Introduction

1.1 Introduction to computer

A computer is a programmable electronic machine. It takes raw facts as input, process these and gives the final output which is the result of processing. It responds to a specific set of instructions in a well-defined manner. It can execute a prerecorded list of instructions (a program).
A computer, or computer system, does not come to life until it is connected to the other parts of its system. A computer system is a combination of five elements.
1.Hardware
2.Software
3.People
4.Procedures
5. Data/Information

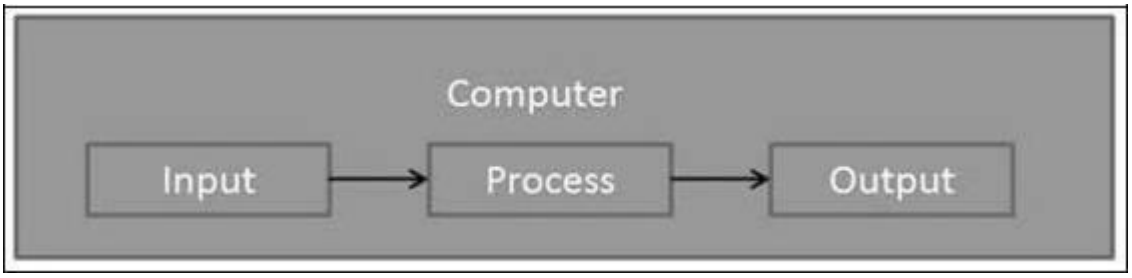


Fig: Working of Computer

1. Input: Input is the raw data entered into a computer from the input devices. It is the collection of numbers, letters, images, etc. Keyboard, Mouse, scanner, webcam, etc are some examples of the input devices.
2. Process: Process is the operation of data or information as per given instruction. It is totally internal process of the computer system. CPU (Central processing Unit) is the main processing device of the computer.
3. Output : Output is the result of processed data given by computer after data processing. we can save these results in the storage devices for the future use. Monitor, Printer, Speaker are the main output devices.
4. Storage: The computer must store data so that it is available for processing. Most computer have more than one storing data (such as hard disk, tapes, CDs/DVDs,pen drive etc).

If we look at it in a very broad sense, any digital computer carries out the following five functions:

Step 1 - Takes data as input.

Step 2 - Stores the data/instructions in its memory and uses them as required.

Step 3 - Processes the data and converts it into useful information.

Step 4 - Generates the output.

Step 5 - Controls all the above four steps.

Characteristics of Computers/ Features of Computer

A computer is an intelligent amplifier that performs the operations in a much taster, accurate and efficient way. Thus, it gives us ample time to use it in matters involving creativity & judgment. The characteristics possessed by computers can be listed as follows:

1. Speed

A computer can add and subtract numbers, compare letters to determine alphabetic sequence, move and copy numbers and letters. As such, there is nothing profound in these operations. What is significant is the speed with which computers carry out these operations. This speed varies from a few microseconds (millionth of second) to Nano (billionth of second). For instance, People would need to do a lot of waiting in queues for grocery payments, for making telephone calls, for making travel reservations, etc. but with the help of computers the processing can be done in a fraction of a second. The speed of a computer at performing a single operation can be measured in terms of:

a) Milliseconds – One thousandth of a second (1/1000)
b) Microsecond – One millionth of a second (1/1000000)
c) Nanosecond – One billionth of a second (1/1000000000).
d) Picoseconds – One trillionth of a second(1/1000000000000).

2. Accuracy

You may work for years before experiencing a system error, such as an updating of the wrong record or and incorrect addition. Errors do occur in computer-based information but precious few can be directly attributed to the computer systems. The vast majority of these errors can be traced to a program logic error, a procedural error, or erroneous data. These are human errors. Hardware errors are usually detected and corrected by the computer system itself.
Computers are very accurate. They can perform their hundreds of thousands of operations with great accuracy. They can run errorless for days at a time.

3. Reliability

Computer output is generally very reliable, subject to the condition that the input data entering the computer should be correct and the program of instructions should be reliable and correct. Incorrect input data and unreliable programs give us computer errors and wrong results.

4. Storage Capability

Computer systems have total and instant recall of data and an almost unlimited capacity to store these data. A typical mainframe computer system will have many billions of characters, and perhaps thousands of graphic images, stored and available for-instant recall. When properly used, a computer can improve

the efficiency of an organization. It provides a fast, accurate, and reliable device with which to process data. There is tremendous savings in the storage area required to maintain the vital records necessary in a business environment. The storing capacity of a computer is measured in terms of bytes, kilobytes and gigabytes.

5. Diligence

Human beings suffer from physical and mental fatigue. They cannot perform the same task over and over again with the same speed, accuracy and enthusiasm as in the first time. This will affect the performance. Being a machine, a computer does not suffer from such weaknesses. The computer is capable of performing task repeatedly at the same level of speed and accuracy even if it has to carry complex operation for a long period of time.

6. Versatile

Computers are versatile (can do many types of jobs). It can carry out processes ranging from simple mathematical calculations to highly complex and logical evaluations for any extended period of time. Computers can communicate with other computers and can receive and send data in various forms such as text, video, etc. This ability of computer to communicate to one another has led to the development of computer networks, Internet and so on. All this is possible because of computers and other related technologies.

7. Automation

Computers are quite capable of functioning automatically, once the process is given to the computer. They do not require any instruction from the operator at any stage of the process. Computers can be programmed to perform a series of complex tasks involving multiple programs. Computers will execute the programs in the correct sequence, provided they are programmed correctly.

Types of Computer

(On the basis of working/operating principal)

Analog Computers
These computers recognize data as a continuous measurement of a physical property (e.g. Rotaional or displacement). Their output is usually in the form of readings on dials or graphs. Voltage, pressure, speed and temperature are some physical properties that can be measured in this way. Example:
A service station gasoline pump contains an analog processor that connects fuel flow measurements into quantity and price values, Automobile speedometer, etc.

The features of analog computer
Operates by measuring voltage and currents.
• The accuracy of this computer is poor.
• Single purpose machine, hence low cost and easily programmable.
• It has limited memory space.
• It is not versatile.

Digital Computers

These are high-speed programmable, electronic devices that perform mathematical calculations, compare values and store the results; they recognize data by counting discrete signals representing either a high (“on”) or low (“off”) voltage stale of electricity. Numbers, alphabets and special symbols can all be reduced to representation by 1’s and 0’s. Example: Personal computers. Scoreboard that directly counts

discrete values such as the time left to play and the score of each team.
Features of Digital Computer
• It works by counting numbers.
• The accuracy of this machine is very high.
• It has large memory capacity.
• It is a multipurpose machine, hence high cost and difficult to program.
• It is versatile in nature.

Digital computers are further grouped into two categories:

a. General-purpose digital computers
   The digital computers, which can theoretically be used for any type of application, from scientific to commercial file processing, are called general-purpose digital computers. For instance, the computers that are used for payroll, graphs, analysis, account, banking system etc.
b. Special purpose digital computers
   These are those digital computers, which are made and used for specific job or narrow range of task. The set of instructions required for that task is permanently stored in the computer memory. For instance, the computer installed in automobiles to control fuel, braking systems.

Hybrid Computers

Hybrid computer is a data processing device, which combines the best features of both analog and digital computers. It helps the user to process both continuous and discrete data. They have the speed of analog computers and the accuracy of digital computers. In the hybrid computer, a converter is fixed to convert the analog signals into digital signals and digital signals into analog signals. They are special purpose machines. These machines are generally used in scientific applications, airplanes and industrial control processes.
Example: A computer used in hospitals, where analog section measures patients' temperature or heart function and the digital section records and prints out in number.

On the basis of size:

a. Super Computers
   A super computer is generally characterized as being the fastest, most powerful and most expensive computer. Supercomputers recognize the largest word lengths of 64 bits or more. They have large memories with high processing speed. They can process up to a billion operations in a second. These computers have multiple Central Processing Units that can process multiple instructions at a time, known as parallel processing. They can take input from over 10000 individual workstations. Supercomputers are widely used in scientific applications such as aerodynamic design and simulation, processing of geological data, processing of data regarding genetic coding and collecting and processing weather data.
   Ex: CRAY-1, CRAY XMP-14, NEC-500

B. Mainframe Computers

A mainframe computer is usually slower, less powerful and less expensive than Super computers. It is general-purpose computer system designed for large-scale data processing. Mainframes is capable of process data at several million instructions per second (MIPS). More than 1000 remote workstations can be accommodated by a typical mainframe computer. A technique that allows many people at terminals to access the same computer at one time is called time-sharing, Mainframes are used by banks and many businesses to update inventory etc.

Ex: IBM 1401 Hp 900 model 3705/300
IBM 4300 Hp 900 model 8705/400

C. Mini Computers

Mini computers are general-purpose computers, smaller than mainframe and give computing power without adding the prohibitive expenses associated with larger systems. The mini computer's size prevents it from being portable but it can be moved more easily than a mainframe. Mini computer integrates commercial and technical operations better than the more powerful computers. It is generally easier to use. Mini computers are well adapted for functions such as accounting, word processing, database management, Statistical packages for social sciences, Computer Aided Design (CAD) and Numerical Analysis etc.
For example:
IBM AS/400/B60
HP 900 VAX 8842

D. Micro Computer

A micro computer is the smallest, least expensive of all computers. The prefix "micro" refers mainly to the physical size of the computer and its circuitry rather than its capabilities. The essential differences between microcomputers and mainframe or mini computers are that microcomputers have smallest memory and less power, are physically smaller and permit fewer peripherals to be attached. Microcomputers are also called "Personal computers."

a) Desktop :-

Desktop computer are also known as micro computers which are used mostly at homes, school, banks and offices. They are small and powerful computer and usually placed on a desk. It has separated device like keyboard, mouse, monitor and CPU cabinet. It is also known as personal computer.

b) Laptop :-

A laptop computer is a small size computer that can be kept on the lap. It is also like a notebook. In laptop, all devices like keyboard, mouse, speaker and CPU are packed in single unit. A laptop has backup power system. A laptop can be carried anywhere and can be used even when there is no electricity.

c) Palmtop :-

Palmtop is also known as personal data assistant. We can work on it by touching on the screen directly with a pin or stick. A palmtop has the facilities of internet, web browsing, playing songs/videos etc.

d. PDA

Short for personal digital assistant, a handheld device that combines computing, telephone/fax, and networking features. A typical PDA can function as a cellular phone, fax sender, and personal organizer. Unlike portable computers, most PDAs are pen-based, using a stylus rather than a keyboard for input. This means that they also incorporate handwriting recognition features. Some PDAs can also react

to voice input by using voice recognition technologies. The field of PDA was pioneered by Apple Computer, which introduced the Newton MessagePad in 1993. Shortly thereafter, several other manufacturers offered similar products. To date, PDAs have had only modest success in the marketplace, due to their high price tags and limited applications. However, many experts believe that PDAs will eventually become common gadgets. PDAs are also called palmtops, hand-held computers and pocket computers.

Uses / Applications of Computer

Business

A computer has high speed of calculation, diligence, accuracy, reliability, or versatility which has made it an integrated part in all business organizations.

Computer is used in business organizations for:

- Payroll calculations
- Budgeting
- Sales analysis
- Financial forecasting
- Managing employee database
- Maintenance of stocks, etc.

Banking

Today, banking is almost totally dependent on computers.

Banks provide the following facilities:

- Online accounting facility, which includes checking current balance, making deposits and overdrafts, checking interest charges, shares, and trustee records.
- ATM machines which are completely automated are making it even easier for customers to deal with banks.

Insurance

Insurance companies are keeping all records up-to-date with the help of computers. Insurance companies, finance houses, and stock broking firms are widely using computers for their concerns.

Insurance companies are maintaining a database of all clients with information showing:

- Procedure to continue with policies
- Starting date of the policies
- Next due installment of a policy
- Maturity date
- Interests due
- Survival benefits
- Bonus

Education

The computer helps in providing a lot of facilities in the education system.

- The computer provides a tool in the education system known as CBE (Computer Based Education).
- CBE involves control, delivery, and evaluation of learning.
- Computer education is rapidly increasing the graph of number of computer students.
- There are a number of methods in which educational institutions can use a computer to educate the students.
- It is used to prepare a database about performance of a student and analysis is carried out on this basis.

Marketing

In marketing, uses of the computer are following:

- Advertising - With computers, advertising professionals create art and graphics, write and revise copy, and print and disseminate ads with the goal of selling more products.
- Home Shopping - Home shopping has been made possible through the use of computerized catalogues that provide access to product information and permit direct entry of orders to be filled by the customers.

Healthcare

Computers have become an important part in hospitals, labs, and dispensaries. They are being used in hospitals to keep the record of patients and medicines. It is also used in scanning and diagnosing different diseases. ECG, EEG, ultrasounds and CT scans, etc. are also done by computerized machines.

Following are some major fields of health care in which computers are used.

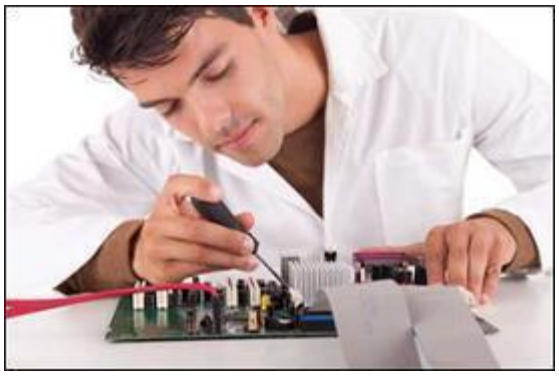
- Diagnostic System - Computers are used to collect data and identify the cause of illness.
- Lab-diagnostic System - All tests can be done and the reports are prepared by computer.
- Patient Monitoring System - These are used to check the patient's signs for abnormality such as in Cardiac Arrest, ECG, etc.
- Pharma Information System - Computer is used to check drug labels, expiry dates, harmful side effects, etc.
- Surgery - Nowadays, computers are also used in performing surgery.

Engineering Design

Computers are widely used for Engineering purpose.

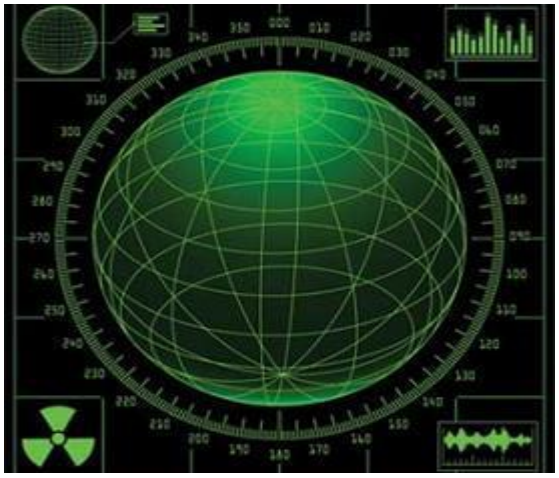
One of the major areas is CAD (Computer Aided Design) that provides creation and modification of images. Some of the fields are:

- Structural Engineering - Requires stress and strain analysis for design of ships, buildings, budgets, airplanes, etc.
- Industrial Engineering - Computers deal with design, implementation, and improvement of integrated systems of people, materials, and equipment.
- Architectural Engineering - Computers help in planning towns, designing buildings, determining a range of buildings on a site using both 2D and 3D drawings.



Military

Computers are largely used in defence. Modern tanks, missiles, weapons, etc. Military also employs computerized control systems. Some military areas where a computer has been used are:



- Missile Control
- Military Communication
- Military Operation and Planning
- Smart Weapons

Communication

Communication is a way to convey a message, an idea, a picture, or speech that is received and understood clearly and correctly by the person for whom it is meant. Some main areas in this category are:

- E-mail
- Chatting
- Usenet
- FTP
- Telnet
- Video-conferencing

Government

Computers play an important role in government services. Some major fields in this category are:

- Budgets
- Sales tax department
- Income tax department
- Computation of male/female ratio
- Computerization of voters lists
- Computerization of PAN card
- Weather forecasting

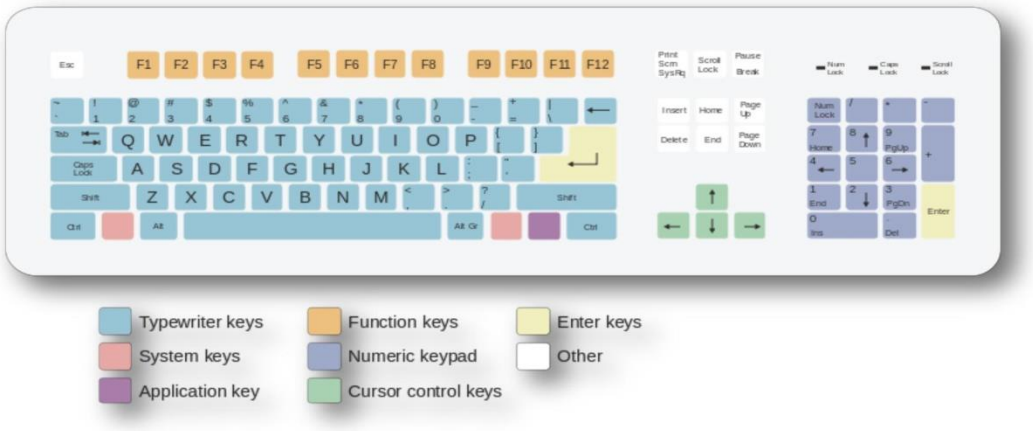
Input/ Output Devices

a. Input device

Devices which transfer data, programs, or signals into a computer systems are called input devices. These devices are used to give raw data to the computer to perform the specific tasks. Firstly, the data, programs, a signals are fed into the input devices in a suitable form, and are then converted by the device into electrical signals from human-readable format that are transmitted to the central processing unit of the computer.

i. Keyboard

- One of the primary input devices used with a computer.
- The keyboard looks very similar to the keyboards of electric typewriters, with some additional keys.
- Keyboards allow a computer user to input letters, numbers, and other symbols into a computer
- Uses an arrangement of buttons or keys.
- Requires pressing and holding several keys simultaneously or in sequence.



Keyboards are input devices that allow the entry of data and commands by simply pressing down keys on the keyboard.Keyboards are a common place input device, often used alongside a mouse. They can be wired or wireless.

Typical Applications

- Used in everyday computing to maunally enter data and commands, e.g. writing a report in a word processor.

Benefits

- Simple and easy to use
- Potentially a fast way to enter data.

Drawbacks

- A slow way to enter lots of data if not a trained typist.
- Mistakes can be made if not careful.

b) Mouse

A mouse is an input device that allows you to control the coordinates and movement of the onscreen cursor/pointer by simply moving the mouse across a flat surface with your hand.Items can be selected or moved using the left mouse button, whilst the right button usually displays additional menus.Most mice are now optical which means they use a laser to detect and track movement across the surface.Mice can be wired or wireless.

Typical Applications

- Used in everyday computing to control the pointer in GUIs.

Benefits

- Simple and easy to use.

- Requires a flat surface

Drawbacks

- Efficient way to navigate
- Requires space to operate

c) Microphone

Microphones are input devices that take analogue sound waves and converts them into electrical signals, suitable for a computer to understand. Microphones play an important role in speech recognition, a technology that is gaining in popularity and usage.

Typical Applications

- Mobile phones, e.g. for traditional phonecalls or VoIP.
- Tablets and laptops, e.g. for video conferencing or VoIP.
- Voice recognition systems, e.g. to input data and commands using spoken words.

Benefits

- Allows disabled users to give instructions to a computer
- Enables the use speech recognition software
- Allows voice calls and the audio in video

Drawbacks

- Speech recognition accuracy can sometimes be hit and miss

d) Digital Camera

Digital cameras are input devices that capture images (and sometimes video) digitally. Digital cameras use an image sensorchip to capture the image, rather than the film used by a traditional camera.The images recorded on a digital camera are stored on memory cards, although some may have a limited amount of external memory of its own.Digital cameras feature an LCD screen which allow you to preview and review your images, plus change menu settings

Typical Applications

- Professional photography, using DSLRs
- Amateur photography
- Speed cameras, e.g. using OCR software to read registration plates

e) Trackball

A trackball is an input device used to control a pointer/cursor. Unlike a mouse, the device stays stationary whilst the user moves the ball within its socket. Trackballs can be stand-alone devices or combined into a keyboard or control panel. Some people prefer using a trackball over a mouse as they believe it gives them a finer degree of control over the pointer. They are also handy for people with limited hand motor skills as they are less demanding then a mouse.

Typical Applications

- Computer Aided Design (CAD) for fine control
- Situations when space is limited
- Disabled people with limited motor skills

Output Device

An output device is any device used to send data from a computer to another device or user. Most computer data output that is meant for humans is in the form of audio or video. Thus, most output devices used by humans are in these categories. Examples include monitors, projectors, speakers, headphones and printers.

1. Monitors/ VDU

Monitors, commonly called as Visual Display Unit (VDU), are the main output device of a computer. It forms images from tiny dots, called pixels that are arranged in a rectangular form. The sharpness of the image depends upon the number of pixels.

There are two kinds of viewing screen used for monitors.

a) Cathode-Ray Tube (CRT)
b) Flat-Panel Display

a) Cathode-Ray Tube (CRT) Monitor

The CRT display is made up of small picture elements called pixels. The smaller the pixels,

the better the image clarity or resolution. It takes more than one illuminated pixel to form a whole character, such as the letter ‘e’ in the word help.

A finite number of characters can be displayed on a screen at once. The screen can be divided into a series of character boxes – fixed location on the screen where a standard character can be placed. Most screens are capable of displaying 80 characters of data horizontally and 25 lines vertically.

There are some disadvantages of CRT −

- Large in Size
- High power consumption

b. Flat-Panel Display Monitor

The flat-panel display refers to a class of video devices that have reduced volume, weight and

power requirement in comparison to the CRT. You can hang them on walls or wear them on your wrists. Current uses of flat-panel displays include calculators, video games, monitors, laptop computer, and graphics display.

The flat-panel display is divided into two categories −

- Emissive Displays − Emissive displays are devices that convert electrical energy into light. For example, plasma panel and LED (Light-Emitting Diodes).
- Non-Emissive Displays − Non-emissive displays use optical effects to convert sunlight or light from some other source into graphics patterns. For example, LCD (Liquid-Crystal Device).

ii.Printers

Printer is an output device, which is used to print information on paper.There are two types of printers –

a) Impact Printers
b)Non-Impact Printers

a)Impact Printers

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

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

These printers are of two types −

- Character printers
- Line printers

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

- Dot Matrix Printer(DMP)
- Daisy Wheel *(for information)*

Dot Matrix PrinterIn the market, one of the most popular printers is Dot Matrix Printer. These printers are popular because of their ease of printing and economical price. Each character printed is in the

form of pattern of dots and head consists of a Matrix of Pins of size (5*7, 7*9, 9*7 or 9*9) which come out to form a character which is why it is called Dot Matrix Printer.

