

(FUNDAMENTALS OF INTERNET ADMINISTRATION)

Network

Before discussion the internet first of all we should discuss about the network, because if our concept will not be clear about the network then we cannot understand concept of internet. So let us start the discussion of the network. *What is meaning of the network ?*. Basically, *network word made-up with two words*. Next I am going to split this *Network Word*.

Net/work
Net + Work
Web/cobweb + task/function

It means like the spider web (cobweb) some task/function/work is happening so on this concept something is running. What.....? Once again

All of you consider that when two or more than two railway stations are connected with railway tracks or two or more than two houses are connected to the roads. These interconnections are called **network** between railway stations and tracks and between houses and roads.

Network

“In information technology a network is a series of points or nodes interconnected by communication path.”

Note: A device, generally the computer that is directly attached to the network, is called a node

Computer Network

A **computer network** is a collection of two or more than two where components interconnected by communication channels that allow sharing of resources and information.

Types of Computer network

There are three different types of network for different purpose:

- 1- LAN
- 2- MAN
- 3- WAN

LAN (Local Area Network)

A Local Area Network is a network that connects computers and devices in a limited geographical area such as home, school, computer laboratory, office building, or closely positioned group of buildings.

Characteristics:

- (i) A diameter not more than a few kms.
- (ii) A total data rate of at least several Mbps.
- (iii) Complete ownership by a single organization.

MAN (Metropolitan Area Network)

A Metropolitan area network is a large computer network that usually spans a city or a large campus.

Characteristics:-

- (i) Covers entire city, but uses LAN technology.
- (ii) Have data rates below 1 Mbps.
- (iii) Owned by multiple organizations.

WAN (Wide Area Network)

A (WAN) is a computer network that covers a large geographic area such as a city, country, or spans even intercontinental distances, using a communications channel that combines many types of media such as telephone lines, cables, and air waves.

Characteristics:-

1. More scalable than LAN and MAN.
2. Connects many sites spread across large geographic distances with many computers at each site.
3. Provides sufficient capacity to permit the computers to communicate simultaneously.

Advantages of Computer Network

- 1- Communication.
- 2- Data sharing.
- 3- Internet Service.
- 4- Video conferencing.
- 5- Instant and multiple accesses.
- 6- Resource Sharing:
- 7- Speed.
- 8- Centralized Software Management.

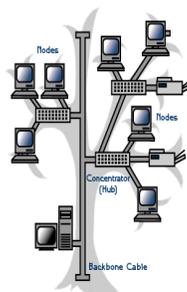
Disadvantages of Computer Networks

- 1- Security Issues:
- 2- Rapid Spread of Computer Viruses:
- 3- Expensive Set Up.
- 4- Dependency on the Main File Server.
- 5- Network faults can cause loss of data.
- 6- Network fault could lead to loss of resources.
- 7- User work dependent upon network.

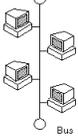
Topologies

A topology is the layout of the network components or the pattern of arrangement of nodes that are connected using cables in a local area network (LAN) environment. There are following study of network topology recognizes eight basic topologies

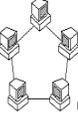
- 1- Bus Topology
- 2- Ring/Circular Topology
- 3- Star Topology
- 4- Tree Topology
- 5- Mesh Topology
- 6- Point-to-Point Topology
- 7- Daisy Chain Topology
- 8- Hybrid Topology



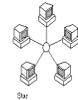
- 1- Bus Topology:** In this topology, the computers are connected to form a network through a single cable that runs from one computer to another. Each node can send messages to all the other nodes in the network. If a node sends a message to a particular node in the network, only that node accepts the message and all the other nodes ignore it.



- 2- Ring Topology:** In this topology, each computer is connected to the computer next to it. Hence, each computer is connected only to two of its neighboring nodes. All the components of the network are connected to a main cable and form a circle. When a node sends a message to any other node on the ring, the message travels (**either in clockwise or counter clockwise direction**) through every other node in the ring until it reaches its destination node. In this topology, the data is transmitted in one direction and if one node fails to transmit the data the **entire network fails**.



- 3- Star Topology:** In this topology, all the computers are connected to a central device. The central device can be a switch or a hub. The central device is usually connected to the server and it receives the data from a node and sends it to the destination node.



- 4- Tree Topology:** Tree topology is the **combination of Bus and Star topology**.

- 5- Mesh Topology:** Every computer has a direct connection to every other computer on the network.

6- Point-to-point (telecommunication)

In telecommunication, a **point-to-point** connection refers to a communications connection between two nodes or endpoints. An example is a, in which one telephone is connected with one other, and what is said by one caller can only be heard by the other. This is contrasted with a communication topology, in which many nodes can receive information transmitted by one node.

7- Daisy chain (electrical engineering)

In electrical and electronic engineering a daisy chain is a wiring scheme in which multiple devices are wired together in sequence or in a ring. Daisy chains may be used for power, analog signals, digital data, or a combination thereof.

8- Hybrid

Hybrid networks use a combination of any **two or more topologies**. A Star Bus network consists of two or more star topologies connected using a bus trunk (the bus trunk serves as the network's backbone).

History of Internet

In 1969, the Department of Defense (DOD) of United States of America started a network called ARPANET (Advanced Research Projects Administration Network). It was started with one computer in California and three in Utah

Later, the military allowed universities to join the network for sharing the hardware and software resources, a number of other networks were developed during the late 1970 and early 1980, with BITNET and CSNET among them. BITNET which is acronym for Because It's Time Network began at the City University of New York. It was provide electronic mail and file transfers. CSNET, which is an acronym for Computer Science Network, Its initial purpose was to provide electronic mail. for a variety of reasons, neither BITNET nor CSNET became a dominant national network.

A new national network, NSFnets, was created in 1986. National Science Foundation (NSF) initially connected the NSF-funded supercomputer centers at five universities. By 1990, NSFnet had replaced ARPANet for most nonmilitary uses and wide variety of organizations had established nodes on this network. By 1992, NSFnet connected more than 1 million computers around the world. In 1995 a small part of NSFnet returned to being a research network. Then it grew bigger and gave birth to the present-day very popular Internet.

Internet

Internet is a network of networks. or

It is an interconnection between several computers of different types belonging to various networks all over the world.

How does internet work?

When information is passed from one computer system to another it is broken up into pieces called packets using the TCP and IP protocol. a message consisting of not more than 1500 bytes or characters is put into a packet. Each packet has the address of sender and the destination. These addresses are called IP addresses.

The packets are passed from one network to another until they reach their destination. At the destination the TCP software reassembles the packets into a complete message, if packets are lost or damaged, a request is sent to resend them. it is not necessary for all packets in a single message to take the same route through the internet or for the same message o take the same route each time it is sent.

Need of Hardware

- 1- PC
- 2- Dialup connection/Telephone lines
- 3- Modem
- 4- Cable
- 5- Topology

Need of Software

- 1- Protocol
- 2- Browser
- 3- Standard OS
- 4- ISP

What is internet:-

It is interconnected computer network by which Communication must be possible through global interconnected computer network. **Tim Berner Lee at MIT/LCS** (Massatutes Institutes of Technology/Laboratory of Computer science) gives the concept of internet.

Types of computer Network:-

- Point-To-Point Computer Network. (By Means Wires).
- Broadcast computer network. (By means of microwaves).

Classification Of computer Network:-

- ❖ LAN(Local Area Network).
- ❖ MAN(Metropolitan Area Network).
- ❖ WAN(Wide Area network).

LAN :-

Area of LANs are limited through which text,graphics,and other types of information must be communicate.

Example:-Computer Network in Bank Office,Computer Lab Network etc

MAN:-

It is similar to LAN but it must be transmit audio,video,animation and other types of informations very efficiently.

Example:-Cable TV Network.

WAN:-

It is the largest network across geographical area.

Example:-

Internet,Telephone(PSTN),ISDN,VSAT etc.

PSTN	Public Switched Telephone Network.
VSAT	Very Small Aperture Terminal.
ISDN	Integrated Services digital Network.
PSDN	Public Switched Data Network.

Network Topology:-

It is the physical layout of computer network.There are following types of network topology.

- Star topology.
- Ring topology.
- Bus Topology.
- Tree Topology.

Protocol:-

Set of access-formalized rule is called protocol.

- TCP/IP (Transmission Control Protocol/Internet protocol)
- Ftp (File Transfer Protocol).
- Http (Hypertext Transfer Protocol).
- SLIP (Serial Line Internet Protocol).
- PPP (Point to Point Protocol).

Who Govern Internet:-

ISOC (Internet Society).

IAB (Internet Architecture Board).

IETF (Internet Engineering Task Force).

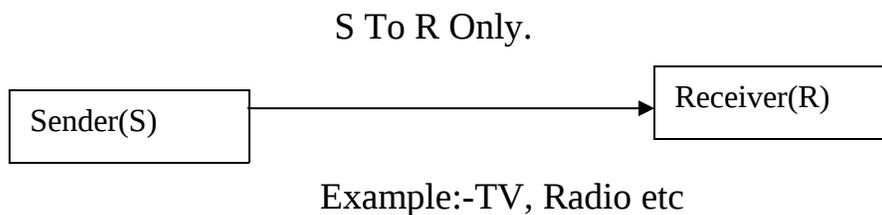
How Connect Internet:-

1. Broad Band Connection.
2. VSAT.(Very Small Aperture Terminal).
3. Mobile Phone.
4. Wi-Fi System.
5. USB Modem.

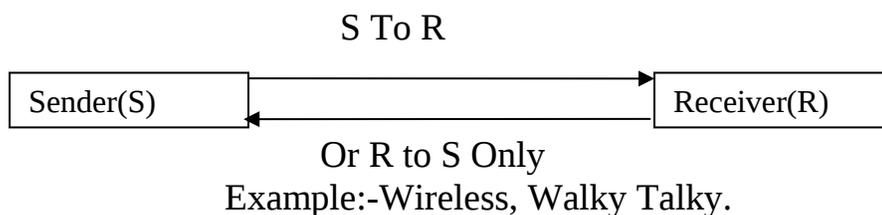
Communication Modes:-

1. Simplex Communication Modes.
2. Half-Duplex communication Modes.
3. Full Duplex Communication Modes.

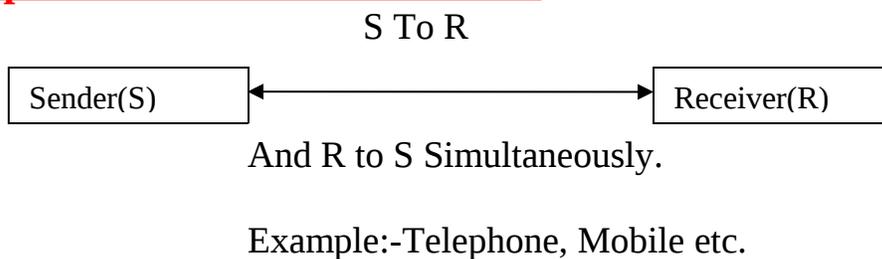
Simplex Communication Modes.



Half-Duplex Communication Modes.



Full Duplex Communication Modes:-



Network=The sharing of resources between two or more peoples

What is Intranet:-

Intranet is the use of internet technologies within an organization (or company) to achieve better results than the conventional means of data access and transfer. Information page of intranet coded into HTML/DHTML, Dot net/Java etc. TCP/IP protocol is responsible for intranet services.

Difference between Internet & Intranet:-

- ❖ Intranet is network within the organization where as internet is a worldwide network.
- ❖ Intranet has access to internet but not vice-versa.

Advantages of Intranet:-

- ❖ Cheaper
- ❖ Versatile
- ❖ Flexible
- ❖ An intranet provides access to electronic databases, documents, electronic training manuals, internal job vacancies etc.
- ❖ It also improves following profitability
 - Improved and More efficient employee training
 - Improved employee and departmental moral
 - Better project management.
 - Increased inter-departmental communication channels. etc.

Types of Intranet:-

Following three functionality accesses through intranet.

- ❖ Bulletin Board.
- ❖ Database Management
- ❖ Information Access

1:- The Communications Intranet.

2:-The Integrating Intranet.

3:-The catalogue intranet.

4:-The Single Sign-On Intranet.

1:- The Communications Intranet:-

This type of intranet types mainly used by big organization such as reliance Industries, Tata Motors, Maruti Udyog, and Hero Honda Industries etc.

2:-The Integrating Intranet.

This types of intranet mainly used by academic institutions, Banking industries etc.

3:-The catalogue intranet.

This type of intranet designed for multimedia catalogue.

Example: - Search Engine.

News Agency.

4:-The Single Sign-On Intranet:-

This type of intranet allows maximum security for access information

Example:-

Railway Reservation.
Airlines reservation.

H/W and S/W for Intranet:-

H/W for intranet:-

- ❖ Server (Node).
- ❖ Workstation.
- ❖ MODEM.
- ❖ Channels/Media.

S/W for intranet:-

- ❖ Operating System(Windows NT,Window98,Linux,Unix etc)
- ❖ Application S/W.

Languages Support By Intranet:-

HTML, DHTML, ASP, DOT Net, XML, CGI, Perl, UML, VRML etc.

Protocol Supported By Intranet:-

IP
HTTP
SMTP
LDAP
TCP
X509
POP3
IMAP4
PPP
SLIP
Etc.

Application Areas of intranet:-

1. Education Sector.
 - a. Universities
 - b. Colleges
 - c. Institutes
2. Industry sector
 - a. Small and large scale manufacturing.
 - b. Automation and control.
3. Service Sector
 - a. Hotel
 - b. Tourism
 - c. Travel
 - d. Transportation
 - e. Communication
4. Research and development
 - a. Laboratories.
 - b. Organizations.

- c. Space.

5. Government Sector

- a. Ministries
- b. departments
- c. States
- d. Law & Order

6. Company Documents

- a. Manuals
- b. Building maps
- c. Airport Directions
- d. Company news letter
- e. Daily bulletins
- f. History graphs

7. Customer related

- a. Feedback Forum
- b. Company Bulletin Boards
- c. News Flashes
- d. Database queries etc

8. Training

- a. Training Materials
- b. Video Training
- c. Employee proficiency Training

9. Meeting Related

- a. Meeting Schedules
- b. On Line Meeting
- c. Meeting Room Schedules

Key Terms Of Intranets:-

1. Applets:-

It is tiny java program, which is used for displaying effect of animation, moving graphics made in any intranet supporting languages.

Applet Creation:-

```
Import java.applet.applet;  
Import java.awt.Graphics;  
Public class test1 extends java.applet.applet  
{  
Public void paint (Graphics gg)  
{  
gg.drawstring ("ICSM", 15, 30);  
}  
}
```

2. Bits, Bitmap:-

The fundamental elements of graphics is called pixels. Which consist of either 0 or 1.

3. Bookmark

A list of pages a user likes to frequently visit.

4. Browser:-

It is a s/w which is used for accessing intranet information.

Example:-

Netscape navigator

Internet explorer

Mozilla

Opera

etc.

5. Counter:- A s/w code that indicates how many times a site has been visited.

6. Cyberspace:-

It is virtual area where pages, data, images and all the rest are stored.

7. FAQ:-

It stands for **frequently asked questions**. Common questions and their answers that occur regularly within a user group.

8. Firewall:-

It is a protection against unauthorized access via the internet.

9. Home Page:-

The first page of Intranet is called home page.

10. Hot Links:-

It is used for linking html documents or any URL with other web pages. Anchor tag is used for linking web pages.

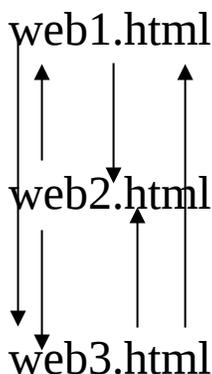
Anchor tag:-

The anchor tag is used to create links between different objects like HTML page files, web site (URL).

Syntax:-

```
<a href=" HTML page files or URL">Text or Graphics</a>
```

Example:-



Hyper text Transfer Protocol (http):-

It is a protocol which is used for transferring web pages from cyberspaces over internet or intranet.

Example:-

<http://www.uprtou.ac.in>

// Valid or not Valid URL

Daemon:-

It is unix background process that implements the server side.

Httpd (Hypertext Transfer Protocol Daemon):-

It is a program that run on a unix platform to establish a web server.

ISDN:-

It is referred to integrated service digital Network.It is way to move more data over existing regular phone lines.

JAVA:-

It is pure object Oriented programming language, which must satisfied following three properties.

- ❖ Polymorphism
- ❖ Inheritance
- ❖ Encapsulation

JPEG:- (Joint Picture Expert Group)

It is image file which is used for internet or intranet. It is smaller than gif files.

LDAP:- (Lightweight Directory Access Protocol)

It is a protocol, which is used for creating directory.This protocol helpful with TCP/IP to access server directory.

Networks:-

A number of computers connected together.

Internet:-A lots of network all over worlds are connected to make the internet.

Intranet:- Lots of networks connected within an organization (locations could be geographically distant) such as bank network, Maruti udyog limited etc.

Search Engine:-

It is URL, which is used for searching information through internet or intranet.

Surfing:-

Click and access information through cyberspace (Internet or intranet) is called surfing.

T-1:-

It is a leased line connection capable of carrying data at 1544000 bits per seconds.

It facilitates full motion video.It is commonly used to connect internet and intranet.

URL:-

It is used for accessing internet or intranet services.

Example:-

www.uprtou.ac.in
www.bhu.ac.in
www.nic.in
www.google.com
www.rediffmail.com
www.yahoomail.com
www.altavista.com
www.timesofindia.com
www.bseindia.com
www.nseindia.com

Web or net:-

WWW consist of a lot of hypertext and hypermedia system.

Format of HTML Coding:-

```
<html>  
<Head>...</head>  
<Title>...</title>  
<Body>  
....  
....  
....  
</body>  
</html>  
< > Open tag  
</ > Closed Tag
```

Web includes audio, video, graphics, text etc.

Web server:-

A computer that stores web pages and responds to requests for viewing.It communicate by means web browser.

Webmaster:-

It is supervisor ensuring that the system is up and running.The system administrator communicate between users and hosts to sites.

Chapter 2:-

Intranets security:-

It is good technology for supporting administrators.It includes rules and validations to inform administrator of potential security back doors, automatic incident reporting to inform administrator. Hackers can not configure intranet inform through strong security.

Security threats for intranet:-

- ❖ Internal Threats.
- ❖ External Threats.

Internal Threats:-

This is most common problem through internal users (Employees).For this reason we apply security for intranet.Information must be confidential.

External Threats:-

This threats are most problematic ones.Till date the greatest threat against viruses.

Security Solutions:-

Following security models is used for intranet security. Property related to securities are:

Classical Case Study:-

Following activities that happen to everyone day to day.

- o The Open House.
- o The Owner.
- o The Garden Party.
- o The Paying Guest.
- o The Fort.

The Open House:-

In this case, The front door and all the rooms are unlocked.Visistors will be free to move around anywhere from any room to any room.

The Owner:-

A case where the front door is locked but all the rooms are unlocked.

The Garden Party.

An excellent case in which the front door is unlocked but certain rooms inside the house are locked. This is a useful security model if any company gets a lot of customers.

The Paying Guest:-

The guest has a key to enter the house and is able to get into his room only but other rooms are off his limits. This model allows for verification whether or not enter the site.

The Fort Model:-

A locked massive iron gate with barbed wire, front door locked, all rooms are also locked and there is a watchman guarding the house.In this model we must have entry pass and Certificates

Security Consideration:-

- ❖ Hardware
 - o Theft of Computer, Printer or other resources.
 - o Destruction of resources by means of fire, electric power surges or floods
- ❖ Software
 - o Deletion of programs
 - o Theft of a program by the user
 - o Virus attack
 - o Bugs in the s/w
 - o Corruption of a program

❖ Information

- Informations theft by hackers.
- Deletion of file or files

Security Certification:-

Security models must be certifying by authentication organization.

Such as:-

- ISO 9001
- ISO 9002

Firewalls:-

It is s/w for facilitate, security over intranet against hacking of informations.

Restrict the users to peek inside the internals of the web site.It is basic foundation for internet and intranet both.

Types of firewall architectures:-

- ❖ Packet filter firewalls.
- ❖ Proxy Server.
- ❖ Stateful Multilayer inspection.

Packet filter firewalls:-

It is common type of firewalls which is used for capable of permitting or denying traffic based on certain simple field level filters. This could determine such things as source or destinations packet address. It is highly inexpensive. Such type of packet filtering can be found in almost every major firewall available today.

Proxy Server/Relay Server:-

It further classified into two types of firewall

- ❖ Application Level Gateway
- ❖ Circuit level gateway

Application Level Gateway:-

It is used for establish a connection to a remote system on behalf of specific application at gateway levels.

Circuit level gateway:-

It provides proxy or relay capabilities in a communicated outside the internal networks. It is directly impact on the overall network performance.

Stateful Multilayer inspection (SMLI):-

It is third generation of firewall technology and usually combines the facilities of above two.It is completely transparent to both users and applications.

Encryption/Decryption Methods:-

It is a method of converting plain text to cipher text and cipher text to plain text.

Plain Text → Algorithm → Cipher → Algorithm → Plain text

Types E/D Method:-

- a) RSA
- b) DES

Write both algorithms from OS notes/BCA 15(Security)

There are three well-known method implementation method of the E/D

- ❖ Public Key infrastructure solution.
- ❖ Web server security.
- ❖ Virtual Private network

Public Key infrastructure solution:-

This implementation of E/D uses public key based security system. The security of entire system totally depend upon a key. E/D is done by specialized H/W such as ATM network.

Web server security:-

Web server security in intranet and extranets are purely based on use of powerful web servers to deliver information to the users. In this server SSL (Secure Socket Layer) protocol is used in **on line trade**.

Virtual Private network:-

E/D communication network traffic that passes through internet or intranet. This type of s/w ,H/w uses in same company network system. VPN is not very efficient flexible features.

Security Policy:-

Security policy in intranet or extranet given below.

1. **Identification of**
 - 1.1. The content, and needs to be secured.
 - 1.2. User groups or categories.
2. **Procedures**
 - 2.1. Access authorization procedure
 - 2.2. Backup procedures
 - 2.3. Disaster recovery procedures
3. **Action against misuse**
 - 3.1. Attacks
 - 3.2. Ensuring employee exercise proper technique.
 - 3.3. Handling sensitive documents.
 - 3.4. Copyright policies

Above implementation of policies in intranet following important of data consist different types of characteristics.

1. Confidentiality.
2. Integrity.
3. Availability.

Socks: Short Notes

It is protocol of industry based intranet network. It apply on circuit level gateway acting as proxy.

It protects each layer of OSI model.

Features of SOCKS:-

- o Authentication
- o Encryption
- o DNS
- o IP addressing
- o UDP protocol

Advice from Security Experts:-

1. Good resources.
2. Qualification of security professionals.
3. Intentional hacking helps in better security.
4. Motivation behind hackers to hack.
5. Lot of care required while programming.
6. Routine security audits are essential.

Audit Trail of security:-

The security has certain routines that maintains audit trail or journal.

- ❖ Who
- ❖ When

- ❖ Where
- ❖ What

Chapter 3:-

Choosing Intranet H/W and S/w:-

Intranet H/w:-

1. Servers

- 1.1. Latest High Speed Processor.
- 1.2. High Storage capacity Hard disk (320 GB, 500 GB 1PB etc).
- 1.3. High Speed RAM (2GB, 4 GB, 10 GB).
- 1.4. Attaches High Speed Leased Line).

2. Clients

- 2.1. Browser is of latest version.
- 2.2. It supports TCP/IP.
- 2.3. It is compatible to Microsoft and java technologies.

3. Security Systems.

- 3.1. To protect the web servers or intranet servers is to use application gateways or simply proxies.

Intranet S/w:-

1. Operating System

- OS (Server And Client)

Example:- (Intranet operation)

- Back office Server 4.5
- Back office Server 2000
- Site Server 3.0
- SNA Server 4.0
- SQL Server 7.0
- SQL Work Station 6.5

2. Groupware

It is collection of s/w tools that encompass a broad range of applications. Intranet could be easily served with about Rs. 8 lakh.

Example:-

Communication tools

Voice Mail

E Mail

Fax

Videoconferencing

Project management

Project Planners

Project management

Project Scheduling

News & General Services

Electronic Bulletin board services

Electronic calendar services

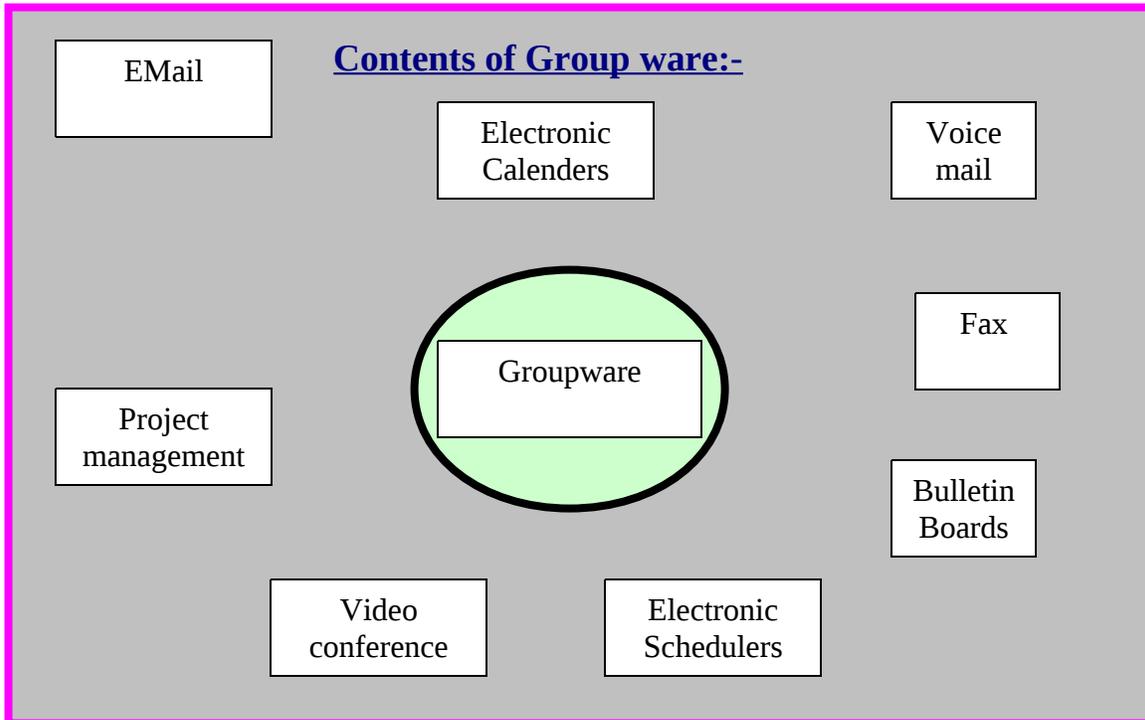
News Services

Reminder services

General Office management
Document management
Spreadsheets
Word Processors
Graphical Editors

Web Tools

Authoring
Publishing
Simple Security Tool



Database Connectivity In Intranet:-

Basic Connectivity
Middle Ware Support
ODBC (Open Database Connectivity)
JDBC (Java database Connectivity)

Basic Connectivity

This connectivity suitable for Oracle, Sybase, Ingres, Gupta's Base etc.

Middle Ware Support:-

All the connectivity interfaces related tools come under the category of middle ware. It provides link for data exchange between different points of processing in a distributed applications

ODBC (Open Database Connectivity):-

ODBC permits connectivity to any type of database from the client applications. It is suitable for windows, Linux, Unix, MacOS, SUN Solaris etc.

JDBC (Java database Connectivity)

It is suitable for java language based S/w to connect database.

Other Aspects for intranet:-

1:- Protocol

- ARP
- TCP
- IP
- FTP
- TELNET
- HTTP
- SPX
- IPX
- UDP
- POP
- LDAP
- SMTP
- HTTPS
- CGI
- IMAP
- SOCKS

2:- Web Based Tools:-

- HTML
- DHTML
- XML
- CGI
- ASP
- JSP
- PHP
- DOT NET
- Perl
- VRML
- Web authoring tools

3:- Security Tools

Firewalls

VPN (Virtual Private Network)

4:-E/D Using by SSL

Network Environment for Intranet:-

Following issues necessary for making intranet environment.

- Preparation of list of components.
- Planning network topology.

- Task of cables.
- Testing of points
- Planning for network Hubs
- Estimating Time schedule
- Estimating man power required
- Estimating total cost of components
- Network installation
 - Buying the components
 - Cabling
 - Expanding the network
 - Installing gateways,Hubs,Switches,routers

Security:-

Firewalls

VPN (Virtual Private Network)

Installation of Essential Services:-

Antivirus

Testing connectivity to database

Testing connectivity to intranet and internet

Chapter 4:- Configuring Intranet

The first step of setting up intranets is to configure a web server. Many web servers are available some of them are commercial and some are free. Web servers are including following informations.

- ❖ Web authoring.
- ❖ Web graphics
 - o .gif
 - o .jpeg
 - o .bmp

Authoring.

Authoring systems are generally menu-driven systems intended to easy to use by the multimedia developer. Authoring languages are specially designed programming languages and have some distinct advantages over generic languages. By using authoring s/w web site become most effective.

Feature of Authoring S/w:-

1. Integrated Multimedia Elements.

It produces better interactivity and control over multimedia system in intranets

2. Script Language Programs

Script Languages are used for facilitating logical effect in multimedia system. It consist of HTML, Javascript, VB Script etc.

3. Icon Based Programs.

Authoring s/w facilities icon based multimedia system in intranets

4. DLLs for extending features.

Authoring s/w also facilitates extending features. With other multimedia system in intranets.

5. Supporting video for windows.

6. Hypertext.

It facilitates one file with another file.

