BUREAU'S

HIGHER SECONDARY

INFORMATION TECHNOLOGY

Class - XII

Prescribed by Council of Higher Secondary Education, Odisha, Bhubaneswar

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Foreword

Twenty first century society is learning, sharing and innovating in a pace that would be only second to the human thought process. Advent of Information and Communication Technology (ICT) has leap fogged the process of computing and communicating among the world society. The ICT policies for the Higher Secondary curriculum aim at augmenting creativity and promote global competitiveness.

Now the aim is to promote critical thinking, collaborative learning and multi discipline problem-solving skills among the budding students ready to plunge in to the professional or vocational courses. The curriculum of "Information Technology" has been revised accordingly with focus on rapid application development using IDE, data processing and domain-specific applications, e.g. e-Governance, e-Business and e-Learning. Further the use of open source software is being encouraged.

The text book of Information Technology, Class-XI has been published by the Bureau. The text book for Class-XII is now ready. In the Syllabus of IT for Class-XII, a unit on Networking has been introduced. Like the book for Class-XI, the RDBMS (Relational Database Management System) and IDE uses MYSQL in place of MS-Access and IDE based programming is done, by using Java in place of VB. It is just a continuation of the Class-XI course. A unit on IT Applications has been continued with the focus on designing both front end and back end with proper data connectivity. A brief but valuable idea about electronic transaction in India has been included at the end of this book as an appendix, which may be of tremendous help for every stake holder.

I record my sincere thanks to the Council for allowing the Bureau to publish the text book and I do hereby express my appreciation and gratitude to the writers, for their cooperation and diligence in preparing the manuscript of this book. My special thanks go to Prof. N.C. Samal for meticulously reviewing the contents of the book before publication.

Finally, I could not but extend my appreciation to the officers and staff of Bureau, and especially to Sri Biraja Bhusan Mohanty, Dy. Director of the Bureau for his untiring efforts to make this new version press ready. Further, I shall be very happy to acknowledge the suggestions regarding any correction or improvement of the from its readers.

I hope all success for the book.

Sri Umakanta Tripathy
Director

Preface

Information Technology that refers to the convergence of computer, communication and content technologies plays catalytic role in emergence of new socio-economic applications. Need of introducing IT as an elective subject to all the students of Arts, Commerce and Science stream was needed to build problem-solving skills among the students just before they enter the professional courses. Accordingly the first part of Textbook on IT was published as per the syllabus of the CHSE (Odisha) last year meant to be taught during the First Year of the Higher Secondary Class. In this Second part, some previous topics are revisited so as to make it a seam less transition for students. These two volumes will help the students to better prepare for careers in various industries requiring IT tools and applications.

In this new version, we have introduced Open Standards and Open Source aims at Vendor Neutrality of tools, Creative computing and Collaborative Learning environment, development of Front End Interface, Back End Database and connectivity of both, so that a student would get a complete feel of Application Development. Emphasis has been given for better awareness of Cyber Laws to adopt good ethical practice, while working on-line. In this era of on-line financial transactions, the students should be doubly alert in respect of on-line frauds. Finally a contemporary overview of 'Cashless Transactions in India' is provided at the end of this book in shape of an Appendix, to help the student community to participate in spreading the idea of Less-Cash Economy in the country.

The authors would like to express their deep sense of appreciation to the expertise, understanding and kindness displayed by the Director Sri Umakant Tripathy, Dy Director Sri Biraja Bhusan Mohanty and staff of the Bureau in the preparation of this book. Authors are grateful to Dr Brundaban Pradhan, Lecturer in Physics, B.J.B. Junior College, Bhubaneswar and Smt. Mrunalinee Patnaik of Rama Devi Women's College, Bhubaneswar for providing valuable logical and material support during the preparation of this book.

Akshay Tritiya **Authors**

The 29th April, 2017

CHSE SYLLABUS

Class - XII

(IT Syllabus - 2016)

Unit 1 : Networking and Open Standards : (25 periods / 30 mark)

(i) Computer Networking: (08 periods / 10 mark)

Networking-a brief overview; Network Devices (Hub, Switch, Bridge, Router, Repeater, Gateway) and their functions, Types of network (LAN, MAN, WAN, PAN), Network Topologies (Star, Ring, Bus, Tree), Communication Media:-Wired Technologies (Co-Axial, Ethernet Cable, Optical Fiber), Wireless Technologies (Blue Tooth, Infrared, Microwave, Radio Link, Satellite Link)

(ii) Internet and its Application: (12 periods / 10 mark)

Internet- an overview, Internet backbone, Internet access (Dial-Up, Direct, Broadband connections), Role of ISP, Internet Protocols (TCP/IP, HTTP, FTP, TELNET, WAIS, GOPHER), Internet Addressing (IP Address, Domain name, MAC (Media Access Control), Internet Application (Web Browser & Search Engines, URL, WWW, Web pages & Web sites, SMS, Voice Mail, Electronic Mail, Chat, IRC, Video Conferencing), Wireless/ Mobile Communication (GSM, CDMA, WLL, 3G, 4G)

(iii) Network Security on Internet: (05 periods / 10 mark)

Threats and prevention from virus, Use of Cookies, Firewall, Digital Signature, Cyber Crimes (Hacking, On-line-Fraud, Pornography, Snooping, Spooling, Cyber Stalking, Software piracy), Cyber Laws

Unit 2 : Programming : (40 periods / 16 mark)

Review of 1st Year Course;

(i) Programming Fundamentals: (28 periods / 10 mark)

Basic concept of Access specifier for class members (data members and methods), Basic concept of Inheritance, Commonly used libraries:- String class methods [toString(), concat(), length(), toLowerCase(), toUpperCase(), trim(), substring()], Math class methods [pow(), round()], Accessing MySQL database using ODBC/JDBC to connect with database

(ii) HTML based web pages covering basic tags: (12 periods / 06 mark)

HTML, DHTML, TITLE, BODY, H1..H6, Paragraph (P), Line Break (BR), Section Separator (HR), FONT, TABLE, LIST (UL, OL), FORM, Creating and accessing static & dynamic pages using HTML, DHTML and introduction to XML.

Unit 3 : Relational Database Management System : (30 periods / 14 mark)

Review of RDBMS from 1st Year Course

(i) Database Fundamentals : (20 periods / 08 mark)

Concept of Database Transaction, Committing and revoking a Transaction using COMMIT and ROLLBACK, Grouping Records (GROUP BY), Group functions [MAX(), MIN(), AVG(), SUM(), COUNT(); using COUNT(*), DISTINCT clause with COUNT; Group Functions and Null Values, Displaying Data From Multiple Tables (Cartesian product, Union, concept of Foreign Key, Equi-Join

(ii) Introduction to MySQL : (10 periods / 06 mark)

Working with NULL values, ORDER BY clause (sorting in ascending and descending order, sorting by Column Alias Name, sorting of multiple columns), Manipulating data of a table/relation (UPDATE command to change existing data of a table, DELETE command for removing rows from a table), Re-structuring a table (ALTER Table for adding new columns / deleting existing columns, DROP Table for deleting a table); String functions:- ASCII( ), CHAR( ), CONCAT( ), INSTR( ), LCASE( ), UCASE( ), LENGTH( ), LTRIM( ), MID( ), RIGHT( ), RTRIM( ), TRIM( ), SUBSTR( ); Mathematical functions:- POWER( ), ROUND( ), TRUNCATE( ); Date & Time functions:- CURDATE( ), MONTH( ), DAYOFMONTH( ), DAYOFWEEK( ), DAYOFYEAR( ), NOW( ), SYSDATE( );

Unit 4 : IT Applications : (10 periods / 10mark)

(i) e-Business: Definition, e-Commerce, Types of e-Commerce & their benefits, e-Business web sites & their salient features, societal impact & challenges of e-Business

(ii) Front-end Interface: Introduction; content and features; identifying and using appropriate components (Text Box, Radio Button, Checkbox, List, etc.) for data entry, validation and display.

(iii) Back-end Database: Introduction and its purpose, exploring the requirement of tables and its essential attributes.

(iv) Development of Database: Demonstration and development of appropriate Front-end interface and Back-end Database for e-Governance applications.

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Star, Ring, Bus, Tree

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Wireless Technologies: Blue Tooth, Infrared, Microwave, Radio Link, Satellite Link

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Internet backbone

Internet access : Dial-Up, Direct, Broadband connections

Role of ISP

Internet Protocols :

TCP/IP, HTTP, FTP, TELNET, WAIS, GOPHER

Internet Addressing:

IP Address, Domain name, MAC (Media Access Control)

Internet Application:

Web Browser & Search Engines, URL, WWW, Web pages & Web sites, SMS, Voice Mail, Electronic Mail, Chat, IRC, Video Conferencing

Wireless/Mobile Communication:

GSM, CDMA, WLL, 3G, 4G

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Mathematical functions: POWER ( ), ROUND ( ), TRUNCATE ( );
Date & Time functions: CURDATE ( ), MONTH ( ), DAYOFMONTH ( ), DAYOFWEEK ( ), DAYOFYEAR ( ), NOW ( ), SYSDATE ( )

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UNIT - 1

NETWORKING

CHAPTER - 1

COMPUTER NETWORKING

In our daily life, we have been communicating with our parents, teachers and friends through mother tongue or any other dialect. This communication takes place either directly or through telephones or via Internet by using computers (a desktop or a laptop or a smart phone)! The use of computer does not stop here. We use Bank ATMs for monetary transactions; take a print-out from a printer attached to some other computer by typing appropriate command from our smart phones, purchase railway tickets from the comfort of our home computer, etc. How the information that we feed gets transferred to various other devices (like printers, servers, speakers, etc.) and we also get return information in most of the cases? Machines do not have mouth or ear for communication! It happens through a process called, Computer Networking.

A computer network is a collection of interconnected computers and other hardware devices which are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users.

Advantages of using a Network :

There are distinct advantages of using networked computers over stand alone computers. Network increases efficiency, optimizes utility and enhances overall applicability of the available resources (man & machine) in large Government or Private Organizations. Current networking software provides the following advantages.

Program Security & Easy Maintenance :

- Store copies of programs in locked, read-only spaces on the server.
- Protect program files from unauthorized copying.
- Prevent tampering with programs.
- Well-planned networking serves the needs of an organization for several years.

More Secure Database & Personal Work Files :

- Users can save copies of their personal work in multiple computers of a network for future safety. Information do not get lost, if a single computer developes any fault.
- Password protection ensures inadvertent or malicious copying and/ or deletion of files.
- A given database in a computer of larger memory(called as Server) can be shared by many stakeholders of a network.
- Boot disks may be needed to start up workstations. But in a network remote booting removes the need for boot disks.

Collaboration of Users by File Sharing :

- Users can share data and program files on a network.
- A network provides publicly accessible storage to keep assignments, tests, results, clipart, and other files.
- A database can be populated / updated by more than one user in a network through active permission.
- Facilitate communication via email, video conferencing, instant messaging, etc.

Resource Sharing :

- Users in a network can share different peripheral devices, like Printers, DVD drives, Scanners, Digital Projectors, etc. which reduces the cost of installation and maintenance substantially. It cost. Share the cost of printers among all users.

- Users can print their documents in a common printer instead of using individual devices. Further, a user can access different types of printers connected to a network!
- Software resources like Application Softwares, Anti-Virus tools etc. can also be shared on computer networks.
- Network modems can access outside resources.

A computer network involves different types of hardware as well as software components. The hardware devices include-

(a) Computers (desktop, laptop, workstations, smart phones, etc.).

(b) Peripheral devices (printers, scanners, projectors, etc.).

(c) Transmission media (wired and wireless media).

(d) Networking devices (hub, switch, router, modem, etc.).

*[Computers and other peripheral devices connected to a network arecalled as **Node**s]*

The software components include,

(a) The rules of communication (Protocols) between the systems connected to a network,

(b) Translation of software formats used in different networks through gateways.

In addition to the hardware and software components, we need to understand the network architecture, which defines a logical manner in which the computers in a network are connected. It is also called as network topology. Different types of Network Topologies are,

(a) Point to Point topology

(b) Bus topology

(c) Star topology

(d) Ring topology

(e) Tree topology

Further the computer networks can be characterized by their size as well as their purpose. The size of a network can be expressed by the geographic area

they occupy and the number of computers that are part of the network. Networks can cover anything from a handful of devices within a single room to millions of devices spread across the entire globe.

Some of the different networks based on size are:

(a) Personal area network, or PAN

(b) Local area network, or LAN

(c) Metropolitan area network, or MAN

(d) Wide area network, or WAN

In terms of purpose, many networks can be considered general purpose, which means they are used for everything from sending files to a printer to accessing the Internet. Some types of networks, however, serve a very particular purpose. Some of the different networks based on their main purpose are:

(a) Storage Area Network, or SAN

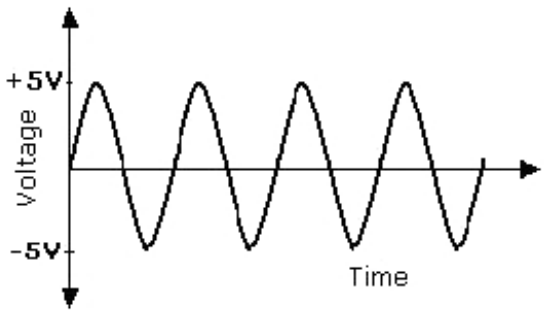
(b) Enterprise Private Network, or EPN

(c) Virtual Private Network, or VPN

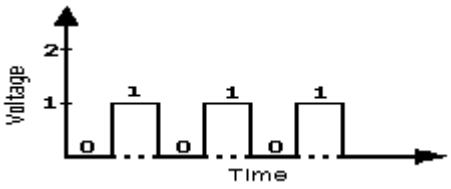
Data Communication in networks:

The idea of different types of Computer systems and peripheral devices has already been outlined in the 1st part of this book. Let's begin from the idea of communication of electromagnetic signals between different devices attached to a computer network.

The signals, which are being used in communication, are of two types; analog and digital. In analog type transmission the signal voltage varies sinusoidal with time. It is transmitted through telephone lines.

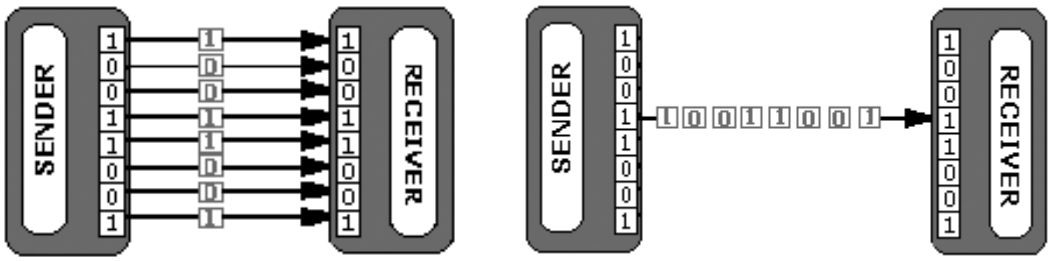


In digital type transmission the signal voltage is transmitted as voltages pulses of fixed amplitude as shown in the following figure.



Transmission mode:

To-day's computers generate data in digital form, which are transmitted in between devices in binary format. Further, the transmissions of binary data across the links are carried either in parallel mode or in serial mode. In parallel mode, group of bits (byte) are sent from one device to another with each clock pulse where as in serial mode one bit is sent with each clock pulse. The parallel mode is fast but expensive, whereas the later is slow but cost effective.



Parallel mode of transmission Serial mode of transmission

To-day's computers generate data in digital form, which are transmitted in between devices in binary format. Further, the transmissions of binary data across the links are carried either in parallel mode or in serial mode. In parallel mode, group of bits (byte) are sent from one device to another with each clock pulse where as in serial mode one bit is sent with each clock pulse. The parallel mode is fast but expensive, whereas the later is slow but cost effective.

Apart from these two types of transmission, the direction of signal flow between two linked devices are basically of three types: Simplex, Half-Duplex, and Full-Duplex.

Simplex mode: In this mode data travels in one direction i.e. communication is unidirectional. We cannot send a message back to the sender. Unidirectional communication is done in simplex systems, like: loudspeaker, television broadcasting, television and remote, keyboard and monitor etc.

Half-Duplex mode: In this mode data travels in both directions but one at a time; that is when the sender is sending the data then at that time we can't send the sender our message. The data is sent in one direction. Example of half duplex is a walkie- talkie in which message is sent are sent in both the directions, but one at a time.

Full-Duplex mode: In this mode data can be sent in both directions simultaneously. Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time is an example of Full Duplex transmission..

Transmission media:

In a computer network, computers have to exchange information (data) among themselves. The information being in form of electromagnetic signals can travel through vacuum, air or other transmission media from one point to another (from source to receiver) in a network. A transmission medium can be wired (guided) or wireless (unguided).

Guided Media: Depending upon their construction type, wired media can be classified in to three categories:

(1) Twisted Pair cables

(2) Co-axial cables

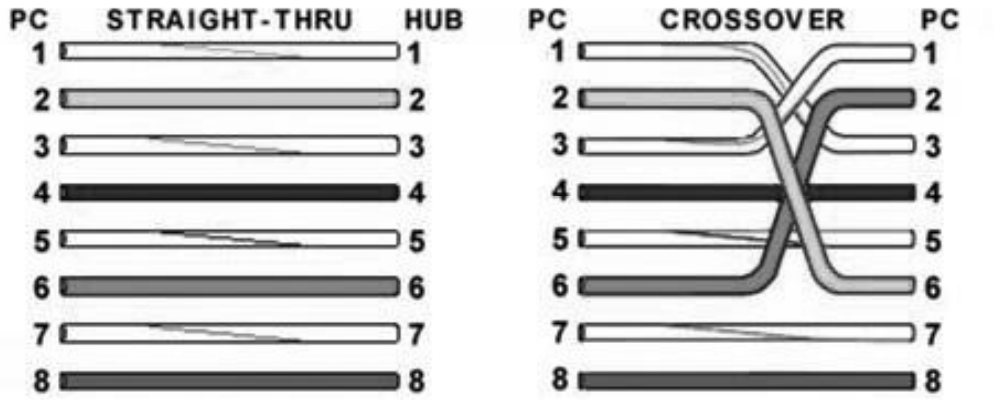
(3) Optic Fiber cables

Twisted Pair Cables / Ethernet Cables :

Invented almost a century ago by Alexander Graham Bell, this is a pair of insulated copper wires twisted over each other in a spiral pattern. The twisted cabling design helps to reduce noise from outside sources and crosstalk on multi-pair cables, making

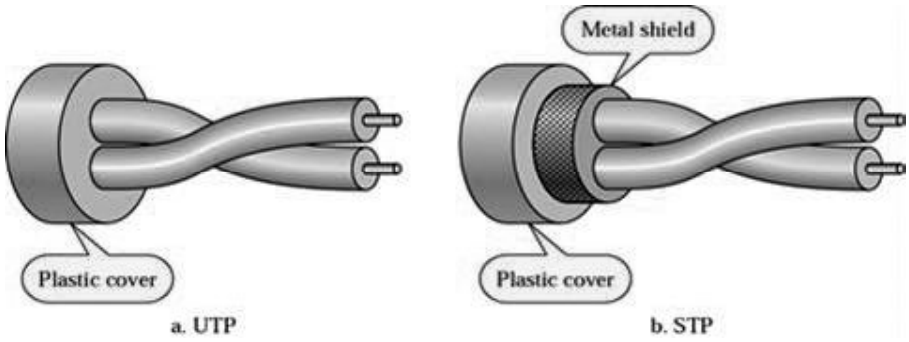
it suitable for use in the field of telecommunication for a long time Each cable consists of one or more twisted pairs and wrapped in a protective sheath. Each pair consists of a single communication link, with one conductor serving as the forward circuit and the other as the return circuit.

Twisted Pair cables used in small computer networks (ethernet) contains four twisted pairs and sometimes called as Ethernet cables. These pairs are colour coded and is used to connect to a computer through RJ-45 connectors. Two types of ethernet cables are used to connect devices to hubs and switches in a network: crossover cables and straight-through cables.



The difference between the two types is that in a crossover cable, two of the wires are crossed; in a straight-through cable, all the wires run straight through. Specifically, in a crossover cable, Wires 1 and 3 and Wires 2 and 6 are crossed: Wire 1 at one end becomes Wire 3 at the other end, Wire 2 at one end becomes Wire 6 at the other end, and vice versa in both cases. Computer in a network is connected to a Hub through a **straight-through** cable; whereas a **crossover cable** directly connects two Ethernet network devices (PCs) to each other. Ethernet crossover cables support temporary host-to-host networking in situations where an intermediate device like a network router is not present.

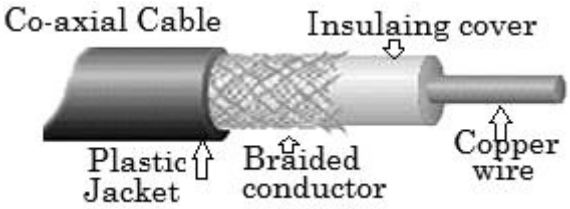
Twisted Pair Cables are of two types: **Unshielded Twisted Pair (UTP)** and **Shielded Twisted Pair (STP); i**ndividual pairs are not shielded within the cable in case of UTP; STP adds a conductive layer (typically metal foil) surrounding either each pair or the entire **cable**. This shielding helps reduce



interference from electrical sources outside the **cable**. These cables are low cost and being used to set up small networks. A cable can carry data up to a length of 100m. Comparative characteristics are given in Table-1.

Co-axial Cables :

This cable has an inner conductor (a copper wire) surrounded by a woven braided metal shield or foil working as the outer conductor; both the conductors share a common central axis, hence the term "co-axial". The central conductor is electrically insulated from the outer conductor by an insulating foam material. The outer conductor not only carries electrical signal in combination with the inner one, but also shields any kind of electromagnetic noise during transmission. Finally, a plastic jacket (PVC sheath) protects the whole cable.



These cables are used for Ethernet connections as well as for cable television transmission. There are two types of Coaxial cables: Baseband and Broadband cables.

Baseband cables (75Ω) are used for digital transmission (mostly used for LAN). Baseband transmits a single signal at a time with very high speed. The major drawback is that it needs amplification after every 1000 feet.

Broadband cables (50Ω) are used for analog transmission on standard cable television. It transmits several simultaneous signal using different frequencies.

Advantages:

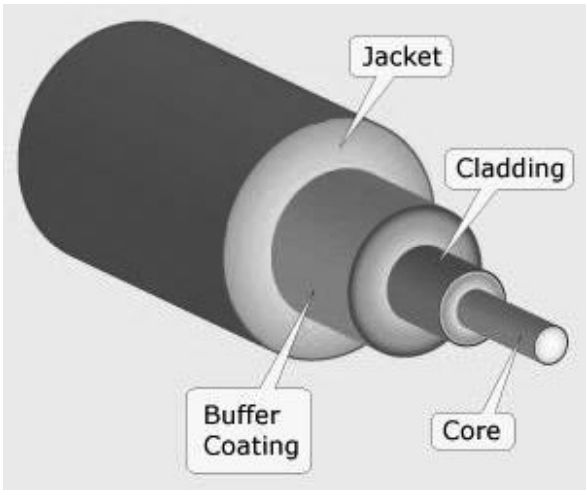
- Bandwidth is high
- Used in long distance telephone lines.
- Transmits digital signals at a very high rate of 10Mbps.
- Much higher noise immunity
- Data transmission without distortion.
- The can span to longer distance at higher speeds as they have better shielding when compared to twisted pair cable

Disadvantages:

- Single cable failure can fail the entire network.
- Difficult to install and expensive when compared with twisted pair.
- If the shield is imperfect, it can lead to grounded loop.

Optic-fibre Cable :

An optical fibre is a flexible, thin, transparent strand made up of high quality glass or plastic, slightly thicker than a human hair. It transmits light pulses by the principle of total internal reflection, which ensures minimum loss and long distance transmission. Each pulse of light represents a 'bit' of data. These fibres are arranged in bundles of hundreds and thousands to form a cable, which is protected by an outer jacket.



An optic fiber cable has following parts:

Core - It is the thin glass /plastic rod at the center through which the light travels

Cladding - It is the outer optical material (of lower refractive index) surrounding the core that reflects the light back into the core

Buffer coating - It is the plastic coating that protects the cable from damage and moisture

Characteristics:

- It can carry data over a long distance without any intermediate amplification.
- It is not affected by any external electromagnetic fields
- The joining of two optical fibres is a complex job, which needs skilled persons to install these cables.
- It is the most expensive and most efficient cable available for computer networks.

Both twisted pair and co-axial cables can support network speeds in megabit and gigabit ranges. Both are susceptible in varying degrees to signal interference, as well as signal leakage. (Signal interference occurs when external signals interfere with transmission inside the cable, and signal leakage means that signals inside the cable leak out and become a source of interference to other devices.) Coaxial cable, being of a standard design, varies little in its susceptibility to interference. From the distance point of view, if cable runs less than 100 metre, co-axial cable is probably the best option. Between 100metre and 1kilometre, UTP wire is often the best choice. More than a kilometer; go for optic fiber cable. Following table enlists some of the comparing parameters of these wired media.

Table-1

Parameters	Ethernet Cables	Co-axial Cables	Optic-fiber Cables
Signal form	Electrical	Electrical	Optical
External interference	High	Low	Nil
Attenuation	High	Low	Very low
Data transfer rate	10Mbps-10Gbps	100Mbps	>100Gbps
Cost of cables	Cheapest	Average	Expensive
Installation	Easy	Fairly easy	Difficult

Wireless Transmission:

However, wireless medium is only the free space (air or vacuum). The transmission of electromagnetic signals in free space is accomplished through carrier waves, which are nothingbut electromagnetic waves; which travels with the speed of light and carries the original signal (data) through free space. Carrier waves are generally high frequency electromagnetic waves.

Electromagnetic waves are categorized on the basis of their frequencies (or wavelengths); however all of them travel with the speed of light. When we arrange the electromagnetic waves according to ascending or descending order of their frequencies (or wavelengths), they are called as Electro-magnetic Spectrum. Frequencies of waves are measured in 'hertz' (Hz). As the frequencies of electromagnetic waves change, their properties also change. Based on their frequencies, electromagnetic waves are categorized as:

Category	Frequency range
Radio waves	3×10^3 Hz to 3×10^9 Hz
Microwaves	3×10^8 Hz to 3×10^{11} Hz
Infrared radiation	3×10^{11} Hz to 4×10^{14} Hz
Visible light	4.3×10^{14} Hz to 7.5×10^{14} Hz
Ultraviolet radiation	more than 10^{14} Hz
X-rays	more than 10^{15} Hz
Gamma rays	more than 10^{17} Hz

[kilo hertz = kHz = 10^3 Hz; giga hertz=GHz = 10^9 Hz]

Out of these radiations, Radio waves, Micro waves and Infra-red waves are used for wireless transmission.

Radio wave transmission:

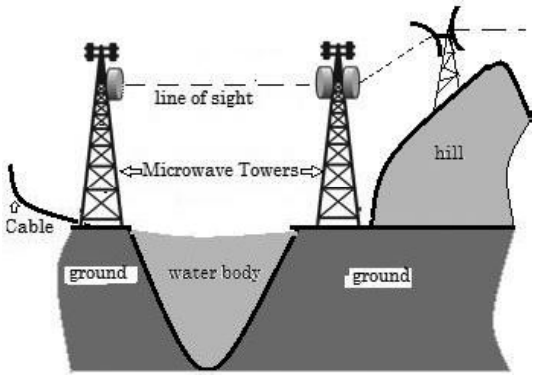
Radio waves having a frequency range of 3 kHz to 3GHz are used for communication over distances ranging from a few meters (in walkie-talkies) up to few kilometers. These waves are easy to generate, can travel long distances and can penetrate buildings easily. That's why they are widely used for communication, both indoors and outdoors. Cordless phones, AM and FM radio broadcast, Garage door openers etc. are examples of radio wave transmission.

Characteristics of Radio wave transmission :

- These waves propagate uniformly in all directions. So the transmitting and receiving antennas do not need any alignment.
- Less expensive as compared to wired media.
- It offers ease of communication over difficult terrain
- The transmission can be interfered by motors or other electrical equipments.
- Permission from concerned authorities is required for use of radio wave transmission
- Less secure mode of transmission

Micro wave transmission:

Microwaves having a frequency range of 0.3 GHz to 300 GHz, travel in straight lines and cannot penetrate any solid object. Therefore, for long distance microwave communication, high towers are built and microwave antennas are put on their tops. Distance between two microwave towers depends on many factors including frequency of the waves being used and heights of the towers.



These waves travel in straight lines and therefore the sending and receiving antennas have to be aligned with each other along the line of sight.

Characteristics of Microwave transmission :

- Quick installation
- Less expensive than wired media
- Offers ease of communication over difficult terrain
- It requires line of sight transmission; so the transmitting and receiving antennas need to be properly aligned.

Infrared wave transmission :

Infrared waves have a frequency range of 300 GHz to 400000 GHz. This frequency range is just below the frequency of Red colour (430000 GHz) of the visible spectrum; hence the name 'infra red'. These are used for short range wireless communications (approx. 5m) like, television remote-control devices, cordless mouse, and intrusion detectors, etc. These waves do not pass through solid objects. So, an infrared device in one room of a building does not interfere with a similar system in adjacent rooms. For example, a TV remote, in one room cannot control a television set in another room.

Characteristics of Infrared wave transmission:

- It is a line of sight transmission; therefore information passed to one device is not leaked to another device.
- No government license is required for their use
- It is a line of sight transmission, therefore at a time only two devices can communicate.
- The waves do not cross any solid object in between
- Performance drops with longer distances

Bluetooth :

This technology uses radio waves in the frequency range of 2.402 GHz to 2.480 GHz. It is used for short range communication (approx. 10m) in a variety of devices for wireless communication. Baby monitors, door openers, and cell phones are some of the devices that utilize Bluetooth communication.

Characteristics of Bluetooth Transmission:

- Line of sight between communicating devices is not required. (Think Why?)
- Bluetooth can connect up to eight devices simultaneously.
- Slow data transfer rate (up to 1Mbps).

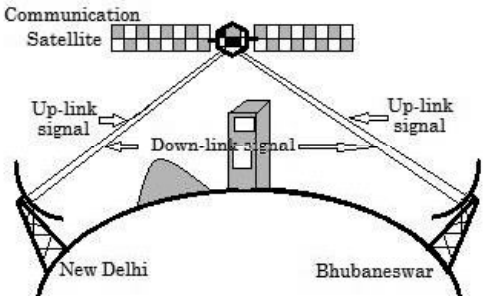
Satellite Link

Satellite links are used for very long distance wireless communication which may range from intercity to intercontinental. Transmission from the earth to a satellite is known as **uplink**. Transmission from a satellite to the earth is known as **downlink**. There are multiple micro wave frequency bands which are used for satellites links. Frequency used for uplink varies from 1.6 GHz to 30.0 GHz and that for downlink varies from 1.5GHz to 20.0GHz. Downlink frequency is always lower than the uplink frequency. For example, the uplink frequency is 6.0GHz, and the corresponding downlink frequency is 4.0 GHz. A communications satellite is a relay station in orbit above the earth that receives, regenerates, and redirects signals carried on a specific frequency. The satellite system is very expensive but its area of coverage and other benefits compensate for the expenses. These satellites are artificial and move around the Earth in different types of orbits: -

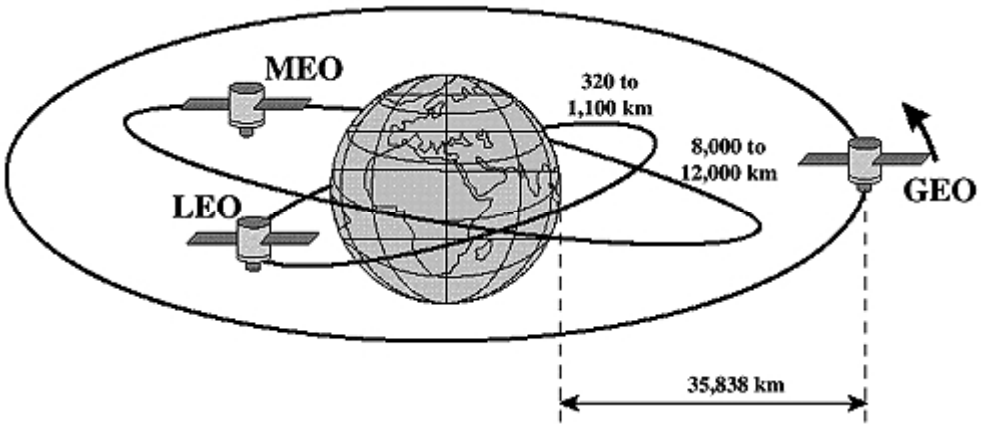
(a) Geo-stationary Orbit (GEO)

(b) Medium Earth Orbit (MEO)

(c) Low-Earth Orbit (LEO)



Satellites in geo-stationary orbit revolve round the Earth in West to East direction along the equatorial plane at a height of 35,838 km. This height ensures that the satellite takes exactly 24 hour to complete one revolution and appear stationary from any place on the surface of earth. These satellites are widely used as communication satellites, especially for transmission of television signal.



Characteristics of Satellite link:

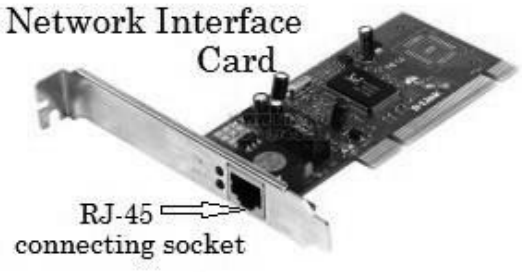
- Because of the height, a satellite covers large area of earth
- Because of larger height, geostationary satellite communication consumes more electrical power for transmission in comparison to medium and low earth orbit satellites.
- A set of low earth orbit satellites are being used for the popular Global Positioning System.
- Though expensive, it is commercially viable because of its long distance transmission.
- Satellite communication very much requires legal permission.

Network devices :

Now we have discussed different types of transmission media for exchange of information (in form of electro-magnetic signal) between the Nodes (computers, printers, scanners, mobile phones, etc.) of a network. Next are the devices, which are responsible for creating a physical network of computers and other peripheral devices need to be elaborated upon. These are called as Network devices, which are meant to distribute and channelize the electric signals throughout the network. Following are the basic devices needed to create a computer network;

1. Network Interface Card
2. Hub
3. Switch
4. Repeater
5. Bridge
6. Router
7. Gateway

Network Interface Card (NIC)



A Network Interface Card is a hardware device which connects a computer with the network. They are installed on the motherboard of computers and are responsible for developing physical contact with network devices and other computers (nodes). Computers send or receive information (in form of electrical signals) from network devices via this card. Thus every node, which is to be connected to a network, must have an NIC installed on it. These cards also manage some data-conversion function. Now a day, the NICs are software configured as against the older versions requiring a driver to configure them.

Hub

A Hub is a network device that connects several nodes to form a network and redirects the received information to all the connected nodes in broadcast mode

(The method of sending data to all systems regardless of the intended recipient is referred to as broadcasting).

Computers and other devices of a network are connected to the ports of a hub by twisted pair cables. Hubs are designed to take data from one connected device, transmit them to the other appended devices without altering any of the transmitted packets received. They act as pathways to direct electrical signals to travel along. They transmit the information to all the nodes of the network, regardless of the fact that, to which node / nodes it is destined. The device for which the information is intended accepts it and others reject it. This method of operation makes a hub an inefficient networking device. Due to the inefficiencies of the hub system and the constantly increasing demand for more bandwidth, hubs are slowly but surely being replaced with Switches; discussed in the next section.

Most hubs are referred to as either active or passive. **Active** hubs regenerate a signal before forwarding it to all the ports on the device and require a power supply. Active hubs are also termed as '**repeaters**'. Small workgroup hubs normally use an external power adapter, but on larger units the power supply is built in. **Passive** hubs, which today are seen only on older networks, do not need power and they don't regenerate the data signal.

Switch

A switch is an intelligent hub. Just as in hub, devices in switches are connected to them through twisted pair cabling. It has the same function as that of a hub: to connect multiple computers/devices in a network. But the difference between the two is in the way they re-transmit the received information. Unlike a hub, instead of broadcasting (sending to each device attached to it) the received information, a switch sends the information selectively only to those computers for which it is intended. It does so by having an in-built learning

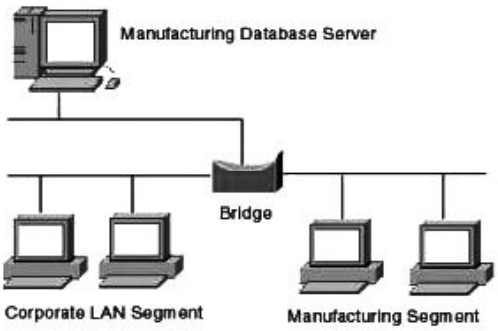
of the MAC address of the devices connected to it. Switches operate in full-duplex mode where devices can send and receive data from the switch at the simultaneously. The transmission speed in switches is higher than that of a hub transferring a 20Mbps connection into 30Mbps and a 200Mbps connection to become 300Mbps. All of these make a switch more efficient than a hub. Performance improvements are observed in networking with the extensive usage of switches in the modern days.

Repeater

When the data is transmitted over a network for long distances, the data signal gets weak after certain distance. This distance depends on the data transfer range of transmission channel being used and can be from a few meters to a few kilometers. If the signal becomes weak, it cannot reach its destination. Therefore, some device is required which can re-strengthen the data signal before it gets too weak. Repeater is such a device. A repeater regenerates the received signal and re-transmits it to its destination

Bridges

Bridges are networking devices that connect networks. Sometimes it is necessary to divide networks into subnets to reduce the amount of traffic on each larger subnet or for security reasons. Once divided, the bridge connects the two subnets and manages the traffic flow between them. Today, network switches have largely replaced bridges.



A bridge functions by blocking or forwarding data, based on the destination MAC address written into each frame of data. If the bridge believes the destination address is on a network other than that from which the data was received, it can forward the data to the other networks to which it is connected. If the address is not on the other side of the bridge, the data is blocked from passing. Bridges "learn" the MAC addresses of devices on connected networks by "listening" to network traffic and recording the network from which the traffic originates.

Routers

Routers are network devices which process logical addressing information in the Network header of a packet such as IP Addresses. Router is used to create larger complex networks by complex traffic routing. It has the ability to connect dissimilar LANs on the same protocol. It also has the ability to limit the flow of broadcasts. A router primarily comprises of a hardware device or a system of the computer which has more than one network interface and routing software.

When a router receives the data, it determines the destination address by reading the header of the packet. Once the address is determined, it searches in its **routing table** to get know how to reach the destination and then forwards the packet to the higher hop on the route. The hop could be the final destination or another router.

Gateway

There are a large number of computer networks operating throughout the globe; ATM network of banks, computer network of big retail chains (like, BigBazar or Reliance Fresh) spread over a city, etc. These networks use different hardware and software. Many times these networks need to communicate with each other. For example, when you swipe your Bank Debit Card in a retail outlet's PoS machine, the data exchange takes place between the particular bank network and the retail company's network. Another example is the Internet, which contains a large number of different types of networks spread over the globe. Different networks are sometimes incompatible with each other. It is like a group of persons using different languages for conversation. When two or more networks using different hardware and software have to be connected, some device is needed which can translate one network's language into the other's. Here comes a 'Gateway'.

The term Gateway is applied to any device, system, or software application that can perform the function of translating data from one format to another. The key feature of a gateway is that it converts the format of the

data, not the data itself. It understands the address architectures used in different networks and seamlessly translate between these address architectures.

Network Topology

Computers in a network have to be connected in some logical manner. The layout pattern of the interconnections between computers in a network is called network topology. It is just a virtual shape or structure of the network and sometimes referred to as 'network architecture.'

Devices on the network are called as 'nodes.' Computers and peripheral devices are examples of common nodes. Network topology is illustrated by showing the nodes and their connections using cables. There are different types of network topologies, including Point-to-Point, Bus, Star, Ring, Mesh, Tree and Hybrid, etc.

Point-to-Point Topology

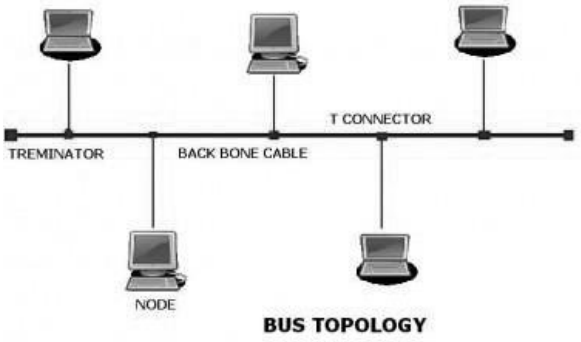
Point-to-point topology is the simplest of all the network topologies. The network consists of a direct link between two computers. This is faster and more reliable than other types of connections since there is a direct connection. The disadvantage is that it can only be used for small areas where computers are in close proximity.

Bus Topology

Bus topology uses one main cable to which all nodes are directly connected. The main cable acts as a backbone for the network. One of the computers in the network typically acts as the computer server. If any node has to send some information to any other node, it sends the signal to the backbone. The signal travels through the entire length of the backbone and is received by the node for which it is intended. A small device called terminator is attached at each end of the backbone. When the signal reaches the end of backbone, it is absorbed by the terminator and the backbone gets free to carry another signal. This prevents the reflection of signal back on the cable and hence eliminates the chances of signal interference.

