese abacus is typically around 20 cm (8 inches) tall and it comes in various widths depending on the application. It usually has more than seven rods. There are two beads on each rod in the upper deck and five beads each in the bottom for both decimal and hexadecimal computation. The beads are usually rounded and made of a hard wood. The beads are counted by moving them up or down towards the beam. The abacus can be reset to the starting position instantly by a quick jerk along the horizontal axis to spin all the beads away from the horizontal beam at the center.

Chinese abaci can be used for functions other than counting. Unlike the simple counting board used in elementary schools, very efficient **suanpan** techniques have been developed to do multiplication, division, addition, subtraction, square root and cube root operations at high speed.

Bead arithmetic is the calculating technique used with various types of abaci, in particular the Chinese abacus. The similarity of the Roman abacus to the Chinese one suggests that one could have inspired the other, as there is some evidence of a trade relationship between the Roman Empire and China. However, no direct connection can be demonstrated, and the similarity of the abaci may be coincidental, both ultimately arising from counting with five fingers per hand. Where the Roman model (like most modern Japanese) has 4 plus 1 bead per decimal place, the standard Chinese abacus has 5 plus 2, allowing less challenging arithmetic algorithms, and also allowing use with a hexadecimal numeral system. Instead of running on wires as in the Chinese and Japanese models, the beads of Roman model runs in groves, presumably making arithmetic calculations much slower. Possibly the Roman abacus was used primarily for simple counting. In a contest between the Chinese abacus and the electric calculator on November 12, 1946, the abacus won 4 to 1.

.



2. Jacquard's Loom

The **Jacquard loom** is a mechanical loom, invented by Joseph Marie Jacquard in 1801, which utilized holes punched in pasteboard, each row of which corresponded to one row of the design. Multiple rows of holes were punched on each card and the many cards that comprised the entire design of the textile were strung together in order.

Each hole in the card corresponds to a "Bolus" hook, which can either be up or down. The hook raises or lowers the harness which carries and guides the warp thread so that the weft will either lie above or below it. The sequence of raised and lowered threads is what creates the pattern. Each hook can be connected via the harness to a number of threads, allowing more than one repeat of a pattern. A loom with a 400 hook head might have four threads connected to each hook, resulting in a fabric that is 1600 warp ends wide with four repeats of the weave going across.

Charles Babbage Difference Engine

The first device that might be considered to be a computer in the modern sense of the word was conceived in 1822 by the eccentric British mathematician and inventor Charles Babbage.

Babbage's engines were among the first mechanical computers. His engines were not actually completed, largely because of funding problems and personality issues. Babbage realized that a machine could do the work better and more reliably than a human being. Babbage directed the building of some steam-powered machines that more or less did their job, suggesting calculations could be mechanized to an extent.

The data and program memory were separated, operation was instruction based, the control unit could make conditional jumps and the machine had a separate I/O unit.

In Babbage's time numerical tables were calculated by humans called 'computers'. At Cambridge he saw the high error rate of the people computing the tables and thus started his life's work in trying to calculate the tables mechanically, removing all human error. He began in 1822 with what he called the difference engine, made to compute values of polynomial functions.

Soon after the attempt at making the difference engine crumbled, Babbage started designing a different, more complex machine called the Analytical Engine. The engine is not a single physical machine but a succession of designs that he tinkered with until his death in 1871. The main difference between the two engines is that the Analytical Engine could be programmed using punch cards, an idea unheard of in his time.

Hollerith Census Tabulator

The US government began to encounter certain problem in data processing. It took seven years to compile the statistics from the 1880 census and it became apparent that it would be time to begin a new census before the analysis one was completed. Hollerith designed a device called the tabulating machine, which used machine readable punched cards. This card has round holes and forty five columns. His machine reduces the tabulating time to one-eighth the time required by the old methods.

Aiken & Mark1

The **IBM Automatic Sequence Controlled Calculator** (**ASCC**), called the **Mark I** by Harvard University[1], was the first large-scale automatic digital computer in the USA. It is considered by some to be the first universal calculator.

The electromechanical ASCC was devised by Howard H. Aiken, created at IBM, shipped to Harvard in February 1944, and formally delivered there on August 7, 1944. The main advantage of the Mark I was that it was fully automatic—it didn't need any human intervention once it started. It was the first fully automatic computer to be completed. It was also very reliable, much more so than early electronic computers. It is considered to be "the beginning of the era of the modern computer"

The building elements of the ASCC were switches, relays, rotating shafts, and clutches. It was built using 765,000 components and hundreds of miles of wire, amounting to a size of 51 feet (16 m) in length, eight feet (2.4 m) in height, and two feet deep. It had a weight of about 10,000 pounds (4500 kg). The basic calculating units had to be synchronized mechanically, so they were run by a 50 foot (15 m) shaft driven by a five-horsepower (4 kW) electric motor.

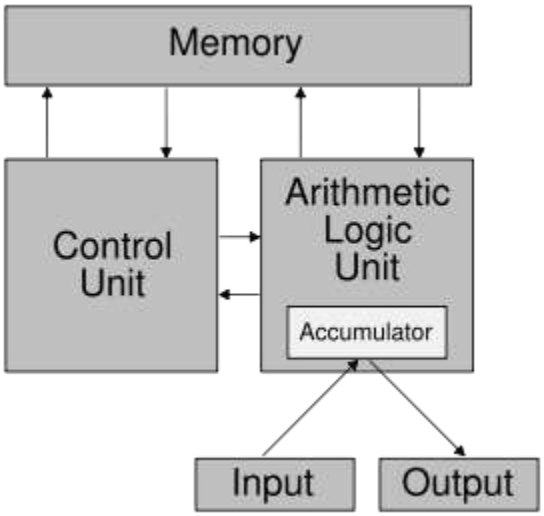
The Mark I could store 72 numbers, each 23 decimal digits long. It could do three additions or subtractions in a second. A multiplication took six seconds, a division took 15.3 seconds, and a logarithm or a trigonometric function took over one minute.

The Mark I read its instructions from a 24 channel punched paper tape and executed the current instruction and then read in the next one. It had no conditional branch instruction. This meant that complex programs had to be physically long. A loop was accomplished by joining the end of the paper tape containing the program back to the beginning of the tape.

1.4 Von Neuumann

The **von Neumann architecture** is a computer design model that uses a processing unit and a single separate storage structure to hold both instructions and data.

The separation between the CPU and memory leads to the von Neumann bottleneck, the limited throughput (data transfer rate) between the CPU and memory compared to the amount of memory. In modern machines, throughput is much smaller than the rate at which the CPU can work. This seriously limits the effective processing speed when the CPU is required to perform minimal processing on large amounts of data. The CPU is continuously forced to wait for vital data to be transferred to or from memory. As CPU speed and memory size have increased much faster than the throughput between them, the bottleneck has become more of a problem.



1.5 Technical Evolution Of Computer:

The term generation is used to characterise the major developments in the computer industry. There are five generations of computers and the term generation means we are able to distinguish between different hardware technologies.

- First Generation 1946-1956
- Second Generation 1956-1964
- Third Generation 1964-1971
- Fourth Generation 1971-Present
- Fifth Generation Present-Future

1.5.1 First Genration Computers

The era of the first generation computers began in 1946 because that was the year when people consciously set out to build stored program computers. In 1946 there was no 'best' way of storing instructions and data in a computer memory. There were four competing technologies for providing computer memory: electrostatic storage tubes, acoustic delay lines (mercury or nickel), magnetic drums (and disks), and magnetic core storage.

Electrostatic Storage tubes: A high-speed electrostatic store was the heart of several early computers. The great advantage of this type of "memory" is that, by suitably controlling the deflector plates of the cathode ray tube, it is possible to redirect the beam almost instantaneously to any part of the screen

Acoustic delay lines: It is based on the principle that electricity travels at the speed of light while mechanical vibrations travel at about the speed of sound. So data can be stored as a string of mechanical pulses circulating in a loop, through a delay line with its

output connected electrically back to its input. The sequence of bits flowing through the delay line is just a continuously repeating stream of pulses and spaces, so a separate source of regular clock pulses is needed to determine the boundaries between words in the stream and to regulate the use of the stream. Delay lines have some obvious drawbacks. One is that the match between their length and the speed of the pulses is critical, yet both are dependent on temperature. Another is a programming consideration. The data is available only at the instant it leaves the delay line. If it is not used then, it is not available again until all the other pulses have made their way through the line.

- A **mercury delay line** is a tube filled with mercury, with a piezo-electric crystal at each end. Piezo-electric crystals, such as quartz, have the special property that they expand or contract when the electrical voltage across the crystal faces is changed. Conversley, they generate a change in electrical voltage when they are deformed. So when a series of electrical pulses representing binary data is applied to the transmitting crystal at one end of the mercury tube, it is transformed into corresponding mechanical pressure waves. The waves travel through the mercury until they hit the receiving crystal at the far end of the tube, where the crystal transforms the mechanical vibrations back into the original electrical pulses. Mercury delay lines had been developed for data storage in radar applications.
- **Nickel delay lines** take the form of a nickel wire. Pulses of current representing bits of data are passed through a coil surrounding one end of the wire. A receiving coil at the other end of the wire is used to convert these pressure waves back into electrical pulses.

Magnetic Drum: The magnetic drum is a more familiar technology, comparable with modern magnetic discs. It consisted of a non-magnetic cylinder coated with a magnetic material, and an array of read/write heads to provide a set of parallel tracks of data round the circumference of the cylinder as it rotated. Drums had the same program optimization problem as delay lines.

Magnetic Core Memory: The most important contribution made by the MIT(Massachusetts Institute of Technology) group was the development of the magnetic core memory, which they later installed in Whirlwind. The MIT group made their core memory designs available to the computer industry .

BENDIX G-15 COMPUTER

Some computers of these generations are given below:

ENIAC: The first generation of computers is said by some to have started in 1946 with ENIAC, the first 'computer' to use electronic valves i.e. vacuum tubes. It is developed at the university of Pennsylvania in U.S.A by the team of Eckert and Mauchly. The full form of ENIAC is Electronic Numerical Integrator and Calculator. It has a very small memory and mostly used for calculating the trajectory of missiles.

EDVAC: The full form of EDVAC is Electronic discrete variable Automatic Computer. In this machine instruction of the program are stored with the data internally. By the help of this the accessing of computer becomes faster.

EDSAC: In May 1949 there is a introduction of EDSAC, the first stored program computer. EDSAC stands for Electronic Delay Storage Automatic Computer. It makes use of mercury delay lines for storage of data.

UNIVAC: The first commercial production of stored electronic computer was UNIVAC. UNIVAC stands for Universal Automatic Computer. Univac division of Remington Rand develops it.

Characteristics of First Generation Computers

- Used vaccum tubes
- Not reliable
- Big and clumsy computers
- Electric consumption is very high
- This type of computers generate too much heat, therefore air conditioners are required.
- Batch processing
- Slow Input/Output operations.

1.5.2 Second Generation Computers

The invention of Transistors marked the start of the second generation. These transistors took place of the vacuum tubes used in the first generation computers. First large-scale machines were made using these technologies to meet the requirements of atomic energy laboratories. One of the other benefits to the programming group was that the second generation replaced Machine language with the assembly language. Even though complex in itself Assembly language was much easier than the binary code.

Second generation computers also started showing the characteristics of modern day computers with utilities such as printers, disk storage and operating systems. Much financial information was processed using these computers.

In Second Generation computers, the instructions could be stored inside the computer's memory. High-level languages such as COBOL (Common Business-Oriented Language) and FORTRAN (Formula Translator) were used.

Characteristics of Second Generation Computers

- Transistor takes place of vaccum tubes.
- Faster than first generation.
- Assembly language is used instead of machine language.
- Generate less heat
- Smaller in size
- Magnetic tapes and disks are used.

1.5.3 Third Generation Computers

Although transistors were great deal of improvement over the vacuum tubes, they generated heat and damaged the sensitive areas of the computer. In third generation of computers, Integrated Circuit replaces the transistors. The Integrated Circuit(IC) was invented in 1958 by Jack Kilby. It combined electronic components onto a small silicon disc, made from quartz. More advancement made possible the fitings of even more components on a small chip or a semi conductor. Also in third generation computers, the

operating systems allowed the machines to run many different applications. These applications were monitored and coordinated by the computer's memory.

From small-scale integrated circuits (SSI) , which had about 10 transistors per chip, technology developed to medium scale integrated circuit with 100 transistors per chip. Magnetic disk technology also improved and it become feasible to have drive having capacity up to 100 MBs.

Characteristics of Third Generation Computers

- Transistors is replaced integrated circuits
- Increases speed as well as reliability.
- Uses multiprogramming operating system .
- Lower power consumption
- Magnetic disk can be used as a secondary storage.

1.5.4 Fourth Generation Computers

Fourth Generation computers are the modern day computers. The Size started to go down with the improvement in the integrated circuits. Very Large Scale (VLSI) and Ultra Large scale (ULSI) ensured that millions of components could be fit into a small chip. It reduced the size and price of the computers at the same time increasing power, efficiency and reliability. "The Intel 4004 chip, developed in 1971, took the integrated circuit one step further by locating all the components of a computer i.e. central processing unit, memory, and input and output controls on a minuscule chip."

Due to the reduction of cost and the availability of the computers power at a small place allowed everyday user to benefit. In 1981, IBM introduced personal computers for home and office use. Computer size kept getting reduced during the years. It went down from Desktop to laptops to Palmtops. Machintosh introduced Graphic User Interface in which the users didn’t' have to type instructions but could use Mouse for the purpose. The continued improvement allowed the networking of computers for the sharing of data. Local Area Networks (LAN) and Wide Area Network (WAN), were potential benefits.

Characteristics of Fourth Generation Computers

- Very large scale and ultra large scale integrated circuits has been developed.
- Computers now becomes portable.
- Semiconductor can be used as primary storage.
- Database Management system can be used
- Distributed data processing.