Advantages

- Inexpensive
- Widely Used
- Other language characters can be printed

Disadvantages

- Slow Speed
- Poor Quality

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

Advantages

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

Disadvantages

- Slower than DMP
- Noisy
- More expensive than DMP

Line PrintersLine printers are the printers which print one line at a time.These are of two types −

- Drum Printer
- chain Printer

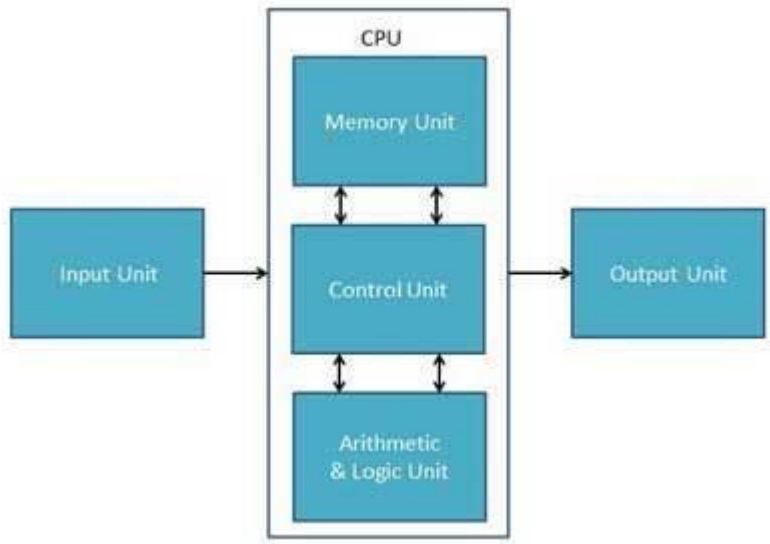
6)Central Processing Unit (CPU)

It consists of the following features −

- CPU is considered as the brain of the computer.
- CPU performs all types of data processing operations.
- It stores data, intermediate results, and instructions (program).
- It controls the operation of all parts of the computer.

CPU itself has following three components.

- Memory or Storage Unit
- Control Unit
- ALU(Arithmetic Logic Unit)



a) Memory or Storage Unit

This unit can store instructions, data, and intermediate results. This unit supplies information to other units of the computer when needed. It is also known as internal storage unit or the main memory or the primary storage or Random Access Memory (RAM).

Its size affects speed, power, and capability. Primary memory and secondary memory are two types of memories in the computer. Functions of the memory unit are −

- It stores all the data and the instructions required for processing.
- It stores intermediate results of processing.
- It stores the final results of processing before these results are released to an output device.
- All inputs and outputs are transmitted through the main memory.

b) Control Unit

This unit controls the operations of all parts of the computer but does not carry out any actual data processing operations.

Functions of this unit are −

- It is responsible for controlling the transfer of data and instructions among other units of a computer.
- It manages and coordinates all the units of the computer.
- It obtains the instructions from the memory, interprets them, and directs the operation of the computer.
- It communicates with Input/Output devices for transfer of data or results from storage.
- It does not process or store data.

c) ALU (Arithmetic Logic Unit)

This unit consists of two subsections namely,

- Arithmetic Section
- Logic Section

i. Arithmetic Section

Function of arithmetic section is to perform arithmetic operations like addition, subtraction, multiplication, and division. All complex operations are done by making repetitive use of the above operations.

ii. Logic Section

Function of logic section is to perform logic operations such as comparing, selecting, matching, and merging of data.

8. Storage

It is used to store data and instructions. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored. The memory is divided into large number of small parts called cells. Each location or cell has a unique address, which varies from zero to memory size minus one. For example, if the computer has 64k words, then this memory unit has 64 * 1024 = 65536 memory locations. The address of these locations varies from 0 to 65535.These are if 2 types:-

a. Primary
b. Auxiliary

a) Primary Memory (Main Memory)

Primary memory holds only those data and instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed resides in the main memory. It is divided into two subcategories RAM and ROM.

Characteristics of Main Memory

- These are semiconductor memories.
- It is known as the main memory.
- Usually volatile memory.
- Data is lost in case power is switched off.
- It is the working memory of the computer.
- Faster than secondary memories.
- A computer cannot run without the primary memory.

i.Cache Memory
ii. RAM and its type
iii. ROM and its type

i. Cache Memory

Cache memory is a very high speed semiconductor memory which can speed up the CPU.

It acts as a buffer between the CPU and the main memory. It is used to hold those parts of data and program which are most frequently used by the CPU. The parts of data and programs are transferred from the disk to cache memory by the operating system, from where the CPU can access them.

Advantages

The advantages of cache memory are as follows −

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores the program that can be executed within a short period of time.
- It stores data for temporary use.

Disadvantages

The disadvantages of cache memory are as follows −

- Cache memory has limited capacity.
- It is very expensive.

ii.RAM

(Random Access Memory) is the internal memory of the CPU for storing data, program, and program

result. It is a read/write memory which stores data until the machine is working. As soon as the machine is switched off, data is erased.

Access time in RAM is independent of the address, that is, each storage location inside the memory is as easy to reach as other locations and takes the same amount of time. Data in the RAM can be accessed randomly but it is very expensive.

RAM is volatile, i.e. data stored in it is lost when we switch off the computer or if there is a power failure. Hence, a backup Uninterruptible Power System (UPS) is often used with computers. RAM is small, both in terms of its physical size and in the amount of data it can hold.

RAM is of two types −

- Static RAM (SRAM)
- Dynamic RAM (DRAM)

Static RAM (SRAM)

The word static indicates that the memory retains its contents as long as power is being supplied. However, data is lost when the power gets down due to volatile nature. SRAM chips use a matrix of 6-transistors and no capacitors. Transistors do not require power to prevent leakage, so SRAM need not be refreshed on a regular basis.

There is extra space in the matrix, hence SRAM uses more chips than DRAM for the same amount of storage space, making the manufacturing costs higher. SRAM is thus used as cache memory and has very fast access.

Characteristic of Static RAM

- Long life
- No need to refresh
- Faster
- Used as cache memory
- Large size
- Expensive
- High power consumption

Dynamic RAM (DRAM)

DRAM, unlike SRAM, must be continually refreshed in order to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second. DRAM is used for most system memory as it is cheap and small. All DRAMs are made up of memory cells, which are composed of one capacitor and one transistor.

Characteristics of Dynamic RAM

- Short data lifetime
- Needs to be refreshed continuously
- Slower as compared to SRAM
- Used as RAM
- Smaller in size
- Less expensive
- Less power consumption

iii. ROM

stands for Read Only Memory. The memory from which we can only read but cannot write on it. This

type of memory is non-volatile. The information is stored permanently in such memories during manufacture. A ROM stores such instructions that are required to start a computer. This operation is referred to as bootstrap. ROM chips are not only used in the computer but also in other electronic items like washing machine and microwave oven.

Let us now discuss the various types of ROMs and their characteristics.

PROM (Programmable Read Only Memory)

PROM is read-only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM program. Inside the PROM chip, there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

EPROM (Erasable and Programmable Read Only Memory)

EPROM can be erased by exposing it to ultra-violet light for a duration of up to 40 minutes. Usually, an EPROM eraser achieves this function. During programming, an electrical charge is trapped in an insulated gate region. The charge is retained for more than 10 years because the charge has no leakage path. For erasing this charge, ultra-violet light is passed through a quartz crystal window (lid). This exposure to ultra-violet light dissipates the charge. During normal use, the quartz lid is sealed with a sticker.

EEPROM (Electrically Erasable and Programmable Read Only Memory)

EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 ms (millisecond). In EEPROM, any location can be selectively erased and programmed. EEPROMs can be erased one byte at a time, rather than erasing the entire chip. Hence, the process of reprogramming is flexible but slow.

Advantages of ROM

The advantages of ROM are as follows −

- Non-volatile in nature
- Cannot be accidentally changed
- Cheaper than RAMs
- Easy to test
- More reliable than RAMs
- Static and do not require refreshing
- Contents are always known and can be verified

b) Secondary Memory

This type of memory is also known as external memory or non-volatile.

It is slower than the main memory. These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it. For example, disk, CD-ROM, DVD, etc.

Characteristics of Secondary Memory

- These are magnetic and optical memories.
- It is known as the backup memory.
- It is a non-volatile memory.

- Data is permanently stored even if power is switched off.
- It is used for storage of data in a computer.
- Computer may run without the secondary memory.
- Slower than primary memories.

Types of Secondary storage Devices

i. Magnetic Tape
ii. Hard Disk
iii. Pen Drive
iv. Memory Card
v. Optical Disk

- CD
- DVD
- Magneto-optical (MO) drives

i.Magnetic tape:

- Tapes are used for recording and storing data for computer processing. It is plastic reel similar to long lengths of movie film.
- A tape is usually ½" wide and 2400 feet in length and it is coated with particles of ferric oxide on which data can be recorded magnetically.
- The process of reading and writing of data is carried out on a device called Tape Drive and the records on magnetic tape are stored in sequential order.
- For example: if the payroll file is to be stored on a magnetic tape, the records would likely to be stored in the sequence of employee numbers. Hence, magnetic tapes are referred to as sequential access device.

ii.HARD DISK

 It is a non-volatile secondary storage device which stores digitally encoded data on rapidly rotating platters with magnetic surfaced.

- A hard disk drive [HDD], commonly referred to as a hard drive, hard disk or fixed disk drive
 The hard disk is an electro mechanical device. The hard disk is also known as Winchester disk. HDDs record data by magnetizing a ferromagnetic material directionally to represent either a "0" or "1" binary digit.
 They read the data by detecting the magnetization of the material.
 the hard disk drive has a set of magnetic heads or read/write heads for both surfaces of each disk, on the spindle.
 The disk drive consists of a motor to rotate the disk pack at a speed of about 3600 revolutions per minute [rpm] about a spindle.

ii.Pen drive

- It is an plug and play device.
- it is a small removable Flash Memory drive which is connected to the usb port.
- Plug and Play device means it does not require any external power supply or software to run on a computer.
- It takes power from the usb port itself and when connected to the usb port, the OS automatically recognizes .
- it. now a dys the storage capacity of pen drive has increased.

- They are available in the range from 1gb-80gb. Pen drives is a memory chip,the computer reads/writes to the pen drive as it would do to the Ram

iv.Memory card

Alternatively referred to as a flash memory card, a Memory card is a type of storage media that is often used to store photos, videos, or other data in electronic devices. Devices that commonly use a memory card include digital cameras, digital camcorders, handheld computers, MP3 players, PDAs, cell phones, printers. The picture to the right is a MicroSD flash memory card, which is just one of the types of memory cards available.

v.Optical disk

The optical storage device that most of us are familiar with is the compact disc.

a) CD-ROM

♦ CD-ROM (Compact Disc Read Only Memory) is a Compact Disc contains data accessible by a computer. While the Compact Disc format was originally designed for music storage and play back, the format was later adapted to hold any form of binary data.

- The CR-ROM is also known as a laser disc, which is shiny metal like disk. . Information of 650 MB can be stored which is equal to nearly 2, 50,000 pages of printed text. The data is recorded as deep holes on the disk surface or burning microscopic bits. The plain and shiny disk surface and the microscopic bits help to represent the binary numbers 0 and 1, as required by the concentric tracks.

b)DVD

Introduced to the market in year 1997, DVD (also known as Digital Versatile Disc or Digital Video Disc) has become the latest generation of optical disc storage technology. Even though it's physical dimension is the same with compact discs (i.e. 8cm or 12cm in diameter), DVD takes its advantages of having much higher density with a single data format. Minimum DVD storage of data is 4.7GB; however its maximum storage capability can be up to 26 times as much as a standard CD-R. Compared with CD technology, DVD allows for better quality of graphics, resolution and surrounded sound. Nowadays, DVD's widespread has gain support from major numbers of electronic companies, computer hardware companies, and also music and audio studios all over the world.

c)Magnetic optical drives

Magnetic optical (MO) drives are usually attached to a SCSI or EIDE (ATA) bus.Before you attempt to use the drive, ensure that the hardware is set up correctly and that the BIOS detects the hardware

properly.The driver that you need depends on whether the drive is attached to a SCSI or EIDE interface.

The drivers for optical disks load the cam-optical.so shared object, which provides a common access method for optical disks.The MO drive should appear in your /dev directory as /dev/mo*x*, where *x* is the number of the drive, starting at 0.

Software:

- Software is a collection of set of programs, which are used to execute all kinds of specific instruction. It consists of a number of machine instructions, array in a specific order to perform a particular task. Software is used to describe all the programs and its associated documents which run on a computer. So, a computer needs both software and hardware for its proper functioning.
- Software means computer instructions or data. Anything that can be stored electronically is software.
- Firmware are software (programs or data) that has been permanently written onto read-only memory (ROM).

All software falls into two general types or categories:

1. System Software
2. Application Software.

System software consists of low-level programs that interact with the computer at very basic level. This includes operating systems, compilers, and utilities for managing resources.

On the other hand, application software includes database programs, word processors, and spreadsheets.

Systems software carries out middleman tasks to ensure communication between other software and hardware to allow harmonious coexistence with the user.

Systems software can be categorized under the following:

- Operating system: Harnesses communication between hardware, system programs, and other applications.
- Device driver: Enables device communication with the OS and other programs.
- Firmware: Enables device control and identification.
- Translator: Translates high-level languages to low-level machine codes.
- Utility: Ensures optimum functionality of devices and applications.

1. Operating System (OS)

The operating system is a type of system software kernel that sits between computer hardware and end user. It is installed first on a computer to allow devices and applications to be identified and therefore functional.System software is the first layer of software to be loaded into memory every time a computer is powered up.

Today, the user interacts with the operating system through the graphical user interface (GUI) on a monitor or touchscreen interface. The desktop in modern OSs is a graphical workspace, which contains menus, icons, and apps that are manipulated by the user through a mouse-driven cursor or the touch of a finger. The disk operating system (DOS) was a popular interface used in the 1980s.

Functions of Operating Systems

- They provide the interface between the user and hardware through GUI.
- Manages and allocates memory space for applications.
- Processes the management of applications, input/output devices, and instructions.
- Configures and manages internal and peripheral devices.
- Manages single or multi-user storage in local and network computers.
- Security management of files and applications.
- Manages input and output devices.

Examples of Operating Systems

Popular OSs for computers are:

- Windows 10
- Mac OS X
- Ubuntu

Popular network/server OSs are:

- Ubuntu Server
- Windows Server
- Red Hat Enterprise

Popular internet/web OSs are:

- Chrome OS
- Club Linux
- Remix OS

Popular mobile OSs are:

- iPhone OS
- Android OS
- Windows Phone OS

- Utility software, often referred as *utility* is a system software that is designed to help analyze, configure, optimize or maintain a computer and enhance the computer's performance.
- It is a program that performs a specific task, which is usually related to managing the system resources. Utilities are sometimes also installed as memory-resident programs.
- Utility software usually focuses on how the computer infrastructure that includes computer hardware, application software, operating system and data storage programs operates.
- These utilities could range from the small and simple to the large and complex that can perform either a single task or a multiple tasks. Some of the functions performed by these utilities are data compression, disk defragmentation, data recovery, management of computer resources and files, system diagnosis, virus detection, and many more.

Examples of Utility Program

Some of the examples of the utility programs (Utilities) include: Disk defragmenters, System Profilers, Network Managers, Application Launchers, Antivirus software, Backup software, Disk repair, Disk

Cleaners, Registry Cleaners, Disk Space analyzer, file manager, File Compression, Data Security and many more. In addition, operating systems contains a number of utilities for managing disk drives, printers, and other devices.

c)Application software

Itis distinct from system software, which refers to the software that actually keeps the systems running such as the operating system, computational science software, game engines, industrial automation, and software as a service applications.

Word Processors:

A word processor is a program that makes us possible to perform word processing functions. We can create, edit, and print documents using word processors. We have many features that helps us to prepare a fine document. Some of the important feature of word processors are: editing, spelling checking, page setup, paragraph alignments, merging documents, typing in columns etc.

MS-Word is the word's most popular word-processor. Although every word processor provides almost the same features, MS-Word is most flexible to work with. It is used to write documents or letter. A file in Ms-Word is called a document. When a file is saved, MS-Word attaches the extension .doc to the file.

Spreadsheets:

A spreadsheet is a table of values arranged in rows and columns. Each value can have a predefined relationship to the other values. If one value is changed, others values need to be changed as well.

Spreadsheet applications are computer programs that let you create and manipulate spreadsheets electronically. In a spreadsheet application, each value sits in a cell. We can define what type of data is in each cell and how different cells depend on one another. The relationships between cells are called formulas, and the names of the cells are called labels. Once we have defined the cells and the formulas for linking them together, we can enter the data. We can then modify selected values to see how all the other values change accordingly. What-if analysis makes the complex decision-making a very easy process. MS-Excel is one of the most popular spreadsheet application.

Multimedia applications:

Multimedia applications makes us possible to run audio and video files. This application recognizes the digital signals and provides necessary signal to output devices and movie signals to the monitor and audio to the audio devices. Along with the video data we also get the text information about the file we are running. In windows operating system Windows Media Player is a good option to play the multimedia files.

Presentation Graphics:

Presentation Graphics enable users to create highly stylized images for slide shows and reports. The software includes functions for creating various types of charts and graphs and for inserting text in variety of fonts. Most systems enable us to import data from a spreadsheet application to create the charts and graphs. Presentation graphics is often called business graphics. Some of the popular presentation graphics software are Microsoft Powerpoint, Lotus Freelance Graphics, Harvard Presentation Graphics, etc.

Programming Language

Programming Language allow humans to create instructions for a computer to perform tasks. It is a set of rules that provides a way of instructing the computer to perform certain opertions. Program is the set of instructions eritten by using some programming language to perform specific task.

There are three categories of programming languages such as

- High-level programming languages,

- Assembly language, and
- Machine language.

i. Machine Level Language

It is the lowest level of programming language. In this language, programs are written by using the combinations of 0s and 1s. These languages are also called first generation programming language.

Advantages:

- No language translator is required
- Fast execution

Disadvantages

- Difficult to remember the binary codes
- Error prone and also difficult to identify errors
- Programs are long
- Machine dependent(i.e different from machine to machine)

Assembly Language:

Assembly languages are also know as symbolic languages as they use abbreviations or mnemonic code which replace the 0s and 1s of machine language. Assembly language is the intermediate language between high-level programing languages and machine language. It is one level above machine language. Assembly language is easier to understand than machine language but harder than high-level programming languages. This language is also known as a low-level language because it is close to the hardware level. In order to write effective programs using Assembly, the programmer should have a good understanding of the computer architecture and the register structure. A special compiler known as an assembler is used to convert assembly language instructions to machine code or object code.

Advantages:

- Easy to memorize the codes than binary codes
- Fast and efficient execution of the codes
- Relatively easy to identify the errors

Disadvantages

- Extra software assembler is needed
- Programs are long
- Programmer needs detailed knowledge of the machine architecture.
- Machine dependent

What is the Difference Between Machine Language and Assembly language?

Machine Language	Assembly Language
• Machine language is the lowest level programming language where the instructions execute directly by the CPU.	• Assembly language is a low-level programming language which requires an assembler to convert to machine code/object code.
• Machine language is comprehensible only to the computers.	• Assembly language is comprehensible to humans.

- A machine language consists of binary digits.
- Machine language varies depending on the platform.
- Machine language is machine code.

- Assembly language follows a syntax similar to the English language.
- Assembly language consists of a standard set of instructions.

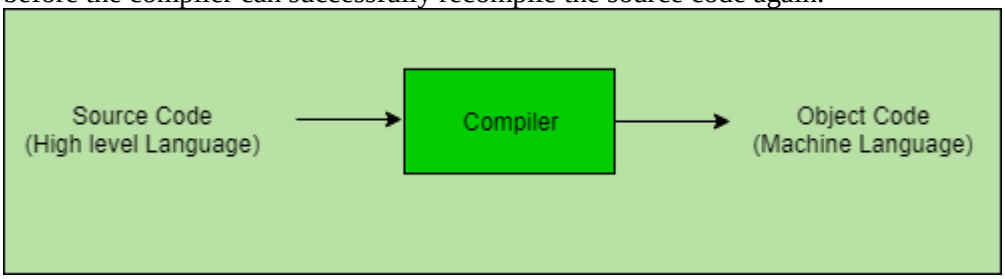
Assembly language is using for microprocessor-based, real-time systems.

Language Processors –

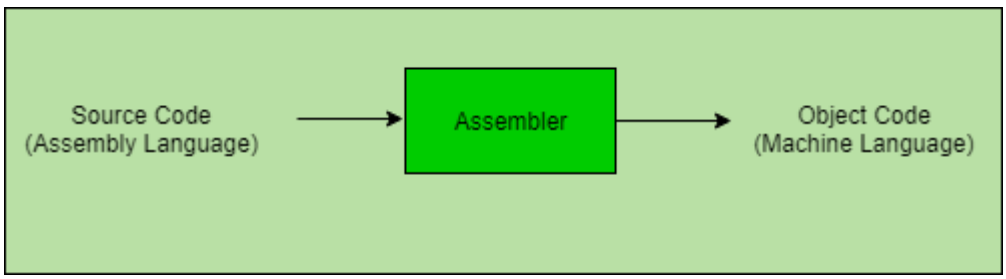
Assembly language is machine dependent yet mnemonics that are being used to represent instructions in it are not directly understandable by machine and high Level language is machine independent. A computer understands instructions in machine code, i.e. in the form of 0s and 1s. It is a tedious task to write a computer program directly in machine code. The programs are written mostly in high level languages like Java, C++, Python etc. and are called source code. These source code cannot be executed directly by the computer and must be converted into machine language to be executed. Hence, a special translator system software is used to translate the program written in high-level language into machine code is called Language Processor and the program after translated into machine code (object program / object code).

The language processors can be any of the following three types:

1. Compiler –
   The language processor that reads the complete source program written in high level language as a whole in one go and translates it into an equivalent program in machine language is called as a Compiler.
   Example: C, C++, C#, JavaIn a compiler, the source code is translated to object code successfully if it is free of errors. The compiler specifies the errors at the end of compilation with line numbers when there are any errors in the source code. The errors must be removed before the compiler can successfully recompile the source code again.>



   ii.Assembler –
   The Assembler is used to translate the program written in Assembly language into machine code. The source program is a input of assembler that contains assembly language instructions. The output generated by assembler is the object code or machine code understandable by the computer.



iii. Interpreter –
The translation of single statement of source program into machine code is done by language processor and executes it immediately before moving on to the next line is called an interpreter. If there is an error in the statement, the interpreter terminates its translating process at that statement and displays an error message. The interpreter moves on to the next line for execution only after removal of the error. An Interpreter directly executes instructions written in a programming or scripting language without previously converting them to an object code or machine code.
Example: Perl, Python and Matlab.

Difference between Compiler and Interpreter –

COMPILER	INTERPRETER
• A compiler is a program which coverts the entire source code of a programming language into executable machine code for a CPU.	• interpreter takes a source program and runs it line by line, translating each line as it comes to it.
• Compiler takes large amount of time to analyze the entire source code but the overall execution time of the program is comparatively faster.	• Interpreter takes less amount of time to analyze the source code but the overall execution time of the program is slower.
• Compiler generates the error message only after scanning the whole program, so debugging is comparatively hard as the error can be present any where in the program.	• Its Debugging is easier as it continues translating the program until the error is met
• Generates intermediate object code.	• No intermediate object code is generated.
• Examples: C, C++, Java	• Examples: Python, Perl

The structures which regulate the order in which program statements are executed are called Control

Structures. There are 3 types of control structure. They are:

- Sequence:
  It is the set of program instructions which follow one another and are to be executed unconditionally (not dependent on any program conditions). Instructions are put in a predefined sequence (just like a queue in a cinema hall) and the next instruction is executed by CPU only after the execution of the previous instruction (C never comes before B).