Characteristics of Bus topology :

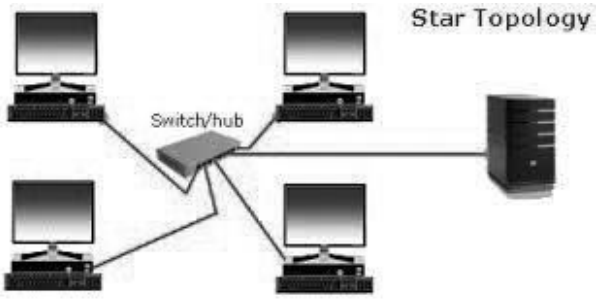
- It is easy to install this network and connect different peripheral devices in it.
- It requires less cable length and hence is cost effective.
- Failure of a node does not affect the network.
- In case of cable or terminator fault, the entire network breaks down.
- It is very difficult to troubleshoot i.e difficult to diagnose the fault.
- For these reasons, this type of topology is not used for large networks.
- At a time only one node can transmit data.



BUS TOPOLOGY

Star Topology

In star topology, each computer is connected to a central hub using a point-to-point connection. The central hub can be a computer server that manages the network, or it can be a much simpler device that only makes the connections between computers over the network possible.



Characteristics of Star topology

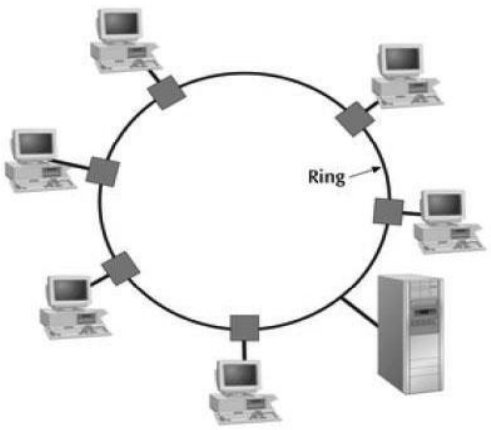
- Star topology is more efficient than the Bus Topology.
- It is easy to add new nodes to the network.
- The network is robust in the sense that if one connection between a computer and the hub fails, the other connections remain intact.
- If the central hub fails, however, the entire network goes down.
- It requires more cable than bus topology and is, therefore, more expensive.

Ring Topology

In ring topology, the computers in the network are connected in a circular fashion, and the data travels in one direction. Each computer is directly connected to the next computer, forming a single pathway for signals through the network.

Characteristics of Ring topology

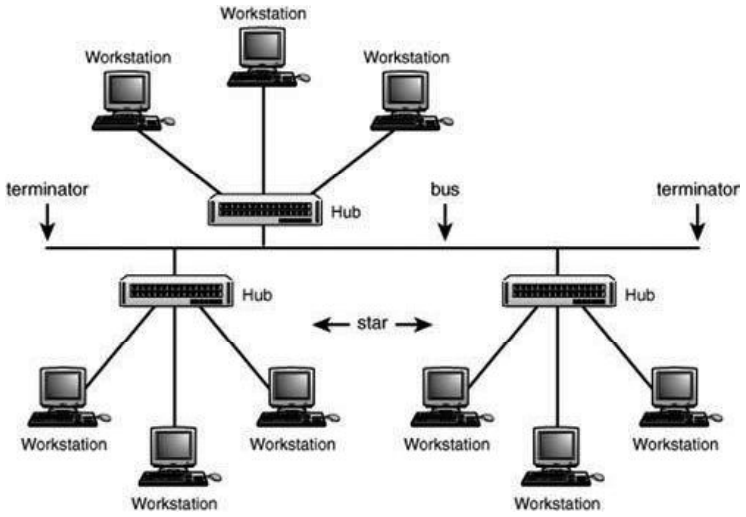
- This type of network is easy to install and manage.
- If there's a problem in the network, it is easy to pinpoint which connection is defective.
- It is also good for handling high-volume traffic over long distances since every computer can act as a booster of the signal.



- Adding computers to this type of network is more cumbersome, and if one single computer fails, the entire network goes down.

Tree Topology

Tree topology is a combination of bus and star topologies. It is used to combine multiple star topology networks. All the stars are connected together

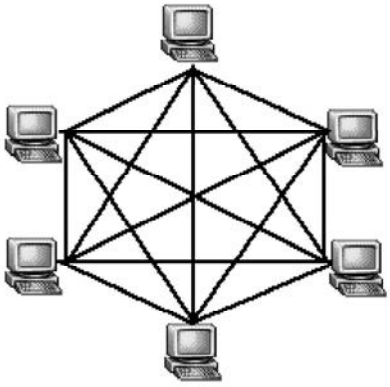


like a bus. This bus-star hybrid approach supports future expandability of the network.

Characteristics of Tree topology

- It offers easy way of network expansion
- Even if one network (star) fails, the other networks remain connected and working.

Mesh Topology



In mesh topology, every node has a direct point-to-point connection to every other node. Because all connections are direct, the network can handle very high-volume traffic. It is also robust because if one connection fails, the others remain intact. Security is also high since data travels along a dedicated connection.

There are so many different types of computer networks in existence; it can be hard to understand the differences between them, particularly the ones with very similar-sounding names. In this section we discussed the structures and functions of some of the most popular computer networks.

Types of Networks

A computer network may span any amount of geographical area. It can be on a table, in a room, in a building, in a city, in a country, across continents or around the world. On the basis of area covered computer networks are classified as:

- PAN - Personal Area Network
- LAN - Local Area Network
- MAN - Metropolitan Area Network
- WAN -Wide Area Network

Personal Area Network

A personal area network, or PAN, is a computer network organized around an individual person within a single building. This could be inside a small office or residence. A typical PAN would include one or more computers, telephones, peripheral devices, video game consoles and other personal entertainment devices.

If multiple individuals use the same network within a residence, the network is sometimes referred to as a home area network. In a very typical setup, a residence will have a single wired Internet connection connected to a modem. This modem then provides both wired and wireless connections for multiple devices. The network is typically managed from a single computer but can be accessed from any device. A PAN can be set up using guided media (USB cable) or unguided media (Bluetooth, Infrared). This type of network provides great flexibility. It allows you to:

- Send a document to the printer in the office upstairs while you are sitting with your laptop.
- Upload the photo from your cell phone to your desktop computer.
- Transfer a file from your PC to an MP3 player
- Watch movies from an online streaming service to your TV.

Local Area Network

A LAN is a network of computing/communicating devices in a room, building, or campus. It can cover an area of a few meters to a few kilometers radius. A networked office building, school, or home usually contains a single LAN, though sometimes one building can contain a few small LANs (Like some schools have independent LANs in each computer lab.). Occasionally a LAN

can span a group of nearby buildings. In addition to operating in a limited space, a LAN is owned, controlled, and managed by a single person or organization. A LAN can be set up using wired media (UTP cables, Co-axial cables etc.) or wireless media (Infrared, radio waves). If a LAN is entirely wireless; it is known as WLAN (wireless LAN).

Metropolitan Area Network

A metropolitan area network, or MAN, consists of a computer network across an entire city, college campus or small region. A MAN is larger than a LAN, which is typically limited to a single building or site. Depending on the configuration, this type of network can cover an area from several miles to tens of miles. A MAN is often used to connect several LANs together to form a bigger network. When this type of network is specifically designed for a college campus, it is sometimes referred to as a campus area network, or CAN.

WAN (Wide Area Network)

A WAN is a network of computing/communicating devices crossing the limits of a city, country, or continent. It can cover an area of over hundreds of kilometer radius. A network of ATMs, BANKs, National Government Offices, International Organizations' Offices etc., spread over a country, continent, or covering many continents are examples of WANs. WANs usually contain a number of interconnected individual computers, LANs, MANs, and maybe other WANs. All types of communication media (guided and unguided) are used to set up a WAN. The best known example of a WAN is the internet.

Following table summarizes the characteristics of PANs, LANs, MANs, and WANs.

Parameter	PAN	LAN	MAN	WAN
Area Covered	Small Area (up to 10m radius)	A few meter to a few km (up to 10km radius)	A city and its vicinity (up to 100km radius)	Entire country, continent, or globe (No upper limit)
Error Rates	Lowest	Lowest	Moderate	Highest
Transmission Speed	High Speed	High Speed	Moderate speed	Low speed
Networking Cost	Negligible	Inexpensive	Moderately expensive	Expensive

SUMMARY

- Computer network is a collection of interconnected computers and other devices which are able to communicate with each other.
- Communication Media are the links over which the data is sent from one node to another over a network.
- Hardware devices used to form a network are: Cables, NIC, Hub, Switch, Repeater, and Gateway.
- Repeaters are used to regenerate the signal which gets weakened during its transmission. Repeater are generally used to connect two networks which are more than 80 m apart.
- Gateway is a device which connects two different types of networks.
- On the basis of area covered by a network it is categorized as PAN, LAN, MAN, or WAN.
- Physical arrangement of computers in a network is called network topology.
- Basic network topologies are bus, star and tree.

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. Which of the following topologies is a combination of more than one topologies?

   a. Bus b. Tree

   c. Star d. None of these

2. Which of the following is used for wireless communication?

   a. Optical Fiber b. UTP cable

   c. Radio Waves d. Coaxial Cable

3. Which of the following is not a transmission medium?

   a. Telephone Network b. Coaxial Cable

   c. Modem d. Microwaves

4. IP addresses of two computers on a network:

   a. can be the same b. cannot be the same

   c. are not defined d. must match with a third computer

5. Bluetooth can be used for

   a. Long distance communication b. Short distance communication

   c. In mobile phones only d. None of the above

6. Micro waves are

   a. Unidirectional b. Omni directional

   c. Guided media d. Not used for communication.

7. A repeater

   a. Regenerates the received signal b. Destroys the received signal

   c. Can be used as a hub d. None of the above

8. Satellite links are generally used for

   a. PANs b. LANs

   c. MANs d. All of the above

LONG ANSWER TYPE QUESTIONS :

1. What is a computer network? What are its advantages?
2. What is meant be communication channels? Give two examples of guided media and two examples of unguided media.
3. Why is a switch called an intelligent hub?
4. When is a repeater used in a computer network?
5. Diagrammatically show how you would connect 6 PCs, 1 server, 1 printer, and 2scanners in a. Star topology b. Bus topology
6. Two engineers in the same room have connected their Palm-tops using Bluetooth for working on a Group presentation. Out of the following, what kind of Network have they formed?

   LAN, MAN, PAN, WAN
7. Differentiate (with examples wherever possible) between:

   (a) LAN and MAN (b) MAN and WAN

   (c) Hub and Switch (d) Guided and Unguided media
8. Write one advantage of star topology over bus topology and one advantage of bus topology over star topology.

■ ■ ■

CHAPTER - 2

INTERNET AND ITS APPLICATIONS

Internet - an overview :

Internet, the network of computers to share information amongst each other was first proposed by J C R Licklider of MIT (Massachusetts Institute of Technology) in 1962. His intention was to share millitary and scientific information between different organisations situated at different places in United States.During that period Leonard Kleinrock of University of California, Los Angeles developed the theory of packet switching, which eventually formed the backbone of today's internet data transmission. The first ever network of computers was installed at National Research Laboratory, England in the year 1968. A year later, a more advanced network was established at Pentagon's Advanced Research Project Agency (ARPA) connecting four high speed computers. This network was called as ARPAnet. By 1972, ARPAnet had 23 nodes, connecting different institutions of United States. In the same year, Raymond Samuel Tomlinson of United States incorporated the first e-mail program and picked @ symbol to link the user name and the address.

The first ever international nodes of ARPAnet were set up in 1973 in England and Norway. A year later Bob Kahn and Vint Cerf put the foundation of Network Transfer protocol, which ultimately standardised as TCP/IP for ARPAnet in 1983. It assigns a number to each computer of a network, and called as IP (Internet Protocol) address. However, numeric addresses of different computers are difficult to remember. Therefore, a new technique called as Domain Name System was introduced in 1984. In this system each computer (host) of a network is given a human readable and easy to remember names called as domain names .The Domain Name Server (DNS) converts these names to corresponding numeric IP addresses. By 1990 ARPAnet ceased to exist, but its functions were continued. In 1991 WAIS (Wide Area Information Server) and Gopher were released, paving the way for modern Internet system.

1992 saw the release of WWW by CERN (European Organisation for Nuclear Research), a physics research institute in Switzerland. The brain child of the physicist Tim Berners Lee, WWW today forms the gateway to any internet transmission. He wrote the first WWW client and WWW server, and defined the standards like URL, HTML and HTTP. In 1993, the first internet browser "Mosaic" was released by Marc Andreessen and his team at National Centre for Supercomputing Applications. Later, he moved to Netscape Communication Corporation and invented the most successful graphical browser 'Netscape Navigator'. This browser dominated the internet browsing until the Microsoft Inc introduced its "Internet Explorer" and integrated it in to its flagship Windows Operating System.

Introduction to Internet:

A global collection of individual networks, connected to each other by different networking devices and functions as a single large network is called an Internetwork of computers or Internet. It is a conglomeration of independent smaller networks and other connected machines spanning the entire globe. It is a window to global information super highway. In short, the internet is a worldwide network of networks.

Internet Backbone and its features:

An Internet backbone refers to one of the principal data routes between large, strategically interconnected networks and core routers on the Internet. It is a very high-speed data transmission line that provides networking facilities to relatively small but high-speed Internet Service Providers (ISP) all around the world.

The first Internet backbone was named NSFNET. It was funded by the U.S. government and introduced by the National Science Foundation (NSF) in 1987. It was a T1 line that consisted of approximately 170 smaller networks operated at 1.544 Mbps. The backbone was a combination of fiber-optic trunk lines, each of which had several fiber-optic cables wired together to increase capacity.

A **backbone** is a larger transmission line that carries data gathered from smaller lines that interconnect with it.

(1) At the local level, a backbone is a line or set of lines that local area networks(LAN) connect to for a wide area network(WAN) or within a LAN to span distances efficiently (for example, between buildings).

(2) On the Internet or other WANs, a backbone is a set of paths that local or regional networks connect to, for long-distance interconnection. The connection points are known as network *nodes* or data switching exchanges (DSEs).

Around the world, each country has at least one backbone network that operates at very high speed and carries bulk of the traffic. Other smaller networks connect to that backbone. Internet backbones are the largest data connections on the Internet. They require high-speed bandwidth connections and high-performance servers/routers. Backbone networks are primarily owned by commercial, educational, government and military entities because they provide a consistent way for Internet service providers (ISPs) to keep and maintain online information in a secure manner. For example, a local ISP may provide service to individual homes or business using bandwidth that it purchases from another company with a backbone network. Backbone networks are usually commercial, educational, or government owned. Some large companies that provide backbone connectivity include Verizon, British Telecom, AT&T, Sprint Nextel, Global Crossing, France Télécom, BSNL, Reliance Communications, Airtel, VSNL International, Idea, Ortel Communications, Tata Tele Services, etc.

Today, these backbones are constructed of fiber optic cables. These links, called OC links (Optical Carrier), use frequency bands of electromagnetic waves (light) to transmit data to get rid of interference. OC connections use SONET (Synchronous Optical Network) technology, which is the industry standard for testing high-speed electrical signals.

Features of an Internet backbone :

(a) ISPs are either connected directly to their contingency backbones or to some larger ISP that is connected to its backbone.

(b) The smaller networks are interlinked to support the backup that is required to keep the Internet services intact in case of failure. This is done through transit agreements and peering processes.

(c) The transit agreement is a monetary contract between several larger and smaller ISPs. It is initiated to share traffic loads or to handle data traffic in case of a partial failure of some networks. In peering, several ISPs also share features and traffic burden.

Different Network Technologies can be connected to create an Internetwork as described below.

Token Ring network is a local area network in which all computers are connected in a ring or star topology and a bit- or token-passing scheme is used in order to prevent the collision of data between two computers that want to send messages at the same time. The Token Ring protocol is the second most widely-used protocol on local area networks after Ethernet.

Ethernet is the most widely-installed local area network technology. Specified in a standard, IEEE(Institute of Electrical and Electronics Engineers) 802.3, Ethernet was originally developed by Xerox from an earlier specification called *Alohanet* (for the Palo Alto Research Center Aloha network) and then developed further by Xerox, DEC, and Intel. An Ethernet LAN typically uses coaxial cable or special grades of twisted pair wires. Ethernet is also used in wireless LANs. The most commonly installed Ethernet systems are called 10BASE-T and provide transmission speeds up to 10 Mbps. Devices are connected to the cable and compete for access using a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol.

Fiber Distributed Data Interface (**FDDI**) provides a standard for data transmission in a LAN that can extend in range up to 200 kilometer. Although FDDI protocol is a token ring network, it does not use the IEEE 802.5 token ring protocol as its basis; instead, its protocol is derived from the IEEE 802.4 token bus *timed token* protocol. In addition to covering large geographical areas, FDDI local area networks can support thousands of users in Metropolitan Area Network (MAN). A FDDI network contains two token rings, one for possible backup in case the primary ring fails. The primary ring offers up to 100 Mbps capacity. When a network has no requirement for the secondary ring to do backup, it can also carry data, extending capacity to 200 Mbps.

Features of Internet :

Geographic Distribution **:** The geographic distribution of the *Internet* continues to spread, around the world and even beyond.

A key attribute of the Internet is that once you have connected to any part of it, you can communicate with all of it. All of the Internet's technologies web, newsgroups, email, mailing lists, IRC, MUD's enable geographically distributed groups of people to communicate who otherwise couldn't do so. Largely because the basic *architecture* of the Internet is open fundamentally designed to connect new networks this powerful communication medium has spread rapidly to interconnect our world and turned it into a true multi-way electronic *global village*.

Robust Architecture : The *Internet* is the most robust communications network ever designed. It is able to adapt itself almost instantaneously to the outages of individual sections. The Internet has no irreplaceable central control, administration, or authority. It can't be bought, hijacked, or monopolized. The loss of individual computers and networks does not affect its overall reliability. The Internet perfectly realizes its original intent, it is actively robust, and cannot be completely deactivated without bringing down every single connection.

Near Light Speed **:** Digital information such as *Internet packets* travel at 2/3 of the speed of light on copper wire and on fiber optic cables. Since light speed is about 300,000 kilometers a second, this means digital communications travel at about 200,000 kilometers a second.

At this speed and neglecting switching delays, two computers have to be more than ten thousand kilometers apart, or almost half way around the world, before they experience a tenth of a second in communications delay.

With fixed near-optimal transmission speed, there are only two ways to make Internet networks faster, increase the number of bits that are traveling at once down the connection, or increase the speed at which you switch them from one connection to another at the junction points.

Universal Access **:** The Internet provides *universal access*, giving the same powerful capabilities to everyone who has access to the network no matter where they are.

The Internet is based on a common standard, the *TCP/IP* network protocol, which provides all computers with access to the network with the same technical interface and capabilities. This common foundation makes all of the internet technologies equally available to anyone connected to the Internet.

This architecture gives everyone the ability to make information like text, audio, and video accessible to a world wide audience at an extremely low cost,

since web site storage space and lots of bandwidth can be rented from *web hosting* providers for low fees. Because the Internet has a "many-to-many" architecture, with everyone having the same capabilities as anyone else, it allows anyone to become a global publisher.

Internet Access :

Internet access is the process that enables individuals and organisations to connect to the Internet using computer terminals, computers, mobile devices, sometimes via computer networks. Once connected to the Internet, users can access Internet services, such as email and the World Wide Web. Internet service providers (ISPs) offer Internet access through various technologies that offer a wide range of data transfer speeds.

Technology is developing rapidly and methods for connecting to the Internet change almost daily. The following types of connections are most commonly available.

(i) Gateway Access

(ii) Dial-up Connection

(iii) Direct / Leased Connection

(iv) DSL

(v) Cable Modem Connection

(vi) VSAT

(vii) Wireless Internet Access

Gateway Access :

Gateway Access is also known as Level-One connection. It is the access to the Internet from a network, which is not on the Internet. The gateway allows the two different types of networks to "talk" to each other. But the users of the Gateway Internet have limited access to the Internet. They might not be able to use all the tools available on Internet. The local Internet Service Provider (ISP) normally defines this limitation. Good example of network with Level One connectivity within India is that of VSNL (Videsh Sanchar Nigam Limited). All access to Internet from India is through VSNL gateway.

Dial-up Connection :

'Dial-up' connection is also known as Level Two connection. This provides connection to Internet through a dial-up terminal connection. Data is transmitted through an analog phone connection. You connect to the Internet by using your phone line to dial into an ISP's (Internet Service Providers) line. This connection allows only one computer at a time, per line, to be connected. When the line is connected to the Internet, voice communication would not be available over it. 56K modem access is now widely available and supported by most ISPs. It allows user to surf the Web at 56 Kbps with graphics. So this type of connection is also known as 'Remote Modem Access' connection.

This type of connection can further be divided into three categories.

(a) Shell Connection:

In this type of Internet Connection, the user will get only textual matter of a Web Page. This connection does not support Graphics display. Shell Accounts were the only type of Internet access available for many years before the Internet entered in to the world of graphics and became more users friendly.

(b) TCP/IP Connection:

Today's graphical World Wide Web browsers provide easier access with multimedia sound and pictures. The major difference between Shell and TCP/IP account is that, Shell account can only display text and does not support graphics display, whereas TCP/IP can display both.

(c) ISDN:

ISDN (Integrated Services Digital Network) offers Internet connectivity at speeds of up to 128 Kbps through the use of digital phone lines. ISDN is a dial-up service that has been provided by telephone companies for many years.

To access any of these dial-up accounts you need the followings;

- Computer
- Modem
- Telephone Connection
- Shell or TCP/IP/ISDN account from the ISP
- Internet client software such as Internet browser

Direct / Leased Connection :

Leased connection is also known as direct Internet access or Level Three connection. It is the secure, dedicated and most expensive, level of Internet connection. With leased connection, your computer is dedicatedly and directly connected to the Internet using high-speed transmission lines. It is on-line 24×7 (twenty-four hours a day, seven days a week) basis.

Direct access can be availed in one of the following two ways:

(1) Dialup IP direct access**:** Dialup IP direct access uses a modem and telephone line. You also need special software to enable internet connectivity conforming to Serial Line Internet Protocol or Point-to-Point Protocol (PPP).These internet standards provide direct connection through telephone lines. The use of dialup IP is growing rapidly.

(2) The second way of obtaining direct access is to connect your computer to a local area network (LAN) that has internet connectivity. Most people in universities and corporations use this method.

DSL connection :

Digital Subscriber Line (DSL) is a family of technologies that provides digital data transmission over the wires of a local telephone network. In telecommunications marketing, the term DSL is widely understood to mean Asymmetric Digital Subscriber Line (ADSL), the most commonly installed DSL technology. This service delivers voice and data simultaneously over the the same telephone line. This is possible because DSL uses higher frequency bands for data & lower band for voice; separate them by filtering. This enables simultaneous use of the telephone and data. The data bit rate of consumer DSL services typically ranges from 256 kbit/s to 40 Mbit/s in the direction to the customer (downstream). In ADSL, the data throughput in the upstream direction, (the direction to the service provider) is lower, hence the designation of asymmetric service. In Symmetric Digital Subscriber Line (SDSL) services, the downstream and upstream data rates are equal.

Advantages :

(1) Security: Unlike cable modems, each subscriber can be configured so that it will not be on the same network. In some cable modem networks, other computers on the cable modem network are left

visibly vulnerable and are easily susceptible to break in as well as data destruction.

(2) Integration: DSL will easily interface with ATM and WAN technology.

(3) High bandwidth

(4) Cheap line charges from the phone company.

(5) Good for "bursty" traffic patterns

Disadvantages :

(1) No proper standardization: A person moving from one area to another might find that their DSL modem is just another paperweight. Customers may have to buy new equipment to simply change ISPs.

(2) Expensive: Installation costs, including the modem is high.

(3) Depends on distance: The farther you live from the DSLAM (DSL Access Multiplexer), the lower the data rate.

Cable Modem Connection :

A cable modem is a type of Network Bridge and modem that provides bi-directional data communication via radio frequency channels on a HFC(hybrid fibre coax) and RFoG (radio frequency over glass) infrastructure. Cable modems are primarily used to deliver broadband Internet access in the form of cable Internet, taking advantage of the high bandwidth of a HFC and RFoG network.

The Cable TV Company (e.g. Ortel Communication in Odisha) runs a coaxial cable into the building to deliver their Internet service. Although fed from the same coax that provides cable TV service, most companies place a splitter outside of the building and runs two cables in, rather than using a splitter at the set-top box. The coax terminates at the cable modem. In most circumstances, the cable modem attaches directly to a user's computer. If a LAN is present on the premises, some sort of router can be connected to the cable modem.

Cable connections provide high speed data transfer downstream (from the Internet to your computer), but are slower when sending data from your computer to the network. Additionally, transfer rates are affected by the number of subscribers online simultaneously. All connections originate on one line per street, so signals degrade as more subscribers come online. Cable connections

can be used by individual subscribers to connect one computer to one line, or can be used to connect multiple computers in a building to the Internet. Some of the features of Cable Internet Connections are outlined below:

(1) **Always Connected:** A cable modem connection is always connected to the Internet. This is advantageous because you do not have to wait for your computer to "log on" to the Internet; however, this also has the disadvantage of making your computer more vulnerable to hackers. Broadband Cable modems transmit and receive data as digital packets, meaning they provide high-speed Internet access. This makes cable modem connections much faster than traditional dial-up connections.

(2) **Bandwidth:** Cable modems have the potential to receive data from their cable provider at speeds greater than 30 megabits per second. Cable lines are shared by all of the cable modem users in a given area; thus, the connection speed varies depending upon the number of other people using the Internet and the amount of data they are receiving or transmitting.

(3) **File Transfer Capabilities:** Downloads may be faster, but uploads are typically slower. Since the same lines are used to transmit data to and from the modem, priority is often given to data traveling in one direction.

(4) **Signal Integrity:** Cable Internet can be transmitted long distances with little signal degradation. This means the quality of the Internet signal is not significantly decreased by the distance of the modem from the cable provider.

(5) **Routing:** Cable routers allow multiple computers to be hooked up to one cable modem, allowing several devices to be directly connected through a single modem. Wireless routers can also be attached to your cable modem.

VSAT (Very Small Aperture Terminal) :

VSAT is an earthbound station used in satellite communications of data, voice and video signals, excluding broadcast television. A VSAT consists of two parts, a transceiver that is placed outdoors in direct line of sight to the satellite and a device that is placed indoors to interface the transceiver with the end

user's communications device, such as a PC. The transceiver receives or sends a signal to a satellite transponder in the sky. The satellite sends and receives signals from a ground station computer that acts as a hub for the system. Each end user is interconnected with the hub station via the satellite, forming a star topology. The hub controls the entire operation of the network. For one end user to communicate with another, each transmission has to first go to the hub station that then retransmits it via the satellite to the other end user's VSAT.

Advantages :

Satellite communication systems have some advantages that can be exploited for the provision of connectivity. These are:

- Costs Insensitive to Distance
- Single Platform service delivery (one-stop-shop)
- Flexibility
- Upgradeable
- Low incremental costs per unit

Disadvantages :

However like all systems there are disadvantages also. Some of these are

- High start-up costs (hubs and basic elements must be in place before the services can be provided)
- Higher than normal risk profiles
- Severe regulatory restrictions imposed by countries that prevent VSAT networks and solutions from reaching critical mass and therefore profitability
- Some service quality limitations such the high signal delays (latency)
- Natural availability limits that cannot be mitigated against
- Lack of skills required in the developing world to design, install and maintain satellite communication systems adequately

Broadband Internet access, often shortened to just broadband, is simply defined as "Internet access that is always on and faster than the traditional dial-up access and so covers a wide range of technologies. Broadband connections are typically made using a computer's built in Ethernet networking capabilities, or by using an NIC expansion card.

Most broadband services provide a continuous "always on" connection; there is no dial-in process required, and it does not interfere with voice use of phone lines. Broadband provides improved access to Internet services such as:

(a) Faster world wide web browsing

(b) Faster downloading of documents, photographs, videos, and other large files

(c) Telephony, radio, television, and videoconferencing

(d) Virtual private networks and remote system administration

(e) Online gaming, especially massively multiplayer online role-playing games which are interaction-intensive

The broadband technologies in widest use are ADSL and Cable Internet access. Newer technologies include VDSL and optical fibre extended closer to the subscriber in both telephone and cable plants. Fibre-optic communication has played a crucial role in enabling broadband internet access by making transmission of information at very high data rates over longer distances much more cost-effective than copper wire technology.

Newer technologies being deployed for fixed (stationary) and mobile broadband access include WiMAX, LTE, and fixed wireless, e.g., Motorola Canopy.

Starting in roughly 2006, mobile broadband access is increasingly available at the consumer level using "3G" and "4G" technologies such as HSPA, EV-DO, HSPA+, and LTE.

Wireless Internet Access: wireless is a high-speed technology that transmits data over radio waves. Wireless transmission can be used to provide connectivity from an ISP to an entire building; however, service will be dependent on the existence of a clear line of sight between the ISP (internet service provider) and the building. Within a building, a wireless local area network (LAN) can connect multiple computers to each other and to the Internet.

Internet access is also being delivered through mobile phone towers to computers, mobile phones and other digital devices using portable modems. Some mobile services allow more than one device to be connected to the Internet using a single cellular connection using a process called tethering. The modem may be built into laptop computers, tablets, mobile phones, and other devices,

added to some devices using PC cards, USB modems, and USB sticks or dongles, or separate wireless modems can be used.

In areas not served by ADSL or cable, some community organizations and local governments are installing Wi-Fi networks. Wireless and Satellite Internet are often used in rural, undeveloped, or other hard to serve areas where wired Internet is not readily available.

Role of Internet Service Provider (ISP) :

The internet started off as a closed network between government research laboratories and relevant parts of universities. It got popular and the universities and colleges started giving more of their members' access to it. As a result, commercial Internet Service Providers emerged to provide access for mainly those who missed their university accounts. It is claimed that 'The World' was the 1st commercial ISP in 1989. Telerama founded in 1991 claims to be the world's 3rd Internet Service Provider.

ISPs employ a range of technologies to enable consumers to connect to their network. For "home users", the most popular options include dial-up, DSL (typically ADSL), Broadband wireless access, Cable modem, and ISDN. For customers who have more demanding requirements, such as medium-to-large businesses, or other ISPs, DSL, Ethernet, Metro Ethernet, Gigabit Ethernet, Frame Relay, ISDN, ATM, satellite Internet access and SONET are more likely. With the increasing popularity of downloading music and online video and the general demand for faster page loads, higher bandwidth connections are becoming more popular.

Just as their customers pay them for Internet access, ISPs themselves pay upstream ISPs for Internet access. In the simplest case, a single connection is established to an upstream ISP using one of the technologies described above, and the ISP uses this connection to send or receive any data to or from parts of the Internet beyond its own network, in turn, the upstream ISP uses its own upstream connection, or connections to its other customers (usually other ISPs) to allow the data to travel from source to destination.

Internet protocols :

Internet Protocol (IP) is a set of rules that governs the exchange (transmitting and receiving) of data or procedures between electronic devices (such as computers) connected across a single network or a series of

interconnected networks. Protocols generally includes rules of how and when a device can send or receive the data, how is the sent data packaged, and how it reaches its destination. Messages are exchanged as datagram, also known as data packets or just packets.

Several protocols are used on the Internet, including Transmission Control Protocol / Internet Protocol (TCP / IP), Electronic Mail (e-mail), File Transfer Protocol (FTP), HTTP (World Wide Web), News (or Usenet), Wais, Gopher and Telnet. Each of these has its own standard and usage.

TCP / IP

It is actually a suite, or family, of protocols that govern the way data is transmitted across networks. TCP / IP protocols work together to break the data into small pieces that can be efficiently handled by the network, communicate the destination of the data to the network, verify the receipt of the data on the other end of the transmission, and reconstruct the data in its original form.

Electronic Mail

Included in the email protocol are three distinct protocols. SMTP (Simple Mail Transfer Protocol), IMAP (Internet Message Access Protocol) and POP3 (Post Office Protocol 3). SMTP is a protocol used for sending mail, while IMAP and POP3 are used for receiving. Almost all Internet service providers support all three protocols. However the most popular setup for most providers is to use SMTP for sending mail while using POP3 for receiving.

File Transfer Protocol

File Transfer Protocol, or FTP, is a means of transferring a file from one computer to another. FTP is commonly used for uploading a web page to a web server so that it may be seen on the World Wide Web. A special program, called a client, is usually needed to use FTP.

HTTP (World Wide Web)

Hypertext Transfer Protocol, or HTTP, is the protocol used by web server to allow web pages to be shown in a web browser. If you look up into the address bar of your web browser, the place where you type in the address that you want to visit, it has the prefix “http://” in front of the address. Because most web

browsers are capable of FTP as well as viewing web pages, the http tells the browser what kind of information to expect.

News (or Usenet)

Network News Transfer Protocol (NNTP) is used for serving Usenet posts Usenet is similar to the forums that many web sites have. Usenet has forums that are dedicated to specific companies as well as forums that have a wide range of topics. Usenet is divided into several areas. Some of the forums that are included in Usenet are: ***comp.*** for discussion of computer-related topics, ***sci.*** for discussion of scientific subjects, ***rec.*** for discussion of recreational activities (e.g. games and hobbies) and talk.

Gopher

Another tool of the Internet is Gopher, a menu-based program that enables you to browse for information without knowing where the material is located. It lets you search a list of resources and then sends the material to you.

Telnet

Telnet lets you log in to a remote computer just as you would if you were there. So any commands that you would be able to run from the remote computer if you were sitting in front of it, you would be able to run from the computer you logged in from.

Wais

It is an Internet search tool that has the capability of searching many databases at one time. The databases to be searched can be determined by the user. When WAIS completes a search, it is actually searching an index of the database. A WAIS database index is created by a person. WAIS retrieves all items from the chosen databases that contain no of the words in the search phrase, provided that the words in the search phrase appear in the indexes of the selected databases. A relevancy ranking is assigned to each retrieved item to help the user determine which items may be most useful. WAIS can be accessed via Telnet, Gopher or a WAIS client program, and increasingly WAIS indexed databases are accessible through the World Wide Web.

Network Identifiers (IP address)

Once a network has been set up, the nodes can communicate among themselves. But for proper communication, the nodes should be uniquely identifiable. If a node A sends some information for node B on a network, then

it is mandatory that nodes A and B are uniquely identifiable on the network. It is achieved in the following manner.

Each NIC (network interface card, installed in a node) has a unique address assigned to it by its manufacturer. This address is known as the MAC (Media Access Control) address of the card. It means that a machine with an NIC can be identified uniquely through its NIC's MAC address.

MAC address of an NIC is permanent and never changes. This addresses is a 12-digit hexadecimal (or 48 bit) number. By convention, MAC addresses are usually written in one of the following two formats:

```
MM:MM:MM:SS: SS: SS
```

```
MM-MM-MM-SS-SS-SS
```

The first half (MM:MM:MM) of a MAC address contains the ID number of the adapter manufacturer. The second half (SS: SS: SS) of a MAC address represents the serial number assigned to the adapter (NIC) by its manufacturer.

For example, in the following MAC address,

```
00:A0:C9: 14:C8:35
```

The prefix `00:A0:C9` indicates that the manufacturer is Intel Corporation & the last three numbers `14:C8:35` are given by the manufacturer to this NIC.

IP Address

Every machine in a network has another unique identifying number, called its IP Address. An IP address is a group of four bytes (or 32 bits) each of which can be a number from 0 to 255. A typical IP address looks like this:

```
216.27.63.135
```

We use this "dotted decimal number" format, to make it easier to remember. But a computer would communicate this in binary format as shown below.

```
11011000·00011011·00111111·01000111
```

The four numbers in an IP address are called *octets,* because they each have eight positions when viewed in binary form. In total there are 32-bits, and hence the IP addresses are considered as 32-bit numbers.

The octets are split into two sections:- *Net* and *Host*. The *Net_Id* section always contains the first octet. It is used to identify the network that a computer

belongs to. *Host* (or Node) identifies the actual computer on the network. The *Host_Id* section always contains the last octet.

The IP address `0.0.0.0` is reserved for the default network and the address `255.255.255.255` is used for broadcasts.

Each octet can have ($2^8 = 256$) any value between 0 and 255. Combining these four octets we can get 2^{32} or a possible 4,294,967,296 unique values! Out of the almost 4·3 billion possible combinations, certain values are restricted from use as typical IP addresses. For example, the IP address 0.0.0.0 is reserved for the default network and the address 255.255.255.255 is used for broadcasts. IP address settings of a node can be changed by the user

There are two versions of IP addresses: version 4 (IPv4) and version 6 (IPv6). IPv4 uses 32 bits, while, the IPv6 uses 128 bits for an IP address. As discussed above, through IPv4 only 2^{32} (approximately 4 billion) distinct devices can be addressed, which in current scenario and in the near future, is a small fraction of the number of objects to be allocated IP addresses. As the number of devices to be online (mobile phones, home appliances, personal communication devices, etc.) is increasing at a very fast pace, IPv4 addresses are going to be exhausted very soon. To address this problem IPv6 was developed and it is now being deployed. Using IPv6 2^{128} (approximately 4 Bn × 4 Bn × 4 Bn × 4 Bn) distinct devices can be addressed. IPv6 also includes an important feature: a set of possible migration and transition plans from IPv4.There are many other features of IPv6.

IP Address Vs MAC Address:

- The IP address is assigned by the network administrator or the internet service provider while the MAC address is assigned by the manufacturer. Thus if a computer is transferred from one network to another, its IP address gets changed where as the MAC address remains the same.
- From the IP address it is usually possible to track the tentative location of a computer but this is not the case with a MAC address.
- On a network, a machine is identified by its IP address, rather than the MAC address of its NIC. Because, as per the IP protocol the data packets are routed to the machines using their IP addresses.

- MAC address is used only when a specific machine is to be targeted. For example, suppose we want to block a specific PC to access some network resource. If we use the PCs IP address, then the PC is not blocked permanently as its IP address may change when it connects to the network next time. Instead, if the PCs MAC address is used for the purpose, then the job is done!

IP Routing Procedure

Let us try to understand the process through an example; Computer A wants to send one frame to computer B

- A sends a DNS request to the local Domain Name Server asking for the IP address of B.
- The DNS sends the IP address of B to A.
- The Net_Id portion of B's IP address is extracted by ANDing B's IP address with the subnet mask of A
- If the Net_Id of the sender and receiver are the same, then the destination is on the same network. A can send the packet directly to B.
- If the Net_Id is different, A must send the packet to the gateway.
- The gateway will forward the packet to another gateway that is closer to the destination's domain.
- The gateway at the destination's domain will send the frame to B.

Domain Names

Whenever we have to communicate with a computer on internet, we can do so by using its IP address. But it is practically impossible for a person to remember the IP addresses of all the computers to communicate with. Therefore, a system has been developed which assigns names to some computers (web servers) and maintains a database of these names and corresponding IP addresses. These names are called Domain Names.

Examples of some of the domain names:

- dheodisha.gov.in
- textbookbureauodisha.in
- domainindia.org
- youtube.com

Domain names are used to identify particular web servers. For example, in the address: ***https://india.gov.in/*** the domain name is ***india.gov.in***

A domain name usually has more than one part: Top Level Domain name or primary domain name and sub-domain name(s).

In the above example,

.in is the primary domain name;

gov is the sub-domain of .***in***;

india is the sub-domain of ***.gov***.

There are only a limited number of top level domains, and these are divided into two categories:

1. Generic Domain Names
2. Country-Specific Domain Names

Generic Domain Names:	**Country Specific Domain Names**
·**com** - Commercial business	**.in** - India
·**edu** - Educational institutions	·**au** - Australia
·**gov** - Government agencies	·**ca** - Canada
·**mil** - Military	**.ch** - China
·**net** - Network organizations	**.nz** - New Zealand
·**org** - Organizations (nonprofit)	**.pk** - Pakistan
.biz - Business	**.jp** - Japan
	.us - United States of America

Within every top-level domain there is a huge list of second-level domains like: - Howstuffworks, Yahoo, MSN, Microsoft and millions of others... Every name in a particular top-level domain must be unique, but there can be duplication across domains. For example, **`howstuffworks.com`** and **`howstuffworks.org`** are completely different machines.

In the case of **`google.co.in`**, it is a third-level domain. Up to 127 levels are possible, although more than four is rare. Because all of the names in a given domain need to be unique, there has to be a single entity that controls the list and make sure no duplication arises.

The Internet Corporation for Assigned Names and Numbers (ICANN) is an internationally organized, non-profit corporation that has responsibility for

Internet Protocol (IP) address space allocation, protocol identifier assignment, generic (gTLD) and country code (ccTLD) Top-Level Domain name system management, and root server system management functions. These services were originally performed under U.S. Government contract by the Internet Assigned Numbers Authority (IANA) and other entities. ICANN now performs the IANA function.

While it is important to have a central authority keeping track of the database of names under different top-level domains, it is not desirable to centralize the database of all of the information in respect of each domain. For example, Microsoft has hundreds of thousands of IP addresses and host names. Microsoft wants to maintain its own domain name server for the microsoft.com domain. Similarly, India wanted to administrate the **in** top-level domain, and Australia probably wants to administrate the **au** domain, and so on. For this reason, the DNS system is a distributed database. Microsoft is completely responsible for dealing with the name server for microsoft.com — it maintains the machines that implement its part of the DNS system, and Microsoft can change the database for its domain whenever it wants to because it owns its domain name servers.

Every domain has a domain name server somewhere that handles its requests, and there is a person maintaining the records in that DNS. This is one of the most amazing parts of the DNS system — it is completely distributed throughout the world on millions of machines administered by millions of people, yet it behaves like a single, integrated database!

Alternative Domain Names

The Internet Corporation for Assigned Names and Numbers (ICANN), the organization responsible for the administration of TLDs worldwide, approved several new extensions that are not specific to any country.

These are:

.aero .biz .coop .info

.museum .name .pro , etc.

Each has been designed for a specific use, and is accompanied by certain restrictions.

Other Domain Extensions

In searching for your domain name, you may encounter Web sites offering extensions like **.xxx,.free** and **.mp3**, etc. These are not true extensions endorsed by ICANN; rather, they rely on software solutions to guarantee their accessibility to users. Because ICANN has not approved any of these extensions, however, users that do not have the correct software cannot access sites using these names; therefore, they should be used for supplemental purposes only.