1.5.5 Fifth Generation Computers

Fifth generations computers are only in the minds of advance research scientists and being tested out in the laboratories. These computers will be under Artificial Intelligence (AI), They will be able to take commands in a audio visual way and carry out instructions. These computers will perform many of the operations, which require low human intelligence.

Parallel Processing is coming and showing the possibility that the power of many CPU's can be used side by side, and computers will be more powerful than those under central processing. Advances in Super Conductor technology will greatly improve the speed of information traffic. Future looks bright for the computers.

1.6 Types Of Computers

The computers can be broadly classified into three types

1. Analog Computers.
2. Digital Computers.
3. Hybrid Computers.

1.6.1 Analog Computers

An analog computer is a form of computer that uses electrical or mechanical phenomena to model the problem being solved. Modeling a real physical system in a computer is called simulation. In this computations are carried out with physical quantities such as voltage, length , temperature etc. The devices that measure such quantities are voltmeter and ammeter.

Computations are often performed, in analog computers, by using properties of electrical resistance, voltages and so on. For example, a simple two variable adder can be created by two current sources in parallel. The first value is set by adjusting the first current source (to say *x* milliamperes), and the second value is set by adjusting the second current source (say *y* milliamperes). The use of electrical properties in analog computers means that calculations are normally performed in real time. The core mathematical operations used in an electric analog computer are:

- summation
- inversion
- exponentiation
- logarithm
- integration with respect to time
- differentiation with respect to time
- multiplication and division

Analog computers are limited by real, non-ideal effects. An analog signal is composed of four basic components: DC and AC magnitudes, frequency, and phase. The real limits of range on these characteristics limit analog computers.

1.6.2 Digital Computers

Computers which are used today is digital computers. They work on binary digits, incase of some alphabetic information, the information must be coded in the form of by binary digit. Digital computers can be classified into two types:

1. **Purpose wise:** Purpose wise digital computers can be classified into two categories.First is, special purpose computer which is designed to perform some specific task.Second is, General purpose computer, whichis used to develop for work on different types of program.
2. **Size And Performance wise:** These digital computers can be classified as follow:

    - **Personal Computer :** A small, single-user computer based on a microprocessor. In addition to the microprocessor, a personal computer has a keyboard for entering data, a monitor for displaying information, and a storage device for saving data. The most common personal computers are desktop machines. The machines made by IBM are called IBM PCs. Other manufacturers use IBM's specification and design their own PC are known as IBM compatible PC.
    - **Workstation :** A powerful, single-user computer. A workstation is like a personal computer, but it has a more powerful microprocessor and a higher-quality monitor. They are single user computers having a lot of features of personal computer. Their processing speed is like mini computers. This powerful machine is greatly used by the scientist, engineers and other professionals. They are very expensive.
    - **Mini Computer :** These are medium sized computers. They possess more work efficiency in comparison with micro computers. Mini computers are more expensive than a micro computers and one cannot think of purchasing a mini computer for personal use. These computers are generally useful for small & medium sized company. More than one person can use this computer at a time. Mini computer possess multiple CPUs. They have bigger memory and higher speed than micro computer but less than that of main frame. They are cheaper than mainframe. A multi-user computer capable of supporting from 10 to hundreds of users simultaneously. Medium sized company can be used for following purpose:

        1. Employees Payroll
        2. Maintenance of books of accounts.
        3. Cost Analysis.
        4. Sales Supervision.

- **Mainframe :** A powerful multi-user computer capable of supporting many hundreds or thousands of users simultaneously. These are large computer with bigger storage capacity. These can store huge data bases and can also process the data wit more speed. Due to there speed in processing huge data bases, they are being used by big companies, banks etc as a centralized computer system. It can continuously work round the clock and hundreds of users can work on them simultaneously. Mainframe can easily attached to any network and even to microcomputer. These computers are used for following purpose.

To maintain customer details

1. To maintain payment details
2. To process bills
3. To process notices.

- **Super Computer :** An extremely fast computer that can perform hundreds of millions of instructions per second. These computers with biggest capacity and higher working speed among all the catgories of computers. It has multiple CPU arranged and working parallel to each other. In a super computer, a CPU consist of many ALU and each ALU is assigned for specific process, working parallel. These computers are used in the following fields:

1. In modeling nuclear fission
2. In weather forecasting
3. In space research and space exploration.

- Laptop: A **laptop computer** or simply **laptop** is a small mobile personal computer, which usually weights 4-12 pounds (2-6 kilograms), depending on size, materials and other factors.

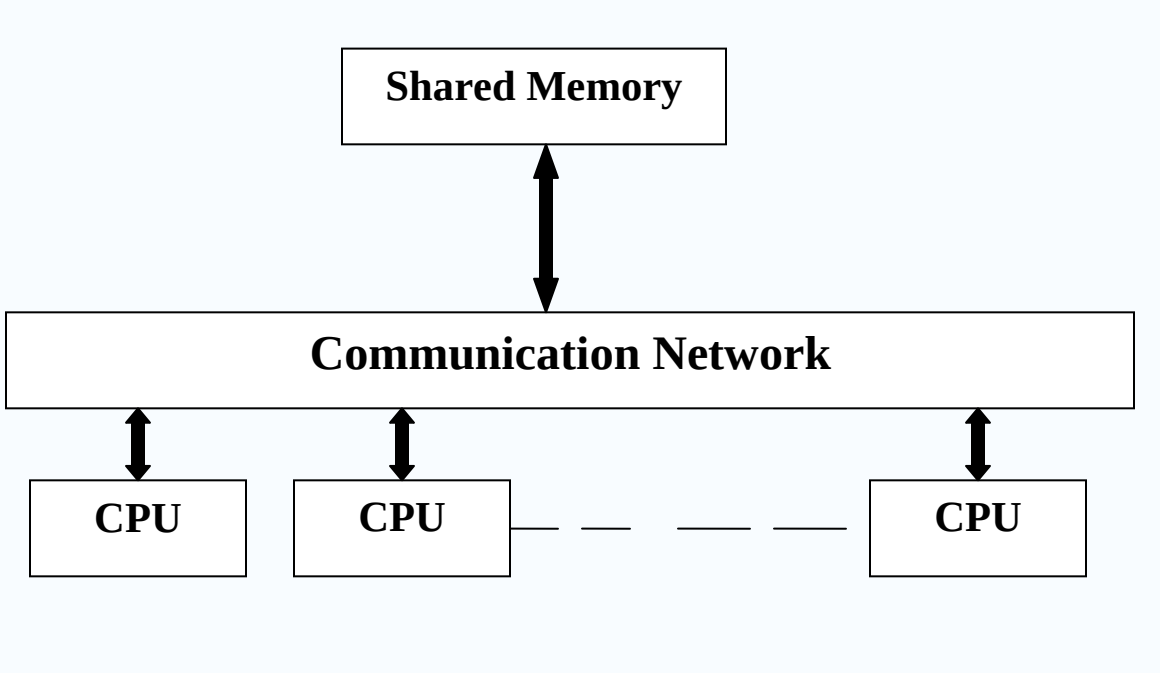
Laptops usually run on a single battery or from an external AC/DC adapter which can charge the battery while also supplying power to the computer itself.

Distributed Computer System: A configuration in which several computers are interconnected by a communication network is called distributed computer system. A common use of distributed computer system is called client server computing. The PC which is requesting for the srevices is called client and the computer providing the services is called server.

Sometime there are problems requirng either large storage or high speed processing which cannot be solved using a single computer in a network. In such cases it may be possible to get a set of computers

connected to the network to cooperate and solve the problem. In distributed computer system it often happens that many computers are not fully utilized. In such cases a user requiring more CPU resources than what he as in his computer can steal CPU cycles from idle processor to do his job. The communication network connecting te computers in a distributed system is normally slow and allows only one message to be communicated between two computers at a time. This type of network is called LAN(Local Area Network).

Parallel Computers: A set of computers connected together by a high speed communication network and programmed in sucha way that they can cooperate to solve a single large problem is called a parallel computer. There are two major types of parallel computers. One of them is called a **shared parallel computer**. In this case a number of processing elements are connected to a common main memory by a communication network. A program for this computer is written in such a way that multiple processsor can work independently and cooperate to solve problem. The processes are allocated to different processors and they read and modify the data accessible to all of them in memory.

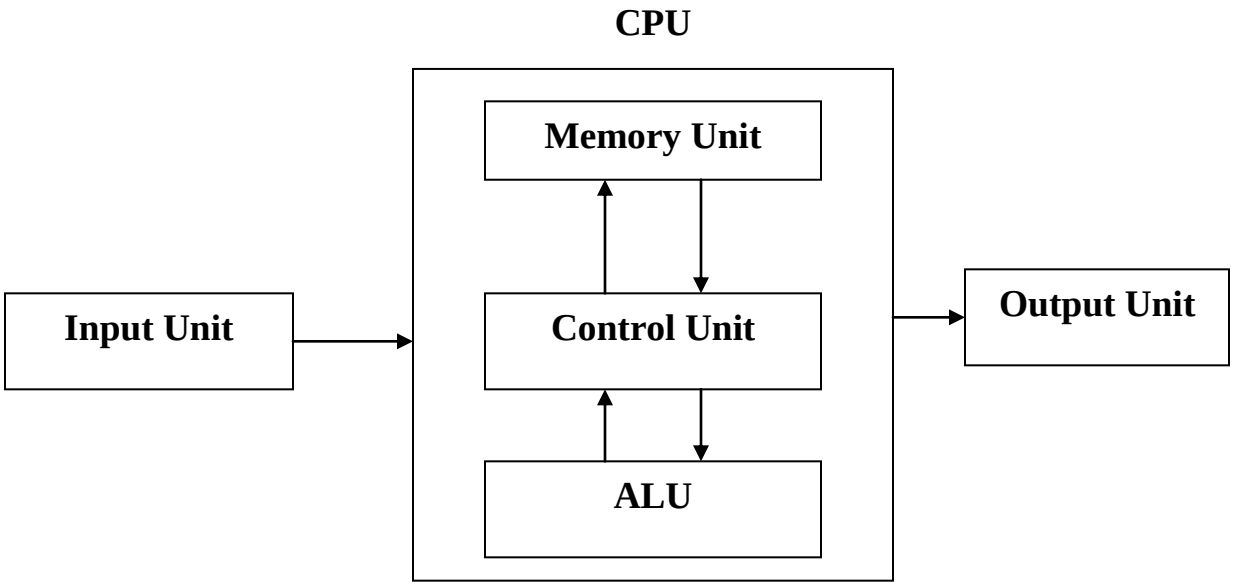


The other type of parallel computer is called a **distributed memory computer**. In this type a number of processors, each with its own memory are interconnected by a communication network. A program is divided into many parts and each computer work independently. Whenever processo need to exchange data to continue with computation they do so by sending messages across the network.Such computers are called message passing multicomputers. A popular interconnection network is called a hypercube.

1.6.3 Hybrid Computers

Hybrid computers are made by combining features of analog computers and digital computers. In general, analog computers are extraordinarily fast, since they can solve most complex equations at the rate at which a signal traverses the circuit, which is generally an appreciable fraction of the speed of light. Digital computers can be built to take the solution of equations to almost unlimited precision, but quite slowly compared to analog computers. Hybrid computers can be used to obtain a very good but relatively imprecise 'seed' value, using an analog computer front-end, which is then fed into a digital computer iterative process to achieve the final desired degree of precision. Hybrid computers utilizes the best qualities of digital and analog computer.

1.7 Block diagram of Computers looks like the one below



A. Central Processing Unit

A central processing unit (CPU), or sometimes simply called processor**,** is the component in a digital computer that interprets instructions and processes data contained in computer programs. CPUs provide the fundamental digital computer trait of programmability, and are one of the necessary components found in computers of any era, along with primary storage and input/output facilities. A CPU that is manufactured using integrated circuits is known as a microprocessor. A typical central processor unit (CPU) consists of the following interconnected functional units:

- Registers
- Arithmetic/Logic Unit (ALU)
- Control Unit

B. Registers:

Register consist of flip flops. These flip flops are connected in parallel. A CPU contains a number of registers to store data temporarily during the execution of a program. The no of register is differ from processor to processor. The advantages of storing the data in register are that it can be retrieved faster than memory because the number of register in the memory is very less. The drawback of using the register is that it is very expensive. Register are classified as follows:

1. **Accumulator:** It is a register, which holds one of the operand prior to the execution of instruction and receives the result of most of the arithmetic and logic operations. It is one of the frequently used registers.
2. **General Purpose Register:** These register stores data and intermediate result during the execution of a program. These are accessible to the user if the user is working in assembly language.
3. **Special Purpose Register:** A CPU contains a number of special purpose registers. It is used for different purpose. These are:
    - Program counter
    - Stack pointer
    - Status register
    - Instruction register
    - Memory address register
    - Memory buffer register

    Program Counter: It holds the address of the memory location, which contains the next instruction, which is to be fetched from the memory. It content is automatically incremented after the execution of an instruction.

    Stack Pointer: It is used to save the contents of the register if it is required during the execution of a program.

    Status Register: It is a 1-bit flag, which is used to indicate certain condition that arises during the arithmetic and logic operation.

    Instruction Register: It holds the instruction until it is decoded.

    Memory Address Register: It holds the address of the instruction or data to be fetched from the memory.

    Memory Buffer Register: It holds the instruction code or data received from or sent to the memory. The data which are written into the memory are held in this register until write operation is completed.

- **Arithmetic/Logic Unit:** All processors contain an arithmetic/logic unit, which is often referred to simply as the ALU. The ALU, as its name implies, is that portion of the CPU hardware which performs the arithmetic and logical operations on the binary data .The ALU must contain an Adder which is capable of combining the contents of two registers in accordance with the logic of binary arithmetic. This provision permits the processor to perform arithmetic manipulations on the data it obtains from memory and from its other inputs. The ALU contains Flag Bits, which specify certain conditions that arise in the course of arithmetic and logical manipulations. Flags typically include Carry, Zero, Sign, and Parity.