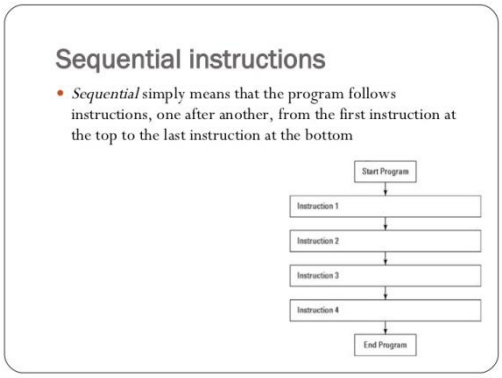


Fig: Sequential Statement Source: www.slideshare.net

- Selection:
  It is the set of instructions which are to be executed conditionally i.e. they are executed based on a condition that can be either true or false. Commonly used logic for selection are if condition, if else condition, if else if condition, nested if else condition and switch case condition.

1. If condition:
   If condition is used in case the given problem has only one condition and only one action. Considering either true or false part, if the given condition is true then the statement will be executed. Otherwise, the control exits from the condition.

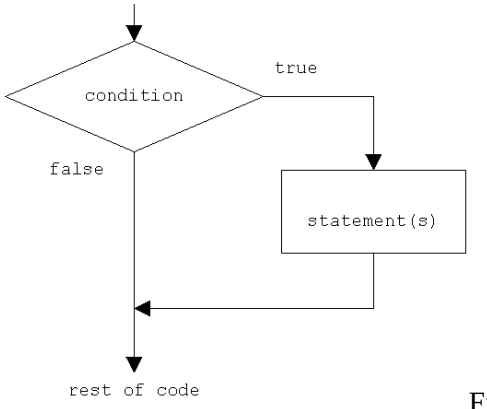


Fig: if condition Source: www.ustudy.in

Example: Check the number is positive.

Algorithm

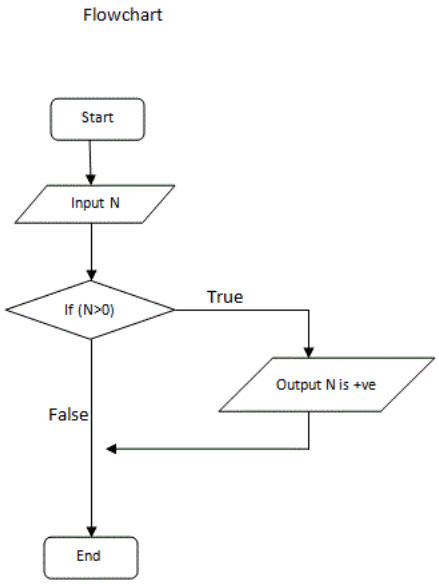
Step 1: start

Step 2: input N

Step 3: if (n>0), output is positive

Step 4: end

Figure:



2. If else condition:
   This condition is used if the problem has one condition but two alternative actions. Here, if the condition is true, statement 1 will be executed; otherwise ,statement 2 will be executed.

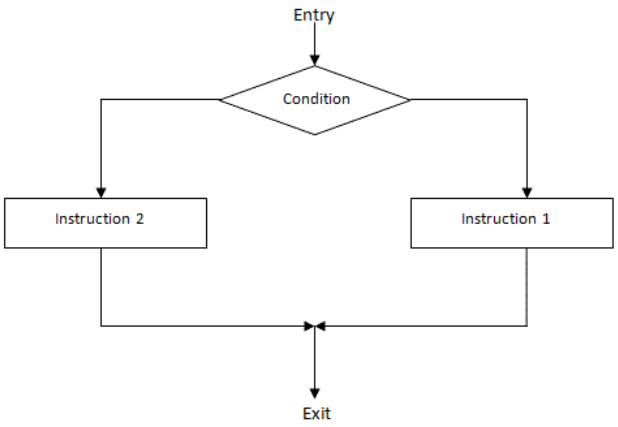


Figure: if else condition

Example: Find the greatest between 2 numbers.

Algorithm

Step 1: start

Step 2: input X, Y

Step 3: if (X>Y)

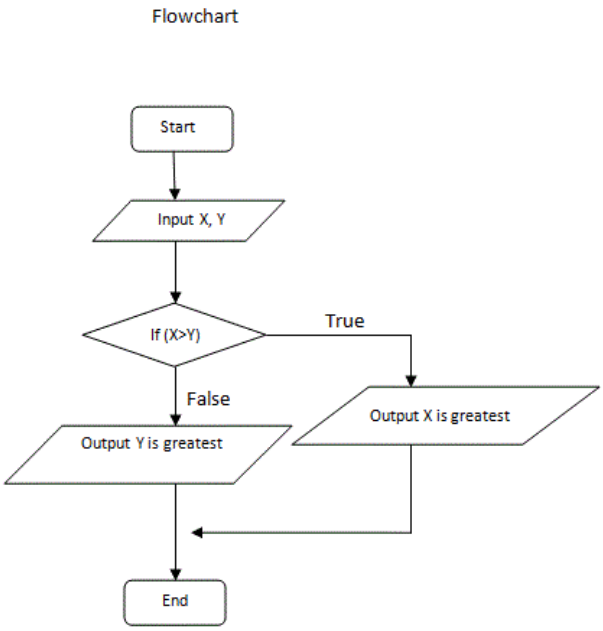
output X is greatest

else

output Y is greatest

Step 4: end

Figure:



3. If else if condition:
   Also known as ladder type if else, we can use this condition if the given problem has more than one interrelated conditions with their respective actions. Here, on a check, if condition 1 is true then, statement 1 is executed. Otherwise, condition 2 is checked and if it is true, statement 2 is executed and so on for next conditions. If all conditions are false, then the last statement will be executed.

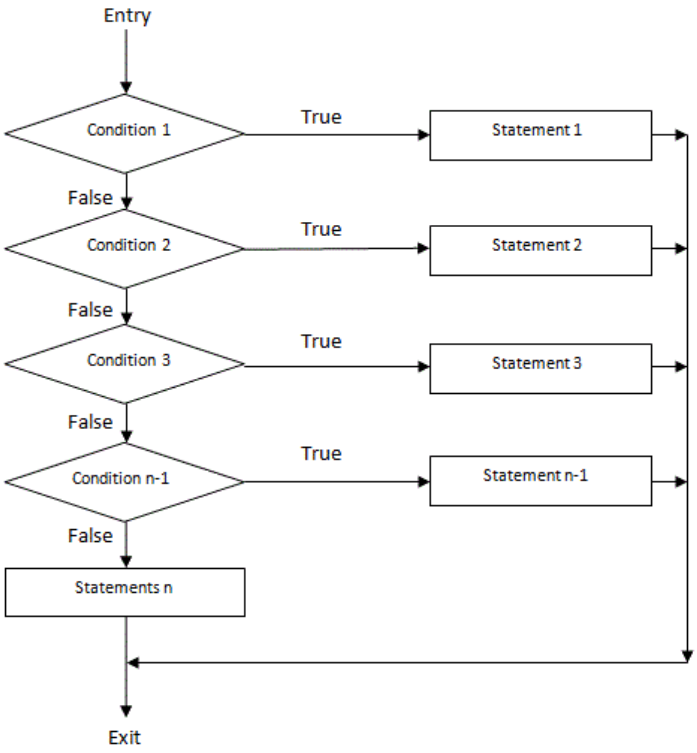


Figure: if else if condition

Example: Find the greatest among 3 numbers.

Algorithm

Step 1: start

Step 2: input P, Q, R

Step 3: if (P>Q && P>R)

output P is greatest

else if (Q>R)

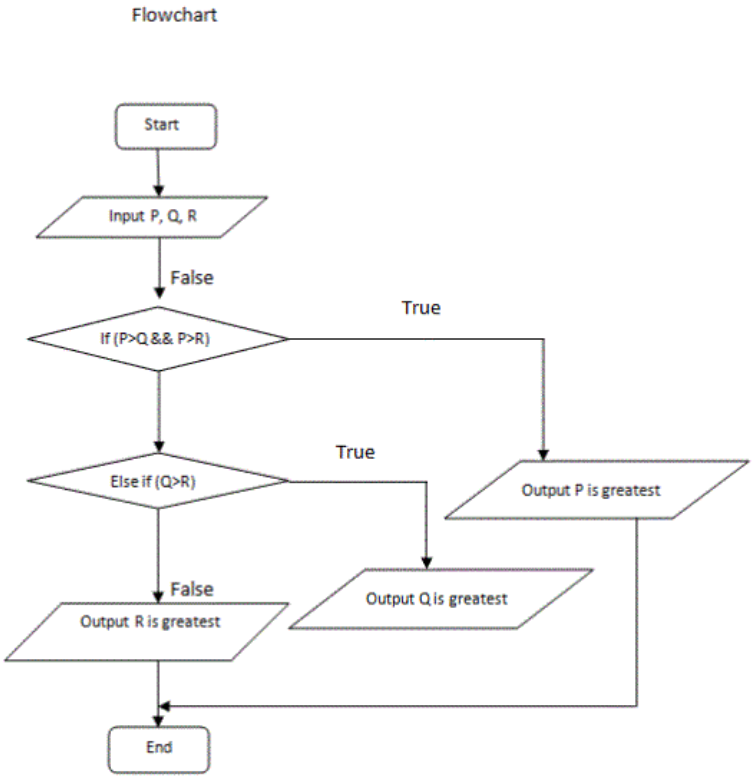
output Q is greatest

else

output R is greatest

Step 4: end

Figure:



4. Nested if else condition:
   Nested if else condition is an entire if-else statement which is written within the body of if part or else part of another if else statement. This condition is used when a condition is to be checked that is inside another condition at a time in the same program, to make a decision.

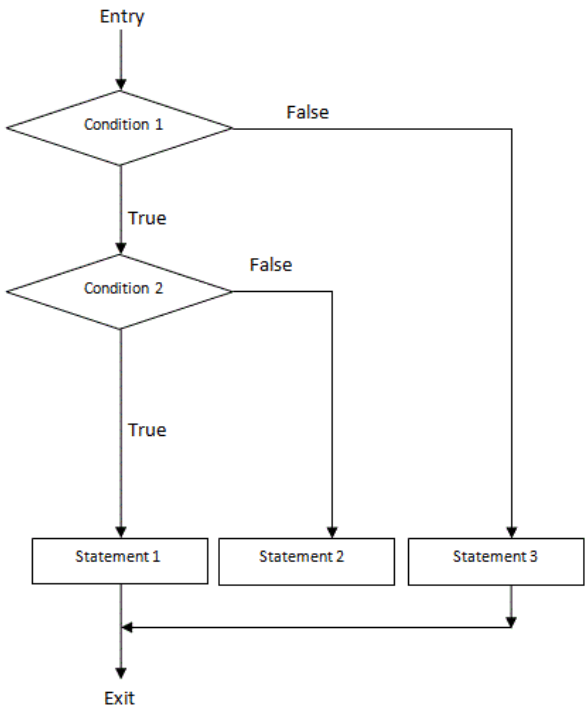


Figure: nested if else condition

Example: Find the greatest 2 positive numbers.

Algorithm

Step 1: start

Step 2: input X, Y

Step 3: if (X>0 && Y>0)

{

if (X>Y)

output X is greatest

else

output Y is greatest

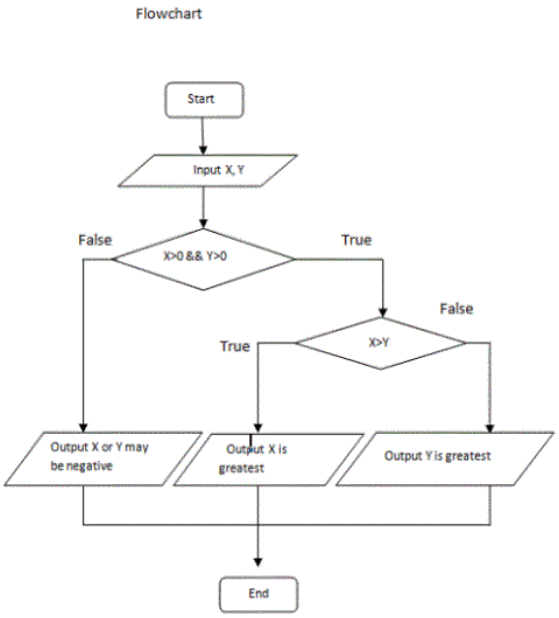
}

output X or Y may be

negative

Step 4: end

Figure:



5. Switch case condition:
   If the given problem has one condition and respective more than two actions, then in this type of case scenario, we can use Switch case condition. It is the multiple branching statements which checks the value of the variable to the case value and then, the statements that are associated with it will be executed. If any expression does not match any of the case value, then the default statement will be executed.

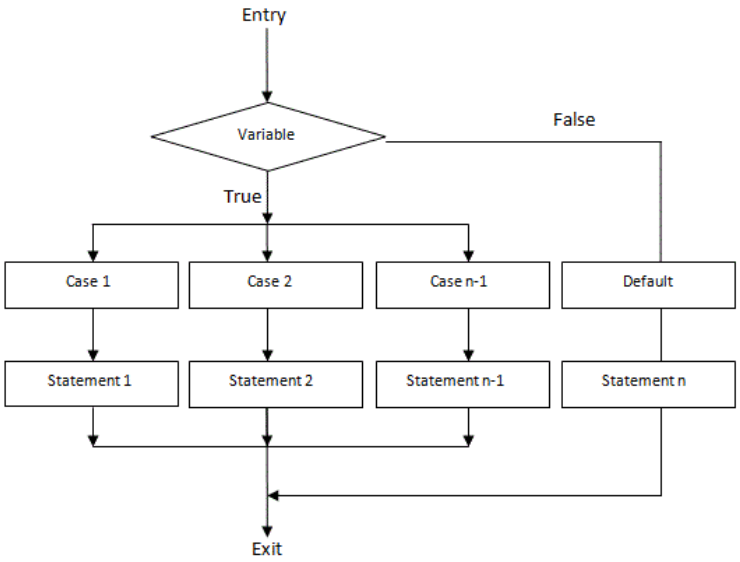


Figure: switch case condition

Example: Write an algorithm and draw a flowchart which takes the integer value 1 to 7 and prints respective day.

Algorithm

Step 1: start

Step 2: switch (day)

{

case 1: output Sunday

break

case 2: output Monday

break

case 3: output Tuesday

break

case 4: output Wednesday

break

case 5: output Thursday

break

case 6: output Friday

break

case 7: output Saturday

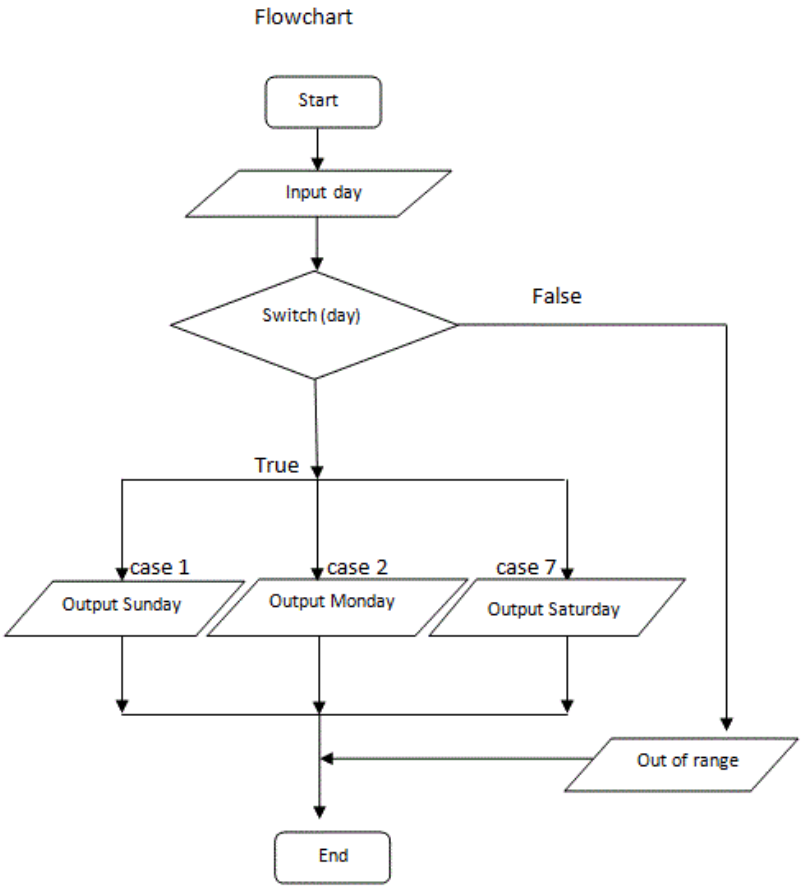
break

default: output out of range

}

Step 4: end

Figure:



- Iteration:These are the computer instructions which are to be performed repeatedly and conditionally i.e. loop statements are driven by the loop condition. Commonly used logic for iteration are while loop, do while loop and for a loop.

1. While loop:
   In this loop, first, the condition is checked by the computer and if the condition turns out to be true, then the statement inside the loop is executed. This process is repeated and the value of increment and decrement operator is always changing. When the condition is false, the loop stops.

   Algorithm Syntax
   Initialization
   while (condition)
   {
   statements
   …….
   …….
   increment/ decrement
   }

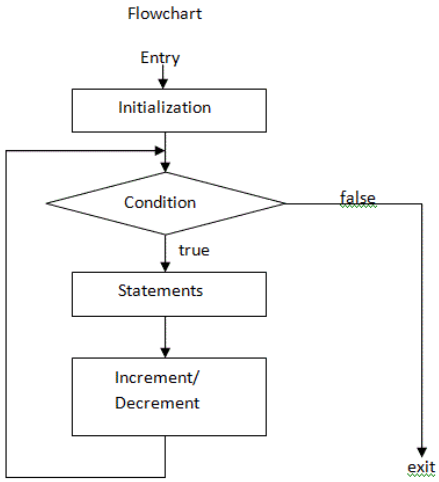


figure: while loop Iteration

Example: Write an algorithm and draw a flowchart to print 1 to 10.

Algorithm

Step 1: start

Step 2: I=1

Step 3: while (I<=10)

{

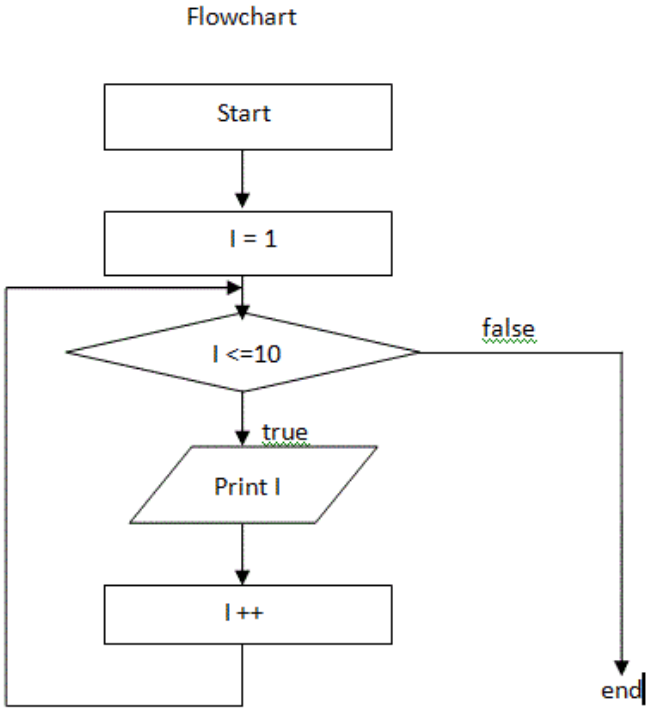
output I

I++

}

Step 4: stop

Figure:



2. Do while loop:
   In this loop, first, the computer checks the initial value; second executes the statements inside the loop and finally, checks the condition. The process is repeated for next pass, if the condition is true. Otherwise, the loop stops. If the condition is initially false, it will execute for at least one time.

   Algorithm Syntax

   Initialization
   do {
   statements
   ……..
   ……..
   increment/ decrement
   } while (condition)

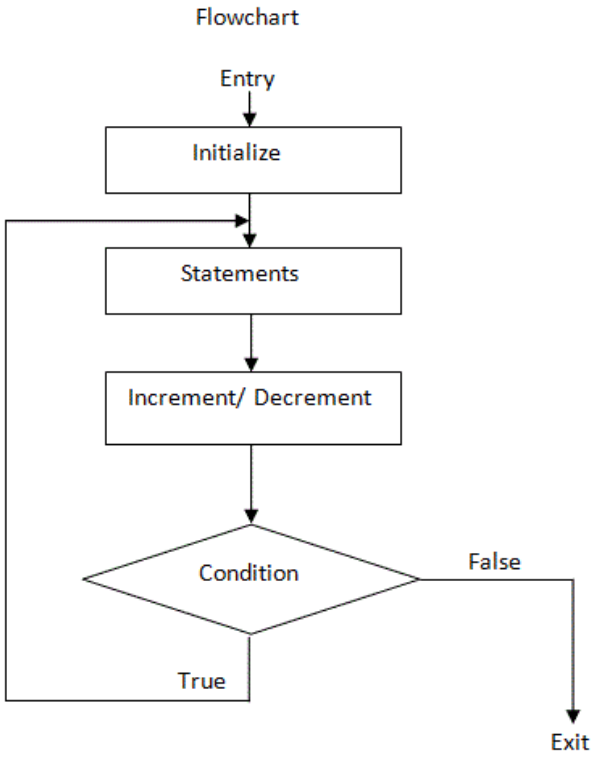


figure: do while loop

Example: Write an algorithm and draw a flowchart to print 100 to 1.

Algorithm

Step 1: start

Step 2: A=100

Step 3: do {

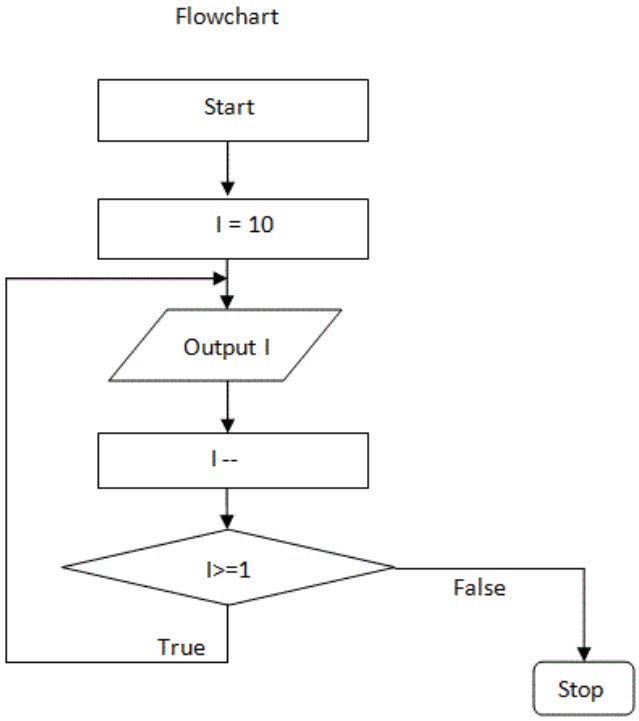
output A

A++

} while (A>1)

Step 4: stop

Figure:



3. For loop:
   It is the most commonly used loop. It consists of 3 expressions; initialization, condition and counter, which are defined within a statement.