Although .com, .net and .org are typically the most visible and talked-about extensions, they are not the only ones available for use. From a functional perspective, country-level domains work just as well as any TLDs, and alternative extensions work just as well. Therefore, don't necessarily settle for a mediocre TLD when you can get a better one using a different extension.

Domain Name Resolution:

Domain Name Resolution is the process of getting the corresponding IP address from a domain name.

When we type the address of a website in the web-browser, the browser first checks our computer to find if the IP address of the server corresponding to the Domain Name (embedded in the address) is present. If this address is present then with the help of this address, the corresponding server is contacted and then the website opens in your browser. Otherwise the browser sends this domain name to some specific servers (called Domain Name Servers) to find the corresponding IP address. Once the IP address is known, the server is contacted and then the website opens in our browser.

Uniform Resource Locator (URL)

In the address bar of a browser we type the address of the desired resource (website/webpage/document of a webpage) on a network and get it loaded on our screen. This address is often called as Uniform Resource Identifier. A URI is a string of characters used to identify a resource over a network. The most common type of URI is URL (uniform resource locator).

A URL addresses a unique resource on the Web. Such resource can be an HTML page, a CSS document, an image, etc. A URL is composed of different sections; some of them are optional. Following statement shows the syntax of a URL:

Protocol: //domain name: [port number][/path of the file][? query][# fragment]

In the above syntax, the parameters within the square brackets are optional.

Example:

`http://www.example.com:80/myfile.htm?key=value#para1`

In the above example,

`http:` is the protocol, the browser must use. Usually this protocol is used to extract resources on Web. Its secure (encrypted) version `https:` is also being used for the same purpose. The protocol is always followed by a colon (**:**) mark. Other protocols, being used are;

`mailto:` to open a mail client

`ftp:` to handle file transfer.

`telnet:` for a session to access remote computers

`www.example.com:80`

It is the domain name section. It may be a registered domain name or may be the IP address (in dotted-decimal format) of the host. It begins with double forward slash (//) and ends with a single forward slash (/). In this section a port number is there (80), which always starts with a colon (:) mark. The port number is optional. If we want to use the default port number we can leave out both the colon and the number, i.e. // www.example.com /.

`myfile.htm`

This is the path to the file "myfile", which has the .htm extension (an HTML document). The file path is optional and always begins with a forward slash. Many sub-paths can be incorporated by placing single forward slashes after the file names in order to pin point the desired resource. The path is always defined, though the defined path may be empty (zero length)

`?key=value`

This is the query portion of a URL, which is again optional. The parameters in this part occurs in *key-value* pairs delimited by either ampersand (**&**) or semicolon (**;**). The web server does an extra filtering before returning the resource. This section is always preceded by (?) mark.

An example of *key-value* pair may be 'year = 2016'

#para1

This is an optional fragment, separated from the preceding part by a hash (#). The fragment contains a fragment identifier providing direction to a secondary resource, such as a section heading in an article (in this case 'para1') identified by the remainder of the URL. When the primary resource is an HTML document, the fragment is often an **id** attribute of a specific element, and web browsers will scroll this element into view.

You might think of a URL like a regular postal mail address: the *protocol* represents the postal service you want to use, the *domain name* is the city or town, and the *port* is like the pin code; the *path* represents the building where your mail should be delivered; the *query parameters* represent extra information such as the apartment number in the building; and, finally, the *fragment* represents the actual person to whom you've addressed your mail.

Internet Applications

As with any area of knowledge, the Internet comes with a lot of jargon, it becomes imperative that we must understand few basic terms being used for the Web at the outset. They are, webpage, website, web server, search engine, etc. It's easy to confuse these terms sometimes, since they refer to related but different functionalities. Even if sometimes these terms get misused in public domain and elsewhere. We'll cover these terms and technologies in more detail as we explore further.

Web page

It is a document which can be displayed in a web browser such as Firefox, Google Chrome, Microsoft Internet Explorer or Edge, or Apple's Safari. These are also often called "web pages" or just "pages."

Such document is written in the HTML language (which we look into in more detail in other sections). A web page can embed a variety of different types of resources such as:

- *style information* - controlling a page's look-and-feel
- *scripts* - which add interactivity to the page
- *Media* - images, sounds, and videos.

All web pages available on the web are reachable through their URL.

Website

A *website* is a collection of linked web pages (plus their associated resources) that shares a unique domain name. Each web page of a given website provides explicit links—most of the time in the form of clickable portion of text-that allow the user to move from one page of the website to another.

To access a website, type its domain name in your browser address bar, and the browser will display the website's main web page, or *homepage* (casually referred as "the home"). Webpage and *website* are especially easy to confuse when a *website* contains only one *web page.* Such a website is sometimes called a *single-page website*"

Web server

A *web server* is a computer hosting one or more *websites*. "Hosting" means that all the *web pages* and their supporting files are available on that computer. The *web server* will send any *web page* from the *website* it is hosting to any user's browser, as per the user request.

Don't confuse *websites* and *web servers*. For example, if you hear someone say, "My website is not responding", it actually means that the *web server* is not responding and therefore the *website* is not available. More importantly, since a web server can host multiple websites, the term *web server* is never used to designate a website, as it could cause great confusion. In our previous example, if we said, "My web server is not responding", it means that no websites on that web server are available.

Search engine

Search engine is a special kind of website that helps users to find web pages from *other* websites. There are plenty out there: Google, Bing, Yahoo, Baidu, AOL, Ask, AltaVista, Lycos, Excite, Yandex, DuckDuckGo, Khoj and many more. Some are generic; some are specialized about certain topics. Beginners on the web confuse search engines and browsers. Let's make it clear:

A search engine operates, in the following order

1. Web crawling
2. Indexing
3. Searching

Web search engines work by storing information about many web pages, which they retrieve from the web. These pages are retrieved by a Web crawler (sometimes also known as a spider) - an automated web browser which follows every link it sees. The contents of each page are then analyzed to determine how it should be indexed (for example, words are extracted from the titles, headings, or special fields called Meta tags).

Data about web pages are stored in an **index database** for use in later queries. Some search engines, like Google, store all or part of the source page (referred to as a cache) as well as information about the web pages, whereas others, such as AltaVista, stores every word of every page they find. This cached page always holds the actual search text since it is the one that was actually indexed, so it can be very useful when the content of the current page has been updated and the search terms are no longer in it. Increased search relevance makes these cached pages very useful, even beyond the fact that they may contain data that may no longer be available elsewhere.

When a user enters a query into a search engine (typically by using key words), the engine examines its index and provides a listing of best-matching web pages according to its criteria, usually with a short summary containing the document's title and sometimes parts of the text. Most search engines support the use of the Boolean operators AND, OR and NOT to further specify the search query. Some search engines provide an advanced feature called proximity search which allows users to define the distance between keywords.

Web Browser

A browser is a software application used to locate, retrieve and display content on the World Wide Web, including Web pages, images, video and other files. As a client/server model, the browser is the client run on a computer that contacts the Web server and requests information. The Web server sends the information back to the Web browser which displays the results on the computer or other Internet-enabled device that supports a browser.

Today's browsers are fully-functional software suites that can interpret and display HTML Web pages, applications, JavaScript, AJAX and other content hosted on Web servers. Many browsers offer plug-ins which extend the capabilities of the software so it can display multimedia information (including sound and video), or the browser can be used to perform tasks such as videoconferencing, to design web pages or add anti-phishing filters and other security features to the browser.

The two most popular browsers are Microsoft's Internet Explorer and Mozilla Firefox. Other major browsers include Google's Chrome, Apple's Safari and Opera. While most commonly use to access information on the web, a browser can also be used to access information hosted on Web servers in private networks.

Name of the browser	Developed by	Year of initial release	Written in	OS Compatibility
Mozilla Fire fox	Mozilla Coportation	2004	Java script, C++, XUL	Cross platform
Internet Explorer	Microsoft Inc.	1995	Visual Basic	MS Windows
Safari	Apple Inc.	2003		Mac OS, Windows iPhone OS
Opera	Opera software ASA, Norway	1997		Cross platform
Chrome	Google Inc	2008	Java script	MS Windows XP

First time someone launches a browser, the browser displays a search engine's homepage. This makes sense, because, obviously, the first thing you want to do with a browser is to find a web page to display. Don't confuse the infrastructure (e.g., the browser) with the service (e.g., the search engine). Here is an instance of Firefox showing a Google search box as its default startup page.

Now we are little bit familiar with the techniques & technology to access internet resources, let's try to discuss few of its applications as well. Internet being the most powerful tool today, it finds it applications in the fields as described briefly here.

1. Communication :

Other than doing searches over the net, human users use it as one of the safest & fastest tool of communication. The techniques include;

(a) E-mail

(b) Voice Mail

(c) Chatting

(d) Internet Relay Chat

(e) Video Conferencing

(a) E-mail

Short for electronic mail, e-mail is a service which allows us to send the message in electronic mode over the internet. It offers an efficient, inexpensive and real time mean of distributing information among people. Computer users around the world extensively use this service on internet to communicate with each other. Pictures, documents and other files are sent as email attachments. Emails can be cc-ed to multiple email addresses

E-Mail Address :

Each user of email is assigned a unique name for his email account. This name is known as E-mail address. Different users can send and receive messages according to the e-mail address. E-mail is generally of the form `username@domainname`. For example, `bjbjuniorcollege@yahoo.in` is an e-mail address where `bjbjuniorcollege` is username and `yahoo.in` is domain name.

- The username & the domain name are separated by the special character @.
- E-mail addresses are not case sensitive.
- Spaces are not allowed in e-mail address.

Components of an e-mail message :

E-mail message comprises of different components: E-mail Header, Greeting, Text, and Signature.

E-mail Header : The first five lines of an E-mail message is called E-mail header. The header part comprises of From, Date, To, Subject, CC and BCC fields.

- **FROM :** This field indicates the sender's address i.e. who sent the e-mail.
- **DATE :** This field indicates the date when the e-mail was sent.
- **TO :** It indicates the recipient's address i.e. to whom the e-mail is sent.
- **SUBJECT :** This field indicates the purpose of e-mail. **CC**
- **CC :** stands for Carbon copy. It includes those recipient addresses whom we want to keep informed but not exactly the intended recipient.
- **BCC :** BCC stands for Black Carbon Copy. It is used when we do not want one or more of the recipients to know that someone else was copied on the message.

Advantages of e-mail :

E-mail has proved to be powerful and reliable medium of communication. An e-mail is Reliable, Convenience, Fast, Inexpensive, Printable, Global & possess Generality

Reliable : Many of the mail systems notify the sender if e-mail message was undeliverable.

Convenience : There is no requirement of stationary and stamps. One does not have to go to post office. But all these things are not required for sending or receiving an mail.

Speed : E-mail is very fast. However, the speed also depends upon the underlying network.

Inexpensive : The cost of sending e-mail is very low.

Printable : It is easy to obtain a hardcopy of an e-mail. Also an electronic copy of an e-mail can also be saved for records.

Global : E-mail can be sent and received by a person sitting across the globe.

Generality : It is also possible to send graphics, programs and sounds with an e-mail.

Disadvantages :

Apart from several benefits of e-mail, there also exist some disadvantages like; Forgery, Overload, Misdirection, Junk, No response.

Forgery : E-mail doesn't prevent from forgery, that is, someone impersonating the sender, since sender is usually not authenticated in any way.

Overload : Convenience of E-mail may result in a flood of mail.

Misdirection : It is possible that you may send e-mail to an unintended recipient.

Junk : Junk emails are undesirable and inappropriate emails. Junk emails are sometimes referred to as spam.

No Response : It may be frustrating when the recipient does not read the e-mail and respond on a regular basis.

Email Protocols :

These are a set of rules that help the client to properly transmit the information to or from the mail server. They include **SMTP, POP,** and **IMAP.**

(i) **SMTP** stands for **Simple Mail Transfer Protocol**. It was first proposed in 1982. It is a standard protocol used for sending e-mail efficiently and reliably over the internet.

(ii) **IMAP** stands for **Internet Mail Access Protocol.** It was first proposed in 1986. There exist five versions of IMAP as : IMAP, IMAP2, IMAP3, IMAP2bis, IMAP4

(iii) **POP** stands for Post Office Protocol. It is generally used to support a single client. There are several versions of POP but the POP 3 is the current standard.

***E-mail System* :**

E-mail system comprises of the following three components:

- Mailer
- Mail Server
- Mailbox

Mailer: It is also called **mail program, mail application** or **mail client.** It allows us to manage, read and compose e-mail.

Mail Server: The function of mail server is to receive, store and deliver the email. It is must for mail servers to be sunning all the time because if it crashes or is down, email can be lost.

Mailboxes: Mailbox is generally a folder that contains emails and information about them.

Attachment :

Ability to attach file(s) along with the message is one of the most useful features of email. The attachment may be a **word document, PowerPoint presentation, audio/video files,** or **images.**

(a) In order to attach file(s) to an email, click the attach button. As a result, a dialog box appears asking for specifying the name and location of the file you want to attach.

(b) Once you have selected the appropriate file, it is attached to the mail.

(c) Usually a paper clip icon appears in the email which indicates that it has an attachment.

(d) When adding an attachment it is better to compress the attached files so as to reduce the file size and save transmission time as sending and downloading large files consumes a lot of space and time.

The following table shows the popular email service providers:

S.N.	Service and Description
1.	**Gmail** Gmail is an email service that allows users to collect all the messages. It also offers approx 7 GB of free storage.
2.	**Hotmail** Hotmail offers free email and practically unlimited storage accessible on web.
3.	**Yahoo Mail** Yahoo Mail offers unlimited storage, SMS texting, social networking and instant messaging to boot.
4.	**iCloud Mail** iCloud Mail offers ample storage, IMAP access, and an elegantly functional web application.
5.	**ATM Mail** ATM Mail is a free email service with good spam protection.
6.	**Mail.com** and **GMX Mail** Mail.com and GMX Mail offers reliable mail service with unlimited online storage.
7.	**Shortmail** Shortmail offers easy and fast email service but with limited 500 characters per message.
8.	**Inbox.com** Inbox.com offers 5 GB of free online storage. IMAP is not supported by Inbox.com
9.	**Facebook Messages** Facebook Messages includes the message conversation.
10.	**My Way Mail** My Way Mail offers clean and fast free email service but lacks in secure messaging.

(b) Voice Mail :

Internet telephony is another common communications service made possible by the creation of the Internet. **VoIP** stands for Voice-over-Internet Protocol, referring to the protocol that underlies all Internet communication.

(c) Chatting :

On the Internet, chatting is talking to other people who are using the Internet at the same time you are. Usually, this "talking" is the exchange of typed-in messages requiring one site as the repository for the messages (or "chat site") and a group of users who take part from anywhere on the Internet. In some cases, a private chat can be arranged between two parties who meet initially in a group chat. Chats can be ongoing or scheduled for a particular time and duration. Most chats are focused on a particular topic of interest and some involve guest experts or famous people who "talk" to anyone joining the chat. (Transcripts of a chat can be archived for later reference.)

Chats are conducted on online services (like America Online), by bulletin board services, and by Web sites. Several Web sites, notably Talk City, exist solely for the purpose of conducting chats. Some chat sites such as Worlds Chat allow participants to assume the role or appearance of a *virtual reality* environment. Talk City and many other chat sites use a protocol called Internet Relay Chat. A chat can also be conducted using sound or sound and video, assuming you have the bandwidth access and the appropriate programming.

(d) Internet Relay Chat (IRC) :

IRC is not only an open-standard electronic chat protocol, but also a global, distributed, real-time chat system that operates over the Internet. An IRC network consists of a set of interconnected servers. Once users are connected to an IRC server, they can converse with other users connected to any server in the IRC network. IRC provides for group communication, via named channels, as well as personal communication through "private" messages. It also facilitates data transfer and file sharing as well.

You can start a chat group (called a channel) or join an existing one. There is a protocol for discovering existing chat groups and their members. Depending

on the type of network, nicknames can be reserved (registered) or just used during the session. Some channels encourage you to register a nickname that you always use and even offer space for a personal profile, picture, and personal home page link.

Popular ongoing IRC channels are #hottub and #riskybus. A number of channels are set up and conducted in foreign languages. The most common IRC networks are IRCnet (mostly European), EFnet (mostly North American), Undernet, and Dalnet. Popular IRC clients include mIRC for Windows, IRCle for Mac OS, and irc2 (the original client) for UNIX-base operating systems. The IRC protocol uses Transmission Control Protocol (you can IRC via a Telnet client), usually on port 6667.

(e) Video conferencing :

Video conference means to conduct a conference between two or more participants at different sites by using computer networks to transmit audio and video data. For example, a *point-to-point* (two-person) video conferencing system works much like a video telephone. Each participant has a video camera, microphone, and speakers mounted on his or her computer. As the two participants speak to one another, their voices are carried over the network and delivered to the other's speakers, and whatever images appear in front of the video camera appear in a window on the other participant's monitor.

Multipoint videoconferencing allows three or more participants to sit in a virtual conference room and communicate as if they were sitting right next to each other. Until the mid 90s, the hardware costs made videoconferencing prohibitively expensive for most organizations, but that situation is changing rapidly. Many analysts believe that videoconferencing will be one of the fastest-growing segments of the computer industry in the latter half of the decade.

2. Job search

Nowadays, many people search for their jobs online as it is quicker and there is a larger variety of job vacancies present. People can publish resume online for prospective job. Some of the web sites providing this service are naukri.com, monster.com, summerjob.com, recuritmentindia.com etc.

3. Online Shopping

The internet has also facilitated the introduction of a new market concept consisting of virtual shops. They provide information about products or services

for sale through www servers. Using the internet services customers can submit specific product queries and request specific sales quotes. For example amazon.com is a www based bookshop on the internet where information on all types of international books can be found and books can be ordered online.

4. Stock market updates

You can sell or buy shares while sitting on computer through internet. Several websites like ndtvprofit.com, moneypore.com, provide information regarding investment

5. Travel

One can use internet to gather information about various tourist place . it can be used forbooking Holiday tours , hotels, train,bus, flights and cabs. Some of the web sites providing this service are goibibo.com, makemytrip.com, olacabs.com.

6. Research

Research papers are present online which helps in the researcher doing aliterature review.

Other applications like E-Business & E-Commerce, Cashless Payments and Social networking, etc are elaborated in Chapter-4 of this book.

Wireless / Mobile Communication

Wireless Communication is, by far the fastest growing segment of the communication industry. As such it has not only captured the attention of the media, but also the imagination of general public. The cellular / mobile systems have experienced exponential growth over the last decade and currently there are around nine billion users worldwide. Cellular Phones indeed have become critical business tools and part of everyday life in developed and developing countries. Wireless Local Area Networks currently supplement or replace wired networks in many homes, business and campuses. Many new applications including wireless sensor networks, automated toll collection, smart homes and telemedicine have become realities. The explosive growth of wireless technologies, coupled with proliferation of laptop computers, tablets and smart phones presents a bright future for wireless communication.

In this section, we shall outline the basic principle of cellular (mobile) telephone system and the evolution of mobile technology. Cellular system provide

two way voice and data communication with regional, national and international coverage. The basic premise behind cellular system design is the re-usability of frequency (spectrum), which exploits the fact that signal power falls off with distance. So a particular frequency can be re used over spatially separated locations called as cells. The coverage area of the cellular system is divided in to non-overlapping cells, where some set of channels (frequency ranges) is assigned to each cell. Operation within a cell is controlled by a centralized base station, often called as cell-tower. The reusability of frequencies over different cells maximizes the spectral efficiency.

The first generation of cellular systems used analog communication, before digital communication becomes prevalent. In digital communication, the components are cheaper, faster, and smaller and require less power. In this second generation (2G) systems, voice quality is improved due to error correction coding. Digital systems also have higher capacity and can use more spectrally efficient digital modulation and more efficient techniques to share the cellular spectrum. Digital communication also takes the advantage of advanced compression techniques, encryption methods to secure digital signal against eavesdropping. In addition to voice, digital communication also offers data services like short messaging, e-mail, internet access and imaging capabilities (video phones).

Evolution of Mobile Technology :

The first operational cellular communication system was deployed in the Norway in 1981 and was followed by similar systems in Japan, Finland, Sweden, United States and UK.

The first generation (1G) mobile network uses analog signals to transmit voice calls between two transmitters by using frequency modulation technique for radio transmission. It uses Frequency Division Multiple Access (FMDA) with channel capacity of 30 kHz and frequency band around 900 MHz This transmission is based on the technology called as Advance Mobile Phone Service (AMPS) and its speed is up to 2·4 kbps. The limitations of this generation mobile communication includes; cannot convert voice to digital mode, no global roaming service, low capacity and poor voice quality.

The second generation (2G) of the wireless mobile communication started around 1990 and was based on low-band digital data signaling. This generation offers additional services like, Short Message Service (SMS), Picture Message Service and Multimedia Message Service (MMS). In this generation two types of digital modulation schemes are used: TDMA (Time Division Multiple Access) and CDMA (Code Division Multiple Access) and the frequency band is 850 – 1900 MHz The most popular 2G wireless technology is known as Global Systems for Mobile Communications (GSM) uses the TDMA scheme. Each frequency is divided using TDMA (Time Division Multiple Access) scheme into eight timeslots and allows eight simultaneous calls on the same frequency. This protocol allows large numbers of users to access one radio frequency by allocating time slots to multiple voice or data calls. The net data rate in GSM is around 14·4 kbps. CDMA uses spread spectrum technology to break up speech into small, digitized segments and encodes them to identify each call. CDMA distinguishes between multiple transmissions carried simultaneously on a single wireless signal. It carries the transmissions on that signal, freeing network room for the wireless carrier and providing interference-free calls for the user. CDMA technology are recognized as providing clearer voice quality with less background noise, fewer dropped calls, enhanced security, greater reliability and greater network capacity.

Based upon the CDMA, a new telephone technology was introduced, called as **Wireless in Local Loop** (WLL). The voice is transmitted via radio signals within a range of 30-35 kilometers. Under CDMA, each phone was given a Code. When somebody calls from WLL to another person, the Base Trans-Receiver accepts the signal and sends it to Base-Station Controller. Controller decodes them according to given code and sends it to Base Station Manager which sends it to Telephone Exchange. This gets back to a specific customer on the same route via different Trans-Receiver

There are few limitations in 2G communications like; requirement of strong digital signal, difficulty in handling complex data like video and proper network coverage.

The Third generation (3G) communication system was introduced around the year 2000. International Mobile Telecommunication-2000 (IMT-2000) is the official ITU name for 3G to provide wireless access to global

telecommunication infrastructure through both satellite and terrestrial systems serving fixed and mobile phone users. Under IMT-2000 agreement, 3G uses three different frequency bands to accommodate five types of radio standards; the bands are: 800/900 MHz, 1·7 to 1·9 GHz and 2·5 to 2·69 GHz band. It follows two earlier generations and combines high speed mobile access with Internet Protocol based services. This network being a follow up of GSM technology evolved as follows: General packet Radio Service (GPRS) offers data speed up to 144kbps (in satellite and rural outdoor), Enhanced Data rates for Global Evolution (EDGE) reached up to 384kbps (in urban outdoor), UMTS (Universal Mobile Telecommunication System) uses Wideband CDMA (WCDMA) which offers downlink speeds up to 1.92Mbps (indoor), High speed Downlink packet Access (HSDPA) boosted the downlink to 14Mbps and LTE Evolved Terrestrial Radio Access (E- UTRA) is aiming for 100Mbps. 3G enables devices such as mobile phones and mobile dongles to deliver broadband-speed internet. 3G works by parceling the data sent on the network into small packets. These packets are then assembled in the correct order at the receiver's end. This is very different from normal 2G technology in which small portion of the network is reserved for a call. 3G technology also enables mobile service providers to know the location of the handset using the service. The 3G delivers new features such as, web browsing, e-mail service, TV streaming & video conferencing, map navigation, downloading mp3 songs, etc. These radio technologies function beneath CDMA, TDMA and FDMA. High bandwidth is perhaps its main limitation.

The Fourth generation (4G) mobile communication system is introduced in the year 2010. This 4G combines together all the existing wireless network technology (GSM, GPRS, IMT-2000, and Wi-Fi & Bluetooth) in order to facilitate seamless roaming from one technology to another. LTE (Long Term Evolution) and Wi-MAX (Worldwide interoperability for Microwave Access) technologies are being used for this mobile network system. This system provides capabilities as mandated by the ITU in IMT-Advanced. Current application under this system includes; improved mobile web access, IP telephony, gaming services, high definition mobile television, video conferencing, 3D TV and cloud computing. This system aims to provide a data speed in the range of 100Mbps and 1Gbps, high QoS (Quality of Service) and security. Because of its "anytime, anywhere" feature of 4G is also referred to as "MAGIC" (Mobile multimedia; Anytime/ anywhere; Global mobility support; Integrated wireless solution; Customized personal services).

Large battery usage, difficult & complicated hardware implementation and exclusive network requirement are some of its limitations.

And the future- the **Fifth Generation** (5G) of mobile wireless communication system would be the wireless internet network to be supported by IPv6. It is called Worldwide Wireless Web (wwww). Physical layer and Data link layer define the wireless technology in 5G.

In reality, 5G does not exist yet but the future network next to 4G we say as 5G. We so far heard about only LTE advanced, which gives peak download speed of 1Gbps and upload speed of 512Mbps. It is expected that 4G network will see its end in few years to come and 5G will be its successor. 5G network will not be only more speed but also capable of carrying huge data. This generation is expected to roll out in the year 2020. 5G might solve the problem of frequency licensing and spectrum management issues. 5G terminals might have software-defined radios; also it might have different modulation schemes and error control schemes. It might also provide hundreds of channel without streaming.

Following table summarizes the wireless mobile technology evolution;

Gen	Definition	Speed	Technology	Time-line	Features
1G	Analog	2·9 kbps	AMPS, NMT, TACS	1970-1980	Voice only
2G	Digital / Packet Data	171·2 kbps	TDMA / CDMA / GPRS	1990-2004	Voice & Data
3G	Digital Broadband / Packet Data	2Mbps	CDMA-2000 / EDGE / UMTS / HSPA	2005-2010	Multimedia Service
4G	Digital Broadband / Packet / All IP	100Mbps	Wi-MAX / LTE / Wi-Fi	At present	Wireless only, HD video, etc.

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. The first ever network of computers was installed at
   a. Advanced Research Project Agency, USA
   b. National Research Laboratory, England
   c. European Organisation for Nuclear Research
   d. None of these
2. An Internet backbone is
   a. larger transmission line b. UTP cable
   c. Radio Waves d. Coaxial Cable
3. In which of the following, the bit is passed to avoid collision?
   a. Ethernet b. Token ring
   c. FDDI d. None of these
4. The protocol for FDDI is derived from
   a. IEEE 802.4 token bus b. IEEE 802.5 token ring
   c. IEEE 802.5 token time d. None of these
5. Which of the following is a Level One connection in Internet Access?
   a. Cable modem b. Dial-Up
   c. Gateway d. Direct
6. A user only get textual matter of a Web page in
   a. ISDN connection b. Shell connection
   c. TCP/IP connection d. None of these.
7. Which of the following is not a mobile broadband technology?
   a. Long Term Evolution b. Global System of Mobiles
   c. Wi-MAX d. ADSL
8. Which of the following protocol lets you log in to a remote computer?
   a. Wais b. Gopher
   c. Telnet d. Usenet
9. The first half of a MAC Address contains
   a. Adapter Serial Number b. Manufacturer ID number
   c. Network ID number d. Computer Serial Number

10. The query section of a URL is preceded by
    a. colon b. semi-colon
    c. question mark d. double forward slash
11. Expand the following abbreviations:
    ARPA, DNS, WAIS, ISP, LTE, CDMA, UMTS, EDGE, FDDI, VSAT, IEEE, ISDN, RFoG, HFC, ICANN, TLD, HTML, HTTP, FTP, XML.

LONG ANSWER TYPE QUESTIONS :

1. What is an Internet backbone? Describe backbone in local and global level.
2. What are the Network Technologies used in an Internetwork.
3. What is an Internet Access? Describe different types of connections used for Internet Access.
4. Describe the role of Internet Service Providers. Name some of the ISPs in India.
5. What do you mean by Internet Protocol? Briefly discuss some of these protocols.
6. Distinguish between IP address and MAC address in Internet.
7. What is a Uniform Resource Locator? Explain different parts of a URL with proper example.
8. Write short Notes on
   a. Web Browser
   b. Search
   c. Video Conferencing
   d. Internet Relay Chat
9. What is an electronic mail and its protocol? Describe different sections of an e-mail with proper example.
10. What are different types of mobile technology currently in operation? Discuss at least two of them with examples.

■ ■ ■

CHAPTER - 3

NETWORK SECURITY ON INTERNET

The Internet is a worldwide collection of computer networks, which may be termed as the communication highway, which links together millions of computers being used by the businesses, the government, the industries, educational institutions, and individuals. Over these networks e-mails are exchanged, banking transactions take place, on-line examinations are taken and moreover people stay connected through various social networking platforms. Protecting the data, either stored or on the move has become a major area of concern as unscrupulous persons indulge in compromising their original status. Using a credit/debit card data for shopping, using a company's data to sell it to some rival company, to find the kind of web sites a person accesses, etc. are some of the examples of such activities. These people may sometimes also want to destroy the data on its way, or block the services of some resources or sites. As the data goes from one point to another point on the Internet, it passes through several points along the way, giving other users the opportunity to access, and even alters it. Unauthorized access to our system may be obtained by intruders, who then use advanced knowledge to impersonate us, steal information or even deny our access to our own resources. Therefore, there is always a threat of some kind of attacks on computer networks' security. These type of threats over a computer network is called as cyber crime.

Cybercrime:

Crime and criminality have been associated with man since his fall. Crime remains elusive and ever strives to hide itself in the face of development. Different nations have adopted different strategies to contend with crime depending on their nature and extent. One thing is certain, it is that a nation with high incidence of crime cannot grow or develop. That is so because crime is the direct opposite of development. It leaves a negative social and economic consequence.

Cybercrime is defined as crimes committed on the internet using the computer as either a tool or a targeted victim. It is very difficult to classify crimes in general into distinct groups as many crimes evolve on a daily basis. However, all cybercrimes involve both the computer and the person behind it as victims; it just depends on which of the two is the main target. Hence, the computer will be looked at as either a target or tool for simplicity's sake. Unlike in traditional crimes, the Information Technology infrastructure is not only used to commit the crime but very often is itself the target of the crime. Pornography, threatening email, assuming someone's identity, sexual harassment, defamation, SPAM and Phishing are some examples where computers are used to commit crime, whereas viruses, worms and industrial espionage, software piracy and hacking are examples where computers become target of crime. For example, hacking involves attacking the computer's information and other resources. It is important to take note that overlapping occurs in many cases and it is impossible to have a perfect classification system.

A **cyber crime is an unlawful act wherein the computer is either a tool or a target or both.**

1. The Computer as a Target:-using a computer to attack other computers.
    a. Hacking
    b. Virus / Worm
    c. Cookies / Spam
    d. Denial of Service
    e. Snooping
    f. Spoofing
    g. Cyber stalking
    h. Software piracy, etc.
2. The computer as a weapon:-using a computer to commit real world crimes.
    a. Cyber Terrorism
    b. Intellectual Property Right violations
    c. Cyber Squatting
    d. On-line frauds
    e. Pornography etc.

Before going to discuss about the security architecture for a computer network, let's have some overview of the threats we have outlined above. This will give definitive idea about different types of threats common to computer networks.

Hacking :

Every act committed towards breaking into a computer and/or network is hacking. Hackers write or use ready-made computer programs to attack the target computer. They possess the desire to destruct and they get the kick out of such destruction. Some hackers hack for personal monetary gains, such as to stealing the credit card information, transferring money from various bank accounts to their own account followed by withdrawal of money.

By hacking web server taking control on another person's website called as web hijacking

Virus / Worm :

Virus - A virus is maliciously written code that replicates itself. It may damage hardware, software, or information files. By definition, human interaction is necessary for a virus to spread to another user's files. New viruses are discovered almost daily. Most viruses exist simply to replicate themselves. Others can do serious damage such as erasing files or even rendering the computer itself inoperable. Many viruses do a large amount of damage by infecting another program, boot sector, partition sector, or a document that supports macros by inserting itself or attaching itself to that medium.

Viruses are classified on the basis of their mode of existences; and there are three categories of virus.

1. Boot Infectors :

Some viruses reside in the boot sector of the disk and not in the program file. It gets loaded as soon as the system is switched on and takes the control of the system. Thus access to the disk becomes impossible. These viruses can create Bad Sectors and stay in memory of the computer until the disk is formatted or system is shut off.

2. System Infectors :

Operating system is required to interact with the computer. The system infectors attach themselves to memory resident files such as COMMAND.COM.

However, the system infectors are different from boot infectors. These infectors take control after the computer system is booted and directly affects the hard disk.

3. Executable Program Infectors :

These are the most dangerous virus around. They attach to the program files and can spread immediately to any of the executable files. When we start a program, the virus is executed first and then allows the original program to follow. It is memory resident and infects every executable program. The size of .EXE and .COM files becomes too large to be executed.

The spread of virus to systems occurs either through the use of infected auxiliary memory devices like memory cards or pen drives or by running infected programs over computer networks. A virus entering a system first monitors the system and then activates itself at proper time to cause maximum damage to the information stored in the system or after replicating itself on a maximum number of memory cards or on a particular date. The Virus copies onto the boot record if it is a boot sector virus or onto the executable files like COM and EXE files.

Worm :

A worm is similar to a virus. A worm is designed to copy itself from one computer to another, but it does so automatically (perhaps over a network) by taking control of features on the computer that can transport files or information. This often occurs without the action of humans. Worms are very effective at using e-mail systems and address books to spread. They replicate themselves like viruses, but do not alter files the way that viruses do. The main difference is that worms reside in memory and usually remain unnoticed until their effects become apparent, obnoxious, or overwhelming. A worm may arrive in the form of a joke program or software of some sort, or by copying itself using email or another transport mechanism. A great danger of worms is their ability to replicate in great volume. When new worms are unleashed, they spread very quickly, clogging networks and possibly making you wait twice as long to view Web pages on the Internet. This is called a **Denial of Service Attack** (to be discussed next). The worm may do damage and compromise the security of the computer. Once a worm is in a computer system it can travel alone. Because worms don't need to travel via a "host" program or file, they can tunnel into the system and allow another person to take control of the computer remotely. To

protect against a worm, networked users must keep up with operating system patches and updates as well as anti-virus software, and be aware of any suspicious traffic.

Trojan Horse : A Trojan (or Trojan horse) is a malicious program disguised as a normal application. Trojan horse programs do not replicate themselves like a virus, but they can be propagated as attachments to a virus. Trojan horses cause damage or compromise the security of the computer. Trojan horses spread when people are lured into opening a program because they think it comes from a legitimate source. But while it runs, it could be allowing "back door" access to the computer by hackers or destroying files on the hard disk. A recent Trojan horse came in the form of an e-mail that included attachments claiming to be Microsoft security updates, but turned out to be viruses that attempted to disable antivirus and firewall software.

Trojan horses can be included in software that you download for free. Never download software from a source that you don't trust. For protection against a Trojan horse, users must be suspicious of any unknown program and be sure it is safe before running it.

Viruses, Worms, and Trojan Horses are all malicious programs that are purposefully written to cause damage to a computer and/or information on the computer. They are also capable of slowing down the Internet, and they can use an individual's computer to spread themselves to friends, family, co-workers, or others. It can be safely stated that an alert prevention and some good common sense can go a long way to prevent one from falling victim to these threats. Please keep in mind that the definitions of Viruses, Worms, and Trojan Horses change with their development. A recent ploy of computer virus authors is the combination of two or more viruses together to make a new, stronger virus. The new virus combines the features of each virus into one so that the virus will slip past the antivirus software. It is very important to keep all operating system and antivirus software updated.

Prevention of VIRUS attack :

When our computers start slowing down or behaving in an unusual way, we are often quick to suspect that we have a virus. It might not be a virus, but it is likely that you have some sort of malware. Some are malicious, and others are just annoying. The worst culprits are the hijackers—malware programs that take over the browser or worse yet, the computer. Following few tips can prevent malware from infecting our computers, keeping the hardware safe.

1. **Installing Anti-Virus/Malware Software**
2. **Keeping the Anti-Virus Software Up to Date**
3. **Running the Scheduled Scans regularly**
4. **Keeping the Operating System Current**
5. **Keeping the Network Secure :**

Many of our computers connect to our files, printers, or the Internet via a Wi-Fi connection. Make sure it requires a password to access it and that the password is strong. Never broadcast an open Wi-Fi connection. Use WPA or WPA2 encryption. WEP is no longer strong enough as it can be bypassed in minutes by experts. It's also a great idea to not broadcast your SSID (the name of your Wi-Fi network). You can still access it with your device, you will just have to manually type in the SSID and the password. If you frequently have guests who use your Internet, provide a guest SSID that uses a different password, just in case your friends are evil hackers

6. **Think before the Click :**

Avoid websites that provide pirated material. Do not open an email attachment from somebody or a company that you do not know. Do not click on a link in an unsolicited email. Always hover over a link (especially one with a URL) before you click to see where the link is really taking you. If you have to download a file from the Internet, an email, an FTP site, a file-sharing service, etc., scan it before you run it. Good anti-virus software will do that automatically, but make sure it is being done.

7. **Keep the Personal Information Safe :**

This is likely the most difficult thing to do on the Internet. Many hackers access our files not by brute force, but through social engineering. They get enough of our information to gain access to our online accounts and glean more of our personal data. They continue from account to account until they have enough of information that they can access our banking data or just steal the identity altogether. We have to be cautious on message boards and social media. Lock down all the privacy settings, and avoid using real name or identity on discussion boards.

8. **Avoid using Open Wi-Fi :**

The open or so called 'free' Wi-Fi (non-password, non-encrypted) must be avoided at the coffee shops, library, and railway stations and especially at the

airports. Think about it before using. If you can access it with no issues, what can a trained malicious individual can do?

9. Always Back Up the Files:

Back the files on your computer up to an external hard drive, and then back them up in a different location. One can also use a backup service for this purpose

10. Use Multiple Strong Passwords:

Never use the same password, especially for the bank account. Combination of lower case, upper case, numbers, and symbols make up a strong password. Keep it easy to remember but difficult to guess. Do not use dates or pet names as pass word

Cookies :

Cookies are messages that web servers pass to your web browser when you visit Internet sites. Your browser stores each message in a small file (only up to 4kb in size!), called 'cookie.txt. When you request another page from the server, your browser sends the cookie back to the server. These files typically contain information about your visit to the web page, as well as any information you've volunteered, such as your name and interests.

Uses of cookies :

(a) Cookies are most commonly used to track website activity. When you visit some sites, the server gives you a cookie that acts as your identification card. Upon each return visit to that site, your browser passes that cookie back to the server. In this way, a web server can gather information about which web pages are used the most, and which pages are gathering the most repeat hits.

(b) Cookies are also used for online shopping. Online stores often use cookies that record any personal information you enter, as well as any items in your electronic shopping cart, so that you don't need to re-enter this information each time you visit the site.

(c) Many portals and search engines use cookies to provide personalized web pages. When you select preferences at a site that uses this option, the server places the information in a cookie. When you return, the server uses the information in the cookie to create a customized page for you.

(d) Only the website that creates a cookie can read it, so other servers do not have access to your information. Additionally, web servers can use only information that you provide or choices that you make while visiting the website as content in cookies.

(e) Webmasters have always been able to track access to their sites, but cookies make it easier to do so. In some cases, cookies come not from the site you're visiting, but from advertising companies that manage the banner ads for a set of sites (such as *DoubleClick.com*). These advertising companies can develop detailed profiles of the people who select ads across their customers' sites.

(f) Accepting a cookie does not give a server access to your computer or any of your personal information (except for any information that you may have purposely given, as with online shopping). Also, it is not possible to execute code from a cookie, and not possible to use a cookie to deliver a virus.

(g) Many websites use cookies to log their users in automatically. By storing a few pieces of user information they can automatically authenticate the user's details and use them to save the user time when they log in.

(h) Visitor tracking and statistics systems often use them to track visitors. By assigning the visitor a cookie, they will not be counted more than once, so accurate unique visitor statistics can be obtained. Also, if a user has a unique cookie the system can 'follow' them through a website, showing the webmaster exactly where the visitor has been, and in what order.

Cookie Security

Cookies pose no real danger to users. The browser actually writes and reads cookies from the computer when requested to by a website, so a malicious website cannot damage the computer. For webmasters, there are some security concerns. When the cookie is set, the domain(s) which can access it are set. Usually this is just the website that set the cookie. This makes them relatively secure; as you can be sure that your competitor cannot load your cookie from one of your visitors' computers (they cannot even find out if it exists).

One major security problem with cookies, though, is that they can easily be read by anyone using the computer. They are just a simple text file, so you should not under any circumstances store passwords in cookies. A common way to log people in automatically is to store an encrypted version of their password,

which can then be matched with an encrypted version on the server. Another method is to store a unique ID and a unique validation number on the user's system. This is then referenced in a database to the user's account. This way, no actual details are stored and a malicious user cannot simply guess users' IDs (as there is the validation number).

Denial of Service:

When a computer resource is flooded with more requests than it can handle, the resource crashes and thereby denying access of service to authorized users. These requests are made deliberately to make one or more network resources unavailable to their legitimate users. These types of attempts are called as Denial of Service attack.

Examples of such attacks include;

(i) Attempts to "flood" a network, thereby preventing legitimate network traffic. This is being done to corrupt, encrypt or change the status pf information so that it would not be accessible to its legitimate user. Such attempt is called as Denial of Information.

(ii) Attempts to disrupt connections between two machines, thereby preventing access to a service. This attack known as ' Denial of Access to Resources', can block any resources like, a printer or a scanner, a USB port of a computer, etc. from being used.