- **Control Unit:** The control unit is the primary functional unit within a CPU. Using clock inputs, the control circuitry maintains the proper sequence of events required for any processing task. After an instruction is fetched and decoded, the control circuitry issues the appropriate signals for initiating the proper processing action. Often the control circuitry will be capable of responding to external signals, such as an interrupt or wait request An Interrupt request will cause the control circuitry to temporarily interrupt main program execution.

1.8 Problem Solving Using Computers

To solve a problem using a computer following steps are carried out.

1. The given problem is analyzed.
2. The method used to solve the problem is broken down into a sequence of elementary tasks.
3. Based on the analysis an algorithm to solve the problem is formulated. The algorithm should be precise, concise & unambiguous (not repeated).
4. The algorithm is expressed in a precise notation. An algorithm expressed using a precise notation is called a computer program.
5. The computer program is fed to the computer.
6. The computer's processing unit interprets the instructions in the program, executes them and sends the result to the output unit.

1.9 Input Devices

These are those devices, which facilitate a user to give input. Information is entered in to a computer through input devices. An input device converts input information in to suitable binary format, which can be accepted by the computer system. Some examples of input devices are keyboard, mouse, Light pen etc. Some of theses devices permit the user to select some thing on the CRT screen by pointing to it. Therefore, these devices are also known as pointing devices.

The computer system has to process details of each command, therefore the command will have to be converted in to machine readable format and this

work can be done through input unit. This unit will transmit the data as a series of electric pulses in to the computer memory unit, where it will be available for processing. These devices translate the data into a code that can be read by the computer's system electronic circuitry.

Keyboard

Keyboard is one of the most widely used peripheral devices. Data is entered in to the computer system through keyboard. Keyboards are designed for the input of text and characters and also to control the operation of a computer. A keyboard is similar to the keyboard of a type-writer.

Physically, computer keyboards are an arrangement of rectangular or near-rectangular buttons, or "keys". Keyboards typically have characters engraved or printed on the keys; in most cases, each press of a key corresponds to a single written symbol. Keyboard come in a variety of sizes and shapes, But most of the keyboard have a common number of features like:

1. Standard type writer keys
2. Function keys
3. Special purpose keys
4. Cursor Movement Keys
5. Numeric keys

Working Of A Keyboard

1. When a key is pressed, it pushes down on a rubber dome sitting beneath the key. A conductive contact on the underside of the dome touches a pair of conductive lines on the circuit below.
2. This bridges the gap between them and allows current to flow.
3. A scanning signal is emitted by the chip along the pairs of lines to all the keys. When the signal in one pair becomes different, the chip generates a "make code" corresponding to the key connected to that pair of lines.
4. The code generated is sent to the computer through a keyboard cable.
5. A chip inside the computer receives the signal bits and decodes them into the appropriate keypress. The computer then decides what to do on the basis of the key pressed. Eg: Either display a character on the screen, or perform some action.

Mouse

This input deice is used especially for Graphica User Interface. Mouse is a device which is used to move the cursor on the screen and to select options. When the mouse is moved on the surface the cursor is also moved in the same direction on the monitor. By moving the mouse the user can point to menu on the screen i..e. Mouse is also known as pointing device. Pressing the button of a mouse is known as clicking. Technicians often describe mouse speed in DPI(dots per inch). One DPI is intended to be the number of pixels the mouse cursor will move when the mouse is moved one inch.

Some common types of mouse are

Mechanical Mouse

This type of mouse are used on personal computer.It has a rubber ball inside it , which can roll in any direction. There is a mechanical sensor which is present inside the mouse and which is able to detect the direction of rolling the ball and moves the pointer according to that.

1 Moving the mouse turns the ball.
2 X and Y rollers grip the ball and transfer movement.
3 Optical encoding disks include light holes.
4 Infrared LED shine through the disks.
5 Sensors gather light pulses to convert to X and Y velocities.

Optical Mouse

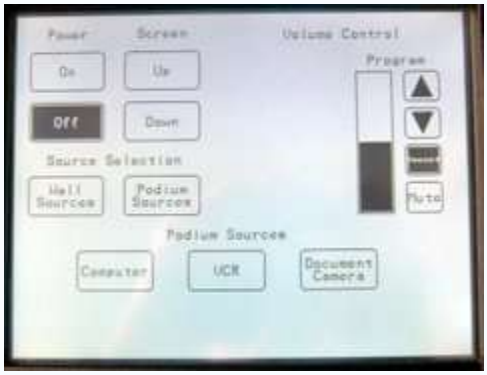
This mouse works on the basis of light source and the base where optical mouse kept should be clean. The statement does not mean that any special base is needed: we should required the base where 50% of the light should be reflected. An optical mouse uses a light-emitting diode and photodiodes to detect movement relative to the underlying surface, rather than moving some of its parts — as in a mechanical mouse.

2.1.3 Light Pen

A light pen is a pointing device.It is an input device in the form of a light-sensitive wand used in conjunction with the computer's CRT monitor. It allows the user to to select a displayed menu option on the CRT. A light pen can work with any CRT-based monitor, but not with LCD screens, projectors or other display devices. It is capable of sensing a position on the screen when its tip touches it ,its photocell sensing element detects the light coming on the screen and sends the corresponding signal to the processor.

2.1.4 Touch Screens

It is a type of display screen in which one can use finger to point the command displayed on the screen. In this user touches the icon that represent their choices and the computer display information about their choices.



There are some types of touch screen technology:

1. A resistive touch screen panel is coated with a thin metallic electrically conductive and resistive layer that causes a change in the electrical current which is registered as a touch event and sent to the controller for processing.
2. Surface wave technology uses ultrasonic waves that pass over the touch screen panel. When the panel is touched, a portion of the wave is absorbed. This change in the ultrasonic waves registers the position of the touch event and sends this information to the controller for processing.

2.1.5 Joystick

A joystick is a personal computer peripheral devices. It is also used to move the cursor position on the CRT screen. Most joysticks are two-dimensional, having two axes of movement, but three-dimensional joysticks do exist. A joystick is generally configured so that moving the stick left or right signals movement along the X axis, and moving it forward (up) or back (down) signals movement along the Y axis. Joysticks are often usedto control games**.**

2.1.6 MICR

Magnetic Ink Character Recognition, or MICR, is a special kind of character recognition technology that was adopted mainly by the banking industry to facilitate the processing of cheques**.** A special ink called magnetic ink is used to write the character of the cheques and deposit forms which are to be processed by an MICR. The magnetic ink is magnetized during the input process. The MICR reads these pattern and compared with the special pattern stored in the memory. This method is fast, accurate and automatic. Moreover, the the chances of errors are negligible.

2.1.7 OCR

It is an abbreviated form of Optical Character Reader. It detects the alphanumeric character printed on paper. It is a computer software designed to translate images of handwritten or typewritten text into machine-editable text, or to translate pictures of characters into a standard encoding scheme representing them (e.g. ASCII or Unicode). It works on the basis of light scanning techniques in which each character is illuminated by the light source and the reflected images of the character is received by the photocells which provides binary data corresponding to the lighted and dark areas.OCR is quite costly because the memory requirement is very high.

2.1.8 Bar Code Reader

Bar code is a machine readable numerical code, printed as a set of varying width vertical bars.Bar codes are used in many applications where strict control of inventory is needed. A barcode reader is a computer peripheral for reading barcodes printed on various surfaces.As you know bar codes are present on most of the grocery item, it consist of a number of thick lines with a varying distance between them.A barcode reader scans the bar code, and converts it into a number that the computer that the computer can then process and display on the screen. Bar code reader, generally consists of a light source, a lens and a photo conductor translating optical impulses into electrical ones. Therefore, it read such bars and convert thm in to electrical pulses which is processed by the computer.

Benefits of using barcodes

- Barcodes can provide very detailed up-to-date information , enabling decisions to be made much quicker and with more confidence.
- Bar code scanners are also relatively low costing and extremely accurate – only about 1/100000 entries will be wrong.

Types of barcodes:

- Linear barcodes
- Stacked barcodes
- 2D barcodes: A matrix code, also known as a 2D barcode, is a two-dimensional way of representing information. It is similar to a linear (1-dimensional) barcode, but has more data representation capability.

2.1.9 Digital Camera

A digital camera is an electronic device used to capture and store photographs electronically instead of using photographic film like conventional cameras. Digital cameras are those cameras whose primary purpose is to capture photography in a digital format. In this once the picture is taken then it can be transferred or downloaded it in to the computer.

Many modern digital photography cameras have a video function, and a growing number of camcorders have a still photography function. The resolution of a digital camera is determined by the camera sensor which is usually a Charged Coupled Device or CCD chip that turns light into digital information, replacing the job of film in traditional photography. It represents this light value in pixels, which are little squares that make up the image. Each pixel can store one digital value, which can then be recalled and put with other pixel values to generate a digital photograph. The more pixels the camera can recall, the better the resolution it can offer. Many digital cameras can connect directly to

a computer to transfer data. Early cameras used the PC serial port. Digital cameras need memory to store data. Common formats for digital camera images are the Joint Photography Experts Group standard (JPEG).

2.1.10 Web Camera

A web camera (or webcam) is a real-time camera whose images can be accessed using the World Wide Web. Web-accessible cameras typically involve a digital camera which uploads images to a web server, either continuously or at regular intervals. Web camera focuses on an object at one end and reflect it on the screen at the other end. You can be able to see the person while chatting by the help of this web camera. Videoconferencing cameras typically take the form of a small camera connected directly to a PC. Webcams typically include a lens, an image sensor, and some support electronics.

2.1.11 Graphic Tablet

A graphics tablet is a computer input device that allows one to hand-draw images and graphics, similar to the way one draws images with a pencil and paper.Graphics tablets consist of a flat surface upon which the user may "draw" an image using an attached stylus,it is just a pen-like drawing apparatus. The image generally does not appear on the tablet itself but, it is displayed on the computer monitor. The stylus is a technology, that was originally designed as a part of the electronics, but later it simply took on the role of providing a smooth, but accurate "point" that would not damage the tablet surface while "drawing".

Graphics tablets, because of their stylus-based interface has the ability to detect pressure, tilt, and other attributes of the stylus and its interaction with the tablet, are widely considered to offer a very natural way to create computer graphics, especially two-dimensional computer graphics. The first home computer graphics tablet was the KoalaPad. ACE CAD Enterprise Co. Ltd, Aiptek, Wacom are some of the manufacturer f the graphic tablet. Some examples are:

- the Crosfield imaging system
- the Quantel Paintbox

2.1.12 Microphone (Mic)

A microphone, sometimes referred to as a mike or mic.It is an electric transducer that converts sound into an electrical signal. The first commercially practical microphone was the carbon microphone conceived in October, 1876 by Thomas Edison. A microphone is a device which is able to capture waves in air, water or hard material and translate it to an electrical signal.

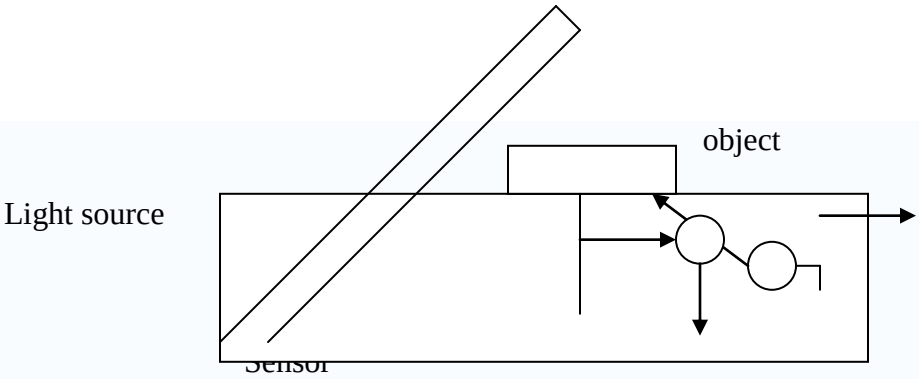
Microphones are used in many applications such as telephones, tape recorders, hearing aids, in radio and television broadcasting and in computers for recording voice, and numerous other computer applications.

2.1.13 Scanner

Scanner is that kind of input device which are capable of entering the information directly in to the computer system. A scanner is a device that analyzes an image such as a photograph, printed text, or handwriting and converts it to a digital image.

Scanners typically read red-green-blue color (RGB) data from the array. This data is then processed with some proprietary algorithm to correct for different exposure conditions and sent to the computer. The other qualifying parameter for a scanner is its resolution, measured in pixels per inch (ppi). The third important parameter for a scanner is its density range. A high density range means that the scanner is able to reproduce shadow details and brightness details in one scan.

Scanner works on the basis of light source. In this light source emit the light to the object. Some amount of light is absorbed by the object, wherease some amount of light is reflected by it to the sensor. The work of the sensor is to convert that amount of light into the digital data and the that digital data is transmitted to the computer.



Side View Of The Scanner

Types Of Scanner

Drum scanners: Drum scanners capture image information with photomultiplier tubes (PMT). It is of medium size. In this drum roles over the image for scanning. The scanner drum, which rotates at high speed while it passes in front of the precision optics that deliver image information to the PMTs. The Most modern color drum scanners use 3 matched PMTs, which read red, blue and green light respectively. Drum scanners are rarely used to scan prints of high quality because inexpensive flatbed scanners are readily available.

Flatbed scanner: A flatbed scanner is usually composed of a glass pane, under which there is a bright light which is often of cold cathode fluorescent which illuminates the pane. Images to be scanned are placed face down on the glass and the sensor array and light source move across the pane reading the entire area.