7. Runtime player for distribution.

Hosting web pages On Intranet:-

Organization that will host the web pages, can be asked from the internet service provider (ISP) or system administrator.

Name of Some ISP:-

❖ **Airtel**

❖ **Reliance**

❖ **BSNL**

❖ **VODAPhone**

❖ **IDEA**

❖ **AIRCELL**

❖ **MTS**

❖ **MTNL**

❖ **TATADOCOMO**

❖ **Reliance jio**

❖ **Tikona**

Network Installation and Administration:-

Following Steps involved in installation

Step 1:-Designing Topography/Topology.

Step 2:-Planning the connectivity or wiring.

Step 3:-Installing routers and hubs.

Step 4:-Setting up Servers.

Step 5:-Establishing security measures (Example:-Firewalls).

Step 6:-Selection of ISP.

User Management In Intranet:-

1:- Authentication

It is a process that is performed by the system automatically to ensure that the user is genuine. There are many types of authentication

a:- Kerberos

b:-Windows NT LAN Manager

c:-Secure Socket

d:-Smart Card

2:-Accounts

a:-Built In accounts

Types:-

I:-Local (For local computer access)

II:-Domain (For access to network resources in the domain)

Following operations are possible in accounts user.

1:-Change password for next login

2:-Password never expires

3:-Store password using reversible encryption

4:-Account is disable

5:-Smart card is required for interactive logon

6:-Use of DES encryption types for this account

3:-Profile-

Set up the environment variables, set a network path to the user profile folders and user home folder

Standard File and Folder Permission:-

a:-Read permission(R)

b:-Write Permission (W)

c:- Read & Execute permission (R & E)

d:-List folder contents Permission (It can perform read and Execute Permission on folders)

e:-Modify permission

f:-Full Control Permission

g:-Delegated permission

It includes :-

i:-creates, delete and manage user groups

ii:- creates, delete and manage user accounts

iii:-Modify group membership

iv:-Read all user information

Disk Quotas:-

Disk quotas are used to track the use of disk space for each user.

Windows explorer can be used to setup and monitor disk quotas.

Window explorer includes following properties.

❖ General Properties

❖ Tools

❖ H/W

❖ Sharing

- ❖ Security
- ❖ **Quota**:-It is used to enable quota management, deny disk space if the quota is exceeded.
- ❖ Web sharing

Security Configuration and analysis:-

It is tool that is used to analyze a computer security configuration. This tools includes following features.

- ❖ Security Templates.
- ❖ Add/Remove Security configuration.
- ❖ Administration tools for database (Open/Close).
- ❖ To perform analysis against template.

User profile:-

It includes user's environment properties. Some of the useful properties associated with profile.

1. Desktop Setting
2. Mouse and Cursor setting
3. Start-up programs, shortcuts and personals groups.
4. Setting for windows applications
 - a. Notepad
 - b. Paint brush
 - c. Calculator
 - d. Clock and more.
5. Favorites.
6. My Document setting.
7. Cookies

Account Policies:-

The three main groupings are

- ❖ Password Restrictions.
- ❖ Account lockout.
- ❖ Kerberos(It is a protocol which is found in Window 2000 for security)

Following four items below are under password restrictions.

- ❖ Enforce password security.
- ❖ Maximum password age
- ❖ Minimum password age
- ❖ Minimum password length

Tunning Server performance:-

Step1:-Choose Server preference/Performance tunning

Step2:-Type the number of request

Step3:-Click Ok

Step4:-Click Save and apply

What are errors in Intranet:-

- ❖ Unauthorized
- ❖ Forbidden
- ❖ Not found
- ❖ Server Error

Network & Security:-

The process of securing network is called security. It secure following related to networks.

- ❖ Risk assessment.
- ❖ Vulnerability.

- ❖ Budget analysis.
- ❖ Security Policy
- ❖ Auditing

Tunning Application Over Intranet:-

- ❖ SQL/API(Structure query Language/Application Program Interface)
- ❖ ODBC(Open Database Connectivity)
- ❖ JDBC(Java Database Connectivity)

Chapter 5:-

Intranet Authoring and management Tools:-

Success of internet and intranet facilitating by authoring tools and management tools.It provides interactive and attractive feature on webpage.

Authoring and management tools are object oriented.

Example:-

Adobe Photoshop, Trellix, Macromedia etc.

Authoring Tools:-

Editors:-

It is used for writing web page coding using HTML, DHTML, Java Script, VB script etc.

Example:-

Open Tag < >

Closed Tag </ >

Format of HTML Coding:-

<HTML>

<Head>...</head>

<Title>...</title>

<Body>

....

....

....
</body>
</html>

Format of Java Script Coding:-

```
<Html>  
<Head>  
<script Language="JavaScript">  
....  
....  
</script>  
</Head>  
<Body>  
<script Language="JavaScript">  
....  
....  
</script>  
</body>  
</Html>
```

Software tools for web authoring:-

- ❖ Adobe page Mill.
- ❖ Microsoft Front page.
- ❖ Netscape Web Tools.
- ❖ Macromedia Dreamweaver.
- ❖ Chili! ASP.
- ❖ Claris Homepage.
- ❖ Revize.
- ❖ Smart Table.
- ❖ Web Wizards.

Feature of Editor Tools:-

- ❖ Autocoding
- ❖ Modifying the code
- ❖ Object Library
- ❖ WYSIWYG
- ❖ Compatibility with other server architectures
- ❖ Compatibility with other platform
- ❖ Less memory usage
- ❖ Preview of the output
- ❖ Java Support
- ❖ Clipart Support
- ❖ Audio Support
- ❖ Video Support
- ❖ Extension of support to various file formats
- ❖ Powerful search and replace facility
- ❖ Managing different peripheral devices

Supporting Application of Intranet services:-

- ❖ ftp
- ❖ telnet

ftp:-It is a protocol which is used for transferring a large amount of textual information, graphical informations and any types of audio, video informations transmitted smoothly and efficiently.Ftp works performed in CUI environment.

ftp> Ftp prompt ready for accept commands.

Telnet:-

It is remote service for accessing web information from web server using intranet network. It establishes packet based connection. Following s/w are used for telnet.

- ❖ NetTerm
 - ❖ Hyperterminal
 - ❖ Secure CRT
 - ❖ EWAN
 - ❖ Kermit
 - ❖ Anzio Lite
- Etc.

Features of common All:-

- ❖ Simple drag and Drop instruction.
- ❖ Extensive host type support
- ❖ Quick connect URL
- ❖ Dial up networking support
- ❖ Record session
- ❖ Wild card macro support (*,?)
- ❖ Support for relevant international standard.

Exclusive for ftp Services:-

- ❖ Simple drag n drop transfers
 - ❖ Transfer queue and file transfer scheduling
 - ❖ Resume upload and download
 - ❖ Directory upload and download
- etc.

Exclusive for security :-

- ❖ Site Security
- ❖ Extensive firewall support

Exclusive for Telnet:-

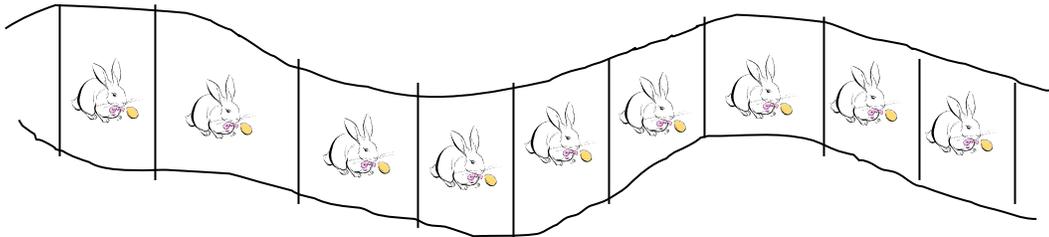
- ❖ File filters.

It display only needed files and unwanted files are suppressed.

Graphical tools for creating Animation:-

Animation:-

An animation is just a continuous series of still images that are displayed in a sequence.



Types of Animation:-

- 1:- 2 D Animation
- 2:- 3 D Animation

2 D Animation: - It is pixels based animation, which produces flat images. There are two effect produces.

Morphing.

Warping.

3 D Animation: - It produces realistically portray with depth. It includes X, Y and Z-axis. There are three steps for making 3 D animations

- ❖ Modeling Steps.
- ❖ Animation Steps.
- ❖ Rendering Steps.

Morphing:-It takes two images seamlessly changes one image to another.

Warping:-Image actually seems to grow out of the first one.

Task of Graphical tools:-

- ❖ Animating enhancing the images

- ❖ Modifying images, text contents
- ❖ Converting file formats
- ❖ Touching and finishing images
- ❖ Dealing with audio/Video
- ❖ Enhancing the content presentation etc

Technology for Graphical tools:-

- ❖ CD ROM, Printers, Digital Camera, Scanner, Blu ray Disk, Pen Drive.
 - ❖ Correctly uses color process (RGB, CYMK).
 - ❖ Digital graphics and animation S/w
 - ❖ Addition of effects and manipulation of waves.
- etc.

Intranet management Tools:-

These tools are sophisticated and require higher expertise to tackle with

- ❖ Database-Basic, ODBC, Distributed
- ❖ Web servers

Database-Basic:-

Almost all programming languages support databases.

Some of popular databases are :-

Oracle

MS Access

SQL Server

DB2

Sybase

Etc.

VB and VC++ may provides various ways to work databases.

ODBC:-

Many web based applications would connect to respective databases for querying and appropriately responding to user requests. ODBC drivers for the following databases must be available.

- ❖ SQL Server
- ❖ MS Access
- ❖ MS EXCEL
- ❖ dBASE
- ❖ Oracle
- ❖ Unix Based databases

Databases Distributed:-

Many organizations may select distributed databases for either or both of following two:-

- 1:-Network On-line databases Such as Railway reservation, Airlines reservation etc.
- 2:-Centralized information Database.

Strong Points Of Implementation of Distributed databases:-

- ❖ More fault tolerance
- ❖ More flexibility
- ❖ Easier to extends
- ❖ Easier to upgrade

Web servers:-

It allows serving information about the organization, Its services and products over internet or intranet. It uses HTML code, DHTML Code, ASP, JSP, JavaScript, VB Script etc.

Application Server availability:-

- ❖ Bluestone
- ❖ Allair cold fusion
- ❖ CreDo
- ❖ Cyberprise
- ❖ Fast Track
- ❖ Infoscape
- ❖ NetDynamics
- ❖ WebStarPro
- ❖ RedNEt Webshare
- ❖ Persistence

Intranet web server:-

1:-AOL Server

It is formerly known as GNNServer.It provides complete web development service. It support

- ❖ SSL
- ❖ CGI
- ❖ SQL database connectivity
- ❖ An integrated search engine
- ❖ Internal image map support

etc.

2:-i Server:-

It is java enabled web server.It support web pages and java servlet.It may support following features.

- ❖ http support
- ❖ Fault tolerance
- ❖ Database Connection Pooling
- ❖ No support for front page.
- ❖ Its fundamental protocols are ODBC,JDBC,SSI and CGI.

3:-WN Web Server:-

It is free web server that run on variants of UNIX platform

It may support HTTP1.1 and CGI1.1 protocols. Its operation methods are very easy.

4:-Sambar Web Server:-

It is an excellent web server for intranet. It provides following features

- ❖ Step-by-step guideline for configuration of web server
- ❖ It uses http protocols
- ❖ It is reliable web server

5:-((PWS Personal) Web Server:-

Such types of server may be supported by Windows NT, Windows 95 .It is suitable for small web sites and intranets

6:-((IIS Personal) Web Server:- Internet Information Server

This version contains many new features along with enhanced performance and reliability.It includes following features.

- ❖ Better & clearly documented security policies.
- ❖ Faster restart of both web and ftp services.
- ❖ It enables multiple machines to share to load and deliver reliable web services.

Chapter 6:- **Intranet Protocols:-**

Some of well-known protocols as following:-

- ❖ ARP
- ❖ TCP
- ❖ IP
- ❖ Telnet
- ❖ Http
- ❖ WAIS
- ❖ SPX
- ❖ IPX
- ❖ UDP
- ❖ POP
- ❖ LDAP
- ❖ SMTP
- ❖ HTTPS
- ❖ SLIP

- ❖ CGI
- ❖ IMAP
- ❖ SOCKS
- ❖ ISAPI
- ❖ WAP
- ❖ WDP
- ❖ WTP
- ❖ WSP
- ❖ ICMP
- ❖ EGP
- ❖ IIOF
- ❖ Millicent
- ❖ SET
- ❖ BGP
- ❖ EGP

etc

Protocols are the rules for guiding the communication over networks

Basic Intranet protocols:-

ARP (Address Resolution Protocol):-

Its function is same as IP protocol. ARP protocol resolve two basic services.

- a:-Obtain media Access Control Address.
- b:-Recording of the media access control address.

SMTP (Simple Mail Transfer Protocol):-

It is used in TCP/IP base network system for transferring mail messages between sender and receiver. It is most popular freeware for UNIX base Server.

POP (Post Office Protocol):-

POP delivers all the messages stored on the server to the user as Email account. It can be easily written for a command line based application.

IMAP (Internet Message Access Protocol):-

It is a standard protocol for accessing e-mail from the local server Its function is very similar to POP. It is totally as remote file server.

Service Protocol:-

- ❖ www's hypertext Transfer protocol.

- ❖ ftp service
- ❖ Telnet service
- ❖ UDP service(Unreliable)
- ❖ SMTP(Simple Mail Transfer Protocol)
- ❖ Exchanging routers information
 - o ICMP(Internet Control Message Protocol)
 - o IGP(Internet Gateway Protocol)
 - o EGP(Exterior Gateway Protocol)
 - o BGP(Border Gateway Protocol)

Role of TCP/IP for intranet:-

Classification of IP Address:-

- Class A
- Class B
- Class C
- Class D

IP address Structure:-

Class A

0	7 bits	Local Address(24 Bits)
---	--------	------------------------

Class B

10	14 bits	Local Address(16 Bits)
----	---------	------------------------

Class C

110	21 bits	Local Address(8 Bits)
-----	---------	-----------------------

Class D

1110	28 bits multicast Address
------	---------------------------

Web Server Specific Protocols:-

- ❖ CGI
- ❖ ISAPI
- ❖ NSAPI
- ❖ DMSP

CGI Protocol:-This protocol is used for exchanging information through gateway.CGI script are used in conjunction with HTML forms to build database applications and query processing.

ISAPI Protocol:-

It is purely based on windows technology of Microsoft.This protocol may supports COM/DCOM technology.
COM Component Object Module.
DCOM Distributed Component Object Module.
ISAPI protocol putting following information.

- ❖ Read Raw Data
- ❖ Send Raw Data
- ❖ Processed Header
- ❖ Authentication
- ❖ Access denied
- ❖ Logging
- ❖ End Of Network Session
- ❖ URL map

NSAPI:-

This protocol is used for handling and address the request response varies slightly and API with java script.It is designed for NCSA and CERN servers.

Function Steps:-

- Step1:-authTrans (Authorization Translation)
- Step2:-Name Trans (Name Translation)
- Step3:-Path Check
- Step4:-Object type
- Step5:-Service
- Step6:-AddLog (Adding Log entries)

DMSP:-

This protocol is referred to as distributed Mail System Protocol. It facilitates multi-session connection for message delivery.

Latest Protocols for Intranet:-

- ❖ CDMA(Code Division Multiple Access)
- ❖ WAP(Wireless Application Program)
- ❖ Agora
- ❖ SET(Secure Electronic Transaction)
- ❖ GPRS(General Packet Radio Services)

CDMA:-

This technology spreads the information contained in a particular signal of interest over a much greater bandwidth than the original signal.

Benefit:-

- ❖ Capacity increases 8 to 10 times than analog signal.
- ❖ Improved call quality.
- ❖ Enhanced privacy.
- ❖ Bandwidth available on demand
- ❖ Low equipment cost
- ❖ Near universal geographical coverage.

WAP:-

It is wireless client server architecture based technology.
It is basically made for mobile or cellphone. It is also known as hand held terminals.
This protocol is helpful for connecting internet with mobile.

Layered Structure of WAP:-

Layer 1	WAE	Wireless Application Environment
Layer 2	WSP	Wireless Session Protocol
Layer 3	WTP	Wireless Transaction Protocol
Layer 4	WTL	Wireless Transport Layer Security
Layer 5	WDP	Wireless Datagram Protocol

Application of WAP:-

- ❖ Remote point Of Sale
- ❖ Customer Service(Ringtones,Fax,Mobile commerce,Chat,Information)
- ❖ Corporate email
- ❖ Remote LAN access facility
- ❖ File Transfer
- ❖ Web browsing
- ❖ Audio
- ❖ Moving images

Agora:-

It is simple and inexpensive protocol for E_commerce.

It support high volume of transactions.

Properties:-

- ❖ Minimal(Free Web browsing)
- ❖ Distributed(It is fully Distributed)
- ❖ On line arbitration (Online connection between customer/Merchant).

SET (Secure Electronic Transaction):-

It is purely on the science of cryptography that speaks of encoding and decoding messages for communications. It is developed by Visa and MasterCard. It support E-commerce over internet. E/D based on DES.

GPRS (General Packet Radio Services):-

This protocol mainly designed for mobile internet. It is better than WAP technology. When it activates on GSM/CDMA, user can access internet services. Its bandwidth equivalent to 177.2 kbps.

Question 1:-What is intranet? Describe its protocol and topology.

Question 2:-Differentiate between internet and intranet.

Question 3:-Explain intranets key terms.

Question 4:-Describe security of intranet?

Question 5:-What is role of firewall for intranet networks?

Question 6:-Describe about E/D Method?

Question 7:-Describe security through SSL?

Question 8:-What is VPN?

Question 9:-Write Security policies?

Question 10:-What is SOCKS?

Question 11:-Describe H/W and S/W for Intranet?.

Question 12:-What are different types of Database connectivity with Intranet?

Question 13:-Write steps of installation for intranet?

Question 14:-What is Disk Quotas?

Question 15:-Discuss about tuning application over intranet?

Question 16:-Discuss about intranet authoring tools?

Question 17:-What is the role of telnet,ftp services over intranet?

Question 18:-Discuss about intranet Management tools?

Question 19:-Discuss about basic intranet protocols?

Question 20:-What are web server specific protocols?

Question 21:-Write Short notes of following?

- ❖ CDMA(Code Division Multiple Access)
- ❖ WAP(Wireless Application Program)
- ❖ Agora
- ❖ SET(Secure Electronic Transaction)
- ❖ GPRS(General Packet Radio Services)
- ❖ Applet
- ❖ Daemon
- ❖ Httpd
- ❖ ISDN
- ❖ Cybespace
- ❖ Web server
- ❖ Web master
- ❖ Hotlinks
- ❖ T-1
- ❖ Webpage
- ❖ Groupware

BCA-19/MCA2.3/PGDCA2.3

Introduction of S/w Engineering:-

Software engineering is the study and an application of engineering to the design, development, and maintenance of software. Typical formal definitions of software engineering are: "the application of a systematic, disciplined, quantifiable approach to the development, operation, and maintenance of software";

Development of procedures and systematic applications that are used on electronic machines. Software engineering incorporates various accepted methodologies to design software. This particular type of engineering has to take into consideration what type of machine the software will be used on, how the software

will work with the machine, and what elements need to be put in place to ensure reliability.

Introduction to Computer Software:-

Computer can neither think nor take any decision itself. We instruct by means of **commands** or **programs**.

Programmer:- The person who writes computer program is called programmer. Programming is **personal activity**.

Program:- It is sequence of **instructions**, which operate on computer **data** to perform certain well-defined task or achieve a goal.

Program = Algorithm+Flowchart+Language+Translator+Operating System + Data Structure.

Software:- A set of programs, which run on hardware and govern the functioning of computer system. Development of s/w is a **team effort**.

S/w engineers follow perfect discipline for development of s/w.

Activity of S/w Engineer:-

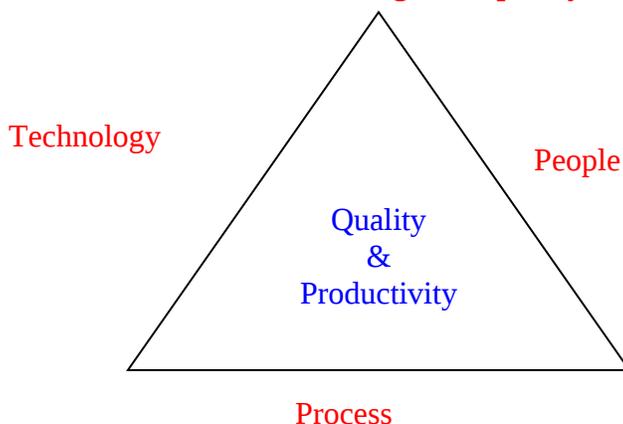
The panel of s/w engineer make a s/w product.

by using **computer language**, **Process model**, **Testing effort**, **Feasibility study**, **Cost estimation**, **Implementaion technique**, **Project Selection**, **DFD**, **Flowchart**, **E-R diagram**.
etc.

Attribute of S/w Quality:-

- ❖ **Functionality.**
 - The capability to provide fuctions which meet stated and implied needs when the s/w is used.
- ❖ **Reliability (Failure free s/w is called reliable s/w).**
 - The capability to maintain a specified level of performance
- ❖ **Usability.**
 - The capability to understand, learned and used.
- ❖ **Efficiency.**
 - The capability to provide appropriate performance relative to the amount of resources used
- ❖ **Maintainability.**
 - The capability to modified for purposes of making corrections, improvements or adaptation.
- ❖ **Portability.**
 - The capability to adapted for different specified environments without applying actions or means other than those provided for this purpose in the product.

The iron triangle for quality of S/w:-



Good technology+Good Process + Good People (Engineer) =Good S/w Product

Phases of System or S/w Development Life Cycle(SDLC):-

- ❖ Preliminary Investigation
 - System Feasibility study
 - Technical feasibility
 - Economical feasibility
 - Operational Feasibility
 - Requirement analysis
- ❖ Design.
- ❖ Coding (C,C++,Java,C#,etc).
- ❖ Testing.
 - Unit testing.
 - Integration testing.
 - White box Testing.
 - Black Box Testing.
 - V & V testing (Verification & Validation).
 - Alpha Testing.
 - Beta Testing.
- ❖ Implementation.
- ❖ Evaluation.
- ❖ Maintenance.

Process Model:- Guaranteed

A process model is a description of a process at the type level. Since the process model is at the type level, a process is an instantiation of it.

The goals of a process model are to be:

A:- Descriptive :-

Track what actually happens during a process

B:- Prescriptive:-

Define the desired processes and how they should/could/might be performed.

C:- Explanatory

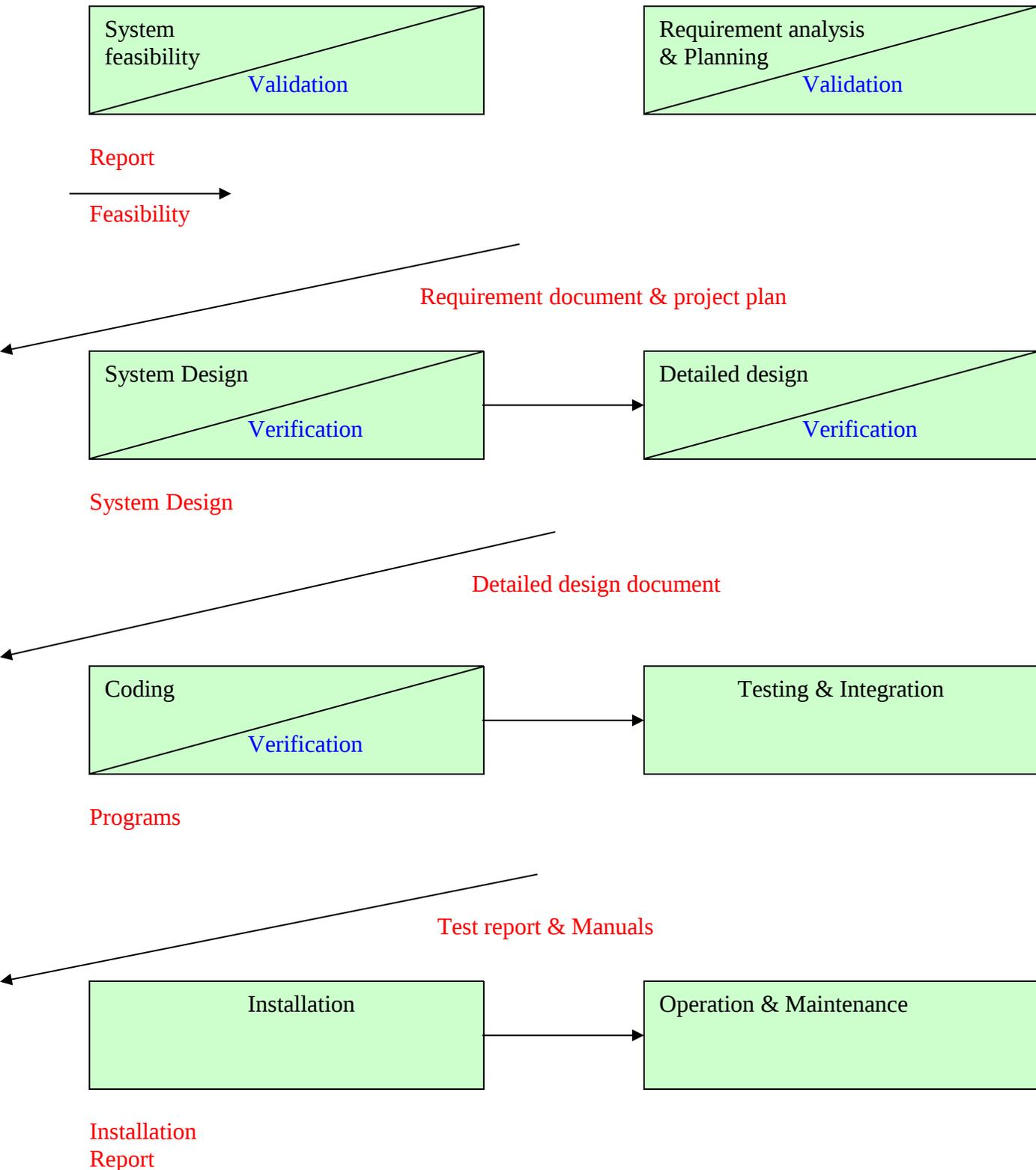
Provide explanations about the rationale of processes.

Various Method of Process Model:-

- ❖ Waterfall Model
- ❖ Prototype Model
- ❖ Iterative Model
- ❖ Spiral Model
- ❖ Win-Win Spiral Model

Waterfall Model:-

The functions of various phases are discussed in following s/w technology.



Prototype Model:-

The goal of prototyping process is to counter the first two limitation of the waterfall model. It is an attractive idea for complicated and large system.

Or

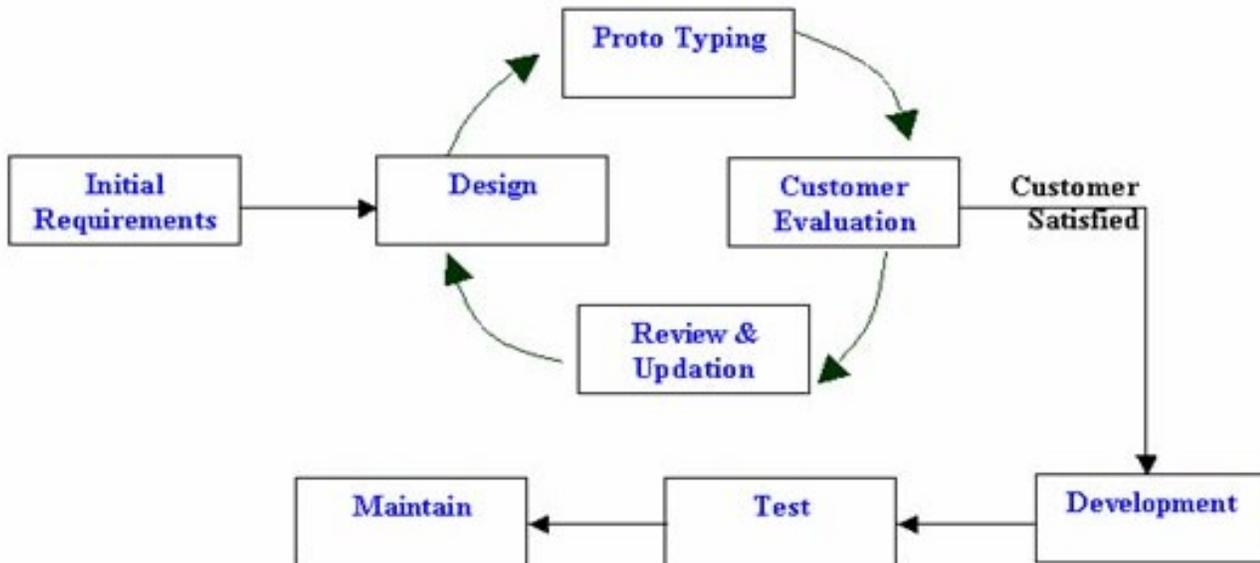
A prototype is an early sample, model, or release of a product built to test a concept or process or to act as a thing to be replicated or learned from. It is a term used in a

variety
programming.

of contexts, including semantics, design, electronics, and software

Software Process Model — Prototyping Process Model

- Client and users can try out prototypes.
- Specifications developed are more likely to be related to needs.