(iii) Attempts to prevent a particular individual from accessing a service like an application. It shuts down an application as soon as it is opened by a legitimate user.

(iv) Attempts to disrupt a specific website. Access to a website can be blocked by sending bulk requests to it, so that it becomes unavailable to other users. This attempt is called as 'Denial of Access to a Website'.

Spam :

Spamming is the act of sending unsolicited messages to many users at a time, possibly up to thousands, with the usual intention of advertising products to potential customers. Spamming can also be used as a form of irritation by singling out an email address and sending the owner of that address hundreds of emails per second. Spamming is usually random and untargeted but it can be targeted to either a group of people, for example, advertisements that cater for

a particular group of people, or certain persons, like in the case of spamming for the purpose of irritating the public. The internet has given spam a much uglier face. Now, what used to be a minor irritation has become a veritable menace!

Snooping :

The act of secretly checking one's mail, writing or any such information without his/her knowledge is called as 'snooping'. In the realm of Computer network, snooping attacks involve an intruder listening to traffic between two machines on a network. If traffic includes passing unencrypted passwords, then an unauthorized individual can potentially access the network and read confidential data. Snooping may be done in a number of ways:

- By getting someone's login information by casually watching what he/she is typing.
- Reading the files on someone's computer in an unauthorized manner
- Using some software which keeps track of the activities and data being sent or received on someone's computer.

Eavesdropping :

Suppose two friends are talking to each other and a third person is secretly trying to listen to their talks. What that person is doing is said to be 'eavesdropping'. Have you ever tried to secretly listen to the conversation between two teachers regarding your class? If yes, then what you have done is 'eavesdropping'. In the context of network security Eavesdropping refers to unauthorized access to another person's or organization's data while the data is on its way on the network. This may be done in a number of ways:

- By setting up parallel telephone lines.
- By installing some software (spyware) in the target computer.
- By installing some receiver which captures the data while on its way.

Spoofing :

Spoofing refers to actively introducing network traffic pretending to be someone else. For example; sending a command to computer-X pretending to be computer-Y is nothing but an act of spoofing. It is typically used in a scenario

where you generate network packets that say they originated by computer B while they really originated by computer C.

Many of the protocols in the TCP/IP suite do not provide mechanisms for authenticating the source or destination of a message. They are vulnerable to spoofing attacks when extra precautions are not taken by applications to verify the identity of the sending or receiving host. Spoofing attacks which take advantage of TCP/IP suite protocols may be mitigated with the use of firewalls capable of deep packet inspection or by taking measures to verify the identity of the sender or recipient of a message. Some examples of spoofing are given below:

- **Caller ID spoofing** is the practice of causing the telephone network to display a number on the recipient's Caller ID display that is not that of the actual originating station. The term is commonly used to describe situations in which the motivation is considered malicious by the speaker or writer. It makes a call appear to have come from any phone number the caller wishes.
- **E-mail spoofing** is the practice of sending an email pretending to be someone else.
- **IP address spoofing** or IP spoofing refers to the creation of Internet Protocol (IP) packets with a forged source IP address, with the purpose of concealing the identity of the sender or impersonating another computing system.
- **Protocol spoofing** is used in data communications to improve performance in situations where an existing protocol is inadequate

Cyber-stalking :

Cyber stalking is use of the Internet or other electronic means to stalk someone. This term is used interchangeably with online harassment and online abuse. Stalking generally involves harassing or threatening behavior that an individual engages in repeatedly, such as following a person, appearing at a person's home or place of business, making harassing phone calls, leaving written messages or objects, or vandalizing a person's property.

Cyber-stalking can include many things including threats, solicitation for sex, false accusations, defamation, slander, libel, identity theft, and vandalism. Cyber-stalking is often used in conjunction with offline stalking, as both are an expression of a desire to control, intimidate, or manipulate a victim. A cyber-

stalker may be someone the victim is familiar with, or a complete stranger, and is a criminal offense.

Key factors to identify cyber-stalking cases include:

- **False accusations**. A cyber-stalker often tries to damage the reputation of his victim by posting false information on social media websites or blogs. A perpetrator may even create fictitious websites or other accounts for the purpose of spreading false rumors and allegations about the victim.
- **Gathering information about the victim**. A cyber-stalker may try to gather as much information as possible about the victim by interacting with the victim's friends, family, and colleagues. In serious cases, a cyber-stalker may hire a private investigator.
- **Monitoring victim's activities**. A cyber-stalker may attempt to trace his victim's IP address, or hack into the victim's social media accounts and emails to learn about his online activities.
- **Encouraging others to harass the victim.** The offender may encourage the involvement of third parties to harass the victim.
- **False victimization**. It is not uncommon for a cyber-stalker to claim the victim is harassing him, taking the position of victim in his own mind.

Software Piracy :

Illegal copying, distribution, or use of software is often termed as software piracy. It causes significant loss of revenue for its publishers, which in turn results in higher prices for the consumers. When you purchase a commercial software package, an end user license agreement is included to protect that software program from copyright infringement. Typically, the license states that you can install the original copy of software you bought on one computer and that you can make a backup copy in case the original is lost or damaged. You agree to the licensing agreement when you open the software package (this is called a shrink wrap license), when you open the envelope that contains the software disks, or when you install the software.

Software piracy generally applies to full-function commercial software. The time-limited or function-restricted versions of commercial software called **shareware** are less likely to be pirated since they are freely available.

Similarly, **freeware**, a type of software that is copyrighted but freely distributed at no charge, also offers little incentive for piracy. Software piracy comes under the purview of Intellectual Property Right violations. Different types of software piracy include:

- **Soft-lifting:** Borrowing and installing a copy of a software application from a colleague.
- **Client-server overuse:** Installing more copies of the software than you have licenses for.
- **Hard-disk loading:** Installing and selling unauthorized copies of software on refurbished or new computers.
- **Counterfeiting:** Duplicating and selling copyrighted programs.
- **Online piracy:** Typically involves downloading illegal software from peer-to-peer network, Internet auction or blog. (In the past, the only place to download software was from a bulletin board system and these were limited to local areas because of long distance charges while online

Cyber Terrorism :

Targeted attacks on military installations, power plants, air traffic control, banks, trail traffic control, telecommunication networks are the most likely targets. Others like police, medical, fire and rescue systems etc.

- Cyber terrorism has become an option for modern terrorists for several reasons.
- It is cheaper than traditional terrorist methods.
- Cyber terrorism is more anonymous than traditional terrorist methods.
- The variety and number of targets are enormous.
- Cyber terrorism can be conducted remotely, a feature that especially appealing to terrorists.
- Cyber terrorism has the potential to affect directly a larger number of people.

IPR Violations :

These include software piracy, copyright infringement, trademarks violations, theft of computer source code, patent violations. etc.

Cyber Squatting :

Domain names are also trademarks and protected by ICANN's domain dispute resolution policy and also under trademark laws. Cyber Squatters registers domain name identical to popular service provider's domain so as to attract their users and get benefit from it.

On-line Fraud :

On-line fraud or Internet fraud is the use of Internet services or software with Internet access to defraud victims or to otherwise take advantage of them and steal their personal information, leading to identity theft. Internet services can be used to present fraudulent solicitations to prospective victims, to conduct fraudulent transactions, or to transmit the proceeds of fraud to financial institutions or to others connected with the scheme. Online scams can also occur in chat rooms, social media, email, message boards, or on websites.

Examples of most common online fraud schemes are briefly described here:

(i) *Non-delivery payment / merchandise*: A purchaser of goods does not receive the items ordered, or a seller does not receive payment for items sold. Additionally, if the buyer pays by credit card, the seller obtains his name and credit card number and can use this data as vehicle for credit card fraud.

(ii) *Bank-related scams*: Scams in which a criminal poses as the bank official to betray victims. For example, a victim receives a phone call from a bank official and is informed that the bank is going to renew the debit / credit card. Then the victim is asked to provide the personal and card details like card serial number and password etc. With the personal details the criminal steals the identity (see identity theft). There are many similar scams in which fake email formats are being used to convince the victim that the RBI has been trying to get in contact with the victim.

Phishing :

Phishing is just one of the many frauds on the Internet, trying to fool people into parting with their money. Phishing refers to the receipt of unsolicited emails by customers of financial institutions, requesting them to enter their username, password or other personal information to access their account for some reason. Customers are directed to a fraudulent replica of the original institution's website when they click on the links on the email to enter their information, and so they remain unaware that the fraud has occurred. The fraudster then has access to the customer's online bank account and to the funds contained in that account. A study found the banking industry as soft target for phishing scams in India.

Vishing :

Vishing is the criminal practice of using social engineering and Voice over IP (VoIP) to gain access to private .personal and financial information from the public for the purpose of financial reward. The term is a combination of "voice" and phishing. Vishing exploits the public's trust in landline telephone services, which have traditionally terminated in physical locations which are known to the telephone company, and associated with a bill-payer. The victim is often unaware that VoIP allows for caller ID spoofing, inexpensive, complex automated systems and anonymity for the bill-payer. Vishing is typically used to steal credit card numbers or other information used in identity theft schemes from individuals.

(iii) *Identity theft*: Identity theft occurs when a party acquires, transfers, possesses, or uses personal information of a natural or legal person in an unauthorized manner, with the intent to commit, or in connection with, fraud or other crimes. Identity theft counts as identity fraud scheme and is a vehicle for perpetrating other types of fraud schemes, especially payment fraud.

(iv) *Computer crimes*: This fraud scheme comprises all categories including crimes targeting a computer or computer network, or crimes that attempt to use a computer or network to perpetrate other crimes.

(v) *Miscellaneous fraud*: These crimes include a variety of scams meant to defraud people, such as work-at-home scams, fake contests and sweepstakes.

(vi) *Advance Fee fraud*: A criminal asks people to pay an upfront fee to receive something of value, but does not deliver anything to the victim.

(vii) *Spam*: Spam, or mass-produced unsolicited bulk email, is a widely used medium for committing traditional white collar crimes including financial fraud, credit card fraud, and identity theft, among others.

(viii) *Auction fraud*: Auction fraud can be described as fraudulent transactions that occur when entering an online auction site. This can be the misrepresentation of a product advertised for sale or the non-delivery of products bought through an Internet auction site.

(ix) *Credit card fraud*: A credit card fraud occurs when someone gains financial or material advantage by using a credit card, or information from a credit card, to complete a transaction that is not authorized by the legitimate account holder.

(x) *Overpayment fraud*: An incident in which the victim receives an invalid monetary instrument, e. g. a cheque, with instructions to deposit it in a bank account and to send excess funds or a percentage of the deposited money back to the sender

Pornography :

The literal mining of the term 'Pornography' is "describing or showing sexual acts in order to cause sexual excitement through books, films, etc." This would include pornographic websites; pornographic material produced using computers and use of internet to download and transmit pornographic videos, pictures, photos, writings etc.

Research shows that 50% of the web-sites containing potentially illegal contents relating to child abuse were 'Pay-Per-View'. This indicates that abusive images of children over Internet have been highly commercialized. Pornography delivered over mobile phones is now a burgeoning business, "driven by the increase in sophisticated services that deliver video clips and streaming video, in addition to text and images."

Research has shown that pornography and its messages are involved in shaping attitudes and encouraging behavior that can harm individual users, their families & society at large. Severe consequences like, insensitivity, lack of concentration, addiction, etc are the result of the on-line pornography.

Bot Networks :

A cyber crime called 'Bot Networks', wherein spamsters and other perpetrators of cyber crimes remotely take control of computers without the users realizing it. Computers get linked to Bot Networks when users unknowingly download malicious codes. Attackers often coordinate large groups of Bot-controlled systems, or Bot networks, to scan for vulnerable systems and use them to increase the speed and spread of their attacks. Trojan horse provides a backdoor (a method of bypassing normal authentication) to the acquired computers or of securing remote access to a computer, while attempting to remain hidden from casual inspection. The backdoor may take the form of an installed program, or could be a modification to a legitimate program. Bot networks create unique problems for organizations because they can be remotely upgraded with new exploits very quickly, and this could help attackers pre-empt security efforts.

Cross site scripting :

Cross-site scripting (XSS) is a type of computer security vulnerability typically found in web applications which allow code injection by malicious web users into the web pages viewed by other users. Examples of such code include HTML code and client-side scripts. An exploited cross-site scripting vulnerability can be used by attackers to bypass access controls.

Network Security Architecture :

The Internet is based on open protocols. This renders it vulnerable to different kinds of security threats. Network security is setup to guard against unauthorized access, alteration, or modification of information, and unauthorized denial of service. A well-established network security and an implemental and dynamic security policy can provide better solutions so that only authorized people gain access to the system. The communications on the network are kept private from outsiders, and that data being communicated is kept safe. The following are the key components of network security architecture:

Authentication : Authentication is the action of verifying information such as identity, ownership or authorization. It verifies that a user requesting access is the one who he or she claims to be prior to being allowed access to the network and network services.

Access Control (Authorization): Access control is a security measure that defines who can access a computer, when they can access it, and what actions they can take while accessing the computer. There are numerous approaches in providing access control, ranging from password protection to token-based mechanisms to biometric encryption technologies.

Privacy: Privacy is the state or quality of being secluded from the view and or presence of others. The goal of privacy is to ensure that unauthorized users on the network cannot see the contents of the message being sent. Privacy is synonymous with confidentiality and secrecy.

Integrity: Integrity includes the security of the network periphery, the network devices, and the flow of information between them. It addresses the unauthorized manipulation or destruction of data. Data integrity is ensured by encryption. If information is received that cannot be decrypted properly, then the recipient knows that the information has been tampered with during transmission.

Network Management: Network management keeps track of detailed records of user identities, all the communications on the network, which network services users are accessing, and the network resources they are utilizing. It provides all this information for billing, auditing, reporting, and subsequent reviews of related security events.

As discussed above Internet security threats impact the network, data security and other internet connected systems. Cyber criminals have evolved several techniques to threat privacy and integrity of bank accounts, businesses, and organizations. In this section we shall discuss some of the precautionary methods to guard the security of data in store or on the move over a network. The most common methods include

1. Encryption
2. Firewall
3. Digital Signature

Encryption :

Encryption is a security method in which information is encoded in such a way that only authorized user can read it. In this process a plaintext gets transformed into unreadable form (called cipher-text) using a mathematical process. An encryption process includes four elements:

(1) the plaintext, the raw data or message to be encrypted,

(2) the cryptographic algorithm, a mathematical method that determines how plain-text is to be combined with a key,

(3) the key, a string of digits, and

(4) the cipher text, the encrypted message.

The longer the key string digits, the more difficult the encrypted data is to break. In theory, trying all possible keys in sequence can break any cryptographic method with a key. If a brute force is used to attack the cryptographic algorithms, the required computing power increases exponentially with the length of the key.

There are two classes of key-based mechanisms, symmetric (private-key or secret-key) and asymmetric (public-key) algorithms

There are two types of encryptions schemes as listed below:

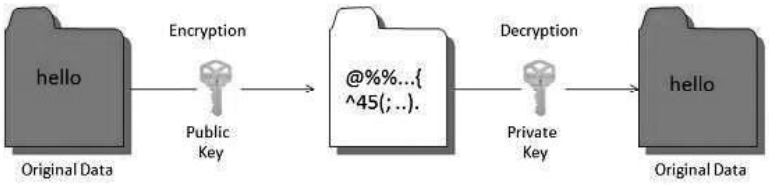
1. Symmetric (Private or Secret Key) Key encryption
2. Asymmetric (Public Key) Key encryption

Symmetric key encryption

Symmetric key encryption algorithm uses same cryptographic keys (a mathematical function) for both encryption (of original text) and decryption (of cipher text).

Public key encryption :

Public key encryption algorithm uses pair of keys, one of which is a secret key (known only to the receiver) and one of which is public (for sender). These two keys are mathematically linked with each other.



Hashing :

In terms of security, hashing is a technique used to encrypt data and generate unpredictable hash values. It is the hash function that generates the hash code, which helps to protect the security of transmission from unauthorized users.

Hashing algorithm provides a way to verify that the message received is the same as the message sent. It can take a plain text message as input and then computes a value based on that message.

Key Points :

- The length of computed value is much shorter than the original message.
- It is possible that different plain text messages could generate the same value.

Here we will discuss a sample hashing algorithm in which we will multiply the number of **a**'s, **e**'s and **h**'s in the message and will then add the number of **o**'s to this value. For example, Aliva sent a message as;

"**The** c**o**mbin**a**ti**o**n t**o** t**he** s**a**f**e** is tw**o**, s**e**v**e**n, **th**irty-fiv**e**"

The hash of this message (containing 2 a's, 6 e's, 3 h's and 4 o's), using our simple hashing algorithm would be: (2 × 6 × 3) + 4 = 40

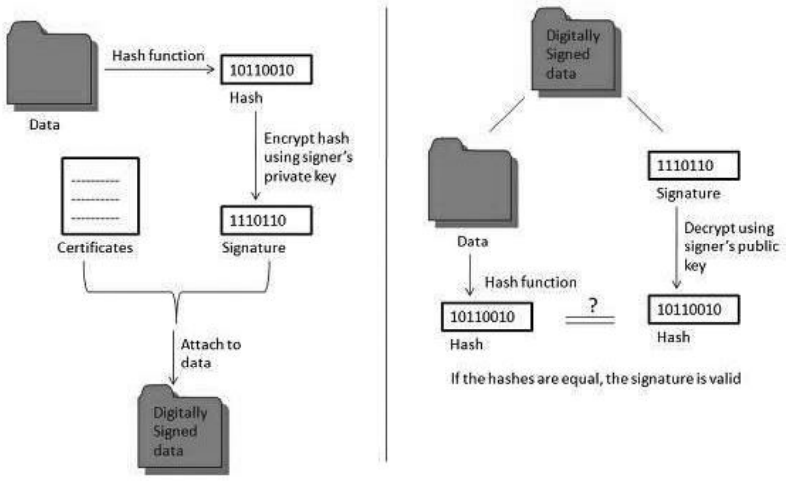
The hash of this message is sent to Ajay with cipher text. After he decrypts the message, he computes its hash value using the agreed upon hashing algorithm. If the hash value sent by Aliva doesn't match the hash value of decrypted message, Ajay will know that the message has been altered.

Digital Signature :

A digital signature is basically a way to ensure that an electronic document (e-mail, spreadsheet, text file, etc.) is authentic. By authenticity we mean that the person, who has created the document, is trusted one and the contents of the document have not been altered since that person has created it.

Digital signatures rely on certain types of encryption to ensure authentication. These two processes work hand in hand for digital signatures.

There are several ways to authenticate a person or information on a computer. One way is to use the Public key cryptography. Public-key cryptography may be vulnerable to impersonation, but it is the sole responsibility of the user to protect his/her private key securely.



Applications :

There are several reasons to implement digital signatures during important electronic communications. The reasons are;

Authentication :

Digital signatures help to authenticate the sources of messages. For example, if a bank's branch office sends a message to central office, requesting for change in balance of an account. If the central office could not authenticate that message is sent from an authorized source, acting of such request could be a grave mistake.

Integrity :

Once the message is signed, any change in the message would invalidate the signature.

Non-repudiation :

By this property, any entity that has signed some information cannot at a later time deny having signed it.

Firewall :

A firewall system is a hardware/ software configuration, physically located between an internal and external network that protects the internal network from unwanted intrusion from the outside network. Firewalls restrict information entering and leaving at carefully controlled points. If implemented

properly, they are very effective at keeping out unauthorized intruders and stopping unwanted activities on the internal network. There are many different ways to implement the firewalls:

(1) packet-level authentication – access by protocol,

(2) address-based authentication – access by IP address (both source and destination),

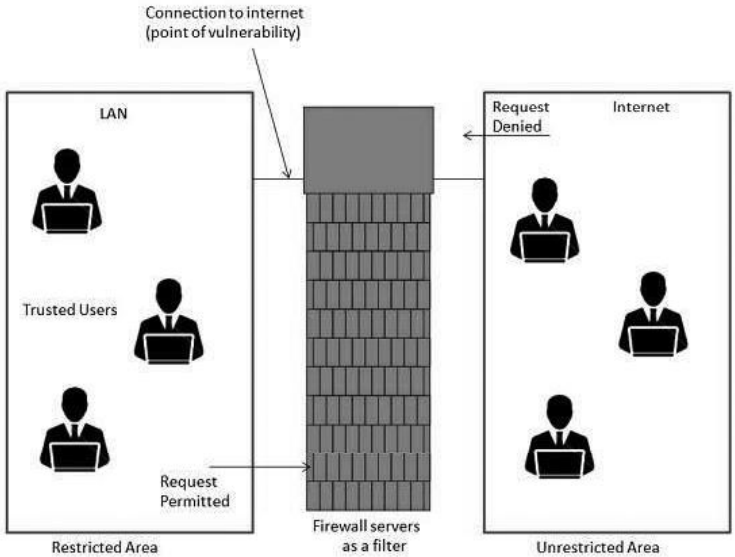
(3) user authentication by login/ password over Secure Socket Layer (SSL),

(4) performing IP address translation, and

(5) point-to-point encryption at IP-level in Virtual Private Networks (VPNs).

Firewalls can also be used for intranet access control. It is a barrier between Local Area Network (LAN) and the Internet. It allows keeping private resources confidential and minimizes the security risks. It controls network traffic, in both directions. The following diagram depicts a sample firewall between LAN and the internet. The connection between the two is the point of vulnerability. Both hardware and the software can be used at this point to filter network traffic.

There are two types of Firewall system: One works by using filters at the network layer and the other works by using proxy servers at the user, application, or network layer.



Key Points

- Firewall management must be addressed by both system managers and the network managers.
- The amount of filtering a firewall varies. For the same firewall, the amount of filtering may be different in different directions.

The term **Network Security** refers to all activities undertaken to protect a computer network from attacks to its security. This covers protection of computers in the premises and data on the network from both internal and external attacks. To protect a network from security attacks, a number of steps are taken. These steps include:

Log In-Password: By assigning login names and strong passwords to the users of a system, it can be ensured that only authorized people access a computer. This helps in increasing the computer as well as network security. A strong password is the one which is easy to remember for the user but difficult (almost impossible) for the others to guess successfully. On the other hand a weak password is generally the name of a person or organization, the registration number of a vehicle, year of birth of a person and so on. A weak password can be cracked in a few attempts. Examples of strong passwords may be raavanisdead (raavan is dead - with spaces removed), 2aur2paanch (name of an old Hindi movie) or anything like that.

Anti Virus Software: These days' anti-virus softwares work against not only the virus but also against almost all kinds of malware. Therefore by installing a full version legal (not the pirated one or freeware) anti-virus software network security can be increased.

File Permissions A data file on a computer can be created, read, or modified. An application file can be run or executed. Accordingly, different rights (privileges) can be given to different users of a computer to perform one or more of these tasks. For example, suppose there is a data file containing students' marks in a school. The system administrator has created that file. If there is a need to create another such file, then again only the system administrator can create it. So, system administrator is given the 'Create' right. A teacher can read this file to go through the marks of the students. She can also enter or alter the marks in this file. Therefore a teacher has 'Read', 'Write', and 'Modify' rights to this file. The students can only view their marks; therefore, the students are given only the 'Read' right to this file. If report cards have to be printed for

a class, the class teacher makes a request to the computer operator, who can run a program to print the report cards. This computer operator has been given the 'Execute' right to the application program which prints the report cards. This way by giving appropriate rights to respective users, computer security as well as network security can be increased.

Cyber Laws :

Cyber Law is the law governing cyber space. Cyber space is a term, which is used to describe the application domain of computers, networks, software, data storage devices, the Internet, websites, emails and even electronic devices such as cell phones, Point of Sales terminals and ATM machines. Every country frames laws to regulate the activities happening in its domain of the Cyber Space and termed as the Cyber Laws of that country. A Law encompasses the rules of conduct which must be **approved** by the government, are in **force** over a certain territory, and be **obeyed** by all persons on that territory. Violation of these rules could lead to government action such as imprisonment or fine or an order to pay compensation.

Cyber law encompasses laws relating to :

1. Cyber Crimes
2. Electronic and Digital Signatures
3. Intellectual Property Rights
4. Data Protection and Privacy

Cyber crimes are unlawful acts where the computer is used either as a tool or a target or both. The enormous growth in electronic commerce (e-commerce) and online share trading has led to a phenomenal spurt in incidents of cyber crime. These crimes are discussed in detail further in this chapter.

Electronic signatures are used to authenticate electronic records. Digital signatures are one type of electronic signature. Digital signatures satisfy three major legal requirements – signer authentication, message authentication and message integrity. The technology and efficiency of digital signatures makes them more trustworthy than hand written signatures.

Intellectual Property refers to creations of the human mind e.g. a story, a song, a painting, a design etc. The facets of **intellectual property** that relate to cyber space are covered by cyber law. These include:

- **copyright law** in relation to computer software, computer source code, websites, cell phone content etc,
- software and source code **licenses**
- **trademark law** with relation to domain names, meta tags, mirroring, framing, linking etc
- **semiconductor law** which relates to the protection of semiconductor integrated circuit designs and layouts,
- **Patent law** in relation to computer hardware and software.

Data protection and privacy laws aim to achieve a fair balance between the privacy rights of the individual and the interests of data controllers such as banks, hospitals, email service providers etc. These laws seek to address the challenges to privacy caused by collecting, storing and transmitting data using new technologies.

Need for Cyber Law :

There are various reasons why it is extremely difficult for conventional law to cope with cyberspace. Some of these are discussed below.

1. Cyberspace has complete **disrespect for jurisdictional boundaries**. A person in India could break into a bank's electronic vault hosted on a computer in USA and transfer millions of Rupees to another bank in Switzerland, all within minutes. All he would need is a laptop computer and a cell phone.
2. Cyberspace handles **gigantic traffic volumes every second**. Billions of emails are crisscrossing the globe even as we read this, millions of websites are being accessed every minute and billions of dollars are electronically transferred around the world by banks every day.
3. Cyberspace is absolutely **open to participation by all**. A ten year-old in Israel can have a live chat session with an eight year-old in Singapore without any regard for the distance or the anonymity between them.
4. Cyberspace offers **enormous potential for anonymity** to its members. Readily available encryption software and steganographic tools that seamlessly hide information within image and sound files ensure the confidentiality of information exchanged between cyber-citizens.

5. Cyberspace offers never-seen-before **economic efficiency**. Billions of dollars worth of software can be traded over the Internet without the need for any government licenses, shipping and handling charges and without paying any customs duty.
6. Electronic information has become the main object of cyber crime. It is characterized by **extreme mobility**, which exceeds by far the mobility of persons, goods or other services. International computer networks can transfer huge amounts of data around the globe in a matter of seconds.
7. A software source code worth crores of rupees or a movie can be **pirated across the globe** within hours of their release.
8. **Theft of** corporeal **information** (e.g. books, papers, auxiliary memory devices) is easily covered by traditional penal provisions. However, the problem begins when electronic records are copied quickly, inconspicuously and often via telecommunication facilities. Here the "original" information, so to say, remains in the "possession" of the "owner" and yet information gets stolen.

Cyber Law in India :

The primary source of cyber law in India is the Information Technology Act, 2000 (IT Act) which came into force on the 17th, October 2000. The primary purpose of the Act is to provide legal recognition to electronic commerce and to facilitate filing of electronic records with the Government.

The Genesis of IT legislation in India :

Mid 90's saw an impetus in globalization and computerization, with more and more nations computerizing their governance, and e-commerce seeing an enormous growth. Until then, most of international trade and transactions were done through documents being transmitted through post and by telex only. Evidences and records, until then, were predominantly paper evidences and paper records or other forms of hard-copies only. With much of international trade being done through electronic communication and with email gaining momentum, an urgent and imminent need was felt for recognizing electronic records ie the data what is stored in a computer or an external storage attached thereto.

The United Nations Commission on International Trade Law (UNCITRAL) adopted the Model Law on e-commerce in 1996. The General Assembly of United Nations passed a resolution in January 1997 inter alia, recommending all States in the UN to give favourable considerations to the said Model Law, which provides for recognition to electronic records and according it the same treatment like a paper communication and record.

Objectives of I.T. legislation in India :

It is against this background the Government of India enacted its Information Technology Act 2000 with the objectives as follows, stated in the preface to the Act itself.

"to provide legal recognition for transactions carried out by means of electronic data interchange and other means of electronic communication, commonly referred to as "electronic commerce", which involve the use of alternatives to paper-based methods of communication and storage of information, to facilitate electronic filing of documents with the Government agencies and further to amend the Indian Penal Code, the Indian Evidence Act, 1872, the Bankers' Books Evidence Act, 1891 and the Reserve Bank of India Act, 1934 and for matters connected therewith or incidental thereto."

The Information Technology Act, 2000, was thus passed as the Act No.21 of 2000, got President Assent on 9 June and was made effective from 17 October 2000.

- The Act essentially deals with the following issues:
- Legal Recognition of Electronic Documents
- Legal Recognition of Digital Signatures
- Offenses and Contraventions
- Justice Dispensation Systems for cyber crimes.

Amendment Act 2008 : Being the first legislation in the nation on technology, computers and ecommerce and e-communication, the Act was the subject of extensive debates, elaborate reviews and detailed criticisms, with one arm of the industry criticizing some sections of the Act to be draconian and other stating it is too diluted and lenient. There were some conspicuous omissions

too resulting in the investigators relying more and more on the time-tested (one and half century-old) Indian Penal Code even in technology based cases with the I.T. Act also being referred in the process and the reliance more on IPC rather on the ITA.

Thus the need for an amendment – a detailed one – was felt for the I.T. Act almost from the year 2003-04 itself. Major industry bodies were consulted and advisory groups were formed to go into the perceived lacunae in the I.T. Act and comparing it with similar legislations in other nations and to suggest recommendations. Such recommendations were analysed and subsequently taken up as a comprehensive Amendment Act and after considerable administrative procedures, the consolidated amendment called the Information Technology Amendment Act 2008 was placed in the Parliament and passed without much debate, towards the end of 2008 (by which time the Mumbai terrorist attack of 26/11/2008 had taken place). This Amendment Act got the President assent on the 05th, Feb 2009 and was made effective from the 27th, October 2009.

Some of the notable features of the ITAA are as follows:

- Focusing on data privacy
- Focusing on Information Security
- Defining cyber café
- Making digital signature technology neutral
- Defining reasonable security practices to be followed by corporate
- Redefining the role of intermediaries
- Recognising the role of Indian Computer Emergency Response Team
- Inclusion of some additional cyber crimes like child pornography and cyber terrorism
- Authorizing an Inspector to investigate cyber offences (as against the DSP earlier)

How the Act is structured :

The Act totally has 13 chapters and 90 sections (the last four sections namely sections 91 to 94 in the ITA 2000 dealt with the amendments to the four

Acts namely the Indian Penal Code 1860, The Indian Evidence Act 1872, The Bankers' Books Evidence Act 1891 and the Reserve Bank of India Act 1934). The Act begins with preliminary and definitions and from there on the chapters that follow deal with authentication of electronic records, digital signatures, electronic signatures etc.

Elaborate procedures for certifying authorities (for digital certificates as per IT Act -2000 and since replaced by electronic signatures in the ITAA -2008) have been spelt out. The civil offence of data theft and the process of adjudication and appellate procedures have been described. Then the Act goes on to define and describe some of the well-known cyber crimes and lays down the punishments therefore. Then the concept of due diligence, role of intermediaries and some miscellaneous provisions have been described.

Rules and procedures mentioned in the Act have also been laid down in a phased manner, with the latest one on the definition of private and sensitive personal data and the role of intermediaries, due diligence etc., being defined as recently as April 2011.

Applicability :

The Act extends to the whole of India and except as otherwise provided, it applies to also any offence or contravention there under committed outside India by any person. There are some specific exclusions to the Act (i.e. where it is not applicable) as detailed in the First Schedule, stated below:

(a) negotiable instrument (Other than a cheque) as defined in section 13 of the Negotiable Instruments Act, 1881;

(b) a power-of-attorney as defined in section 1A of the Powers-of-Attorney Act, 1882;

(c) a trust as defined in section 3 of the Indian Trusts Act, 1882

(d) a will as defined in clause (h) of section 2 of the Indian Succession Act, 1925 including any other testamentary disposition

(e) any contract for the sale or conveyance of immovable property or any interest in such property;

(f) any such class of documents or transactions as may be notified by the Central Government.

Some interesting **definition**s under the IT Amendment Act-2008 are given below:

1. '**Computer**' means any electronic magnetic, optical or other high-speed data processing device or system which performs logical, arithmetic, and memory functions by manipulations of electronic, magnetic or optical impulses, and includes all input, output, processing, storage, computer software, or communication facilities which are connected or related to the computer in a computer system or computer network;

2. '**Communication devices'** includes cell phones, personal digital assistance or such other devices used to transmit any text, video etc like what was later being marketed as iPad or other similar devices on Wi-fi and cellular models. Definitions for some words like 'cyber café' were also later incorporated in the ITAA 2008 when 'Indian Computer response Emergency Team' was included.

3. **Digital Signature**: 'Electronic signature' was defined in the ITAA-2008 whereas the earlier ITA-2000 covered in detail about digital signature, defining it and elaborating the procedure to obtain the digital signature certificate and giving it legal validity. Digital signature was defined in the ITA -2000 as "authentication of electronic record" as per procedure laid down in Section 3 and Section 3 discussed the use of asymmetric crypto system and the use of Public Key Infrastructure and hash function etc. Thus Section 3 which was originally "Digital Signature" was later renamed as "Digital Signature and **Electronic Signature**" in ITAA - 2008 thus introducing technological neutrality by adoption of electronic signatures as a legally valid mode of executing signatures. This includes digital signatures as **one of the modes** of signatures and is far broader in ambit covering biometrics and other new forms of creating electronic signatures not confining the recognition to digital signature process alone. While M/s. TCS, M/s. Safescript and M/s. MTNL are some of the digital signature certifying authorities in India, IDRBT (Institute for Development of Research in Banking Technology – the research wing of RBI) is the Certifying Authorities (CA) for the Indian Banking and financial sector licensed by the Controller of Certifying Authorities, Government of India.

It is relevant to understand the meaning of digital signature (or electronic signature) here. It would be pertinent to note that electronic signature (or the earlier digital signature) as stipulated in the Act is NOT a digitized signature or a scanned signature. In fact, in electronic signature (or digital signature) there is no real signature by the person, in the conventional sense of the term. Electronic signature is not the process of storing ones signature or scanning ones signature and sending it in an electronic communication like email. It is a process of authentication of message using the procedure laid down in Section 3 of the Act.

Some important **Sections** under the IT Amendment Act-2008 are given below:

Chapter-III / Section-4 :

This Chapter discusses Electronic Governance issues and procedures and the legal recognition to electronic records is dealt with in detail in Section 4 followed by description of procedures on electronic records, storage and maintenance and according recognition to the validity of contracts formed through electronic means.

Procedures relating to electronic signatures and regulatory guidelines for certifying authorities have been laid down in the sections that follow.

Chapter-IX / Section 43 :

This section deals with penalties and compensation for data theft, damage to computer, computer system, etc. This Section addresses the civil offence of theft of data. If any person without permission of the owner or any other person who is in charge of a computer, accesses or downloads, copies or extracts any data or introduces any computer contaminant like virus or damages or disrupts any computer or denies access to a computer to an authorized user or tampers etc…he shall be liable to pay damages to the person so affected. The essence of this Section is **civil liability.** Criminality in the offence of data theft is being separately dealt with later under Sections 65 and 66. Writing a virus program or spreading a virus mail, a bot, a Trojan or any other malware in a computer network or causing a Denial of Service Attack in a server will all come under this Section and attract civil liability by way of compensation. Under this Section, words like Computer Virus, Compute Contaminant, Computer database and Source Code are all described and defined.

Section 65: This Section deals with tampering with source documents:- Concealing, destroying, and altering any computer source code when the same is required to be kept or maintained by law. This is an offence punishable with three years imprisonment or two lakh rupees or with both. Fabrication of an electronic record or committing forgery by way of interpolations in CD produced as evidence in a court attract punishment under this Section. Computer source code under this Section refers to the listing of programmes, computer commands, design and layout etc in any form.

Section 66: The act of data theft or the offence stated in Section 43 if done dishonestly or fraudulently becomes a punishable offence under this Section and attracts Imprisonment or Fine or both as stipulated from time to time. Earlier hacking was defined in Sec 66 and it was an offence.

Under the IT Amendment Act-2008, Section 66 is widened with a list of offences as follows:

66A: Sending offensive messages through communication service, causing annoyance, etc. through an electronic communication or sending an email to mislead or deceive the recipient about the origin of such messages (commonly known as IP or email spoofing) are all covered here.

66B: Dishonestly receiving stolen computer resource or communication device.

66C: Electronic signature or other identity theft like using others' password or electronic signature etc.

66D: Cheating by impersonation, using computer resource or a communication device shall be punished under this Section.

66E: Privacy violation – Publishing or transmitting private area of any person without his or her consent etc.

66F Cyber terrorism – Intent to threaten the unity, integrity, security or sovereignty of the nation and denying access to any person authorized to access the computer resource or attempting to penetrate or access a computer resource without authorization. Acts of causing a computer contaminant (like virus or Trojan horse or other spyware or malware) likely to cause death or injuries to persons or damage to or destruction of property etc. come under this Section. Punishment is life imprisonment.

To summarise, what was civil liability with entitlement for compensations and damages in Section 43, has been referred to here, if committed with criminal intent, making it a criminal liability attracting imprisonment and fine or both.

Section 67: This section deals with publishing or transmitting obscene material in electronic form. It involves sending obscene message in the name of a married women amounting to cyber stalking, email spoofing and the criminal activities stated in this Section.

Section 69: This section empowers the Government or agencies as stipulated in the Section, to intercept, monitor or decrypt any information generated, transmitted, received or stored in any computer resource, subject to compliance of procedure as laid down here. This power can be exercised if the Central Government or the State Government, as the case may be, is satisfied that it is necessary or expedient in the interest of sovereignty or integrity of India, defence of India, security of the State, friendly relations with foreign States or public order or for preventing incitement to the commission of any cognizable offence relating to above or for investigation of any offence. In any such case too, the necessary procedure as may be prescribed, is to be followed and the reasons for taking such action are to be recorded in writing, by order, directing any agency of the appropriate Government. The subscriber or intermediary shall extend all facilities and technical assistance when called upon to do so.

Section **69A** inserted in the ITAA, vests with the Central Government or any of its officers with the powers to issue directions for blocking for public access of any information through any computer resource, under the same circumstances as mentioned above.

Section **69B** discusses the power to authorize to monitor and collect traffic data or information through any computer resource.

Conclusion:

It should be constant endeavour of rules to keep the crimes lowest. Especially in a society that is dependent more and more on technology, crime based on electronic offences are bound to increase and the law makers have to go the extra mile compared to the fraudsters, to keep them at bay. Technology is always a double-edged sword and can be used for both the purposes – good or

bad. Steganography, Trojan Horse, Scavenging and even DoS or DDoS (Distributed Denial of Service) are all technologies and per se not crimes, but falling into the wrong hands with a criminal intent who are out to capitalize them or misuse them, they come into the gamut of cyber crime and become punishable offences. Hence, it should be the persistent efforts of rulers and law makers to ensure that technology grows in a healthy manner and is used for legal and ethical business growth and not for committing crimes. It should be the duty of the three stake holders, such as; i) the rulers, regulators, law makers and investigators; ii) Internet or Network Service Providers or banks and other intermediaries and iii) the users to take care of information security & playing their respective roles within the permitted parameters and ensuring compliance with the law of the land.

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. Which of the following is a cyber crime, where computer is being used as a target?
   a. Squatting b. Spamming
   c. Snooping d. Spoofing
2. A malicious code that replicates itself is called a
   a. worm b. bot
   c. cookie d. virus
3. Web hijacking is a process of
   a. Sniffing b. Hacking
   c. Spoofing d. None of these
4. Un authorized access to a third party conversation is called as
   a. Denial of Service b. Cyber Stalking
   c. Cyber Squatting d. Eavesdropping
5. False victimization is an act of
   a. Denial of Service b. Cyber Stalking
   c. Cyber Squatting d. Eavesdropping
6. Counterfeiting comes under which of the following category?
   a. Hacking b. Software piracy
   c. On-line fraud d. Phishing.
7. Which of the following is a fraud over Internet, to fool people in to parting with their money?
   a. Phishing b. Vishing
   c. Soft-lifting d. Cross site Scripting
8. Non-repudiation is a feature of
   a. Encryption b. Firewall
   c. Digital Signature d. Public Key
9. Patent Law comes under
   a. Electronic Signature b. Intellectual Property Right
   c. Data Protection d. None of these

10. The primary source of Cyber Law in India is
    a. Information Technology Act-2000
    b. Internet Control Act-2008
    c. Cyber Crime Cell Act
    d. Indian Penal Code
11. Expand the following abbreviations:
    Wi-Fi, EPA, WEP, SSID, DoS, XSS, SSL, VPN, ITAA, IDRBT

LONG ANSWER TYPE QUESTIONS :

1. What is a Cyber crime? Discuss different types of cyber crimes, where the computer is used as a target.
2. What is a computer virus? How does a virus affect a computer system? Describe some of the preventive mechanism against this attack.
3. Describe the uses and security related to computer cookies.
4. What do you mean by Spoofing? Discuss different types of spoofing.
5. What do you mean by Internet Protocol? Briefly discuss some of these protocols.
6. Distinguish between Phishing and Vishing.
7. Describe the different types of Network Security Architecture.
8. Write short Notes on
    a. Encryption
    b. Firewall
    c. Digital Signature
    d. Hashing
9. Discuss various need of a Cyber Law.
10. Discuss the objectives and features of Information Technology Act of India.