Hand scanner: Hand scanners are manual devices which are dragged across the surface of the image to be scanned. They typically have a "start" button which is held by the user for the duration of the scan, some switches to set the optical resolution, and a roller which generates a clock pulse for synchronisation with the computer. Most hand scanners were monochrome, and produced light from an array of green LEDs to illuminate the image.

Scanner quality

Scanners typically read red-green-blue color (RGB) data from the array. This data is then processed with some proprietary algorithm to correct for different exposure conditions and sent to the computer, via the device's input/output interface (usually SCSI or USB, or LPT in machines pre-dating the USB standard). Color depth varies depending on the scanning array characteristics, but is usually at least 24 bits. High quality models have 48 bits or more color depth. The other qualifying parameter for a scanner is its *resolution*, measured in pixels per inch (ppi), sometimes more accurately referred to as samples per inch (spi). Instead of using the scanner's true optical resolution, the only meaningful parameter, manufacturers like to refer to the *interpolated resolution*, which is much higher thanks to software interpolation., a good flatbed scanner has an optical resolution of 1600–3200 ppi, high-end flatbed scanners can scan up to 5400 ppi, and a good drum scanner has an optical resolution of 8000–14,000 ppi.

The third important parameter for a scanner is its density range. A high density range means that the scanner is able to reproduce shadow details and brightness details in one scan.

2.1.14 Smart Card Reader

Smart cards were invented and patented in the 1970s. The first mass use of the cards was used for payment in French pay phones, starting in 1983. A smart card, is also known as chip card, or integrated circuit(s) card (ICC), is defined as any pocket-sized card with embedded integrated circuits. Although there is a diverse range of applications, there are two broad categories of ICCs. Memory cards contain only non-volatile memory storage components, and perhaps some specific security logic. Microprocessor cards contain memory and microprocessor components.

Smart cards stores data in the magnetic stripes which is present at the back side of the card. These data cannot be read visually, and therefore, to read this data, special card reader machine is required, which can decode data present on these magnetic strips.The smart card can hold many information and it is impossible to duplicate it because data is stored in magnetic strips. They can serve as multipurpose card such as credit card, electronic cash card etc.

There is a , Contact Smart Cards which has a small gold chip about ½ inch in diameter on the front. When inserted into a reader, the chip makes contact with electrical connectors that can read information from the chip and write information back. The cards do not contain any batteries, energy is supplied by the card reader. Contact smart card readers are used as a communications medium between the smart card and a host, e.g. a computer.

2.1.15 Biometric Sensor

Biometric sensor is a type of input device which is used for identifyind a person. This technology includes signature verification, voice recognition, finger prints identification. Automated Fingerprint Identification System (AFIS) or Automated Fingerprint Verification System refers to a computer system capable of establishing the identity of an individual through fingerprints. Automated Fingerprint Verification is used to refer to more civilan applications such as attendance and access control systems. On a technical level, verification systems verify a claimed identity (a user might claim to be John by presenting his PIN or ID card and verify his identity using his fingerprint) where as an identification system determines the identity based solely on fingerprints. The US government maintains an extensive database system containing fingerprint and criminal history system that is maintained by the Federal Bureau of Investigation (FBI).

Pointing Devices

The pointer is a graphical representation of the movements made by a pointing device. A pointing device is "An input device that is used to move the pointer on the computer screen."The most common pointing device is the mouse, other kinds include a tracker ball, touchpad, pointing stick, lightpen, and various other kinds of digitising tablets.

A mouse moves the graphical pointer by being slid across a smooth surface. The conventional roller-ball mouse uses a ball to create this action. The ball is in contact with two small shafts that are set at right angles to each other. As the ball moves these shafts rotate, and the rotation is then measured by sensors within the mouse. The distance and direction information from the sensors is then transmitted to the computer. The computer then moves the graphical pointer on your screen by following the movements of the mouse. Another common mouse is the optical mouse. This device is very similar to the conventional mouse but it does not use a roller-ball. An optical mouse uses visible or infrared light to detect the changes in position.

A **trackball** is a pointing device consisting of a ball housed in a socket containing sensors to detect rotation of the ball about two axes. It is similar to an upside-down mouse. As the user rolls the ball with their thumb, fingers, or palm the mouse cursor on the screen will also move. Tracker balls are commonly used on CAD workstations for ease of use, where there may be no desk space on which to use a mouse. Some are able to clip onto the side of the keyboard and have buttons with the same functionality as mouse buttons.

A **touchpad** is a stationary pointing device. It is commonly used on laptop computers. It is flat surface that you slide your finger over to make the graphical pointer move. You use the same movements as you would with a mouse. It uses a two-layer grid of electrodes to measure finger movement. The upper layer has vertical electrode strips that handle vertical movement, and the lower layer has horizontal electrode strips to handle horizontal movements.

A **pointing stick** is a pointing device that is comparible to a touchpad. It is found on laptops embedded between the 'G', 'H', and 'B' keys. The mouse buttons are commonly

placed just below the Spacebar. It operates by sensing the force applied by the user. It has also been observed on computer mice and on some desktop keyboards.

Digitizing tablet is "An input device that enables you to enter drawings and sketches into a computer. A digitizing tablet consists of an electronic tablet and a cursor or pen. A cursor (also called a puck) is similar to a mouse, except that it has a window with cross hairs for pinpoint placement, and it can have as many as 16 buttons. A pen (also called a stylus) looks like a simple ballpoint pen but uses an electronic head instead of ink. The tablet contains electronics that enable it to detect movement of the cursor or pen and translate the movements into digital signals that it sends to the computer." [5] This is different from a mouse because each point on the tablet represents a point on the screen.

OMR:

Optical mark recognition is the process of capturing data by contrasting reflectivity at predetermined positions on a page. By shining a beam of light onto the document the scanner is able to detect a marked area because it is more reflective than an unmarked surface. Some OMR devices use forms which are preprinted onto 'Transoptic' paper and measure the amount of light which passes through the paper, thus a mark on either side of the paper will reduce the amount of light passing through the paper.

It is generally distinguished from optical character recognition by the fact that a recognition engine is not required. That is, the marks are constructed in such a way that there is little chance of not reading the marks correctly. This requires the image to have high contrast and an easily-recognizable or irrelevant shape.

One of the most familiar applications of optical mark recognition is the use of #2 (HB in Europe) pencil bubble optical answer sheets in multiple choice question examinations. Students mark their answers, or other information, by darkening circles marked on a pre-printed sheet. Afterwards the sheet is automatically graded by a scanning machine.

Other examples of OMR are the MICR recognition of the numbers on the bottom of checks, scannable bar codes.

Disadvantages

There are also some disadvantages, limitations to OMR. If the user wants to gather large amounts of text then OMR complicates the data collection , there is also the possibility of missing data in the scanning process, incorrectly or unnumbered pages can lead to them being scanned in the wrong order. Also, unless safeguards are in place, a page could be rescanned providing duplicate data and skewing the data.For the most part OMR provides a fast, accurate way to collect and input data.

Digitizing:

Digitization, is the process of turning an analog signal into a digital representation of that signal. The term is often used for the scanning of analog sources, such as printed photos and taped video into computers for editing, but it also can refer to audio (where sampling rate is often measured in kilohertz) and textures map transformation.

In this last case, like in normal photos, sampling rate refers to the resolution of the image (often measured in dots per inch). Digitizing is the primary way of storing images in a form suitable for transmission and computer processing.

Voice Input Devices

In an effort to increase worker productivity, a substantial amount of research is being done in voice recognition-programming the computer has to recognizspoken commands. Voice Input devices or voice recognition system converts the spoken words into electrical signal by comparing the electrical patterns produced by the speakers voice with a set of pre recorded patterns. If matching pattern is found, the computer accept this pattern as a part of its standard vocabulary. This technology is also used by the people who are not able to use traditional devices.

The biggest problems with this technology involve limitation on the size of the computers vocabulary. Pronunciation differences among the individuals and the computers inability to accept continous speech.

Output Devices

The output devices receive information from the computer and provide them to user in a readable format. The computer sends information to the output devices in binary coded forms. Then, output devices convert them in to a form, which can be used by user. Some output devices are

- Printer
- Monitor
- Plotter
- Speaker

2.2.1 Printer

A computer printer, or more commonly just a printer, is a device that produces a hard copy which is permanent human-readable text of documents stored in electronic form, usually on physical print media such as paper or transparencies. Many printers are primarily used as computer peripherals, and are permanently attached to a computer which serves as a document source. Other printers, commonly known as network printer, have built-in network interfaces, and can serve as a hardcopy device for any user on the network. Some printers are combined with a scanners. A printer which is combined with a scanner can essentially function as a photocopier. Printers are designed for low-volume,

short-turnaround print jobs; requiring virtually no setup time to achieve a hard copy of a given document. However, printers are generally slow devices, and the cost-per-page is relatively high. The choice of print engine has a substantial effect on what jobs a printer is suitable for, as different technologies are capable of different levels of image/text quality, print speed, low cost, noise; in addition, some technologies are inappropriate for certain types of physical media such as carbon paper or transparencies. Printers vary considerably in price, speed, resolution, noise level, paper-handling abilities, printing mechanism and quality and all of these points should be considered when making a selection. The data received by a printer may be:

1. a string of characters
2. a bitmapped image
3. a vector image

Some printers can process all three types of data, others not.

- Daisy wheel printers can handle only plain text data or rather simple point plots.
- Plotters typically process vector images.
- Modern printing technology, such as laser printers and inkjet printers, can adequately reproduce all three.

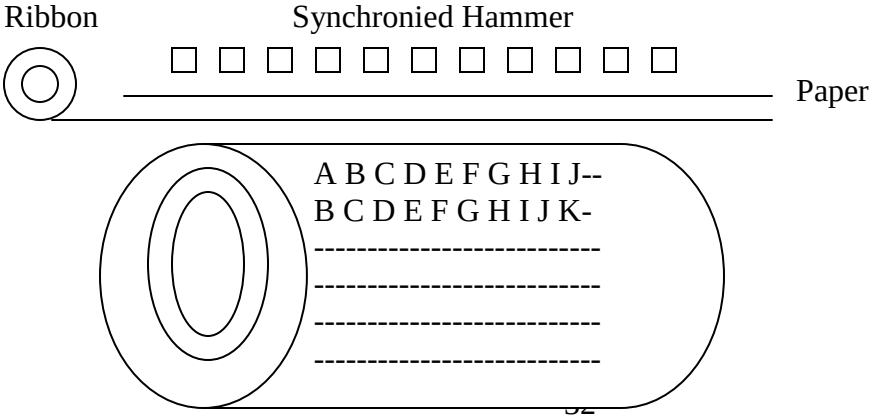
Printers which are used with computer can be classified in two ways. One way of classification of printer is how they print:

Character Printer: Character printer print one character at a time. Their speed lies in the range of 30-600 characters per second. It depends upon the type of printer.

Line Printer: Line printers, as the name implies, print an entire line of text at a time. It make use of a thermal technology. Three principle designs existed.

Drum Printer
Chain Printer
Comb Printer

In **drum printers**, a drum carries the entire character set of the printer repeated in each column that is to be printed. The printer recieves all characters to be printed in one line of the text from the processor. The hammer hit the paper and ribbioon against the desired character on the drum when it comes in the printing position.



In **chain printers** which is also known as train printers, the character set is arranged multiple times around a chain that travels horizontally past the print line. In either case, to print a line, precisely timed hammers strike against the back of the paper at the exact moment that the correct character to be printed is passing in front of the paper. The paper presses forward against a ribbon which then presses against the character form and the impression of the character form is printed onto the paper.

Comb printers represent the third major design. These printers were a hybrid of dot matrix printing and line printing. In these printers, a comb of hammers printed a portion of a row of pixels at one time. By shifting the comb back and forth slightly, the entire pixel row could be printed.

Another way of classifying the printer is on the basis of manufacture:

Impact Printer: Impact printer use electromechanical mechanism that causes hammer or pin to strike against a ribbon and a paper to print the text. A printer that forms an image on paper by forcing a character image against an inked ribbon. Dot-matrix, Daisy-wheel etc are impact printer.

Non Impact Printer: A printer that creates an image without striking a ribbon against the paper.It does not use electromechanical printing head to strike against ribbon and paper.These type of printer use thermal, chemical, electrostatic, laser beam or inkjet technology for printing the text. A nonimpact printer is faster than impact printer. Non impact printer include thermal printer, inkjet printer and laser printer. These printer are all much quieter in operation than impact printer.

2.2.1.1 Dot Matrix Printer

It is a type of impact printer. The term dot matrix printer is specifically used for impact printers that use a matrix of small pins to create precise dots. The advantage of dot-matrix over other impact printers is that they can produce graphical images in addition to text; however the text is generally of poorer quality than impact printers that use letter forms.

In this character is printed by printing the selected no of dots from a matrix of dot. The formation of a character has been shown 5 dot rows and 7 dot columns. This pattern is called 5*7 dot matrix. Such printers would have either 9 or 24 pins on the print head. Print head is that part of the printer that creates the printed image. 24 pin print heads were able to print at a higher quality. Dot matrix printers were one of the more common types of printers used for general use - such as for home and small office use. These print hammer strikes the ribbion individually as the print mechanism that move across the

entire printline in both the directions i.e. from left to right and viceversa. The speed of a dot matrix printer is about 240 to 4800 words per minutes.

Some dot matrix printers, such as the NEC P6300, can be upgraded to print in color. This is achieved through the use of a four-color ribbon mounted on a mechanism that raises and lowers the ribbons as needed. Color graphics are generally printed in four passes at standard resolution, thus slowing down printing considerably. As a result, color graphics can take up to four times longer to print than standard monochrome graphics, or up to 8-16 times as long at high resolution mode.

Dot matrix printers are still commonly used in low-cost, low-quality applications like cash registers, or in demanding, very high volume applications like invoice printing.