   Algorithm Syntax

   for (initialization; condition; counter)

   {

   statements

   …….

   …….

   }

   Where, initialization is starting point,

   the condition is stopping point and increment/ decrement is a counter.

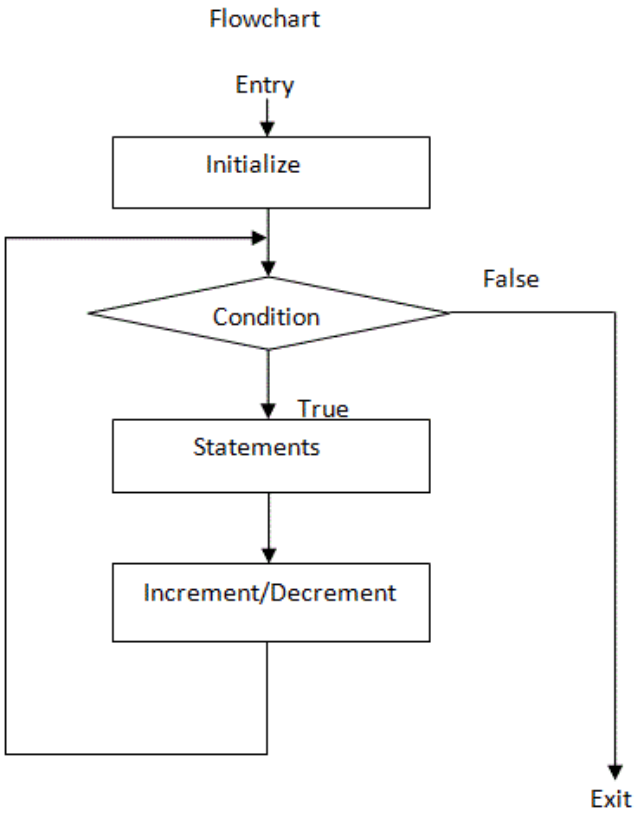


figure: for loop

Write an algorithm and draw a flowchart to print a multiplication table of 7.

Algorithm

Step 1: start

Step 2: for (i=1; i<10; i++)

{

m= i*7

output m

}

Step 4: stop

Write an algorithm and draw a flowchart to print a multiplication table of 7.

Algorithm

Step 1: start

Step 2: for (i=1; i<10; i++)

{

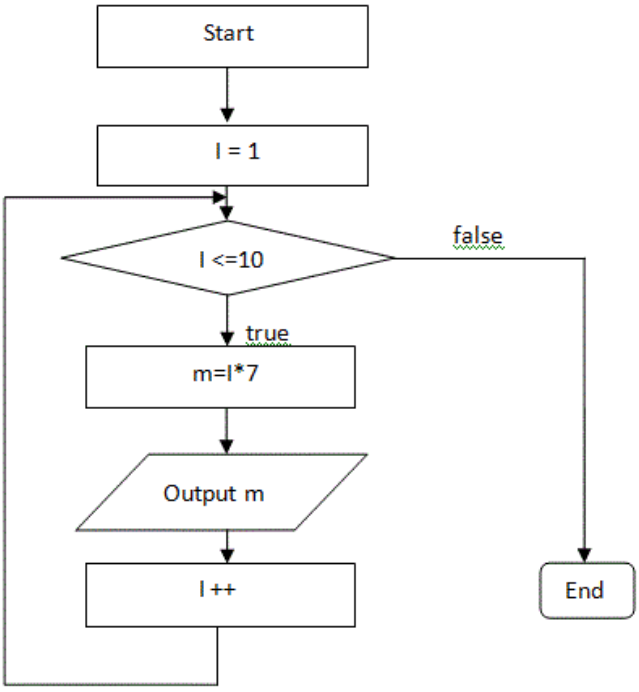
m= i*7

output m

}

Step 4: stop

Flowchart



ALGORITHM

An algorithm is a set of instructions, sometimes called a procedure or a function that is used to perform a certain task. This can be a simple process, such as adding two numbers together, or a

complex function, such as adding effects to an image. For example, in order to sharpen a digital photo, the algorithm would need to process each pixel in the image and determine which ones to change and how much to change them in order to make the image look sharper

Steps in development of Algorithms
1. Problem definition
2. Development of a modal
3. Specification of Algorithm
4. Designing an Algorithm
5. Checking the correctness of Algorithm
6. Analysis of Algorithm
7. Implementation of Algorithm
8. Program testing
9. Documentation Preparation

Problem: Add two numbers
Algorithm
Step 1: Start
Step 2: Read A, B
Step 3: C=A+B
Step 4: Print C
Step 5: Stop

Algorithm Problem: Average of 3 numbers
Step 1: Start
Step 2: Read A, B, C
Step 3: Avg=(A+B+C)/3
Step 4: Print Avg
Step 5: Stop

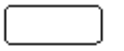
Algorithm Problem: Find Pass or Fail

Detailed Algorithm
Step 1: Start
Step 2: Read Mark
Step 3: Is (Mark>=60) then Print “PASS” else Print “Fail”
Step 4: Stop

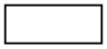
Flowchart

A flowchart is a graphical representation of an algorithm. These flowcharts play a vital role in the programming of a problem and are quite helpful in understanding the logic of complicated and lengthy problems. Once the flowchart is drawn, it becomes easy to write the program in any high level language. Often we see how flowcharts are helpful in explaining the program to others. Hence, it is correct to say that a flowchart is a must for the better documentation of a complex program.

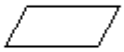
Flowcharts are usually drawn using some standard symbols; however,



Start or end of the program



Computational steps or processing function of a program



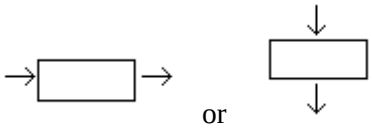
Input or output operation

Decision making and branching

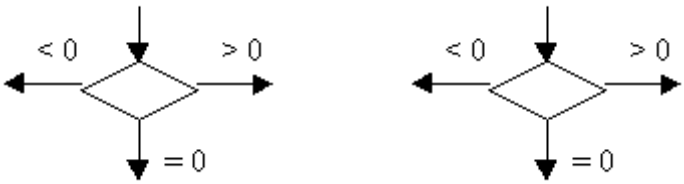
Connector or joining of two parts of program

The following are some guidelines in flowcharting:

a. In drawing a proper flowchart, all necessary requirements should be listed out in logical order.
b. The flowchart should be clear, neat and easy to follow. There should not be any room for ambiguity in understanding the flowchart.
c. The usual direction of the flow of a procedure or system is from left to right or top to bottom.
d. Only one flow line should come out from a process symbol.



e. Only one flow line should enter a decision symbol, but two or three flow lines, one for each possible answer, should leave the decision symbol.



f. Only one flow line is used in conjunction with terminal symbol.

h. If the flowchart becomes complex, it is better to use connector symbols to reduce the number of flow lines. Avoid the intersection of flow lines if you want to make it more effective and better way of communication.
i. Ensure that the flowchart has a logical *start* and *finish.*
j. It is useful to test the validity of the flowchart by passing through it with a simple test data.

Example of a flowchart:

Problem 1: Write an algorithm and draw the flowchart for finding the average of two numbers

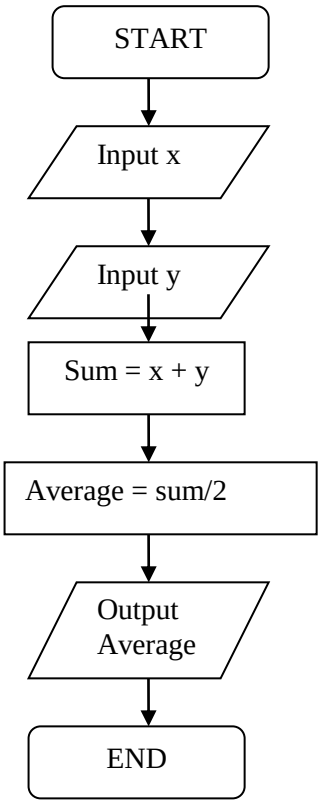
Algorithm:

Input: two numbers x and y

Output: the average of x and y

Steps:

1. input x
2. input y
3. sum = x + y
4. average = sum /2
5. output average



Advantages of Using flowchart

• Communication: Flowcharts are better way of communicating the logic of a system to all concerned or involved.
• Effective analysis: With the help of flowchart, problem can be analysed in more effective way therefore reducing cost and wastage of time.
• Proper documentation: Program flowcharts serve as a good program documentation, which is needed for various purposes, making things more efficient.
• Efficient Coding: The flowcharts act as a guide or blueprint during the systems analysis and program development phase.

• Proper Debugging: The flowchart helps in debugging process.
• Efficient Program Maintenance: The maintenance of operating program becomes easy with the help of flowchart. It helps the programmer to put efforts more efficiently on that part

Disadvantages of Using flowchart

• Complex logic: Sometimes, the program logic is quite complicated. In that case, flowchart becomes complex and clumsy. This will become a pain for the user, resulting in a waste of time and money trying to correct the problem
• Alterations and Modifications: If alterations are required the flowchart may require re-drawing completely. This will usually waste valuable time.
• Reproduction: As the flowchart symbols cannot be typed, reproduction of flowchart becomes a problem.

5. Structured Programming

Structured Programming is designed which focuses on process/ logical structure and then data required for that process. Structured Programming is also known as Modular Programming and a subset of procedural programming language. Structured Programming is less secure as there is no way of data hiding.

Advantages of structured programming

The following are the different advantages of structured programming

1. It is user friendly and easy to understand.
2. Similar to English vocabulary of words and symbols.
3. It is easier to learn.
4. They require less time to write.
5. They are easier to maintain.
6. These are mainly problem oriented rather than machine based.
7. Program written in a higher level language can be translated into many machine languages and therefore can run on any computer for which there exists an appropriate translator.
8. It is independent of machine on which it is used i.e. programs developed in high level languages can be run on any computer.

Object Oriented Programming

OOP (Object Oriented Programming) is the most recent concept in computer programming. Unlike structural programming approach, it uses the bottom up programming approach. OOP treats data as a critical (Very important) element in the program development and does not allow data to move freely around the program. OOP ties the data more closely to the function that operates on it and protects data from accidental modification from outside function. It allows decomposition of a program into a number of entities called objects and then builds data and

functions around these objects. The data of an object can be accessed only by the function associated with that function.

Features of OOP:

- Emphasis is on data rather than procedures.
- Programs are divided into objects and modules.
- Functions that operate on the data of an object are tied together in the data structure.
- Data is hidden inside the object and cannot be accessed by external functions.
- Objects may communicate with each other through functions.
- New data and functions can be easily added whenever necessary.
- Follows bottom-up approach in program design.

Features of OOP:

1. Object: Object is a basic run time entities in an object oriented program which consists of data and functions. They may represent a person, a place, a bank account, a table of data or any item that the program has to handle. It may also represent user defined data. An object is a variable consisting both routine and data that is treated as discrete entity within programming. Each object contains data and functions to manipulate the data. The different objects can interact by sending message through functions to one another.

Object: Ram

Roll no.

Name.

Function:

Study()

Sleep()

Eat()

Play()

2. Class:

Class is the collections of the objects of similar types. For example, mango, apple and orange are members of the class 'fruit'. Classes are user defined data types and behave like the built in data types of the programming languages. Classes are also known as abstract data types (ADT) in OOP because they use the concept of data abstractions.

Class example

Class item

{

Private:

Int number;

```
Float cost;
Public:
Getdata(int a, float b);
Putdata(void);
}
```

3. Data abstraction:

Data abstraction refers to the act of representing essential features without including the background details or explanation. Classes use the concept of abstraction and are defined as a list of abstract attributes such as size, weight and cost and functions to operate on these attributes.

4. Encapsulation:

The wrapping up of data and function into a single unit called class is known as encapsulation. Unlike the POP approach, the data is hidden inside the object. The data is not accessible to outside world and only those functions which are wrapped in the class can access the data. This feature of OOP approach prevents the data from the accidental or unnecessary modification. This is also called data hiding or information hiding feature of OOP.

5. Inheritance:

Inheritance is the process by which objects of one class acquires the similar properties of objects of another class from which they are derived. For example, 'dog' is a part of class mammal which is again a part of the class 'animal'. Besides it has all the features of the class 'animal', it also has some special features of mammal. The concept of inheritance provides the idea of reusability. This means that we can add additional features to an existing class without modifying it. This is possible by deriving a new class from the existing one. The new class will have the combined features of both the classes.

6. Polymorphism:

Polymorphism is a Greek term which means ability to take more than one form. An operator or function may exhibit different operation in different instances. The operation depends upon the types of data used in the operation. For example, the '+' symbol for two numbers, the operator will generate a sum and if the operands are string (text), then the operator would produce a third string by concatenating two strings. For example: 20+30=50 'WEL' + 'COME' = 'WELCOME'

Application of OOP:

OOP is suitable for virtually many programming task including development of editors, compilers, databases, communication systems and any other complex real-life application systems.

i. OOP allows us to create hierarchy-related objects, we can build special object- oriented libraries which can be used later by many programmers.

ii. OOP is able to map the real-world problem properly.

iii. OOP can be used to create such programs which are easily maintainable and expandable as when new features are required, it is very easy to add to them to the existing structure of an object.

Difference between OOP and Structured Programming Language

Structured Programming	Object Oriented Programming
• Structured Programming is designed which focuses on process/ logical structure and then data required for that process.	• Object Oriented Programming is designed which focuses on data.
• Structured programming follows top-down approach.	• Object oriented programming follows bottom-up approach.
• Structured Programming is also known as Modular Programming and a subset of procedural programming language.	• Object Oriented Programming supports inheritance, encapsulation, abstraction, polymorphism, etc.
• In Structured Programming, Programs are divided into small self contained functions.	• In Object Oriented Programming, Programs are divided into small entities called objects.
• Structured Programming is less secure as there is no way of data hiding.	• Object Oriented Programming is more secure as having data hiding feature.
• Structured Programming can solve moderately complex programs.	• Object Oriented Programming can solve any complex programs.
• Structured Programming provides less reusability, more function dependency.	• Object Oriented Programming provides more reusability, less function dependency.
• Less abstraction and less flexibility.	• More abstraction and more flexibility.

Scripting Language

A scripting language is a programming language designed for integrating and communicating with other programming languages. Some of the most widely used scripting languages are JavaScript, VBScript, PHP, Perl, Python, Ruby, ASP and Tcl. Since a scripting language is normally used in conjunction with another programming language, they are often found alongside HTML, Java or C++.

a) Client-side

The client is the system on which the Web browser is running. JavaScript is the main client-side scripting language for the Web. Client-side scripts are interpreted by the browser. The process with client-side scripting is:

1. the user requests a Web page from the server
2. the server finds the page and sends it to the user
3. the page is displayed on the browser with any scripts running during or after display

So client-side scripting is used to make Web pages change after they arrive at the browser. It is useful for making pages a bit more interesting and user-friendly. It can also provide useful gadgets such as calculators, clocks etc. but on the whole is used for appearance and interaction.

Client-side scripts rely on the user's computer. If that computer is slow they may run slowly. They may not run at all if the browser does not understand the scripting language. As they have to run on the user's system the code which makes up the script is there in the HTML for the user to look at (and copy or change).

b) Server-side

The server is where the Web page and other content lives. The server sends pages to the user/client on request. The process is:

1. the user requests a Web page from the server
2. the script in the page is interpreted by the server creating or changing the page content to suit the user and the occasion and/or passing data around
3. the page in its final form is sent to the user and then cannot be changed using server-side scripting

The use of HTML forms or clever links allow data to be sent to the server and processed. The results may come back as a second Web page. Server-side scripting tends to be used for allowing users to have individual accounts and providing data from databases. It allows a level of privacy, personalisation and provision of information that is very powerful. E-commerce, MMORPGs and social networking sites all rely heavily on server-side scripting. PHP and ASP.net are the two main technologies for server-side scripting.

The script is interpreted by the server meaning that it will always work the same way. Server-side scripts are never seen by the user (so they can't copy your code). They run on the server and generate results which are sent to the user. Running all these scripts puts a lot of load onto a server but none on the user's system

Computer system Development

The System Development Life Cycle, "SDLC" for short, is a multistep, iterative process, structured in a methodical way. This process is used to model or provide a framework for technical and non-technical activities to deliver a quality system which meets or exceeds a business"s expectations or manage decision-making progression.

A life cycle is a plan, composed of several phases, aimed at maximizing the efficient development of a quality, usable product. A life cycle is a set of procedures, some required and others optional, which serve as a template for generating an individual design process. The plan is not meant to be a strict step by step process, but rather a flexible process insuring that users, designers, and management are directly involved in the development of the final product. In general, a life cycle requires the project team to plan the development process, obtain training, generate the deliverables, and obtain timely product team manager approval for continued development. The typical life cycle is composed of five phases: Investigation, User Requirements, Analysis, Design, and Implementation & Release. Each phase is defined by activities, deliverables, and checkpoints.

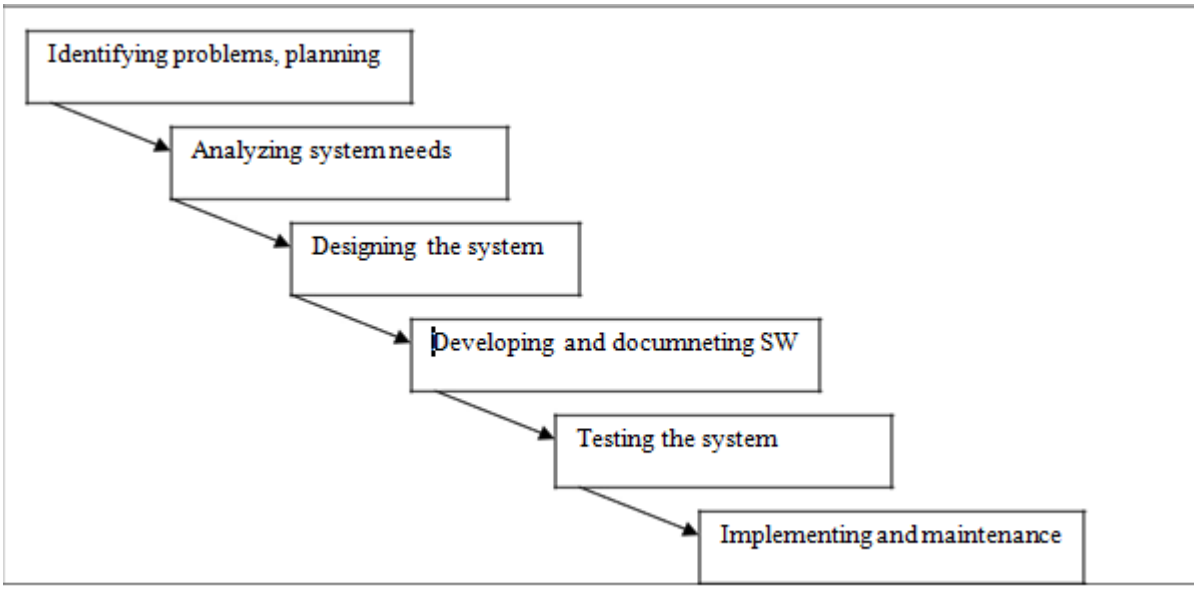


Figure 1 – SDLC

Identifying problems, planning

This is the first and very important phase of system development live cycle. This phase is critical to the success of the project . Specialist identifies the need for a new or enhanced system. Information needs of the organization are examined and projects to meet these needs are proactively identified.The organizations IS needs may result from requests to deal with problems in current procedures, from the desire to perform additional tasks, or from realization that information technology could be used to capitalize on an existing opportunity. These needs can then be prioritized and translated into a plan for the IS department, including a schedule for developing new major systems. In smaller organizations determination of which systems to develop may be affected by ad hoc user requests submitted as the need for new or enhanced systems arises, as well as from formalized information planning system. Two additional major activities are also performed during the planning phase, the formal, yet still preliminary , investigation of the system problem or opportunity at hand and the presentation of reasons why the system should or should be not developed by the organization.

Analyzing system needs

In this phase special tools help the analyst make requirement determinations. One such tool is the use of data flow diagrams. With DFD (see Figure 2) are input, processes and output of the business functions convert into structured graphical form. During analysis the analyst studies the organization´s current procedures and the information systems used to perform organizational tasks. They prepares materials that sumarizes what has been found , provides cost and benefits analyses of alternatives and makse recommendations on what should be done. Once the recommendation is accepted the analyst can begin to make plans to acquire any hardware and system software necessary to build or operate the system as proposed.

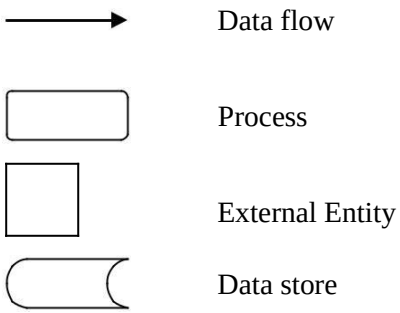


Figure 2 - Data flow diagram symbols

Systems Design

The third phase describes, in detail, the necessary specifications, features and operations that will satisfy the functional requirements of the proposed system which will be in place. This is the step for end users to discuss and determine their specific business information needs for the proposed system. It”s during this phase that they will consider the essential components (hardware and/or software) structure (networking capabilities), processing and procedures for the system to accomplish its objectives.

Development

The fourth phase is when the real work begins—in particular, when a programmer, network engineer and/or database developer are brought on to do the major work on the project. This work includes using a flow chart to ensure that the process of the system is properly organized. The development phase marks the end of the initial section of the process. Additionally, this phase signifies the start of production. The development stage is also characterized by instillation and change. Focusing on training can be a huge benefit during this phase.

5. Integration and Testing

The fifth phase involves systems integration and system testing (of programs and procedures)—normally carried out by a Quality Assurance (QA) professional—to determine if the proposed design meets the initial set of business goals. Testing may be repeated, specifically to check for errors, bugs and interoperability. This testing will be performed until the end user finds it acceptable. Another part of this phase is verification and validation, both of which will help ensure the program”s successful completion.

6. Implementation

The sixth phase is when the majority of the code for the program is written. Additionally, this phase involves the actual installation of the newly-developed system. This step puts the project into production by moving the data and components from the old system and placing them in the new system via a direct cutover. While this can be a risky (and complicated) move, the cutover typically happens during off-peak hours, thus minimizing the risk. Both system analysts and end-users should now see the realization of the project that has implemented changes.

7. Operations and Maintenance

The seventh and final phase involves maintenance and regular required updates. This step is when end users can fine-tune the system, if they wish, to boost performance, add new capabilities or meet additional user requirements.

Multimedia

Introduction to multimedia:

The combination of two or more media sound, graphics, animation, images, text or video in one pack as a unit information is called multimedia. Multimedia simply means multiple media in one content. The multimedia may be combined with movie, presentation, interactivity, graphics or animation to give some information. Others, such as virtual reality, computer programming and robotics are possible candidates for future inclusion. The multimedia is used to human-computer interaction or conveys information. It also refers to the use of computer technology to create, store and experience multimedia contents.