Proto Type Model

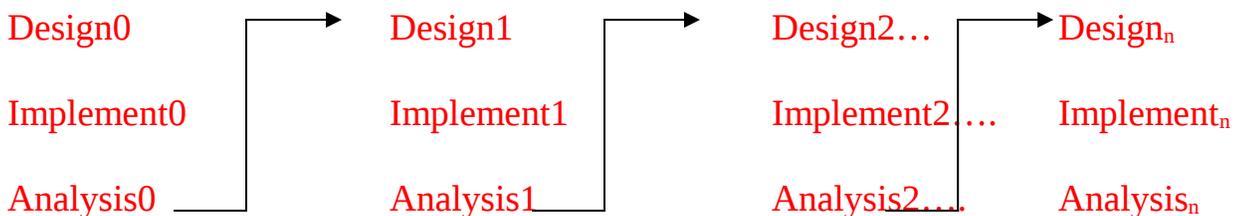
Advantages:-

- Because users have worked with prototype, the feedback paths are less used.
- Some design has already been done in developing the prototype.
- Implementation is based on a partly working model.

Prototyping can be part of requirement analysis or part of the design as well. The model described here is referring to the design prototypes.

Iterative development Model:-

It combines Waterfall model and Prototype model.



Spiral Model:- Most Important

This process model consists of many task of region. These tasks represented in the form of spiral.

Or

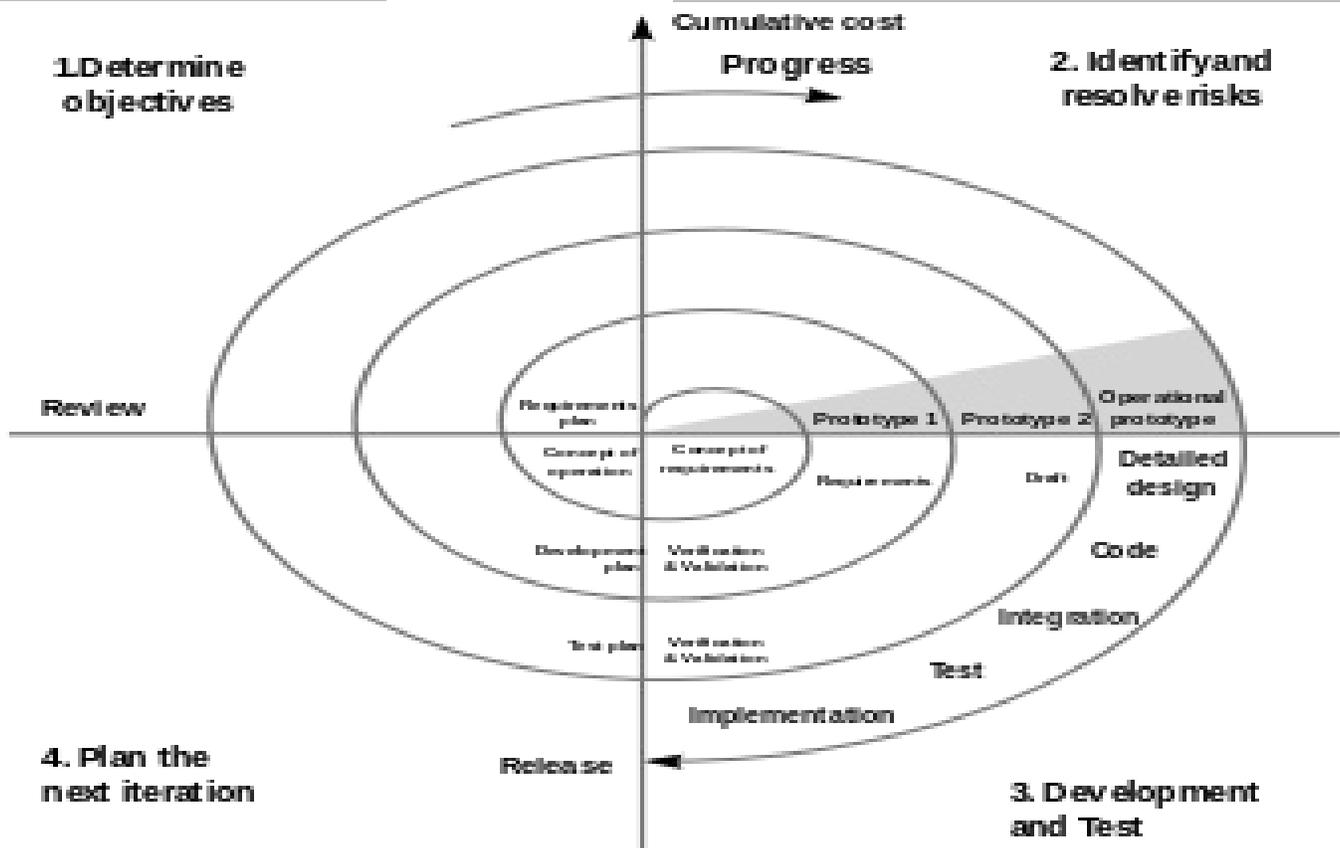
The spiral model is a risk-driven process model generator for software projects. Based on the unique risk patterns of a given project, the spiral model guides a team to adopt elements of one or more process models, such as incremental, waterfall, or

evolutionary prototyping.

- ❖ Determine Objectives.
- ❖ Alternatives.
- ❖ Constraints (Security related situation).
- ❖ Evaluate Alternatives.
- ❖ Identify.
- ❖ Resolve Risk.
- ❖ Development.
- ❖ Verify Test Product.
- ❖ Review Commitment.

Determine, Objective, Alternative, Constraints

Evaluate alternatives, identify, and resolve risks



Review Commitment

Development, Verify, test-level product

Step1:-

Each cycle in spiral, begin with the identification of objectives for that cycle. The different alternatives that are possible for achieving the objectives and constraints that exist.

Step2:-

Next Step in the cycle is to evaluate alternative based objectives and constraints. That is, focus of evaluation and risk preparation for the product.

Step3:-

In this step development & Verification of S/W product may begin. Following activity must be performed.

- ❖ S/W requirements.
- ❖ Requirements Validation.
- ❖ Coding.
- ❖ Testing.
 - Unit testing.
 - Integration testing.
 - Acceptance Testing.
 - Implementation Testing.
- ❖ Design Validation & Verification.

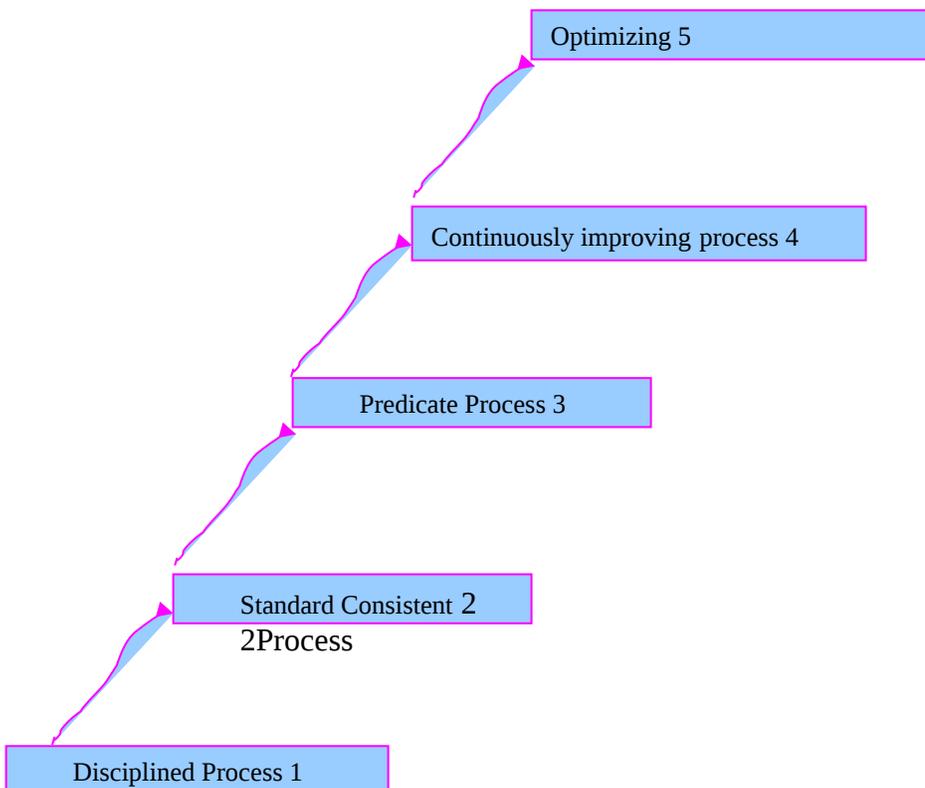
Step4:- This step includes complete development plan & review commitment.

Process Management Processes:-

It includes capability of s/w process. That is process capability of an organization determines what can be expected from the organization in terms of **quality** and **productivity**. There are **five levels** are included in capability process.

- ❖ Disciplined Process
- ❖ Standard Consistent Process
- ❖ Predicate Process
- ❖ Continuously improving process.
- ❖ Optimizing (Achieving the best or minimum input and Maximum Output).

Note:- Our opinion is to implement **ergonomics (Work with discipline)** in process management.

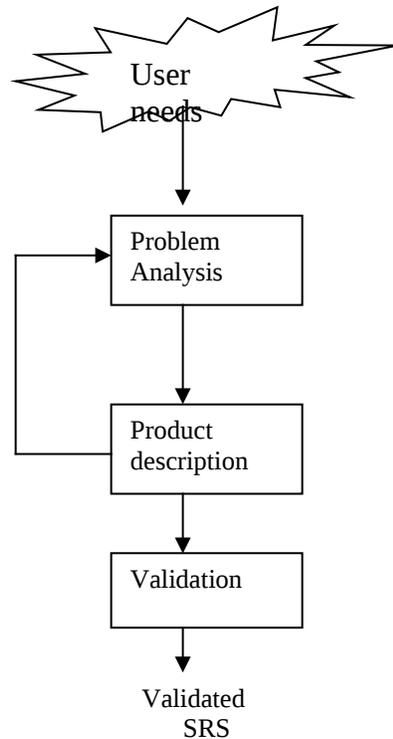


This model is also known as CMM (Capability Maturity Model)

SRS: - (S/W Requirements Analysis & Specification)

An SRS establishes the basis for agreement between the client and the suppliers on what the s/w product will do. It provides a reference for validation of the final product. A highly quality SRS is a prerequisite to high quality s/w.

A high quality SRS reduces the development cost.



Elements of SRS:-

- ❖ Algorithm.
- ❖ Flowchart.
- ❖ DFD.
- ❖ E-R Model.
- ❖ Language Selection.
- ❖ Testing.
- ❖ Bibliography.

Algorithm:- Step by step, problem-solving technique is called algorithm.

Example:-1

$S=a+b$

Step:-1	Start/Begin
Step:-2	Read/Input a,b
Step:-3	Calculate $S=a+b$
Step:-4	Print S
Step:-5	Stop/End

Example:-2

$S_i=p*n*r/100$

Where:-

S_i Simple Interest

p Principal Amount
r Rate of interest
n Time Period

Step:-1 Start/Begin
Step:-2 Read/Input p, n, r
Step:-3 Calculate $S_i = (p * n * r) / 100$
Step:-4 Print S_i
Step:-5 Stop/End

Example:-3 Write algorithm of following formula.

$$A = p * (1 + r/100)^n$$

A Amount
p Principal Amount
r Rate of interest
n Time Period

Step:-1 Start/Begin
Step:-2 Read/Input p, n, r
Step:-3 Calculate $A = p * (1 + r/100)^n$
Step:-4 Print A
Step:-5 Stop/End

Example:-4 Write algorithm for checking year is leap or Not Leap

Step:-1 Start/Begin
Step:-2 Read/Input year
Step:-3 Calculate $y = \text{year} \text{ Mod } 4$
Step:-4 If $y = 0$
Step:-5 Print "Leap Year"
Step:-6 If $y \neq 0$
Step:-7 Print "Not Leap Year"
Step:-8 Stop/End

Characteristics:-

- ❖ Finiteness
- ❖ Definiteness
- ❖ Effectiveness
- ❖ Input
- ❖ Output

Finiteness :- Steps of algorithm must be finite.

Definiteness :- Every step must be defined.

Effectiveness :- Every step must be effective.

Input :- Algorithm must be associated with inputation.

Output :- Algorithm must be associated with output components.

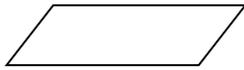
Flowchart:-

The diagrammatical representation of any algorithm is called flow chart.

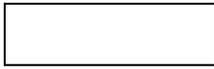
Following symbols are used in flowchart.



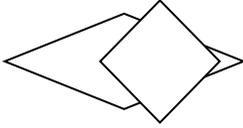
Oval for Start/Stop



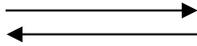
Parallelogram for **input** and **output**



Rectangle for **process**



Diamond for **Decision**

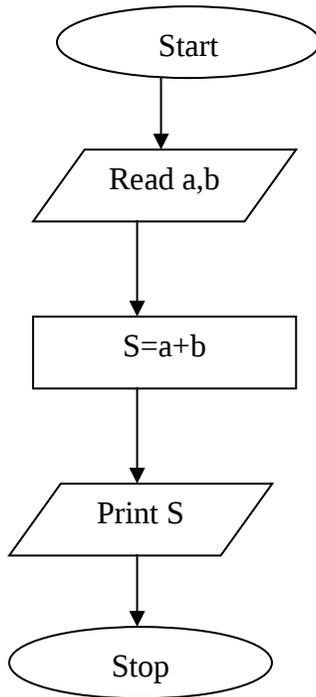


Arrow For **flow direction**

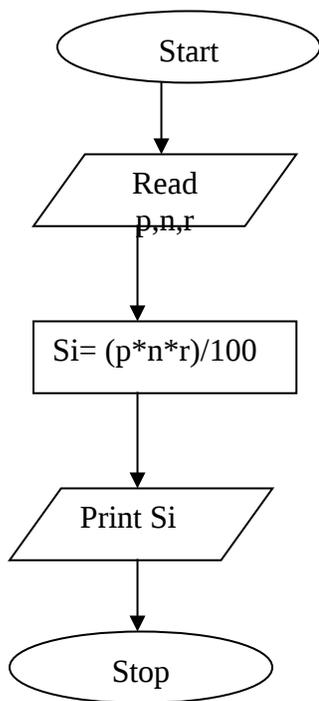


Open Ended Box For **comment**

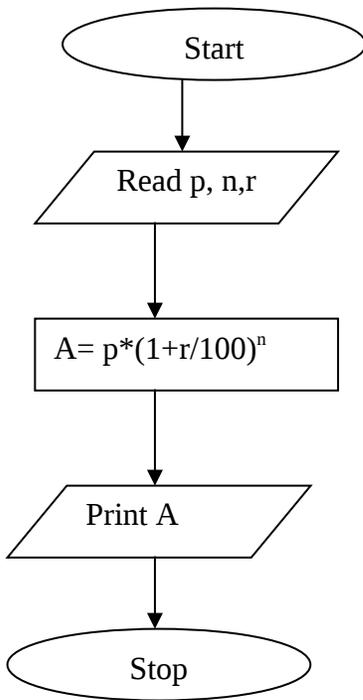
Example:-1 Draw a flow chart for $S=a+b$



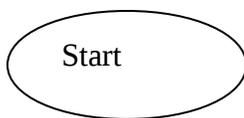
Example:-2 Draw a flow chart for $S_i=(p*n*r)/100$



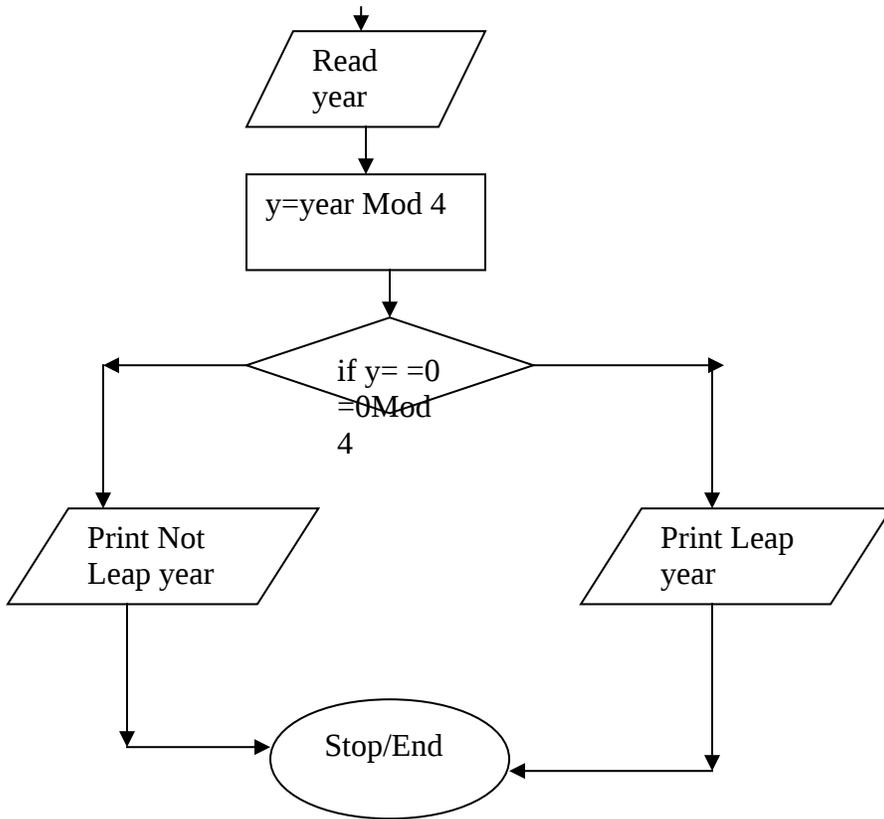
Example:-3 Draw a flow chart for algorithm 3.



Example:-4 Draw a flow chart for algorithm 4



Yes



DFD (Data Flow Diagram):- Most Important

It is used for displaying flow of information in system. This level based on steps.
or

It is used for displaying mechanism of information flow in system.

That is,

DFD-0

DFD-1

DFD-2

DFD-3

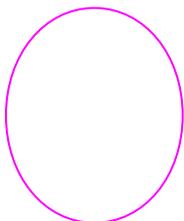
DFD-4

DFD-5

Symbols used in DFD:-



Input/Output



Process of data



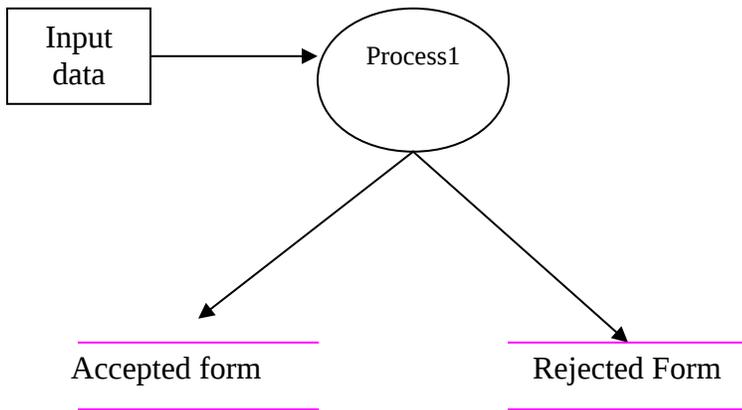
Flow direction



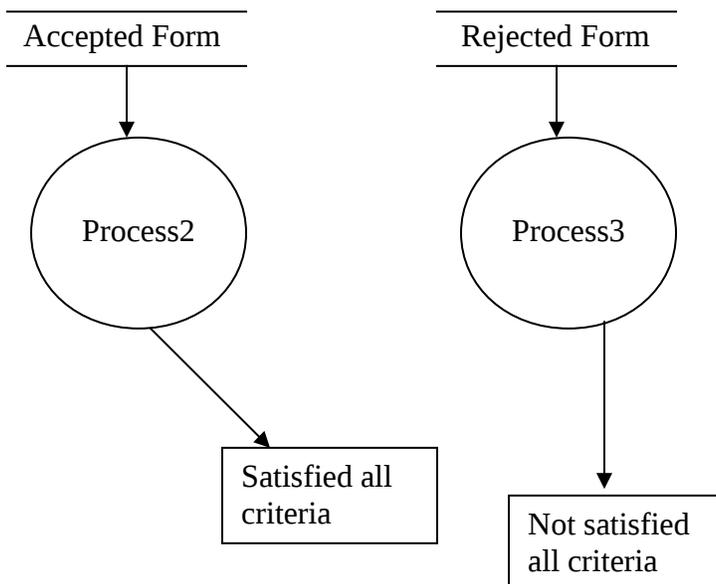
Data Storage

Example of DFD on Line admission System:-

DFD-0 level



DFD-1 level



E-R Model:-

E-R Model (Entity –Relationship):-

Entity:-

It is an object, which is **distinguishable** from other object.

Example:-

Enrollment=02181050001.

SB A/c number=234567.

Passport Number=AB968754.

Entity Set:-

Collection of entity is called entity set.

- Employee table.
- Students Records table.

Relationship (Mapping):-

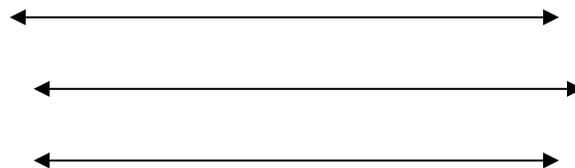
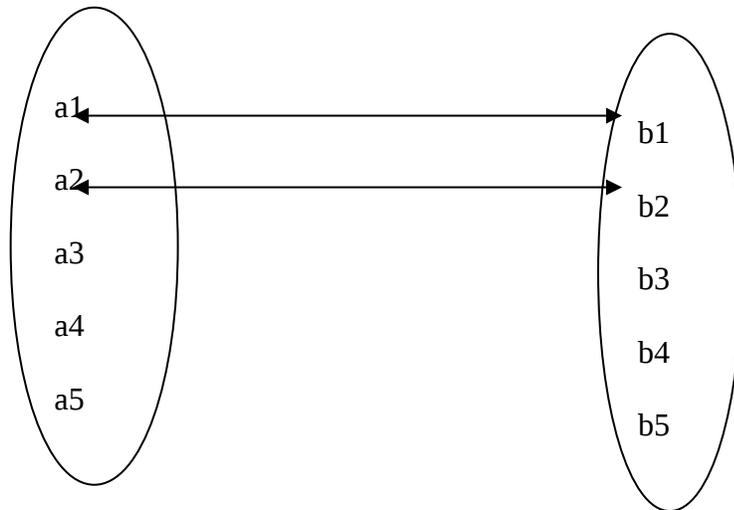
Relations between attributes of two entity sets is called mapping.

There are following types of relationships.

- 1:- 1:1(One: One) Mapping.
- 2:- 1: M (One: Many) Mapping.
- 3:- M: N (Many: Many) Mapping.

Example:-

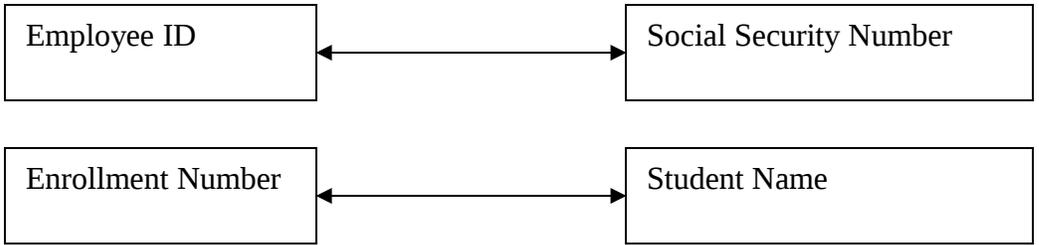
1:1(One: One) Mapping.



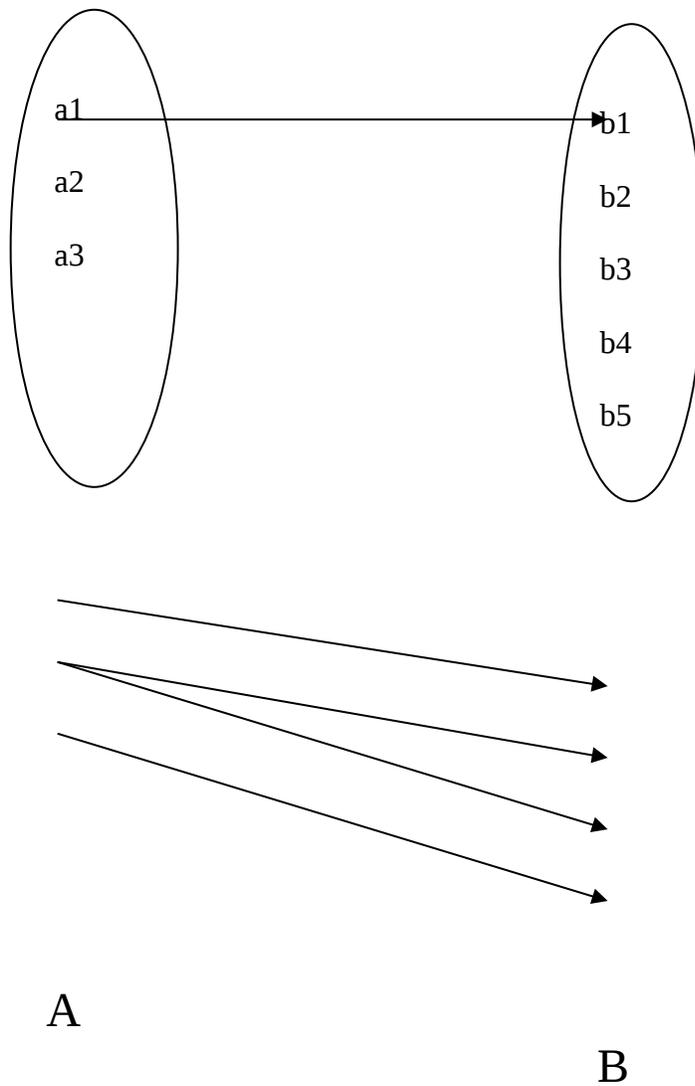
A

B

- Relationship between **enrollment** number and **student**.
- Relationship between **Passport number** and **person**.



Example:-
1: M (One: Many) Mapping.

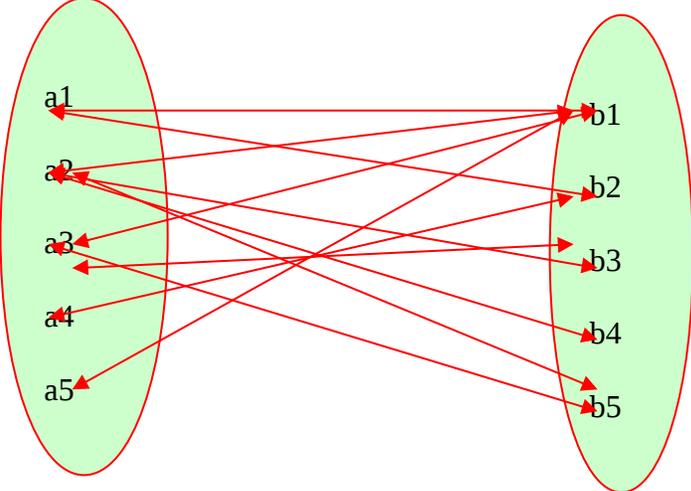


Relationship between Manager and Employee.



Example:-

M: N (Many: Many) Mapping



A

B



Types of Entity:-

- ❖ Strong Entity
- ❖ Weak Entity

Strong Entity:-

An entity object which gives almost maximum related attributes information is called strong entity.

Example:-

- Passport Number.
- SSN (Social security Number).
- UID(Unique Identification number)

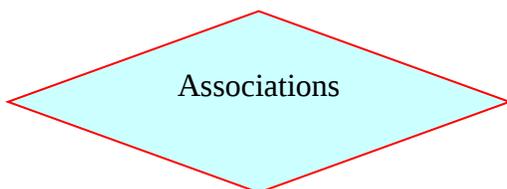
Weak Entity:-

An entity object which gives minimum related attributes information is called weak entity.

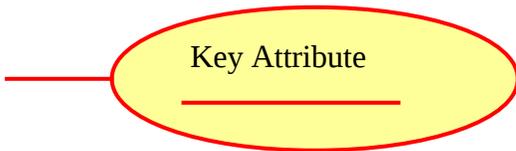
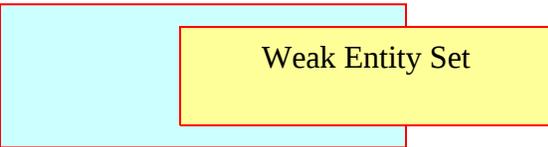
Example:-

- Voter Id.
- Deptno.