2.2.1.2 Inkjet Printer

It is a type of non impact printer. It is a printer that creates an image by spraying tiny droplets of ink from the printhead. While many dot matrix printers have 9 to 24 pins, most ink-jets have printheads with some where between 30 and 60 nozzles, and this allows them to create high resolution images in a single pass over the paper. Both color and black-and-white ink jet printers are avaiable.

In ink-jet printer, whenever we want to print the image the nozzel spread the ink, so there is a permanent remark on the paper. Suppose there is a 5 pin then it spread the ink up to 5 pixels. But it can approximately print up to 16 to 32 pixel at a time.

As you know inkjet printers consist of nozzles that produce very small ink bubbles that turn into tiny droplets of ink. The dots formed are the size of tiny pixels. Ink-jet printers can print high quality text and graphics. They are also almost silent in operation. Inkjet printers have a much lower initial cost than do laser printers, but have a much higher cost-per-copy, as the ink needs to be frequently replaced.

In inkjet printer the ink is stored in a cartridge.A colour inkjet printer cosist of four cartridge one each for blue, green, cyan, magenta and black. This system of colour is called CYMK(K stands for black). Inkjet printers are also far slower than laser printers.

2.2.1.3 Laser Printer

A high-resolution non impact printer that uses a variation of electrophotographic process which is used in photocopying machines to print the text and graphics on to the paper. Laser printer are page printer. They make use of laser beam to produce an image of the page containing text /graphics on a photo sensitive drum. The most common type of toner-based printer is the laser printer. Laser printers are known for high quality prints, good print speed, and a low cost-per-copy; they are the most common printer for many general-purpose office applications. Laser printers are available in both color and monochrome varieties.

A laser printer uses a rotating disc to reflect laser beam onto a photosensitive drum, where the image of the page is converted in to an electrostatic charge that attracts and hod the toner. A piece of charged paper is then rolled against the drum to transfer the image , and heat is applied to fuse the tonnerand paper together to create the final image. In simple we can say that, the laser printer consist of a drum coated with photoconductive material and there is a laser beam, and the control of the laser beam is on to the computer to turn it either on or off. When the aser beam falls on the drum, then it produces a –ve potential on it. And the graphite powder has +ve potential, therefore both paper and powder attracts each other. The powder is attached only where the electric potential is present, but the powder is also spread on an unwanted area and it is removed by the heat. The graphite powder is stored in the tonner. The ink is spread through the tonner and it is spread in an unsaturated form. These type of printer are quite, fast, clean and well suitedto the home or office environment.

2.2.2 Plotter

A plotter is a vector graphics printing device that connects to a computer. It is an output device. It is used to produce precise and good quality grphics and drawings under computer control. Plotters print their output by moving a pen across the surface of a piece of paper. This means that plotters are restricted to line art, rather than raster graphics as with other printers. They can draw complex line art, including text, but do so very slowly because of the mechanical movement of the pens. It is just like dot matrix printer but the difference is that , in printer the paper has the movement wherease in plotter the pen will move arround the pape. In this the pen will move in horizontal as well as in vertical direction. In plotter only one pin is availale.The pen moves up on the page where we want to draw the image.

Another difference between plotters and printers is that a printer is aimed primarily at printing text. This makes it fairly easy to control, simply sending the text to the printer is usually enough to generate a page of output. This is not the case of the line art on a plotter, where a number of printer control languages were created to send the more detailed information like "draw a line from here to here".

Early plotters for e.g. the Calcomp 565 of 1959 worked by placing the paper over a roller which moved the paper back and forth for X motion, while the pen moved back and forth on a single arm for Y motion. Plotter draw the graphic faster. Plotters uses inkpen to draw graphics or drawing. Either single colour or multicolour pen is used. The pen are driven by motors.The pen potter may be classified in to the following types

Drum plotter: It contain along cylinder and a pen carriage. The paper is placed over the drum. The drum rotates back and forth. The pen moves horizontally along the surfacei.e either left to right or right to left.

Flat-Bed Plotter: It uses horizontal flat surface on which paper is fixed and the pen moves along both the axes i.e. x axis and y axis.

Inkjet Plotter: These plotter uses inkjet in place of ink pens.

2.2.3 VDU

VDU stands for visual display unit. A computer display (also known as a computer monitor, computer screen, or computer video display) is a device that can display signals generated by a computer as images on a screen. A visual display terminal contain a key board for input and visua display unit for output. Quality factors used in monitor are:

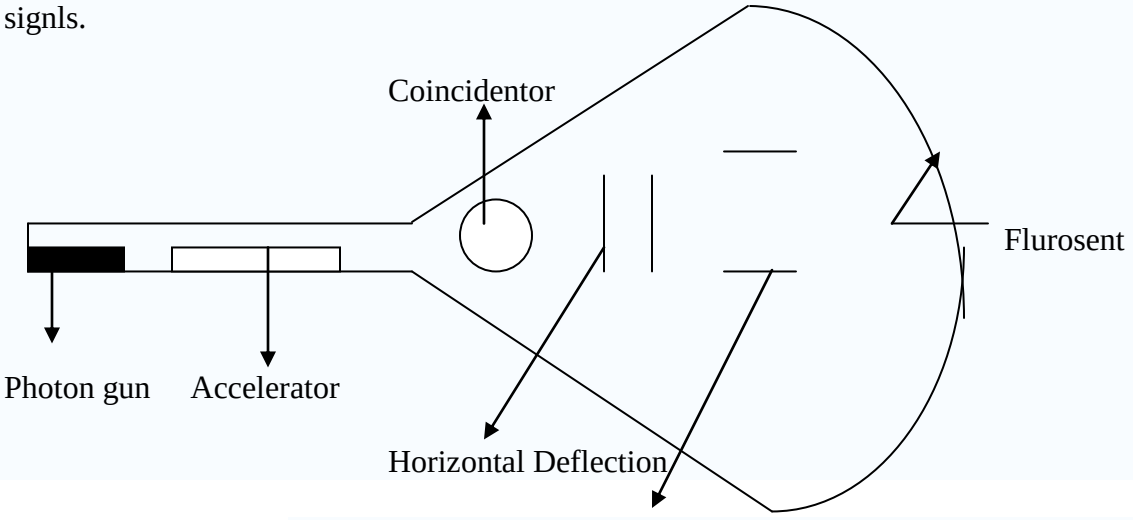
- **Pixels:** It is the smallest unit of monitor which is displayed without disturbing the other point .While designning the pixels, some distance between the pixels must be there in the horizontal as well as in vertical directin also.
- **Aspect Ratio:** It is the ratio of the pixels in the horizontal as well as in vertical direction also.
- **Resolution:** No of pixels in a per unit area.
- **Refreshing Rate:** The rate by which the pixels glow again

Refreshing Rate = 1/Refreshing Time

The visual display unit is known as monitor. Visual display unit is broadly divided into two categories:

2.2.3.1 CRT Monitors

CRT stands for the cathode ray tube.To see an image on the screen we have to glow that part. Energy of the photon goes to the fluroscent material,it produces the light and a point is introduced on the monitor.CRT makes use of the directing devices to give direction to the photon otherwise, it will goes towards the center. Some amount of magnetic field is applied to run photons in correct directions. Magnetic field is nothing but electrical signls.



In thae above diag, there is a photon gun which is used to produce photonsbut the speed of the generated photon is very slow, therefore to increase its speed,there is an accelerator. It will give velocity to the photon. Before shifting the photons to different directions we have to coincident all the photonsat a point and this point is known as coincidentor. Two horizontal and vertical defection plates is usedto give direction to the photon in the upward and the downward direction. For colour monitor, 3 electron gun is used.

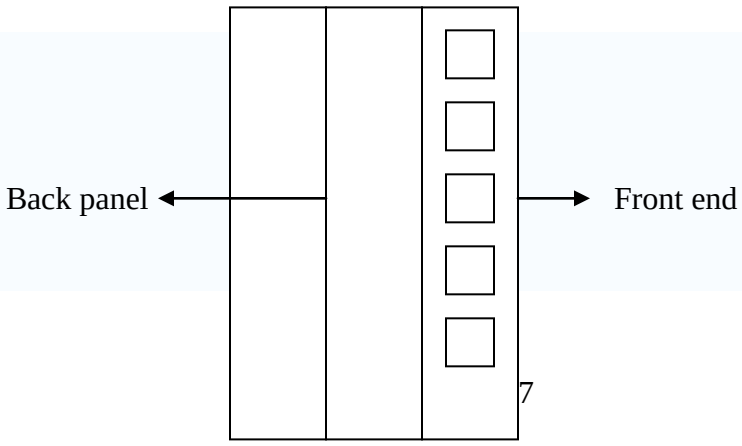
Monochrome & Colour Monitors:

Monochrome monitor is a monitor which is capable of displaying only a single colour image and an RGB monitor is a colour monitor. Both monitors differ in two ways, first, they have no of electron guns. A monochrome monitor has one electron gun whereas RGB monitor has 3 electron gun. Secod tscreen in an RGB colour monitor is coated with 3 types of phosphors: red, green, blue. In this each ixel is made up of 3 dots one of each colour. The 3 electron gun direct their beam togeter. Each gun is aimed precisely so that it can hit a specific colour dot in each pixel. A wide variety of colour is made by the combination of gun fire. For eg: if all the three guns are fired at full intensity , aspecific coour is made, if only two guns are fired with full intensiy and the third gun is fired at half intensity, an entire different colour is made,. By varying the intensity of the gun, RGB monitors are capable of displaying a large no of different colour.

2.2.3.2 Non CRT Display

1. **LCD:** LCD stands for liquid crystal display. In LCD a liquid crystaline material is sandwiched between two plate that is made of plastic the front plate is transparent and the back plate is reflective.At the back end there is one more field and the function of this field is to generate the electric field. Through back panel the light is emitted which falls on the crystal then the crystal induces the colour on the screen. When the amunt of light source falls then some amount of light source also get wasted also. The area around a particular crystal is known as segment.Each and every liquid crystal has separate segment area.

In LCD for colour monitor there is 3 layers which is made up of transparent materialand all they are made up of RGB colour. These 3 layers are overlapped with one another. Suppose, if we want to emit the light of different colour which is made by th mixture of any two colour then it is predecided that what is the proportion of each colour to be mixed so that particular colour is made.



Side view Of LCD

The Principle advantage of LCD are:

- Lower power consumption.
- Low cost.
- Small size.

The biggest disadvantage of LCD are:

- LCD do not emit light; as a result, the image has very little contrast.
- The screen is very suspectible to glare, so the optimum viewing angle is very narrow.
- The resolution is not as good as that of a CRT.

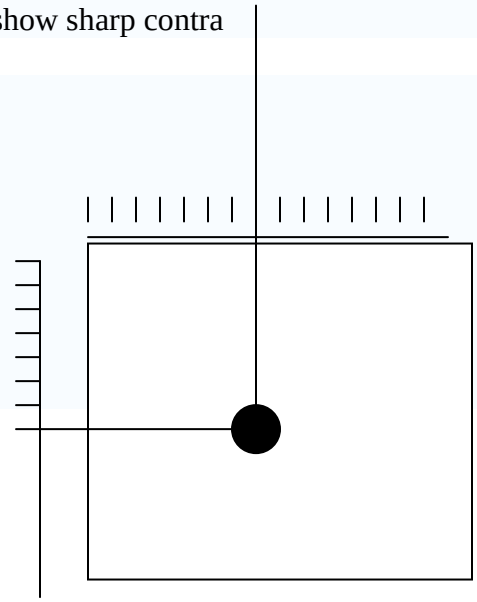
2. **Plasma Display:** In this ionized gas is sandwiched between two glass plates. A no of parallel wires run horizontally as well as vertically. A small amount of current is passed through one horizontal and one vertical wire to cause the gas to glow at a spot at the intersection of wires.

The Principle advantage of gas plasma display are:

- The images are much brighter than on a standard CRT.
- The resolution is excellent.
- The screen does not flicker like some CRTs.

The biggest disadvantage of gas plasma display are:

- Only single colour is available.
- The technology is expensive.
- It uses a lot of power.
- It does not show sharp contra



2.2.4 Speaker

Speaker is one of the output devices which is mainly used for entertainment, video conferencing etc.Computer speakers, or multimedia speakers, are external speakers and are usually equipped with a male-end stereo jack plug .The sound capability of the computer system does not work unless and unti there is a sound card. Speaker recieves the data from the sound card in the form of electric signal and then convert it in to the sound format.There are also USB speakers which gain their power from the 5 volts of a USB port. Computer speakers are usually a simplified stereo system without a radio or other media sources built in.

Computer speakers range widely in quality and in price. Typically, the simplest computer speakers come with computers. There are also advanced forms of computer speakers that have graphic equalization features such as bass, treble, etc for dynamic audio flexibility. Speaker must have the following features

- An LED, typically green, that acts as a power indicator.
- A 1/8" or even 1/4" headphone jack.
- Dials or buttons for volume, bass, and treble.
- A wired or wireless remote control for volume and power control.

3. Software:

The term "software" was first used in this sense by John W. Tukey in 1957. In computer science,computer software is nothing but all computer programs.To perform any task on computer, the programmer has to write a set of instruction. This sequence of instruction given to the computer is called a program. A set of program written for the computer is called software. Software is a program that enables a computer to perform a specific task, as opposed to the physical components of the system. This includes application software such as a word processor, which enables a user to perform a task, and system software such as an operating system, which enables other software to run properly, by interfacing with hardware and with other software. In computers, software is loaded into RAM and executed in the central processing unit. At the lowest level, software consists of a machine language specific to an individual processor. A machine language consists of groups of binary values signifying processor instructions i.e. object code. Software is an ordered sequence of instructions for changing the state of the computer hardware in a particular sequence. It is usually written in high-level programming languages that are easier and more efficient for humans to use than machine language. High-level languages are compiled or interpreted into machine language object code. Software may also be written in an assembly language, essentially, a mnemonic representation of a machine

language using a natural language alphabet. Assembly language must be assembled into object code by the help of assembler. Software is categorized on the basis of application it performs. Software can be classified as:

3.1Custom made software

Custom-made programs are usually composed to meet the processing needs of a specific organization or an individual. The need for custom-made programs arises when the specific needs of users are not matched with the capabilities of any of the packages available in the market. The main advantage of such programs is that they can be tailored to the user's exact specifications.