Computer delivered electronic system that allows the user to control, combine and manipulate different types of media, such as text, sound, video, computer graphics and animation. The most common multimedia machine consists of a personal computer with a sound card, network interface card, speaker and optical devices. Interactive multimedia systems under commercial development include games, flight simulations, virtual reality, direct to home (DTH) services which enable TV viewers to choose channel, pause live games and record TV programs.

Components of Multimedia:

The component of multimedia includes text, audio, still images, animation, video and interactivity content forms:

i. Text:

Text is the most widely used and flexible means of presenting information on paper, display unit or in multimedia for conveying ideas and thoughts. Data that consists of characters representing the words and symbols of human speech. Text represented in computer system usually represented to the ASCII standards. The text may include characters, letters, numbers and other special symbols. In multimedia, text is broadly used for expressing different types of information. For example: casts on the movies, contents of presentation, web pages etc.

ii. Graphics:

A picture is a worth of thousands words. An image, figure, picture or drawing can be considered as graphics. The graphics can express many things in shorter time frame. Graphics represents still images and defined as static representation. It gives better and clear idea on the particular topic. For example: charts, pictures in presentation, bitmap images, animated GIF.

iii. Audio:

Audio is the one of the most important components in multimedia presentation. Sound is a mechanical energy that transmits through matter as wave. Audible sound is characterized by various properties like frequency, wavelength, period, amplitude and velocity of speed. Audio represents the audible sounds via speakers. It is important in some multimedia presentation. Most of the video games, movies, simulation and advertising audio is the most effective tools for convey the information. For example: audio on movies.

iv. Video:

The main component of the presentation if video. It is the sequential representation of figures in systematic order. Video contains images, figures, graphs, animations and other components to

represents on particular topic. Video is used to generate visual environment during presentation. For example: videogame, movies etc.

v. Animation:

Animation is the displaying of images in a sequence. Animation gives artwork or model in order to create an illusion of movement. It is an optical illusion of motion due to the phenomenon of persistence of vision. It can be created and demonstrated in a number of ways. The most common method of presenting animation is as a motion picture or video program. Animation is widely used in modern animated movies, games and videos, which give the exciting look and feel to the viewers.

Application of multimedia:

The application of multimedia has the broad range of applied fields. From cinema halls to homes, advertising agency to satellite television stations and computer simulation to new aircraft designing uses the multimedia for their improvement on business or performance. Multimedia finds its application in various areas including advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial temporal applications.

i. Creative Industries:

Creative industries use multimedia for a variety of purposes ranging from fine arts to entertainment, commercial art to journalism, media houses to advertising agencies uses multimedia for the effective presentation. An individual multimedia designer may cover the spectrum throughout their career. For example: advertisement development, cartoon movies, animated movies etc.

ii. Commercial:

Most of the commercial purpose multimedia agencies use computer system. Exciting presentations are used to grab and keep attention in advertising. The methods are often developed by creative services for advanced multimedia presentations beyond simple slide shows to sell ideas or trainings. Commercial multimedia developers may be hired to design for effective multimedia and service applications. For example: hoarding board design, design of multimedia webpages etc.

iii. Entertainment and fine arts:

Multimedia is heavily used in the entertainment industry especially to develop special effects in movies, games and interactive animations. Multimedia games are a popular pastime and are software programs available either in CD/DVD ROMs or in online. Multimedia applications that allow users to actively participate instead of just sitting by as passive recipients of information are called interactive multimedia. For example games, movies, audio recording etc

iv. Education:

In education, multimedia is used to produce computer-based training courses and reading reference book and encyclopedia. A computer based training lets the user go through a series of presentations, text on a particular topic and associated illustrations in various animations, graphs and images. Edutainment is emerging term used to describe combining education with entertainment, especially multimedia entertainment focused for schooling students.

v. Journalism:

Newspaper companies all over are also trying to embrace the new phenomenon by implementing its practices at their work. News reporting is not limited to traditional media outlets. Freelance journalists can make use of different new media to produce multimedia pieces for their news stories. It engages global audiences and tells stories with technology to the world, which develops new communication techniques for both media producers and consumers.

vi. Engineering:

Software engineering may use multimedia in computer simulations for anything. Multimedia implementation range from entertainment to trainings such as military or industrial training.

Multimedia for software interfaces are often done as collaboration between creative professionals and software engineers. Designing of real project has higher cost than implementing and testing on computer based system with simulation. These simulation methods used broad range of multimedia tools.

vii. Industry:

In the industrial sector, multimedia is used as a way to help present information to shareholders, superiors and coworkers. Multimedia is also helpful for providing employee training, advertising and selling products all over the world via virtually unlimited web-based technology. Interactive devices are used to operate devices in the case of excessive danger. The common example at industry is using multimedia feature computers at atomic energy plant for Uranium/Plutonium insertion and removal.

viii. Mathematical and scientific research:

In mathematical and scientific research, multimedia is mainly used for modelling and simulation. For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Representative research can be found in journals such as the journal of multimedia.

ix. Medicine:

In medicine, doctors can get trained by looking at a virtual surgery. They can simulate how the human body is affected by diseases spread by viruses and bacteria. Modern medical equipment having full range of multimedia features are handy to operate. Telemedicine, a new concept of medication to rural areas is emerging where specialist doctors are not available. The medication process is conducted via specialized centers with some medical professional and multimedia features communicating devices.

x. Disabilities:

The modern multimedia techniques broadly cover the area designed for disable people. Disable people can take advantages in their daily life with the help of multimedia. For example, a blind people can use computer and type correctly as you can. This is possible with the help of multimedia assistance software. These software assist with the audio voice on what they type.

Image File Format

a. JPEG (.jpg, .jpeg)

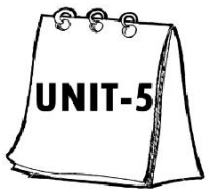
JPEG, which stands for Joint Photographic Experts Groups is a “lossy” format meaning that the image is compressed to make a smaller file. The compression does create a loss in quality but this loss is generally not noticeable. JPEG files are very common on the Internet and JPEG is a popular format for digital cameras – making it ideal for web use and non-professional prints.
Compression: Lossy – some file information is compressed or lost
Best For: Web Images, Non-Professional Printing, E-Mail, Powerpoint
Special Attributes: Can choose amount of compression when saving in image editing programs like Adobe Photoshop or GIMP.

b. GIF (.gif)

GIF or Graphics Interchange Format files are widely used for web graphics, because they are limited to only 256 colors, can allow for transparency, and can be animated. GIF files are typically small is size and are very portable.
Compression: Lossless – compression without loss of quality
Best For: Web Images
Special Attributes: Can be Animated, Can Save Transparency

c. TIFF (.tif, .tiff)

TIFF or Tagged Image File Format are lossless images files meaning that they do not need to compress or lose any image quality or information (although there are options for compression), allowing for very high-quality images but also larger file sizes.
Compression: Lossless – no compression. Very high-quality images.
Best For: High quality prints, professional publications, archival copies
Special Attributes: Can save transparencies



Network and Communication

Computer network:
A group of autonomous computer and associated devices are connected together by wire or wireless in order to share resources (file, data, printer, hard drives, CD-ROM, software etc.), allow electronic communication (e-mail, messenger, VOIP, Facebook etc.) and increase productivity is called computer network. The computer devices include palmtop to mainframe, networking devices includes repeaters to gateways and other components like telephone, mobile etc. may include to form a computer network.

Advantages of computer network:

Some of the main goal of the computer network is to enable its users to share resources, to provide low cost communication and easy addition of new processing services. The computer network creates a global environment for its users and computers. Some of the advantages of computer networks are as follows:

i. Resource sharing:
The main advantage of computer network is resource sharing to minimize operating cost. We can share different hardware and software resources like file, printer, operating system, scanner or computer peripheral devices in the network. A single file can be shared and used between multiple users at the same time. Similarly, computer hardware such as printer, modem, hard disk etc. can be shared in the network to access these devices simultaneously.

ii. Communication Medium:
From the beginning of computer networking, the main goal was to establish communication between two autonomous devices. In modern days, it is the fast growing branch of the internet and became possible due to the computer networking. It is very fast and cheap to communicate long distance through computer networking. We communicate via computer networking by sending text, listening online FM stations, e-commerce, Facebook etc.

iii. Centralized computing:
All the computers and other components of a network are managed and controlled by a central computer which is known as the server. From the security measures server data can be protected easily and then data can be transferred to all the clients. It is easy and convenient to manage and troubleshoot all the clients through server rather than individually. Hence, centralized

computing is the advantage of computer network. Without computer network, client and server cannot share data and information between them.

iv. Simultaneous Access:

Many organizations like banks works on same database system. This database should be modified, updated and deleted frequently. This work becomes possible only when there exist network server. A network server is a central computer with a large storage capacity and other resources that all users can share. If server stores data files for user to access it is commonly called a file server. The business can store data file on the server that user can access whenever they want. Then, if one user modifies it other user will see the change when they use the file.

v. Backup and Recovery:

Server is the main component of the computer network so it is kept in a very secured place and good security mechanism have been implemented to keep the data and files safe. In networking environment, all the data and files are centralized in a server. If any data or files are lost in the clients, it is possible to restore the from the server.

vi. Saving money:

Small computers have a much better price/performance ratio than larger ones. Mainframe are hundreds time faster than personal computers but they cost thousands times than personal computers. Because of this imbalance, personal computers with network system emerge to share data and resource through different mainframe servers. This process definitely saves money of buying large systems instead of personal computers with networking

Disadvantages of networking:

i. Increase expenses:

The networking process requires devices, technical manpower and operating cost. These devices cost more and increases expenses of organization. The commonly used devices such as hubs, cable, NIC, modem etc. These devices increase the cost of the organization.

ii. Possibility of leakage and corruption of data:

The networking server manages and controls all the other computer nodes in the networks. The data server transmit data by implementing some security mechanism. The data transmission in between the nodes may be hacked and used by third parties. This causes the data corruption and leakage in networking. Similarly, the hackers and computer viruses are the great threat to the computers in the networks. Even a virus theft personal data from one computer and send it to other.

iii. Need special technical knowledge:

To work in the networking environment, the organization needs very high skilled manpower to install and operate. In Nepal, there is still lack of technical manpower. The absence of technical manpower causes shutdown of network. There are others technical issues like availability of devices, lack of teaching institution etc.

Types of Transmission

Data Communication	Voice Communication
Requires connection set up time of about 1 sec or less	Requires connection set up time of about 1 sec to 1 minute.
one or two way communication based on application(FTP/browsing/VOIP)	mostly two way communication
data received is error free, in case of errors either retransmission is initiated or it is corrected using FEC techniques.	voice received is with noise and degradation in quality
transmission usually is in the form of bursts	transmission is continuous due to real time operation needed for voice
Data can be stored in database servers and tranmitted based on congestion and application(sms,email)	not tolerant of transmission delays and hence to be transmitted in real time
connection may be required for 24 hrs/day and 7 days/week in	Connection duration is limited to

certain applications such as ATM cash machine

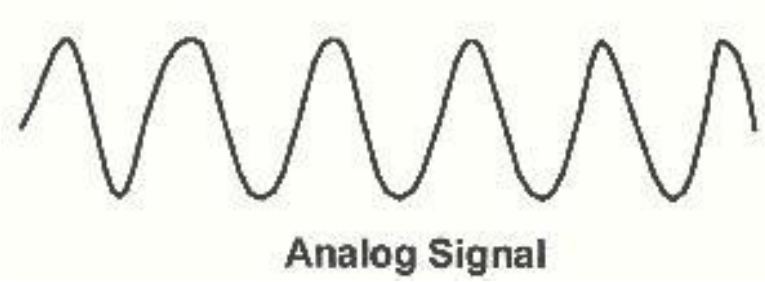
May require wide range of bandwidths

several minutes

May require a fixed bandwidth of about 4KHz

Analog and Digital signal:

Analog Signal: The analog signal is continuous and can be represented in sine waves. Human voice, listening music, television signal transmission are common examples of analog signals. Human voice generate analog (continuous varying) signal containing multiple frequencies that is transmitted as an analog signal over any medium. The signals which are vary in amplitude and frequency. Any information can be converted into an analog signal; such a signal is a measured response to changes in physical phenomena such as sound, light, temperature, position or pressure. The examples are: FM radio music, TV transmission, hearable audio, light etc.



Advantages:

i. High density, large amount of data can be transfer in analog signal.

ii. The installation of analog devices is easier than the digital equipment.

iii. Long distance data transmission is possible.

iv. Installing, operating and maintenance is cheaper.

Disadvantages:

i. Noise is the main disadvantage.

ii. Noise can create signal loss. EMI, high voltage, radiation, quality of media causes data loss as well as mixing of noise on data.

iii. The lost data cannot recover during transmission.

iv. The quality of analog transmission is poor.

Digital signal:
A digital signal is a physical signal that is a representation of a sequence of discrete values. Digital signal describes any system based on discontinuous data or events. Computers are digital machines, at their most basic level they can distinguish between just two values 0 and 1(OFF and ON case of electrical charge). Information transmitting in and out of the computer system is in the form of digital signals. The bandwidth of the digital transmission indicated how much data transfer in particular amount of time. Modern computer are digital machines because at their most basic level they can distinguish between just two values 0 and 1 or absence and presence of voltage. Hence,

the data transmission between computer peripheral and inner parts of computer is digital transmission. For example, Pen drive to hard disk data transmission, DVD-ROM to Pen drive, RAM to Microprocessor and ADSL modem to your computer etc.

Digital Signal

Advantages:

i. Error free and high quality transmission is possible.

ii. Suitable for short range error free data transmission.

iii. Regeneration of signal is easy.

iv. Error detection and correction is easy than analog communication.

Disadvantages:

i. Digital transmission has distance limit, repeaters required to transmit more than 200 meters.

ii. Cost of equipment is high.

iii. The data transmission capacity is lower than analog transmission.

iv. Skilled manpower requires to install, operate and maintenance.

Mode of communication:

The mode of communication shows how two or more devices communicate each other. There are three types of data communication methods:

i. Simplex:

In simplex communication, one of the communicating devices can only send data where the other can only receive it. The unidirectional mode of communication is called simplex mode of communication. Commercial radio broadca st, television broadcast and keyboard to CPU communication are some of the most common examples of simplex communication

ii. Half duplex:

Half duplex refers to two-way communication but only one can transmit data at a time. The half-duplex mode of communications provides simplex communication in both directions. When one device sending data, the other device must only receive it and vice versa. In simplex mode, one device just transmits data and others receive. But in half duplex, every device has capable of sending and receiving data but only one job at the same time. While sending data it cannot receive it and while receiving data it cannot send. An example of half-duplex system is a two-party system such as "walkie-talkie" style two-way radio.

iii. Full Duplex:

Full duplex refers to the transmission of data in two directions simultaneously. Here, both the devices are capable of sending as well as receiving at the same time. Bidirectional communication at the same time is called full duplex communication. An example of full duplex mode of communication is land line telephone, mobile phones and full duplex Ethernet communication.

Network Architecture (Model of Computer)

The arrangement of the computer nodes on the network is based on the computing model is called network architecture. There are two main model of arranging computer on the network. They are as follows:

i. Client server model:

An arrangement of computers to resource sharing and communicate each other through a central device (server) to all workstations (clients) is called client server architecture. The server can be high-speed microcomputer, minicomputer or mainframe computer. The workstations can be simple microcomputers having their own application packages with network operating system. The central server manages, organize and co-ordinate all network clients on the network. Other workstations request server for data and communicate to other workstations. The client and server computers are interconnected by a hub, switch or router. A server machine is a host that is running one or more server programs which share its resources with clients. Client to client communication is also possible with the help of server. Clients therefore initiate communication sessions with servers which await incoming requests. The devices such as email server, web server and database server are built on the client-server model.

ii. Peer to peer model:

A type of network in which each workstation has equal capabilities and responsibilities to share data and information, the arrangement of components attached in one-to-one basis is called peer to peer network architecture. Here, each workstation act as both a client and a server. There is no central repository for information and no central server to maintain. Data and resources are distributed throughout the network, and each user is responsible for sharing data and resources connected to their system. Peer to peer networks are generally simpler and less expensive, but they usually do not give the same performance under large networked computers.

Difference between client-server model and peer-to-peer model:

client-server model	peer-to-peer model:
1. It is also known as centralized or server based network. 2. Some computers in the network are dedicated to a particular task and are called server. 3. The data and resource are centrally located or data on the network is directly managed by server. 4. These networks are more expensive when compared to peer to peer network. 5. These networks can support large number of nodes (workstations) in a single network. 6. Data and information is stored in central computer hence security mechanism implemented easily. 7. If server crashes there is a chance of data loss. 8. Computerized bank, finance company, yahoo server and Google server are some of the common example of client server networking. 9. There is no burden to workstation of other workstations. Server manages all workstations by its own.	1. It is also known as distributed network. 2. Each workstation has equal rights and responsibilities i.e. each workstation acts as both a client and a server. 3. Data and resources are distributed throughout the network and each user is responsible for sharing data and resources connected to their system. 4. These networks are generally simpler and less expensive. 5. This network can support only small number of nodes in it. 6. Less secure because data are distributed around the network. 7. Data and information is shared around network, hence less chance of data loss. 8. Distributed network and one to one computer connectivity via Bluetooth are the common example of peer to peer network. 9. There is extra burden to manage other workstations in the network because there is no central server to manage network

Types of computer networks:

The mostly classification is based on the distance covered, geographical area and bandwidth of the data transmission. This type of network has specific features on its own types. Some of them used within room and some of them used to share data from one continent to another. There are different types of computer network on the basis of geographical area covered.

A. Personal Area Network (PAN): is the computer network used to communicate among electronic devices, including phones, television, personal digital assistance (PDA) etc. The range of these devices bounds within a room, ranging upto a few meters. The PAN can be use to communicate among personal devices themselves. Personal area networks may be wired or wireless in nature. Infrared communication (Remote controller), Bluetooth, Z-Wave and ZigBee are the common example of wireless personal area network.

Advantages of PAN:

i. It has high bandwidth.

ii. It is easy to troubleshoot because minimum devices are used.

iii. It has low cost in comparison to other network types.

iv. It has minimum chance of hacking or data lost.

Disadvantages of PAN:

i. It cannot use for general purpose.

ii. The transmission generally has one to one communication.

B. Local Area Network (LAN):group of computer and other devices dispersed over a relatively limited area and connected by a communications link that enables any device to interact with any other on the network. LANs commonly include PCs and shared resources such as laser printer and hard disks. The devices on a LAN are known as nodes and the nodes are connected by cables through which messages are transmitted.

Advantages of LAN:

i. It provides high bandwidth for resource sharing.

ii. It provides cheaper and reliable communication medium.

iii. It provides a great deal of design flexibility, easy maintenance and cost efficiency.

iv. It can support centralized data storage.

Disadvantages of LAN:

i. Large number of nodes cannot handle efficiently.

ii. Fault on network can lost data and information.

iii. One time installation cost is high.

C. Metropolitan Area Network (MAN):
high speed network that can carry voice, data, video and images up to 512 Mbps or faster over distances up to 75 Km. Based on network architecture, the transmission speed can be higher for shorter distances and lower for long distances. A MAN can include one or more LANs as well as telecommunication equipment, microwave relay stations and satellite base stations. A MAN is larger than LANs and smaller than Wide Area Network (WAN) and operates at high speed. Cable television, cable internet, wireless internet, telephone exchange station, bank networking within city is the most common examples of MAN.

D. Wide Area Network (WAN):

A geographically widespread network capable for communicating and sharing all types of data and information all around the world is called WAN. WAN is a large network also called network of network and consists large numberof LANs and MANs. The span of WAN is in thousands kilometers around the world connecting countries and continents. The bandwidth is lesser in comparison to the LANs and MANs. The operator of the WAN is by internet service provider (ISP) or by a telephone company.

Difference between LAN and WAN

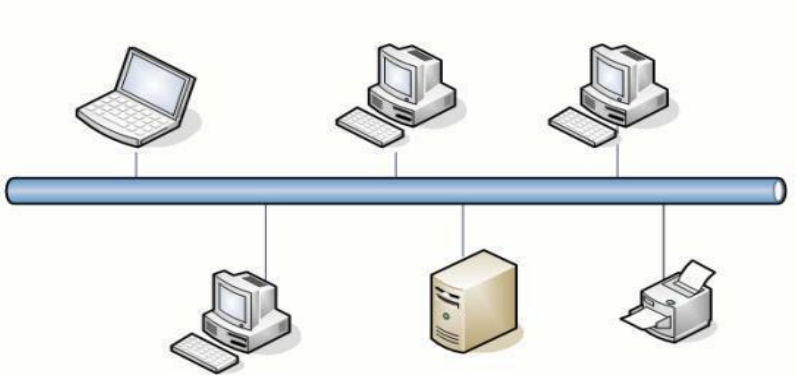
LAN	WAN
1. Area covered within a local site.	1. Distance up to thousands of kilometers.
2. Higher data rates higher than 10 Mbps to 1 Gbps even more.	2. Typical data rates less than 1 Mbps.
3. It has low error rates.	3. It has higher error rates.
4. It uses digital signal over private cables (generally CAT5,6,7)	4. It uses telephone to optical fiber back bone.
5. It is managed by the same company who owns it.	5. It is generally managed by organizations apart from users.
6. It uses simple protocols, low cost devices and low cost installation.	6. It uses complex protocols, expensive devices and high cost installation.
7. It can support limited number of hosts (computers) generally less than 1024.	7. It can support large number of hosts theoretically not bound in numbers i.e. infinite.
8. For example: star topology, cellular topology etc.	8. For example: Internet and intranet.
9. Generally, LANs use wireless or digital transmission.	9. WANs use digital or analog signal transmission.

Network Topology :

Network topology is the layout pattern or configuration of interconnected various components. Most of the all network topology is used to create Local Area Network (LAN) and connect two distinct LANs between computer and computer related components. Hence, topology refers to the shape of a network. How different nodes in a network are connected to each other and how they communicate with each other is determined by the network topology. Some of the topologies are as follows:

A. Bus Topology:

In bus topology all the devices are connected to a central cable called bus or backbone. The bus topology connects workstations using a single cable. Each workstation is connected to the next workstation in point-to-point fashion. Each node monitors the activities on the bus. The data sent are detected by all the nodes but accepted only those nodes which are addressed. A malfunction of node cannot disturb the network operation.



Advantages of Bus Topology:

i. Installation is cheap and easy.

ii. Addition of nodes/new connection is easily made.

iii. Less cable is required.

iv. If one computer down it does not affect the network.