Symbols Used In E-R Model:-

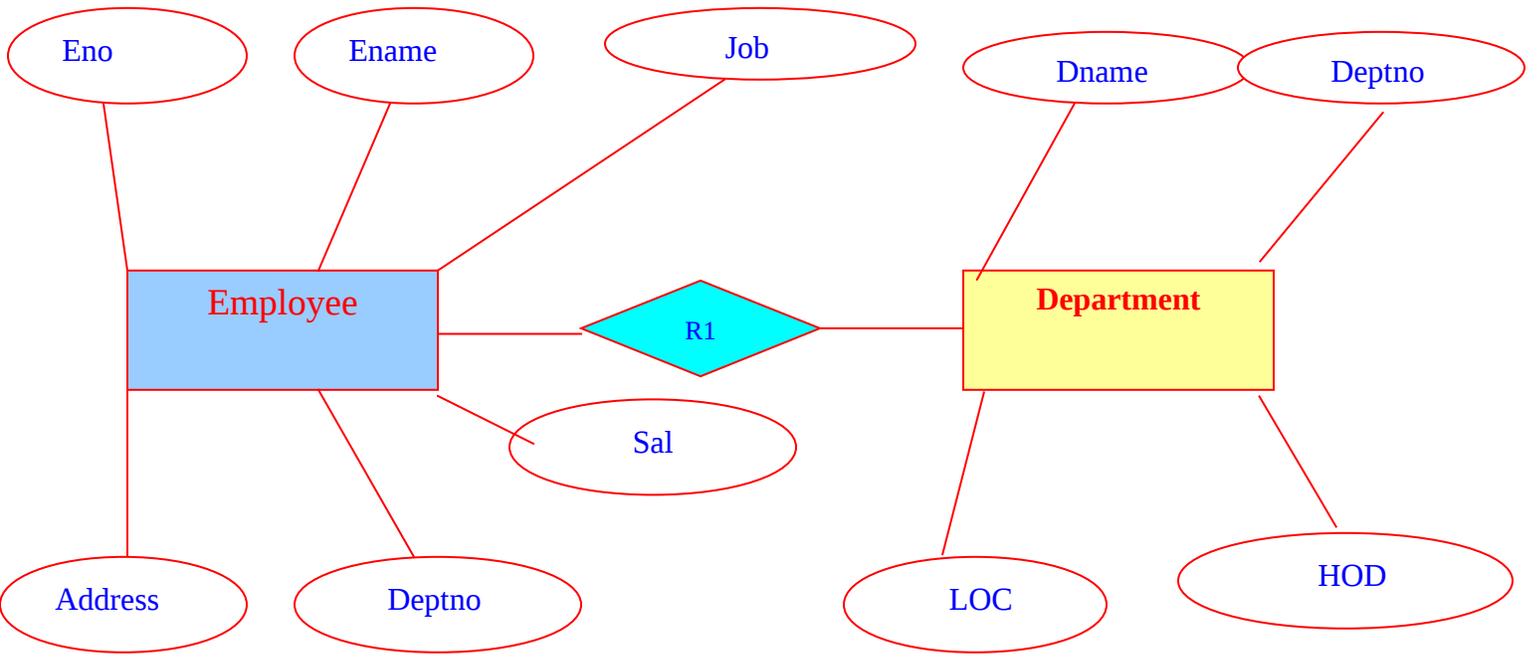


Link

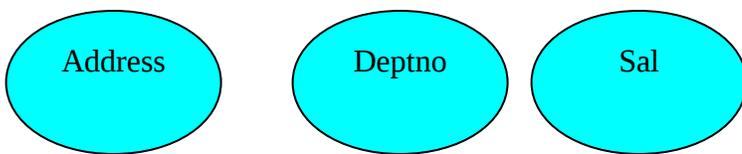
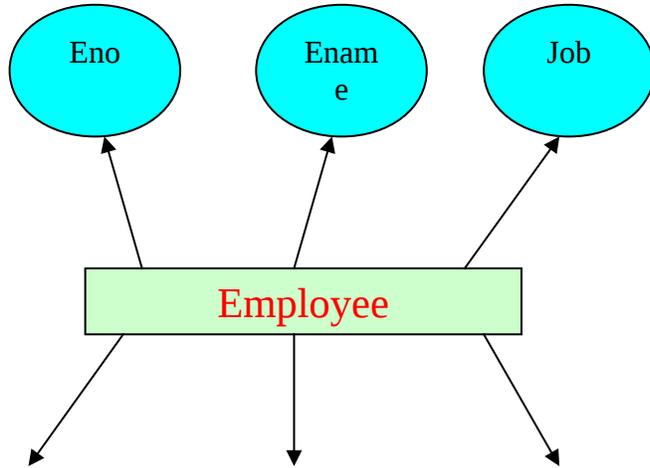


Example of E-R Model:-

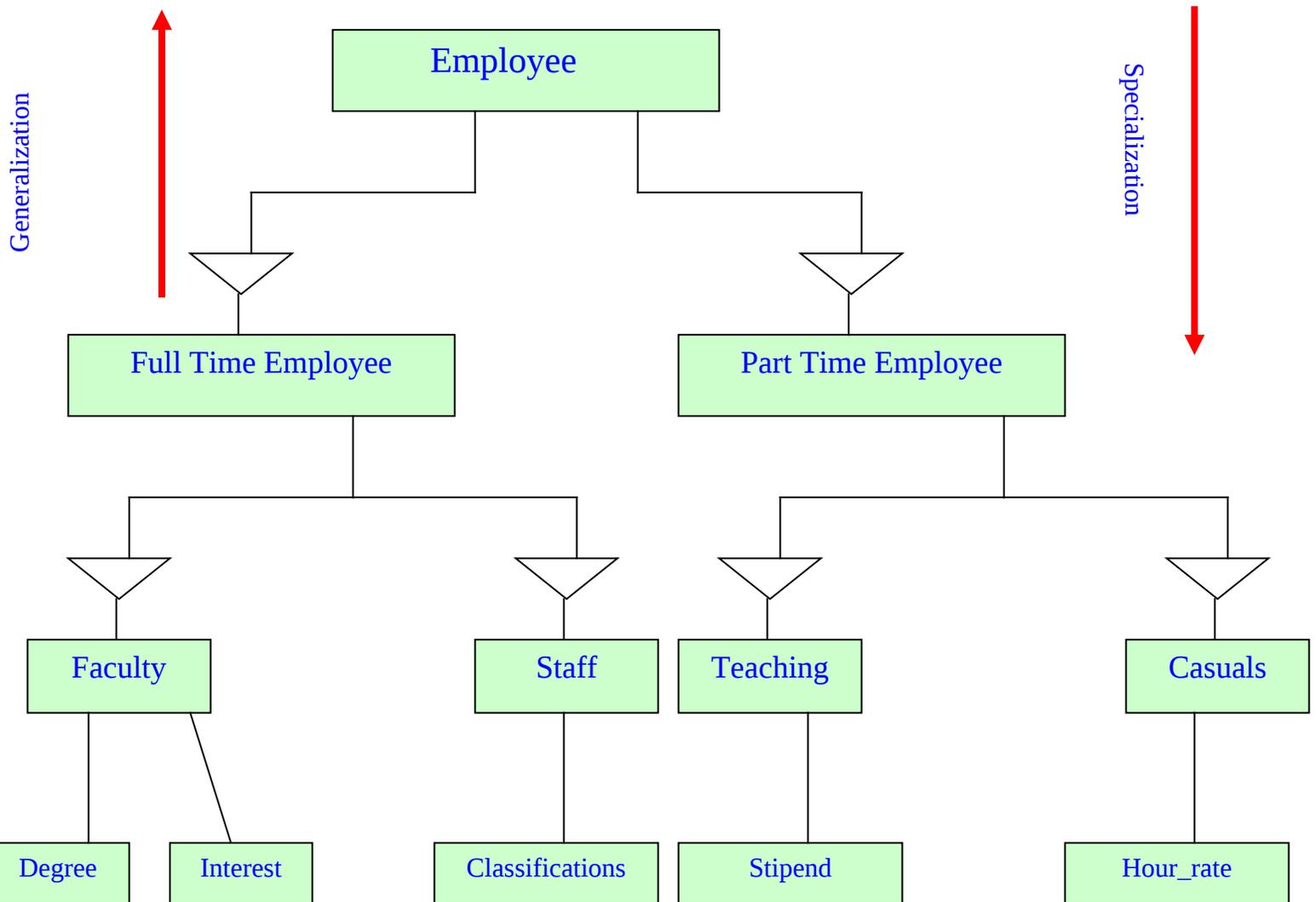
Employee- Department



Concept of Aggregation:-



Concept of Generalization & Specilization:-



Language Selection:-

Computer languages are categorized into two types

1. **LLL**(Low Level Language)
 - ❖ Machine language(0 and 1)
 - ❖ Assembly Language(**Symbols**, **codes** are used instead of 0 and 1)
2. **HLL**(High Level Language)

Natural English like language.

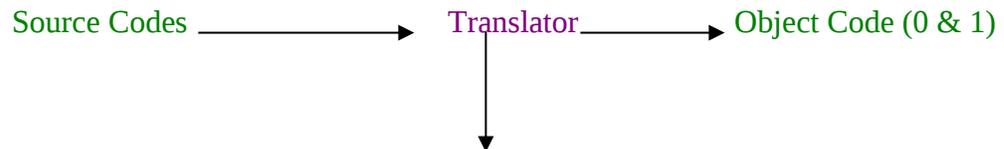
Example:-

C, C++, JAVA, C#, COBOL, PASCAL, FORTRAN, BASIC, LISP, PROLOG, BETA, SMALL TALK, PYTHON, FORTRAN Etc.

TRANSLATOR:-

It is used for converting **source (Program)** code into **object codes** (Machine Codes). There are following three types of translator.

- ❖ **Assembler** (Only for **Assembly** language).
- ❖ **Interpreter** (Only for **BASIC** Language).
- ❖ **Compiler** (All **HLL** except Basic).



No any syntactical error (bug) in source code

Debug :- To remove error from source codes.

Testing:- **Most Important & Full Question**

Once source code has been generated. Software must be tested to uncover (and correct) as many errors as possible before delivery to your customer. Following steps are used in testing of s/w.

1. Internal program logic exercised using **“White Box testing.”**
2. Software requirements are exercised using **“Black Box testing.”**
3. **V&V Testing. (Verification And Validation).**
4. Alpha testing (Developer Site Program testing).
5. Beta Testing (User Site s/w testing).
6. Special Testing.

White Box testing (Module testing):-

It is also known as **glass box testing** Using this methods of testing the s/w engineer can derive test cases.

Case 1:- Guarantee that all independent path in **module**.

Case 2:- Exercise all logical decisions on their true and false side.

Case 3:- Execute all loops at their boundaries.

Case 4:- Exercise Internal data structure.

Black Box testing (System testing):-

It is also known as **behavioural** testing, focuses on the functional requirements of the s/w. It arises following questions.

- ❖ How is functional validity test?
- ❖ How is system behaviour and performance tested?
- ❖ What classes of input will make good test case ?
- ❖ How are the boundaries of a data class isolated?

V&V Testing. (Verification And Validation):- Most Important

Verification :- “Are we building the product right?”

Validation :- “Are we building the right product?”

Special System Tests:-

There are other six tests which fall under special category.

- **Peak Load Test:-** It determines whether the system will handle the volume of activities that occur when the system is at peak of its processing demand.
- **Storage testing:-**It determines the capacity of the system to store transaction data on a disk or in other files.
- **Performance Time testing:-**It determines the length of time system used by the system to process transaction data.
- **Recovery testing:-**This testing determines the ability of user to recover data or restart system after failure.
- **Procedure testing:-**It determines the clarity of documentation on operation and use of system having users to do exactly what manual request.
- **Human Factor testing:-**It determines how users will use the system when processing data or preparing reports.

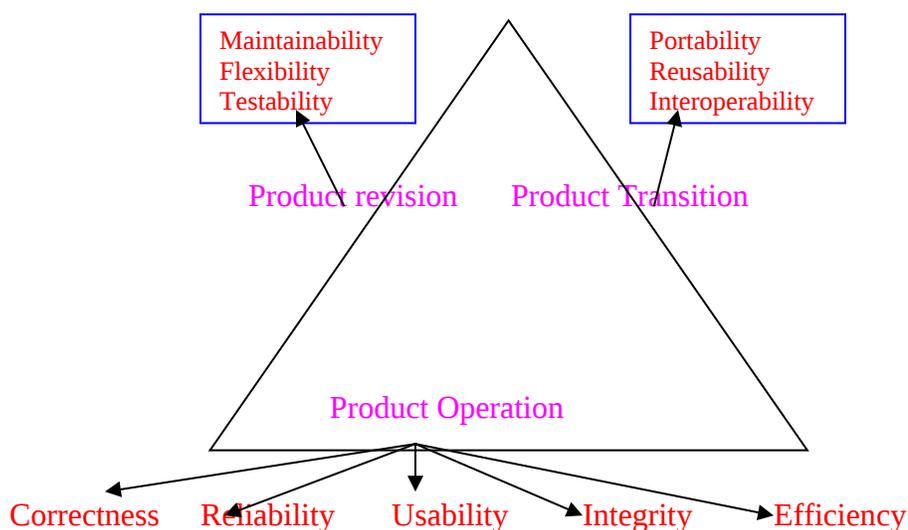
BIBLIOGRAPHY

A list of the books referred to in a scholarly work, typically printed as an appendix.

- 1) The C++ COMPLETE of G.S. BALUJA of Khanna Publications.
- 2) The C++ PROGRAM DESIGN of DIETEL & DIETEL.
- 3) The TURBO C++ of ROBERT LAFORE.
- 4) The KR Venugopal, Rajkumar & T Ravishankar.

McCall's Quality Factors Or SQA(S/w Quality Assurance):- Most Important
It includes following descriptions:-

- ❖ Correctness
- ❖ Reliability
- ❖ Efficiency
- ❖ Integrity
- ❖ Usability.
- ❖ Maintainability.
- ❖ Flexibility.
- ❖ Testability.
- ❖ Portability.
- ❖ Reusability.
- ❖ Applications.
- ❖ Interoperability.



- Correctness:-** It satisfies its specifications and fulfills the customers missions objective.
- Reliability:-** It satisfies failure free operations.
- Efficiency:-** The amount of computing resources and code required by a program to perform its functions.
- Integrity:-** Data by unauthorized persons can be controlled.
- Usability:-** Effort required to learn, operate, prepare, input and interpret output of a program.
- Maintainability:-**Effort requires to locate and fix an error in a program.
- Flexibility:-** Effort required to modify an operational program.
- Testability:-** Effort required to test a program.
- Portability:-** Effort required to transfer the program from one h/w to another H/w.
- Reusability:-** Extent to which a program can be reused in other applications.
- Interoperability:-** Effort required to complete one system to another.

Most Important:-

How to Measurement of software Reliability & Availability:-

Measurement of Reliability

A simple measure of reliability is mean time between failures (MTBF).

$$MTBF=MTTF+MTTR.$$

MTTF is Mean time to Failure.

MTTR is Mean Time to Repair.

Measurement of Availability:-

It is defined as

$$Availability= [MTTF/(MTTF+MTTR)]*100\%$$

Quality Standards:-

A quality assurance may be defined as the organizational structure, responsibilities, procedures, processes and resource for implementing quality management. Some of the standards are given below.

❖ **ISO 9001**

It is a set of guidelines such as

- o Responsibility
- o Design Control
- o Inspection
- o Traceability
- o Product Identification
- o Contract review
- o Document & data Control
- o Statistical technique
- o Process Control

Project Estimation Model:- Most Important Model

It is an estimation model for s/w users empirically derived formula to predict effort as function of LOC(Line of Code).

Estimation is defined as

$$E=A+B*(ev)^c$$

Where :-

A, B and C are derived constant.

E → is effort in Person-months

ev → is estimation Variable

LOC oriented Estimation Model:-

- o $E=5.2*(KLOC)^{0.91}$ Walston- Felix model.
- o $E=5.5+.73*(KLOC)^{1.16}$ Bailey –Basili Model.
- o $E=3.2*(KLOC)^{1.05}$ Bohem Simple Model.
- o $E=5.288*(KLOC)^{1.047}$ Doty Model.

FP oriented Estimation Model:-

- ❖ $E=-13.39 +0.0545 FP \rightarrow$ Albrecht & Gaffiny Model.
- ❖ $E=60.62 +7.728*10^{-8} FP^3 \rightarrow$ Kemerer Model.
- ❖ $E=585.7+15.12FP \rightarrow$ Matson,Barnet and Mellichamp Model.

COCOMO Model:-

It is referred to as **Constructive Cost Model**. It is a hierarchy of estimation models that address the following areas.

1. Application Composition Model.
2. Early Design Stage Model.
3. Post architecture Model.

Application Composition Model:-

It is used the early stages of s/w engineering when prototyping of user interfaces. Assessment of performance, Evaluation of technology.

Early Design Stage Model:-

In this hierarchy s/w architecture has been established.

Post architecture Model:-

It is used during the construction of the s/w.

Effort can derived as :-

Estimated effort=NOP/PROD

$NOP=(Object\ Points)*[(100-\%reuse)/100]$

NOP=New Object Points

Estimation Model of the s/w in the form of:-

$E= [LOC*B^{0.333}/p]^3*(1/t^4)$

Where:-

E= Effort Person Months

t=Project Duration in months or Year

B=Special Skill factor

P=Productivity parameter

Complexity Weight:-

Simple	1
Medium	2
Difficult	3

Putnam's Model:-

It is defined as

$P=Kt \exp (t^2/2T^2)/ T^2$

P=Number of persons on the project at time 't'

K=Total life cycle effort (Area under Raleigh curve).

T=Development time.

Raleigh curve is used to derive an equation that relates lines of codes delivered to parameters like development time. It is defined as

$$S = C_K K^{1/3} T^{4/3}$$

S=Number of delivered lines of source code (LOC).

C_K=State of technology constraints.

K=life cycle effort in man years.

T=Development time.

The following equation shows the relationship of project effort as a function of project delivery time.

$$E_a = m \left(\frac{t_d^4}{t_a^4} \right)$$

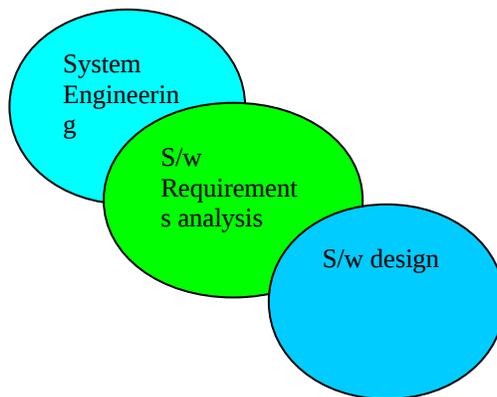
Where

- E_a=Effort in person months.
- T_a =The nominal delivery time for the schedule.
- T_d =Actual delivery time desired.

Analysis Concept and Principles:-

Analysis Concept:-

Analysis as a bridge between system engineering and s/w design.



Analysis Principles:-

It is a set of operational principles.

- ❖ The information domain of a problem must be represented and understood
- ❖ The function that the s/w is to perform must be defined
- ❖ The behaviour of the s/w must be represented
- ❖ The models that depict information, function and behaviour must be partitioned in a manner that uncover details in a layered forms
- ❖ The analysis process should move from essential information towards implementation detail.

The Elements of Analysis Model:-

The analysis model must achieve three primary objectives.

- ❖ To Describe What the customer Requires.
- ❖ To Establish a basis for the creation of s/w.
- ❖ Define a set of requirements.

Structure of Analysis Model:-

Data Modeling for System :-

A set of specific questions those are relevant to any data processing applications. Data Modeling method make use of the entity relationship diagram(ERD).

Data Object:-

It is a representation of almost any composite information that must be understood by s/w.data object must be associated with attributes.

Person object \longrightarrow Attributes:-

Name
Address
Age

Relationship:-

1:1 Mapping
1 to M Mapping
M To N Mapping

Data Object, Attributes and relationship:-

Example:-

Person object \longrightarrow Attributes:-

Name
Address
Age
DL
Own Car

\downarrow
Model
ID Number
Body Type
Color

Concept of Cardinality and Modality:-

Cardinality:-

The data model must be capable of representing the number of occurrence objects in a given relationship. as a pair of followings:-

Object	A	:	B	
	1	:	1	Mapping.
	1	:	M	Mapping.
	M	:	N	Mapping.

For 1:1 mapping:-

Object A occurs relate to Only one Of Object B.
Object B occurs relate to Only one Of Object A.

For 1:M mapping:-

Object A occurs relate to One or Many Occurrence of B.
Object B occurs relate to Only one Of Object A.

For M:N mapping:-

Object A occurs relate to One or Many Occurrence of B.
Object B occurs relate to One or Many Occurrence of A.

Modality:-

The modality of a relationship is **0** if there is no explicit need for the relationship to occur or the relationship is **optional**.

The modality of a relationship is **1** if an occurrence of the relationship is **mandatory**

Design Concept And Principle of S/w:- (Page No 337)

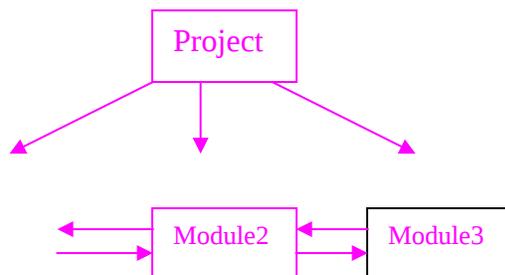
Design model of system includes following steps.

- 1 Component Level design
 - 1.1 Relate to Control Specification
 - 1.2 Relate to State transition diagram
 - 1.3 Relate to Process Specification
- 2 Interface design
 - 2.1 Relate to State Transition diagram.
 - 2.2 Relate to DFD(Data Flow Diagram).
- 3 Architectural design
 - 3.1 Relate to DFD
- 4 Data design
 - 4.1 Relate To Data Dictionary
 - 4.2 Relate To ERD(Entity relationship Diagram)

Design Process:- Most Important

- ❖ The design must implement all the explicit requirements contained in the analysis model.
- ❖ The design must be readable, understandable.
- ❖ Design should provide a complete picture of the s/w.
There are two ways for design process of system.

A:- Modular design Model of System:-



M

Modular design of system must be associated with **high cohesion** and **Low coupling**

Cohesion:-

It is a qualitative indication of the degree to which a module focuses on just one thing.

It may be represented as **spectrum**. There are many relations occurs **inside modules**

Types of Cohesion:-

- ❖ **Coincidental Cohesion:-** Perform unrelated task.
- ❖ **Logical Cohesion:-** Perform a series of action.
- ❖ **Procedural Cohesion:-** Modules perform a series of steps.
- ❖ **Communicational Cohesion:-** All elements in a module are executed on the same data set and produces same output data set.
- ❖ **Sequential Cohesion:-** It operates on same data structure.
- ❖ **Functional Cohesion:-** Modules contain elements that perform exactly one function

Coupling:-

It is a measure of **interconnection among modules** in a s/w structure. It depends on interface complexity between modules.

Types of Coupling:-

- ❖ **Data Coupling** :- It interact through parameter.
- ❖ **Stamp Coupling** :- It shares composite data structure .
- ❖ **Control Coupling** :- One module control logic flow of another module.
- ❖ **External Coupling** :- It shares external data format.
- ❖ **Common coupling** :- Module shares the same global data
- ❖ **Content Coupling** :- One module modifies the data of another module.

Note:- One module interacts with another module to perform certain well defined task.

B:- Object Oriented Design Model of System:-

This Model must be support following four properties.

- ❖ Polymorphism(P)
- ❖ Inheritance(I)
- ❖ Encapsulation(E)
- ❖ Abstraction

Polymorphism:-

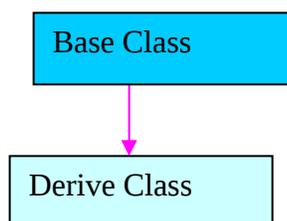
A single function may perform various types of tasks depending upon arguments.

Example:-

Draw (line)	
Draw (Circle)	
Draw(Rectangle)	
Draw(oval)	

Inheritance:-

It means reusability. That is property of base class is going to access by its derive class.



Encapsulation:-

It is an abstraction process of **binding** and **hiding** properties.

Abstraction:- It is representation of essential features of a system without involving the complexity of system.

Concepts of Class & Objects:-

Class:-

It is combination of **data member (Attributes)** and **member functions (Behaviors)**. It has no physical existence.

Example:-

Class person
Class Animal
Class Vehicle
Class Vegatable
Class Students
Etc.

Object:-

It is an instance of class is called object.

Example:-

Vishal is an object of class person.
Monkey is an object of class animal.

Format of class Declaration:-

```
class <class_Name>
{
private :
    Data_members;
    Member_functions;
public:
    Data_members;
    Member_functions;
protected:
    Data_members;
    Member_functions;
};
```

Where :-

Private, public and protected are called **visibility mode**.

Function/Tasks of Object Oriented Modeling:-

- ✓ Basic user requirements must be communicated between the customers and methods are defined.
- ✓ Classes must be identified.
- ✓ A class hierarchy must be specified.
- ✓ Object to object relationships should be represented.
- ✓ Object behavior must be modeled.
- ✓ Task 1 to 5 are reapplied iteratively until the model is complete.

MIS (Management Information System):-

It constitutes following elements.

- ✓ **Planning:-** It call for a lot of environmental information like shifting markets, changing technology as well as internal information like core competitive strength of

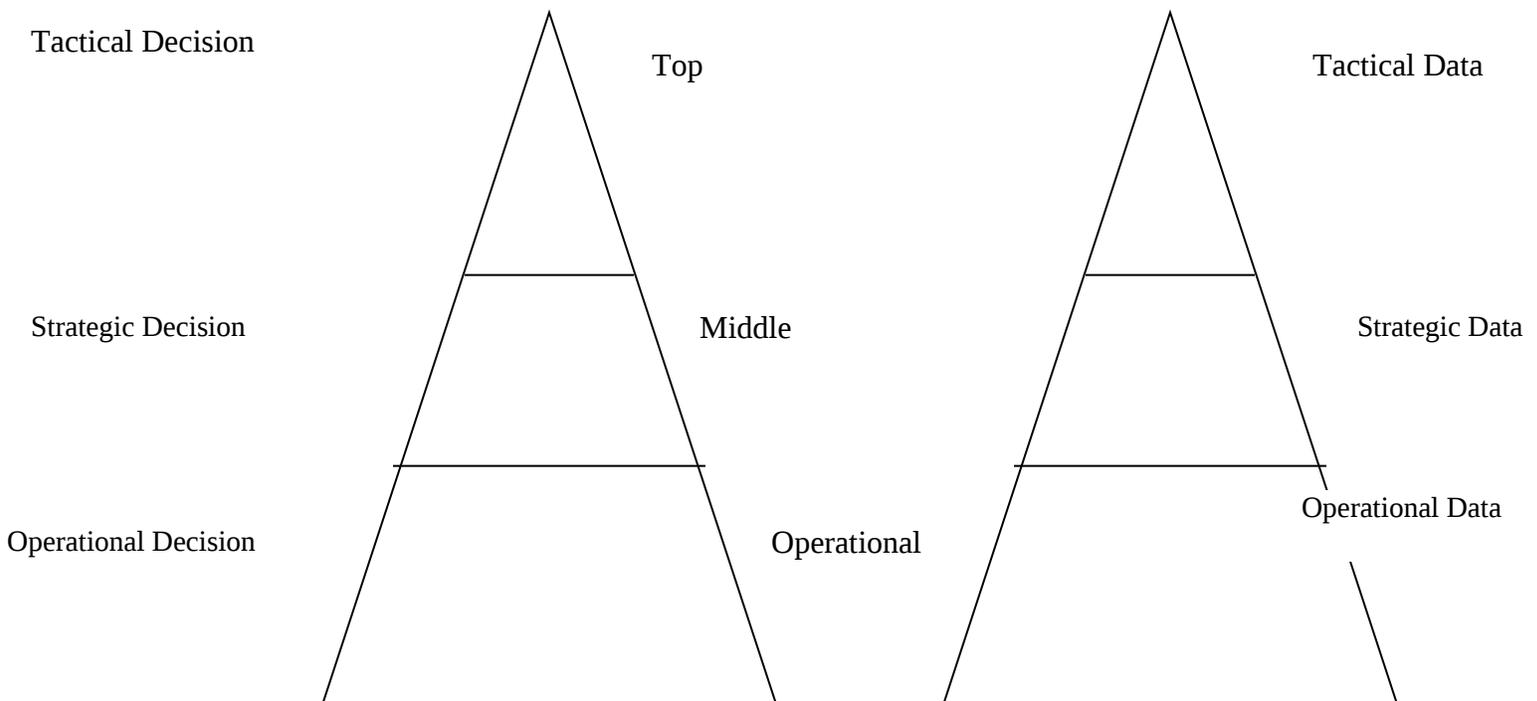
organization.Operatinal planning staff scheduling would need a lot amount of internal information like schedules,attendenc etc.

- ✓ **Organizing:**-In this stage we will organize gathering of planning informations.We will also provide training information for staffs.
- ✓ **Coordinating:**-Coordination would call for industry wide data corresponding to technology availability.
- ✓ **Directing:**-Organization provides directions for successful running works.
- ✓ **Control:**-It provides total quality management that produce better performance.

Implementation of Successful MIS:-

Organization, Information and Decision:-

Successful development of information system call for a deep understanding of the organizational structure and dynamics of enterprise. Any successful information system should take into account such as a pattern of information needs by the management. It is pictorially displayed in the form of management Vs Information Pyramid.



Typical MIS System:-

	Production	Finance	Personal	Marketing
Strategic	<u>New Plant location</u>	<u>Alternative financing</u>	<u>Welfare policy</u>	<u>Competitor survey</u>
Tactical	<u>Production Bottleneck</u>	<u>Variance analysis</u>	<u>Performance appraisal</u>	<u>Advertising</u>
Operational	<u>Daily scheduling</u>	<u>Payroll</u>	<u>Leave records</u>	<u>Sales analysis</u>

Software Crisis:-

S/w crisis can be broadly classified in the following major areas.

- ❖ **From Programmer's Point of View**
 - o Problem of portability.
 - o Problem in documentation.
 - o Problem of piracy.
 - o Problem of maintenance in proper manner.
 - o Problem of compatibility.
- ❖ **From User's Point of View**
 - o Problem of virus.
 - o Problem of s/w bugs.
 - o Problem of different version of s/w.
 - o Security problem for protected data in s/w.

Role of System Analyst:-

1. Define problem.
2. How to solve problem.
3. Gathering the related data.
4. System analysts coordinate the process of development model.
5. Analyst must have good planning idea.
6. Reasonable design of system, which must be achieved by management.
7. System must be thoroughly tested.