■ ■ ■

UNIT - 2

PROGRAMMING

CHAPTER - 4

PROGRAMMING FUNDAMENTALS

Introduction :

Computer programming is a process of designing, writing, testing, debugging and maintaining the source code of computer programs written in a particular programming language. The purpose of programming is to organize instructions that are capable of solving real life problems. The process of writing source code of programs requires expertise in subject, knowledge of desired application domain, a formal logic and knowledge of syntax of the relevant programming language. Writing instructions in the desired order gives the required results from the program but when these instructions increase in number, it becomes extremely difficult for the programmer to debug, maintain or troubleshoot codes. For this reason, technology experts kept developing and introducing different programming paradigms and accordingly kept developing languages to support these paradigms. The latest and most versatile and efficient paradigm is object oriented programming, where a programming task was broken into objects. Each object is capable of **encapsulating** its own **data and methods** (subroutines / procedures). The most important distinction is that where procedural programming uses procedures to operate on data object oriented programming bundles data and methods together and operates as an independent entity of the program. There are several object-oriented languages. The three most common ones are, Smalltalk, C++ and Java.

In the previous class, we have read the basics of the core Java language. We have learnt how to work with variables and data, perform operations on that data, and make decisions based on the data. Now we will move on to learn a concept that is central to the Object Oriented Programming. This approach follows bottom up approach in program design and emphasizes on safety and security of data. It helps in wrapping up of data and methods together in a

single unit which is known as **data encapsulation**. Object Oriented Programming allows some special features such as **polymorphism** and **inheritance**. Polymorphism allows the programmer to give a generic name to various methods or operators to minimize his memorizing of multiple names. Inheritance enables the programmer to effectively utilize already established characteristics of a class in new classes and applications.

The major components of Object Oriented Programming are as follows:

1. Class
2. Object
3. Data Members & Methods
4. Access Specifier and Visibility Modes

A **class** is used to encapsulate data and methods together in a single unit. It helps the programmer to keep the data members in various visibility modes depending upon what kind of access needs to be provided in the remaining part of the application. These visibility modes are called as **Access specifiers**. They are classified as private, public and protected. Usually, data members of a class are kept in private or protected visibility modes and methods are kept in the public visibility mode.

An **object** is an instance of a class that is capable of holding actual data in memory locations. Class and objects are related to each other in the same way as data type and variables.

For example, when we declare float variable named marks, the variable marks can be thought of as an object of type float which can be assumed as the class. If we take another hypothetical case in which Human is a class, Sri Ashok Kumar Ojha, Ms Nitu Mohapatra may be the objects of this class.

We have already learnt that a class contains **data members** and **methods**. As discussed in the above example, Ms Nitu Mohapatra is an object of class Human. The phone numbers retained by Ms Mohapatra in her brain (memory) will be the data. Her eyes, ears, nose and mouth can be considered as various **methods** which allow Ms Nitu Mohapatra to collect, modify and delete data from her memory. In real java programming, this data will be required to conform to a specific data type as in char, int, float or double whereas the methods will be a sequence of steps written together to perform a specific task on the data. In the following section we shall discuss about Access specifiers, Inheritance and commonly used Java libraries.

Basic concepts of Access Specifier for Class Member :

Access specifier controls the accessibility of members in the same class, other class, same package and other package. It is used to set access levels for classes, variables, methods and constructors. All the access specifiers are keywords, thereby should be written in **lowercase letters** only.

Java offers four types of access specifiers:

1. **Public**
2. **Protected**
3. **Default**
4. **Private**

Public Access Specifier :

When a class member is declared as public it means this member can be accessed anywhere, i.e. in any class of any package. Java source code can only contain one public class, where name must also match with the filename. To declare the class and its members as public, use public keyword.

Example :

```
package mypackl:
public class A
          {
public int a;  //public variable declaration
public void call()//public method declaration
          {
.....
          }
     }
```

If B is defined in another package and we want to access members of A within B class, write following code:

e.g.

```
package mypack2;
import mypackl.A;
public class B
     {
public void access()
          {
A  obj = new A();
obj.a = 10;    //legal
obj.call();    //legal
     }
     }
```

PACKAGE

Packages are group of related interfaces and classes that provide a convenient mechanism for managing large set of interface and classes. To use a package, you need to import it into your program by using the import statement.

e.g. ***import java.lang.*;***

java.lang *is a default package which is already available to you. Some examples of packages are:* ***java.applet. java.util, java.io****, etc. Java also allows you to create user defined packages according to your requirements.*

Protected Access Specifier :

Member of a class declared with protected access specifier can be accessed within the same class, and its subclasses within same package or in other package. To declare the members as protected, use protected keyword.

e.g.

```
package my pack;
class XYZ
     {
protected int a;
protected void add()
     {
.................
     }
}
```

If you want to access protected members outside the package, you will have to extend this class using **extends** keyword. If ABC class is defined in another package and we want to access members of XYZ class within ABC class, write the following code:

e.g.

```
package mypackl;
import mypack.XYZ;
class ABC extends XYZ
          {
public void show()
     {
a = 15; // legal because after extending object
is not required
add () ; // legal
}
}
```

Default Access Specifier :

The default means, we do not specify any specifier at all, then such a class, method or field will be accessible within the class and other classes within

same package. It is known as package level access specifier, because the classes of the same package only are allowed to access the members of the class.

e.g.

```
package mypack;
class ABC
{
int a ;
void add()
{
.........
}
    }
```

If XYZ is a class within the same package and we want to access the members of class ABC within the XYZ class, write the following code:

```
package mypack;
class XYZ
{
protected void show ( )
{
ABC object= new ABC ( );
object.a =  5; / / legal
object.add (); / /  legal
}
}
```

Private Access Specifier :

Members of a class declared with private access specifier, accessed only within the class in which they are declared. These members are not available for subclass and other package. To declare the members as private, use private keyword. A class cannot be declared as private.

e.g.

```
class XYZ
{
private int a;
private void add( )
{
a = 10;
    }
}
```

Accessibility of Different Types of Access Specifier :

The accessibility of different types of access specifiers can be rated through the following table:

Access	Class	Sub class	Package	Other package
public	✓	✓	✓	✓
protected	✓	✓	✓	×
private	✓	×	×	×
default	✓	✓	✓	×

Basic concept of Inheritance :

Inheritance is an important concept in object oriented programming because it allows re-using code without having to rewrite from scratch. Inheritance can be defined as the process, where one class acquires the properties of another. 1t supports the concepts hierarchical classification.

Supper Class and Sub Class :

In Java language, inheritance is a mechanism that allows you to build new classes from existing classes, the old class is known as **base class, super class** or **parent class** and the new class is known as **derived class, sub class**

or **child class.** The sub class is the specialised version of super class. It inherits all of the instance variables and methods defined by the super class and add its own unique members.

Super Class :

A super class is a class that has been extended to another class.

Syntax

```
<access_specifier> class <c l as s_name >
{
}
e.g.
    public class parent
    {
    }
```

Sub Class

A sub class is a class that derives from another class. A sub class is defined by using the keyword **extends** alongwith super_class_name.

Syntax

```
<access-spec i fi er> class <sub- class name>
extends <super class-name >
{
}
e.g.
    public class Child extends Parent
    {
    }
```

Note : *The keyword* ***extends*** *signifies that, the properties of super class are extended to the sub class, that means, sub class contains its own members as well as share the members of the super class. The inheritance allows sub classes to inherit all properties (variables and methods) of their parent classes.*

Advantages of Inheritance :

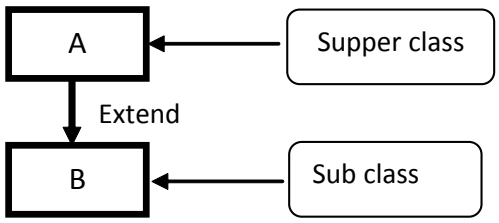
- **Reusability :** Inheritance helps the code to be reused in many situations. The base class is defined and once it is compiled, it needs not to be reworked. Using the concept of inheritance, the programmer can create as many derived classes from the base class as needed, while adding specific features to each derived class as needed.
- **Saves Time and Effort :** Since, the main code written can be reused in various situations (as needed), it saves time and effort of the programmer.
- **Reliability :** Increases program structure which results in greater reliability.

Forms of Inheritance :

We know that, inheritance is an ability of Object Oriented Programming (OOP) to inherit the properties of an existing class to a sub class. There are five forms of inheritance:

(a) Single Inheritance :

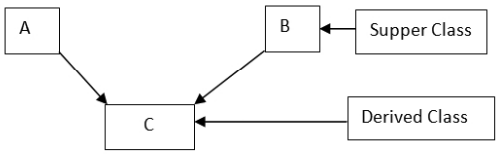
When a sub class inherits from only one super class or base class. It is known as single inheritance. It represents a linear relationship between a super class and its sub class.



Here, class B inherits the properties and methods of class A.

(b) Multiple Inheritance :

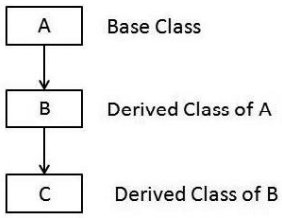
When a sub class inherits from more than one super classes or base classes, it is known as multiple inheritances. Java does not support multiple inheritances, but the multiple inheritances can be achieved by using a keyword implements and concept of interface.



Here, class C inherits the properties and methods of class A and class B.

(c) Multilevel Inheritance :

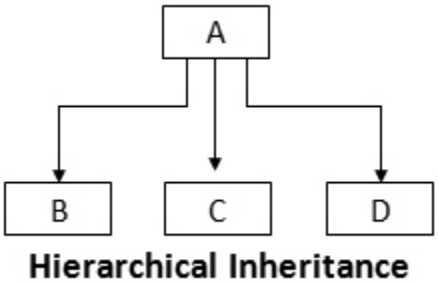
When a sub class inherits from a super class, which itself inherited from another super class, then such inheritance is known as multilevel inheritance.



Here, class B inherits the properties and methods of class A and class C inherits the properties and methods of class B as well as inherits the properties and methods of class A.

(d) Hierarchical Inheritance :

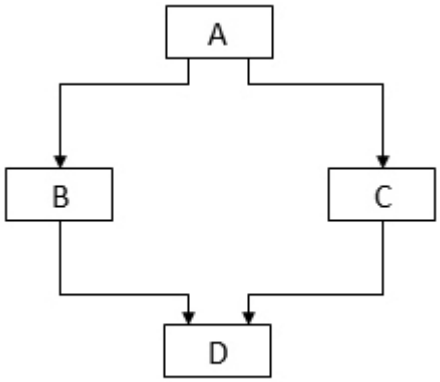
When more than one sub classes are inherited from one super class or base class, it is known as hierarchical inheritance



Here, class B, C and class D inherits the properties and methods of class A.

(e) Hybrid Inheritance :

When a sub class inherits from multiple base classes and all of its base classes inherit from a single base class, this form of inheritance is known as hybrid inheritance i.e. it is a combination of multilevel and multiple inheritance.



Hybrid Inheritance

Here, class B and C inherits the properties and methods of class A. class D inherits the properties and methods of class B and class C as well as inherits the properties and methods of class A.

Note : *In the combination, if one of the form is multiple inheritance then the inherited combination (hybrid inheritance) is not supported by Java through the concept of class but it can be supported or achieved by using the concept of inheritance.*

Access Control of Class Members

Member Type	Inside Own Class	Inside Sub Classes		Inside Non-sub Classes	
		In Same Package	In Other Package	In Same Package	In Other Packages
private	✓	×	×	×	×
public	✓	✓	✓	✓	✓
protected	✓	✓	✓	✓	×
default	✓	✓	×	✓	×

Example 1 :

To show single inheritance or class inheritance.

```
class A
{
int    x;
int    y;
int get(int p,int q)
{
x   = p;
y = q;
return 0;
}
void show()
{
System.out.println("value of x ="+x);
System.out.println("value of y ="+y);
}
}
class B extends A
{
public static void main(String args[ ])
{
b=new B();
b.get(5. 6);
b.show();
}
}
```

Using Final Keyword :

The **final** keyword provides three functionality to your program.

(a) If a data member is declared with the help of final keyword, its value cannot be change.

(b) If a class is declared as final, it cannot be inherited by other classes.

(c) If a method is declared as final, it cannot be overridden.

Example 2 :

The final variable of super class cannot be ***changed or initialised in a sub class.***

```
class Super
{
public final int var=1;
public final void display()
{
System.out. print l n( " Invoking super class final display method");
class Sub extends Super
//final class cannot be inherited
public static void main(String s[J)
l
System.out.pri ntl n ("Initializing integer type variable ' var ' ") ;
Sub obj= new Sub(); obj.displa y() ;
System .out.pri ntl n ("Value of va r="+obj.var); void display()
//final method cannot be override
l
System.out.pr i nt l n(" i nvok i ng sub class display method");
obj.var=2;
//final variable can also not be override
```

Commonly used JAVA Library :

A library is reusable software component that saves developer's time, by providing access to the code that performs a programming task. In Java language, there are many libraries for performing different types of tasks as per requirement.

Some commonly used Java libraries are String library, Math library, Utilities library, I/O library, etc. Libraries are made available in program through import statement.

e.g. **import java . lang. * ;**

The **java.lang** library is imported in a Java program by default.

String

In Java language, we can work with character data, i.e. single character or group of characters is known as strings. In the Java programming language, strings are objects. There are many classes which are available in Java language to work with characters or string.

Some common classes are as follow:

String Class

The String class is the class, whose instances or objects can hold unchanging strings. It means once the objects are initialised they cannot be modified or changed.

It provides several methods for creating and manipulating String object. Strings in Java program are created by declaring object of string type class and initialising it with a string literal.

e.g.

```
String name= "My name is Shreyash";
```

The String objects can also be created by using new keyword.

e.g.

```
String name = new String
("What is your name?");
```

Method of String :

String class has many methods. Some common methods are as follows:

1. **charAt (int Index)** - It returns the character at the specified index.

   e.g.

```
String str = "Shreyash";
System.out.println (str .charAt(2));
```

Output
r

2. **concat (String Str)** - It concatenates the specified string to the end of current string object.

   e.g.

```
String sl="Shreyash";
sl=sl.concat("Pradhan " );
System.out. println(sl) ;
```

Output
Shreyash Pradhan

3. **int length()** - It returns the length of current or this string.

   e.g.

```
String str = "Shreyash";
System.out.println(str . length( ));
```

Output
8

4. **to lower case ()** - It converts all the characters of a given string to lowercase.

   e.g.

```
String str = "SHREYASH" ;
System.out.println (str.tolowe rCase()) ;
```

Output
shreyash

5. **to upper case ()**- It converts all the characters of a given string to uppercase.

e.g.

```
String str = " Shreyash" ;
System.out.println (str .toupperCase()) ;
```

Output

SHREYASH

6. **trim ()**- It removes the spaces from the beginning and end of the current or this string.

e.g.

```
String ob="    Hello      ";
 String object= ob.trim ();
```

Output

Hello

7. **Substring (int startlndex)** - It returns a substring from the current string, which is starting from the start index character to the end of invoking string object.

e.g.

```
String str = "0123456789" ;
System.out. println( str.substring(4));
```

Output

456789

8. **String substring(int startlndex, int endlndex)** : It returns a substring from the current string, which is starting from the startlndex character and ends at the endlndex character.

e.g.

```
String str = "0123456789" ;
System.out. println(str.substring( 4,7)  ) ;
Output
456
```

Math Class :

To perform some mathematical operation in a program, Java provides a class that contain some mathematical methods is known as Math class. The general syntax of using a method is:

Math.method_name (arguments)

Methods of Math Class :

Some commonly used mathematical methods are as follows:

1. **pow ( )** - It is used to find the value of a number raised to another number.

   Syntax :

   ```
   double pow(double a. double b);
   ```

   Example :

   ```
   Math.pow(3, 2);
   ```

   Output

   9

2. **round ( )** - It is used to find the value of a number as rounded.

   Syntax :

   ```
   The round has two syntax versions:
   public static long round (double  a) ;
   public static int round (float a) ;
   ```

   Example :

   ```
   Math.round (4.5);
   Math.round( - 4 . 5);
   ```

   Output

   5

   -4

Accessing MySQL Database using ODBC, JDBC

To design real-life application, we encounter the situations, where we need to manipulate data scored in a database through an application (Java GUI application using NetBeans IDE). For this purpose, we have to setup a database connection with your application.

A database connection is the means by which a database server such as Oracle, MySQL, Microsoft SQL server, etc and client software designed in Java. C, C++, etc., communicate with each other. The client uses a database connection to send commands to and receives reply from the server.

A database is stored as a file or a set on magnetic disk or tape or optical disk or some other secondary storage device. The information in these files may be broken down into records, each of which consists of one or more fields. In this section, we will discuss about connectivity with MySQL to Java applications.

Database connectivity with ODBC/JDBC

Database connectivity refers to connection and communication between application software and the database system. To connect the database with an application, a framework is used to send and execute SQL statements from or within the application code.

ODBC (Open Database Connectivity) is the most popula1 programming interface for accessing relational database, but it is Microsoft's API, which cannot be directly used with Java because it uses a C interface (i.e. platform independent and in secure). That is why Java has defined its own API (JDBCAPI) chat uses JDBC drive written in Java language.

JDBC (Java Database Connectivity) API (Application Programming Interface) is a natural Java interface and is built on ODBC, so JDBC is a better choice for accessing database like MySQL.

JDBC (Java Database Connectivity)

It is an API (Application Programming Interface), which consists of a set of Java classes, interfaces and exceptions. It allows the programmer to connect Java application to the database and provide methods for querying and updating data into the database. JDBC is a relational database orientation, which mainly performs following tasks:

(a) Establishing the connection with a database.

(b) Send the defined SQL statements to the database server.

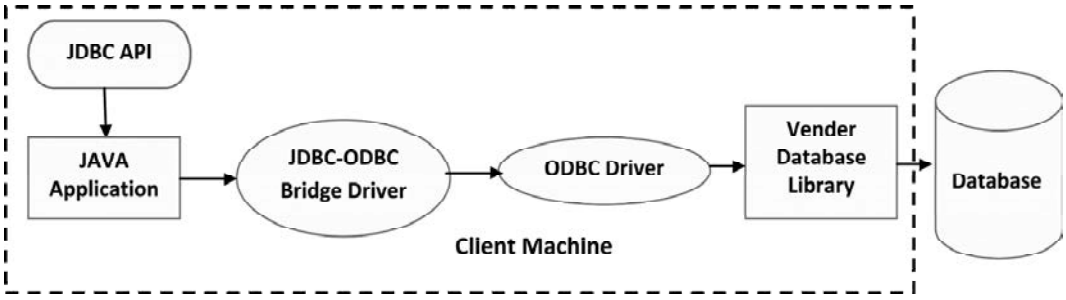
(c) Process the statements to get the result.

JDBC Driver :

JDBC driver is a software component that enables Java application to interact with the database. There are four types of JDBC drivers,

1. JDBC-ODBC Bridge

This type of driver provides access to database through ODBC driver. It converts JDBC call methods to ODBC call methods to connect to the database. The ODBC drive needs to be installed on the client machine. It is also known as **Type l driver**. The JDBC-ODBC Bridge chat comes with JDK 1.2 is a good example of this kind of driver.



Advantages of JDBC-ODBC Bridge

- ❖ It is very easy to use.
- ❖ It can be easily connected to any database.

Disadvantages of JDBC-ODBC Bridge

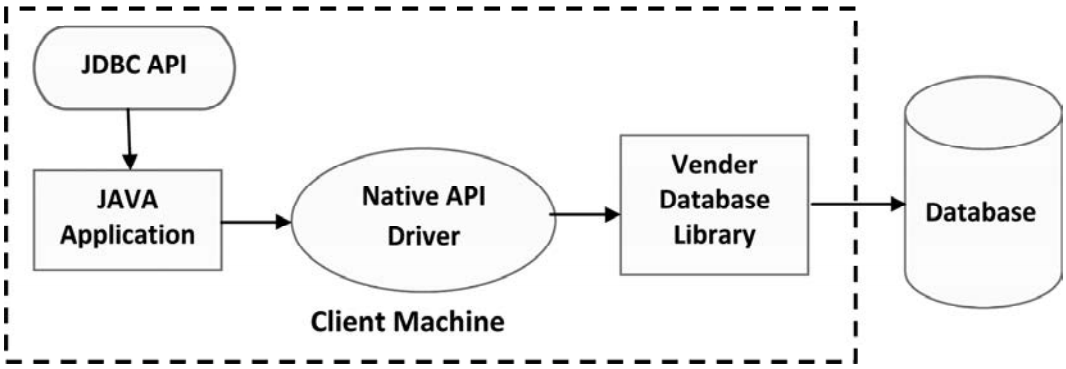
- ❖ Its performance degraded because it converts JDBC method into the ODBC function calls.

2. Native- API Driver (Partially Java Driver)

In this type of driver, client side libraries are used to access database. These libraries need to be installed on client machine and these libraries are database specific. So different libraries are used for different database

connectivity. This driver converts JDBC method calls into native calls of the database APL It is also known as **Type2 driver**.

The Oracle OCI (Oracle Call Interface) driver is an example of a **Type2 driver.**



Advantages of Native- API Driver

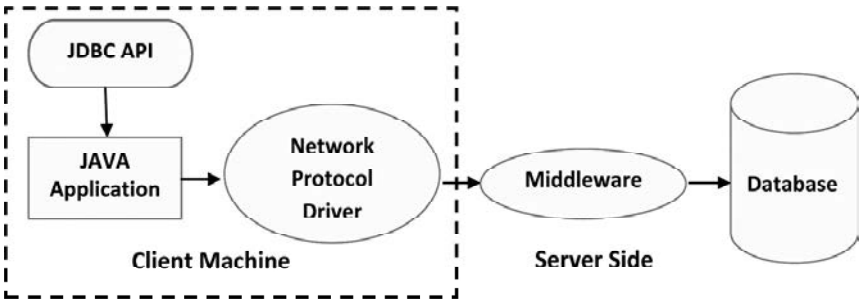
- Its performance upgraded than JDBC-OI bridge driver.

Disadvantages of Native- API Driver

- The vendor client library needs to be installed on client machine.
- The native driver needs to be installed on the each client machine.

3. Network Protocol Driver (Fully Java Driver)

The network protocol driver uses middleware (application server) that converts JDBC calls directly or indirectly into the vendor-specific database protocol. Here, all libraries are installed on a server. To connect to database, these libraries accessed from the server. So, network is required. This driver is also k as **Type3 driver** or middleware driver.



Advantages of Network Protocol Driver

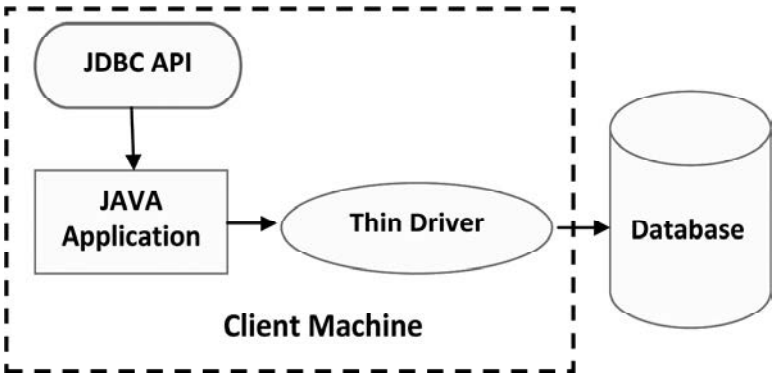
- No client side library is required..

Disadvantages of Network Protocol Driver

- It requires database specific coding to be done in the middle tier.
- Network support is required on client machine.

4. Thin Driver (Fully Java Driver)

The thin driver converts JDBC calls directly into the vendor specific database protocol. It is pure Java driver, its methods call is not need to be converted to connect database or execute query. This is most popular driver which is being used to connect to database. It is also known as Type4 driver. MySQL's Connector/J driver is a **Type4 driver**.



Advantages of thin Driver

- There is no software required at client side or server side.
- Better performance than all other drivers.

Disadvantages of thin Driver

- Drivers depend on the database.

Classes used for Database connectivity :

There are four main classes, required for the database connectivity. he classes are as follows:

1. DriveManager Class

The JDBC DriveManager class loads the JDBC driver needed to access a particular data source, located and logs on) the database and returns a connection object. The DriveManager class works between the user and the rivers. The task of the DriveManager class is to keep track f the drivers chat are available and handles in establishing a connection between a database and the appropriate driver.

It even keeps track of the driver login time limits and, printing of log and tracing messages. This class is mainly useful for the simple application. This class has many methods. Some of the commonly uses methods are given bellow:

(a) **deregisterDriver** (Driver driver) It drops the driver from the list of the driver registered in the DriveManager class .

(b) **registerDriver** (Driver driver) It registers the driver in the DriveManager Class.

(c) **getConnection**(String url) It establishes the connection co a given database URL.

(d) **getConnection**(String url, String user, String password) It establishes the connection co a given database URL, with appropriate username and password.

(e) **getConnection**(String url, Properties info) It establishes the connection co a given database URL, as per passed driver properties.

(f) **getDriver**(String url) It attempts to locate the driver by the given string char understand the given URL.

(g) **getDrivers**( ) It retrieves the enumeration of the drivers which has been registered with the DriverManager class.

2. Connection Class

It manages the communications between a Java client application and a specific database, including passing SQL statements to the DBMS and managing transactions. Some of the commonly used methods are given below:

(a) **createStatement**( ) It returns the statement reference object.

(b) **setAutoCommit** (boolean status) It controls transactions to be committed by default or not.

(c) **commit( )** -It is used to commit transactions.

(d) **rollback()**-It rollback co the failure transaction or all transaction.

(e) **close()** - It is used to close the connection.

3. Statement Class

The Statement class contains SQL strings that are submitted to the database management system. A SQL SELECT statement returns a ResultSet object. There are three methods which are used commonly:

(a) **execute** (String query) This method executes which does not return any value.

(b) **executeQuery**(String query) This method executes query and returns a single ResultSet object ·

(c) **executeUpdate**(String query) This method is used for performing updation query. It return type is int that tells the number of rows affected.

4. Result set class

It is a logical set of records that are fetched from the data base by executing a query and made available to the application program. Some commonly used methods are described here:

(a) **first( )** This method moves the cursor to the first row in the ResultSet object. It returns true, if the cursor is currently positioned on the first row and false, if the ResultSet object does not contain any rows.

(b) **next( )** This method moves the cursor forward one row from its position. It returns true, if the cursor is currently positioned on a row and return false, if the cursor is positioned after the last row.

(c) **last( )** This method moves the cursor to the last row in the ResultSet. It returns true, if the cursor is currently positioned on the last row and false, if the ResultSet is empty.

(d) **relative**(int rows) This method moves the cursor relative to its current position. It returns true, if the cursor is positioned on a valid row and false otherwise.

(e) **absolute**(int rowno) This method moves the cursor to the row specified by row value. It returns true, if the cursor is positioned on a valid row and false otherwise.

(f) **getRow**( ) This method retrieves the current row number, to which the cursor is pointing at. If cursor is at first row the getRow( ) will return 1.

Connecting MYSQL Database from Java :

To connect two different types of applications (i.e. Java an object oriented language and MySQL an RDBMS (Relational Database Management System)), we need a software called MySQL Connector/j.

MySQL Connector/] is a thin Java driver that converts JDBC calls into the vendor specific database protocol.

Steps for connecting MySQL from Java, we need to do the following steps:

Step 1 Start NetBeans IDE.

Step 2 Click on Tools menu® Libraries.

Step 3 In the Ant Library Manager dialog, From the Libraries: select MySQL JDBC Driver under class libraries.

Step 4 Click at Add JAR/Folder button and then select the downloaded and extracted driver file and click Add JAR/Folder button.

Step 5 Select the desired file and click on OK. button. After that install the appropriate driver's, now establish a database connection using JDBC.

MySQL Database Connectivity in Java :

Step 1:

Import the Packages: It consist of two sub-steps:

First sub step is, to import library package containing the JDBC classes needed for database programming. To import various classes from java.sql package,

such as:

For Connection **import java.sql .Connection**:

For DriverManager **import java.sql.DriverManager**:

For Statement **import java. sql. Statement**:

ForResultSet **import java.sql .ResultSet:**

But to import the entire package, the following command is used:

import java.sql .*;

Second sub step, is to add the MySQLJDBC connector.

Step 2:

Register the JDBC Driver : It requires that you must initialise a driver, so you can open a communication channel with the database. For this purpose, firstly register the JDBC driver with the DriverManager and the java.lang package's one class namely Class offers a method called forName() that registers the driver with the DriverManager.

Syntax **class. forName("<driver' s name>");**

e.g. You can connect to MySQL using one of the following two drivers.

Class.forName("java.sql .Driver"); or

Class.forName("com.mysql .jd bc.Driver");

Step 3:

Open a Connection : It requires a DriverManager.getConnection() method to create a connection object, which represents a physical connection with database. The getConnection () method requires three parameters, these are user, password and db_url.

A connection is the session between the application program and the database. To do anything with database, one must have a connection object.

e.g.

connection conn = (Connection) DriverManager.get Connection ("jdbc:mysql://localhost:3306/database"; "username", "password"); Here, database is name of the database in which table is exist.

Step 4:

Execute a Query Requires an object of type Statement for building and submitting an SOL statement to the database using createStatement( ) method of connection type object.

e.g.

Statement stmt=conn.createStatement();

ResultSet result = stmt.executeQuery

("SELECT firstName, lastName, age FROM EMP");

Step 5:

Extract Data from ResultSet: In case you are fetching data fror the database. ResultSet's methods are used to retrieve the data from the ResultSet. ResultSet object provides several methods fo1 obtaining column data for a row.

Some examples of this method are

getlnt( ), getlong( ), getString( ), getFloat( ). getDate( ), etc.

```
String firstName = result.getString("First Name")
String lastName = result.getString("Last Name");
int age = result.getlnt("age");
```

Step 6:

Clean Up The environment requires explicitly closing all databases.

resources using close() method as shown below: To clean-up environment

```
rs .close();
stmt.close();
conn . close();
```

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. Which of the following key word is not an access specifier?
   a. void b. public
   c. protected d. private
2. Which of the following key word is not accessible to a sub-class?
   a. void b. public
   c. protected d. private
3. Which of the following statement is true?
   a. A super class is a subset of a sub class
   b. class Second extends First means First is a sub class
   c. class Second extends First means Second is a super class
   d. None of the above
4. Which of the following method extracts specified no. of characters from a string?
   a. subStr( ) b. subString( )
   c. takeString( ) d. extract( )
5. Which of the following method(s) does not accept any arguments?
   a. pow( ) b. toLowerCase( )
   c. round( ) d. All of the above
6. Which of the following statement is true?
   a. The trim( ) method removes spaces from one side
   b. The trim( ) method is used to trim a number by removing zeroes
   c. The trim( ) method removes spaces from both sides of a string
   d. The trim( ) method is used to trim a string by removing extra characters.
7. Which of the following is not a valid method of the String class?
   a. length( ) b. concat( )
   c. trim( ) d. round( )
8. Which of the following class contains methods for basic numerical operations?
   a. Number b. String
   c. Math d. Integer
9. Which of the following method is used to retrieve data from a table without modifying the contents of the table?
   a. execute() b. queryexecute()
   c. query() d. executeQuery()

10. Which of the following class libraries are essentially required for setting up a connection with the database and retrieve data?
    a. Driver Manager b. Connection
    c. Statement d. All of the above
11. Which of the following is not a primitive data type in Java?
    a. float b. int
    c. string d. void
12. Which of the following method is used to move to the next row of the result set.
    a. next( ) b. findNext( )
    c. last() d. forward( )

LONG ANSWER TYPE QUESTIONS :

1. What is a class?
2. Name any four native classes of Java and briefly explain the use of each.
3. Give two appropriate advantages of using in-built methods over creating user-defined methods.
4. Explain the general syntax of using any method of the String class. Is it in anyway different from using a method of the Math class?
5. What will be the contents of F1 and F2 after the following code is executed?

   String F1="Hello",F2="Friend";

   F1=F1.concat (F2);
6. Explain the terms ResultSet with respect to a database.
7. Explain the usage of the following methods:

   a) next( )

   b) removeRow( )
8. Give two appropriate reasons of connecting GUI form with a Database.
9. What is JDBC? What is the importance of JDBC in establishing database connectivity?
10. Explain the importance of:

    a) JDBC

    b) forName( ) method

    c) getModel( ) method

■ ■ ■

CHAPTER - 5

HTML BASED WEB PAGE COVERING BASIC TAG

Introduction :

HTML is a language for developing web pages. HTML stands for ***H****yper****T****ext* ***M****arkup* ***L****anguage*. It is not a programming language, it is a markup language. A markup language is a collection of markup tags. HTML uses markup tags to describe web pages. HTML markup tags are usually called HTML tags or just tags. HTML tags are keywords surrounded by angle brackets like <html>. HTML tags normally come in pairs, like and . The first tag in a pair is the start tag; the second tag is the end tag. Start and end tags are also called opening tags and closing tags.

HTML is a complete code that allows the user to create web pages. It includes text and graphics. You can add links to your web pages. Hyperlinks are the highlighted text or images that connect to other pages on the web. Let us analyze the word HTML.

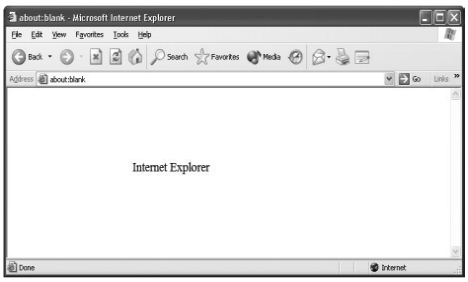
Hyper Text : Hypertext is the text used to link various web pages. It is the text on a webpage, which on clicking opens a new web page.

Mark-up : It means highlighting the text either by underlining or displaying it in different colors, or both.

Language: It refers to the way of communication between web pages, which has its own syntax and rules.

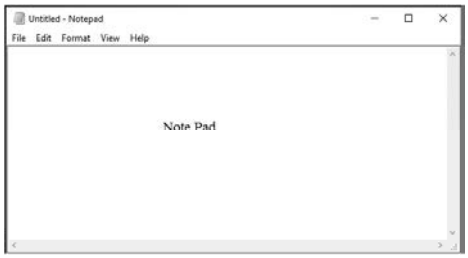
Requirements of HTML :

1. **Browser:** It is an application software package used to view and explore information on World Wide Web. A List of web browsers are :



   - Internet explorer
   - Netscape Navigator
   - Mozilla Firefox
   - Google Chrome
   - Opera etc.

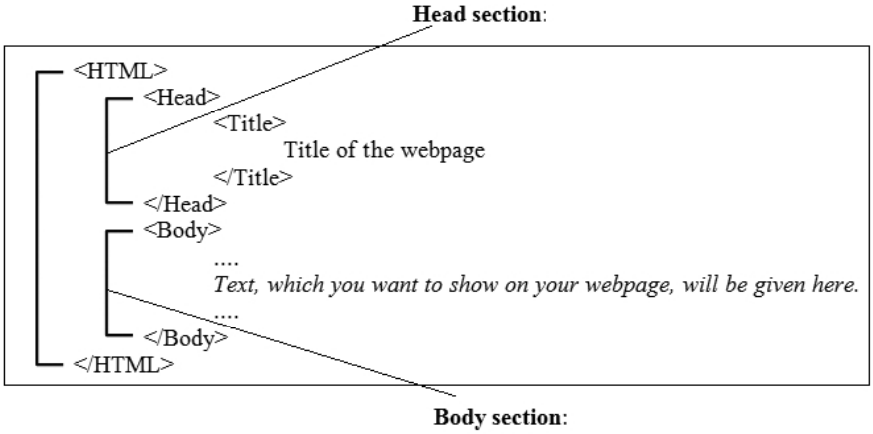
2. **Editor :** The simple word processor (**Notepad**) is called a **text editor** and used for writing HTML codes or tags for creating or developing web pages.



HTML Documents :

The general structure of HTML document has two sections: **Head** and **Body.**

1. **Head section**: The Head section contains the Title that identifies the first part of your HTML coded document.



2. **Body section**: The body section is where you do most of the works that includes text, graphics, and other HTML elements that provide control and formatting of a page like: fonts, paragraph, list and other elements. The general format of HTML document is:

Basic HTML Elements / Tags :

HTML is Tag based language. Tag is an element, which instructs the web browser, what to show and how to show. We can use various attributes in the Tag that contains additional information like formatting effects, alignment, colors, etc. Each Tag giving a specific instruction is enclosed in< > angle brackets.

HTML tags are of two types:-

1. **Paired Tag**: A paired tag has set of two commands, starting & ending commands or tags. The first tag (<H1>) in a pair is the start tag; the second tag </H1> is the end tag. Start and end tags are also called opening tags and closing tags.
2. **Singular Tags:** The second type of tag is the singular or stand-alone tag. A stand-alone tag does not have a companion tag. For example.
 tag. There is no ending tag. Sometimes it is called as unpaired tag.

Every HTML page should contain certain standard HTML tags. There are four tags that are required for every page. They are:

1. <HTML></HTML>
2. <HEAD></HEAD>
3. <TITLE></TITLE>
4. <BODY></BODY

<HTML>

The HTML document starts with *<HTML>* tag and ends with *</HTML>* tag, which identifies that it is a standard HTML document. Everything is written with in these tags. If the commands are not enclosed in tags then a web browser will assume the commands as text.

Syntax:

<HTML>
……..
……..
……..
</HTML>

<HEAD> & <TITLE>

The <TITLE> tag has to be given within the <HEAD> tag. It contains the title of the document. The Title should be short and it is recommended to include less than 64 characters in a Title. The contents of the head are not displayed.

Syntax:

<HEAD>
<TITLE>
The Title is included here
</TITLE>
</HEAD>

The head of a HTML document is an unordered collection of information about the document. The main element in the Head section is the <TITLE> tag. Generally, the title appears in the title bar of the web Browser window.

<BODY>

The <BODY> tag includes the text that contains the information about the document that gets displayed on the Web Page along with all other tags and attributes. In body tag only we use all formatting elements, images, heading, list, hypertext links to enhance the appearance of a web page.

Syntax:

<HTML>
<HEAD>
<TITLE>
……..
</TITLE>
</HEAD>
<BODY>
The body is include here
……
</BODY>
</HTML>

Syntax of HTML Document :

In its simplest form, following is an example of an HTML document:

```
<!DOCTYPE html>
<html>
        <head>
                <title>This is document title</title>
        </head>

        <body>
                <h1>This is a heading</h1>
                <p>Document content goes here.....</p>
        </body>
</html>
```

Above example of HTML document uses following tags:

TAGS	DESCRIPTION
<! DOCTYPE...>	This tag defines the document type and HTML version.
<html>	This tag encloses the complete HTML document and mainly comprises of document header which is represented by <head>...</head> and document body which is represented by <body>...</body> tags.
<head>	This tag represents the document's header which can keep other HTML tags like <title>, <link> etc.
<title>	The <title> tag is used inside the <head> tag to mention the document title.
<body>	This tag represents the document's body which keeps other HTML tags like <h1>, , <p> etc.
<h1> to <h6>	Define HTML heading.
<p>	This tag represents a paragraph.
 	Insert a single line brack

Common Elements :

1. **BOLD**: The Bold element specifies that the text should be displayed in bold face.*Syntax:* <*B*> ..... </*B*>

2. **ITALIC**: The Italic element specifies that the text should be displayed using the italic font.

   Syntax: <I> .....</I>

3. **UNDERLINE**:The Underline element states that the enclosed text should be underlined.

   Syntax: <U> .....</U>

4. **BIG**: The Big element specifies that the enclosed text should be displayed using a bigger font (compared with the current font).

   Syntax: <BIG> ..... </BIG>

5. **SMALL:** The Small element specifies that the enclosed text should be displayed using a smaller font (compared with the current font).

   Syntax: <SMALL> .....</SMALL>

6. **BLINK**: Surrounding any text with this element will cause the selected text to blink on the viewing page.

   Syntax: <BLINK> .....</BLINK>

   The <BLINK>< /BLINK> element is currently only supported by the Netscape Navigator browser. In the internet explorer <marquee> is used to get the same effect.

7. **STRIKE**: The Strike element states that the enclosed text should be displayed with a horizontal line striking through the text.

   Syntax: <STRIKE> . . . <; STRIKE>

8. **SUBSCRIPT**: The Subscript element specifies that the enclosed text should be displayed as a subscript using a smaller font (compared to the rest of the text).