Disadvantages of Bus Topology:

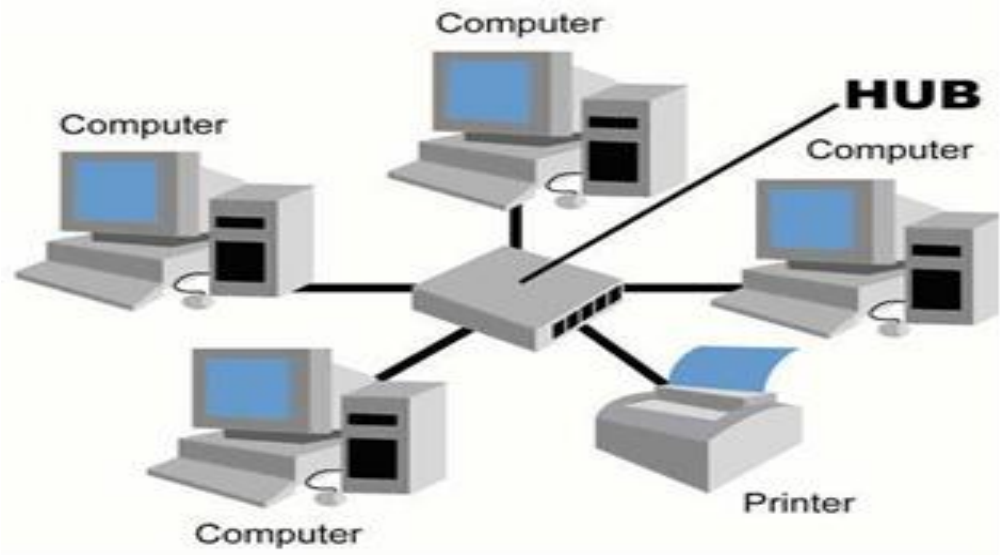
i. It is used only for small network.

ii. Fault identification is difficult.

iii. A single fault in cable disturbs network transmission.

iv. All computers share the same path hence performance decreases while network grows.

B. Star Topology:
Star topology uses a central hub through which all the components are connected. The central hub is the host and the end of each connection is a terminal. Nodes communicate across the network by passing data through the hub. The central hub makes decision to transmit data around the network and make simple communication channel among devices.



Advantages of star topology:

i. Installation and configuration of network is easy.
ii. Less expensive when compare to Mesh Topology.
iii. Fault in the network can be easily tracked.
iv. Expansion and modification of star topology is easy.
v. Single computer failure does not affect the network.
vi. It supports multiple cable type like STP, UTP, telephone cable etc.

Disadvantages of star topology:

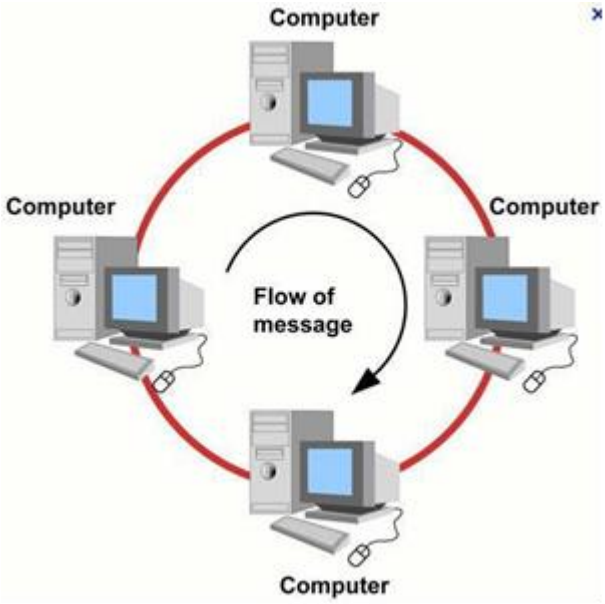
i. Failure of central hub brings the entire network halt.
ii. More cabling is required in comparison to tree, bus or ring topology.

C. Ring Topology:

All the devices are interconnected to one another in the shape of closed loop so that each device is connected directly to other two devices, forming a ring is called Ring Topology. The data transmitted on the closed ring is in one direction only. Information travels around the ring from one workstation to the next. Each packet of data sent by fixing its destination address, when data arrives in one computer it simply checks destination address is same as its own. If both address matches then it accepts the data otherwise it sends the data to other workstation in the ring.

Advantages of ring topology:

i. It is easy to install and modify the network.
ii. The fault isolation is simplified.
iii. No signal/data loss in ring topology

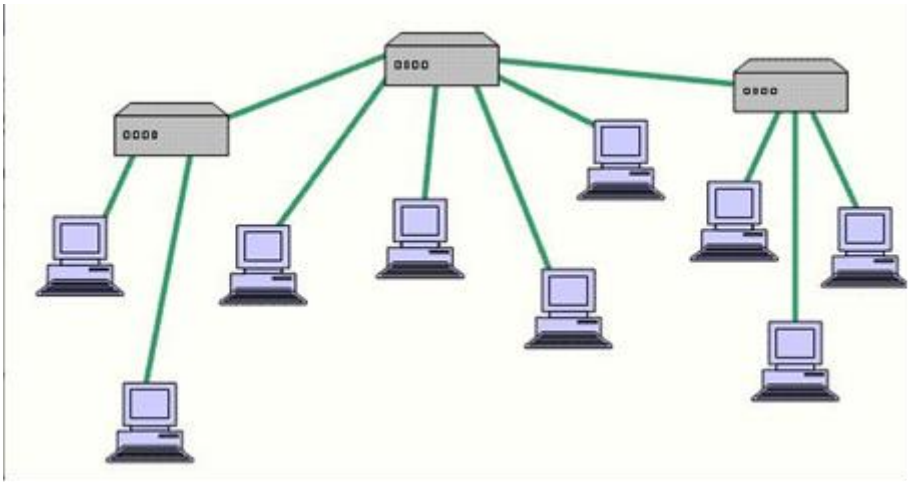


Disadvantages of ring topology:

i. Adding and removing computers disturbs the entire network.
ii. A break in the ring can stop transmission in the network.
iii. It cannot use for large scale network. D

D. Tree Topology:

Tree topology is a LAN topology in which only one path exists between any two nodes on the network. The pattern of the connection branching further and construct tree. The top most devices from where roots are generated is called root of the network. The last ending point of the network which does not have further nodes is called leaf node. It is a type of hybrid topology forming after multiple star topologies.



Advantages of Tree Topology:

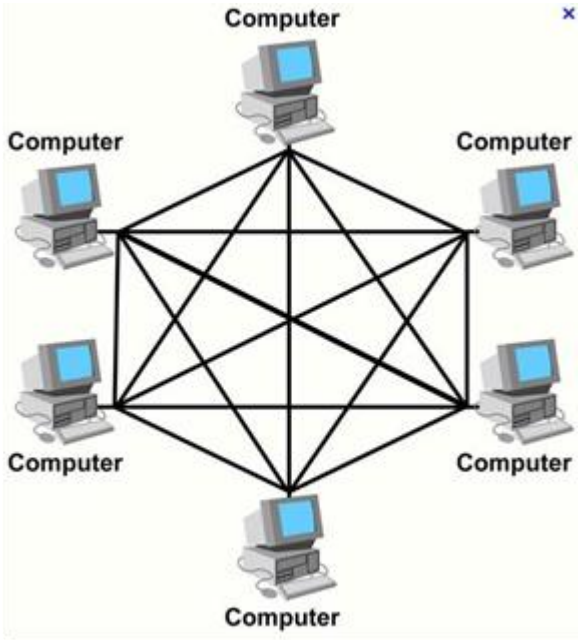
i. Installation and configuration of network is easy.
ii. The fault can be easily tracked.
iii. Expansion of the network is easy.
iv. It supports for multiple cable type.

Disadvantages of Tree Topology:

i. Failure of root brings communication breakup.
ii. The more cable required for interconne ction.
iii. More devices are needed to interconnect topology.
iv. Data bandwidth is higher in root nodes.

E. Mesh Topology:

Devices are connected in one to one system between multiple nodes. In well-connected mesh topology, every node has a connection to every other node in the network. Mesh topology is used in critical connection of host computers. Alternate path allow each computer to balance the load of other computer systems in the network by using more than one connection path available. A fully connected mesh network has n*(n- 1)/2 physical links between n devices



Advantages of Mesh topology:

i. Use of dedicated links eliminates traffic problems.
ii. Failure in one of the computer does not affect the entire network.
iii. Point-to-point link makes fault isolation easy.
iv. It is robust. v. Privacy between computers is maintained as message travel along dedicated path.

Disadvantages of Mesh topology:
i. The length of cabling required is high.
ii. A large number of input/output ports are required.
iii. Cost of the networking is high because of cable and ports

Transmission Media:

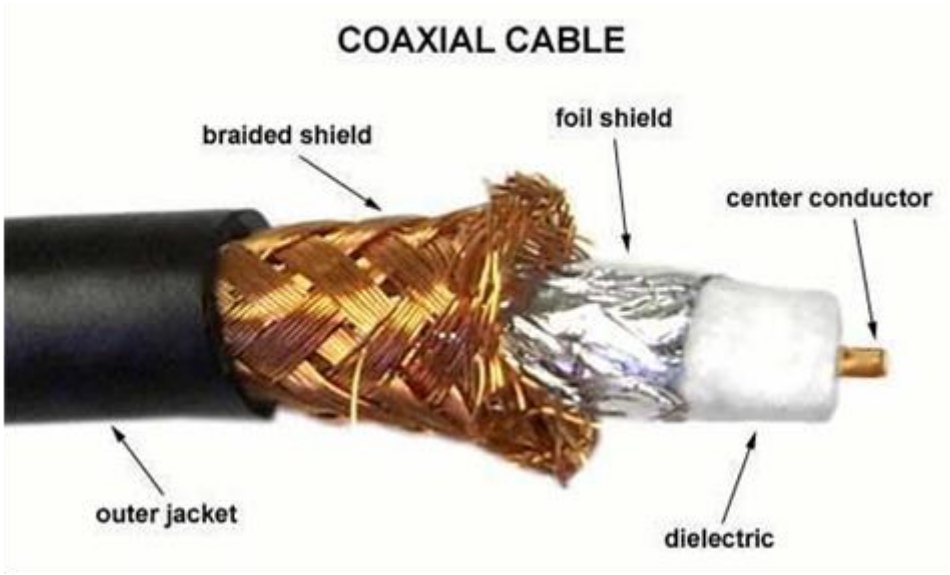
Transmission media generate a pathway between sender and receiver. Each transmission media has its own properties like bandwidth, delay, cost, error rate, ease of transmission and maintenance. Transmission media are roughly grouped into bound media and unbound media.

1. Bounded Media:

The transmission of data and information from source to destination by using physical medium like wires are called bounded transmission media. Bound transmission media are also called guided transmission media. It provides a single pathway from source to destination. Coaxial cable, twisted pair cable and optical fiber are the some of the most using bound transmission media.

i. Coaxial cable:

Coaxial cable is also called coax. The inner conductor is held inside an insulator with the other conductor woven around it providing a shield. An insulating protective coating called a jacket covers that outer conductor. The inner conductor is used to carry data signal to other. The outer conductor is used to protect data signal from external factors like EMI, high voltage, radiation interface etc. There are two types of coaxial cables.



a) Thinnet:

Thinnet is a variant of Ethernet technology uses thin type of coaxial cable. These cables are 0.19 inch in diameter. It is also known as 10Base2, i.e. 10Mbps Baseband connection and 200 meter for data transmission. This cable was broadly used in late 1980s as Ethernet technology. The exact distance covered by Thinnet cable segment up to 185 meters and maximum of 30 nodes can be attached on it.

b) Thicknet:

Thicknet is an Ethernet technology uses thick type of coaxial cable. It has extra protective aluminum/copper cover within its outer jacket. These cables are 0.375 inch in diameter. It is technically known as 10Base5, i.e. 10Mbps data transmission, baseband connection and 500 meter for data transmission. Thicknet cable supports 100 nodes on it.

Advantages of coaxial cable:

i. These cables are less effective by EMI because of shield.
ii. It is easy to install, modify and maintain network.
iii. It has high bandwidth upto 10Mbps.
iv. It has sufficient frequency range to support multiple channels.

Disadvantages of coaxial cable:

i. It is most expensive to install.
ii. It can use only for bus topology not suitable for other topology.
iii. It is an outdated technology for computer networking.
iv. It can support limited number of computers in network.

ii. Twisted Pair Cable:

The wires are twisted in each other in form twisted pair cable. Each pair consist of a wire used for the +ve data signal and a wire used for the –ve data signal. Each pair is twisted together to minimize electromagnetic interference (EMI) between the pairs. Any noise that appears on first wire of the pair will also occur on the other wire because of twisting. Twisted pair cables are generally represented by 10BaseT i.e. 100 Mbps as baseband transmission and T means twisted pair cable. There are two types of twisted pair cable:

a. Shielded twisted pair cable (STP):

If the twisted pair cable is shielded by metallic cover is called STP cable. These metallic cover is inside the plastic jacket is used to protect from external factors. The protection from EMI on STP cable is higher than UTP cable.

b. Unshielded twisted pair cable (UTP):

If the twisted pair cable is uncovered by the metallic protective cover is called UTP cable. UTP cables are prone to interference of EMI but is main advantage is low cost. These cables are ideal for short range data transmission like Ethernet networking, telephone networking etc.

Advantages of twisted pair cable:

i. It is a thin and flexible hence it is easy to string between walls.
ii. More lines can be run through the same wiring ducts.
iii. UTP costs less per meter than any other type of LAN cable.
iv. These cables can carry higher bandwidth, even in Gbps.
v. It can support 1024 computers in network.

Disadvantages of Twisted pair cable:

i. It cannot transmit data for long distance. Typical range is less than 200 meters.
ii. These cables are prone to EMI, electricity and magnetic noise.
iii. These cables are not suitable for video transmitting

Fiber Optics

Fiber optic cable uses electrical signals to transmit data. It uses light. In fiber optic cable light only moves in one direction for two way communication to take place a second connection must be made between the two devices. It is actually two stands of cable. Each stand is responsible for one direction of communication. A laser at one device sends pulse of light through this cable to other device. These pulses translated into “1’s” and “0’s” at the other end.

In the center of fiber cable is a glass stand or core. The light from the laser moves through this glass to the other device around the internal core is a reflective material known as CLADDING. No light escapes the glass core because of this reflective cladding.

Fiber optic cable has bandwidth more than 2 gbps (Gigabytes per Second)

Characteristics Of Fiber Optic Cable:

- Expensive
- Very hard to install
- Capable of extremely high speed
- Extremely low attenuation
- No EMI interference

Advantages Of Fiber Optic Cable:

- Fast
- Low attenuation
- No EMI interference

Disadvantages Fiber Optics:

- Very costly
- Hard to install

2. Unbound Transmission:

Unbound transmission is also called wireless/unguided transmission media. If there is no physical connectors (wires) between the two communicating devices is called wireless transmission media. Usually the transmission is sent through the atmosphere, but sometimes it can be air, water or earth surface. These transmission may occur from within room to satellite connection. Wireless media is used when wired media is not appropriate or suitable. There are different types of unbound transmission media. Some of the following are:

i. Satellite transmission: A satellite is object built and placed by human in earth orbit. These are also called artificial satellite because these are man-made. These satellite uses microwave transmission frequency. Satellites are used for different purposes, common type include military, communication, navigation, weather forecasting and research. According to the distance satellites are categorized into three types:

a. Low Earth Orbit (LEO):The satellites which are placed on the earth's atmospher above 200 km up to 2000 km range are called LEO. The satellite placed in this region travel about 8km/s completing rotation of earth in around 90 minutes. Remote sensing satellite, Hubble space telescope, international space station, former Russian space stations, sputnik-1 are some of the common examples of satellite situated in LEO region.

b. Medium Earth Orbit (MEO):

The satellites which are placed on the Earth's atmosphere above 2000 km up to 35786 km are called MEO. This orbit is also called intermediate circular orbit. The satellites take 2 to 24 hours to complete one revolution. The less power base stations receiver can receive data from the satellites but powerful antenna and device require for transmitting. Global Positioning System (GPS), Communication satellites are some of the common examples of satellite situated in MEO region.

c. Geosynchronous Earth Orbit (GEO):

The satellites which are placed on the earth's atmosphere above 35786 from the sea level are called GEO. These satellites take 24 hours (exactly 23.934461 hours) to rotate earth. These satellites rotate same

as earth rotation, hence this orbit called geosynchronous satellites. These satellites are important because they appear stationary with respect to the earth location. Because of this reason, we use parabolic fixed antenna to established lint to satellite. Telecommunication satellites, VSATs and television stations are the most common examples of satellites situated in GEO region.

Advantages of satellite transmission:

i. Long distance communication is possible.

ii. It can be used for television transmission with multiple channels.

iii. Satellite communication provides high bandwidth for large amount of audio, data and video transmission.

Disadvantages of satellite transmission:

i. The installation cost of communication satellite at orbit is huge.

ii. The receiving station cost is still high.

iii. Technical manpower requires operating and installing.

iv. Communicating satellite require in line of sight, physical object disturbs communication sometimes even clouds disturb communication.

ii. Microwave transmission:

Microwave is a radio spectrum, which uses high frequencies to send and receive data. The spectrum of the microwave is range from 1 GHz to 30GHz. The wavelength of microwave frequency is range from 30 centimeter to 1 centimeter. These can carry large number of voice channels, video channels and some data channels. These microwave frequencies travels almost straight in nature. Therefore, its base stations are used only in line of sight ranging from 30 km to 42 km. There are two types of microwave transmission:

a. Terrestrial microwave:

Terrestrial microwave employs earth-based transmission and receivers. The frequency used in low range gigahertz, this limits the communication in line of sight. Parabolic antennas are used to transmit and receive in line of sight to each other. Terrestrial microwave typically operate at 2-6GHz and 21-23GHz.

b. Satellite microwave:

Satellite microwave systems relay transmission from base stations to the satellite at 35786 km above sea level via microwave frequencies. Satellite microwave typically operate at 4-6GHz range and above.

Advantages of microwave communication:

i. Medium cost and large capacity transmission.

ii. It is suitable for voice, data and video communication suitable TV.

iii. It can travel long distance, but the receiver must be in line of sight.

Disadvantages of microwave transmission:

i. Noise interference, disturb by physical obstacles or by clouds.

ii. It cannot use for long distances in terrestrial (ground to ground).

iii. Satellite installation cost is extremely high, still receiver cost is higher than other medium.

iii. Wireless Media: Transmission of waves takes place in the electromagnetic (EM) spectrum. The carrier frequency of the data is expressed in cycles per second called Hertz (Hz). Low frequency signals can travel for long distances through many obstacles but cannot carry a high bandwidth of data. The high frequency signals can travel or shorter distances through few obstacles and carry a narrow bandwidth. The four broad categories of wireless media are:

a. Radio:

They use 10 KHz to 1 GHz frequency range. It is broken into many bands including AM, FM and VHF bands. These frequencies are used for unregulated use not in the form of bound media. This type of radio frequency is mainly used for low cost audio and data signal transmission.

b. Microwave:

Terrestrial microwave use to link networks over long distances usually 4- 6 GHz or 21-23GHz. Speed is often 1-10Mbps. The microwave transmission is mainly used for medium cost high quality larger data bandwidth transmission. It is mainly used by telecommunication sectors.

c. Satellite:

The transmission frequency is normally 11-14GHz with a transmission speed in the range of 1-10Mbps. The satellite transmission is used for high cost, high quality and larger bandwidth for data, audio, video and other format. d. Infrared: Infrared uses frequency from 100 GHz to 100 THz. The speed is 100Kbps to 16Mbps. The typical use of infrared media is for short range data transmission like remote controller. The technology also used for night vision to long range data transmission

Network Connecting Devices:

a. Modem:

MODEM(Modulator Demodulator) is a device that used in computer system to transmit information over a standard telephone line. The computer is digital device and telephone line carries analog signal. Modems are needed to convert digital to analog and vice versa. The process of converting digital signal in the form of 0 and 1 into analog signal term is called modulation. Or in other words, conversion of discrete data into continuous data is called modulation. The modulation process is required to transmit data over telephone line. The process of converting analog signal to digital signal in the form of 0 and 1 is called demodulation. Or in other words, conversion of continuous data into discrete data is called demodulation. Some of the data transmission internal modems were 28Kbps or 56Kbps only. Some of the external modems are DSL and ADSL are the common examples of high data transmission modems. These can transmit from 128Kbps to more than 100Mbps.

b. Network Interface Card (NIC):

An NIC (Network Interface Card) is an expansion card that provides connectivity between a PC and a network such as a LAN. Network Interface Cards are also referred to as Ethernet adapters, network adapters, LAN cards, LAN adapters or NICs (Network Interface Controllers). Internal NICs can be either built-in to the system motherboard or plugged into an expansion slot inside the motherboard. One specification is the transfer rate, which is specified in Mbps (Megabits per second) or Gbps (Gigabits per second). Most modern network interface card support 100Mbps data transmission.

c. Repeaters:

Repeaters are also called generators. These are physical hardware devices and used to connect two network segments. The main purpose of the repeaters is used to expand physical limit of the network segment. As signal travels along a cable, its strength or amplitude decreases. This is called attenuation. The attenuation process limits the length of a cable used to connect the computers together. Repeaters can regenerate or amplify the weak signals so that they can travel additional cable length.

d. Hubs:

An Ethernet hub or simply hub is a device for connecting multiple twisted pair or fiber optic devices and making them act as a single network segment. Hubs can also be called either multiport repeaters or connectors. They expand one Ethernet connection into many. They are physical hardware devices. A hub is a similar to multiple repeaters, except that it broadcasts data received by any port to all other ports on the hub. Hubs are connected with nodes by using RJ45 jack. The problem of the hubs are the all nodes will share the same bandwidth over network. If the Ethernet is 100 Mbps all the nodes attached to this hub will share same 100 Mbps during data transmission.

e. Switch:

Switch omits the problem of hubs, switch did not share the same bandwidth but provides dedicated bandwidth between communicating nodes. If the network is 100 Mbps the each and every communicating devices use 100 Mbps channel. Switching hubs are hubs that are directly switch ports to each other. They are similar to full duplex hubs, except that they allow dedicated pathway between them. If hubs are 100 Mbps/1000 Mbps the data transmission between two hubs remain same. The main purpose of switch is to establish dedicated channel between communicating devices.

f. Bridges:

Bridges have all the features of the repeaters. Besides regenerating the signals, a bridge can segment or divide a network to isolate traffic related problems. A bridge sends the data frame only to the connected segment if destination device is situated there, thus preventing traffic. A bridge can split on overloaded network into two separate networks, reducing the amount of traffic on each segment and thus making each network more efficient.

g. Routers:

A router is a special purpose computer having CPU and memory like any other computer. It is an intermediary device on a communications network that store, process and forward message delivery. Routers are both hardware and software devices. Routers can connect networks that used different technologies, addressing methods, media types, frame formats and speeds. Routers are used in complex network situations because they provide better traffic management than bridges. Routers determine shortest path for delivery, filter malicious data and keep record of all attached nodes including other routers. Routers are extremely fast devices on the network for receive, process, store and forwarding data packets.

h. Gateways:

Gateways are just like routers but much more complex and powerful than routers. They are slower than router and expensive. A gateway has all the features of router and bridges but it can translate instruction set on sending network into receiving network. Gateways make communication possible between different architecture and environments.

i. Wi-Fi:

The term Wi-Fi suggests Wireless Fidelity. It is hardware and software devices. It is wireless technology and network connecting device. Wi-Fi is not a technical term. The technical term of Wi-Fi is "IEEE 802.11". The term Wi-Fi, first used commercially in august 1999. Wi-Fi networks have limited range. A typical wireless router with a stock antenna might have a range of 32 meter indoors and 95 meter outdoors. Nowadays Wi-Fi is used in many personal computers, video game consoles, MP3 players, smart phones, printers, digital cameras laptop computers and other devices. Wi-Fi is used to create wireless LAN to connect computer system.