Attribute of System Analyst:-

- ❖ Knowledge of people.
- ❖ Knowledge of business function.
- ❖ Good analytical mind.
- ❖ Well educated(MCA/MSc(CS)/Btech(CS)/MTech(CS))

Project Planning & Control:-Imp

The **planning, design and installation of a system is called project.** It is directed by project leader.

Following four steps for project planning.

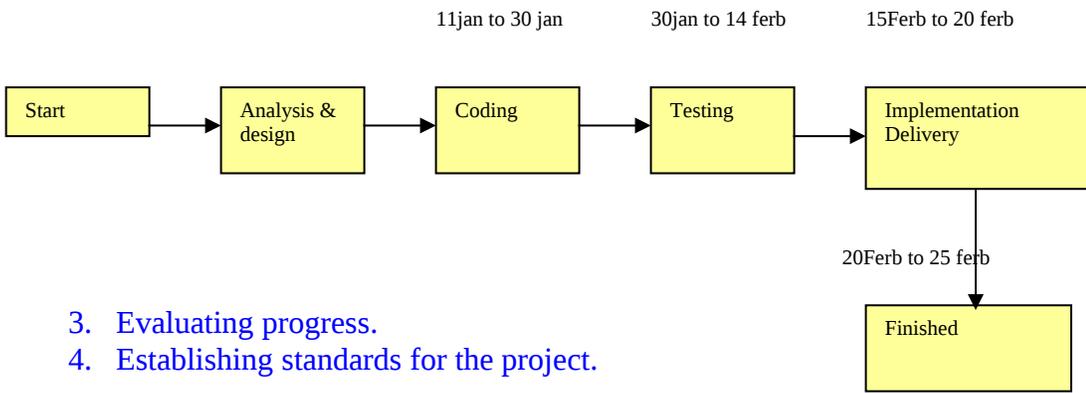
1. Organizing the resources available for project.
 - a. Need of Suitable H/w and S/w
 - b. Language expert's People
 - c. Database designers
 - d. Predesigned document
2. Scheduling the event in the project.

It is charting technique of project.

 - a:-PERT Chart(Project Evaluation And review technique)
 - b:-Gant Chart (Bar Chart)

Example :-

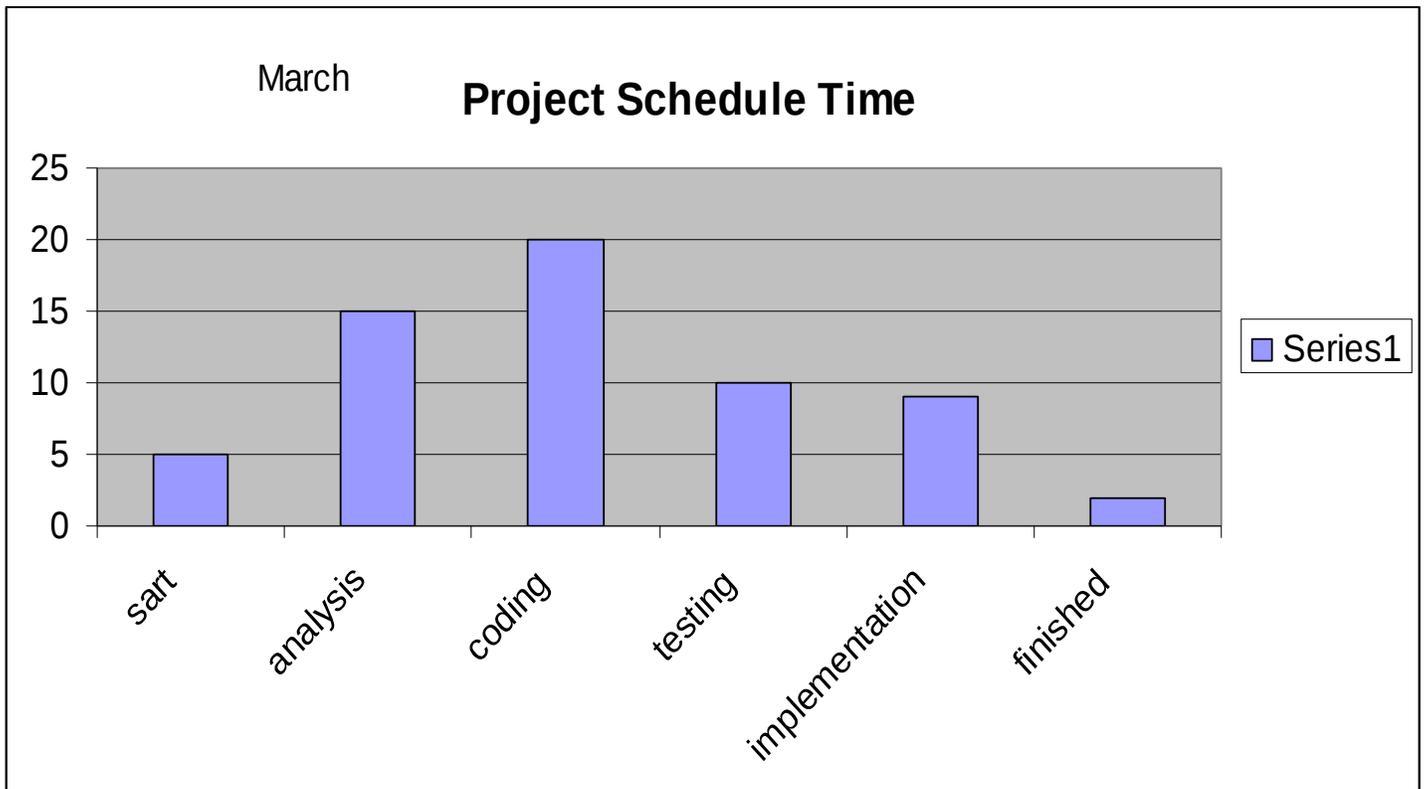
PERT Chart (Project Evaluation and review technique)



- 3. Evaluating progress.
- 4. Establishing standards for the project.

Example:-

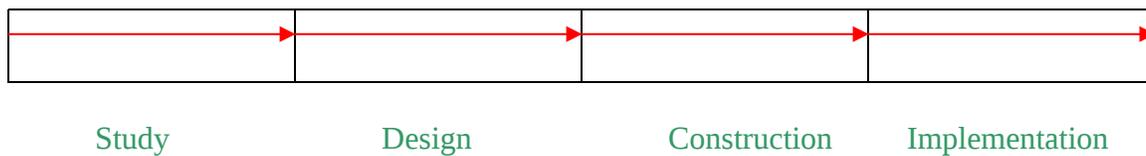
GANT Chart



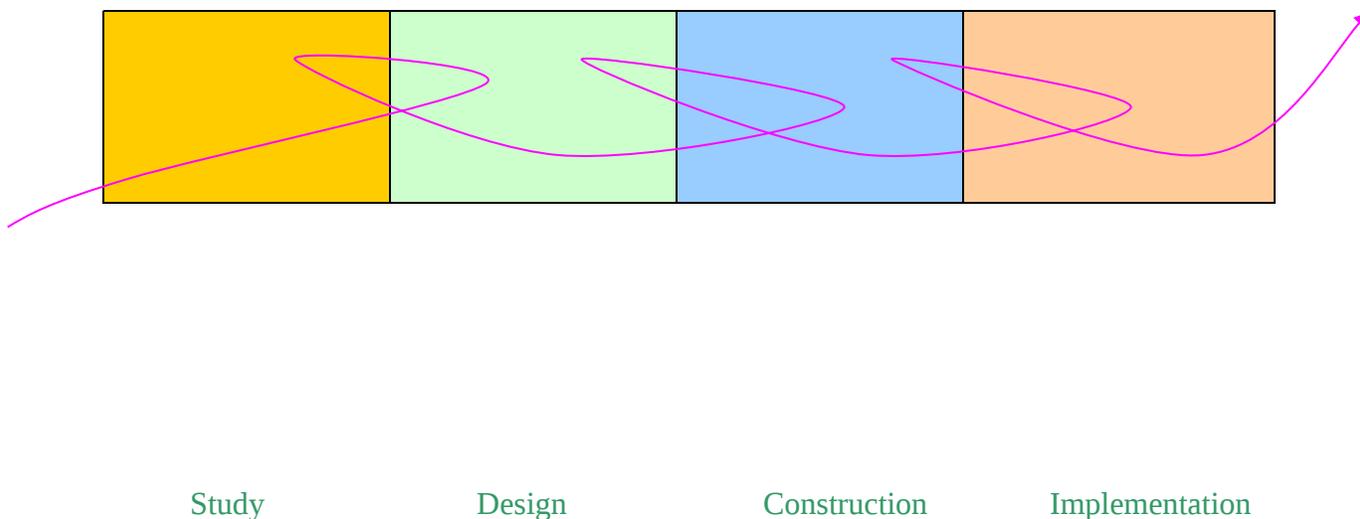
3:-Evaluation Progress:-

- Ideal Project Progress
- Reality Of Project progress

Ideal Project Progress:-



Reality of Project Progress:-



Establishing standards for the project:-

- ❖ Review project progress.
- ❖ Analyze the impact of delays on the entire project
- ❖ Examine any problems existing in the quality of data.
- ❖ S/w Must be satisfied **MC Call theory**(For SQA).
- ❖ Measurement of **Reliability & Availability**.
- ❖ Satisfy **ISO 9001** Quality sets.

Benchmark testing:-

It is a simple program specially designed to evaluate the performance of different computers and their s/w. This is necessary because computers will not generally use the same instructions, words of memory or machine to solve particular problems.

Note:- Benchmark testing does not affect standards of the project. It optimizes (achieving the best) the solution of the proposed project.

Quality Concept (MC Call Theory +V &V):-

Principle of S/w Engineering:-

- ✓ High Quality s/w is possible.
- ✓ Give Products To Customers early
- ✓ Determine The Problem Before Writing The Requirements.
- ✓ Evaluate design Alternatives.
- ✓ Use an appropriate process Model.
- ✓ Good management is More Important than good technology.
- ✓ People is the key of success.
- ✓ Follow with care.
- ✓ Take responsibility.

4GL:- (Fourth Generation Language):-

It is also known as **Very high level language**. Following basic types of language tools fall into this category.

- ✓ Query (Questionnaires on database) Language.
- ✓ Report Generator.
- ✓ Application Generators.
- ✓ Decision Support System & Financial Planning.
- ✓ Some Microcomputer application S/w.

Example:-

- ✓ Oracle.
- ✓ Sql Server.
- ✓ Foxpro.
- ✓ LINC.

Emp (empno, ename, job, sal, deptno, address) → Table

1:- To display all employee records.

Sql>Select * from emp;

2:- To display empno, ename and job only.

Select empno, ename, job from emp;

3:- To display employee records who is found salary more than 10000.

Select empno, ename, job, Sal from emp where sal>=10000;

5GL:- (Fifth Generation Language):-

It is also known as HAL(Human Accessible Language) based language.

This language make to smarter.Example:-ROBOT, Shuttale Space, Fighter plain

Example:-LOTUS-1-2-3

How to Solve 4 GL to Help solving problem

- ✓ They are much easier to learn use.
- ✓ They provide more power full feature.
- ✓ They provide convenient feedback on systematic mistakes.
- ✓ It is much faster than 3GL.

Impact of 4 GL:-

It deserve management attention such as

- ✓ Productivity and s/w development
- ✓ Restructuring of the system development process.
- ✓ Empasis on DSS and End User Computing

CASE Tools:-

It is a tool for developing s/w. Which categorized into following four types

- ✓ Front End CASE Tools
 - It deals with design, Specification, analysis and requirements.
- ✓ Back-End Tools
 - It deals with the detailed design, coding, assembly and testing of s/w.
- ✓ Maintenance tool
 - It deal with s/w after initial release. It may assist in tracking bug fixes and enhancements requests.
- ✓ Support s/w and frameworks
 - It provides basic functionality required in tools of type 1,2 and 3.

Factors Affecting CASE TOOLS:-

- ✓ The people that are to develop the product
- ✓ The methodologies and tools that they use
- ✓ The need to produce quality product
- ✓ The politics of the organization
- ✓ The psychology of the term member
- ✓ The need of standardisation

Types of CASE Tools:-

- ✓ Selecting CASE Tools(It was developed by P-CUBE corporation.)
 - Developing a menu of features and facilities
 - Improve long term productivity and quality significant.
 - It maximizing performance per unit is the objective.
- ✓ Deft CASE tools
 - Assist them in gathering the initial requirements from end-users
 - design the system general algorithms.
 - Check their designs for completeness and consistency.
 - Automatically generates the RDBMS(tables and Forms).

SDLC Phases:-

Phase 1:- Requirements Analysis & Feasibility

Phase 2:- Decomposition.

Phase 3:- Specifications.

Phase 4:- Design.

Phase 5:- Coding

Phase 6:- Testing

Phase 7:- Documentation

Phase 8:- use

Phase 9:- Evaluation

Complete Phases in SDLC:-

Question1:- Describe all types of process Model for system development.

Question2:- Discuss about feasibility study.

Question3:- What are different types of testing?

Question4:- Describe about SQA.

Question5:- Describe about modularization and object oriented design technique.

Question6:- Differentiate between modality and cardinality.

Question7:- Describe about detail description of SRS.

Question8:-What is iron triangle of quality?

Question9:-What is DFD and E-R model explain with suitable example.

Question10:-Describe principle of s/w engineering?

Question11:-What is CASE Tools?

Question12:-What is COCOMO model?

Question13:- Write about project?How it can solve efficiently

Question14:- Write Short Notes of following

- ✓ 4GL
- ✓ DBMS
- ✓ 5GL
- ✓ Black box testing and white box testing
- ✓ Benchmark testing
- ✓ Spiral Model and Prototype model
- ✓ Waterfall Model
- ✓ S/w Crisis
- ✓ GANT Chart
- ✓ PERT Chart
- ✓ CMM
- ✓ Project Progress

- ✓ Attributes and role of system analyst
- ✓ Reliability
- ✓ Availability
- ✓ Prototyping Model
- ✓ Aggregation, generalization and specializations
- ✓ Putnam's Model
- ✓ Risk Management
- ✓ CASE TOOL
- ✓ Estimation Effort for project
- ✓ Role of system analyst
- ✓ Analysis concept and Principles

FEASIBILITY STUDY:- Most Important

Many feasibility studies are disillusioning for both user and analysts. First the study often presupposes that when the feasibility document is being prepared, the analyst is in apposition to evaluate solutions. Second, most studies tend to overlook the confusion inherent in system development the constraints and assumed attitudes.

Feasibility is the determination of whether or not a project is worth doing. The process followed in making this determination is called a feasibility study. This type of study determines if a project can and should be taking. Once it has been determined that a project is feasible, the analyst can go ahead and prepare the project specification which finalizes project requirements. Generally, feasibility studies are undertaken within tight time constraints and normally culminate in a written and oral feasibility report. The contents and recommendation of such a study will be used as a sound basis for deciding whether to proceed, postpone or cancel the project. Thus, since the feasibility study may lead to commitment of large resources, it becomes necessary that it should be conducted completely and that no fundamental errors of judgments are made.

In the conduct of the feasibility studied the following:-

- Technical feasibility
- Operational feasibility
- Economical feasibility
- Social feasibility
- Management feasibility
- Legal feasibility
- Time feasibility

➤ Behavioral feasibility

Technical feasibility :-

A study of function, performance and constraints that may affect the ability to achieve an acceptable system. Technical feasibility centers on the required/existing computer system ([Hardware/software](#)) and to what extent it can support the proposed application.

Operational Feasibility:-

Operational feasibility is concerned with human, organization and political aspects. One is technical performance aspect and other is acceptance within the organization.

Economical Feasibility:-

Economic feasibility study is the most frequently used method for evaluating the effectiveness of a new system. Cost benefit analysis is performed to determine the benefits and savings are expected from the new system and compare them with costs. The benefit of project includes three types:-

- ❖ Cost saving of our project leads to the reduction in administrative and operational cost.
- ❖ A cost avoided benefit of our project does not require any additional skill.
- ❖ Encoding of modules is for improve service level of benefits.

Social Feasibility:-

[Social feasibility is a determination of whether proposed project will be acceptable to the people or not.](#) This determination typically examine the portability of the project be accepted by the group directly affected by the proposed system changed. My system will reduce the workload therefore it has a better social feasibility for the existing system.

Behavioral Feasibility:-

People are inherently resistant to change and computers have been known to facilitate change. It is common knowledge that computer installation has something to do with turnover, transfer, re-training, and changes in employee's job status.

Management Feasibility:-

It is the determination of whether the proposed project will be acceptable to the management. If management does not accept the project or gives a negligence support to it analyst will tend to view the project as a non-feasible one. My project provides a timely report to the management, so it is feasible for the management.

Legal Feasibility:-

Legal feasibility is the determination of whether the proposed project is legal, it fulfills the requirement of acts or not.

My project is legally feasible as it does not violate any law and also provide essential help to the entire law system.

Time Feasibility:-

Time feasibility is a determination of whether the proposed project can be implemented within a stipulated time frame. My project will be completed within the time frame because of water fall model (Software Paradigm) is applied.

Documentation:-Most Imp

A system cannot be completely effective unless it is adequately documented. It consists of complete information about system. Such as

- ✓ Introduction of system
- ✓ Complete details about SDLC
- ✓ H/w and S/w informations
- ✓ Informations of programming elements
- ✓ Information about implementation
- ✓ Acknowledgement
- ✓ Table of contents
- ✓ Definition of problem
- ✓ System study(By means of feasibility)
- ✓ Cost and Benefit Analysis System
- ✓ Fact finding.
- ✓ Project technical details.
- ✓ DFD.
- ✓ E-R Model.
- ✓ Source code.
- ✓ Complete testing of System.
- ✓ Process Model.
- ✓ Conclusion
- ✓ User Manuals
- ✓ Installation Procedure
- ✓ Bibliography

Characteristics of good documentation:-

A documentation is considered to be good if it has following qualities:

- ✓ Availability
- ✓ Objectivity
- ✓ Cross-referable
- ✓ Easy to maintain
- ✓ Completeness

Types of documentation:-

- ✓ Program documentation
- ✓ Operation documentation
- ✓ User documentation
- ✓ Management documentation
- ✓ System documentation

S/w Design and S/W tools:-

There are following three specific tools are described below

- ✓ Structured flowchart
- ✓ HIPO diagrams
- ✓ Warnier/Orr diagram

Structured flowchart:-

There are three basic elements are used in developing structured flowchart

- ✓ Process

It represent process steps in program that are shown by using rectangle box.

- ✓ Decision

It represent alternative conditions that can occur and that the program must have a manner of handling.

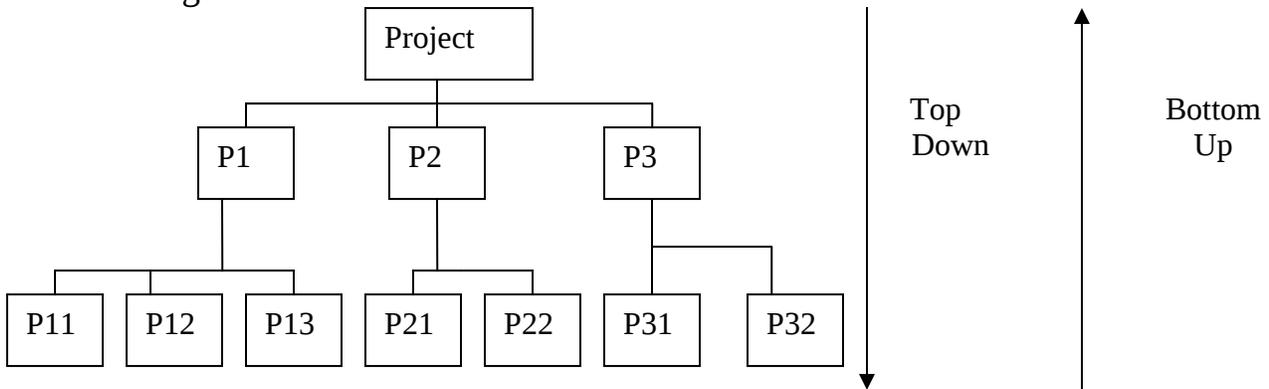
- ✓ Iteration

It represent looping and repetition of operation.

HIPO diagrams:-

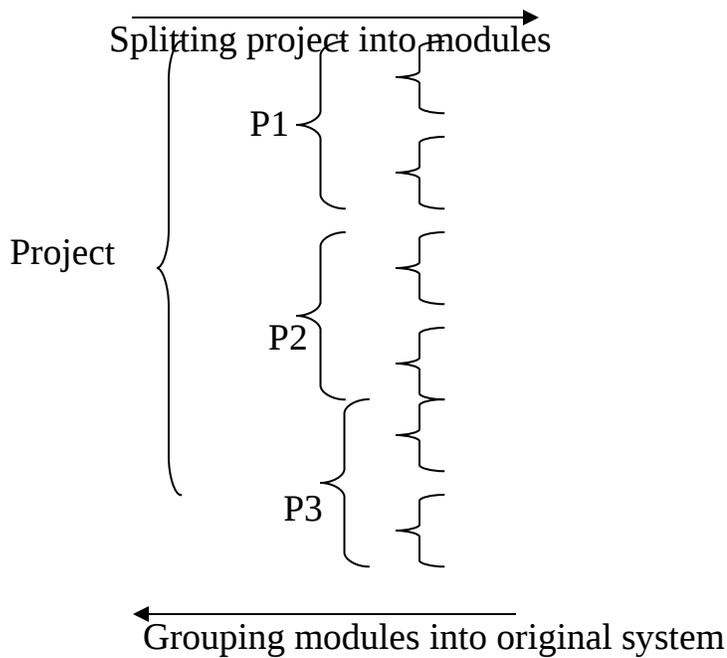
It is another tool commonly used for developing system s/w It based highly structured modular design.

Figure:-



Warnier/Orr diagram:-

It is also known as logical construction of program. It is very powerful tools aimed at designing of program structures by identifying the output and processing result. This diagram is shown in following figures.



Need for documentation:-

- ✓ Communicates facts about system to users.
- ✓ Provide operating instruction to user and operating staff.
- ✓ Assist in the reconstruction of the system in case it is destroyed.
- ✓ It provides necessary guidelines to allow correction of a system or its computer program.
- ✓ Reviews the progress of an application s/w.

System Implementation:-

Pseudo Code:-

It is a technique for writing logic of solving computer program. Pseudo code write into natural English language. This pattern based on user way.

Example:-1

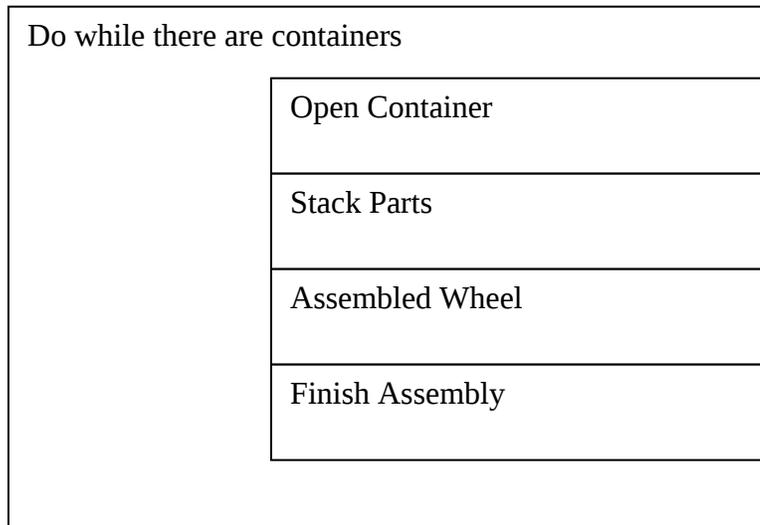
Write pseudo code for checking year is leap or not

- Step1:-Start writing of Pseudo code.
- Step2-First we enter year value.
- Step3-We will calculate remainder after dividing by four.
- Step4-We will write logic for check remainder is zero or not.
- Step5-If remainder is zero then print Year is leap Year.
- Step6- If remainder is not zero then print Year is not leap Year.
- Step7- Stop writing of pseudo code.

N-S Charts (Nassi-Shneidermann):-

It is a charts offer an alternative to either pseudo code or program flow charts. Named their authors-S charts are much more compact than program flow charts, include pseudo code like statements and feature sequence, decision and repetition constructs.

Nassi-Shneidermann chart for bicycle assembly:-



Example:-2

Write pseudo code for solving quadratic equation

Step1:-Start writing of Pseudo code.

Step2-First we enter coefficient of X^2 , X and Constant Value c

Step3-We will calculated $=b*b-4*a*c$

Step4-We check values of d

Step5- If $d=0$ then roots are real and equal but opposite sign

Step6- $x_1=-b/(2a)$ and $x_2=-b/(2a)$

Step7- If $d>$ then roots are real and unequal

Step10- $x_1=(-b+\sqrt{d})/(2a)$ and $x_2=(-b-\sqrt{d})/(2a)$

Step11- If $d<$ then roots are imaginary.

Step12- Stop writing of pseudo code.

Green PC:-Imp

The Green PC is characterized by consumption of the less power and feature of consuming only say 20 w in the stand by mode.It does not use chlorofluorocarbons in the manufacturing process and uses recyclable packaging material. Green PC consumes less than 30 W of power is stand by mode.

Types of Green PC:-

- Dark Green PC:-It consumes 15-20 W in stand by mode.
- Light Green PC:-It consumes 25-30 W in stand mode.

I/O design:-Most Imp

Designing of I/O screen for proposed project must be userfriendly.

Screen for Input Design:-

Example Student Admission System:-

Admission Form of UPRTOU ALLAHABAD										
Enter Name of Student										
Enter Name of Father										
Enter Name of Mother										
Enter Name of Course										
Enter Amount		DD No/Challan Number				Name of bank				
E-Mail Address		Complete Address				Contact Number				
Paper Codes										
Submit	Cancel	Edit	Help	Display	Next	Back				

Example Employee Record Database System:-

The screenshot shows a window titled "Form1" with a grid background. The title "EMPLOYEE RECORDS DATABASE" is centered at the top. Below it are four input fields labeled "EMPNO", "EMPLOYEE NAME", "EMPLOYEE JOB", and "SALARY". To the right of the "SALARY" field is a data control box with "Data1" and navigation arrows. At the bottom is a row of six buttons: "ADD", "DELETE", "NEXT", "PREV", "FIRST", and "LAST".

Screen for Output Design:-

UPRTOU Admission Report			
Control number	S-158/AC0012		
Enrollment Number	921581050001		
Student name	Anil Kumar		
Father name	Sunil Kumar		
Mother name	Smt Madhuri Devi		
Course name	BCA	Semester	I II
Address	Rajatalab Varanasi-221110		
Contact number	858485384		
Return Main Form		Edit Record	Help

Cost/Benefit Analysis:- (Minimum input and Maximum Output):-

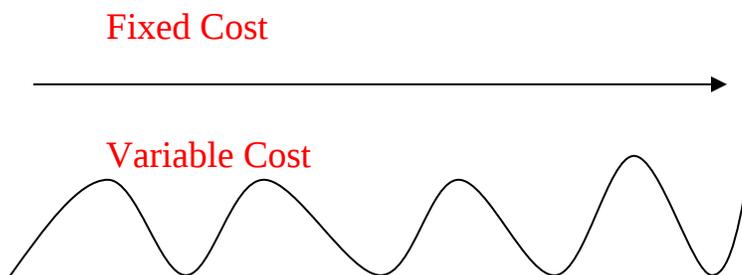
Benefits of project include four types.

- **Cost-saving benefit:-**A reduction in the size of the clerical staff used in the support of an administrative activity.
- **Cost-avoidance benefits:-**No need to hire additional staff in future to handle administrative activity.
- **Improved-Service-level benefits:-** Improved performance of system using new computer based method.
- **Improved-information benefits:-**This analysis makes it easier to provide better service to major customers

Categories of Cost and Benefits:-

It is classified into three categories

- **Tangible or Intangible:-**Tangibility refers to the ease with which costs or benefits can be measured. Where as Intangibility can not be exactly measured in terms of financial values.
- **Fixed or Variable:-**Some costs and benefits remain constant, regardless of how a system is used. Fixed cost considered as sunk costs.



- **Direct or Indirect:-**Direct costs are those which are directly associated with a system. Where as indirect costs are not directly associated with a specific activity in the system.

Example:- Direct

Cost of CD ROM/DVD/PEN DRIVE etc.

Example:-Indirect

Maintenance of computer, Heat,Light and air conditioning environment etc.

Audit Trail:-Short note

It is the path which a transaction traces through a data processing system from source documents to summary reports. In other words, it refers to the facilities or procedures which allow a transaction to be traced through all stages of data processing beginning with its appearance on a source document and ending its transformation into information on a final output document.

Knowledge Based System:- Imp

Data treated as raw material it is also known as fact and figures. → After processing data it produces information. → Collection of related informations produce knowledge → A collection of related knowledge produce → Intelligence → Genius.

There are two categories of knowledge based system.

- Natural Intelligence
- Artificial Intelligence Example:-ROBOT, Fighter Plain.

Artificial intelligent system based on logic of statements/Propositions.

A statement must be either universal truth or universal false.

Example:- Sun rises from east. → True statement
Sun set in west. → True statement.
Value of gravity is 10.6 → False statement.