Creation of specification software involves a series of steps to be taken in an ordered manner:

Step1: **Defining the problem**- the problem or the need of new software may result from a number of reasons, say, changing operating conditions. So, the problem should be defined and defined and specific goals outlined.

Step2: **System Analysis**- system analysis is the study of existing operations to learn what they accomplish, why they work as they do and what role they may have in future processing activities. A system is a group of parts which are integrated to achieve some objective.
After the need for specific changes is identified, the next step is to analyze data about current processing operations. It involves

- Data collection
- System Flowchart
- Analysis of findings

Step3**: System design-** It is the process of creating alternative solutions for satisfying the set goals, evaluating different choices available and then drawing up the specifications for the chosen alternative solution. Once the best alternative approach is decided, the new specifications which include the outputs desired, the inputs data needed and the processing procedures requires for converting input data into output results are prepared.

Step4**: Programming Analysis-** It is the process in which the new are broken down into four operations.

- Input/Output
- Calculation/text manipulation
- Logic/comparison
- Storage/retrieval operations

This can be done by using analysis tools such as program flowchart.

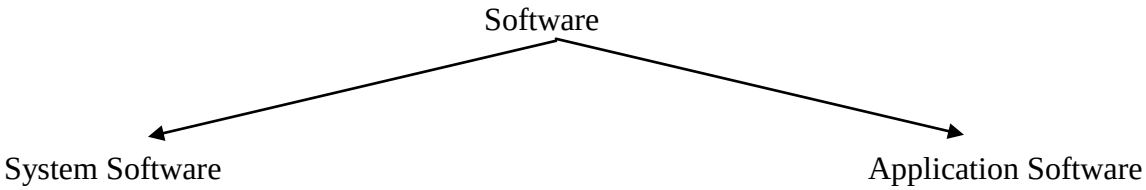
Step5**: Program Generation-** the operations identified during the programming analysis stage is converted into programs in a programming language.

Step6**: Implementation and Maintenance-** the new software is tested and implemented. Finally the successfully implemented systems and programs are usually subjects to continual change for maintenance purposes.

3.2 Pre – written software

Pre-written software packages typically address the processing needs of users. They can be separated into two divisions::

(a)System software packages
(b)Application packages



3.2.1 System Software

As you know that, a set of programs written for the computer is called software. The software required to execute user program is called system software. This software controls all processing activities and make sure that resources and the power of the computer are used in most efficient manner. The major purpose of system software is it controls the execution of program and helps in the development of software.

System software helps in running the computer hardware and computer system. It includes operating systems, device drivers, diagnostic tools, servers, windowing systems, utilities and more. The purpose of systems software is to insulate the applications programmer as much as possible from the details of the particular computer complex being used, especially memory and other hardware features, and such accessory devices as communications, printers, readers, displays, keyboards, etc. System software can be classfied as:

- ✓ System Control Software
- ✓ System Support Software
- ✓ System Development Software

3.2.1.1 System Control Software:

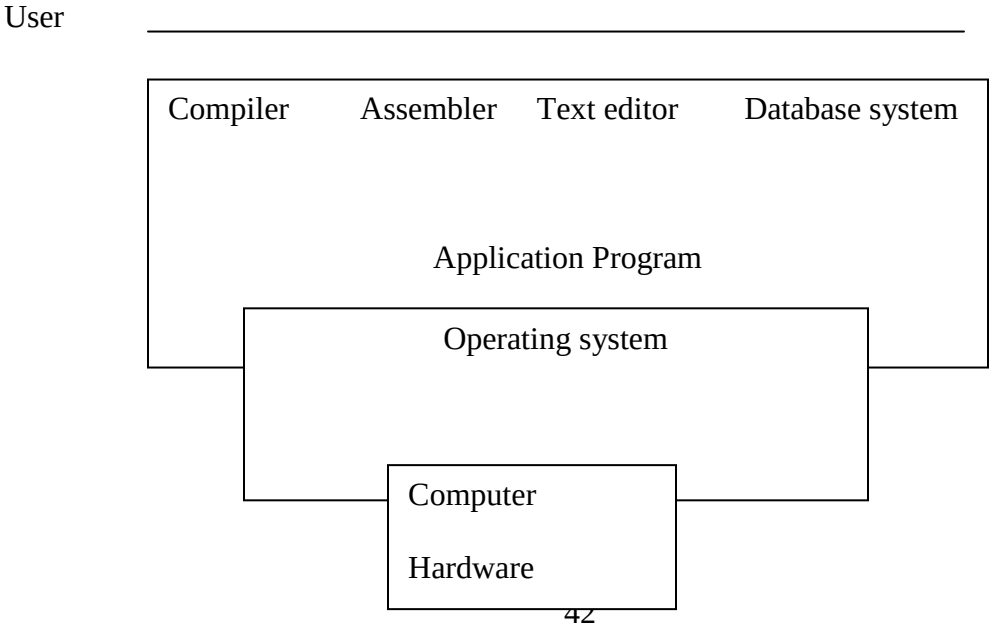
System Control programs control the execution of programs, manage the storage and processing resources of the computer, and

perform other management and monitoring functions. The most important of these program is the operating system & DBMS(Data Base Management System).

Operating system

An operating system is a program that acts as an intermediate between the user and computer hardware. It is a computer program that manages the hardware and software resources of a computer. At the foundation of all system software, the OS performs basic tasks such as controlling and allocating memory, prioritizing system requests, controlling input and output devices, facilitating networking, and managing files. It also may provide a graphical user interface for higher level functions. The purpose of an operating system is to provide an environment. In which user can execute the program.

Modern general-purpose computers, including personal computers and mainframes, have an operating system to run other programs, such as application software. Examples of operating systems for personal computers include Microsoft Windows, and Linux. The primary goal of an operating system is thus to make the computer system convenient to use. A secondary goal is to use the computer hardware in an efficient manner.



When the hardware provides the basic computing resources, then the application program defines the way in which these resources are used to solve certain problem. Operating system controls and coordinates the use of hardware among the application program. Efficiency of operating system can be measured on the basis of following 3 factors.

1. Turn around time : It is the time delay between the submission and completion of any job.
2. Response time: It is the time taken by the system to give first response.
3. Throughput: It is the no of job executed in an unit time.

A Function Of Operating system

- Process Management
- Memory Management
- File Management
- Device Management

Process Management: A program does nothing unless and until its instruction are executed by a CPU. A process can be thought of as a program in execution. Every action on a computer, be it background services or applications, is run inside a process. In older operating system, only one process per CPU can be run at a time. Older OS such as DOS did not attempt any artifacts to bypass this limit and only one process could be run under them. Modern operating systems are able to simulate execution of many processes at once via multitasking even with one CPU. Process management is an operating system's way of dealing with running multiple processes. Process management involves computing and distributing "timeshares". Most OSs allow a process to be assigned a process priority which impacts its timeshare. The OS is responsible for the following activities:

1. The creation and deletion of both the user and system processes.
2. The suspension and resumption of process
3. The provision of mechanism for process synchronization
4. The provision of mechanism for dealock handling.

When a program is submitted to the CPU, it may be one of the three states:

- Running
- Ready
- Wait

Running : A process is running when its instruction sequence is being executed by the processor.

Ready: A process is ready if all the conditions are satisfied for the process to be in the running state and it is waiting for the processor.

Wait: A process is blocked when it is waiting for an event to occur, before continuing execution.

Job scheduling is also a part of process management, there are two types of scheduling techniques:

- Non Preemptive Scheduling
- Preemptive Scheduling

Non Preemptive Scheduling:

In this type of scheduling, a scheduled job always completes first before another scheduling decision is made. In this the job finishes there working in the order in which they are scheduled. There are certain different types of Non Preemptive scheduling techniques, they are:

- FCFS (First Come First served)
- SJF(Shortest Job First)

First Come First Served: It is one of the simplest scheduling technique, i.e. the job is executed in the order of there arrival. Batch processing is an example of FCFS scheduling . in this case turn arround time for the very first job is the best and the for the very last job, it is the worst..

Shortest Job First: In this type of scheduling , a process or job is executed on the basis of having shortest execution time. If the two process have the same execution time, FCFS is used.

Preemptive Scheduling

In preemptive scheduling, as cheduling decision can be made even while the job is executing wherease in non preemptive scheduling , a scheduling decision can be made only when some job finishes its execution.

Round Robin Scheduling Algorithm:

In this the CPU time is divided in to small parts which is known as time slices. Each process allocated a small time slice while it is running. No process can run for more than one time slice when there are others process waiting in the queue. If the process needs more CPU time to complete after exhausting one time slice, iot goes to the end of the queue to wait for the next alloccation.

Memory Management: The main memory is central to the operation of a modern computer. Main memory is a large array of words or bytes. Each words or bytes has its own address. For a program to be executed, it must be mapped to the absolute address and loaded into the memory. As the program executes it access program instruction from the memory by generating these absolute address. Besides this, the memory manager in an OS coordinates the memories by tracking which one is available, which is to be allocated or deallocated and how to swap between the main memory and secondary memories. This activity which is usually referred to as virtual memory management greatly increases the amount of memory available for a process.

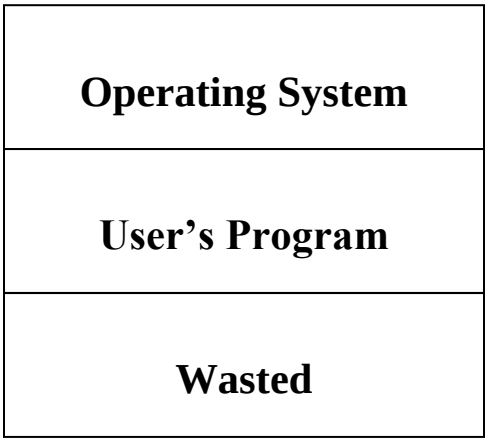
Another important part of memory management activity is managing virtual addresses, with help from the CPU. If multiple processes are in memory at once, they must be prevented from interfering with each other's memory. This is achieved by having separate address spaces. Each process sees the whole virtual address space as uniquely assigned to it. The CPU stores some tables to match virtual addresses to physical addresses. This process, as it is known, is called paging. The OS is responsible for the following activity:

1. Keep track of which part of the memory are currently being used and by whom
2. Decide whichprocess is to be loaded in to the memory when the memory space becomes available.
3. Allocate and deallocate the memory space as needed.

Techniques For Memory Management

Single Contiguous Allocation

In this allocation, the operating system usually resides in either the upper or lower part of the core memory. A job is assigned all of the core although it typically desires and uses only a small fraction. The job has complete control on the CPU until completion. In this resources are not managed efficiently. There is not enoughhardware flexibility to allow effective allocation of memory. This type of allocation is used for small computing system.



Partitioned Allocation

This technique is used to solved the problem of wasted memory. This approach is based on partitioning the memory to accommodate more programs in to the main memory. There are two ways for this type of allocation:

- Fixed Size Partiton Allocation
- Variable Size Partitioning Allocation

A. Fixed Size Partiton Allocation

In this the main memory is divided in to fixed partitions. This partitions can be of equal size or unequal size.the number and sizes of partitions are fixed, thus also fixing the degree of multiprogramming. In this case user must be aware of the size of partiton:

Case1: In case of equal partiton , if a program of size 30 k then it cannot resides in the memory, therefore cannot be executed. Similarly if a program size is 8K or 12K the the memory will be wasted.

Case2: In case of unequal sized partitionsif aprogram size is of 10 kbthen it can be executed in any of the partition except * KB but again memory is wasted.

To overcome this type of problem variable sized partitioning is made:

B. Variable Size Partitioning:

In this a memory of exactly the same size is alklocated when a program is brought into the memory. Thus no wastage of memory is there. As job terminates, the system keep track of the released storage. When a new job is initiated , it creates a partition to suit its storage requirement.

File Management: A file isa collection of related information. Commonly file represent programs and data. A file consist of a sequence of bits, byte, lines or record whose meaning are defined by the creators. File management is one of the important component of the operating system. Computer can store information on several different type of information media such as magnetic disk or magnetic tape etc. The operating system is responsible for the following activities:

1. The creation and deletion of file.
2. The creation and deletion of directories.
3. The mapping of file on to the secodary storage.
4. The backup files on stable storage media.

Device Management: A computer system comprises of peripheral devices apart from the basic CPU. These peripheral devices are usually the input/output devices like printer, drives, tapes, card readers etc. These type of devices also have to be managed by the operating system. The operating system is responsible for the following activities:

1. It should activate them, control them, issue command to the device, handle errors etc.
2. It should also provide an interface between the devices and the system, so that it becomes easy to use this devices.
3. The operating system provide coordination between all the peripheral devices, instead of they arev quite different.

Security

Many operating systems include some level of security. Security is based on the two ideas that:

- The operating system provides access to a number of resources, directly or indirectly, such as files on a local disk, privileged system calls, personal information about users, and the services offered by the programs running on the system;

- The operating system is capable of distinguishing between some requestors of these resources who are authorized (allowed) to access the resource, and others who are not authorized (forbidden). While some systems may simply distinguish between "privileged" and "non-privileged", systems commonly have a form of requestor identity, such as a user name. Requestors in turn divide into two categories:
- Internal security: an already running program. On some systems, a program once it is running has no limitations, but commonly the program has an identity which it keeps and is used to check all of its requests for resources.
- External security: a new request from outside the computer, such as a login at a connected console or some kind of network connection. To establish identity there may be a process of authentication. Often a username must be quoted, and each username may have a password.