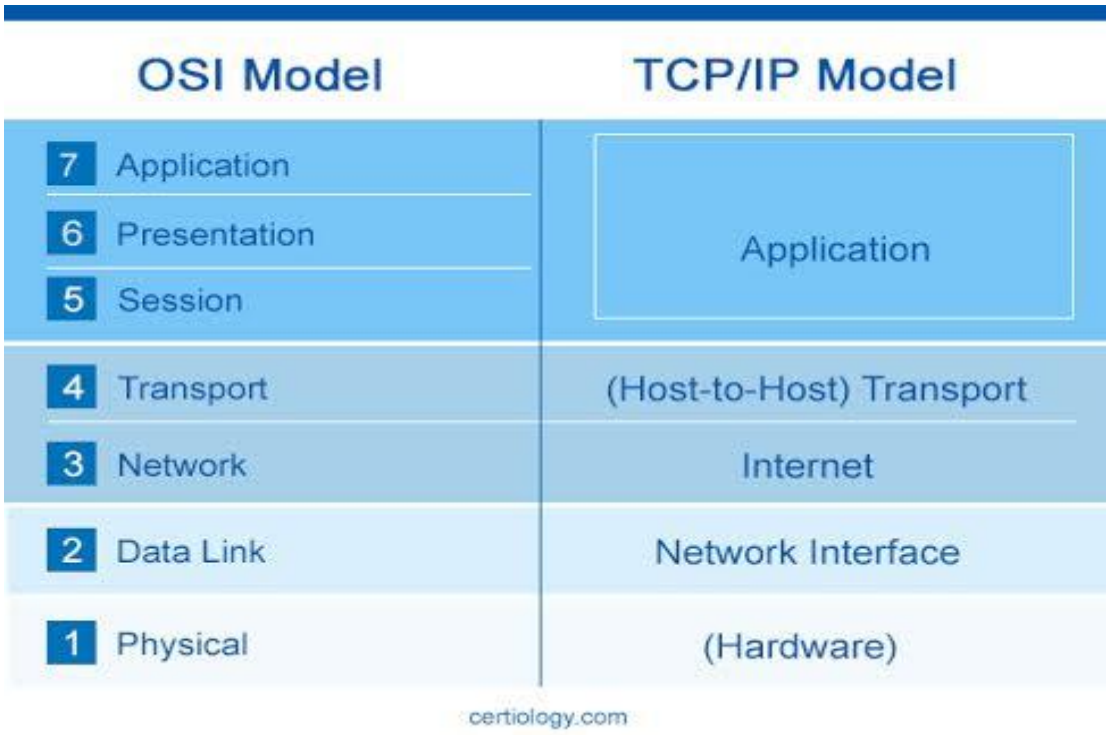
j. Bluetooth:

Bluetooth is a wireless technology standard for exchanging data over short distances from fixed and mobile devices. Bluetooth is used to create personal area networks (PANs) with high levels of security. Bluetooth was created by telecoms vendor Ericsson in 1994.

k. Infrared (IR):

Infrared (IR) light is electromagnetic radiation with a wavelength longer than that of visible light and below the red light. These wavelengths correspond to a frequency range of approximately 100 GHz to 100 THz and include most of the thermal radiation emitted by objects near room temperature. These frequencies are very high offering nice

TCP/IP functionality is divided into four layers each of which include specific protocols.



- The application layer provides applications with standardized data exchange. Its protocols include the Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Post Office Protocol 3 (POP3), Simple Mail Transfer Protocol (SMTP) and Simple Network Management Protocol (SNMP).

- The transport layer is responsible for maintaining end-to-end communications across the network. TCP handles communications between hosts and provides flow control, multiplexing and reliability. The transport protocols include TCP and User Datagram Protocol (UDP), which is sometimes used instead of TCP for special purposes.

- The network layer, also called the internet layer, deals with packets and connects independent networks to transport the packets across network boundaries. The network layer protocols are the IP and the Internet Control Message Protocol (ICMP), which is used for error reporting.

- The physical layer consists of protocols that operate only on a link — the network component that interconnects nodes or hosts in the network. The protocols in this layer include Etherenet for local area networks (LANs) and the Address Resolution Protocol (ARP).

Communication Protocols:

A communication protocol is a formal description of digital message formats and the rules for exchanging those messages in between computer system. Protocols define a set of formal rules describing how to transmit data especially across a network. Low level protocol define the electrical and physical standards to be observed, bit- and byte-ordering and the transmission of the bit stream. High level protocols deal with the data formatting, including the syntax of messages, character sets, sequencing of messages etc.

1. TCP/IP:

The Transmission Control Protocol (TCP) and Internet Protocol (IP) are commonly referred layer 4 and layer 3 protocols respectively. But TCP/IP represents a protocol suit. It is a collection of different

protocols and work as an implemented version of protocols. TCP represents transport layer protocol that provides end to end reliable transmission. For the same purpose, TCP includes such functions such as flow control, error control and status exchange information. IP represents unreliable source of transmission between networks. TCP delivers message in reliable manner i.e. message will not discarded or dropped but the delivery time is high. TCP/IP is not a single protocol but a set of more than a dozen protocols. Each protocol within the TCP/IP family is dedicated to a different task.

2. SMTP:

Simple Mail Transfer Protocol (SMTP) is an application layer protocol used for email transmission across the internet. The mail applications use SMTP for sending messages to a mail server on the internet. SMTP is a delivery protocol only. It cannot pull messages from a remote server on demand. Other protocols such as Post Office Protocol (POP) and the Internet Message Access protocol (IMAP) are specifically designed for retrieving messages and managing mail boxes. However, SMTP have a feature to initiate mail queue processing on a remote server so that the requesting system may receive any messages destined for it.

3. POP3:

The Post Office Protocol version 3 (POP3) is an application layer protocol used by local email clients to retrieve email from a remote server over internet connection. POP and IMAP are the most common internet standard protocols for email retrieval. Virtually all modern email clients and servers support both. POP3 is supported by most webmail services such as Hotmail, Gmail and Yahoo! Mail.

4. FTP:

The File Transfer Protocol (FTP) is an application layer protocol for transferring files between computer systems. FTP is not hardware dependent hence it can work anywhere in the network. FTP is built on client server architecture and utilizes separate control and data connections between the client and server. FTP client and server exist in the network, where client sends commands to the FTP server and the server responds.

5. HTTP:

It is the underlying protocol used by the World Wide Web. HTTP (Hyper Text Transfer Protocol) defines how messages are formatted and transmitted over the Internet. It decides what actions should be taken on web-servers and web-browsers for the various commands. HTTP has been in use by the world wide web since 1990. HTTP is called a stateless protocol because each command is executed independently. The HTTP is a networking protocol for distributed, collaborative, hypermedia informati on systems. HTTP is the foundation of data communication for the world wide web.

6. Telnet:

Telnet is a remote login protocol for executing commands on remote host. The telnet protocol runs in a client server mode and uses the TCP for data transmission. The telnet data will encoded before transmission by telnet client.

Introduction to the Internet

1.Domain Name System (DNS)

The Domain Name System (DNS) translates Internet domain and host names to Ip address and vice versa.On the Internet, DNS automatically converts between the names we type in our Web browser address bar to the IP addresses of Web servers hosting those sites. Larger corporations also use DNS to manage their own company intranet Home networks use DNS when accessing the Internet but do not use it for managing the names of home computers.

2. Client-server architecture, architecture of a computer networking which many clients (remote processors) request and receive service from a centralized server (host computer). Client computers provide an interface to allow a computer user to request services of the server and to display the results the server returns. Servers wait for requests to arrive from clients and then respond to them.

3. HyperText Transfer Protocol (HTTP) is an application-layer protocol used primarily on the World Wide Web. HTTP uses a client-server model where the web browser is the client and communicates with the webserver that hosts the website. The browser uses HTTP, which is carried over TCP/IP to communicate to the server and retrieve Web content for the user.HTTP is a widely used protocol and has been rapidly adopted over the Internet because of its simplicity. It is a stateless and connectionless protocol.

4. E-mail (electronic mail) is the exchange of computer-stored messages by telecommunication. (Some publications spell it email; we prefer the currently more established spelling of e-mail.) E-mail messages are usually encoded in ASCII text.

5. File Transfer Protocol, FTP is the most common way of sending and receiving files between two computers. A good example of how FTP is used today is by web developers, who connect to theirweb server using an FTP program (e.g., FleZillia) and send updated versions of their web pages to the server.

6. World-Wide Web (also called WWW or W3) is a hypertext-based information system. Any word in a hypertext document can be specified as a pointer to a different hypertext document where more information pertaining to that word can be found. The reader can open the second document by selecting the word (using different methods depending on the interface; in a mouse based system, a user would probably place the mouse over the word and click the mouse button); only the part of the linked document which contains relevant information will be displayed.

7.A remote login facility permits a user who is using one xomputer to interact with a program on another computer. The service extends the login concept used by conventional timesharing computer systems to permit access to a remote timesharing system.

The Internets remote login service is called TELNET. To use the service, one must invoke a local application program and specify a remote machine. The local program becomes a cleint, which forms a connection to a server on the remote computer. The client passes keystrokes and mouse movements to the remote machine, and displays output from the remote machine on the user's display screen.

Remote login is significant because it shows how the Internet can provide interactive services. Unlike other available services, remote login does not merely transfer static data. Instead, remote login permits a user to interact with a program that runs on a remote computer. The remote program can respond to input from the usre, and the user can respond to output the display program displays.

8. Static and Dynamic web pages

Web pages can be either static or dynamic. "Static" means unchanged or constant, while "dynamic" means changing or lively. Therefore, static Web pages contain the same prebuilt content each time the page is loaded, while the content of dynamic Web pages can be generated on-the-fly.

Standard HTMLpages are static Web pages. They contain HTML code, which defines the structure and content of the Web page. Each time an HTML page is loaded, it looks the same. The only way the content of an HTML page will change is if the Web developer updates and publishes the file.

Other types of Web pages, such as PHP<ASp pages are dynamic Web pages. These pages contain "server-side" code, which allows the server to generate unique content each time the page is loaded. For example, the server may display the current time and date on the Web page. It may also output a unique response based on a Web form the user filled out. Many dynamic pages use server-side code to access databse information, which enables the page's content to be generated from information stored in the database. Websites that generate Web pages from database information are often called database-driven websites.

Data Processing and Database

3.1. Data
Processing: Data vs
Information:
Data refers to a collection of natural phenomena descriptors, including the results of experience, observation or experiment, or a set of premises. This may consist of numbers, words, or images, particularly as measurements or observations of a set of variables.
Raw data are numbers, characters, images or other outputs from devices to convert physical quantities into symbols, in a very broad sense. Such data are typically further processed by a human or input into a computer, stored and processed there, or transmitted (output) to another human or computer. Raw data is a relative term; data processing commonly occurs by stages, and the "processed data" from one stage may be considered the "raw data" of the next. After processing of data we get information. Information is then useful for decision making. Information is nothing but refined data, data that have been put into meaningful and useful context and communicated to a recipient who uses it to make decisions.

Database components

A database is made up of several main components.

- Schema – A database contains one or more schemas, which is basically a collection of one or more tables of data.
- Table – Each table contains multiple columns, which are similar to columns in a spreadsheet. A table can have as little as two columns and as many as one hundred or more columns, depending on the type of data being stored in the table.
- Column – Each column contains one of several types of data or values, like dates, numeric or integer values, and alphanumeric values (also known as varchar).
- Row – Data in a table is listed in rows, which are like rows of data in a spreadsheet. Often there are hundreds or thousands of rows of data in a table.

An Entity Relationship (ER) Diagram

It is a type of flowchart that illustrates how “entities” such as people, objects or concepts relate to each other within a system. ER Diagrams are most often used to design or debug relational databases in the fields of software engineering, business information systems, education and research.

File Processing:

1. Sequential file processing: It stores and access records in sequence. Such processing can be accomplished either by using tape storage or disk storage. To perform sequential file processing, records are sorted before they are processed. Sequential file processing is used in situations where data ca be processed in batches and where a substantial portion of the master file is changed with processing of each batch. Payroll processing is a classic example of sequential processing.
2. Direct-access file processing: There are many ways of organizing a file for direct-access. First, the file must be stored on a direct-access device like a disk, so that the records need not be processed in sequence. Second, some means must be developed for determining the location of a particular record.

Indexes are on common means.

Database Processing:

A database is a self-describing collection of integrated records because it contains, a part of itself, a directory, or dictionary of its contents. The records are integrated because a database can contain multiple files (usually called tables in databases processing), and records within those tables are processed by their relationship to one another.

3.2. Database Management

System: Introduction:

A collection of programs that enables us to store, modify, and extract information from a database. There are many different types of DBMSs, ranging from small systems that run on personal computers to huge systems that run on mainframes. The following are examples of database applications:

- computerized library systems
- automated teller machines
- flight reservation systems
- computerized parts inventory systems

From a technical standpoint, DBMSs can differ widely. The terms *relational*, *network*, *flat*, and *hierarchical* all refer to the way a DBMS organizes information internally. The internal organization can affect how quickly and flexibly you can extract information.

Requests for information from a database are made in the form of a *query*, which is a stylized question. For example, the query

SELECT ALL WHERE NAME = "SMITH" AND AGE > 35

requests all records in which the NAME field is SMITH and the AGE field is greater than 35. The set of rules for constructing queries is known as a *query language*. Different DBMSs support different query languages, although there is a semi-standardized query language called *SQL (structured query language)*. Sophisticated languages for managing database systems are called *fourth-generation languages*, or *4GLs* for short.

The information from a database can be presented in a variety of formats. Most DBMSs include a *report writer program* that enables you to output data in the form of a report. Many DBMSs also include a graphics component that enables you to output information in the form of graphs and charts.

Quality of Information:

Accuracy: This means the data must be accurate. The data must be clear and accurately reflects the meaning of data on which it is based. It conveys an accurate picture to the recipient and may require a graphical presentation rather than a table full of numbers.

Timeliness: The recipients must the get the data within the needed time frame. For example, yesterday's newspaper today or stock quotes a day or two after are normally of little value.

Relevancy: This means the information for a particular person must be useful. Information relevant for one person may not be relevant for another.

Significance of DBMS :

- Reduction in data redundancy : Redundancy can be controlled using DBMS. Thus, space is efficiently used. The existing applications can share the data in the database.Reduces problem of inconsistencies in stored information, e.g. different addresses in different departments for the same customer
- Maintenance of data integrity and quality : Integrity means that the data in the database is accurate. Centralized control of the data helps in permitting the administrator to define integrity constraints to the data in the database.
- Data are self-documented or self-descriptive: Information on the meaning or interpretation of the data can be stored in the database, e.g. names of items, metadata
- Avoidance of inconsistencies : Reducing the redundancy also avoids the inconsistency of data. Data must follow prescribed models, rules, standards
- Security restrictions : With complete authority over the operational data, the database administrator can ensure that the only means of access to the database is through proper channels. He can define authorization checks to be carried out whenever access to sensitive data is attempted. Different checks can be established for each type of access (retrieve, modify, delete, etc). to each piece of information in the database.

Characteristics of Data in a database:

- Shared : Date in a database are shared among different users and applications.
- Persistence: Data in a database exist permanently in the sense, the data can live beyond the scope of the process that created it.
- Validity/Integrity/Correctness: Data should be correct with respect to the real world entity that they represent.
- Security: Data should be protected from unauthorized access.
- Consistency: Whenever more than one data element in a database represents related real-world values, the values should be consistent with respect to the relationship.
- Non-redundancy: No two data items in a database should represent the same real-world entity.
- Independence: The three levels in the schema (internal, conceptual and external) should be independent of each other so that the changes in the schema at one level should not affect the other levels.

Database Management System and its services:

- Transaction Processing : A transaction is a sequence of database operations that represent a logical unit of work. It accesses a database and transforms it from one state to another. A transaction can update a record, delete one, modify a set of records, etc. When the DBMS does a 'commit', the changes made by the transaction are made permanent. If you don't want to make the changes permanent you can roll back the transaction and the database will remain in its original state.
- Concurrency Management: It is the database management activity of coordinating the actions of

database manipulation process that operate concurrently, access shared data and can potentially interface with each other. The goal of an idea concurrency management mechanism is to allow concurrency while maintaining the consistency of the shared data.

- Recovery: The objective of recovery in a database is to ensure that the aborted or failed transactions do not create any adverse effects on the database or other transactions. Recovery mechanisms in a DBMS make sure that the data is returned to a consistent state after a transaction fails or aborts. Recovery is very much related to concurrency in the sense that , the more the concurrency, the more is the chance of an aborted transaction can affecting many other transactions.
- Security: It refers to the protection of data against unauthorized access. Security mechanism of a DBMS make sure that only authorized users are given access to the data in the database. The level of access for each user and the operations that each user can perform on the data will be monitored and controlled by the DBMS depending on the access privileges of the user.
- Language Interface: The DBMS provides support languages used for the definition and manipulation of the data in the database. The data structures are created using the data definition language commands. The data

manipulation is done using the data manipulation commands. By providing language support for data definition and manipulation, the DBMS create an environment where the users can do their jobs without worrying about the physical implementation.

- Data catalog: Data catalog or Data Dictionary is a system of database that contains the description of data in the database (metadata). It contains information about data, relationships, constraints and the entire schema that organize these features into a unified database. The data catalog can be queried to get information about the structure of the database.
- Storage Management: The DBMS provides a mechanism for management of permanent storage of the data. The internal schema defines how the data should be stored by the storage management mechanism and the storage manager interfaces with the operating system to access the physical storage.

Types of Database Management System:

Hierarchical Model:

Hierarchical Database model is one of the oldest database models. The hierarchical model assumes that a tree structure is the most frequently occurring relationship.

In this model data follow the hierarchical model. Rather than one record type (flat file), a business has to deal with several types which are hierarchically related to each other , e.g. company has several departments, each with attributes: name of director, number of staff, address

Certain types of geographical data may fit the hierarchical model well , e.g. Census data organized by state, within state by city, within city by census tract. The database keeps track of the different record types, their attributes, and the hierarchical relationships between them. The attribute which assigns records to levels in the database structure is called the key (e.g. is record a department, part or supplier?)

Network Model:

The Network Model structures in a network connecting every nodes. The network model was evolved to specifically handle non-hierarchical relationships. The network model has greater flexibility than the hierarchical model for handling complex spatial relationships.

Relational Model:

In an *RDBMS*, a database is considered to be a collection of interrelated data and programs. The data in a database has to be related. For example, in a College Management System, which takes care of maintaining students' records, storing data such as the salary details of the teachers would be inappropriate and considered unrelated. On the other hand the marks details, fee details and other personal details of students would be considered 'interrelated' data. The programs in a database perform the role of manipulating this data. A database that is designed on the concept of '*relational*' model is called a *'Relational Database Management System'*.

A relational database is made up of set of *relations* or *tables*. These tables store user data as well as system data. Each of these relations is made up of *attributes* (fields) and *tuples* (records).

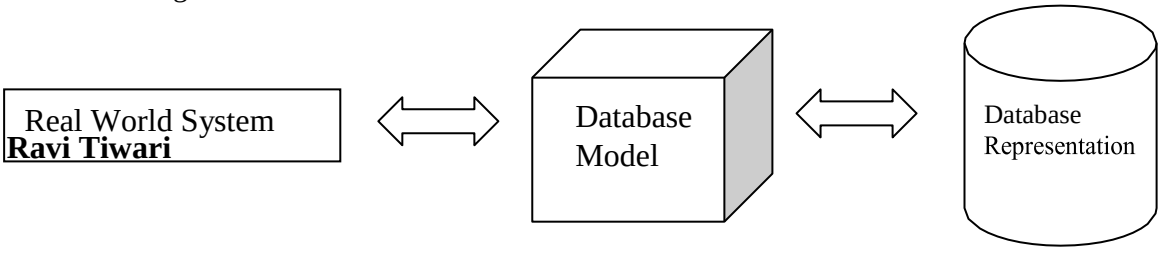
Structured Query Language (SQL) serves as a uniform interface for users providing a collection of standard expressions for storing and retrieving data.

Object-oriented Model

Object-oriented model represents an entity as a class. A class represents both object attributes as well as the behaviour of the entity. The objects that falls in the similar class have the similar behaviour as mentioned in the class and each object may have special attributes to distinguish itself from other object.

3.3 Database Design:

Database Design



Process:

- To develop a good design, one has to understand the meaning of information and the intended use of the information's stored representation with the computer system. Once we develop the understanding and have identified the use of information in the application, we can determine how much and what kind of information we require.
- We could also determine in what format these information should be captured and represented in the computer system or database. During this phase, it will become clear that what data entities represent information redundancies and which entities are critical, which are useful and which are not related to the application.

- It is important to collect and analyze the static and dynamic information available about the real world application before starting the database design. For evolving a good database design, it is important that one uses a model or a database design model.

Data Normalization:

Normalization is the process of building database structures to store data. Normalization is a formal process of developing data structures in a manner that eliminates redundancy and promotes integrity. Data normalization is a corner stone of the relational theory.

Keys:

A key uniquely identifies a row in a table. There are two types of keys: intelligent keys and non-intelligent keys. (Covered in Class Discussion).

First Normal Form
Second normal
Form Third
Normal Form.
(Already Discussed : Refer to the class note).

Data Warehouse:

To execute queries efficiently on diverse data, companies have built data warehouses. Data warehouse gather data from multiple sources under a unified schema, at a single site. Thus, they provide the user a single uniform interface to data.

A data warehouse is a large repository (or archive) of data which comes from operational sources and has four properties:

(1) Non volatile
(2) Time varying
(3) Subject oriented
(4) Integrated.

Once gathered, the data are stored for a long time, permitting access to historical data, making decision-support queries easier to write. Moreover, by accessing information for decision support from a data warehouse, the decision maker ensures that online transaction processing systems are not affected by the decision support workload.

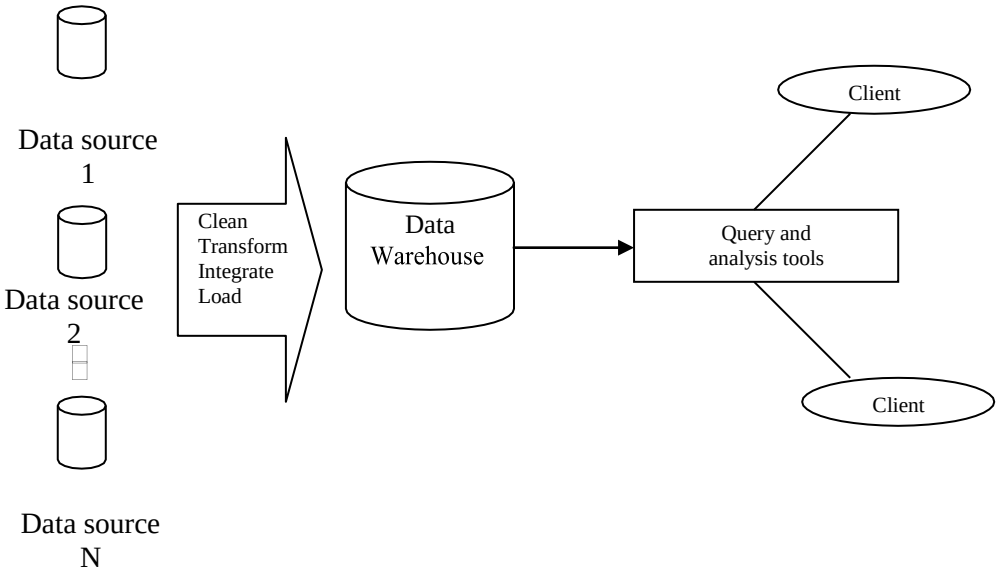


Fig: Typical architecture of a data warehouse.