Operations on Statement:-

Connectives:-

- Conjunction \wedge
- Disjunction \vee
- Negation \sim
- Conditional \rightarrow
- Biconditional \leftrightarrow
- Symmetric Sum \oplus

True $\rightarrow 1 \rightarrow T$

False $\rightarrow 0 \rightarrow F$

Conjunction $A \wedge B$

A	B	$A \wedge B$
F	F	F
F	T	F
T	F	F
T	T	T

Disjunction $A \vee B$

A	B	$A \vee B$
F	F	F
F	T	T
T	F	T
T	T	T

Negation $\sim(A \vee B)$

A	B	$A \vee B$	$\sim(A \vee B)$
F	F	F	T
F	T	T	F
T	F	T	F
T	T	T	F

Conditional $(A \rightarrow B)$

A	B	$A \rightarrow B$
F	F	T
F	T	T
T	F	F
T	T	T

Biconditional $(A \leftrightarrow B)$

A	B	$A \leftrightarrow B$	$A \oplus B$
F	F	T	F
F	T	F	T
T	F	F	T
T	T	T	F

Application of Knowledge based System:-

- Modern Petrol Pump
- ATM
- DISH TV
- Satellite
- Mobile Phone
- CT Scan Machine
- MRI Machine
- Airlines Controlling system
- Railway Controlling System
- Shuttle space controlling system
- ROBOT
- Fighter Plane
- Internet and Intranet
- Supercomputer
- Mainframe Computer

etc

Note:-Perfect knowledge based system is known as expert system.

Software risks:-

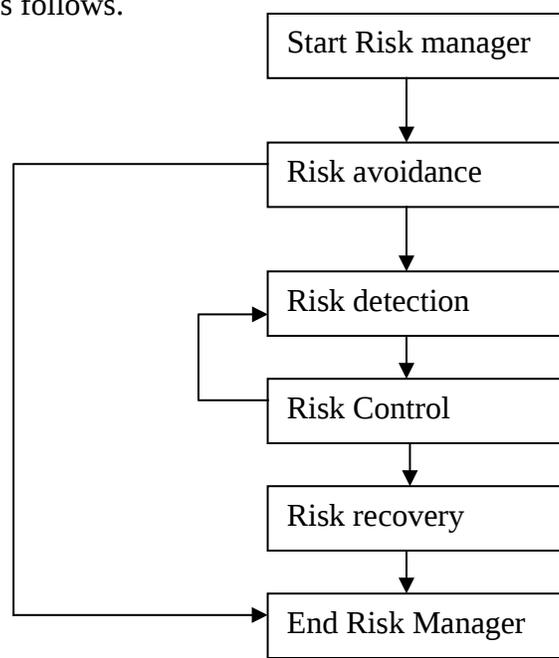
Risks can arise from various factors like improper technical knowledge or lack of communication between team members. Lack of knowledge about software product, Hardware resources etc.

Basis for different types of S/w risks:-

- Skills or Knowledge.
- Interface modules.
- Poor knowledge of tools.
- Programming Skills.
- Management issues.
- Updates in the H/w resources.
- Customer risks.
- External risks.
- Commercial risks.

Management of Risks:-

It plays an important role in ensuring that the s/w product is error free. The flow of risk management is as follows.



Formal Technique Review: - (FTR)

It can be defined as filter for the s/w engineering process. The purpose of any review is to discover errors in analysis, design, coding, testing and implementation phase of s/w development cycle. There are basically two types of reviews.

- Informal Technical Review. It modifies the proposed system between discussion of customer & Analyst.
- Formal Technical Reviews. It modify the proposed system between discussion/Opinion of senior they have sharp mind and genius.

BCA –E2(Theory Of Computer Science)

Introduction Language:- *Important*

A word in the languages or **rules** can tells us how to construct all the words in the language by some clear **procedures**.

Alphabet:-A finite set of symbols/characters.We generally denote an alphabet by Σ .

Example:- 1

$$\Sigma = \{m\}$$

It means alphabet consist of one letter

Example:-2

$$\Sigma = \{0,1\}$$

It means alphabet consist of digits 0 and 1

Letter: - Each symbol of an alphabet may also be called a letter of the alphabet or simply a letter.

Example:-3

$$\Sigma = \{0,1\}$$

Letter/Symbol=0 and 1

Example:-4

$$\Sigma = \{m\}$$

Letter/Symbol=m

String/Word Over Alphabet: -

Evey member of any language is said to be a **string** or **word**.

Example:-5

$$\Sigma = \{m\}$$

$L = \{m, mm, mmm, mmmm, mmmmm, mmmmmm, \dots\}$ used natural number procedure.

Where :-

$m, mm, mmm, mmmm, mmmmm, mmmmmm \dots$ are called words/Strings

Example:-6

$$\Sigma = \{z\}$$

$L = \{z, zz, zzz, zzzz, zzzzz, zzzzzz, \dots\}$

Where :-

$z, zz, zzz, zzzz, zzzzz, zzzzzz \dots$ are called word/Strings.

Example:-7

$$\Sigma = \{0,1\}$$

$L = \{0,1,00,01,10,11,000,001,010,011,100,0000,0001,0010,0100,1000, \dots\}$

Where :-

$0,1,00,01,10,000,001,010,100,0000,0001,0010,0100,1000, \dots$ are called word/Strings.

Example:-8

$$\Sigma = \{z\}$$

$L = \{z^n \mid n=0,1,2,3,4,5, \dots\}$

Or

$L = \{\wedge, z, zz, zzz, zzzz, zzzzz, zzzzzz, \dots\}$

Where:-

$z = z^0 = \wedge$ is called null string/word

Example:-9

$$\Sigma = \{z\}$$

$L = \{z^p \mid p=2,3,5,7,11,13, \dots\}$

Or

$L = \{zz, zzz, zzzzz, zzzzzzz, zzzzzzzzz, zzzzzzzzzzz, zzzzzzzzzzzz, \dots\}$

Example:-10

$$\Sigma = \{a,b\}$$

$L(\text{PALINDROME}) = \{\wedge, a, b, aa, bb, aaa, bbb, aba, bab, \dots\}$

Where:-

$\wedge, a, b, aa, bb, aaa, bbb, aba, bab, \dots$ are called of words/string for language of palindrome.

Kleen Closure Definition/Repetition:- *Important*

Suppose an alphabet Σ , and define language in which any string of letters from Σ is a word, even the null string. We shall call this language the **closure of the alphabet**. It is denoted by Σ^* . This notation also called **Kleen Star**.

Example:-11

$\Sigma = \{z\}$

$L = \{z^n \mid n=0,1,2,3,4,5,\dots\}$

Or

$\Sigma^* = \{\wedge, z, zz, zzz, zzzz, zzzzz, zzzzzz, \dots\}$.

Example:-12

$\Sigma = \{0,1\}$

$\Sigma^* = \{\wedge, 0, 1, 00, 01, 10, 000, 001, 010, 100, 0000, 0001, 0010, 0100, 1000, \dots\}$

Regular Expressions

Just as finite automata are used to *recognize* patterns of strings, regular expressions are used to *generate* patterns of strings. A regular expression is an algebraic formula whose value is a pattern consisting of a set of strings, called the language of the expression.

Operands in a regular expression can be:

- **characters** from the alphabet over which the regular expression is defined.
- **variables** whose values are any pattern defined by a regular expression.
- **epsilon** which denotes the empty string containing no characters.
- **null** which denotes the empty set of strings.

Operators used in regular expressions include:

- **Union:** If R_1 and R_2 are regular expressions, then $R_1 \mid R_2$ (also written as $R_1 \cup R_2$ or $R_1 + R_2$) is also a regular expression.

$L(R_1 \mid R_2) = L(R_1) \cup L(R_2)$. Or $L(R_1) + L(R_2)$.

- **Concatenation:** If R_1 and R_2 are regular expressions, then R_1R_2 (also written as $R_1.R_2$) is also a regular expression.

$L(R_1R_2) = L(R_1)$ concatenated with $L(R_2)$.

- **Kleene closure:** If R_1 is a regular expression, then R_1^* (the Kleene closure of R_1) is also a regular expression.

$L(R_1^*) = \epsilon \cup L(R_1) \cup L(R_1R_1) \cup L(R_1R_1R_1) \cup \dots$

Or

$$L(R1^*) = \epsilon + L(R1) + L(R1R1) + L(R1R1R1) + \dots$$

Definition Of regular Expression:- Important

Certain sets of strings or languages can be represented in algebraic fashion. Then these algebraic expressions of languages are called regular expression. Following symbols are used in regular expressions.

- ✓ ϵ Nul String
- ✓ Σ Alpabet/Input Symbol
- ✓ $\{ \}$ Set of letters or strings or words
- ✓ $+$ (Union)
- ✓ $*$ (Repetition)

Following rules are applying in regular expressions:-

1. Every letter Σ can be made into a regular expression. ϵ itself is a regular expression.
2. if l and m are regular expressions, then
 - (l) .
 - lm (Concatenation).
 - $l+m$ (Union) or lUm (Union)
 - l^* (Clean Star/Repitition).
 - $l^+=ll^*$ (Positive Closure).
3. Nothing else is regular expression.

Example:-

- $0\ 1$ Concatenation (It means 0 followed by 1).
- $0+1$ Union It means either 0 or 1
- 0^* means $\epsilon+0+00+000+0000+\dots$ {Kleen Closure}

Example:-

Find a language to describe each of the following regular expression:-

- [A] $a+b$
- [B] $a+b^*$
- [C] a^*+bc^*

Solution:-

- [A] $a+b$

We know that, if l and m are regular expressions, then union defined as

$l+m$ (Union)

using above theorem, Language of $a+b$ is

$$L = \{a, b\}$$

- [B] $a+b^*$ apply union and kleen star method of language.

$$L = \{a, \epsilon, b, bb, bbb, bbbb, \dots, b^n\}$$

- [C] a^*+bc^* apply union and kleen star method of language.

$$L = \{\epsilon, a, aa, aaa, aaaa, \dots, a^n b^c, c, bcc, bccc, \dots, bc^n\}$$

Example:-

Find a language to describe each of the following languages over the alphabet $\Sigma = \{a, b\}$

- [A] string with even length.
- [B] string containing the sub string aba.

Solution:-

- [A] String with even length.

$$L = \{ab, aa, bb, ba, aaaa, aabb, bbbb, bbaa, \dots, a^{2n}, b^{2n}\}, \text{ Where } n=1, 2, 3, 4, 5, \dots$$

Or

$$L = (aa+ab+ba+bb)^*$$

Solution:-

- [B] string containing the sub string aba.

$L = (a+b)^*aba(a+b)^*$ apply rule of union, concatenation and kleen star.

Algebra Of regular Expression:- Important

There are many equalities for regular expressions. Let R, S and T denote arbitrary regular expressions then Its properties:-

1. $(R+S)+T=R+(S+T)$
2. $R+R=R$
3. $R+\emptyset = \emptyset +R=R$
4. $R+S=S+R$
5. $R\emptyset = \emptyset R=R$
6. $R^\wedge = \wedge R=R$
7. $(RS)T=R(ST)$
8. $R(S+T)=RS+RT$
9. $(S+T)R=SR+TR$
10. $\emptyset^* = \wedge^* = \wedge$
11. $R^*R^* = R^* = (R^*)^*$
12. $RR^* = R^*R = R^* = \wedge + RR^*$
13. $(R+S)^* = (R^*S^*)^* = (R^*+S^*)^* = R^*S^* = (R^*S)^*R^* = R^*(SR^*)^*$
14. $(R^*S)^* = (R^*S^*)^* = (R^*+S^*)^*$
15. $(RS)^* = (R^*S^*)^* = (R^*+S^*)^*$

Prove that $R+R=R$

Prove:-

$$\begin{aligned}L(R+R) &= L(R) \cup L(R) \\ &= L(R) \\ &= R \quad \text{Proved}\end{aligned}$$

Prove that $R(S+T)=RS+RT$

Prove:-

$$\begin{aligned}L(R(S+T)) &= L(RS) + L(RT) \\ &= L(RS+RT) \\ &= RS+RT \quad \text{Proved}\end{aligned}$$

Regular Languages:- Important

Definition:-

For a given alphabet (Σ), the following rules define the regular language associated with a regular expression.

Rule1:- \emptyset , $\{\wedge\}$ and $\{a\}$ are regular languages denoted respectively by a regular expression \emptyset and \wedge .

Rule2:- For each a in Σ , the set $\{a\}$ is regular language denoted by the regular expression a .

Rule3:- If l is regular expression associated with L and m is regular expression associated with M then

- ✓ The language $= \{xy : x \text{ belong in } L \text{ and } y \text{ belong in language } M\}$ is a regular expression associated with regular expression lm .
- ✓ The regular expression $l+m$ is associated with the language formed by the union of the set L and M . That is $\text{language}(l+m) = L \cup M$
- ✓ $\text{Language}(l^*) = L^*$

Example:- $\Sigma = \{a, b\}$

If $L = \{aa, ab, ba, bb\}$, then the corresponding regular expression is represented as

$aa+ab+ba+bb$ is regular expression

Example:- $\Sigma = \{0, 1\}$

If $L = \{00, 01, 10, 11\}$, then the corresponding regular expression is represented as

$00+01+10+11$ is regular expression

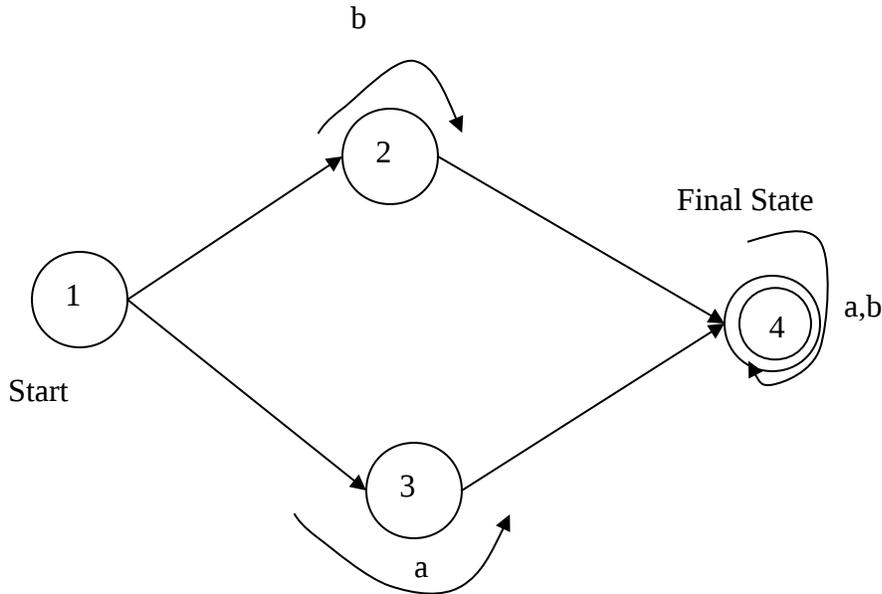
Finite Automata (FA):- *Important*

A finite automata is similar to finite state machine .It consist of five parts.

- ✓ A finite set of state(Q)
- ✓ A finite set of alphabets(Σ)
- ✓ An initial states (q_0)
- ✓ A subset of set of states (Whose elements are called “yes” states or Accepting states) (F)
- ✓ A next state function or a transition state function. (δ)

Example:-

$$\Sigma = \{a,b\}$$



Another Definition Of Finite Automation:- *Important*

It is defined as by using quintuple

$$M = \{Q, \Sigma, \delta, q_0, F\}$$

Where

- Q is finite set (of states).
- Σ is a finite alphabet(of input symbol).
- δ Next State function.
- q_0 Belong in finite set Q/Initial State.
- $F \subseteq Q$ (Accepting States).

Example of Finite Automata:-

- Mealy Machine
- Moore Machines

Mealy machine:-

A Mealy machine is a finite-state machine whose output values are determined both by its current state and the current inputs. (This is in contrast to a Moore machine, whose output values are determined solely by its current state.)

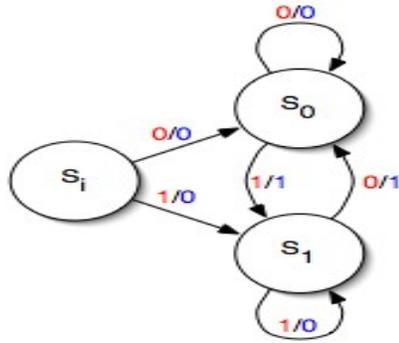
It is first automatic machine invented by Mealy in 1955.It is called Mealy Machine.

Example:-1

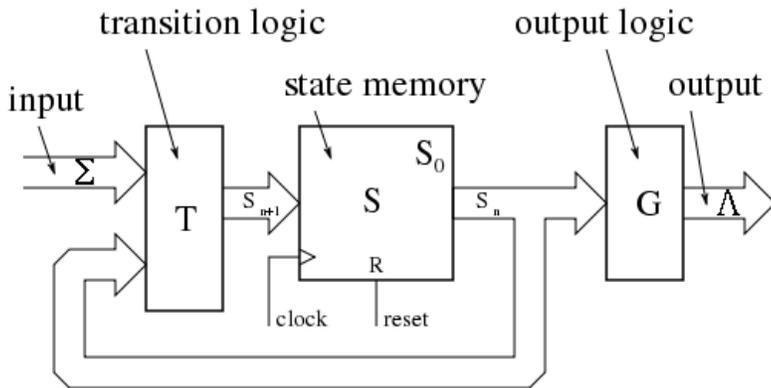


i is initial state which gives output x and entire state j .

Example:-2



Example:-3



Moore machine:- Most Important

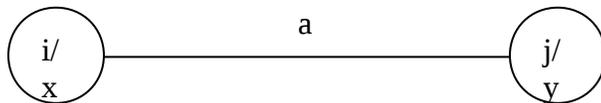
A Moore machine can be defined as a 6-tuple consisting of the following: a finite set of states. a start state (also called initial state) which is an element of. a finite set called the input alphabet. a finite set called the output alphabet.

It is defined as six tuple $(Q, \Sigma, \Delta, \delta, \lambda, q_0)$

Where :-

- Q is a finite set of states.
- Σ is the input alphabet.
- Δ Is the output alphabet.
- λ Is the output function mapping Q into Δ .
- δ Is the transition function $\Sigma \times Q$ into Q.
- q_0 Is the initial state.

In Moore machine each time a state is entered, simultaneously an output takes place.



So the first output always occurs as soon as the machine is started.
Mealy and Moore both are equivalent machine.

Diagram of mealy:-

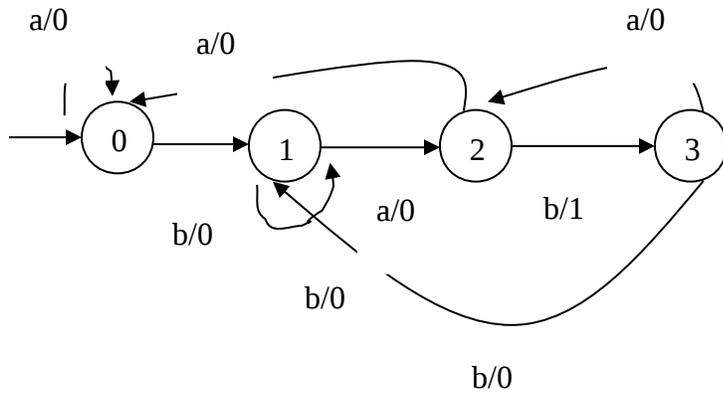


Diagram of moore Machine:-

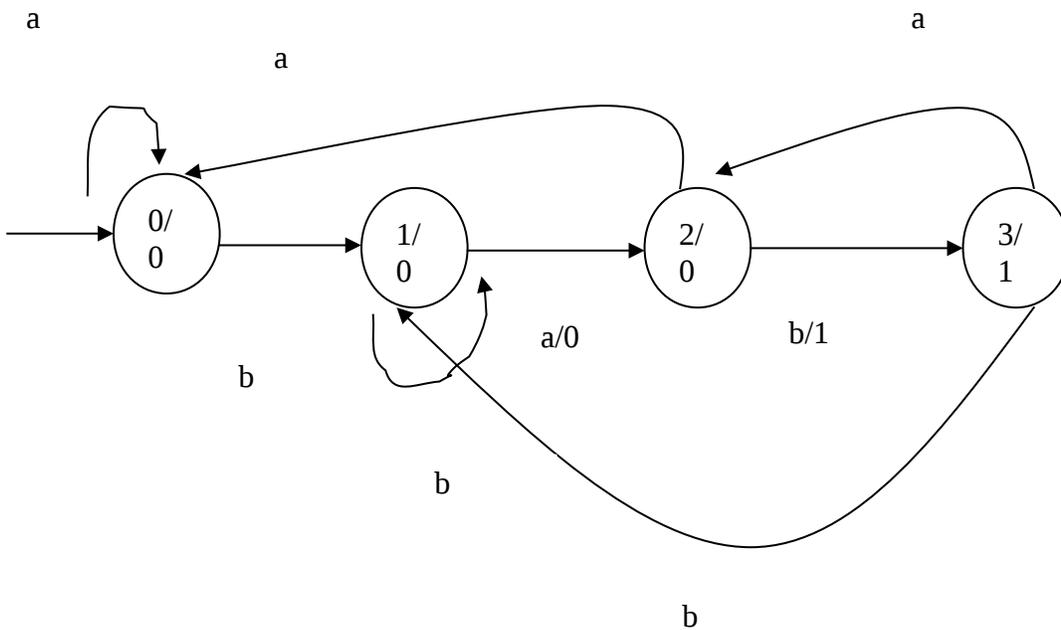


Diagram of Simple Traffic Signal Machine(USING MOORE MACHINE):-

Signal Color:-

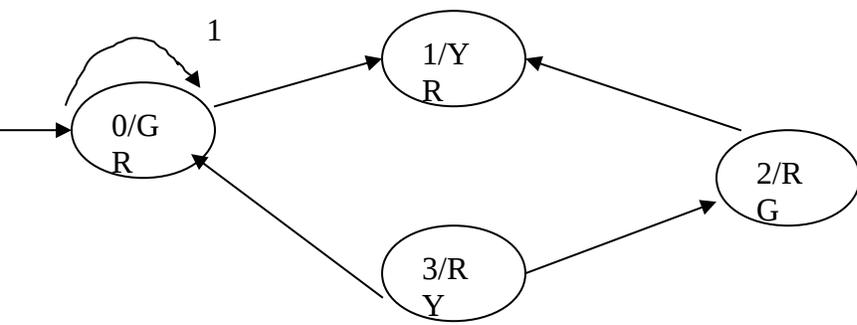
- R Red
- Y Yellow
- G GREEN

$\Sigma = (R, G, Y)$

OUTPUT STRINGS/WORDS :- {GR, YR, RG, RY}

0

0,1



0,1

0 NO TRAFFIC DETECTED
1 TRAFFIC DETECTED

NDFA (Non Deterministic FA):-

It is referred to as Non deterministic finite automata, which is defined as:-

$$M = \{Q, \Sigma, \delta, q_0, F\}$$

Where

Q is finite set (of states)

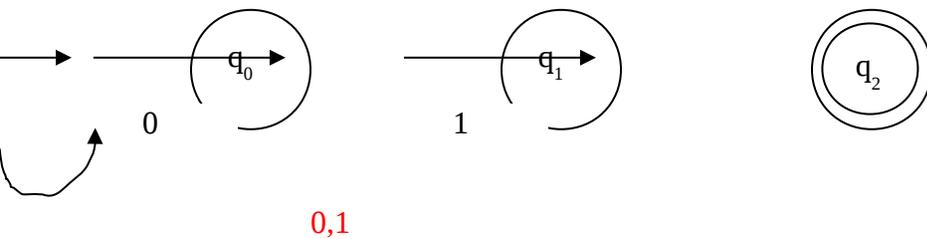
Σ is a finite alphabet (of input symbol)

δ is transition function from $Q \times \Sigma$ to the **power set** of Q. That is 2^Q

q_0 Belong in finite set Q start/initial state

$F \subseteq Q$ (Final Accepting States)

Transition Diagram:-



0,1

Such types of automatic machines are categorized into two types:-

DFA (Deterministic Finite automata)

NFA (Non Deterministic Finite automata)

Equivalence of NFA and DFA:- Most Important

Definition of DFA:-

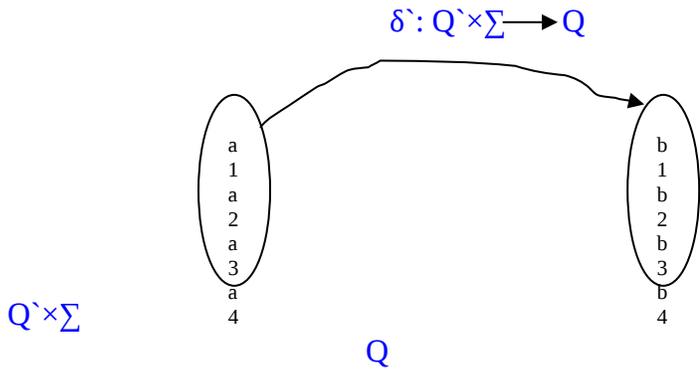
It is defined as

$$M = \{Q, \Sigma, \delta, q_0, F\} \tag{1}$$

Where :-

Q is finite set (of states)
 Σ is a finite alphabet (of input symbol)
 δ is transition function from $\delta: Q \times \Sigma \rightarrow Q$
 q_0 Belong in finite set Q start/initial state
 $F \subseteq Q$ (Final Accepting States)

NFA accepting all the string ended by aba



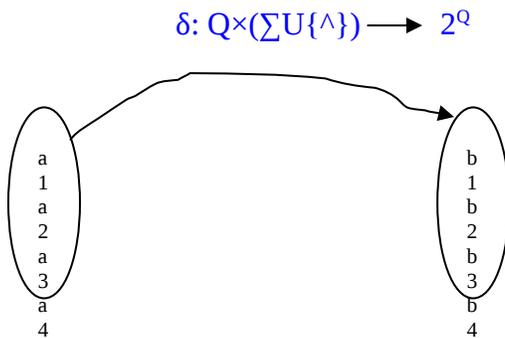
Definition of NFA:-

It is defined as

$$M = \{Q, \Sigma, \delta, q_0, F\} \quad (2)$$

Where

Q is finite set (of states)
 Σ is a finite alphabet (of input symbol)
 δ is transition function from $\delta: Q \times (\Sigma \cup \{\epsilon\}) \rightarrow 2^Q$
 q_0 Belong in finite set Q start/initial state
 $F \subseteq Q$ (Final Accepting States)



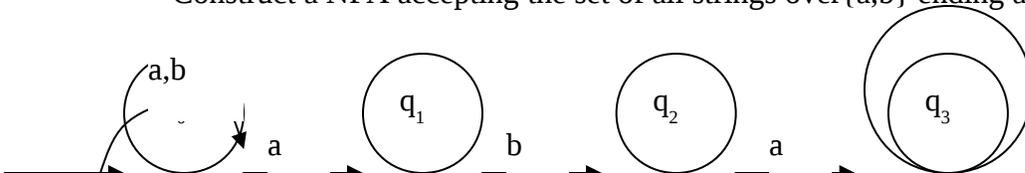
Conclusion:-

From 1 and 2 NFA and DFA both are equivalent.

Theorem:- NFA is accepted by DFA.

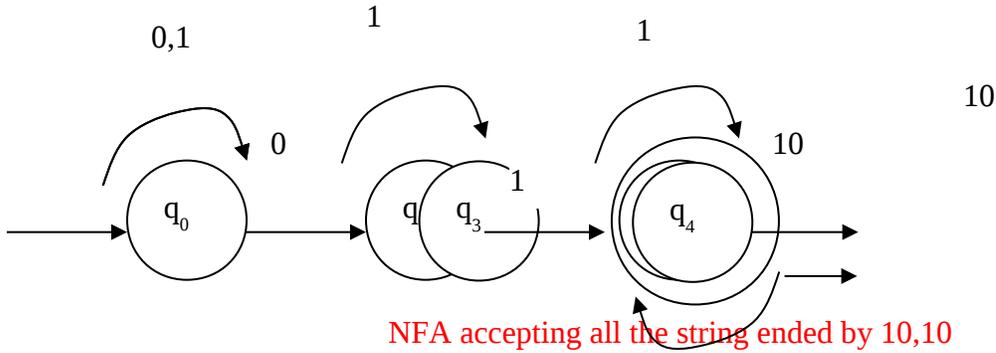
Example:-1

Construct a NFA accepting the set of all strings over {a,b} ending aba.



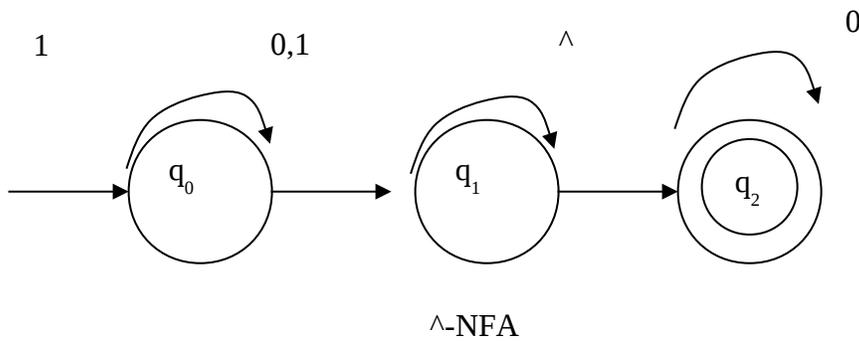
Example:-2

Construct a NFA accepting $\{10, 10\}$.