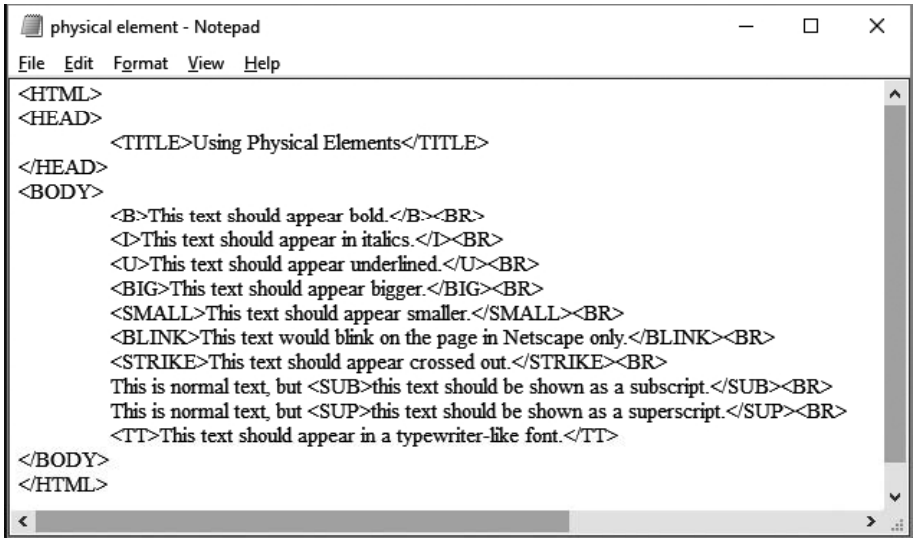
   Syntax: _{...}

9. **SUPERSCRIPT**: The Superscript element specifies that the enclosed text should be display as a superscript using a smaller font (compared to the rest of the text).*Syntax: ^{...}*

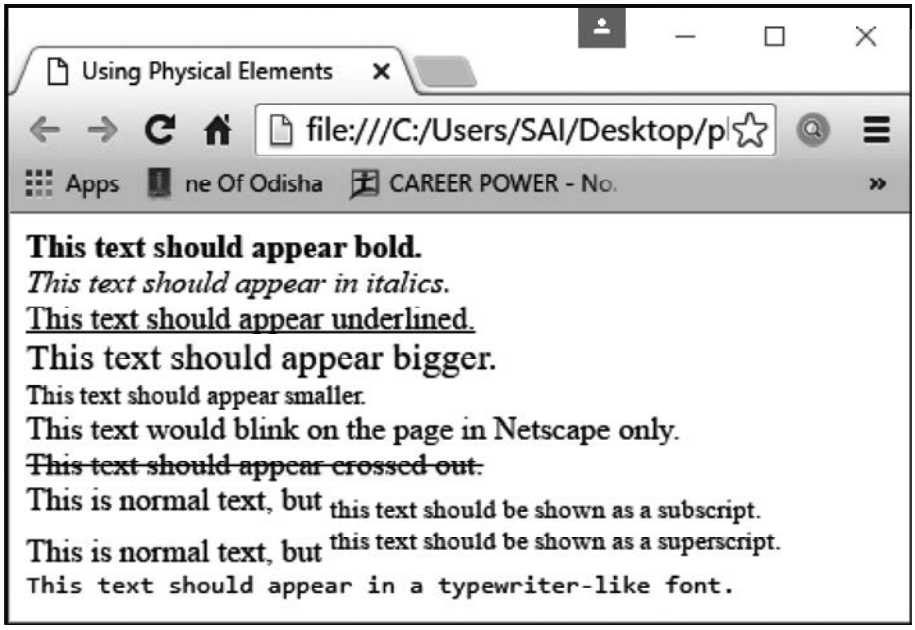
10. **TYPEWRITER**:The Teletype element specifies that the text should be rendered in fixed-width typewriter font.

    Syntax: <TT> ... </TT>

Example: Type the HTML code in your Notepad window as shown in the figure bellow.



The output is shown as per the following figure

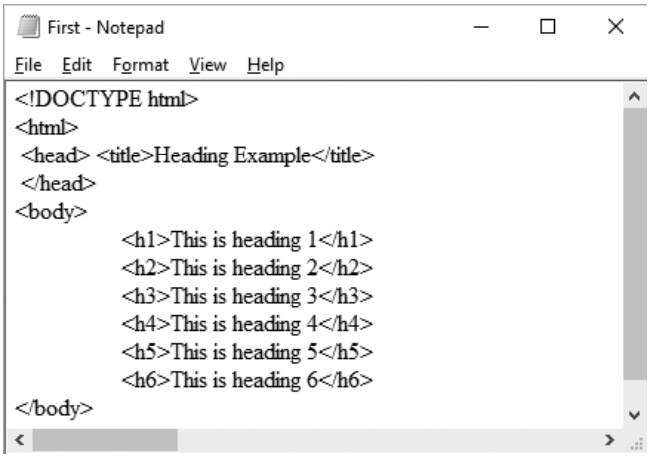


Heading Tags (H1...H6) :

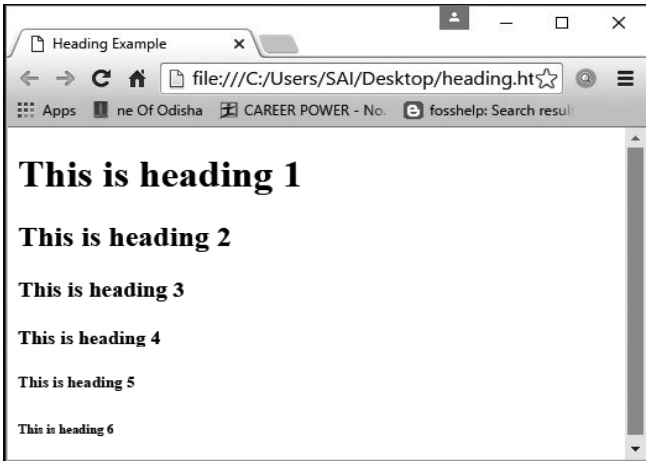
Any document starts with a heading. You can use different sizes for your headings. HTML also has **six** levels of headings, which use the elements <h1>, <h2>, <h3>, <h4>, <h5>, and <h6>. While displaying any heading, browser adds one line before and one line after that heading. The lower the number, the larger the heading size, as shown

Example

Type the HTML code in your Notepad window as shown in the figure bellow.

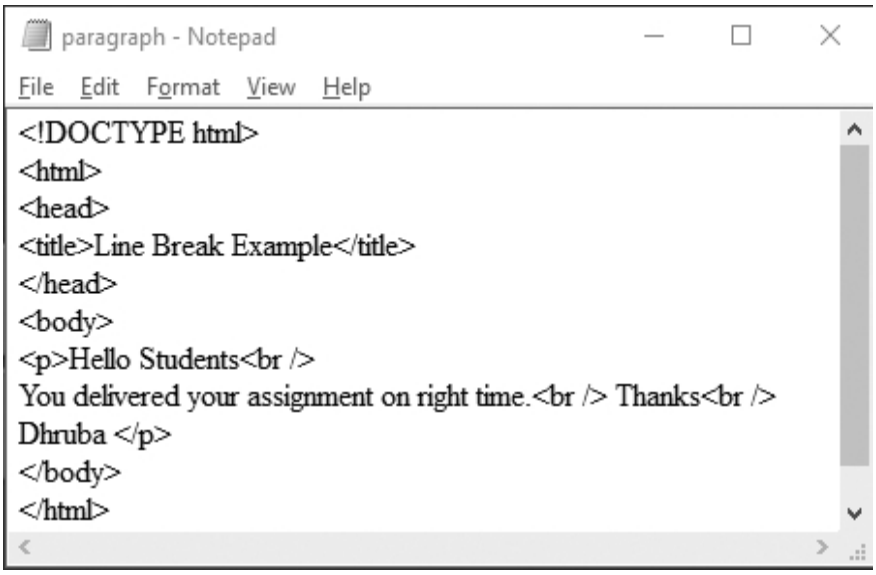


The output is shown as per the following figure.

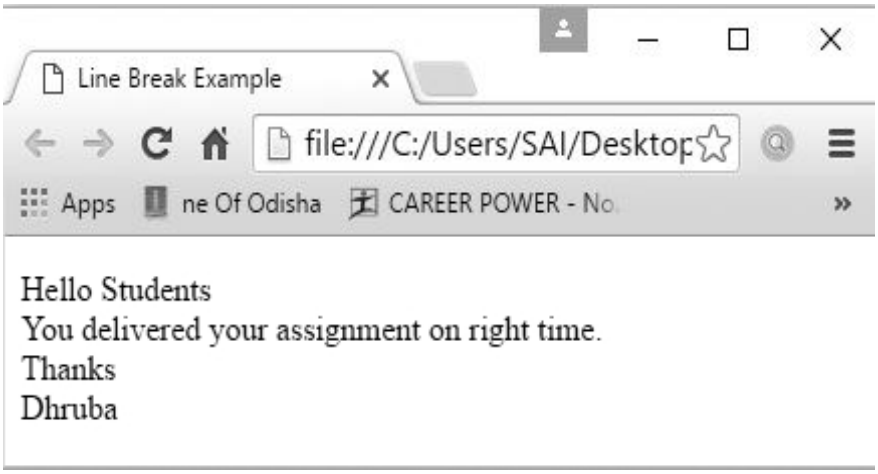


Line Break Tag :

Use the <br /> tag, if you want a line break (a new line) without starting a new paragraph. The <br /> element is an empty HTML element. It has no end tag.The <br /> tag has a space between the characters br and the forward slash. HTML code in your Notepad window

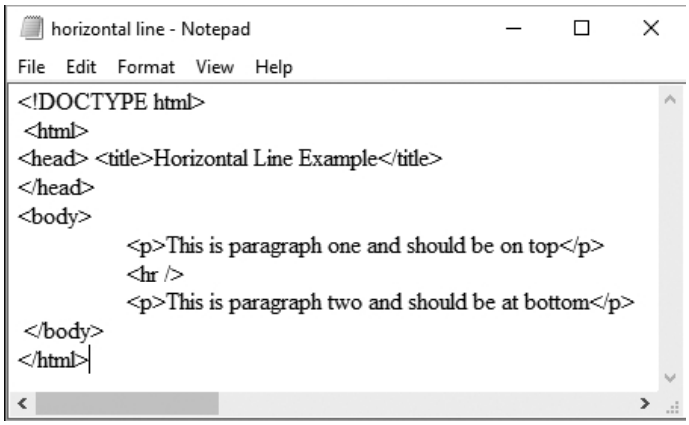


The output is shown as per the following on the web browser



Section Separator (HR tag) :

Horizontal lines are used to visually break up sections of a document. The <hr> tag creates a line from the current position in the document to the right margin and breaks the line accordingly. For example, you may want to give a line between two paragraphs as in the given example below:



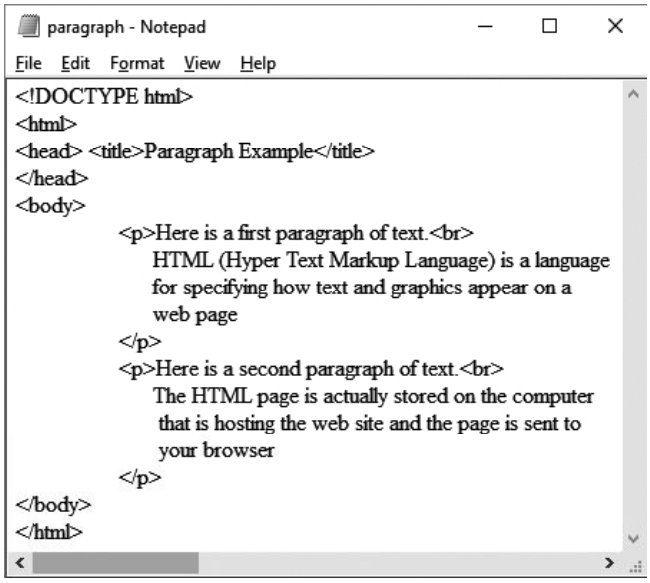
The output is shown as per the following figure.

Paragraph Tag :

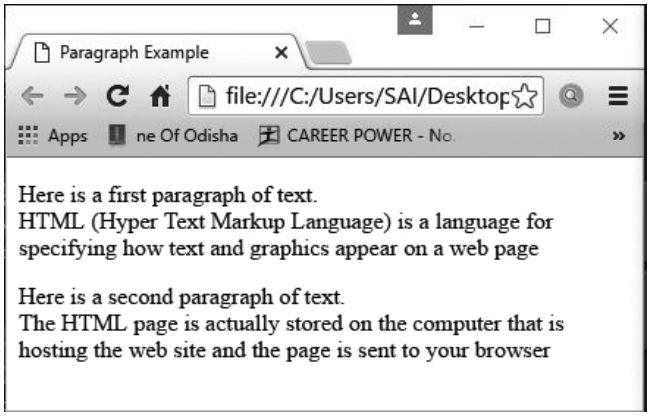
HTML documents are divided into paragraphs. Paragraphs are defined with the tag. Each paragraph of text should go in between an opening and a closing tag as shown below in the example:

Example :

Type the HTML code in your Notepad window as shown in the figure bellow.



The output is shown as per the following figure.



Attribute :

An attribute is used to define the characteristics of an HTML element and is placed inside the element's opening tag. All attributes are made up of two parts: a **name** and a **value**:

The name is the property you want to set. For example, the paragraph<p>element in the example carries an attribute whose name is align, which you can use to indicate the alignment of paragraph on the page.

The value is what you want the value of the property to be set and always put within quotations. The below example shows three possible values of align attribute: left, center and right.

Attribute names and attribute values are case-insensitive. However, the World Wide Web Consortium (W3C) recommends lowercase attributes/attribute values in their HTML 4 recommendation.

Example

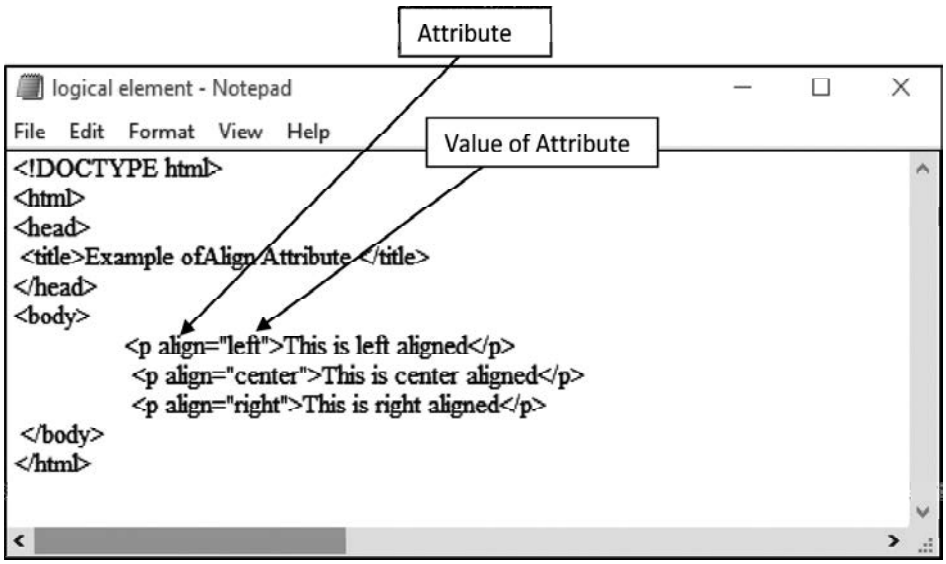
In the paragraph<p> tag uses align attribute: Type the HTML code in your Notepad window as shown in the figure bellow.

Tag - <P>

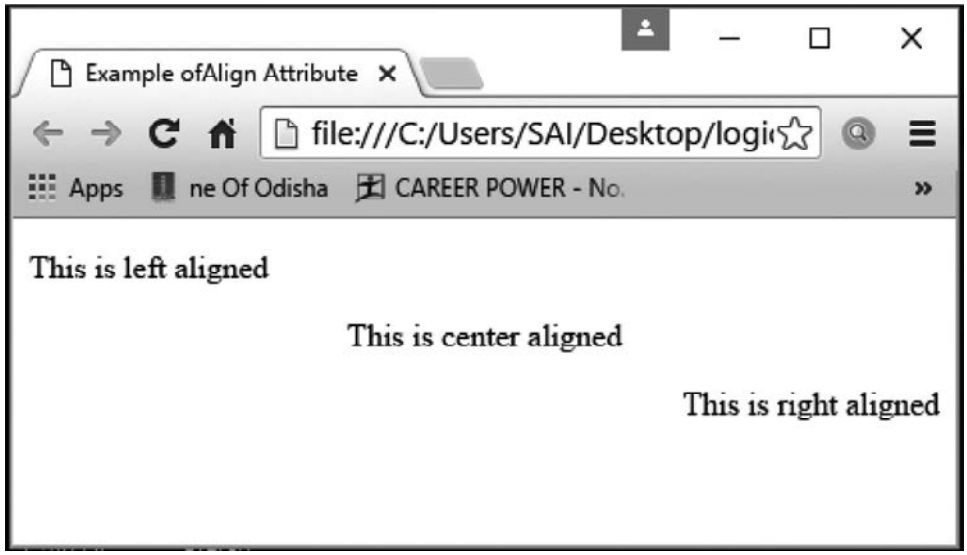
Attribute- Align

Value - Left, Center, Right, Justified

Syntax : <P Align = "Left" > This is the left align </P>
<P Align = "Center"> This is the Center align </P>
<P Align = "Right"> This is the left align </P>
<P Align = "Justified" >This is the left align </P>



The output is shown as per the following figure:



Font Tag :

The Font element lets you change the color, size, and face of the font. The Font tag overrides any other settings. In other words, text within the scope of the Font tag is displayed in the color and size you specify, regardless of any other settings. Font tag has the following **attributes:**

1. **FACE:** This attribute allows you to change of the face of the HTML document. For example Arial, Times New Roman, etc.
2. **COLOR:** This attribute defines the text color to be set. Colors can either be set by using one of the color names or as a hex 'rrggbb' triplet value. Where r-red, g-green, b-blue.
3. **SIZE:** This attribute defines the size of the font, in a range from 1 to 7, with a default size of 3.

Syntax:

```
<FONT FACE="fontlist" COLOR="color" SIZE="fontsize">
    ……
    ……
</FONT>
```

Example:

Tag - <FONT>

Attribute - FACE, COLOR, SIZE

Value -

Face: Times New Roman, Impact, Bookman old style, Courier New, Arial, Arial Black.

Color: Red, Green, Blue, Purple, Cyan, Maroon etc.

Size : The range of accepted values is from 1(smallest) to 7(largest). The default size of a font is 3.

Example :

font - Notepad

File Edit Format View Help

```
<!DOCTYPE html>
<html>
<head>
<title>Setting Font , Size and color</title>
</head>
<body>
<font face="Arial Black"size="1" color="red">font face-Arial Black, Font size="1"</font><br/>
<font face="Verdana" size="2" color="green">font face-Comic sans MSVerdana, Font size="2"</font><br />
<font face="Comic sans MS" size="3" color="blue">font face-Comic sans MS, Font size="3"</font><br />
<font face="WildWest" size="4" color="black">font face-WildWest, Font size="4"</font><br />
<font face="Bedrock" size="5" color="Purple">font face-Bedrock, Font size="5"</font><br />
 <font face="Arial"size="6" color="cyan">font face-Arial, Font size="6"</font><br />
 <font face="Times New Roman" size="7" color="Maroon">font face-,Times New Roman,  Font size="7"</font><br />
</body>
</html>
```

This will produce following result:

Table Tag :

Tables are an excellent way to organize and display information on a page. ***Tables*** are defined using the **<table> tag**.A table is divided into ***rows*** with the **<tr> tag**, and each row is divided into data cellsusing the ***<td> tag***. The letters td stand for "***table data***," which is the content of a data cell. A data cell can contain text, images, lists, paragraphs, forms, horizontal rules, tables, and so on.Table ***headings*** are defined with the **<th> tag**.

Table Tags :

Tags	Description
<table>	Defines a table
<th>	Defines a table header
<tr>	Defines a table row
<td>	Defines a table cell data(or table data)
<caption>	Defines a table caption
<thead>	Defines a table head
<tbody>	Defines a table body
<tfoot>	Defines a table footer

There are two attributes called ***cell padding*** and ***cell spacing*** which you will use to adjust the white space in your table cells. The cellspacing attribute defines the width of the border, while cellpadding represents the distance between cell borders and the content within a cell.

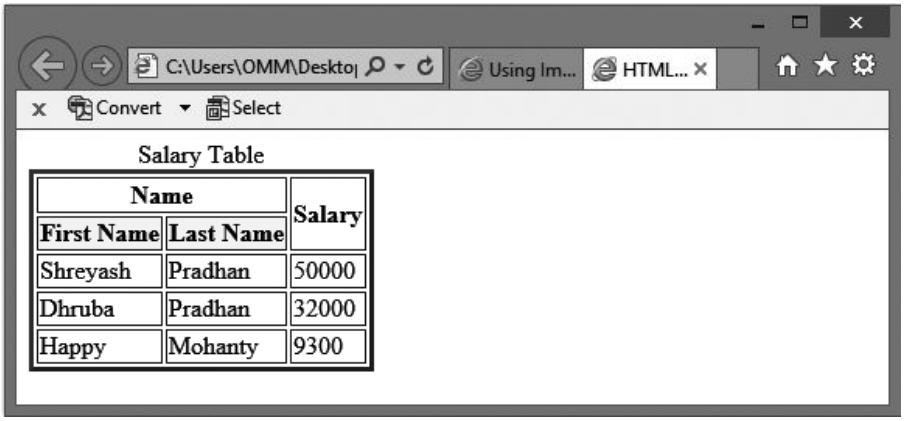
The use of ***colspan*** attribute if you want to merge two or more columns into a single column. Similar way you will use ***rowspan*** if you want to merge two or more rows.***bgcolor***attribute - You can set background color for whole table or just for one cell.***background*** attribute - You can set background image for whole table or just for one cell.The ***bordercolor*** attribute use the border of the table.***Width*** and ***height***attribute is used for change the **width** and **height** of a table.

Example:

```
<!DOCTYPE html>
<html>
    <head>
        <title>HTML Table </title></head>
```

```
<body>
<table border="3" bordercolor="red" width="400" height="100">
<caption>Salary Table</caption>
    <tr>
        <th colspan="2">Name</th>
        <throwspan="2">Salary</th>
    </tr>
    <tr>
        <th bgcolor="Yellow">First Name</th>
        <th bgcolor="Yellow">Last Name</th>
    </tr>
    <tr>
        <td>Shreyash</td>
        <td>Pradhan</td>
        <td>50000</td>
</tr>
<tr>
        <td>Dhruba</td>
        <td>Pradhan</td>
        <td>32000</td>
</tr>
<tr>
        <td>Happy</td>
        <td>Mohanty</td>
        <td>9300</td>
</tr>
</table>
        </body>
        </html>
```

This will produce following output:



List Tag [OL, UL] :

HTML supports ordered, unordered, and definition lists.

1. <ul> - An unordered list. This will list items using plain bullets.
2. <ol> - An ordered list. This will use different schemes of numbers to list your items.
3. <dl> - A definition list. This arranges your items in the same way as they are arranged in a dictionary.

HTML Unordered Lists :

An unordered list is a collection of related items that have no special order or sequence. This list is created by using HTML <ul> tag. Each item in the list is marked with a bullet.An unordered list starts with the <ul> tag. Each list item starts with the <li> tag.You can use type attribute for <ul> tag to specify the type of bullet you like. By default it is a disc.Following are the possible options:

<ul type="square"> [■]

<ul type="disc"> [●]

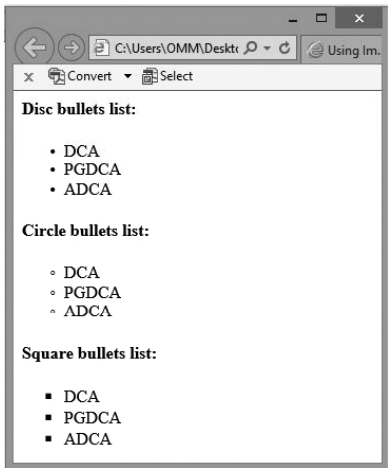
<ul type="circle"> [○]

Example:

```
<html>
<body>
<h4>Disc bullets list:</h4>"
<ul type= "disc">
        <li>DCA</li>
        <li>PGDCA</li>
        <li>ADCA</li>
</ul>
<h4>Circle bullets list:</h4>
<ul type="circle">
        <li>DCA</li>
        <li>PGDCA</li>
        <li>ADCA</li>
</ul>

<h4>Square bullets list:</h4>
<ul type="square">
        <li>DCA</li>
        <li>PGDCA</li>
        <li>ADCA</li>
</ul>
</body>
</html>
```

This will produce following output:



HTML Ordered Lists :

If you are required to put your items in a numbered list instead of bulleted list then HTML ordered list will be used. This list is created by using <ol> tag.The numbering starts at one and is incremented by one for each successive ordered list element tagged with <li>. You can display different kinds of ordered lists by using the type attribute.By default it is a number. Following are the possible options:

<ol type="1"> - Default-Case Numerals.

<ol type="I"> - Upper-Case Roman Numerals.

<ol type="i"> - Lower-Case Roman Numerals.

<ol type="a"> - Lower-Case Letters.

<ol type="A"> - Upper-Case Letters.

You can use start attribute for <ol> tag to specify the starting point of numbering you need. Following are the possible options:

<ol type="1" start="4"> → Numerals starts with 4.

<ol type="I" start="4"> → Numerals starts with IV.

<ol type="i" start="4"> → Numerals starts withiv.

<ol type="a" start="4"> → Numerals starts with D.

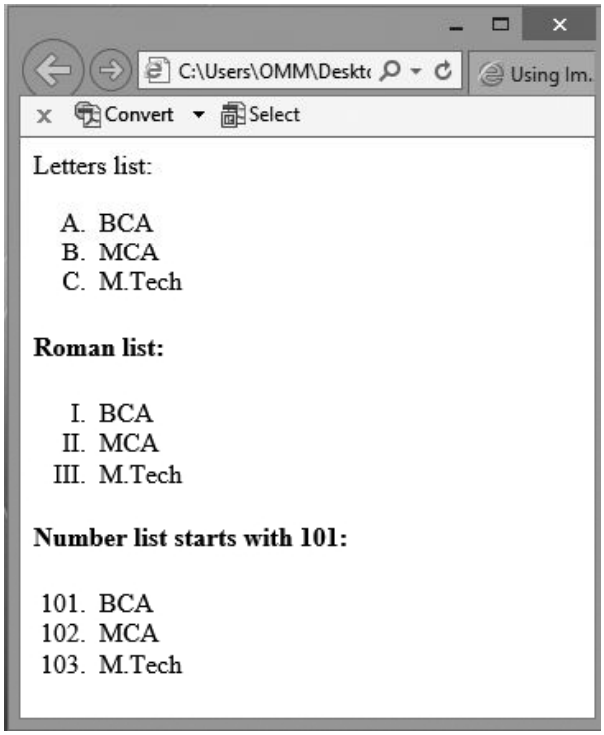
<ol type="A" start="4"> → Numerals starts with d.

Example:

```
<html>
<body
<h4>Letters list:</h4>
<ol type="A">
<li>BCA</li>
<li>MCA</li>
<li>M.Tech</li>
</ol>
<h4>Roman list:</h4>
```

```
<ol type="I">
<li>BCA</li>
<li>MCA</li>
        <li>M.Tech</li>
</ol>
<h4>Number list starts with 101:</h4>
<ol type="1" start=101>
<li>BCA</li>
<li>MCA</li>
        <li>M.Tech</li>
</ol>
</body>
</html>
```

This will produce following output:



HTML Definition Lists :

HTML and XHTML support a list style which is called definition lists where entries are listed like in a dictionary or encyclopedia. The definition list is the ideal way to present a glossary, list of terms, or other name/value list.

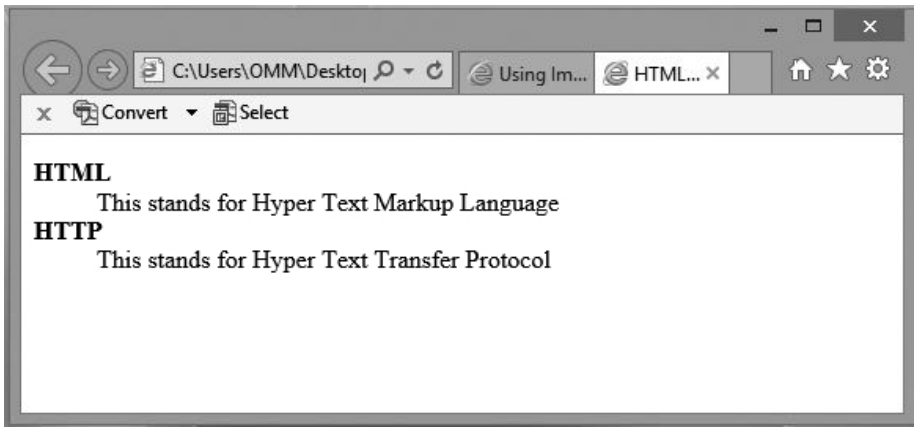
Definition List makes use of following three tags.

- <dl> - Defines the start of the list
- <dt> - A term
- <dd> - Term definition
- </dl> - Defines the end of the list

Example:

```
<!DOCTYPE html>
<html>
<head>
<title>HTML Definition List</title>
</head>
<body>
<dl>
<dt><b>HTML</b></dt>
<dd>This stands for Hyper Text Markup Language</dd><dt><b>HTTP</b></dt>
<dd>This stands for Hyper Text Transfer Protocol</dd></dl>
</body>
</html>
```

This will produce following output:



Form :

HTML Forms are required when you want to collect some data from the site visitor. For example, during user registration you would like to collect information such as name, email address, credit card, etc. A form will take input from the site visitor and then will post it to a back-end application such as CGI, ASP Script or PHP script etc. The back-end application will perform required processing on the passed data based on defined business logic inside the application. There are various form elements available like text fields, textarea fields, drop-down menus, radio buttons, checkboxes, etc. The HTML <form> tag is used to create an HTML form and it has following syntax:

<form action="Script URL" method="GET|POST">

form elements like input, text area etc

</form>

Form Attributes :

Apart from common attributes, following is a list of the most frequently used form attributes:

Attribute	Description
action	Backend script ready to process your passed data.
method	Method to be used to upload data. The most frequently used are GET and POST methods.
target	Specify the target window where the result of the script will be displayed. It takes values like blank, self, _parent etc.
enctype	You can use the enctype attribute to specify how the browser encodes the data before it sends it to the server. Possible values are:

HTML Form Controls :

There are different types of form controls that you can use to collect data using HTML form.

- ❖ Text Input Controls
- ❖ Checkboxes Controls
- ❖ Radio Box Controls
- ❖ Select Box Controls
- ❖ File Select boxes
- ❖ Hidden Controls
- ❖ Clickable Buttons
- ❖ Submit and Reset Button

Text Input Controls :

There are three types of text input used on forms:

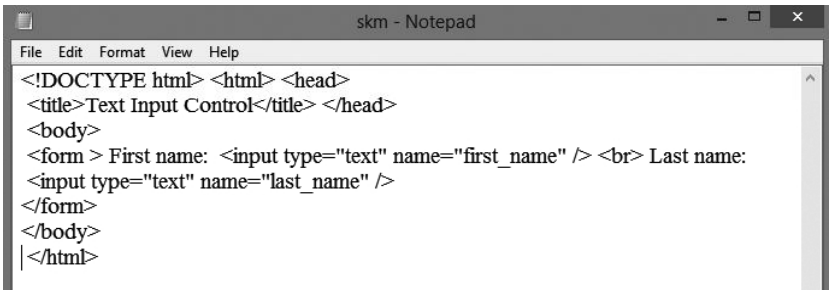
- ➢ Single-line text input controls - This control is used for items that require only one line of user input, such as search boxes or names. They are created using HTML <input> tag.
- ➢ Password input controls - This is also a single-line text input but it masks the character as soon as a user enters it. They are also created using HTML <input> tag.
- ➢ Multi-line text input controls - This is used when the user is required to give details that may be longer than a single sentence. Multi-line input controls are created using HTML <textarea> tag.

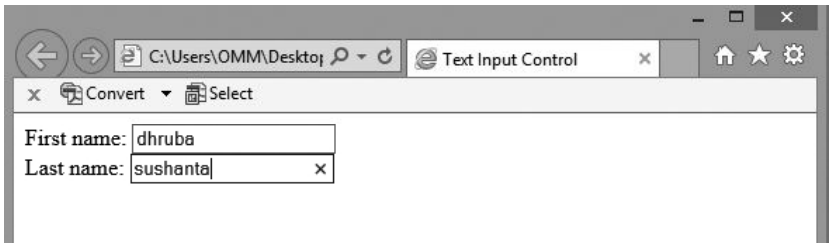
Single-line text input controls :

This control is used for items that require only one line of user input, such as search boxes or names. They are created using HTML <input> tag.

Example :

Here is a basic example of a single-line text input used to take first name and last name.





Attributes :

Following is the list of attributes for <input> tag for creating text field.

Attribute	Description
type	Indicates the type of input control and for password input control it will be set to password.
name	Used to give a name to the control which is sent to the server to be recognized and get the value.
value	This can be used to provide an initial value inside the control.
size	Allows to specify the width of the text-input control in terms of characters.
maxlength	Allows to specify the maximum number of characters a user can enter into the text box.

Multiple-Line Text Input Controls :

This is used when the user is required to give details that may be longer than a single sentence. Multi-line input controls are created using HTML <textarea> tag.

Example :

Here is a basic example of a multi-line text input used to take item description:

```
<!DOCTYPE html>
<html>
<head>
<title>Multiple-Line Input Control</title>
```

</head>

<body>

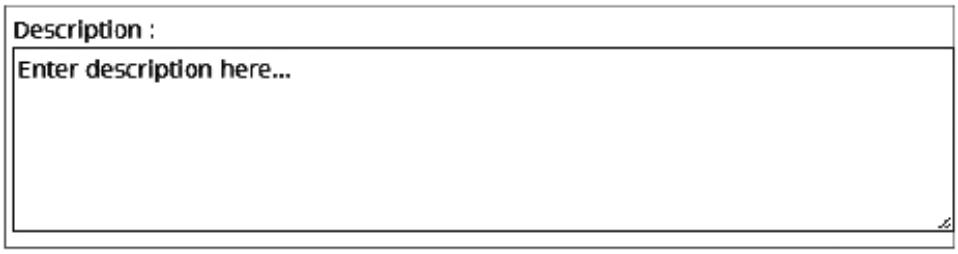
<form>

*Description :
*

<textarea rows="5" cols="50" name="description">Enter description here...

</textarea>

</form></body></html>



Following is the list of attributes for <textarea> tag.

Attribute	Description
name	Used to give a name to the control which is sent to the server to be recognized and get the value.
rows	Indicates the number of rows of text area box
cols	Indicates the number of columns of text area box

Checkbox Control :

Checkboxes are used when more than one option is required to be selected. They are also created using HTML <input> tag but type attribute is set to checkbox.

Example :

Here is an example HTML code for a form with two checkboxes:

<!DOCTYPE html>

<html>

<head>

<title>Checkbox Control</title>

```
</head>
<body>
<form>
<input type="checkbox" name="maths" value="on">Maths
<input type="checkbox" name="physics" value="on"> Physics
</form>
</body>
</html>
```

Attributes :

Following is the list of attributes for checkbox.

Attribute	Description
type	Indicates the type of input control and for checkbox input control it will be set to checkbox.
name	Used to give a name to the control which is sent to the server to be recognized and get the value.
value	The value that will be used if the checkbox is selected.
checked	Set to checked if you want to select it by default.

Select Box Control :

A select box, also called drop down box which provides option to list down various options in the form of drop down list, from where a user can select one or more options.

Example :

Here is example HTML code for a form with one drop down box.

```
<!DOCTYPE html>
<html>
<head>
<title>Select Box Control</title>
</head>
```

```
<body>
<form>
<select name="dropdown">
<option value="Maths" selected>Maths</option><option
value="Physics">Physics</option>
<option value="dca" selected>Dca</option><option value="Dcs">Dcs</
option>
</select>
</form>
</body>
</html>
```

Attributes

Following is the list of important attributes of <select> tag:

Attribute	Description
Value	Used to give a name to the control which is sent to the server to be recognized and get the value.
Size	This can be used to present a scrolling list box.
Multiple	If set to "multiple" then allows a user to select multiple items from the menu..

Following is the list of important attributes of <option> tag:

Attribute	Description
Value	The value that will be used if an option in the select box box is selected.
Selected	Specifies that this option should be the initially selected value when the page loads.
Label	An alternative way of labeling options

File Select Boxes :

Submit and Reset, Button

Attribute	Description
Type	Description
Submit	This creates a button that automatically submits a form
Reset	This creates a button that automatically resets form controls to their initial values.
Button	This creates a button that is used to trigger a client-side script when the user clicks that button.

```
<html>
<head>
<title>File Upload Box</title>
</head>
<body>
<form>
<input type="submit" name="submit" value="Submit" />
<input type="reset" name="reset"  value="Reset" />
<input type="button" name="ok" value="OK"  />
<input type="image" name="imagebutton" src="/html/images/logo.png" />
</form>
</body>
</html>
```

HTML5 Input Types :

HTML5 added several new input types:

- color
- date
- datetime
- datetime-local
- email

- month
- number
- range
- search
- tel
- time
- url
- week

Input Type colour

color : Gives the user a color picker to choose a color.

<form>

CHOOSE U R FAVORITE COLOR <input type=”color” value=”#b97a59">

<form>

Input Type DATE

date

Offers a date picker. To the user.

DOB: <form><input type=”date” value=”2016-07-08"></form>

Input Type DATETIME

An element to choose both date and time.

Current Time

:<input type=”datetime” value=”2011-06-09T20:35:34.32">

Input Type DATETIME

An element to choose both date and time, with local settings support. LOCAL TIME:<input type=”datetime-local” value=”2011-06-09T22:41">

Input Type EMAIL

A field for entering e-mail address(es).

Enter ur email id:<input type=”email” value=”susant.mty@gmail.com”>

Input Type Month

The **<input type=”month”>** allows the user to select a month and year. Depending on browser support, a date picker can show up in the input field.

<form> Birthday(month and year):

<input type=”month” value=”2011-06">

</form>

Input Type Number

- The **<input type=”number”>** defines a **numeric** input field.
- You can also set restrictions on what numbers are accepted.
- The following example displays a numeric input field, where you can enter a value from 1 to 5:

<form>

Numbers (between 1and 5):

<input type=”number” name=”quantity” min=”1" max=”5">

</form>

Input Type Range

The **<input type=”range”>** is used for input fields that should contain a value within a range.

Depending on browser support, the input field can be displayed as a slider control.

<form>

UR HEIGHT IN FT.<input type=”range” name=”points” min=”0" max=”10">

</form>

Input Type Search

The **<input type=”search”>** is used for search fields (a search field behaves like a regular text field).

<input type=”search” value=”[Any search text]”>

<form>

Search Google:

<input type="search" value="googlesearch">

</form>

Input Type Tel

The **<input type="tel">** is used for input fields that should contain a telephone number.

The tel type is currently supported only in Safari 8.

<form>

CONTACTNO:

<input type="tel" name="usrtel">

</form>

Input Type Time

The **<input type="time">** allows the user to select a time (no time zone). Depending on browser support, a time picker can show up in the input field.

<form>

Select a time:

<input type="time" name="usr_time">

</form>

Input Type Url

The **<input type="url">** is used for input fields that should contain a URL address. Depending on browser support, the url field can be automatically validated when submitted.

Some smartphones recognize the url type, and adds ".com" to the keyboard to match url input.

<form>

Add your homepage:

<input type="url" name="homepage">

</form>

Input Type Week

The **<input type="week">** allows the user to select a week and year. Depending on browser support, a date picker can show up in the input field.

```
<form>
Select a week:
<input type="week" name="week_year">
</form>
```

Creating & accessing static &dynamic pages using HTML – DHTML :

DHTML is NOT a language. DHTML is a TERM describing the art of making dynamic and interactive web pages.

DHTML combines HTML, JavaScript, DOM, and CSS.

Below is a listing of DHTML technologies.

HTML 4

The W3C HTML 4 standard has rich support for dynamic content:

- HTML supports JavaScript
- HTML supports the Document Object Model (**DOM**)
- HTML supports HTML Events
- HTML supports Cascading Style Sheets (**CSS**)

DHTML is about using these features to create dynamic and interactive web pages.

JavaScript

JavaScript is the scripting standard for HTML.

DHTML is about using JavaScript to control, access and manipulate HTML elements.

HTML DOM

The HTML DOM is the W3C standard **Document Object Model** for HTML.

The HTML DOM defines a standard set of objects for HTML, and a standard way to access and manipulate them.

DHTML is about using the DOM to access and manipulate HTML elements.

HTML Events

The W3C HTML Event Model is a part of the HTML DOM.

It defines a standard way to handle HTML events.

DHTML is about creating web pages that reacts to (user)events.

CSS

CSS is the W3C standard style and layout model for HTML.

CSS allows web developers to control the style and layout of web pages.

HTML 4 allows dynamic changes to CSS.

DHTML is about using JavaScript and DOM to change the style and positioning of HTML elements.

Introductions to XML :

XML (eXtensible Markup Language) is also a markup language like HTML. But XML is different from HTML in the sense that HTML describes how to display and format the data, text and images in the browser whereas XML is used to describe the data. XML has nothing to do with presentation of data in the browser. The XML standard was created by W3C to provide an easy to use and standardized way to store self-describing data (Self-describing data is data that describes both its content and its structure). Essentially, XML is a software- and hardware-independent tool for storing and transporting data.

Example:

This note is a note to Asit from Kunu, stored as XML:

```
<note>
    <to>Asit</to>
    <from>Kunu</from>
    <heading>Reminder</heading>
    <body>Don't forget me this weekend!</body>
</note>
```

The XML above is quite self-descriptive:

- It has sender information.
- It has receiver information

- It has a heading
- It has a message body.

The Difference between XML and HTML

XML and HTML were designed with different goals:

- HTML is used to display data and to focus on formatting of data, whereas XML is used to describe data and focus on what data is.
- HTML tags are predefined, whereas XML tags are not predefined. We create our own tags.
- HTML tags are not case sensitive, whereas XML tags are case sensitive.

XML Syntax Rules: The syntax rules of XML are very simple and logical. The rules are easy to learn, and easy to use.

a) XML Documents Must Have a Root Element: XML documents must contain one root element that is the parent of all other elements:

```
<root>
<child>
    <subchild>.....</subchild>
   </child>
</root>
```

In the following example **<note>** is the root element:

```
<?xml version="1.0" encoding="UTF-8"?>
<note>
   <to>Asit</to>
   <from>Kunu</from>
   <heading>Reminder</heading>
   <body>Don't forget me this weekend!</body>
</note>
```

b) **All XML Elements Must Have a Closing Tag:** In HTML, some elements might work well, even with a missing closing tag:

```
<p>This is a paragraph.
<br>
```

c) **It is illegal to omit the closing tag**: All elements **must** have a closing tag:

```
<p>This is a paragraph.</p>
<br />
```

d) **XML Tags are Case Sensitive:** XML tags are case sensitive. The tag <Letter> is different from the tag <letter>. Opening and closing tags must be written with the same case:

```
<Message>This is incorrect</message>
<message>This is correct</message>
```

"Opening and closing tags" are often referred to as "Start and end tags". Use whatever you prefer. It is exactly the same thing.

e) **XML Elements Must be Properly Nested:** In HTML, you might see improperly nested elements:

```
<b><i>This text is bold and italic</b></i>
```

In XML, all elements **must** be properly nested within each other:

```
<b><i> this text is bold and italic</i></b>
```

In the example above, "Properly nested" simply means that since the <i> element is opened inside the <b> element, it must be closed inside the <b> element.

f) **XML Attribute Values Must be quoted:** XML elements can have attributes in name/value pairs just like in HTML & the attribute values must always be quoted.