Properties of Data warehouse:

- Subject-oriented: A data warehouse is organized around major subjects, such as customer, supplier, product, and sales. Data warehouses typically provide a simple and concise view around a particular subject issues by excluding data that are not useful in the decision support system.
- Integrated: A data warehouse is usually constructed by integrating multiple heterogeneous sources, such as relational databases, flat files, and on-line transaction records.
- Time-dependent: that is, containing information collected over time which implies there must always be a connection between the information in the warehouse and the time when it was entered.
- Nonvolatile: Data once loaded in the data warehouse is not going to change in the future. This means that a data warehouse will always be filled with historical data.

Data Mining:

It is a process of semi automatically finding of useful information from large repositories which was not previously found.

Simply stated, data mining refers to extracting or "mining" knowledge from large amounts of data.

A broad view of data mining functionality: Data mining is the process of discovering interesting knowledge from large amounts of data stored either in databases, data warehouses, or other information repositories.

Data mining involves an integrating of techniques from multiple disciplines such as database technology, statistics, machine learning, high-performance computing, pattern recognition, neural networks, data visualization, information retrieval, image and signal processing, and spatial data analysis.

By performing data mining, interesting knowledge, regularities or high-level information can be extracted from databases and viewed or browsed from different angles.

The discovered knowledge can be applied to decision making, process control, information management, and query processing.

Therefore, data mining is considered one of the most important frontiers in database systems and one of the most promising interdisciplinary developments in the information industry.

Data mining is a step in the Knowledge Discovery Process.

Artificial Intelligence

Introduction to AI:
Artificial intelligence is generally defined as the study and design of intelligent agents where an intelligent agent is a system that perceives its environment and takes actions that maximizes its chances of success. It is the science and engineering of making intelligent machines.
Completely AI capable system has not come yet. Still the scientists are trying to develop such computers. Researchers have used concept of psychology, physiology, linguistic and computer science to develop AI system. Then such system will be able to solve problems, decode and respond to natural languages like English, French, and Nepali etc. In short, "Artificial Intelligence is the field of computer science and linguistics that studies computer systems that can recognize and react to human language either spoken or written."

Component of AI:
a) Natural Language Programs:
It is the field of computer science and linguistic that studies computer systems that recognize and react to human language either spoken or written. Thus, communicating with computer by using natural languages such as English instead of an artificial language such as C, C++, Java, VB etc. is the main goal of natural language program. This type of program is also in implementation phase such as some mobile devices search on Google after processing human voice as input. It has following elements:

i. Parser: It figures out how a sentence is put together with noun, verbs and other components.
ii. Semantic analyzer: It uses a built in dictionary to interpret the meaning of words in a sentence. iii. Code generator: It translates the user's sentence to machine language codes.

b) Expert system:
It is an application program that makes decisions or solves problems in a particular field, such as finance or medicine, by using knowledge and analytical rules defined by experts in the field. Every expert system consists of three parts: i. A user interface, which is a way of communicating with the user through such devices as menus, commands, or short-answer questions. ii. A knowledge base containing stored expertise
iii. An inference engine, which draws conclusions by performing simple logical operations on the knowledge base and the information supplied by the user.

Uses of AI:

i. Game playing:
AI plays very important roles in playing games so that we can play with computer which think and decide itself like a human player. It makes the game more exciting and livelier. For example, playing chess uses some AI.

ii. Speech Recognition:

AI is very useful in speech recognition so that we can give data and instructions to computer through speech (word) without using keyboard or mouse.

iii. Understanding Natural Language:

The AI helps the computer to understand our natural language like English, Nepali etc. so that we can communicate with the computer like a human being.

iv. Computer vision:

AI can be used to improve the vision of the real world object on computer so that we can view it with 3-Dimension.

v. Expert system:

It is software which collects the knowledge and decision making roles of the specialists in a particular field and uses it to analyze and decide according to the requirements. The expert system plays very important roles especially in the area of medical science.

vi. Robotics:

It is the branch of engineering developed to the creation and training of robots. Robot cists work within a wide range of fields, such as mechanical and electronic engineering, cybernetics, bionics, and artificial intelligence, all toward the end of endowing their creations with as much sensory awareness, physical dexterity, independence, and flexibility as possible.

Ethical aspect of AI:

The ethics of artificial intelligence addresses a number of oral and legal issues which arise if researchers are able to build machines with intellectual capacities that rival human beings. It considers the unexpected consequences, dangers and potential misuse of the technology. It also considers the ways in which artificial intelligence may be used to benefit humanity. There are three sides of the arguments:

2. Applications of Neural Networks

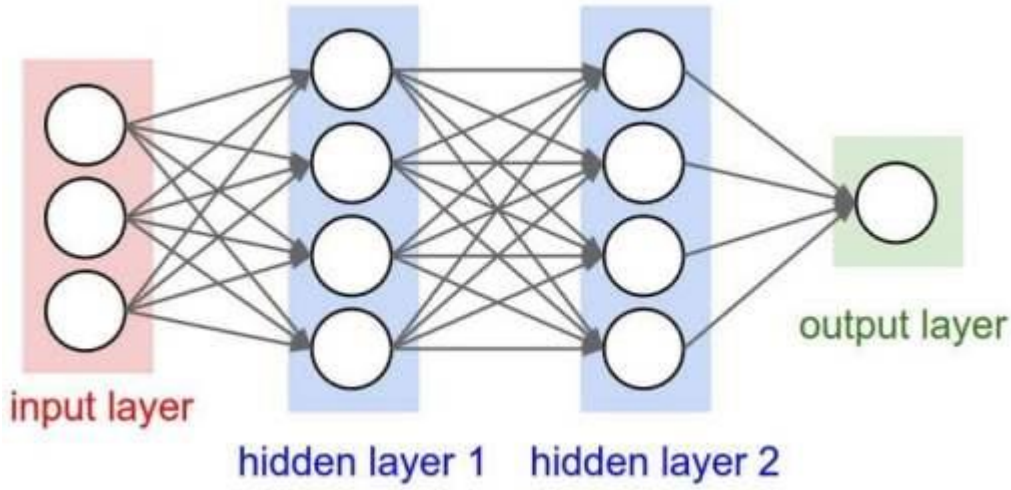
They can perform tasks that are easy for a human but difficult for a machine −

- Aerospace − Autopilot aircrafts, aircraft fault detection.
- Automotive − Automobile guidance systems.
- Military − Weapon orientation and steering, target tracking, object discrimination, facial recognition, signal/image identification.
- Electronics − Code sequence prediction, IC chip layout, chip failure analysis, machine vision, voice synthesis.
- Financial − Real estate appraisal, loan advisor, mortgage screening, corporate bond rating, portfolio trading program, corporate financial analysis, currency value prediction, document readers, credit application evaluators.
- Industrial − Manufacturing process control, product design and analysis, quality inspection systems, welding quality analysis, paper quality prediction, chemical product design analysis, dynamic modeling of chemical process systems, machine maintenance analysis, project bidding, planning, and management.

3.Neural network

- Artificial neural networks are one of the main tools used in machine learning. As the “neural” part of their name suggests, they are brain-inspired systems which are intended to replicate the way that we humans learn.
- Neural networks consist of input and output layers, as well as (in most cases) a hidden layer consisting of units that transform the input into something that the output layer can use.
- They are excellent tools for finding patterns which are far too complex or numerous for a human programmer to extract and teach the machine to recognize.

For a basic idea of how a deep learning neural network learns, imagine a factory line. After the raw materials (the data set) are input, they are then passed down the conveyer belt, with each subsequent stop or layer extracting a different set of high-level features. If the network is intended to recognize an object, the first layer might analyze the brightness of its pixels.



The next layer could then identify any edges in the image, based on lines of similar pixels. After this, another layer may recognize textures and shapes, and so on. By the time the fourth or fifth layer is reached, the deep learning net will have created complex feature detectors. It can figure out that certain image elements (such as a pair of eyes, a nose, and a mouth) are commonly found together.

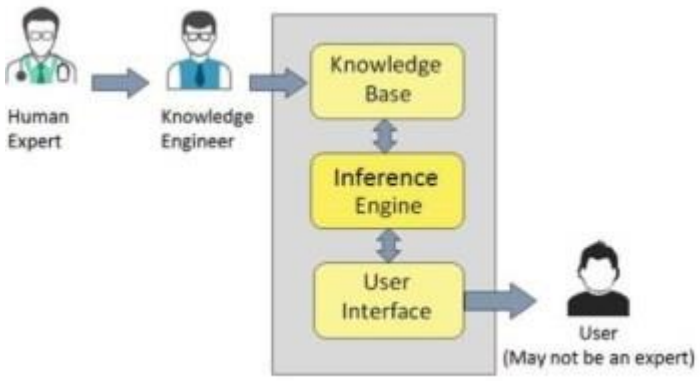
Once this is done, the researchers who have trained the network can give labels to the output, and then use backpropagation to correct any mistakes which have been made. After a while, the network can carry out its own classification tasks without needing humans to help every time.
<h3style="background-color: gray;">4.Genetic Algorithm

5.Expert Systems

The expert systems are the computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise.

Characteristics of Expert Systems

- High performance
- Understandable
- Reliable
- Highly responsive



Components of Expert Systems

The components of ES include −

- Knowledge Base

- Inference Engine
- User Interface

Let us see them one by one briefly −

a. Knowledge Base

It contains domain-specific and high-quality knowledge.Knowledge is required to exhibit intelligence. The success of any ES majorly depends upon the collection of highly accurate and precise knowledge.

Components of Knowledge Base

The knowledge base of an ES is a store of both, factual and heuristic knowledge.

- Factual Knowledge − It is the information widely accepted by the Knowledge Engineers and scholars in the task domain.
- Heuristic Knowledge − It is about practice, accurate judgement, one's ability of evaluation, and guessing.

b. Inference Engine

Use of efficient procedures and rules by the Inference Engine is essential in deducting a correct, flawless solution.

In case of knowledge-based ES, the Inference Engine acquires and manipulates the knowledge from the knowledge base to arrive at a particular solution.

In case of rule based ES, it −

- Applies rules repeatedly to the facts, which are obtained from earlier rule application.
- Adds new knowledge into the knowledge base if required.
- Resolves rules conflict when multiple rules are applicable to a particular case.

To recommend a solution, the Inference Engine uses the following strategies −

- Forward Chaining
- Backward Chaining

c.User Interface

User interface provides interaction between user of the ES and the ES itself. It is generally Natural Language Processing so as to be used by the user who is well-versed in the task domain. The user of the ES need not be necessarily an expert in Artificial Intelligence.

It explains how the ES has arrived at a particular recommendation. The explanation may appear in the following forms −

- Natural language displayed on screen.
- Verbal narrations in natural language.
- Listing of rule numbers displayed on the screen.

The user interface makes it easy to trace the credibility of the deductions.

Applications of Expert System

The following table shows where ES can be applied.

Application	Description
Design Domain	Camera lens design, automobile design.
Medical Domain	Diagnosis Systems to deduce cause of disease from observed data, conduction medical operations on humans.
Monitoring Systems	Comparing data continuously with observed system or with prescribed behavior such as leakage monitoring in long petroleum pipeline.
Process Control Systems	Controlling a physical process based on monitoring.
Knowledge Domain	Finding out faults in vehicles, computers.
Finance/Commerce	Detection of possible fraud, suspicious transactions, stock market trading, Airline scheduling, cargo scheduling.

UNIT 9

Computer Crime and Safety Measure

1. Computer crime

Alternatively referred to as cyber crime, e-crime, electronic crime, or hi-tech crime. Computer crime is an act performed by a knowledgeable computer user, sometimes referred to as a hackerthat illegally browses or steals a company's or individual's private information. In some cases, this person or group of individuals may be malicious and destroy or otherwise corrupt the computer or data files.

2.Software piracy

A term used to describe the act of illegally using, copying or distributing software without ownership or legal rights. The majority of software today is purchased as a one-site license, meaning that only one computer may have that software installed on it at one time. Copying that software to multiple computers or sharing it with your friend without multiple licenses is considered software piracy, which is illegal.Software piracy penalties apply to users that illegally reproduce copyrighted works and/or users who are knowingly in possession of illegally reproduced works. Unknowingly accepting pirated software is another scenario, provided it can be proven. End users may notice red flags, which indicate pirated software, especially if the acquired digital media is encased in inconspicuous or generic containers, such as CD sleeves or unnamed disk packaging.

3.Defining viruses, worms, and Trojan horses

- A computer virus is "a computer program usually hidden within another seemingly innocuous program that produces copies of itself and inserts them into other programs or files, and that usually performs a malicious action (such as destroying data)".

- Worms: Worms are very similar to viruses in that they are computer programs that replicate functional copies of themselves (usually to other computer systems via network connections) and often, but not always, contain some functionality that will interfere with the normal use of a computer or a program. Unlike viruses, however, worms exist as separate entities; they do not attach themselves to other files or programs. Because of their similarity to viruses, worms also are often referred to as viruses.

- Trojan horses: A Trojan horse is a program that does something undocumented which the programmer intended, but that users would not accept if they knew about it. By some definitions, a virus is a particular case of a Trojan horse, namely, one which is able to spread to other programs (i.e., it turns them into Trojans too). According to others, a virus that does not do any deliberate damage (other than merely replicating) is not a Trojan. Finally, despite the definitions, many people use the term "Trojan" to refer only to a non-replicating malicious program.
- Spyware is unwanted software that infiltrates your computing device, stealing your internet usage data and sensitive information. Spyware is classified as a type of malware — malicious software designed to gain access to or damage your computer, often without your knowledge. Spyware gathers your personal information and relays it to advertisers, data firms, or external users.

  Spyware is used for many purposes. Usually it aims to track and sell your internet usage data, capture your credit card or bank account information, or steal your personal identity. How? Spyware monitors your internet activity, tracking your login and password information, and spying on your sensitive information.

  5. ETHICAL ISSUES

  The foundations of all secure systems are the moral principles and practices and the professional standards of all employees of the organization, i.e., while people are part of the solution, they are also most of the problem. The following issues are examples of security problems which an organization may have to deal with:

  A. Ethics and Responsible Decision-Making

  The foundation of all security systems is formed by moral principles and practices of those people involved and the standards of the profession. That is, while people are part of the solution, they are also most the problem. Security problems with which an organization may have to deal include: responsible decision-making, confidentiality, privacy, piracy, fraud & misuse, liability, copyright, trade secrets, and sabotage.

  B. Confidentiality & Privacy

  Computers can be used symbolically to intimidate, deceive or defraud victims. Attorneys, government agencies and businesses increasingly use mounds of computer generated data quite legally to confound their audiences. Criminals also find useful phony invoices, bills and checks generated by the computer. The computer lends an ideal cloak for carrying out criminal acts by imparting a clean quality to the crime.

  The basic law that protects our privacy is the Fourth Amendment to the United States Constitution, which mandates that people have a right to be secure in homes and against unreasonable search and seizure. In addition, many laws have been enacted to protect the individual from having damaging information stored in computerized databases.

  C. Piracy

  Microcomputer software presents a particular problem since many individuals are involved in the use of this software. Section 117 of the copyright laws, specifically the 1980 amendment,

deals with a law that addresses the problem of backup copies of software. This section states that users have the right to create backup copies of their software. That is, users may legally create a backup copy of software if it is to be held in archive. Many software companies provide a free backup copy to users that precludes the need for to users purchase software intended to defeat copy protection systems and subsequently create copies of their software.

The software industry is prepared to do battle against software piracy. The courts are dealing with an increasing number of lawsuits concerning the protection of software. Large software publishers have established the Software Protection Fund to raise between $500,000 and $1 million to promote anti-piracy sentiment and to develop additional protection devices.

D. Fraud & Misuse

The computer can create a unique environment in which unauthorized activities can occur. Crimes in this category have many traditional names including theft, fraud, embezzlement, extortion, etc. Computer related fraud includes the introduction of fraudulent records into a computer system, theft of money by electronic means, theft of financial instruments, theft of services, and theft of valuable data.

E. Liability

Under the UCC, an express warranty is an affirmation or promise of product quality to the buyer and becomes a part of the basis of the bargain. Promises and affirmations made by the software developer to the user about the nature and quality of the program can also be classified as an express warranty. Programmers or retailers possess the right to define express warranties. Thus, they have to be realistic when they state any claims and predictions about the capabilities, quality and nature of their software or hardware. They should consider the legal aspects of their affirmative promises, their product demonstrations, and their product description.

F. Patent and Copyright Law

A patent can protect the unique and secret aspect of an idea. It is very difficult to obtain a patent compared to a copyright (please see discussion below). With computer software, complete disclosure is required; the patent holder must disclose the complete details of a program to allow a skilled programmer to build the program. Moreover, a United States software patent will be unenforceable in most other countries.

Copyright law provides a very significant legal tool for use in protecting computer software, both before a security breach and certainly after a security breach. This type of breach could deal with misappropriation of data, computer programs, documentation, or similar material. For this reason the information security specialist will want to be familiar with basic concepts of to copyright law.

G. Trade Secrets

A trade secret protects something of value and usefulness. This law protects the unique and secret aspects of ideas, known only to the discoverer or his confidants. Once disclosed the trade secret is lost as such and can only be protected under one of the following laws. The application of trade secret law is very important in the computer field, where even a slight head start in the development of software or hardware can provide a significant competitive advantage.

H. Sabotage

The computer can be the object of attack in computer crimes such as the unauthorized use of computer facilities, alternation or destruction of information, data file sabotage and vandalism against a computer system. Computers have been shot, stabbed, short-circuited and bombed.

6.Cyber law

IT is the part of the overall legal system that deals with the Internet, cyberspace, and their respective legal issues. Cyber law covers a fairly broad area, encompassing several subtopics including freedom of expression, access to and usage of the Internet, and online privacy. Generically, cyber law has been referred to as the Law of the Internet.

7.Firewall

It is a network device that isolates organization's internal network from larger outside network/Internet. It can be a hardware, software, or combined system that prevents unauthorized access to or from internal network.All data packets entering or leaving the internal network pass through the firewall, which examines each packet and blocks those that do not meet the specified security criteria.

Firewall is categorized into three basic types −

- Packet filter (Stateless & Stateful)
- Application-level gateway
- Circuit-level gateway

8. Encryption and Decryption

BASIS FOR COMPARISON	ENCRYPTION	DECRYPTION
Basic	Conversion of a human understandable message into an unintelligible and obscure form that can not be interpreted.	Conversion of an unintelligible message into a comprehensible form which could be easily understood by a human.
Process takes place at	Sender's end	Receiver's end
Function	Conversion of plaintext into ciphertext.	Conversion of ciphertext into plaintext.

Computer Ethics:
The word „ethics" means „moral beliefs and rules about right and wrong". Thus, Computer Ethics also refers to the responsible use of computers and computer networks. It is a branch of practical philosophy which deals with how computing professionals should make decisions regarding professional and social conduct. Some important points to remember :

i. People have the same legal and ethical responsibilities when using a computer as at any other time.
ii. Computers will not necessarily prevent all improper acts; users and responsible for what they do.
iii. Some of the information stored in computers is private and confidential and should not be abused.
iv. Electronic communications are not guaranteed to be private.
v. Users must respect software copyrights and licenses.
vi. Manufacturers, programmers and independent consultants have responsibilities to their customers.
vii. On the Internet, you are everyone else"s guest.

Intellectual properties right:

The term „intellectual property" refers broadly to a distinct types of the creations of the human mind such as musical, literary, photographic and artistic works; discoveries and inventions; and words, phrases, symbols and designs etc. Intellectual property rights protect the interests of creators by giving them property rights over their creations. Common types of

intellectual property rights includes copyright, trademarks, patents, industrial design rights etc. Following matters are protected by intellectual property rights:

i. Literary, artistic and scientific works.
ii. Performances of performing artists, phonograms and broadcasts.
iii. Inventions in all fields of human endeavor.
iv. Scientific discoveries. v. Industrial designs.
vi. Trademarks, service marks and commercial names and designations.
vii. Protection against unfair competition.
viii. All other rights resulting from intellectual activity in the industrial, scientific, literary or artistic fields.

Computer Crime

Computer crime refers to any crime such as tempering, physical danger and unwanted disclosure of data that involves a computer and a computer network. It includes the computer that may have been used in the commission of a crime, or it may be the target. It is the illegal use of a computer by an unauthorized individual, either for pleasure such as by a computer hacker or for profit as by a thief. Generally computer crimes are committed for the following:
Attempt illegally to access information stored on a computer as information may have a sale value, may be valuable to the owner or may be useful for further illegal activity such as fraud. Try to impede or alter the functioning of the computer itself as if computer can be controlled it can be used to send spam, host illegal content, or conduct further attacks. Technological solutions for Computer crime:

a. Firewalls:
These are hardware or software devices that block certain network traffic according to their security policy.

b. Software solutions:
These are used to identify and remove malware and to help manage spam email. For example, Antivirus, antispyware software.

c. Authentication:
This process involves determining that a particular user is authorized to use a particular computer. This can include simple mechanisms such as passwords, to more complex methods using biometric technology.

d. Hardware cryptography:
It uses computer chips with cryptographic capabilities intended to protect against a range of security threats.

e. Patches:
These are the programs designed by software manufacturers to fix software security flaws. Patching is often installed automatically. This reduces end-user participation and increases ease of use

Concept of Cyber Law:

The term 'cyber' is a prefix attached to 'everyday' words in order to given them a computer-based or internet online meaning, as in cyber law, cyberspace, cybercafé etc. Cyber law is a term that encapsulates the legal issues related to use of communicative, transactional, and distributive aspects of networked information devices and technologies. Hence, it is related to the practice of law either in relation to or through the use of the Internet. Basically cyber law deals with internet hacking,

pornography, cyber-stalking, cyber- scams, online fraud, software piracy and much more. Legal experts are working in this field to help educate and guide the internet community on crime prevention and the reporting of cybercrimes.

Areas of cyber law:

Cyber law includes many laws relating to the following issues:

i. Computer Crime Law:

Computer crime refers to any crime such as tampering, physical danger and unwanted disclosure of data that involves a computer and a computer network. Some countries have enacted the law related to computer crime.

ii. Data protection and privacy law:

Ethical issues about storage of personal information are now becoming an increasing problem. With more storage of personal data for social networking arises the problem of selling that information for monetary gain. This gives rise to different ethical situations regarding access, security and the use of hacking in positive and negative situations. Thus, data protection and privacy law deals with these issues.

iii. Intellectual property right law:

Intellectual property refers to the creations of the human mind such as musical, literary, photographic and artistic works; discoveries and inventions; and words, phrases, symbols and designs etc. Intellectual property rights protect the interests of creators by giving them property rights over their creations. Common types of intellectual property rights law include copyrights, trademarks, patents, industrial design rights etc.

iv. Electronic and Digital Signature Law:

Digital signature is a way of authenticating that an electronic message really came from the person it claims to have come from. A digital signature can be encrypted with your private key. The recipient can decrypt the message with your public key to verify that it is really you. This law deals with the electronic and digital signature in e-commerce or electronic transaction.

v. Telecommunication Law: Communication through the telecommunication also uses the internet. Cyber law also deals with the laws related to the telecommunication.

*** THE END ***