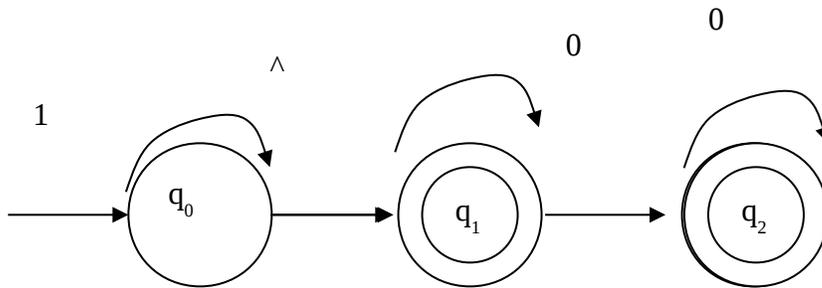


Example:-

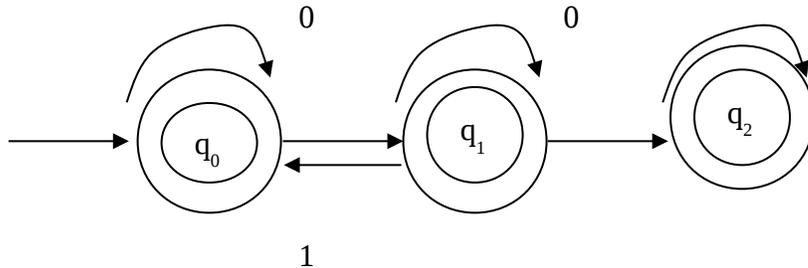
Show that equivalence of \wedge NFA and NFA input symbol 0 and 1



After removing of one \wedge the transition diagram of NFA will be



After removing of Both \wedge the transition diagram of NFA will be



PL(Pumping Lemma):- Important Question

Let L is a regular language, then there exists a constant n such that every string w in L, of length n or more, can be written as w=xyz

Or

Pumping lemma for regular languages, the fact that all sufficiently long strings in such a language have a substring that can be repeated arbitrarily many times, usually used to prove that certain languages are not regular.

Where:-

1:- $|y| > 0$

2:- $|xy| \leq n$

3:- $xy^i z$ is belong in L for all $i \geq 0$ here y^i denotes y represented i times and $y^0 = \Lambda$

Example:-

Consider $L = \{0^n \mid n \geq 0\}$

Suppose L is regular. Then there exists a constant n satisfying the PL conditions.

Now

$w = 0^{n^2}$ belonging in regular language L and $|w| = n^2$

We write $w = xyz$, where $|xy| \leq n$ and $|y| > 0$ and $|y| \leq n$

By PL, $xyyz$ is belong in regular language L.

$|w| = n^2$

$|xyz| = n^2$

$|x| + |y| + |z| = n^2$

$n^2 + n \geq |x| + |y| + |z| > n^2$

[as $|y| > 0$ and $|xy| \leq n$]

$n^2 + n \geq |xyz| > n^2$

$(n+1)^2 > |xyz| > n^2$

$(n+1)^2$ is the perfect square after n^2 , therefore

$xyyz$ is not square length and is not belong in L. Therefore it is a **contradiction**.

Closure/Repetition properties of regular Languages and FA:-

✓ If L and M are regular languages, then $L+M$, LM and L^* are also regular languages.

○ Compliments and Intersection

▪ **Compliments:-**

If L is a language over the alphabet Σ we define its compliments, \bar{L} to be the language of all strings of letters from Σ^* that are not in L
ie, $\bar{L} = \Sigma^* - L$

▪ **Intersection:-**

$L \cap M = \overline{\bar{L} + \bar{M}}$

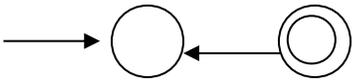
Equivalence of regular expression and FA:-

Most Important

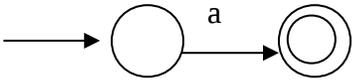
Transition diagram of Λ



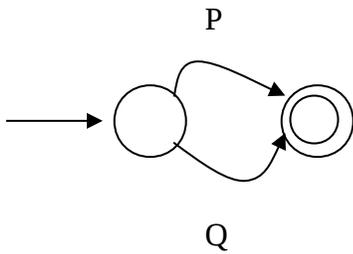
Transition diagram of \emptyset



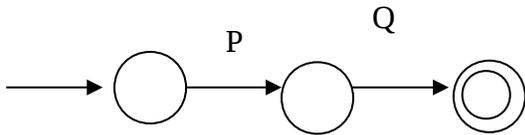
Transition diagram to a



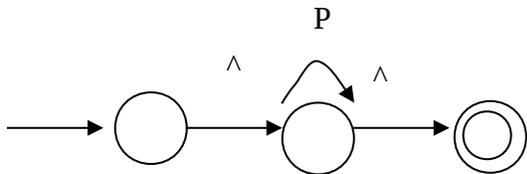
Transition diagram to $R=P+Q$



Transition diagram to $R=PQ$



Transition diagram to $R=P^*$



Question:-

Get FA of following expression

1:- $(a+b)^*$

2:- $(ab+ba)$

3:- $(a+b)^*$

4:- $(a+b)^*(a+b)^*$

5:- $(a+b)+(a+b)$

Context Free Grammar:- Most Important

Definition:-

A context-free grammar (CFG) is a set of recursive rewriting rules (or productions) used to generate patterns of strings. A CFG consists of the following components: a set of terminal symbols, which are the characters of the alphabet that appear in the strings generated by the grammar.

Example:-1

Ram plays. Sentence

Ram Noun

Plays Verb

$\langle \text{Sentence} \rangle \rightarrow \langle \text{Noun} \rangle \langle \text{Verb} \rangle$.

Example:-2

Anil eats a mango. Sentence

$\langle \text{Sentence} \rangle \rightarrow \langle \text{Noun} \rangle \langle \text{Verb} \rangle \langle \text{article} \rangle \langle \text{Object} \rangle$.

What is Grammar:-

A grammar G is defined as:-

$$G = (V, \Sigma, P, S)$$

Where V is called the set of variables

Σ Is the set of terminals/Input symbol. ie(a,b)

P Is a set of production rules.

S Is a special variables called the start symbol S belong in V

Structure of Grammar:-

Let L is a language over an alphabet A, then a grammar for L consists of grammar rules of the form.

$x \rightarrow y$ x is replaced by y. It is called **derivation**

Every grammar has a start symbol, which must be at least one production with the left side consisting of only start symbol. If S is start symbol then its production rule is

$S \rightarrow y$

Example:-

Let $A = \{a, b, c\}$ then a grammar for the language A^* can be described by following production rules:-

$S \rightarrow \Lambda$

$S \rightarrow aS$

$S \rightarrow bS$

$S \rightarrow cS$

$S \rightarrow aS \rightarrow aaS \rightarrow abS \rightarrow abcS \rightarrow aabaccS$

$S \rightarrow aS \rightarrow aaS \rightarrow baaS \rightarrow cbaaS$

Sentential Form of Grammar:-

A string made up of terminals and /or non terminals is called sentential form

Example:-

$$G = (V, \Sigma, P, S)$$

$$V = \{ \langle \text{Sentence} \rangle, \langle \text{Noun} \rangle, \langle \text{Verb} \rangle \}$$

$$\Sigma = \{ \text{Anil eats a mango} \}$$

$$P = \langle \text{Sentence} \rangle \rightarrow \langle \text{Noun} \rangle \langle \text{Verb} \rangle \langle \text{article} \rangle \langle \text{Object} \rangle$$

$$\langle \text{Noun} \rangle \rightarrow \text{Anil}$$

<Verb> → eats

<Article> → a

<Object> → Mango

S = <sentence>

Language of Grammar:-

A language of grammar G is defined as

$$L(G) = \{W \mid W \in \Sigma^* \text{ and } S \rightarrow W\}$$

Recursive Production:-

A production is called recursive if its left side occurs on its right side.

Example:-1

$$S \rightarrow abS$$

$$S \rightarrow baS$$

Example:-2

Consider $\{\Lambda, aa, aaa, aaaa, aaaaa, aaaaaa, \dots\} = \{a^n \mid n \geq 0\}$

Its derivation is

$$S \rightarrow \Lambda/aS$$

$$S \rightarrow aS \rightarrow aaS \rightarrow aaaS \rightarrow aaaaS \dots$$

Example:-3

Consider $\{\Lambda, ab, aabb, aaabbb, \dots, a^n b^n\} = \{a^n b^n \mid n \geq 0\}$

Solution:-

The grammar of above language is written as

$$S \rightarrow \Lambda/abS$$

Its recursive is written as

$$S \rightarrow \Lambda/baS$$

Example:-4

Consider a language $\{\Lambda, ab, abab, \dots, (ab)^n\} = \{(ab)^n \mid n \geq 0\}$

Solution:-

The grammar of above language is written as

$$S \rightarrow \Lambda/abS$$

Rules based on Language:-

Let M and N are languages whose grammars rules are written as

Union Rule:-1

MUN defined as

$$S \rightarrow A/B$$

Product Rule:-2

MN defined as

$$S \rightarrow AB$$

Closure Rule:-3

Closure of language M is defined as M^*

$$S \rightarrow AS/\Lambda$$

Example:-Write the grammar of following languages

$L = \{\wedge, a, b, aa, bb, \dots, a^n, b^n\}$
 Language L can be written as
 $L = M \cup N$

Where $M = \{a^n | n \geq 0\}$
 $N = \{b^n | n \geq 0\}$

Solution:-

Thus we write the grammar for L
 $S \rightarrow A/B$
 $A \rightarrow \wedge/aA$
 $B \rightarrow \wedge/bB$

Example:- Using the product rule write grammar for following language.

$L = \{a^m b^n | m, n \geq 0\}$

Solution:-

$L = MN$
 $M = \{a^m | m \geq 0\}$
 $N = \{b^n | n \geq 0\}$

We can grammar for L

$S \rightarrow AB$
 $A \rightarrow \wedge/aA$
 $B \rightarrow \wedge/bB$

Chomsky Classification for grammar:- Most Important
 Classification of Chomsky classified into the following types

Type 0 :- (Unrestricted grammar)

It is a grammar whose production rules are unrestricted.

Example:- $\Sigma = \{0, 1\}$
 $\Sigma^* = \{\wedge, 0, 00, 01, 10, 000, 001, 010, 100, 0000, 0001, 0010, 0100, 1000, \dots\}$

Type 1:- (Context sensitive Grammar)

A production of the form $xAy \rightarrow x\alpha y$ is called a type 1 production if $\alpha \neq \wedge$ here x is left context and y is right context

Type 2:- (Context Free Grammar)

A grammar is called type 2 if all the production rules are type 2. A type is said to be of type 2 if it is of the form $A \rightarrow \alpha$ where $\alpha \in V$ and $\alpha \in (V \cup \Sigma)^*$

Type 3:- (Regular Grammar)

A grammar is called type 3 if all its production rules are of type 3. Its form is written as

$A \rightarrow \wedge$, or $A \rightarrow aB$
 Where $a \in \Sigma$ and $A, B \in V$

Turing machine(TM):-

1. A mathematical model of a hypothetical computing machine which can use a predefined set of rules to determine a result from a set of input variables.

Or

TM is essentially a finite automaton that has a single tape of infinite length on which it may read and write data.

Or

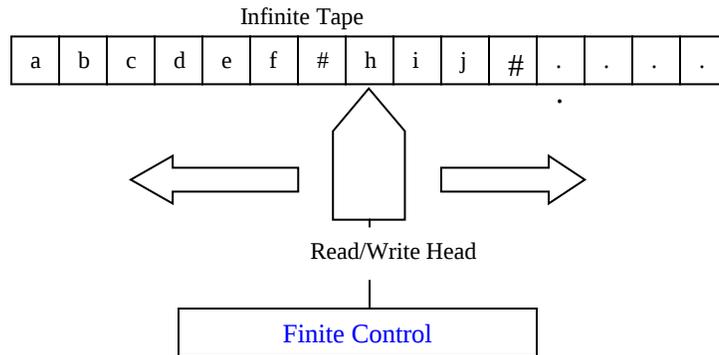
Turing machine(TM):- *Most Important*

It is defined as using six tuple (Sextuple).

$TM = \{Q, \Sigma, \Gamma, \delta, q_0, h\}$

Where :-

- Q Is the finite set of states.
- Σ It is the finite set of non-blank information symbol.
- Γ It is the set of tape symbols, including the blank symbol (#).
- δ It is the next move (L,R, N).
- q_0 It is the initial/Start State($q_0 \in Q$).
- h $h \in Q$ is the halt state.



TM is computing device which shown in above figure. It was invented by Alan Mathison Turing (1921-1954).

Feature of TM:-

- ❖ It is finite automata computational modal which is equivalent to regular language model.
- ❖ It is PDA model, which is computationally equivalent to Context Free Language.
- ❖ It accept the language $\{x^n y^n | n \in \mathbb{N}\}$.
- ❖ It also accept the language $\{x^n y^n z^n | n \in \mathbb{N}\}$.

Note:- PDA work on the principle using PUSH and POP technique.

According to human view the TM consist of

- ❖ A tape.
- ❖ A finite Control.
 - o The initial state.
 - o The halt State.
 - o Other State.
- ❖ A tape head.

Instantaneous Description and Transition Diagrams:-

Instantaneous Description of TM:-

TM: Formal notation

$$M = (Q, \Sigma, \Gamma, \delta, q_0, B, F)$$

Q: The finite set of states of the finite control

Σ : The finite set of input symbols

Γ : The complete set of tape symbols;

Σ is always a subset of Γ

δ : The transition function

The arguments of $\delta(q, X)$ are: a state q and a tape symbol X . The value of $\delta(q, X)$, if it is defined, is (p, Y, D)

Where:

p is the next state, in Q

Y is the symbol, in Γ , written in the cell being scanned, replacing whatever symbol was there.

D is a direction (either L or R), telling us the direction in which the head moves.

q_0 : The start state ($q_0 \in Q$) in which the finite control is found initially.

B: blank symbol ($B \in \Gamma$ but B not belong Σ).

F: The set of final or accepting states ($F \subseteq Q$). Automata T

FA, PDA & Turing machines include following differences.

- ❖ FA and PDA always moves from left to right where as TM moves both directions
- ❖ FA or PDA are only read/scanned but are never/written into, where as the cells of tape of a TM may be written also.

We use the instantaneous description to describe the configuration.

An ID is represented by the string:

$$X_1 X_2 \dots X_{i-1} q X_i X_{i+1} \dots X_n$$

where: -

1. q is the state of the TM.
2. The tape head is scanning the i th symbol from the left.
3. $X_1 X_2 \dots X_n$ is the portion of the tape between the leftmost and the rightmost non blank

Transition Diagrams:-

A transition diagram is the graphical representation of the next move function of a TM.

Example:-

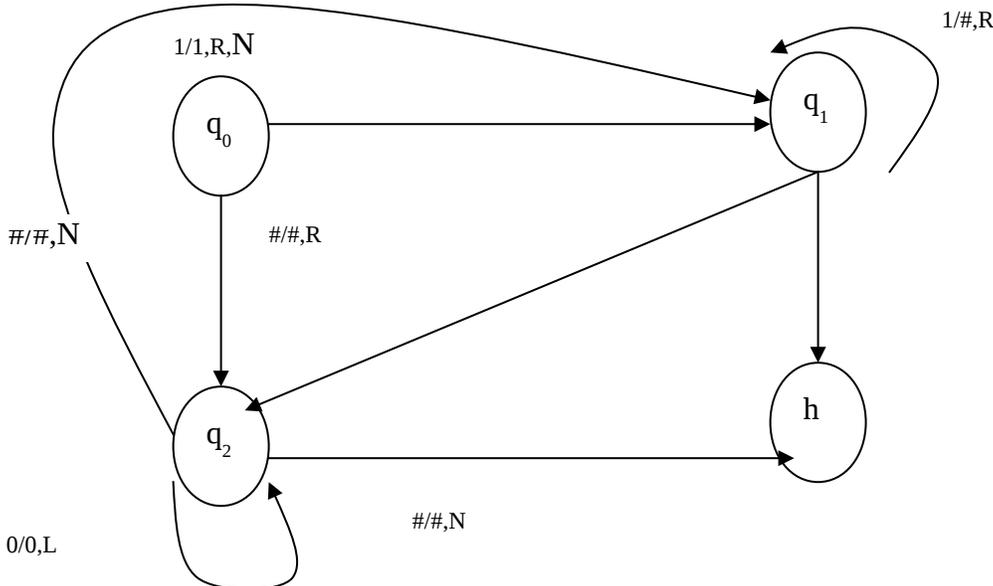
Let $M = \{Q, \Sigma, \Gamma, \delta, q_0, h\}$

Where $Q = \{q_0, q_1, q_2, h\}$

$\Sigma = \{0, 1\}$

$\Gamma = \{0, 1, \#\}$

	0	1	#
q_0	-	-	$(q_2, \#, R)$
q_1	$(q_2, 0, R)$	$(q_1, \#, R)$	$(h, \#, N)$
q_2	$(q_2, 0, L)$	$(q_1, 1, R)$	$(h, \#, N)$
h	-	-	-



Definition of Move TM:-

Move of TM include following three possible different types of moves.

- ❖ Move to the left
- ❖ Move to the right
- ❖ Do not Move

Definition of Length of Computation of TM:-

If C_0 is an initial configuration state of TM M and $C_0, C_1, C_2, \dots, C_n$ is a computation, and then n is called the length of the computation $C_0, C_1, C_2, \dots, C_n$.

Definition of Language accepted by TM:-

Let $M = \{Q, \Sigma, \Gamma, \delta, q_0, h\}$

is a TM It is accepted by Langage L , Which is denoted by $L(M)$.

$L(M)$ is defined as:-

$L(M) = \{ \omega \mid \omega \in \Sigma^* \text{ and if } \omega = a_1 a_2 a_3 \dots a_n \text{ then}$

$(q_0, e, a_1 a_2 a_3 \dots a_n) \vdash^*$

$(h, b_1 b_2 b_3 \dots b_n)$

for some $b_1 b_2 b_3 \dots b_n \in \Gamma^*$

Where :- \vdash^* (Configuration Result) is finite numbers of moves. or \vdash^n

Note Based On Parse Tree:-

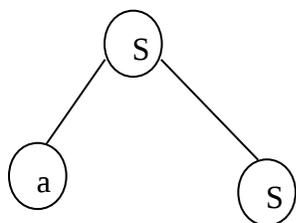
A parse tree is an entity which represents the structure of the derivation of a terminal string from some non-terminal (not necessarily the start symbol). The definition is as in the book. Key features to define are the root $\in V$ and yield $\in \Sigma^*$ of each tree.

Or

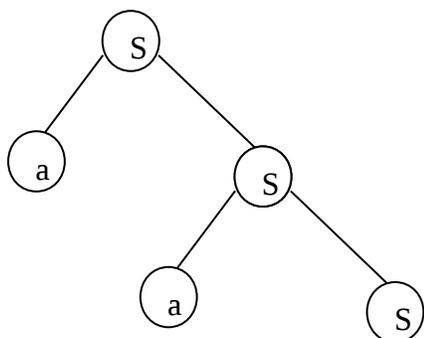
In Other words parse tree is mathematically defined as :-A parse tree is an entity which represents the structure of the derivation of a terminal string from some non-terminal . Key features to define are the root $\in V$ and yield $\in \Sigma^*$ of each tree.

- For each $\sigma \in \Sigma$, there is a tree with root σ and no children; its yield is σ
- For each rule $A \rightarrow \epsilon$, there is a tree with root A and one child ϵ ; its yield is ϵ
- If t_1, t_2, \dots, t_n are parse trees with roots r_1, r_2, \dots, r_n and respective yields y_1, y_2, \dots, y_n , and $A \rightarrow r_1 r_2 \dots r_n$ is a production, then there is a parse tree with root A whose children are t_1, t_2, \dots, t_n . Its root is A and its yield is $y_1 y_2 \dots y_n$

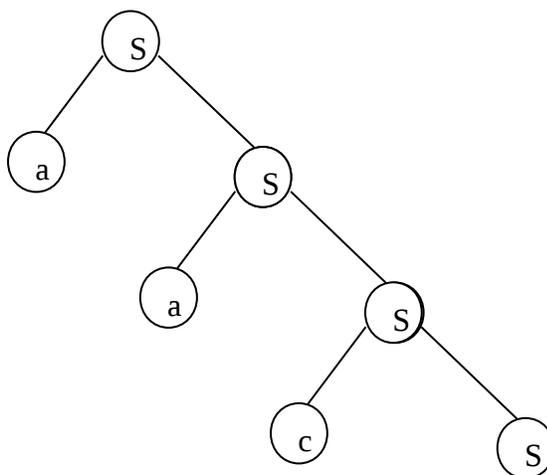
$S \rightarrow aS$



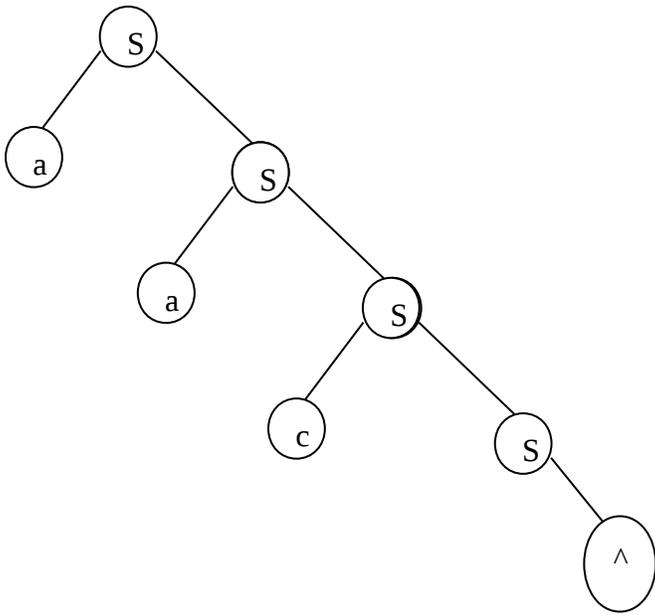
$S \rightarrow aS \rightarrow aaS$



$S \rightarrow aS \rightarrow aaS \rightarrow aacS$

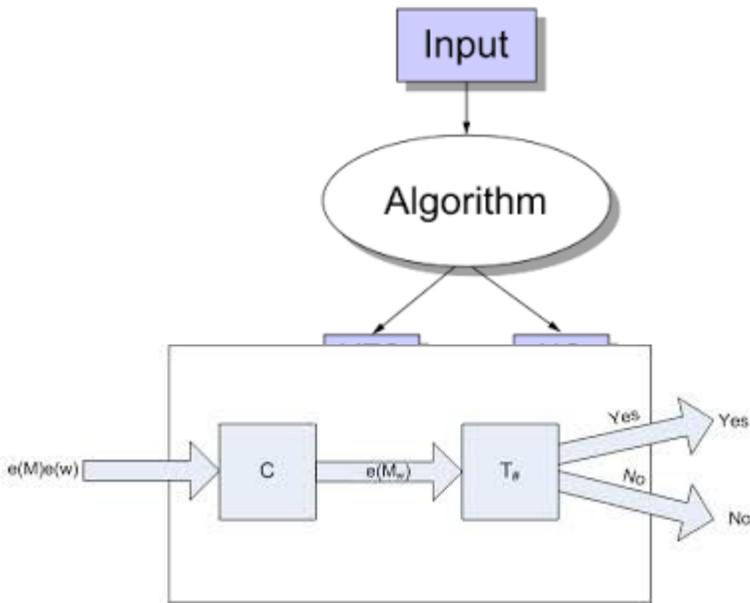


$S \rightarrow aS \rightarrow aaS \rightarrow aacS^{\wedge}$



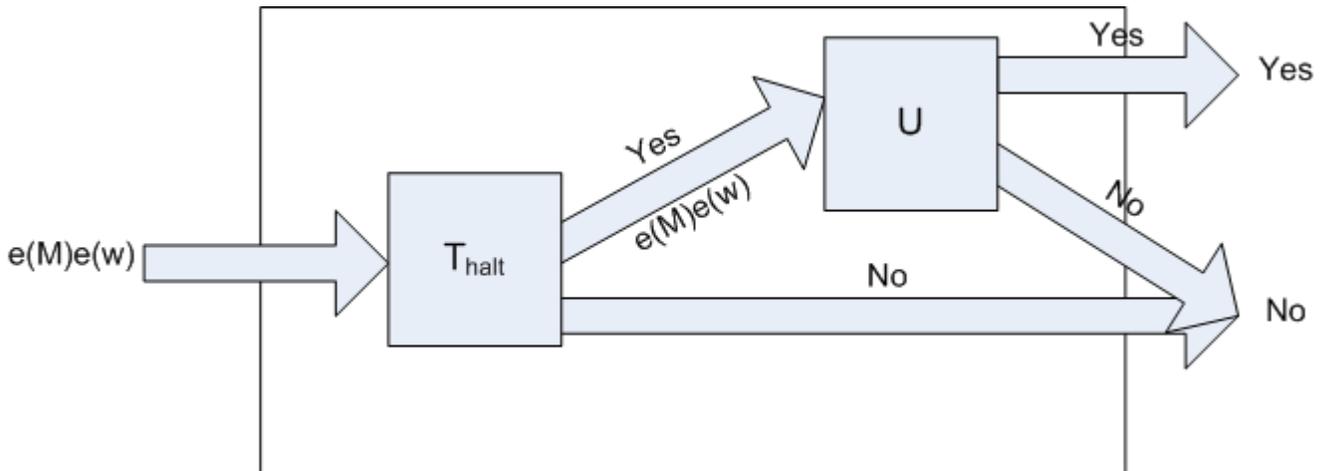
Definition of Turing acceptable language:-

A language L over some Σ is said to be Turing acceptable language, if there exists a TM M such that $L=L(M)$



Definition of Turing decidable language:-

A language L over Σ is said to be Turing decidable, if both the languages L and its compliments $\Sigma^* \sim L$ are Turing Decidable



Observations of TM:-

The concept of observation of TM consists of following remarks.

Remark a:-

TM is a powerful computational machine.

Remark b:-

It is accepting devices for language.

Remark c:-

Halt State of TM Vs Set of Final States of FA/PDA

Remark d:-

Final State version of TM

Acceptability of $\omega \in \Sigma^*$ in final state version

Let $M = \{Q, \Sigma, \Gamma, \delta, q_0, F\}$ is final state version of TM.

ω is said to be acceptable if C_0 is the initial configuration of TM, M

and $C_0 \vdash^* C_n$

is such that

$C_n = (p, \alpha, a, \beta)$

with $p \in F$, $a \in \Gamma$ and $\alpha, \beta \in \Gamma^*$

TM performs Computer functions:-

Computing functions in TM is somewhat different from accepting a language by a TM. In accepting a string of the language the TM has to go to Halt state. Thus going to a halt state is same as saying "yes", i.e, the string is accepted. If it does not go to a halt state, it means "no", i.e, the string is not accepted.

TM may be used as

- ❖ Language recognizer/acceptor
- ❖ A computer of function
- ❖ An enumerator of string of language.

Note:-

Enumerator:-

TM Computation Function:-

$f: \Sigma_0^* \rightarrow \Sigma_1^*$

SUM function of TM:-

Sum of TM can be defined as

SUM={Q, Σ , Γ , δ , q_0 , F}
 Where Q={ q_0 , q_1 , q_2 , q_3 ...Halt }
 Σ ={I}
 Γ = {I, #}

❖ **Legal Configurations for TM**

Some more definitions. The start configuration of the machine M on input w is the configuration q_0w . An accepting configuration is one where the state of the configuration is q_a . A rejecting configuration is one where the state of the configuration is q_r . Accepting and rejecting configurations together are called halting configurations. A Turing machine M accepts input w if a sequence of configurations C_1, C_2, \dots, C_k exists, where

1. C_1 is the start configuration of M with input w.
2. Each C_i yields C_{i+1} .
3. C_k is an accepting configuration

❖ **Illegal Configurations for TM**

Legal Configurations for TM:-

Configuration (i)

Take two natural numbers n and m such that

$$n=0, m=0$$

#	#	#	#	#	#	#	#	#	#	#	#	#	#	***
---	---	---	---	---	---	---	---	---	---	---	---	---	---	-----

*** indicate does not contain #

Configuration (ii)

$$n=0, m \neq 0$$

#	#	1	2	3	4	5	#	6	7	8	9	10	#	...
---	---	---	---	---	---	---	---	---	---	---	---	----	---	-----

Configuration (iii)

$$n \neq 0, m \neq 0$$

#	#	...	1	2
---	---	-----	---	---

Illegal Configurations for TM:-

Configuration (iv)

***	I...	...	***	***
-----	------	-----	-----	-----

Where at least one of *** does not contain # and initially the head is scanning an 'I' or any symbol other than #.

Configuration (v)

I	***	#	***	***
---	-----	---	-----	-----

Where *** does not contain # then the configuration represents only one of the natural numbers

Configuration (vi)

###	...	#	#	
-----	-----	---	---	--



Also in case of legal initial configurations, the final configuration that represents the result $m+n$ should be of the confirm.

Halting

Note:-

In a deterministic Turing machine, the set of rules prescribes at most one action to be performed for any given situation. A non-deterministic Turing machine (NTM), by contrast, may have a set of rules that prescribes more than one action for a given situation.

Sum of TM can be defined as

$$SUM = \{Q, \Sigma, \Gamma, \delta, q_0, F\}$$

$$\text{Where } Q = \{q_0, q_1, q_2, q_3, \dots, \text{Halt}\}$$

$$\Sigma = \{I\}$$

$$\Gamma = \{I, \#\}$$

Example:- TM compute binary function **MONUS** (or also called proper subtraction).

It is defined as

$$\text{Monus: } \mathbb{N} \times \mathbb{N} \rightarrow \mathbb{N}$$

$$\text{Such that } \text{monus}(m,n) = \begin{cases} m-n & \text{if } m \geq n \\ 0 & \text{else} \end{cases}$$

Example:- To compute the function $n \pmod{2}$

Let if f denotes the function, then

$$f: \mathbb{N} \rightarrow \{0,1\}$$

is such that

$$f(n) = \begin{cases} 0 & \text{if } n \text{ is even} \\ 1 & \text{if } n \text{ is odd} \end{cases}$$

There are two types of basic machines.