INCORRECT:

```
<note date=12/11/2007>
    <to>Asit</to>
    <from>Kunu</from>
</note>
```

CORRECT:

```
<note date="12/11/2007">
    <to>Asit</to>
    <from>Kunu</from>
</note>
```

The error in the first document is that the date attribute in the note element is not quoted.

g) **Comments in XML:** The syntax for writing comments in XML is similar to that of HTML.

<!— This is a comment —>

Two dashes in the middle of a comment are not allowed.

Not allowed:

```
<!– This is a – comment –>
```

Strange, but allowed:

```
<!– This is a - - comment –>
```

Viewing XML Files

```
<?xml version="1.0" encoding="UTF-8"?>
    - <note>
    <to>Asit</to>
    <from>Kunu</from>
    <heading>Reminder</heading>
    <body>Don't forget me this weekend!</body>
</note>
```

Look at the XML file above in your browser: **note.xml**

XML and XQuery

XQuery is a language for finding and extracting elements and attributes from XML documents.

- XQuery is ***the*** language for querying XML data
- XQuery for XML is like SQL for databases
- XQuery is supported by all major databases
- XQuery is a W3C Recommendation

XQuery can be used to:

- Extract information to use in a Web Service
- Generate summary reports
- Transform XML data to XHTML
- Search Web documents for relevant information

Well Formed XML Documents

An XML document with correct syntax is called "Well Formed".

- XML documents must have a root element
- XML elements must have a closing tag
- XML tags are case sensitive
- XML elements must be properly nested
- XML attribute values must be quoted

Features of XML

- XML is extensible. XML allows the user to create his own tags and document structure.
- XML can be used to store data. Applications can be written to store and retrieve information.
- XML can be used to exchange data. In the real world, databases contain data in different formats. It is difficult to exchange data between such systems over the Internet. Converting the data to XML can help in solving this problem and create data that can be read by different types of applications.
- XML is free. It can be written with a simple text editor or one of the many freely available XML authoring tools, such as XML Notepad.
- XML is a W3C recommendation.

Benefits of XML

The main benefit of XML is that it can be used to share data between two entirely different platforms. For example, we can take data from a database like MySQL, convert it into XML, and then share it with any other platform like MS Excel, HTML etc. Each of these receiving platforms can then convert the XML into a structure the platform uses normally. This way communication between two potentially different platforms is achieved using XML.

To store self-describing data, XML allows us to create our own tags. Once an XML file is created with the help of user-defined tags, it needs to be transformed into the target platform format. We shall take an example in which data in an XML file is transformed into HTML format. The file used for this purpose is an XSLT (eXtensible Stylesheet Language Transformations) file.

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. The address of a resource on the net is known as:
   (a) ISP (b) HTTP
   (c) URL (d) WWW
2. A program that serves requested HTML files and pages.
   (a) Web Address (b) Web Page
   (c) Web Server (d) None of these
3. HTML tags must be written within:
   (a) < > (b) { }
   (c) [ ] (d) ( )
4. Which of the following is the correct structure of HTML tags?
   (a) < HTML> </HTML> <HEAD> </HEAD> <BODY> </BODY>
   (b) <HTML> <HEAD> </HEAD> </HTML> <BODY> </BODY>
   (c) <HTML> <HEAD> <BODY> </BODY> </HEAD> </HTML>
   (d) <HTML> <HEAD> </HEAD> <BODY> </BODY> </HTML>
5. Which of the following tags is used to specify the items in a list.
   (a) <LI> (b) <OL>
   (c) <UL> (d) <DL>
6. The IMAGE tag uses the _____ attribute to specify the URL of the image to be displayed.
   (a) SCR (b) SRC
   (c) Source (d) None of these
7. The align attribute of <Table> tag refers to _____ placement of the table in relation to the window screen.
   (a) Vertical (b) horizontal
   (c) Both a and b (d) None of these
8. Choose the best suitable input type to input gender from the user:
   (a) Text (b) Submit
   (c) checkbox (d) Radio

9. Elements, such as heading, paragraph and tables etc can be contained in the FORM element.
   (a) Holds True always (b) Holds True Sometimes
   (c) Is Never True (d) None of these
10. Data entry on a web page can be done using:
   (a) Tables (b) Formatting Tags
   (c) Forms (d) Lists
11. Which tag is used to embed an image in an HTML document.
   (a) <FIX> (b) <IMG>
   (c) <IMAGE> (d) <FIX IMAGE>
12. To create a nested list we use the tag:
   (a) <OL> (b) <UL>
   (c) <NL> (d) combination of (a) and (b) as required.
13. Input type="_____" will send the form to its destination place.
   (a) Button (b) File
   (c) Submit (d) Reset
14. FACE is the attribute of which tag:
   (a) <BODY> (b) <FONT>
   (c) <P> (d) <IMG>
15. Radio buttons can be grouped together so that only one is selected at a time by using the attribute:
   (a) name (b) selected
   (c) checked (d) font
16. XML document is used to
   (a) Only interpret data
   (b) Store any kind of data
   (c) Store only highly structured data (like in databases)
   (d) Store only loosely structured data (like letters)
17. XML can be used to
   (a) Exchange data (b) Store data
   (c) Interpret data (d) All of these

18. Every XML document must begin with a
    (a) Root element (b) Child element
    (c) XML version details (d) Any of these

LONG ANSWER TYPE QUESTIONS :

1. Explain the basic structure of an HTML document with the help of an example.
2. Explain with an example the difference between container and empty elements.
3. What is the importance of the BODY element? List the commonly used attributes within the <BODY> tag.
4. What is the purpose of the TITLE element in HTML?
5. Explain the src and align attribute of the IMG tag.
6. What is the difference between the <TD> and <TH> tags?
7. Explain align and bgcolor attributes of the <TR> tag.
8. How can we create an HTML page that allows the user to enter his details on that webpage? Explain with the help of suitable HTML code/ example.
9. Differentiate between HTML and XML.
10. Write a few features of XML.

■ ■ ■

UNIT - 3

RELATIONAL DATABASE MANAGEMENT SYSTEM

CHAPTER - 6

DATABASE FUNDAMENTALS

A database is an organized collection of information arranged in well defined tabular form. The purpose of a database is to collect, store, and retrieve related information for use by database applications. Software used to manage (control the storage, organize and retrieval) databases is called Data Base Management System (DBMS).

A table is a two-dimensional representation of a relation in the form of rows (records or tuples) and columns (fields or attributes). Each row in a table has the same set of columns. A relational database is a database that stores data in relations (tables). For example, a relational database could store information about the students in a STUDENT table, a SUBJECT table, and a BOOKISSUE table. A DBMS used to manage Relational Databases is called an RDBMS (Relational Data Base Management System). Some popular RDBMS software available are: Oracle, MySQL, Sybase, Ingress.

In the previous class, we have discussed database concepts and some of the SQL commands. We have also learnt how to access data from a table using various clauses of SELECT command. In this section we are going to revise briefly the concept of RDBMS those SQL commands and will make the base for further reading of some more SQL commands which are really very useful in practical applications.

Relational Database Management System (RDBMS)

The relational model is the basis for a relational database management system (RDBMS). Essentially, an RDBMS moves data into a database, stores the data, and retrieves it so that it can be manipulated by applications. An RDBMS distinguishes between the following types of operations:

- *Logical operations*
  In this case, an application specifies ***what*** content is required. For example, an application requests a student name or adds a student employee record to a table.
- *Physical operations*
  In this case, the RDBMS determines ***how*** things should be done and carries out the operation. For example, after an application queries a table, the database may use an index to find the requested rows, read the data into memory, and perform many other steps before returning a result to the user. The RDBMS stores and retrieves data so that physical operations are transparent to database applications.
- Popular RDBMSs include MySQL, Oracle, Sybase, DB2, and Microsoft SQL Server.

Database concepts we have learnt during the 1st Year class can be summarized as follows:

1) **Relational Database:** A database in which the data is stored in the form of relations (also called tables) is called a Relational Database. In other words a Relational Database is a collection of one or more tables.

2) **Benefits of using a DBMS are:**
   a. Redundancy can be controlled
   b. Inconsistence can be avoided
   c. Data can be shared
   d. Security restrictions can be applied.

3) **Relation/Table:** A table refers to a two dimensional representation of data arranged in columns (also called fields or attributes) and rows (also called records or tuples). The tables in a database are generally

related to each other to facilitate efficient management of the database. Interrelated tables also reduce the chances of errors in the database.

4) **Key:** A column or a combination of columns which can be used to identify one or more rows (tuples) in a table is called a key of the table.

5) **Primary Key:** The group of one or more columns used to uniquely identify each row of a relation is called its Primary Key.

6) **Candidate Key:** A column or a group of columns which can be used as the primary key of a relation is called a candidate key because it is one of the candidates available to be the primary key of the relation.

7) **Alternate Key:** A candidate key of a table which is not made its primary key is called its Alternate Key

Concept of Database Transaction

Till now we have studied about various SQL statements manipulating data stored in a MySQL database. We executed SQL statements without concern about inconsistencies arising due to group of statements not being executed in entirety. In this section, we will study the basic concepts of Transaction processing and how MySQL ensures consistency of data when a group of statements is executed.

To get some idea about a transaction performed in a database; let's consider the case of 'Fund Transfer' that very often takes place between the bank account of a student (staying away from home) and his/her guardian's bank account or between the Bank accounts of the Employer and Employee. Bapi, son of Sandhya is reading in a College away from their home town; but both of them have Bank Accounts in a particular bank. 93397 is the Bank Account Number of Bapi and his mother's account number is 93386. One day Bapi telephoned his mother and asked for 2000 rupees. Sandhya immediately send the said amount to Bapi's account through Electronic Fund Transfer. (She also could have handed over a cheque to her son either). In this case two simple things happen; a sum of rupees 2000 get debited from mother's

account and the same amount gets credited to son's account. Combination of this debit & subsequent credit procedure forms a database transaction.

Thus a Transaction is a unit of work that must be done in logical order (debit then credit) and successfully as a group (debit & credit) or not done at all. Unit of work means that a Transaction consists of different tasks (debit, credit, etc) - but together they are considered as one unit. Each transaction has a beginning and an end. If anything goes wrong in between the execution of transaction, the entire transaction (No matter to what extent has been done) should be cancelled. If it is successful, then the entire transaction should be saved to the database.

Following diagram suggests different states of a database transaction.

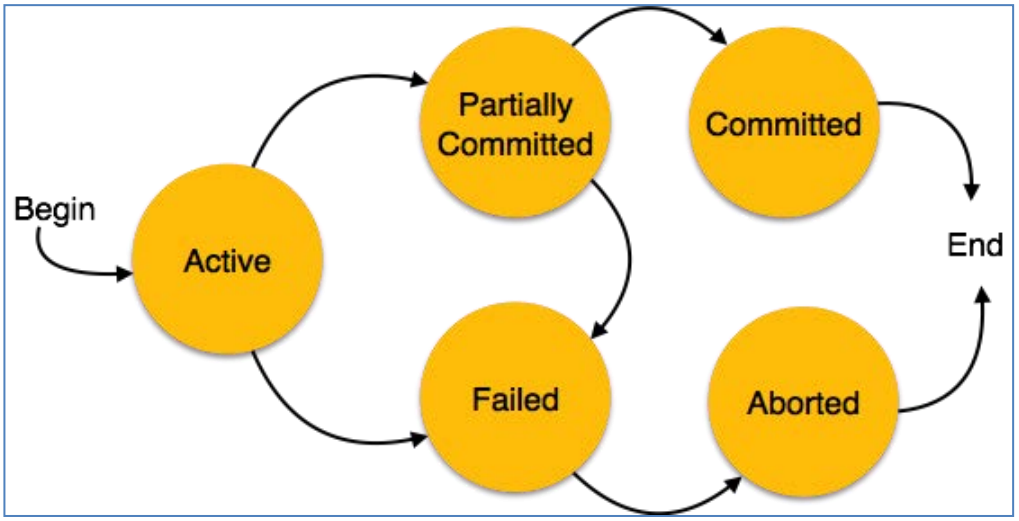


Fig. States of Database Transaction

- **Active** – This is the initial state of every transaction, where a transaction is executed.
- **Partially Committed** – When a transaction executes its final operation, it is said to be in a partially committed state.

- **Failed** − A transaction is said to be in a failed state if any of the checks made by the database recovery system fails. A failed transaction can no longer proceed further.

- **Aborted** − If any of the checks fails and the transaction has reached a failed state, then the recovery manager rolls back all its write operations on the database to bring the database back to its original state where it was prior to the execution of the transaction. Transactions in this state are called aborted. The database recovery module can select one of the two operations after a transaction aborts-

    - Re-start the transaction
    - Kill the transaction

- **Committed** − If a transaction executes all its operations successfully, it is said to be committed. All its effects are now permanently established on the database system.

Properties of Transactions

A transaction in a database system must maintain **A**tomicity, Consistency, Isolation and **D**urability − in order to ensure accuracy, completeness, and data integrity.

- **Atomicity** ensures that all operations within the work unit are completed successfully. Otherwise, the transaction is aborted at the point of failure and all the previous operations are rolled back to their former state.

- **Consistency** ensures that the database properly changes states upon a successfully committed transaction.

- **Isolation** enables transactions to operate independently of and transparent to each other.

- **Durability** ensures that the result or effect of a committed transaction persists in case of a system failure.

Transaction Control :

Following commands are used to control and manage database transactions.

- **COMMIT** − to save the changes.
- **ROLLBACK** − to roll back the changes.
- **SAVEPOINT** − creates points within the groups of transactions in which to ROLLBACK.

Further, these commands are only used with the **DML Commands** such as - INSERT, UPDATE and DELETE only. They cannot be used while creating tables or dropping them because these operations are automatically committed in a database.

START TRANSACTION statement commits the current transaction and starts a new transaction. It tells MySQL that the transaction is beginning and the statements that follow should be treated as a unit, until the transaction ends. It is written like this:

`START TRANSACTION;` *This statement does not use any clause.*

COMMIT statement

COMMIT is a transactional command used to save changes invoked by a transaction to the database. A Commit statement is issued at a time when the transaction is complete- all the changes have been successful and the changes should be saved to the database. COMMIT ends the current transaction. Thus it saves all the transactions to the database since the last COMMIT or ROLLBACK command.

The syntax for the COMMIT statement is as follows.

`COMMIT;`

Or

`COMMIT WORK;` Here WORK is a key word and is optional

In the following example, the table named 'Savings' has two rows. A transaction is started and balance in Bapi's account (with account number 93397) is increased by Rs. 2000·00 and the balance in Sandhya's account (with account number 93386) is decreased by Rs. 2000·00. COMMIT statement makes the changes made by the transaction permanent.

Example:

```
mysql> select * from Savings;
```

```
+-----------+-----------------+----------+
| AccountNo | Name            | Balance  |
+-----------+-----------------+----------+
|     93386 | Sandhyarani     | 45000.00 |
|     93397 | Bapi            |  2000.00 |
+-----------+-----------------+----------+
```

```
mysql> START TRANSACTION;
mysql> UPDATE Savings
-> SET balance = balance - 2000
-> WHERE AccountNo = 93386;
mysql> UPDATE Savings
-> SET balance = balance + 2000
-> WHERE AccountNo = 93397;
mysql> SELECT * FROM Savings;
```

```
+-----------+-----------------+----------+
| AccountNo | Name            | Balance  |
+-----------+-----------------+----------+
|     93386 | Sandhyarani     | 43000.00 |
|     93397 | Bapi            |  4000.00 |
+-----------+-----------------+----------+
2 rows in set (0.00 sec)
```

```
mysql> COMMIT;
```

ROLLBACK statement:

When a transaction is being executed, some type of error checking is usually performed to check whether it is executing successfully or not. If not, the entire transaction is reverted using the ROLLBACK statement. The

ROLLBACK statement cancels the entire transaction i.e. it rolls the transaction back to the beginning. It aborts any changes made during the transaction and the state of database is returned to what it was before the transaction began to execute and does not save any of the changes made to the database during the transaction.

Syntax for ROLLBACK statement is:

```
ROLLBACK;
```

Or

```
ROLLBACK WORK;
```

Again WORK is a keyword and is optional.

In the previous example, if ROLLBACK would have been used instead of COMMIT the updation of incrementing Bapi's account by Rs.2000·00 and decrementing Sandhya's account by Rs.2000·00 wouldn't have taken place. Let us now initiate a transaction, increase Bapi's account by Rs.3000·00, then Rollback the transaction and see what happens to the updation done on his account.

Example:

```
mysql> select * from Savings;
+-----------+-----------------+----------+
| AccountNo  | Name            | Balance  |
+-----------+-----------------+----------+
|      93386 | Sandhyarani     | 43000.00 |
|      93397 | Bapi            |  4000.00 |
+-----------+-----------------+----------+
```

Current status of their Account

```
mysql> START TRANSACTION;
mysql> UPDATE Savings
-> SET balance = balance + 3000
-> WHERE AccountNo = 93397;
mysql> ROLLBACK
mysql> SELECT * FROM Savings;
```

Bapi's AccountNo-93397 is incremented by an amount Rs.3000

ROLLBACK cancelled updation!

```
+-----------+-----------------+----------+
| AccountNo  | Name            | Balance  |
+-----------+-----------------+----------+
|      93386 | Sandhyarani     | 43000.00 |
|      93397 | Bapi            |  4000.00 |
+-----------+-----------------+----------+
2 rows in set (0.00 sec)
```

Account balances remain unchanged.

What we saw here that, a ROLLBACK statement cancels the entire operation since starting. If number of steps are too large in certain complex transactions and an error is made towards the end; definitely we would not want to roll the entire process back to square one. It would be wise just to roll back to that wrong step, keeping earlier operations intact. Such task can be accomplished by a 'marker' technique called as 'SAVEPOINT' in MySQL. This command creates intermediate halts to ROLLBACK action; i.e. a ROLLBACK action takes place up to the specified 'marking' or 'save point'.

Inserting Save Points:

The SAVEPOINT statement defines a marker in a transaction. These markers are useful in rolling back a transaction till the marker. We can add a save-point anywhere in a transaction. When you roll back to that save-point, any changes made to the database after the save-point are discarded, and any changes made prior to the save-point are saved. It is like semi-committing a transaction.

To define a save-point, we enter the SAVEPOINT statement in following syntax:

```
SAVEPOINT <savepoint-name>;
```

Let us try out some more MySQL statements on 'Students' table to understand the database transactions.

```
mysql> SELECT*FROM EMPLOYEE;
+---------+--------------------+----------+------+
| EmpCode | EmpName            | Pay      | Age  |
+---------+--------------------+----------+------+
| EDNOO1  | Ratnakar Khuntia   | 96300.00 |   60 |
| EDNOO2  | Bijayanand Lenka   | 96000.00 |   58 |
| EDNOO3  | Sudhansu Mohanty   | 86065.00 | NULL |
| EDNOO4  | Rama Chandra Behera| 23500.00 | NULL |
| EDNOO5  | Itishree Patnaik   | 12000.00 | NULL |
| EDN006  | Gunum Patnaik      | 23450.00 |   42 |
| EDN007  | Kiranmayee Sahu    | 43400.00 |   39 |
| EDN008  | Sahadev Debata     | 13400.00 |   54 |
| EDN010  | Daitary Sahoo      | 33500.00 |   50 |
| EDN014  | Sulagna Pandit     | 12500.00 |   36 |
+---------+--------------------+----------+------+
10 rows in set (0.64 sec)
```

In the above Employee table following modifications have to be made;

- Record of EmpCode-EDNOO1 has to be removed as he has retired.
- Three employees' ages have to be updated from NULL to real values.
- EmpCode014 need to be changed to EDN009.
- Meanwhile a new employee has joined.

Let's start coding:

```
mysql> DELETE FROM Employee
          WHERE EmpCode='EDNOO1';
mysql> SAVEPOINT SP1;
mysql> UPDATE Employee
    -> SET Age=55 WHERE EmpCode='EDNOO3';
mysql> UPDATE Employee
    -> SET Age=56 WHERE EmpCode='EDNOO4';
mysql> UPDATE Employee
    -> SET Age=45 WHERE EmpCode='EDNOO5';
mysql> SAVEPOINT SP2;
mysql> UPDATE Employee
```

EDNOO1 row is removed

Marker'SP1' is added

Age updated

Marker'SP2' added

```
       ->SET EmpCode='EDNOO9' WHERE
       -> EmpName='Sulagna Pandit';
mysql> SAVEPOINT SP3;
mysql> INSERT INTO Employee VALUES
       -> ('EDN011','Prasant K Baral',92500,27);
mysql> ROLLBACK TO SP3;
mysql> INSERT INTO Employee VALUES
    -> ('EDN011','Prasant K Baral',12500,27);
mysql> COMMIT;
```

Emp Code modified

Marker'SP3' added

Wrong data 92500 entered

Rolled back and correct data 12500 entered. Finally transaction is saved.

```
mysql> SELECT*FROM EMPLOYEE;
+---------+--------------------+----------+------+
| EmpCode | EmpName            | Pay      |  Age |
+---------+--------------------+----------+------+
| EDNOO2  | Bijayanand Lenka   | 96000.00 |   58 |
| EDNOO3  | Sudhansu Mohanty   | 86065.00 |   55 |
| EDNOO4  | Rama Chandra Behera| 23500.00 |   56 |
| EDNOO5  | Itishree Patnaik   | 12000.00 |   45 |
| EDN006  | Gunum Patnaik      | 23450.00 |   42 |
| EDN007  | Kiranmayee Sahu    | 43400.00 |   39 |
| EDN008  | Sahadev Debata     | 13400.00 |   54 |
| EDNOO9  | Sulagna Pandit     | 12500.00 |   36 |
| EDN010  | Daitary Sahoo      | 33500.00 |   50 |
| EDN011  | Prasant K Baral    | 12500.00 |   27 |
+---------+--------------------+----------+------+
10 rows in set (0.00 sec)
```

New Table

The save point markers can be removed from the execution process by invoking the following statement containing RELEASE SAVEPOINT command as follows:

```
mysql> RELEASE SAVEPOINT <savepoint_name>;
```

Aggregate / Group / Multiple row Functions :

We have discussed various MySQL functions in another Unit of this book. Here we shall briefly describe some useful functions, which operate over a range of records in a data table. Because they take multiple rows in account, the functions are categorized as 'Multiple row' or 'Group' functions. Example of these functions as given in the following table would be self explanatory for the name 'Aggregate'.

Aggregate Function Table

Sl No	Function	Purpose
1	MAX( )	Returns the MAXIMUM of the values under the specified column / expression.
2	MIN( )	Returns the MINIMUM of the values under the specified column / expression.
3	AVG( )	Returns the AVERAGE of the values under the specified column / expression.
4	SUM( )	Returns the SUM of the values under the specified column / expression.
5	COUNT( )	Returns the COUNT of the number of values under the specified column / expression.

To study the utility of these functions, let's use 'Student' table in 'College' database, which we have created earlier for the purpose of this book. We ADDed a new field 'Class' in to it by using ALTER TABLE command and UPDATED their values. The table is extracted by using SELECT statement as follows:

Table: Student

```
mysql> select Class, Roll, Name, Mark, Gender, DoB from Student;
+-------+----------+------------------+-------+--------+------------+
| Class | Roll     | Name             | Mark  | Gender | DoB        |
+-------+----------+------------------+-------+--------+------------+
| Art   | IA16-001 | ASHIMA MISHRA    | 540.0 | Female | 1998-12-27 |
| Sci   | IS16-003 | SARAH SMRUTI     | 351.0 | Female | 1999-06-15 |
```

```
| Art   | IA16-005 | SARFRAZ AHMAD      | 551.0 | Male   | 1999-11-23 |
| Sci   | IS16-005 | AGNAJITA PATNAIK   | 540.0 | Female | 2000-01-03 |
| Com   | IC16-005 | Clement Samaria    | 351.0 | Female | 1996-02-12 |
| Art   | IA16-006 | BISMAY PRADHAN     | 452.0 | NULL   | 1997-05-15 |
| Com   | IC16-006 | PRIYANKA PATRA     | 352.0 | Female | 1999-11-14 |
| Sci   | IS16-010 | SAIMA KHAN QUADRI  | 552.0 | Female | 1999-10-30 |
| Art   | IA17-001 | Trupti Biswal      | 555.0 | Female | 2000-05-27 |
| Art   | IA17-002 | Kiran Behera       | 594.0 | Male   | 1999-02-01 |
| Com   | IC17-001 | Nibedita Behera    | 414.0 | Female | 2001-05-15 |
| Com   | IC17-009 | Dasarathi Kumbhar  | 405.0 | Male   | 2001-09-01 |
+-------+----------+--------------------+-------+--------+------------+
12 rows in set (0.00 sec)
```

MAX ( ): This function is used to find the highest value of a numeric column or any expression based on a column. MAX ( ) takes one argument which can be any column name or a valid expression involving a column name.

Following three examples illustrate the use of this function. Students are advised to utilize their own logic to try out the usefulness of these functions later.

1. Direct application: To find out the highest Mark in the Student table.
2. With condition: Highest mark among 'Art' students.
3. Used in an expression: Highest percentage of Mark among 'Com' students (% age is calculated over 6 subjects)

```
mysql> SELECT MAX(Mark) FROM
Student;
+-----------+
| MAX(Mark) |
+-----------+
|     594.0 |
+-----------+
1 row in set (0.09 sec)
```

```
mysql> SELECT MAX(Mark) FROM
Student
    -> WHERE Class='Art';
+-----------+
| MAX(Mark) |
+-----------+
|     594.0 |
+-----------+
1 row in set (0.03 sec)
```

```
mysql> SELECT ROUND(MAX(Mark/6),1) FROM Student WHERE Class='Com';
+----------------------+
| ROUND(MAX(Mark/6),1) |
+----------------------+
|                 69.0 |
+----------------------+
1 row in set (0.00 sec)
```

MIN ( ): This function is used to find the lowest value of a numeric column or any expression based on a column. MAX ( ) takes one argument which can be any column name or a valid expression involving a column name.

```
mysql> SELECT MIN(Age) FROM
Employee;
+----------+
| MIN(Age) |
+----------+
|       27 |
+----------+
1 row in set (2.01 sec)
```

```
mysql> SELECT MIN(Pay) FROM
Employee
    -> WHERE Age >54;
+----------+
| MIN(Pay) |
+----------+
| 23500.00 |
+----------+
1 row in set (0.09 sec)
```

```
mysql> SELECT ROUND(MIN(Pay*0.6)) AS "Min.D A" FROM Employee;
+---------+
| Min.D A |
+---------+
|    7200 |
+---------+
1 row in set (0.28 sec)
```

AVG ( ): This function is used to find the average value of any numeric column or an expression based on a column having numeric values. AVG ( ) takes one argument which can be any column name or a valid expression involving a column name. Averages of String and Date type data are not defined.

```
mysql> SELECT AVG(Pay)
    ->FROM Employee;
+--------------+
| AVG(Pay)     |
+--------------+
| 35631.500000 |
+--------------+
1 row in set (0.08 sec)
```

```
mysql> SELECT AVG(Mark) FROM Student
    -> WHERE Gender='Female';
+-----------+
| AVG(Mark) |
+-----------+
| 456.87500 |
+-----------+
1 row in set (1.22 sec)
```

SUM ( ): This function is used to find the total value of any column or an expression based on a column. SUM ( ) also takes one argument which can be any column name or a valid expression involving a column name. Like AVG ( ), the argument of SUM ( ) function can be of numeric (integer / decimal) type only. Sums of String and Date type data are not defined.

```
mysql> SELECT SUM(Mark)
    -> FROM Student;
+-----------+
| SUM(Mark) |
+-----------+
|    5657.0 |
+-----------+
1 row in set (0.03 sec)
```

```
mysql> SELECT SUM(Mark) FROM Student
WHERE Gender='Male';
+-----------+
| SUM(Mark) |
+-----------+
|    1550.0 |
+-----------+
1 row in set (0.00 sec)
```

COUNT ( ): This function is used to count the number of values in a column. It takes one argument which can be any column name, an expression based on a column, or an asterisk (*). COUNT ( ) returns the number of non-NULL values in a column. If the argument is a *, then COUNT ( ) counts the total number of rows satisfying the condition, if any, in the table. Following table explains various use of COUNT ( ) function.

Purpose	Statement	Output

To count the total number of records in the table Student	`SELECT COUNT(*) FROM Student;`	`+----------+`
		`| COUNT(*) |`
		`+----------+`
		`| 12 |`
		`+----------+`

To count the total number of classes in Student table (in this case Art, Com, Sci =3)	`SELECT COUNT(DISTINCT Class) FROM Student;`	`+----------------------+`
		`| COUNT(DISTINCT Class) |`
		`+----------------------+`
		`| 3 |`
		`+----------------------+`

To count the number of Female in the Student table	`SELECT COUNT(Gender) FROM Student WHERE Gender='Female';`	`+---------------+`
		`| COUNT(Gender) |`
		`+---------------+`
		`| 8 |`
		`+---------------+`

Aggregate functions and NULL values:

All the above mentioned aggregate functions do not take NULL values in to account; neither NUULs are counted nor is average taken over them.

GROUP BY:

Group by clause is used to group the results of a SELECT query based on one or more columns. It is also used with SQL functions to group the result from one or more tables.

Syntax for using GROUP BY clause in a statement is;

```
SELECT <column_name>, <function (column_name)>
FROM <table_name> [WHERE <condition>]
GROUP BY <column_name>;
```

Statement ⇒ Output	Explanation

`SELECT Class,COUNT(*) FROM Student GROUP BY Class;`
`+-------+----------+`
`| Class | COUNT(*) |`
`+-------+----------+`
`| Art  |  5 |`
`| Com  |  4 |`
`| Sci  |  3 |`
`+-------+----------+`
`3 rows in set (0.23 sec)`
	Class wise total number of students from 'Student' table is displayed in the output.

`SELECT Class, MIN(Mark), MAX(Mark), AVG(Mark) FROM Student GROUP BY Class;`
`+-------+-----------+-----------+-----------+`
`| Class | MIN(Mark) | MAX(Mark) | AVG(Mark) |`
`+-------+-----------+-----------+-----------+`
`| Art  |  452.0 |  594.0 | 538.40000 |`
`| Com  |  351.0 |  414.0 | 380.50000 |`
`| Sci  |  351.0 |  552.0 | 481.00000 |`
`+-------+-----------+-----------+-----------+`
`3 rows in set (0.00 sec)`
	Different aggregate functions are used to retrieve their values in a Class wise manner from 'Student' table.

`SELECT Gender, COUNT(*) FROM Student GROUP BY Gender;`
`+--------+----------+`
`| Gender | COUNT(*) |`
`+--------+----------+`
`| NULL  |  1 |`
`| Female |  8 |`
`| Male  |  3 |`
`+--------+----------+`
`3 rows in set (0.03 sec)`
	Gender wise counting of students in the Student table.

`SELECT Class, COUNT(*) FROM Student WHERE Mark>500 GROUP BY Class;`
`+-------+----------+`
`| Class | COUNT(*) |`
`+-------+----------+`
`| Art  |  4 |`
`| Sci  |  2 |`
`+-------+----------+`
`2 rows in set (0.03 sec)`
	Output table shows Class wise number of students having secured more than 500 marks; No student from Com class has secured more than 500 in the table!

Note: If you carefully observe these examples, you will find that GROUP BY is always used in conjunction with some aggregate function(s). A SELECT command with GROUP BY clause has a column name and one or more aggregate functions which are applied on that column and grouping is also done on this column only.

HAVING:

Sometimes we do not want to see the whole output produced by a statement with GROUP BY clause. We want to see the output only for those groups which satisfy some condition. It means we want to put some condition on individual groups (and not on individual records). A condition on groups is applied by HAVING clause.

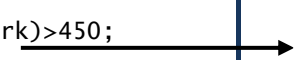
As an example, the following statement would give those Classes, whose students have secured average mark more than 400.

```
mysql> SELECT Class, AVG(Mark) FROM Student
    -> GROUP BY Class HAVING AVG(Mark)>400;
+-------+-----------+
| Class | AVG(Mark) |
+-------+-----------+
| Art   | 538.40000 |
| Sci   | 481.00000 |
+-------+-----------+
2 rows in set (0.00 sec)
```

In the above statement if we try to put the condition using WHERE instead of HAVING, we shall get an error. Another way of remembering this is that whenever a condition involves an aggregate function, then we use HAVING clause in conjunction with GROUP BY clause.

Situations may also arise when we want to put the conditions on individual records as well as on groups. In such situations we use both WHERE (for individual records) and HAVING (for groups) clauses.

```
mysql> SELECT Class, AVG(Mark) FROM Student
    -> WHERE Gender='Female'
    -> GROUP BY Class HAVING AVG(Mark)>450;
+-------+-----------+
| Class | AVG(Mark) |
+-------+-----------+
| Art   | 547.50000 |
| Sci   | 481.00000 |
+-------+-----------+
2 rows in set (0.05 sec)
```



Displaying Data from Multiple Tables

So far we learnt the retrieval of data in different ways from one database table at a time by using MySQL statements. But in practice, very often we may be asked to produce reports out of multiple tables. For example, let's create two tables; 'Subject' and 'Allotment' to study this aspect.

```
mysql> SELECT*FROM Subject;
+--------+-------+-------------------------+
| Sub_Id | Class | Sub_Comb                |
+--------+-------+-------------------------+
| A1     | Art   | Eng,MILO,Pol,Eco,His,Log |
| A2     | Art   | Eng,MILO,Pol,Eco,Soc,Edn |
| A3     | Art   | Eng,AE,Pol,His,Psy,Ant   |
| C1     | Com   | Eng,MILO,Act,BSM,BMS,BNK |
| C2     | Com   | Eng,MILH,Act,BSM,BMS,IT  |
| C3     | Com   | Eng,MILS,Act,BSM,BMS,SBE |
| S1     | Sci   | Eng,MILO,Phy,Che,Mat,Bio |
| S2     | Sci   | Eng,AE,Phy,Che,Mat,IT    |
| S3     | Sci   | Eng,MILS,Phy,Che,CSc,IT  |
+--------+-------+-------------------------+
9 rows in set (0.00 sec)
```

```
mysql> SELECT*FROM Allotment;
+--------+----------+-------+
| Alt_Id | Roll     | SubId |
+--------+----------+-------+
|      1 | IA16-001 | A1    |
|      2 | IA16-005 | A3    |
|      3 | IA16-006 | A2    |
|      4 | IA17-001 | A2    |
|      5 | IA17-002 | A3    |
|      6 | IC17-001 | C3    |
|      7 | IC17-009 | C1    |
|      8 | IC16-005 | C1    |
|      9 | IC16-006 | C2    |
|     10 | IS16-003 | S1    |
|     11 | IS16-005 | S2    |
|     12 | IS16-010 | S3    |
+--------+----------+-------+
12 rows in set (0.00 sec)
```

Cartesian product or Cross Join of tables:

Cartesian product (also called Cross Join) of two tables is a table obtained by pairing up each row of one table with each row of the other table. This way if two tables contain **m** rows and **n** rows respectively, then their Cartesian product will contain (m×**n)** rows. This is illustrated below, where we have combined 'Allotment' & 'Subject' tables, which contains 108 rows. (We can have Cartesian product of more than two tables also)

```
mysql> SELECT Roll,Sub_Comb FROM
              Allotment, Subject;
+----------+-------------------------+
| Roll     | Sub_Comb                |
+----------+-------------------------+
| IA16-001 | Eng,MILO,Pol,Eco,His,Log |
| IA16-001 | Eng,MILO,Pol,Eco,Soc,Edn |
| IA16-001 | Eng,AE,Pol,His,Psy,Ant   |
| IA16-001 | Eng,MILO,Act,BSM,BMS,BNK |
| IA16-001 | Eng,MILH,Act,BSM,BMS,IT  |
```

```
| IA16-001 | Eng,MILS,Act,BSM,BMS,SBE |
| IA16-001 | Eng,MILO,Phy,Che,Mat,Bio |
| IA16-001 | Eng,AE,Phy,Che,Mat,IT    |
| IA16-001 | Eng,MILS,Phy,Che,CSc,IT  |
| IA16-005 | Eng,MILO,Pol,Eco,His,Log |
| IA16-005 | Eng,MILO,Pol,Eco,Soc,Edn |
    ----------------------------
    ----------------------------
| IS16-010 | Eng,MILO,Phy,Che,Mat,Bio |
| IS16-010 | Eng,AE,Phy,Che,Mat,IT    |
| IS16-010 | Eng,MILS,Phy,Che,CSc,IT  |
+----------+--------------------------+
108 rows in set (0.08 sec)
```

Equi- Join of tables:

The complete Cartesian product of two or more tables is, generally, not used directly. Sometimes the complete Cartesian product of two tables may give some confusing information also. For example, the above table shows that the Arts Roll Numbers have been allotted with Commerce and Science subject combinations and vice versa, which is incorrect!

But we can extract meaningful information from the Cartesian product by placing some conditions in the statement. For example, to find out the Subject combinations allotted to each Roll Number, we can enter the following statement:

```
mysql> SELECT Roll,Sub_Comb FROM Allotment,Subject
    -> WHERE SubId = Sub_Id;
+----------+--------------------------+
| Roll     | Sub_Comb                 |
+----------+--------------------------+
| IA16-001 | Eng,MILO,Pol,Eco,His,Log |
| IA16-005 | Eng,AE,Pol,His,Psy,Ant   |
| IA16-006 | Eng,MILO,Pol,Eco,Soc,Edn |
| IA17-001 | Eng,MILO,Pol,Eco,Soc,Edn |
| IA17-002 | Eng,AE,Pol,His,Psy,Ant   |
| IC17-001 | Eng,MILS,Act,BSM,BMS,SBE |
```

```
| IC17-009 | Eng,MILO,Act,BSM,BMS,BNK |
| IC16-005 | Eng,MILO,Act,BSM,BMS,BNK |
| IC16-006 | Eng,MILH,Act,BSM,BMS,IT  |
| IS16-003 | Eng,MILO,Phy,Che,Mat,Bio |
| IS16-005 | Eng,AE,Phy,Che,Mat,IT    |
| IS16-010 | Eng,MILS,Phy,Che,CSc,IT  |
+----------+--------------------------+
12 rows in set (0.09 sec)
```

It always happens that whenever we have to get the data from more than one table, there is some common column based on which the meaningful data is extracted from the tables. We specify table names in the FROM clause of SELECT command. We also give the condition specifying the matching of common column. (When we say common column, it does not mean that the column names have to be the same. It means that the columns should represent the same data with the same data types.) Corresponding to this statement, internally the Cartesian product of the tables is made. Then based on the specified condition the meaningful data is extracted from this Cartesian product and displayed.