B Need Of Operating System

1. The operating system provides access to a number of resources, directly or indirectly, such as files on a local disk.
2. The operating system is capable of distinguishing between some requestors of these resources who are authorized to access the resource, and others who are not authorized.
3. Many operating systems allow the user to install or create any user interface they desire.
4. A device driver is a specific type of computer software developed to allow interaction with hardware devices.

C Types Of Operating System

Batch Operating System

Batch operating system is one of the earliest operating system. In this the user does not has any interaction with the user. In this the user take his/her request to the operator. The operator than prepare a punch card and the card reader is used to read the information from the card. In this type of operating system, to speed up the processing the program of similar needs were batched together and were run to the computer as a group. This operating system takes hours or even sometimes days to give the output. In these OS only one job is processed at a time,therfore, sometime is also known as single user operating system.

Multiprogramming Operating System

The intermediate execution of two or more program is known as multiprogramming.It is a multi user operating system. Some important terms whichis used in these operating system:

Job Pool: It is queue of task stored on the disk.

Job Scheduler: It decides which program goes to the main memory.

CPU Scheduler: Executes the program selected by the job scheduler.

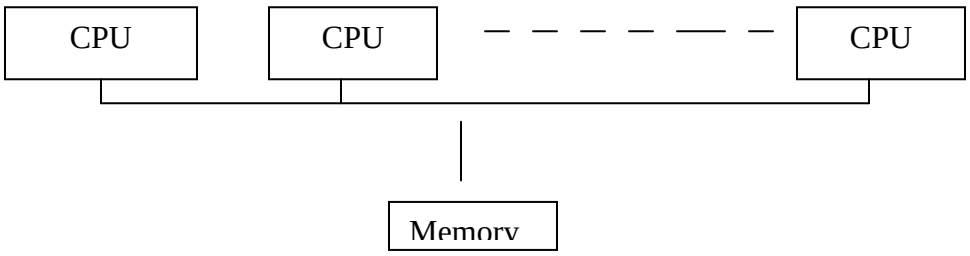
The basic idea behind the multiprogramming operating system is that the CPU should not remain idle at any instant of time. This work is done by lining of the programs in main memory means the the program is in ready state. Then scheduler picks up the program for execution means the program is now in active state.Suppose the active program does not need CPU at a given time then, it comes under the wait state.Meanwhile the CPU is given another program for execution. When the previous process completes its I/O operations it enters to the ready queue. The advantages of multiprogramming operating system is:

Short Response Time: The multiprogramming operating system has a very short response time because the CPU devoting its time to each of the process in turns. The majoer aspect in any response time is the CPU idle time, which is removed or reduced so that it results in the shporter response time.

Increased Productivity: Productivity is a measure of the total amount of processing which can be done by a CPU in a fixed amount of time. Multiprogramming operating system is capable to execute more than one program at a time. When there is a need of input/output the CPU instead of waiting will swiotch over the next program, by that time the input/outp[ut operation takes place, thereby there is no wastage of CPU time, thus this type of operating system can execute more number of programs in a given instance of time, which leads to higher productivity of the system.

Multiprocessing Operating System

The multiprocessing operating system is capable of handling more than one processor. Such system have more than one processor in close communication, sharing the computer bus, clock, sometimes memory and peripheral devices. In these types of operating system, by increasing the no of processor, we hope to get more work done in less time. These type of operatng system can save money because they can share peripherals, mass storage and power supplies. If several program operate on same set of data then it is cheaper to store those data on one disk and have all the processor share them. If function can be distriubted properly among all the processor then the failure of one processor should not halt the system. Instead of this, the work of failed processor has been taken up by the remaining processor.



The most common multiprocessing operating system in use is Symmetric multiprocessing operating system refers to the OS that has the abiity to assign tasks dynamically to the next available processor, wherease asymmetrical multiprocessing requires that the original program designer choose the processor to use for a given taskat a time of writing a program.

Time- Sharing Operating System

It make use of time sharing technique. It is an interactive computer systemthat provide communication between the user and the system. The user gives the instruction to9 the operating system directly by making use of a keyboard , or a mouse. It allows many user to share the computer simultaneosy. In this only a little CPU time is shared for each user. It make use of CPU scheduling alogrithms for executing the programs.

Time sharing operating system are more complex than multiprogrammed operating system. In both several jobs must be kept in memory, so the system must has memory management. It also has file management as well as disk management. In Time sharing operating system the time is distributed in between each user.

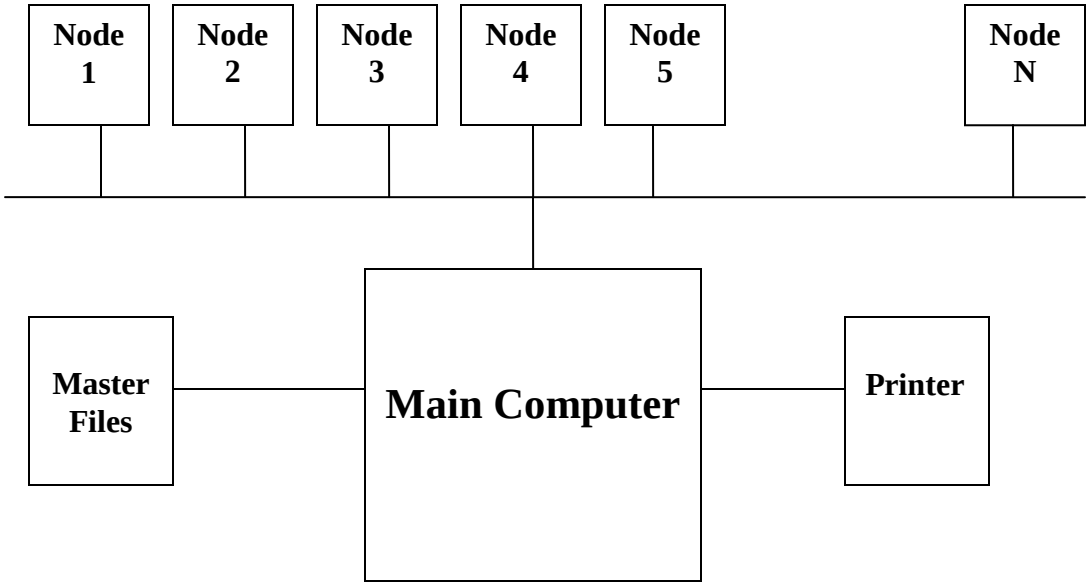
Real Time Operating System

It is a type of special purpose operating system. This type of operating system is used when there is a rigid time requirement for the completion of any job or in other words there is a fixed deadline, job must be completed on that deadline. In this sensor bring data to the computer. Then the computer must analyze the data and modify the input. These operating system has a well defined and fixed time constraint and processing must be done under this constraint, otherwise, the system will fail.

Any computer system designed to respond immediately, as event occurred in the real world. Computer system used in airplane automatic pilots, patient monitoring system, process control, or traffic control system are all real time operating system.

Multi-User Operating System

This operating system takes the best advantage of CPU. Here, many users are4 connected through different terminals. Each user work at his own terminal. the operating system of the computer allows many user to work simultaneously by assisting user a part of RAM and it divides the computer time among various user. Here the computer gives a user his time and then goes to the other user giving him his quota of time and then shift to the other user and this process will go on. As the environment is multi user, there is a great amount of security provided, so that no one can tamper each others data.



3.2.1.2 System Development Software

It assists in the creation of application programs. An example of system development software is Language Processor.

Language Processor

When a program written in a language other than the machine language of computer, the computer will not understand it. Hence, the program written in other language must be translated into the machine language of the computer. Such translation is done with the aid of software. This type of software is known as language processor.

A Compiler

A compiler is a computer program or set of programs that translates text written in a computer language i.e. in the source language into another computer language i.e. the target language. The original sequence is usually called the source code and the output called object code. The most common reason for wanting to translate source code is to create an executable code. The name "compiler" is primarily used for programs that translate source code from a high level language to a lower level language or machine language. A program that translates from a low level language to a higher level one is a

decompiler. A compiler is likely to perform many or all of the following operations: lexing, preprocessing, parsing.

Early computers did not use compilers. Compilers had not yet been invented because early computers had very little memory and programs were necessarily quite short. Users often entered the decimal or binary machine code for a program. With the evolution of programming languages and the increasing power of computers, compilers are becoming more and more complex to bridge the gap between problem-solving modern programming languages and the various computer.

A compiler is itself a computer written in some implementation language. Early compilers were written in assembly language. The first self-hosting compiler which is capable of compiling its own source code in a high-level language — was created for Lisp.

- A program that translates from a low level language to a higher level one is a decompiler.
- A program that translates between high-level languages is usually called a language translator.

Most compilers are classified as either self-compilers or cross compilers. If a compiler run on a computer for which it produces the object code, then it is known as self-compiler. If a compiler run on a computer other than that for which it produces the object code, then it is known as cross compiler.

Compiled versus interpreted languages

Many people divide higher-level programming languages into compiled languages and interpreted languages. However, there is rarely anything about a language that requires it to be compiled or interpreted. Compilers and interpreters are *implementations* of languages, not languages themselves. The categorization usually reflects the most popular or widespread implementations of a language -- for instance, BASIC is thought of as an interpreted language, and C a compiled one, despite the existence of BASIC compilers and C interpreters.

There are exceptions; some language specifications spell out that implementations must include a compilation facility (eg, Common Lisp), while other languages have features that are very easy to implement in an interpreter, but make writing a compiler much

harder; for example, SNOBOL4, and many scripting languages are capable of constructing arbitrary source code at runtime with regular string operations, and then executing that code by passing it to a special evaluation function. To implement these features in a compiled language, programs must usually be shipped with a runtime environment that includes the compiler itself.

B Assembler

A program that converts an assembly language program into machine language so that computer can run the program. As you know that assembly language program can be written by making use of mnemonic code (symbolic code). The use of symbolic references is a key feature of assemblers, saving tedious calculations and manual address updates after program modifications. Assemblers are available since the 1950s. An assembler, which runs on the computer for which it produces the object code, is called self-assembler. The assembler runs on the computer other than that for which it produces the object code is called cross assembler. There is two types of assembler, first is one pass assembler, it is an assembler which read the program once and assign addresses to the labels used in assembly language program. Second is Two pass assembler, which goes to the program twice, in first pass it will assign address to the labels and in the second pass it will convert each assembly language instruction into machine language instruction.

More sophisticated High-level assemblers provide language abstractions such as:

- Advanced control structures.
- High-level procedure/function declarations and invocations.
- High-level abstract data types, including structures/records, unions, classes, and sets.
- Sophisticated macro processing.

C Interpreter

An interpreter is a program which translates a high level language rogram into machine level language. It translates one instruction of a program at a time. If it is correct then only it proceeds towards the next instruction. It reads the instruction, translate it,and after that it executes the instruction. An interpreter is a smaller program as compared to the compiler. It occupy less memory space. Interpreting code is slower than running the compiled code because the interpreter must analyse each statement in the program each time it is executed and then perform the desired action whereas the compiled code just performs the action. Access to variables is also slower in an interpreter because the mapping of identifiers to storage locations must be done repeatedly at run-time rather than at compile time. The IBM 550 Numeric Interpreter and IBM 557 Alphabetic Interpreter are typical examples of the interpreter.

Difference Between Compiler & Interpreter

Compiler	Interpreter
Scans the entire program first and translate it in to machine code.	Translates the program line by line.
Compiler produces object code.	During conversion, the interpreter does not produce its object code.
Converts the entire program to machine code; when all the syntax errors are removed, execution takes place.	Each time the program is executed, every line is checked for syntax error and then converted to equivalent machine code.
Slow for debugging (removal of mistakes from the program).	Good for fast debugging
Execution time is less	Execution time is more.

3.2.1.3 System Support Software

System support program provide routine service functions to the other computer programs and computer users. Example of this type of software is Utility software.

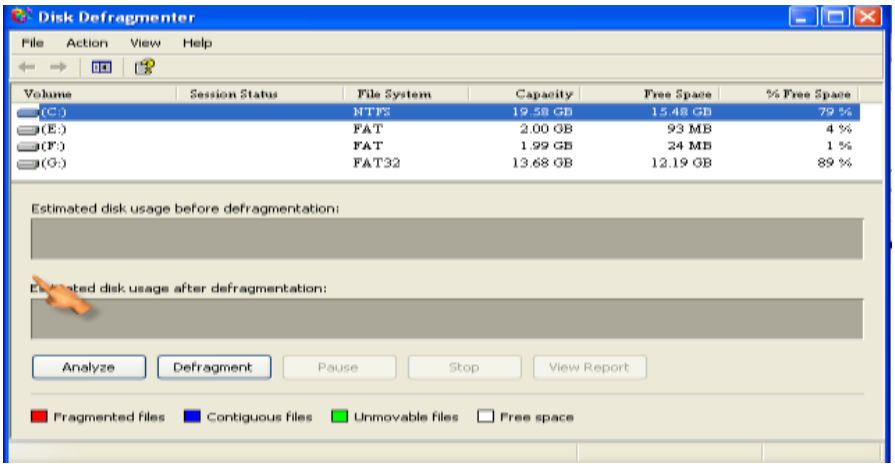
Utility Software

It is a set of program, that supports the operating system by providing the additional services that the operating system does not provide. There are many task which are performed by utility programs are hard disk backup, disk optimization, file recovery, safe formatting and resource editing.