❖ Symbol Writing machines

Let $M = \{Q, \Sigma, \Gamma, \delta, q_0, h\}$, Let $a \in \Sigma$ be a particular symbol such that for some $\delta(q_0, x) = (h, a, N)$ for all $x \in \Sigma$. If we put 'a' in place of q_0 then machine will be halt. We denote such machine by W_n

❖ Right/Left head Moving Machines

o **Right head Moving Machines**

Let $M = \{Q, \Sigma, \Gamma, \delta, q_0, h\}$ δ is given by $\delta(q_0, x) = (h, x, R)$ for all $x \in \Sigma$ where x is a sense variable which is not a member of Σ . The machine moves one square to the right and halts.

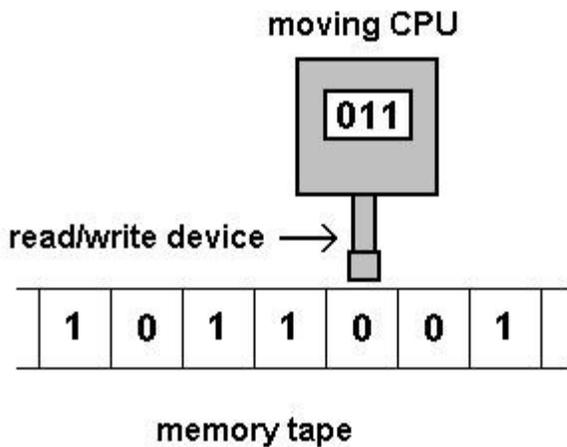
o **Left head Moving Machines**

Let $M = \{Q, \Sigma, \Gamma, \delta, q_0, h\}$ δ is given by $\delta(q_0, x) = (h, x, L)$ for all $x \in \Sigma$ where x is a sense variable which is not a member of Σ . The machine moves one square to the left and halts.

Turing machine –miscellany:-

Extension of TM considered are:-

- ❖ The tape may be allowed to be finite in both the directions.
- ❖ There may be more than one head scanning various cells of the tape. there are two or more heads may simultaneously read the same cell or may attempt to write in the same cell.
- ❖ There may be several tapes instead of only one. each tape having its own independent head.
- ❖ The tape may be k-dimensional, $k \geq 2$ instead of one dimensional.
- ❖ It is non-deterministic turing machine.



This TM can satisfy all the above given property.

Extension of TM-miscellany:-

Extension (I):-

It is two-way turing machine (Infinite tape).

Extension (II):-

TM having R heads , $K \geq 2$ with only one tape.

Extension (III):-

Multi-tape machine.

#	W1	W2	W3	...	#	W1	W2	W2	W3	W4	...	#
---	----	----	----	-----	---	----	----	----	----	----	-----	---

Tape2

w1	w2	w3	#	...	#	w1	w2	w2	#	#	...	#
----	----	----	---	-----	---	----	----	----	---	---	-----	---

Configuration of TM:-

(TM1, (#w1,w2,w3), (#,w1,w2,w3,w4))

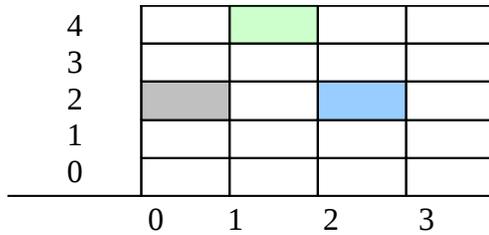
Tape1

(TM1, (w1,w2,w3,#), (#,w1,w2,w3,w4))

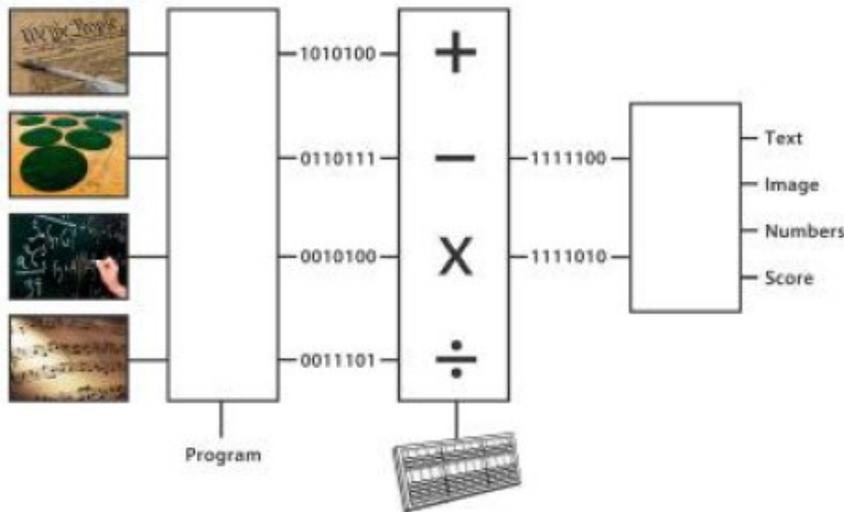
Tape2

Extension (IV):-

K-Dimensional Turing machine



Example:-



Extension (V):- NDTM

It is defined as a TM is one way & infinite. Its movement is Left, Right and No move. It consists of six tuple (sextuple).

NDTM = (Q, Σ, Γ, δ, q₀, h).

Where :-

- Q Is the finite set of states
- Σ It is the finite set of non-blank information symbol.
- Γ It is the set of tape symbols, including the blank symbol (#)
- δ It is the next move (L, R, N)
- q₀ It is the initial/Start State (q₀ ∈ Q)
- h h ∈ Q is the halt state.

δ: Q × Γ → Power set of (Q × Γ × {L, R, N})

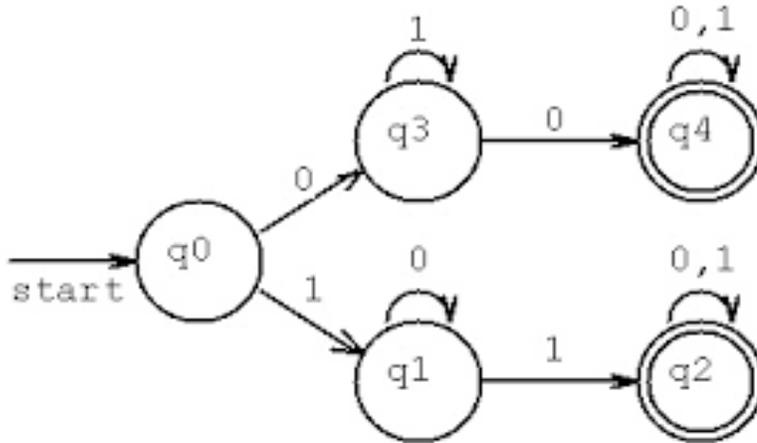
TM final State version:- Most Important

It is defined as

NDTM = (Q, Σ, Γ, δ, q₀, F)

- Q Is the finite set of states
- Σ It is the finite set of non-blank information symbol.
- Γ It is the set of tape symbols, including the blank symbol (#)

- δ It is the next move (L,R, N)
- q_0 It is the initial/Start State($q_0 \in Q$)
- F Final state.
- $\delta: Q \times \Gamma \rightarrow$ Power set of $(Q \times \Gamma \times \{L,R,N\})$



UTM(Universal TM):-

A TM which can solve all sorts of solvable problems. Such a Turing Machine is called a UTM. To make UTM following observation must be implementing.

- ❖ Observation I
- ❖ Observation II
- ❖ Observation III
- ❖ Observation IV

Observation I:-

A TM M designed to solve a particular problem P, consists, apart from the description of the set possible states and the set of possible inputs.

Observation II:-

A TM, M designed to solve a particular problem P, can essentially be specified by.

- ❖ The initial state q_{0m} of the TM, M.
- ❖ The next move function δ_m of M, which can be described by the rules of the form: if the current state of TM M is q_i and contents of cell being scanned are a_i then the next state of M is q_k , The symbol to be written in the current cell is a_i and move M_i of the tape head may be To-Left, To-Right or None.

Observation III:-

UTM should be able to simulate each Turing Machine. Therefore we assume each of the set of states,

$$Q_\infty = \{ q_0, q_1, q_2, q_3, q_4, \dots \}$$

And The tape symbol is

$$\Gamma_\infty = \{ a_1, a_2, a_3, a_4, \dots \}$$

$$H_{mv} = \{ L, R, N \}$$

Observation IV:-

Each of the set Q_m and Γ_∞ involves infinitely many symbols.

Language accepted/Decided By TM.

A problem is a set of its instances, where each instance is obtained by assigning values to the parameters from the domain, say D, over which the problem is defined. Thus, a problem is equivalently defined as a set from a domain D.

Example:-1

A quadratic equation $ax^2 + bx + c = 0$, with $a \neq 0$ and a, b, c belong in real number R.

$b^2-4ac \geq 0$ Accepted for real roots.
 $b^2-4ac < 0$ Rejected due to complex roots/Imaginary Roots.

Example:-2

$\log_b a \neq 0$ and $a \neq 0$

$\log_b a > 0$ and $a > 0, b \neq 0$ and $a \neq 0$ Accepted for real log value. Where $a, b \in \mathbb{R}$

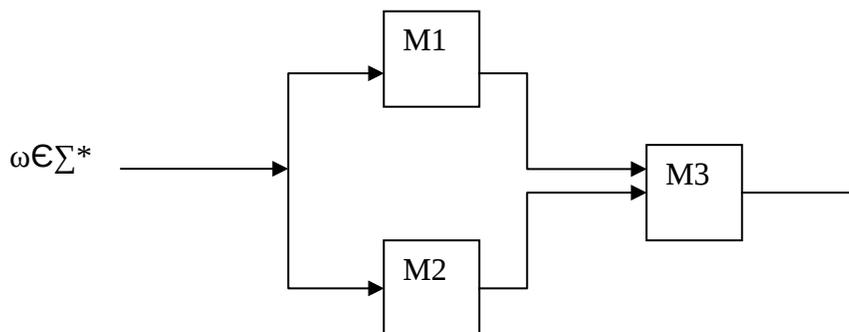
$\log_b a < 0$ and $b < 0$ Rejected due to find undefined value. Where $a, b \in \mathbb{R}$

Theorem:-

Let L_1 and L_2 are two languages, each of the following languages.

- ❖ $L_1 \cup L_2$
- ❖ $L_1 \cap L_2$
- ❖ $\Sigma^* - L_1$

$L_1 \cup L_2$

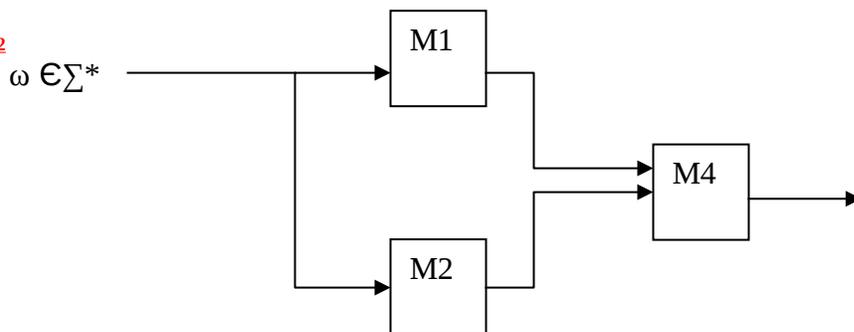


M1, M2, M3 are Turing machines

Machine M3 returns Yes as output, if at least one of the inputs of M1 or M2 is Yes.

Machine M3 returns No as output, if both of the inputs of M1 and M2 are No.

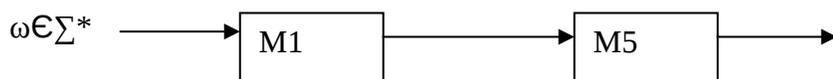
$L_1 \cap L_2$



Machine M4 returns Yes as output, if both inputs of M1 and M2 are Yes.

Machine M4 returns No as output, if at least one of the inputs of M1 or M2 is No.

$\Sigma^* - L_1$



M5 delivered as output of M-compliment. Thus for each $\omega \in \Sigma^*$ m compliment returns either Y or N such that if $\omega \in L$ then complements return No else return Yes.

Chomsky Hierarchy:- Most important

Regular languages (Type 3 Languages) So far, we know that a language L is regular if

- ❖ L is accepted by a finite automata.
- ❖ L can be expressed by a regular expression.

We know that regular language is a context free language and a context free language can be described by context free grammar. A regular grammar to be defined below.

- ❖ Right Linear Grammar:-
 $G=(V,T,P,S)$ is said to be right linear if every production p is of the form $A \rightarrow a$ or $A \rightarrow aB$
 A and b belong to V
- ❖ Left Linear Grammar:-
 $G=(V, T,P,S)$ is said to be left linear if every production p is of the form $A \rightarrow a$ or $A \rightarrow Ba$
- ❖ Regular Grammar
 A context free grammer $G=(V,T,P,S)$
 is called regular, if it is either left linear or it is right linear

Define Context Sensitive Grammar:-

Short Notes

A grammar $G=(V,T,P,S)$.

Where V is the set of variables. T is the set of terminals is the set of production and S is the start symbol. It is said to be context sensitive grammar if every production is of the form

$\alpha \rightarrow \beta$

Where

- ❖ $\alpha, \beta \in (V \cup T)^*$
- ❖ $|\beta| \geq |\alpha|$
- ❖ α contains at least one variables

Define Context Sensitive Language:-

Short Notes

A language generated by a context sensitive grammar is called a context sensitive language.

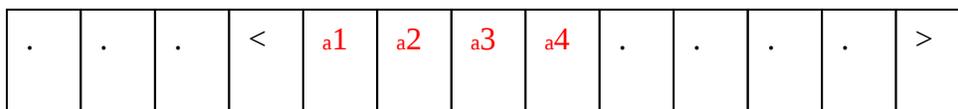
Linear Bounded Automata (LBA):-

Short Notes

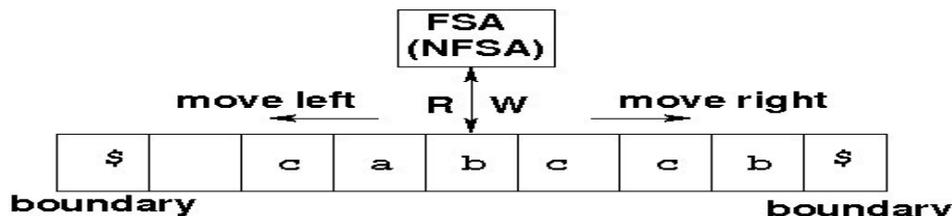
LBA is an NDTM

$M= (Q, \Sigma, T, S, q_0, h)$ with the following restrictions

- ❖ Two special symbol $>$ and $<$ not belong in Γ . It is written as $x=a_1, a_2, a_3, a_4 \dots a_n$



- ❖ Tape head may scan the cells containing $>$ and $<$ but these cells can not be written into
- ❖ Tape head cannot move to or seam any cell right of $>$ and any cell to the left of $<$



LINEAR BOUNDED AUTOMATON

Recursive Function Theory:-

Short Notes

o Recursive function/Calling itself function.

A function that contains a function call to itself or a function call to a second function which eventually calls the first function is known as recursive function.

Condition for recursion:-

- ❖ Each time a function calls itself it must be nearer, in some sense to a solution.
- ❖ There must be a decision criterion for stopping the process or computation.

Example:-1

Recursive function for factorial:-

$$\begin{aligned} \text{fact}(n) &= 1 && \text{if } n=0 \\ \text{fact}(n) &= n * \text{fact}(n-1) && \text{if } n > 0 \end{aligned}$$

Example:-2

The exponential x^n is recursively defined as:-

$$\begin{aligned} x^0 &= 1 \\ x^n &= x \cdot x^{n-1}, \text{ for a natural number } n \geq 1 \end{aligned}$$

Example:-3

Recursive function for Fibonacci series:-

$$\begin{aligned} \text{fib}(n) &= 0 && \text{if } n=0 \\ \text{fib}(n) &= 1 && \text{if } n=1 \\ \text{fib}(n) &= \text{fib}(n-1) + \text{fib}(n-2) && \text{if } n > 1 \end{aligned}$$

Partial, Total and Constant Functions: - Full question

Constant Functions:-

A function is called constant function if

Example:-1

$$\begin{aligned} F: \mathbb{N} &\rightarrow \mathbb{N} \text{ such that} \\ F(n) &= 10 \text{ for all } n \in \mathbb{N} \end{aligned}$$

Example:-2

$$\begin{aligned} F: \mathbb{N}^0 &\rightarrow \mathbb{N} \text{ such that} \\ F(_) &= 15 \end{aligned}$$

Example:-3

$$\begin{aligned} F_q^k: \mathbb{N}^k &\rightarrow \mathbb{N} \text{ such that} \\ F_q^k(n_1, n_2, n_3, n_4, \dots, n_k) &= q \\ \text{for } n_1, n_2, n_3, \dots, n_k &\in \mathbb{N} \text{ and for some integers } k \text{ and } q \text{ in } \mathbb{N} \end{aligned}$$

Partial Functions:-

A function in mathematical sense is called partial function if

$F: X \rightarrow Y$ is a rule that associates to each element of $x \in X$ a unique element $y \in Y$.

X is called domain

Y is called codomain of F

Example:-

$$\begin{aligned} F(x_1) &= y_1 \\ F(x_2) &= y_2 \end{aligned}$$

Total and Partial Function:-

1:- **Successor function** $S:N \rightarrow N$ such that $S(x)=x+1$ for all $x \in N$. The S is a total function from N to N.

2:- **The function**
Plus: $N^2 \rightarrow N$
 $Plus(x,y)=x+y$ for all x,y in N
is also called total function.

3:- **The function**
Minus: $N^2 \rightarrow N$
 $Minus(x,y)=x-y$ for $x \geq y \in N$
is also called total function.

4:- **The function**
 $Monus(x,y) = \begin{cases} x-y & \text{if } x \geq y \\ 0 & \text{if } x < y \end{cases}$
is also called total function.

5:- **The function**
SQRT: $N \rightarrow N$
Such that for $x,y \in N$
 $SQRT(x)=y$ if $y^2=x$
is called strictly partial function

Primitive recursion Function:-

A function is primitive recursive function if(and only if) either

- ❖ It is one of the initial function or one of the projections
 $\prod_i^k, i \leq k$ or
- ❖ It is obtained by application of some finite sequence of structuring rules such as combination, primitive recursion and composition.

Primitive recursive functions:-

The set of primitive recursive functions is obtained by three types of initial functions and three * structuring rules for constructing more complex functions from already constructed functions.

Three Types of Initial functions:-

- ❖ The 0-place zero function
 $\xi: N^0 \rightarrow N$ such that $\xi()=0$
- ❖ The successor function
 $\partial: N \rightarrow N$
such that
 $\partial(n)=n+1$ for all n in N
- ❖ The projection :-
We know that for $k \geq 1, N^k$ is the set of all k-tuples of the form

$$\bar{n} = (n_1, n_2, n_3, n_4, \dots, n_k) \text{ for } 1 \leq i \leq k$$

Projection is defined as:-

$$\prod_i^k: N^k \rightarrow N \text{ such that for } \bar{n} = (n_1, n_2, n_3, n_4, \dots, n_k) \text{ for } 1 \leq i \leq k$$

$$\prod_i^k: \bar{n} = \prod_i^k: (n_1, n_2, n_3, n_4, \dots, n_k)$$

Combination:-

The combination of two functions may be defined as

$$g: N^k \rightarrow N$$

$$h: N^k \rightarrow N$$

is a function

$$f: N^k \rightarrow N * N$$

such that for $(n_1, n_2, n_3, n_4, \dots, n_k) = \bar{n}$ belong N^k

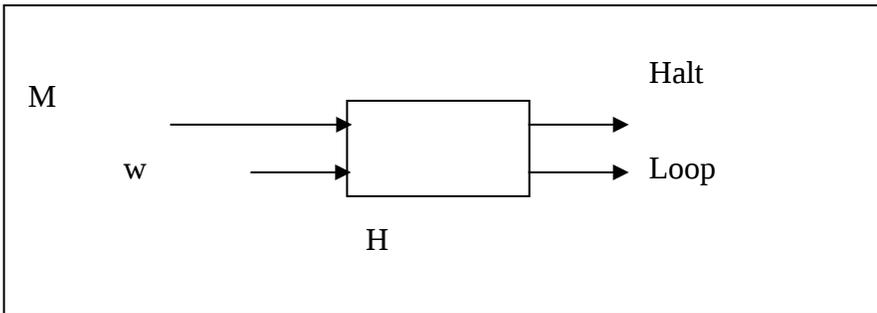
$$f(\bar{n}) = (g(\bar{n}), h(\bar{n}))$$

Decidable and Undecidable Problems:-

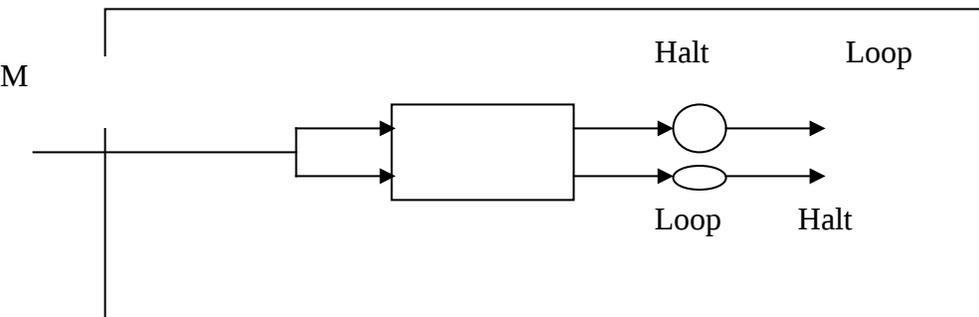
A class of problems with two outputs “Yes” or “no” is said to be decidable(solvable) if there exist some definite algorithm which always terminates (halts) with one of two outputs “yes” or “no”. Otherwise the class of problems is said to be undecidable (unsolvable).

Halting Problems:-

Given a Turing machine M and an input w to the machine M, determine if the machine M will eventually halt when it is given input w.



H generate an output “halt” if H determines that M stops on input w or it outputs “loop” otherwise



Undecidability of Post Correspondence Problem(PCP):-

Let Σ be an alphabet, and let L and M be two lists of nonempty strings over Σ , such that L and M have the same number of strings. We can represent L and M as follows:

$$L = (w_1, w_2, w_3, w_4, w_5, \dots, w_k)$$

$$M = (v_1, v_2, v_3, v_4, v_5, \dots, v_k)$$

❖ Each of the integers is greater than or equal to one

- ❖ Each of the integers is less than or equal to k
- ❖ The concatenation of $w_1, w_2, w_3, w_4, \dots, w_m$ is equal to the concatenation of $v_1, v_2, v_3, v_4, \dots, v_m$

Example:- Consider the following instance of the PCP

$$\Sigma = \{a, b\}$$

$$\text{List } L = \{a, ab\}$$

$$\text{List } M = \{aa, b\}$$

Complexity:- Most Important Full Question of 15 marks

Complexity of computer based problems may be following two types

- ❖ Space complexity:- It determines line of codes in source codes.
- ❖ Time complexity:- It determines execution time of object code. It depends upon size of source codes.

Notation for measuring growth rates of functions (Asymptotic Notation):-

There are five well known notations and how these are pronounced.

- ❖ $O(n^2)$ is pronounced as big-Oh of n^2
- ❖ $\Omega(n^2)$ is pronounced as big-omega of n^2
- ❖ $\Theta(n^2)$ is pronounced as theta of n^2
- ❖ $o(n^2)$ is pronounced as little oh of n^2
- ❖ $\omega(n^2)$ is pronounced as little omega of n^2

Asymptotic Notation O:-

It is defined as

$$f(x) \leq Cg(x) \text{ for all } x \geq k$$

Where :-

f and g are functions

C is called Integer constant

k is called real constant

Example:-

$$f(x) = 2x^3 + 3x^2 + 1$$

Show that

- ❖ $F(x) = O(x^3)$
- ❖ $F(x) = O(x^4)$

Solution:-

$$F(x) = O(x^3)$$

$$f(x) = 2x^3 + 3x^2 + 1$$

we know that

$$f(x) \leq Cg(x) \text{ for all } x \geq k$$

$$g(x) = 2x^3 + 3x^3 + 1 \cdot x^3$$

$$f(x) \leq Cg(x)$$

$$2x^3 + 3x^2 + 1 \leq 2x^3 + 3x^3 + 1 \cdot x^3$$

$$f(x) \leq 6g(x)$$

$$O(x^3) \leq 6O(x^3)$$

$$F(x) = O(x^3)$$

Above Inequality is true.

Solution:-

$$F(x) = O(x^4)$$

$$f(x) = 2x^3 + 3x^2 + 1$$

we know that

$$f(x) \leq Cg(x)$$

$$2x^3+3x^2+1 \leq 2x^4+3x^3+1x$$

$$F(x) \leq O(x^4)$$

Above Inequality is true.

Asymptotic Notation Ω :-

It is defined as

$$f(x) \geq Cg(x) \text{ where } x \geq k \text{-----(1)}$$

Example:- For the functions

$$f(x) = 2x^3+3x^2+1$$

and $h(x) = 2x^3-3x^2+2$

Proof:-

$$\diamond f(x) = \Omega(x^3)$$

$$\diamond h(x) = \Omega(x^3)$$

Solution:-1

$$f(x) = \Omega(x^3)$$

$$f(x) = 2x^3+3x^2+1$$

$$f(x) \geq Cg(x) \text{ where } x \geq k$$

$$\text{put } C=1$$

$$2x^3+3x^2+1 \geq x^3 \text{ for all } x \geq 1$$

In this inequality for $x \geq 1$ must satisfy the give inequality expression ---(1) for any value of x according $x \geq k$.

Therefore above Inequality is true.

Solution:-2

$$h(x) = \Omega(x^3)$$

$$h(x) = 2x^3-3x^2+2$$

$$h(x) \geq Cg(x) \text{ where } x \geq k$$

$$2x^3-3x^2+2 \geq Cx^3 \text{ for all } x \geq 1$$

$$x^3(2-C) - 3x^2+2 \geq 0$$

$$\text{Put } C=1$$

$$x^3-3x^2+2 \geq 0 \text{ for all } x \geq k$$

Above Inequality is true.

Asymptotic Notation Θ :-

It is defined as

$$C_2g(x) \leq f(x) \leq C_1 g(x) \text{ for all } x \geq k \text{-----(1)}$$

Where

C_1, C_2 are called positive constant

Example:-

For the function

$$f(x) = 2x^3+3x^2+1$$

Show that

$$f(x) = \Theta(x^3)$$

Solution:-

for $C_1=3$, $C_2=1$ and $k=4$

$C_2 g(x) \leq f(x) \leq C_1 g(x)$ for all $x \geq k$

$C_2 x^3 \leq 2x^3 + 3x^2 + 1 \leq C_1 x^3$

$1x^3 \leq 2x^3 + 3x^2 + 1 \leq 3x^3$

$x^3 \leq 2x^3 + 3x^2 + 1 \leq 3x^3$

Above Inequality is true.

Asymptotic Notation o (Little oh):-

It is defined as

$f(x) \leq Cg(x)$ for all $x \geq k \geq 1$

$C \geq 0$

Example

for $f(x) = 2x^3 + 3x^2 + 1$ we have

$f(x) = o(x^n)$ for any $n \geq 4$

$2x^3 + 3x^2 + 1 \leq C x^n$

Divide by x^3

$2 + 3/x + 1/x^3 \leq C x^{n-3}$

Above Inequality is true.

Asymptotic Notation ω :-

It is defined as

$f(x) = \omega(g(x))$

if there exist a positive integer k such that

$f(x) > C g(x)$ for all $x \geq k$

Example:-

if $f(x) = 2x^3 + 3x^2 + 1$

then show $f(x) = \omega(x)$

$f(x) > C g(x)$

$2x^3 + 3x^2 + 1 > Cx$

Divide by x in both sides

$2x^2 + 3x + 1/x > C$

$2x^2 + 3x + 1/x \geq 2x^2 + 3x \geq 2C^2 + 3C^1$ ($K \geq C+1$)

$f(x) = \omega(x)$

Above Inequality is true.

Theorem:-

Let $f(x)$ and $g(x)$ be functions in the definitions of little-omega then

$f(x) = \omega(g(x))$ if and only if

$\lim_{x \rightarrow \infty} f(x)/g(x) = \infty$

$x \rightarrow \infty$

$\lim_{x \rightarrow \infty} g(x)/f(x) = 0$

$x \rightarrow \infty$

Classification of problems:-

What is P:-

P is the set of all decision problems which can be **solved** in *polynomial time* by a *deterministic Turing machine*. Since they can be solved in polynomial time, they can also be verified in polynomial time. Therefore P is a subset of NP.

What is **NP**:-

NP is the set of all **decision problems** (questions with a yes-or-no answer) for which the 'yes'-answers can be verified in polynomial time ($O(n^k)$ where n is the problem size, and k is a constant) by a **deterministic Turing machine**. Polynomial time is sometimes used as the definition of fast or quickly.

NP Completeness:-

A nondeterministic Turing machine can do everything a regular computer can and more. This means all problems in **P** are also in **NP**.

Or

Definition: - A problem is said to be Nondeterministically Polynomial (**NP**) if we can find a nondeterministic Turing machine that can solve the problem in a polynomial number of nondeterministic moves.

NP-hard:-

If a problem is **NP-hard**, this means I can reduce any problem in **NP** to that problem. This means if I can solve that problem, I can easily solve any problem in **NP**. If we could solve an **NP-hard** problem in polynomial time, this would prove $P = NP$.

NP-complete:-

A problem is **NP-complete** if the problem is both

- **NP-hard**
- **NP**.

Example 1: Let us consider the classical version of **TSP** (Travelling Sales Person) .

Example 2: The halting problem is **NP-hard**.

TSP:-