Utility software is also known as service program, or utility routine. It is specifically designed to help in managing and tune the computer hardware, operating system or application software, and perform a single task or a small range of tasks.Some important utilities are bein discussed below:

- **Disk defragmenters/Disk management tools** Disk defragmenter can detect computer files whose contents have been stored on the hard disk in disjointed fragments, and move the fragments together to increase efficiency. There is a Disk checker which can scan the contents of a hard disk to find files or areas that are corrupted in some way, or were not correctly saved, and eliminate them for a more efficiently operating hard drive. A Disk cleaner can find files that unnecessary to computer operation, or take up considerable amounts of space. Disk cleaner helps the user to decide what to delete when his hard disk is full. To

start disk defragmentation we have to click start>Programs>Accessories>System tools>Disk Defragmentation. It will show like this



- **Virus scanners/Antivirus**. Virus Scanners scan for computer viruses among files and folders. Virus is a program intended to damage your computer sytem without your knowledge and belief. A virus may itself attach to another programon your hard disk and when the date passes, or a certain event occurs, the virus is trigerred into action. The most famous virusis jerusalem virus, which is also known as Friday the 13th, first seenat the university of jerusalem in july 1987. The virus slow down the system. There are several precautions that you can take to protect yoursef from infection, including backing up your system on the regular basis , and you can also buy and run the commercially available virus detecting program.

  Antivirus is an application program that can detect and eliminate the computer virus. Some antivirus program can detect suspicious activity on your computer as it happens. While, the other must be run periodically. The antivirus program locates and identifies a virus by looking some of the characteristics, like unexpected disk access. It recognizes the virus by comparing the information from the system against the database of known virus that is kept n the disk. There are several simple precautions that you can take to minimize your chances of contracting a virus:

  1. Back up your hard disk regularly.
  2. Do not install software if you don't know where it's been or where it came from.
  3. Write protect disks as soon as you get them.

- **Compression** utilities output a shorter stream or a smaller file when provided with a stream or file. A file that has been processed by a special utility program so that it occupies a little hard disk space. When the file is needed, the same

program decompresses the file back into its original form so that it can be read by the computer.

Two kind of file compression program are available those program that can compress more than one file at a time such as winzip. Those program that can compress al the files on a specific disk. Any method of encoding data so that it occupies less space than its original form.

- **File Management tools** A file manager or file browser is a computer program that provides a user interface to work with file systems. They are very useful for speeding up interaction with files. The most common operations on files are create, open, edit, view, print, play, rename, move, copy, delete, attributes, properties, search/find, and permissions.

- **Encryption** utilities use a specific algorithm to produce an encrypted stream or encrypted file when provided with a key and a plaintext.

Programming Language

The process of designing, writing, testing, debugging, documenting and maintaining a program is known as programming. A language is a medium, which is used for understanding each other ideas. Communicating medium should be such that one has to understand, what we are expressing i.e., medium of communication should be common between the two. Similarly we need computer languages for giving instructions to the computer. A language used to write a program that a computer can execute. Almost, 200 different programming languages exist. Some are well suited to all sorts of computing task. However there are certain kind of tasks particularly those involving artificial intelligence, process control, or very high mathematical applications that can be benefit from a more specific language.

Programming languages provide various ways of specifying programs for computers to run. Unlike natural languages, programming languages are designed to permit no ambiguity and to be concise. They are generally either translated into machine language before being run by a compiler or an assembler or translated directly at run time by an interpreter. Programming languages are classified as follows:

- Machine Language.
- Assembly Language.
- High Level Language.

A. Machine Language

Machine language is a system of instructions and data which is directly understandable by a computer's central processing unit. In this instructions are patterns of bits. Every CPU model has its own machine code, although there is considerable overlap between some. If CPU A understands the full language of CPU B it is said that A is compatible with B. CPU B may not be compatible with CPU A, as A may know a few codes that B does not. Machine language is built up from discrete statements or instructions. Depending on the processing architecture, a given instruction may specify:

- Particular registers for arithmetic, addressing, or control functions
- Particular memory locations or offsets
- Particular addressing modes used to interpret the operands

Some operations which is available in most instruction sets include:

1. **Moving**
    a. set a register to a fixed constant value
    b. move data from a memory location to a register, or vice versa. This is done to obtain the data to perform a computation on it later, or to store the result of a computation.
    c. read and write data from hardware devices
2. **Computing**
    a. add, subtract, multiply, or divide the values of two registers, placing the result in a register .
    b. compare two values in registers

The program written in these language are non-portable. These are the language which are understood by the machine directly as it consist of a binary digit. Instruction written in machine language has two parts, first is opcode which tells the computer what operation has to be performed. The second part of the instruction is operand that specify the address of the data.

Advantages Of machine Language

1. The machine easily understands these languages.
2. Processing is faster.

Limitations Of Machine Language

1. It is machine dependent; it is different from one computer to another.
2. All the instructions are to be given into binary digits, therefore it is very difficult to program.
3. It is difficult to rectify a program written in machine language.
4. It is very time consuming and tedious task to write a program in machine language.

B. Assembly Language

Writing the programs in machine language is a very tedious and boring job. To solve this problem, assembly languages is developed which makes use of alphanumeric symbols for writing the set of instruction instead of 0 and 1. Assembly languages are specific to a given microprocessor, and therefore, it is not portable. In this program written for one type of processor must be rewritten before they can be used for another type of processor. A program written in assembly language consists of a series of instructions in symbolic code i.e. mnemonics that correspond to a stream of executable instructions, when translated by an assembler, that can be loaded into memory and executed.

The equivalent assembly language representation is easier to remember (more mnemonic):

- mov al, 061h

This instruction means, Move the hexadecimal value 61 (97 decimal) into the processor register named "al".

The mnemonic "mov" is an operation code or opcode, and was chosen by the instruction set designer to abbreviate "move." A comma-separated list of arguments or parameters follows the opcode; this is a typical assembly language statement. Transforming assembly into machine language is accomplished by an assembler, and the reverse by a disassembler.

Advantages Of Assembly Language

1. Easy to understand because of mnemonic code.
2. Easy to detect and correct error.
3. Eassily modified
4. It saves time and reduce complexity than machine language program.
5. The computation time of assembly anguage program is less.

Limitations

1. The assembly language is machine oriented. This means that program must have the detailed knowledge of the structure of the computer.
2. Assembly language program contains more instruction as compared to high-level languages.

C. High Level Language

To overcome the difficulties associated with assembly language, high level language has been developed. It is a problem oriented language. A high-level programming language is

a programming language that, in comparison to low-level programming languages, may be more abstract, easier to use, or more portable across platforms. Such languages often abstract away CPU operations such as memory access models and management of scope. high-level languages deal with variables, arrays and complex arithmetic or boolean expressions. In addition, they have no opcodes that can directly compile the language into machine code, unlike low-level languages like Assembly language. In general, high-level languages make complex programming simpler, while low-level languages tend to produce more efficient code. In a high-level language, complex elements can be broken up into simpler.

The advantage of high level language program is that they are portable from computer to computer. But the computer can only understand the machine language, so we have to translate the instruction from high level language to machine language. For that, we need language translator which is interpreter and compiler.Language translator is a program which is used to translate a language into a low-level programming language for which native code compilers are already widely available.

> **Compiler:** The name "compiler" is primarily used for programs that translate source code from a high level language to a lower level language or machine language.
>
> **Interpreter:** An interpreter is a program, which translates a high-level language rogram into machine level language. But, it translates one instruction of a program at a time.

Advantages Of High Level Language

1. It is a machine independent language.
2. They are easier to learn and understand.
3. Program written in this anguage are portable and easier to maintain.
4. In this program can be easily written because natural language English is used.

Limitations

1. The high level language program take more time to run.
2. Computer are unable to understand instruction given in high level language.

Algorithms

In mathematics and computing, an **algorithm** is a procedure (a finite set of well-defined instructions) for accomplishing some task which, given an initial state, will terminate in a defined end-state. The computational complexity and efficient implementation of the algorithm are important in computing, and this depends on suitable data structures.

Informally, the concept of an algorithm is often illustrated by the example of a recipe, although many algorithms are much more complex; algorithms often have steps that

repeat (iterate) or require decisions (such as logic or comparison). Algorithms can be composed to create more complex algorithms.

The concept of an algorithm originated as a means of recording procedures for solving mathematical problems such as finding the common divisor of two numbers or multiplying two numbers. The concept was formalized in 1936 through Alan Turing's Turing machines and Alonzo Church's lambda calculus, which in turn formed the foundation of computer science.

Most algorithms can be directly implemented by computer programs; any other algorithms can at least in theory be *simulated* by computer programs. In many programming languages, algorithms are implemented as functions or procedures.

Flowcharts are often used to graphically represent algorithms.

Why algorithms are necessary: an informal definition

> *For a detailed presentation of the various points of view around the definition of "algorithm" see Algorithm characterizations. For examples of simple addition algorithms specified in the detailed manner described in Algorithm characterizations, see Algorithm examples.*

No generally accepted *formal* definition of "algorithm" exists. We can, however, derive clues to the issues involved and an informal meaning of the word from the following quotation from Boolos and Jeffrey (1974, 1999):

> "No human being can write fast enough, or long enough, or small enough to list all members of an enumerably infinite set by writing out their names, one after another, in some notation. But humans can do something equally useful, in the case of certain enumerably infinite sets: They can give **explicit instructions for determining the nth member of the set**, for arbitrary finite n. Such instructions are to be given quite explicitly, in a form in which **they could be followed by a computing machine**, or by a **human who is capable of carrying out only very elementary operations on symbols**" (boldface added, p. 19).

The words "enumerably infinite" mean "countable using integers perhaps extending to infinity". Thus Boolos and Jeffrey are saying that an algorithm *implies* instructions for a process that "creates" output integers from an *arbitrary* "input" integer or integers that, in theory, can be chosen from 0 to infinity. Thus we might expect an algorithm to be an algebraic equation such as **y = m + n** -- two arbitrary "input variables" **m** and **n** that produce an output **y**. Unfortunately -- as we see in Algorithm characterizations -- that the word algorithm implies much more than this, something on the order of (for our addition example):

> Precise instructions (in language understood by "the computer") for a "fast, efficient, good" *process* that specifies the "moves" of "the computer" (machine or

> human, equipped with the necessary internally-contained information and capabilities) to find, decode, and then munch arbitrary input integers/symbols **m** and **n**, symbols + and = ... and (reliably, correctly, "effectively") produce, in a "reasonable" time, output-integer **y** at a specified place and in a specified format.

Formalization of algorithms

Algorithms are essential to the way computers process information, because a computer program is essentially an algorithm that tells the computer what specific steps to perform (in what specific order) in order to carry out a specified task, such as calculating employees' paychecks or printing students' report cards. Thus, an algorithm can be considered to be any sequence of operations which can be performed by a Turing-complete system. Authors who assert this thesis include Savage (1987) and Gurevich (2000):

> "...Turing's informal argument in favor of his thesis justifies a stronger thesis: every algorithm can be simulated by a Turing machine" (Gurevich 2000 p.1) ...according to Savage [1987], an algorithm is a computational process defined by a Turing machine."(Gurevich 2000 p.3)

Typically, when an algorithm is associated with processing information, data is read from an input source or device, written to an output sink or device, and/or stored for further processing. Stored data is regarded as part of the internal state of the entity performing the algorithm. In practice, the state is stored in a data structure, but an algorithm requires the internal data only for specific operation sets called abstract data types.

For any such computational process, the algorithm must be rigorously defined: specified in the way it applies in all possible circumstances that could arise. That is, any conditional steps must be systematically dealt with, case-by-case; the criteria for each case must be clear (and computable).

Because an algorithm is a precise list of precise steps, the order of computation will almost always be critical to the functioning of the algorithm. Instructions are usually assumed to be listed explicitly, and are described as starting 'from the top' and going 'down to the bottom', an idea that is described more formally by *flow of control*.

So far, this discussion of the formalization of an algorithm has assumed the premises of imperative programming. This is the most common conception, and it attempts to describe a task in discrete, 'mechanical' means. Unique to this conception of formalized algorithms is the assignment operation, setting the value of a variable. It derives from the intuition of 'memory' as a scratchpad. There is an example below of such an assignment.

For some alternate conceptions of what constitutes an algorithm see functional programming and logic programming .

Description of Processor

The processing unit in a computer interprets instructions given in a program and carries out the instructions. Processors are designed to interpret a specified number of instruction codes. Each instruction code is string of binary digits. All processors have input/output instructions, arithmetic instructions, logic instructions, branch instructions and instructions to manipulate characters.

In this section we will describe the processor of a hypothetical computer which we will call HYPCOM. The processor of HYPCOM has an accumulator register (ACC). The other registers are an instruction register (IR) and a program counter register (PC).

The instruction register is used to temporarily store the instruction being executed. It consist of two parts :

1) An operation code part
2) Address part

The PC register stores the address of the next instruction to be executed**.**

The other specifications of HYPCOM are :

1) It has a 4K word addressable memory.
2) A word of HYPCOM is 16 bits long.
3) A word of HYPCOM stores either an instruction or data to be processed.
4) It has 15 operation codes.
5) The instructions are single address instructions. Four bits are needed to represent 15 operation codes. Twelve bits are needed to address a 4K memory

   An instruction is thus 16 bits long.

6) It has an input unit which is used to feed both instructions and data.

   A 16 bit word is read via the input and stored in memory when a READ operation

   code is executed by the processor.

7) It has a printer as its output unit which is used to output a 16 bit word from the

   memory when a PRINT operation code is executed by the processor

C

JNE

- Take next instruction from address 446 if ACC<0 else next instruction from address given in PC.

JZE

- Take next instruction from the address 648 if ACC=0 else next instruction from the address given in PC.

READ

- Input into specified address in memory data read from input unit.

PRINT

- Print data retrieved from the specified address in the memory.

SHR

- Shift contents of ACC right by 8 bits.

COM

- Complements contents of ACC.

EOR

- Match each bit of ACC with each bit of contents of specified address.

HLT

- Halt computation