Let us try to join three tables 'Student', 'Subject' and 'Allotment' to extract a report showing the Roll Number, Name and Subject combination of each student. We can do this by writing the following statement;

```
SELECT Student.Roll AS Roll_No,Name,Sub_Comb AS
Subject_Combination
FROM Student, Allotment,Subject
WHERE Student.Roll=Allotment.Roll AND SubId=Sub_Id;
```

Look at the above statement, where we have used the field name 'Roll' from two different tables--Student & Allotment. Because the column names are same, we attach their table names to them. This is called as qualifying a column. But this not case for SubId and Sub_Id ; even if both of them store same data; their names are different! So it is to remember that, while

creating a new table, naming of columns (particularly those, which may be used for joining) becomes very important! Above statement extracts the following report;

```
+----------+------------------+-------------------------+
| Roll_No  | Name             | Subject_Combination     |
+----------+------------------+-------------------------+
| IA16-001 | ASHIMA MISHRA    | Eng,MILO,Pol,Eco,His,Log |
| IA16-005 | SARFRAZ AHMAD    | Eng,AE,Pol,His,Psy,Ant   |
| IA16-006 | BISMAY PRADHAN   | Eng,MILO,Pol,Eco,Soc,Edn |
| IA17-001 | Trupti Biswal    | Eng,MILO,Pol,Eco,Soc,Edn |
| IA17-002 | Kiran Behera     | Eng,AE,Pol,His,Psy,Ant   |
| IC17-001 | Nibedita Behera  | Eng,MILS,Act,BSM,BMS,SBE |
| IC17-009 | Dasarathi Kumbhar | Eng,MILO,Act,BSM,BMS,BNK |
| IC16-005 | Clement Samaria  | Eng,MILO,Act,BSM,BMS,BNK |
| IC16-006 | PRIYANKA PATRA   | Eng,MILH,Act,BSM,BMS,IT  |
| IS16-003 | SARAH SMRUTI     | Eng,MILO,Phy,Che,Mat,Bio |
| IS16-005 | AGNAJITA PATNAIK | Eng,AE,Phy,Che,Mat,IT    |
| IS16-010 | SAIMA KHAN QUADRI | Eng,MILS,Phy,Che,CSc,IT  |
+----------+------------------+-------------------------+
12 rows in set (0.28 sec)
```

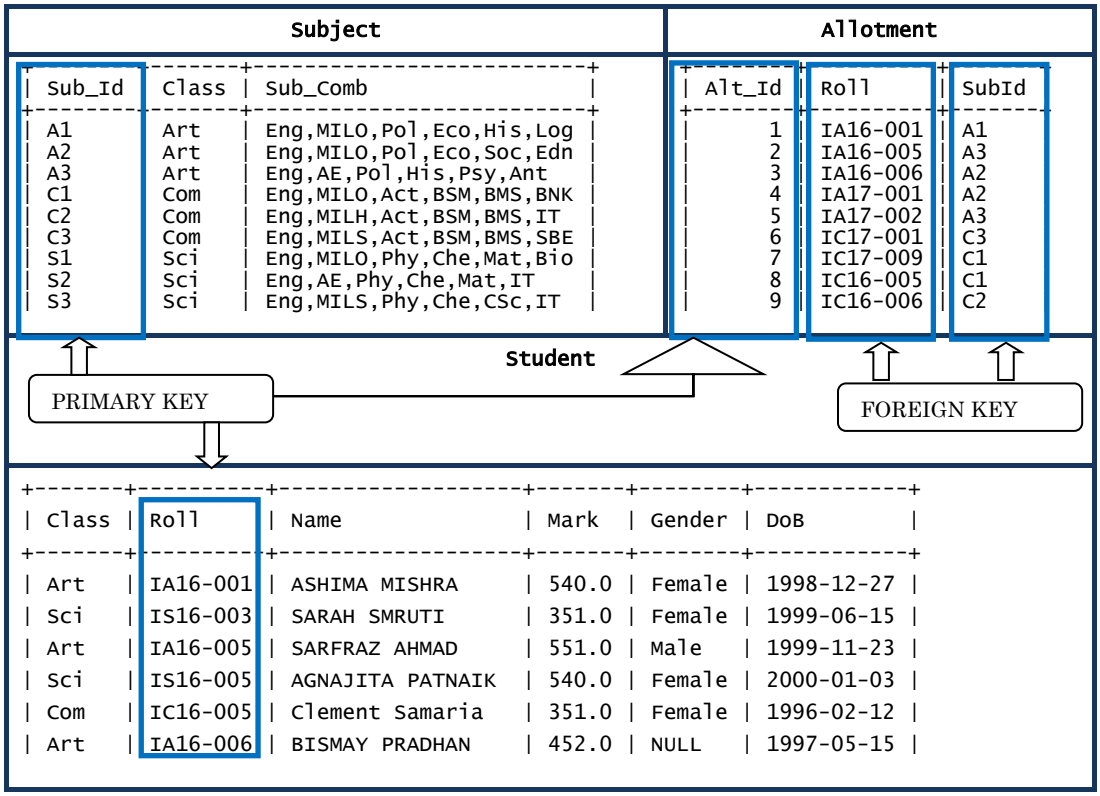
Thus in a join, the data is retrieved from the Cartesian product of two tables by giving a condition of equality of two corresponding columns - one from each table. Generally, this column is the Primary Key of one table. In the other table this column is the foreign key.

Such a join which is obtained by putting a condition of equality on cross join is called an 'equi-join'.

Concept of Foreign key:

We observe in the above discussion that, an equi-join is possible, only when there is a common column between two tables, i.e. *Sub_Id* column in ***Subject*** and *SubId* column in ***Allotment*** table. *Sub_Id* is the Primary Key of ***Subject*** table and in ***Allotment*** table it cannot be the same because we can allot a given subject combination to more than one student. Therefore, *SubId* in the ***Allotment*** table, is qualified to be a **Foreign Key**.

Similarly, *Roll* is the primary key in ***Student*** table whereas it is a Foreign Key in ***Allotment*** table. A foreign key in a table is used to ensure referential integrity and to get Equi-Join of two tables. Following diagram illustrates this concept.



Subject

Sub_Id	Class	Sub_Comb
A1	Art	Eng,MILO,Pol,Eco,His,Log
A2	Art	Eng,MILO,Pol,Eco,Soc,Edn
A3	Art	Eng,AE,Pol,His,Psy,Ant
C1	Com	Eng,MILO,Act,BSM,BMS,BNK
C2	Com	Eng,MILH,Act,BSM,BMS,IT
C3	Com	Eng,MILS,Act,BSM,BMS,SBE
S1	Sci	Eng,MILO,Phy,Che,Mat,Bio
S2	Sci	Eng,AE,Phy,Che,Mat,IT
S3	Sci	Eng,MILS,Phy,Che,CSc,IT

Allotment

Alt_Id	Roll	SubId
1	IA16-001	A1
2	IA16-005	A3
3	IA16-006	A2
4	IA17-001	A2
5	IA17-002	A3
6	IC17-001	C3
7	IC17-009	C1
8	IC16-005	C1
9	IC16-006	C2

Student

Class	Roll	Name	Mark	Gender	DoB
Art	IA16-001	ASHIMA MISHRA	540.0	Female	1998-12-27
Sci	IS16-003	SARAH SMRUTI	351.0	Female	1999-06-15
Art	IA16-005	SARFRAZ AHMAD	551.0	Male	1999-11-23
Sci	IS16-005	AGNAJITA PATNAIK	540.0	Female	2000-01-03
Com	IC16-005	Clement Samaria	351.0	Female	1996-02-12
Art	IA16-006	BISMAY PRADHAN	452.0	NULL	1997-05-15

Referential Integrity: Suppose while entering data in ***Allotment*** table we enter a SubId that does not exist in the ***Subject*** table. It means we have allotted a Subject combination that does not exist! Such human errors should not happen during data entry and can be avoided by explicitly making *SubId* a foreign key of ***Allotment*** table which always references the ***Subject*** table to make sure that a non-existing Subject combination is not entered in the ***Allotment*** table. Similarly, we can also make *Roll* a Foreign key in ***Allotment*** table which always references ***Student*** table to check validity of Roll Numbers. This can be done, but how to do it is beyond the scope of this book.

This property of a relational database which ensures that no entry in a foreign key column of a table can be made unless it matches a primary key value in the corresponding related table is called Referential Integrity.

UNION

Union is an operation of combining the output of two SELECT statements. Union of two SELECT statements can be performed only if their outputs contain same number of columns, having same data types of corresponding columns.

The syntax of this operation is:

```
SELECT <selected column_list> FROM <table1name>
[WHERE <condition>]
UNION [ALL]
SELECT <selected column_list> FROM <table2name>
[WHERE <condition>];
```

#Union does not display any duplicate rows unless ALL is specified with it.

To see the output of this operation, let's create another table ***Employee1*** in 'College' database, having same structure as that of ***Employee*** table, we already have in it. After populating the new table with new data, both the tables are shown below.

```
mysql> SELECT*FROM Employee1;
+---------+------------------+----------+------+
| EmpCode | EmpName          | Pay      | Age  |
+---------+------------------+----------+------+
| EDN012  | Soumyajit Behera | 23550.00 |   28 |
| EDN013  | Sarita Mishra    | 33550.00 |   27 |
| EDN014  | Sukumar Sinha    | 43500.00 |   51 |
| EDN015  | Sankarsan Behera | 42500.00 |   52 |
+---------+------------------+----------+------+
4 rows in set (0.00 sec)
```

```
mysql> SELECT*FROM Employee;
+---------+--------------------+----------+------+
| EmpCode | EmpName            | Pay      | Age  |
+---------+--------------------+----------+------+
| EDNOO2  | Bijayanand Lenka   | 96000.00 |   58 |
| EDNOO3  | Sudhansu Mohanty   | 86065.00 |   55 |
| EDNOO4  | Rama Chandra Behera| 23500.00 |   56 |
| EDNOO5  | Itishree Patnaik   | 12000.00 |   45 |
| EDN006  | Gunum Patnaik      | 23450.00 |   42 |
| EDN007  | Kiranmayee Sahu    | 43400.00 |   39 |
| EDN008  | Sahadev Debata     | 13400.00 |   54 |
| EDN010  | Daitary Sahoo      | 33500.00 |   50 |
```

```
| EDN009  | Sulagna Pandit      | 12500.00 |   36 |
| EDN011  | Prasant K Baral     | 12500.00 |   27 |
+---------+---------------------+----------+------+
10 rows in set (0.00 sec)
```

Now we shall join these two tables by using UNION operation and show the employees' Name, Pay and Age. Further, we have taken the employees from ***Employee*** table, whose Pay is more than 30000 & taken the employees from ***Employee1*** table, having Age less than 30. This filtering is done, by using WHERE clause. The final report is prepared, showing the names in ascending order by the use of ORDER BY clause.

```
mysql> SELECT EmpName, Pay, Age FROM Employee WHERE Pay>30000
    -> UNION
    -> SELECT EmpName, Pay, Age FROM Employee1 WHERE Age<30
    -> ORDER BY EmpName;
+-----------------+----------+------+
| EmpName         | Pay      | Age  |
+-----------------+----------+------+
| Bijayanand Lenka | 96000.00 |   58 |
| Daitary Sahoo    | 33500.00 |   50 |
| Kiranmayee Sahu  | 43400.00 |   39 |
| Sarita Mishra    | 33550.00 |   27 |
| Soumyajit Behera | 23550.00 |   28 |
| Sudhansu Mohanty | 86065.00 |   55 |
+-----------------+----------+------+
6 rows in set (0.00 sec)
```

EXERCISES

MULTIPLE CHOICE QUESTIONS :

1. Which of the following is a logical unit of work that must succeed or fail in its entirety.

   a) Primary key b) Database

   c) Transaction d) none of these

2. When AutoCommit is _____, changes made to database are not committed unless explicitly requested.

   a) Equal to "-" b) on

   c) off d) Equal to "%"

3. When a CREATE TABLE command is issued, a _____occurs on the database.

   a) ROLLBACK b) COMMIT

   c) SAVEPOINT d) ROLLBACK TO SAVEPOINT

4. By default AUTOCOMMIT is _____.

   a) disabled b) enabled

   c) inactive d) none of the above

5. Which of the following statement or command? Completes a transaction?

   a) INSERT INTO b) COMMIT

   c) DELETE d) SELECT

6. If Feroze deposits a cheque of Rs. 1200.00 in his account, which was given to him by Ali, two tasks: decreasing of Rs. 1200.00 from Ali's account and increment of Rs.1200.00 in Feroze's account are done. _____ constitute(s) a transaction.

   a) First task b) Both the tasks

   c) None of the tasks d) Second task.

7. START TRANSACTION statement

   a) Updates the current database.

   b) Rolls back the current transaction.

   c) Commits the current transaction and starts a new transaction.

   d) Starts a new transaction only.

8. ROLLBACK statement

a) Cancels the entire transaction.

b) Deletes the rows added to the table.

c) Commits the current transaction and starts a new transaction

d) Rolls back all the insertions of rows made during the current transaction.

ANSWER THE FOLLOWING QUESTIONS :

1. Define a Transaction.
2. Explain with the help of an example that why should a transaction be executed as a whole or it should be not executed at all.
3. Distinguish between COMMIT and ROLLBACK.
4. Write the purpose of inserting Savepoints in a transaction.
5. What does the ROLLBACK statement do?
6. How do you tell the system that a transaction is beginning?
7. Why do we generally execute a COMMIT statement before beginning a transaction?
8. Name two statements that can be used to end a transaction?
9. Does executing the COMMIT or ROLLBACK statement end the current transaction?
10. What happens to the current transaction if a DDL Statement is executed?

■ ■ ■

CHAPTER - 7

INTRODUCTION TO MySQL

MySQL is an open source relational database management system (RDBMS). It was originally founded and developed in Sweden by David Axmark, Allan Larsson and Michael Widenius, who had worked together since the 1980s.

Characteristics of MySQL:

- MySQL is released under an open-source license so it is customizable & requires no cost or payment for its usage.
- It has superior speed, is easy to use and is reliable.
- It uses a standard form of the well-known ANSI-SQL standards.
- MySQL is a platform-independent application which works on many operating systems like Windows, UNIX, LINUX etc. and has compatibility with many languages including JAVA , C++, PHP, PERL, etc.
- It is an easy to install RDBMS and is capable of handling large data sets.

Since MySQL is released under an open-source license, it does not require any cost or payment for its usage. Anyone can download this software from specific location on Internet. If you want to download, follow the following steps. The steps outlined here are for Windows OS platform.

1. Installation file for MySQL may be downloaded from the website **https://dev.mysql.com.** (Choose appropriate download link as per the operating system).
2. Click on the "Download" button for the Community Server and choose from the list of supported platforms (i.e., operating systems that it will run on; in present case 32-bit or 64-bit Windows).
3. After the installation file has finished downloading, double-click it, which begins the MySQL Setup Wizard.

4. At the welcome dialog box, click the "Next" button. The MySQL Setup Wizard allows us to choose the installation directory on the computer, and whether or not to have optional components installed.
5. In the "Setup Type" dialog box, choose "Typical" from the three options. MySQL will be installed in the default directory, "C:\Program Files\MySQL\MySQL Server.
6. Click the "Next" button. Now it is ready to install MySQL's files.
7. Click the "Install" button.
8. After the Setup is complete, we should configure the new server. At the initial Server Instance Configuration Wizard dialog box, click the "Next" button.
9. Keep selecting the default options provided in subsequent windows. If the configuration does not encounter any errors, then information will be prompted that the configuration file is created, MySQL server is now installed and started, and the security settings applied.

***Note*: In the process of configuration of MySQL, a prompt for password will be displayed - Here you should enter a password and remember this password, as it will be required each time to start MySQL**

Testing MySQL:

Follow the steps to start MySQL

`Start> Programs>MySQL>….>MySQL Command Line Client`

OR

Go to the folder

`C:\Program Files\MySQL\MySQL Server 5.6\bin`

[Assuming C:\ drive as the drive having MySQL] and

Click on the file **`MySQL.EXE`**

MySQL will prompt a message to provide password (it requires the same password which was entered during the installation). The above steps ensure successful installation and configuration of MySQL database server. Next time in the MySQL prompt, you can create and use databases, create tables and execute SQL queries.

Before going to discuss more commands and statements of MySQL, let's revisit the concepts, we have already learnt in the previous class.

- **SQL (Structured Query Language):** It is the language used to manipulate and manage databases and tables within them using an RDBMS.
- **DDL (Data Definition Language):** This is a category of SQL commands which are used to create, destroy, or restructure databases and tables come under this category. Examples of DDL commands are - CREATE, DROP, and ALTER.
  - **CREATE DATABASE -** creates a new database
  - **CREATE TABLE -** creates a new table
  - **ALTER TABLE -** modifies a table
  - **DROP TABLE -** deletes a table
- **DML (Data Manipulation Language):** These categories of SQL commands are used to manipulate data within tables come under this category. Examples of DML commands are - INSERT, UPDATE, and DELETE.
  - **SELECT -** extracts data from a table
  - **UPDATE -** updates data in a table
  - **DELETE -** deletes data from a table
  - **INSERT INTO -** inserts new data into a table
- **TCL (Transaction Control Language):** This is a category of SQL commands which are used to manage transactions in database. These are also used to manage the changes made by DML statements. It allows statements to be grouped together into logical transactions. Examples of TCL commands are - COMMIT, SAVEPOINT, ROLLBACK, and SETTRANSACTION.
- **DCL (Data Control Language):** This is a category of SQL commands. All the commands which are used to control the access to databases and tables fall under this category. Examples of DCL commands are - GRANT, REVOKE.

Different SQL commands studied in the previous class are summarized below:

Sl No	Command, Syntax, Purpose	Category
1	**Command:** CREATE DATABASE **Syntax:** CREATE DATABASE <database name>; **Purpose:** Creates a database with the specified name.	DDL
2	**Command:** CREATE TABLE **Syntax:** CREATE TABLE <table name> (<column name1> <data type1> [,<column name2> <data type2>, ---------- <column name N> <data type N>]); **Purpose:** Creates a table with the specified name.	DDL
3	**Command:** ALTER TABLE **Syntax:** ALTER TABLE <table name> ADD <column name> <data type>; ALTER TABLE <table name> DROP <column name>; ALTER TABLE <table name> MODIFY <column> <new definition>; **Purpose:** Modifies the structure of a table	DDL
4	**Command:** USE **Syntax:** USE <database name>; **Purpose:** Opens the specified database for use.	DML
5	**Command:** SELECT DATABASE() **Syntax:** SELECT DATABASE(); **Purpose:** Shows the name of the current database	DML
6	**Command:** SHOW TABLES **Syntax:** SHOW TABLES; **Purpose:** Shows a list of tables present in the current database.	DML
7	**Command:** INSERT **Syntax:** INSERT INTO <table name> [<column1>, <column2>, ..., <column N>] VALUES (<value1>, <value2>, ... <value N>); **Purpose:** Inserts data into a table	DML

8	**Command:** SELECT **Syntax:** SELECT <* / column name / expression> , [<column name/Expression list>] FROM <table name> [WHERE <condition>] [ORDER BY <column name / expression> [ASC/DESC]]; There are multiple ways to use SELECT. **Purpose:** Retrieves data from a table	DML
9	**Command:** DESCRIBE **Syntax:** DESC[RIBE] <table name>; **Purpose:** Shows the structure of a table.	DML
10	**Command:** UPDATE **Syntax:** UPDATE <table name> SET <column name> = <value> [,<column name> = <value>, …] [WHERE <condition>]; **Purpose:** Updates/Modifies data in a table	DML
11	**Command:** DELETE **Syntax:** DELETE FROM < table name> [Where < condition>]; **Purpose:** Deletes data from a table	DML

Different SQL clauses used with SELECT command are summarized below:

Sl #	Clause	Used for
1	DISTINCT	Used to display distinct values from a column of a table.
2	BETWEEN	Used to define the range of values within which the column values must fall to make a condition true. Range includes both the upper and the lower values.
3	IN	Used to select values that match any value in a list of specified values.
4	LIKE	Used for pattern matching of string data using wildcard characters % and _ .
5	IS NULL / NOT NULL	Used to select rows in which the specified column is NULL (or is NOT NULL)
6	ORDER BY	Used to display the selected rows in ascending or in descending order of the specified column/expression.

We will now revisit the commands and clauses used in MySQL through following examples. Let's create three tables named **Student, Employee** and **Book** to be placed in a Library database.

After starting MySQL, we shall create a database in which all the tables will be stored. For this we shall use the 'CREATE DATABASE' statement as;

```
CREATE DATABASE Library;
```

Now the database 'Library' is created and we have to open it for placing tables. For this we give the statement;

```
USE Library;
```
where the command USE is used.

Before creating a table; the choice of columns, their names & data types have to be planned very carefully. The nature of data to be stored in a column decides what datatypes should be defined. Most common datatypes used in a table are;

Text: CHAR (size) or VARCHAR (size)
Numeric: INT (size) or INTEGER (size)
Date: DATE

After planning, we arrive at the following data types for columns of our tables in the College database. Here the column sizes are based on our assumption. These may be different for different databases.

Planning for the table **Student**:

Column	Datatype	Reason
Roll	CHAR(8)	A standard Roll Number of a student is 'IA16-001' or 'BS16-009' consists of eight characters: First letter stands class (I for intermediate or +2, B for bachelor or +3), second letter stands for stream (Arts/ Commerce/ Science), next two digits for year of admission and last three digits admission serial number, separated by the character '-'.
NameStd	VARCHAR(18)	The name of a student does not contain fixed number of characters; here the maximum limit has been fixed to 18. Whether the length of the name is short or long, the number of memory places reserved for each name would be 18.

AcsnNo	INTEGER(5)	Accession number of a book is an integer in the range 1 to 99999.
IssueDt	DATE	It is the date of issue of the book.
RetnDt	DATE	It is the date on which the book is returned

Planning for the table **Employee:**

Column	Datatype	Reason
EmpCode	CHAR(6)	For example 'BJB099' may be an Employee Code; where the first three letters indicates a college and last three digits gives the employee serial number.
NameEmp	VARCHAR(18)	As described earlier
AcsnNo	INTEGER(5)	
IssueDt	DATE	
RetnDt	DATE	

Planning for the table **Book:**

Column	Datatype	Reason
AcsNo	INTEGER(5)	Described earlier
Title	VARCHAR(20)	
Author	VARCHAR(18)	
Publisher	VARCHAR(18)	
Edition	INTEGER(4)	Year of edition of the book
Price	DECIMAL(6, 2)	The maximum a price of a book should not exceed Rs. 9999.99

To create the table 'Book' we have to write the following code in MySql window;

```
mysql> USE Library;
Database changed
mysql> CREATE TABLE Book
      ->(AcsnNo INTEGER(5),
      ->Title VARCHAR(20),
      -> Author VARCHAR(18),
```

```
-> Publisher VARCHAR(18),
-> Edition INTEGER(4),
-> Price DECIMAL(6,2));
```

Note: *Each column in a table are given unique names. This doesn't mean each column that is named has to be unique within the entire database. It only has to be unique within the table where it exists. Also the column names do not use any spaces. When naming tables and columns be sure to keep it simple with letters and numbers. Spaces and symbols are invalid characters except for underscore(_). Column names like Std*_name, Emp_Name, Book_Id, email *are valid column names.*

Similarly other two tables; 'Student' and 'Employee' can be created. To verify that the tables are created, we give the statement:

```
SHOW TABLES;
```

To further verify that the tables have been created as per the required specifications, we view the structure of each table by giving the statements:

```
DESC Book;
DESC Student;
DESC Employee;
```

```
mysql> DESC Book;
+-----------+-------------+------+-----+---------+---+
| Field     | Type        | Null | Key | Default |
Extra |
+-----------+-------------+------+-----+---------+---+
| AscnNo    | int(5)      | YES  |     | NULL    |
|
| Title     | varchar(20) | YES  |     | NULL    |
|
| Author    | varchar(18) | YES  |     | NULL    |
|
| Publisher | varchar(18) | YES  |     | NULL    |
|
| Edition   | int(4)      | YES  |     | NULL    |
|
| Price     | decimal(6,2) | YES  |     | NULL    |
|
+-----------+-------------+------+-----+---------+---+
6 rows in set (0.17 sec)
```

If the structure of a table is not as per the required specifications, we can modify it by using the ALTER TABLE command. Following are three examples of this:

a) Suppose we decide to categorize the books into categories 'A', 'B' and 'C' based on some criteria. Then a new column Category of type CHAR(1) can be added to the table by the statement:

```
ALTER TABLE Book ADD Cat CHAR(1);
```

The structure would look like the following;

```
mysql> DESC Book;
+-----------+--------------+------+-----+---------+-------+
| Field     | Type         | Null | Key | Default | Extra |
+-----------+--------------+------+-----+---------+-------+
| AscnNo    | int(5)       | YES  |     | NULL    |       |
| Title     | varchar(20)  | YES  |     | NULL    |       |
| Author    | varchar(18)  | YES  |     | NULL    |       |
| Publisher | varchar(18)  | YES  |     | NULL    |       |
| Edition   | int(4)       | YES  |     | NULL    |       |
| Price     | decimal(6,2) | YES  |     | NULL    |       |
| Cat       | char(1)      | YES  |     | NULL    |       |
+-----------+--------------+------+-----+---------+-------+
7 rows in set (0.03 sec)
```

b) Suppose we wish to change the size of column 'Publisher' of 'Book' table from 18 characters to 20 characters, then we can give the statement:

```
ALTER TABLE Books MODIFY Publisher VARCHAR(20);
```

c) Suppose we decide to remove the 'RetnDt' column from the table Employee. We can do so by the statement:

```
ALTER TABLE Employee DROP RetnDt;
```

d) Once the tables are created as per the required specifications, we can populate these tables with the given sample data as follows:

Now we populate the Book table by using the INSERT command as follows;

```
mysql> INSERT INTO Book VALUES
    -> (1001,'TextBook of English','Dr N N Dash','ABC Publ',2015,162,'A'),
    -> (1002,'Geology made Simple','Dr UKTripathy','TBB Odisha',2016,270,'B'),
    -> (1003,'TextBook of IT-II','Dr N C Samal','TBB Odisha',2015,243,'C'),
    -> (1004,'Astronomy is Easy','Dr M Patnaik','XYZ Publ',2016,500,'C');
Query OK, 4 rows affected (0.19 sec)
Records: 4  Duplicates: 0  Warnings: 0

mysql> SELECT*FROM Book;
```

```
+--------+--------------------+---------------+------------+-------+-------+----+
| AscnNo | Title              | Author        | Publisher  |Edition| Price | Cat
|
+--------+--------------------+---------------+------------+-------+-------+----+
|   1001 | TextBook of English | Dr N N Dash   | ABC Publ   | 2015 | 162.00 | A
|
|   1002 | Geology made Simple | Dr UKTripathy | TBB Odisha | 2016 | 270.00 | B
|
|   1003 | TextBook of IT-II   | Dr N C Samal  | TBB Odisha | 2015 | 243.00 | C
|
|   1004 | Astronomy is Easy   | Dr M Patnaik  | XYZ Publ   | 2016 | 500.00 | C
|
+--------+--------------------+---------------+------------+-------+--------+---+
4 rows in set (0.00 sec)
```

Similarly we can populate the 'Student' & 'Employee' tables by using the INSERT command with some issue and return dates. The entered data in to the tables can be verified by using the SELECT statements as shown above for 'Book' table;

```
SELECT * FROM Student;
SELECT * FROM Employee;
```

'*' in the SELECT statement shows all records from a table.

In order to display selective records, we use various clauses with SELECT command; e.g. to check the names (without repetition) of various publishers whose books are present in the library, we enter the statement:

```
SELECT DISTINCT Publisher FROM Book;
```

To check the books of publisher 'TBB Odisha' present in the library, we enter the statement:

```
SELECT * from Books WHERE Publisher = 'TBB Odisha';
```

To display the books list for which the price is between 200 and 300, we enter the statement:

```
SELECT * FROM Book WHERE Price > 200 and Price < 300;
```

OR

```
SELECT * FROM Books WHERE Price BETWEEN 200 and 300;
```

To display the details of books from the publishers 'ABC Publ' 'TBB Odisha', or ' XYZ Publ', we enter the statement:

```
SELECT * from Book
WHERE Publisher = 'ABC Publ'
OR Publisher = 'TBB Odisha'
OR Publisher = 'XYZ Publ';
```

OR

```
SELECT * from Book
WHERE Publisher IN
      ('ABC Publ', 'TBB Odisha', ' XYZ Publ');
```

Note: Here '*' will retrieve all the fields of specified records.

To list the AcsnNo, Title, and Price of all the books whose Title contains the word
'Text Book', we can enter the statement:

```
SELECT AcsnNo, Title, Price from Book
WHERE Title LIKE '%TextBook%';
```

To display the AcsnNo of all the books which have been issued to students but not returned by them, we enter the statement:

```
SELECT AcsnNo FROM Student
WHERE IssueDt IS NOT NULL and RetnDt IS NULL;
```

To Display a List of all the Books in the alphabetical ascending order of Titles, we enter the statement:

```
SELECT * FROM Book ORDER BY Title;
```

To get the same list in descending order of Titles, we enter the statement:

```
SELECT * FROM Book ORDER BY Title DESC;
```

Suppose a student returns a Book with AcsnNo 1245 on 12 August 2016; this information can be recorded in the 'Student' table as follows:

```
UPDATE Student
SET RetnDt = '2016-08-12'
WHERE AcsnNo = 1245;
```

If we want to delete the records of all the books by the Publisher 'ABC Publication' with edition year earlier than 2010, we can enter the statement:

```
DELETE FROM Book
WHERE Publisher = 'ABC Publication' AND Edition <
2010;
```

Suppose for some analysis we decide to keep track of how many times each book is issued. This can be done if there is an extra column 'IssueFreq' in the table 'Book' to keep this count. Every time a book is issued, the corresponding

value in this column is incremented by 1. To add this extra column in the table, we enter the statement:

```
ALTER TABLE Book ADD IssueFreq INTEGER(3);
```

Till now, we discussed the topics already learnt in the previous class. To further our grip on the subject, we shall now describe some important MySQL commands, statements, clauses and functions in this section. To begin with let's put a table named 'Student' in a new database named 'College'. We follow the methods, already described earlier to do this job as follows.

```
mysql> USE College;
Database changed
mysql> SELECT * FROM Student;
+----------+-----------------------+------------+-------+
| Roll     | Name                  | DoB        | Mark  |
+----------+-----------------------+------------+-------+
| IA16-001 | ASHIMA MISHRA         | 1998-12-27 | 540.0 |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 342.0 |
| IS16-003 | SARAH SMRUTI          | 1999-06-15 | 351.0 |
| IA16-005 | SARFRAZ AHMAD         | 1999-11-23 | 551.0 |
| IS16-005 | AGNAJITA PATNAIK      | 2000-01-03 | 554.0 |
| IC16-005 | CLEMENT XESS          | 1996-02-12 | 252.0 |
| IA16-006 | BISMAY PRADHAN        | 1997-05-15 | 452.0 |
| IC16-006 | PRIYANKA PATRA        | 1999-11-14 | 352.0 |
| IS16-010 | SAIMA KHAN QUADRI     | 1999-10-30 | 552.0 |
+----------+-----------------------+------------+-------+
9 rows in set (0.63 sec)
```

Constraints

Many times it is not possible to keep a manual check on the data that is going into the tables using INSERT or UPDATE commands. The data entered may be invalid. MySQL provides some rules, called Constraints, which help us, to some extent, ensure validity of the data. These constraints are:

SlNo	Constraint	Purpose
1	**PRIMARY KEY**	Sets a column or a group of columns as the Primary Key of a table. Therefore, NULLs and Duplicate values in this column are not accepted.

2	**NOT NULL**	Makes sure that NULLs are not accepted in the specified column.
3	**FOREIGN KEY**	Data will be accepted in this column, if same data value exists in a column in another related table. This other related table name and column name are specified while creating the foreign key constraint.
4	**UNIQUE**	Makes sure that duplicate values in the specified column are not accepted.
5	**ENUM**	Defines a set of values as the column domain. So any value in this column will be from the specified values only.
6	**SET**	Defines a set of values as the column domain. Any value in this column will be a seubset of the specied set only.

PRIMARY KEY:

Remember, the primary key of a table is a column or a group of columns that uniquely identifies a row/ record of a table. Therefore no two rows of a table can have the same primary key value. Now suppose that the table 'Students' is created with the following statement:

```
mysql> USE College;

Database changed

mysql> CREATE TABLE Students
      ->(Roll CHAR(8),

      -> Name VARCHAR(18),

      -> DoB DATE,

      -> Mark DECIMAL(4,1));
```

```
mysql> desc Students;
+-------+-------------+------+-----+---------+-------+
| Field | Type        | Null | Key | Default | Extra |
+-------+-------------+------+-----+---------+-------+
| Roll  | char(8)     | YES  |     | NULL    |       |
| Name  | varchar(18) | YES  |     | NULL    |       |
```

```
| DoB   | date          | YES  |     | NULL    |       |
| Mark  | decimal(4,1)  | YES  |     | NULL    |       |
+-------+---------------+------+-----+---------+-------+
```

We know that in this table 'Roll' is the primary key. But, MySQL does not know that! Therefore it is possible to enter duplicate values in this column or to enter NULLs in this column. Both these situations are unacceptable.

To make sure that such data is not accepted by MySQL, we can set Roll as the primary key of the 'Students' table. It can be done by using the PRIMARY KEY clause at the time of table creation as follows:

```
mysql> CREATE TABLE Students
    ->(Roll CHAR(8)PRIMARY KEY,
    -> Name VARCHAR(18),
    -> DoB DATE,
    -> Mark DECIMAL(4,1));
```

```
mysql> DESC Students;
+-------+--------------+------+-----+---------+-------+
| Field | Type         | Null | Key | Default | Extra |
+-------+--------------+------+-----+---------+-------+
| Roll  | char(8)      | NO   | PRI | NULL    |       |
| Name  | varchar(18)  | YES  |     | NULL    |       |
| DoB   | date         | YES  |     | NULL    |       |
| Mark  | decimal(4,1) | YES  |     | NULL    |       |
+-------+--------------+------+-----+---------+-------+
```

Look at the two structures of the table 'Students' displayed above. In the first structure, the field 'Roll' can accept Null value & is not associated with any Key. In the second structure, the 'Roll' field will not accept any Null value & is the Primary Key of the table.

If in a Table; combination of two or more fields has to be combined to be the primary key, then the syntax for creating such table would be like:-

```
CREATE TABLE Result
    (CHSE_Roll CHAR(9),
     Name VARCHAR(36),
     Pass_Yr DATE,
     Mark DECIMAL(4,2),
     PRIMARY KEY(CHSE_Roll, Pass_Yr));
```

In the above example, the combination of CHSE_Roll & Pass_Yr forms the primary key of the table 'Result'.

NOT NULL:

Many times there are some columns of a table in which NULL values should not be accepted. We always want some known valid data values in these columns. For example, we cannot have a Book for which the Category is not known. It means whenever we enter a row in the Book table, corresponding Category cannot be NULL. Similarly while entering records in the Salary table, we must enter the salary amount, it cannot be set NULL. There may be any number of such situations.

While creating a table we have to specify in which columns NULLs should not be accepted as outlined below:

```
CREATE TABLE Book
      (AcsnNo INT(5) PRIMARY KEY, Title VARCHAR(20),
      Author VARCHAR(20), Category CHAR(2) NOT NULL,
      Price DECIMAL(5,2), Publisher VARCHAR(20));
CREATE TABLE Salary
      (Emp_SlNo INT(4), Emp_Dept VARCHAR(10),
      Bill_Date DATE, Sal_Amt DECIMAL(7,2) NOT NULL,
      PRIMARY KEY (Emp_SlNo, Emp_Dept));
```

Now if we try to enter a NULL in the specified column, MySQL will reject the entry and give an error.

If the required constraints have not been specified at the time of creation of a Table or required to be changed or modified later; we use ALTER TABLE command to accomplish it.

ALTER TABLE can be used:

- to add a constraint
- to remove a constraint
- to remove a column from a table
- to modify a table column

Suppose we have created the Book table without specifying any Primary key; later we want to make 'AcsnNo' as the primary key field. For that, we have to enter the following statement:

```
ALTER TABLE Book ADD PRIMARY KEY(AcsnNo);
```

This will set 'AscnNo' as the primary key of the table. However, if this column contains some duplicate values, then the statement will give an error.

It is also possible to change the primary key column(s) of a table. Suppose, in the 'Students' table, instead of 'Roll', we want to set the combination of 'Roll' and 'DoB' as the primary key. For this first we have to DROP the already existing primary key (i.e., Roll) and then add the new primary key (i.e., Roll and DoB). The corresponding statements would be as follows:

The DROP statement removes the primary key status of the field.

```
mysql> ALTER TABLE Students DROP PRIMARY KEY;
mysql> DESC STUDENTS;
+-------+-------------+------+-----+---------+-------+
| Field | Type        | Null | Key | Default | Extra |
+-------+-------------+------+-----+---------+-------+
| Roll  | char(8)     | NO   |     | NULL    |       |
| Name  | varchar(18) | YES  |     | NULL    |       |
| DoB   | date        | YES  |     | NULL    |       |
| Mark  | decimal(4,1)| YES  |     | NULL    |       |
+-------+-------------+------+-----+---------+-------+
```

Now we can add the new primary key by using ADD statement;

```
mysql> ALTER TABLE Students ADD PRIMARY KEY(Roll,DoB);
mysql> DESC STUDENTS;
+-------+-------------+------+-----+---------+-------+
| Field | Type        | Null | Key | Default | Extra |
+-------+-------------+------+-----+---------+-------+
| Roll  | char(8)     | NO   | PRI | NULL    |       |
| Name  | varchar(18) | YES  |     | NULL    |       |
| DoB   | date        | NO   | PRI | NULL    |       |
| Mark  | decimal(4,1)| YES  |     | NULL    |       |
+-------+-------------+------+-----+---------+-------+
```

Remove and Modify columns:

In MySQL, it is not possible to add or drop NOT NULL constraint explicitly after the table Is being created. But it can be done by using MODIFY clause of ALTER TABLE command. As an example, suppose we don't want to accept NULL values in Bill_date column of 'Salary' table, we can use the following statement to do the job:

```
ALTER TABLE Salary MODIFY Bill_date DATE NOT NULL;
```

Later on if we wish to change this status again, we can do so by entering the command:

```
ALTER TABLE bills MODIFY Bill_date DATE NULL;
```

ALTER TABLE can also be used to remove a column from a table. This is done by using DROP clause in ALTER TABLE command. The syntax is as follws:

```
ALTER TABLE <tablename> DROP <columnname>

[, DROP <columnname> [, DROP <columnname> [. . .]]];
```

Following are some self explanatory examples of SQL statemenets to remove columns from tables:

```
ALTER TABLE Salary DROP Bill_date;

ALTER TABLE Student DROP DoB, DROP Mark;
```

Although any column of a table can be removed, MySQL puts the restriction that a primary key column can be removed only if the remaining, primary key columns, if any, do not contain any duplicate entry. This can be understood more clearly with the help of following example:

The Roll and DoB columns of the Students table constitute its primary key. Now if we drop the Roll column from the table, DoB will be the remaining Primary Key column of the table. Therefore, duplicate entries in the DoB column should not be allowed. To ensure this, before removing Roll column from the table, MySQL checks that there are no duplicate entries present in the DoB column of the table. If there are any, then the statement trying to remove Roll column from the table will result in an error and that column will not be removed. If there are no duplicate entries in the DoB column, then Roll column will be removed. Similar will be the case with the Roll column, if we try to remove DoB column. But there won't be any problem if we try to remove both the primary key columns simultaneously with one ALTER TABLE statement as follows:

```
ALTER TABLE Students DROP Roll, DROP DoB;
```

ALTER TABLE can also be used to change the data type of a field in a table. For this the syntax is as follows:

```
ALTER TABLE <tablename> MODIFY <col_name> <new
datatype>

[,MODIFY <col_name> <new datatype>

[,MODIFY <col_name> <new data type> [, . . . ]]];
```

For example, the statement:

`ALTER TABLE Students modify Roll VARCHAR(10), modify Name CHAR(15);`changes the data type of column Roll to VARCHAR(10) and that of Name to CHAR(15).

When we give a statement to change the data type of a column, MySQL executes that statement correctly only if the change in data type does not lead to any data loss. i.e. if the number of characters(including spaces) in any Name field is more than 15, we'll get an error. Similarly the Mark field of this table cannot be changed to INT type, if any of the Mark value is not an integer.

DROP TABLE

Sometimes there is a requirement to remove a table from the database. In such cases we don't want merely to delete the data from the table, but we want to delete the table itself. DROP TABLE command is used for this purpose. The syntax of DROP TABLE command is as follows:

```
DROP TABLE <tablename>;
```

To remove the table 'Customer' from the 'College' database we enter the statement:

```
DROP TABLE Customer;
```

After this statement Customer table is no longer available in the database as shown below.

```
mysql> SHOW TABLES;
+-------------------+
| Tables_in_college |
+-------------------+
| customer          |
| employee          |
| student           |
| students          |
+-------------------+
4 rows in set (0.03 sec)
```

```
mysql> DROP TABLE Customer;
mysql> SHOW TABLES;
+-------------------+
| Tables_in_college |
+-------------------+
| employee          |
| student           |
| students          |
+-------------------+
3 rows in set (0.00 sec)
```

Working with NULL values:

While inserting data in to a Table, it may so happen that we don't know what to enter in certain fields. Do we enter a zero or leave it blank! In a table, we can store these unknowns as NULL. NULL means a value that is

unavailable, unassigned, unknown or inapplicable. NULL is not the same as zero or a space or any other character. . In a table NULL is searched by using IS NULL keyword.

```
SELECT * FROM Student WHERE Name IS NULL;
SELECT * FROM Employee WHERE Pay IS NULL;
```

NOT NULL values in a table can be searched using IS NOT NULL.

```
SELECT * FROM Employee WHERE Salary IS NOT NULL;
```

We saw SQL **SELECT** command along with **WHERE** clause to fetch data from MySQL table, but when we try to give a condition, which compares a field or column value to **NULL**, it does not work properly.

To handle such situation MySQL provides three operators

1. **IS NULL:** operator returns true if column value is NULL.
2. **IS NOT NULL:** operator returns true if column value is not NULL.
3. **<=>:** operator compares values, which (unlike the = operator) is true even for two NULL values.

Conditions involving NULL are special. You cannot use = NULL or != NULL to look for NULL values in columns. Such comparisons always fail because it's impossible to tell whether or not they are true. Even NULL = NULL fails.

To look for columns that are or are not NULL, use IS NULL or IS NOT NULL.

 # If any column value involved in an arithmetic expression is NULL, the result of the arithmetic expression is also NULL.

Sorting the Data in a Table by using ORDER BY clause

The result obtained using SELECT statement is displayed in the order in which the rows were entered in the table using the INSERT INTO statement. The results of the

SELECT statement can be displayed in the ascending or descending values of a single column or multiple columns using ORDER BY clause.

The syntax for using this clause is;

```
SELECT <column name>, [<column name>…]

[WHERE <Condition list>]

ORDER BY <column name>;
```

Note: The syntax enclosed within [ ] are optional.

To learn about different types of sorting, let's insert a new field 'Gender' in the 'Student' table and add some more records (rows) in to it by using INSERT INTO statements as given below.

```
mysql> ALTER TABLE Student ADD Gender CHAR(6);

mysql> INSERT INTO Student VALUES

    ->          ('IA17-001','Trupti          Biswal','2000-05-
27',555,'Female'),

    -> ('IA17-002','Kiran Behera','1999-02-01',594,'Male'),

    ->         ('IC17-001','Nibedita         Behera','2001-05-
15',414,'Female');
```

Now the Student table with these new additions looks like;

```
mysql> SELECT*FROM Student;
+----------+-----------------------+------------+-------+--------+
| Roll     | Name                  | DoB        | Mark  | Gender |
+----------+-----------------------+------------+-------+--------+
| IA16-001 | ASHIMA MISHRA         | 1998-12-27 | 540.0 | NULL   |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 342.0 | NULL   |
| IS16-003 | SARAH SMRUTI          | 1999-06-15 | 351.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD         | 1999-11-23 | 551.0 | NULL   |
| IS16-005 | AGNAJITA PATNAIK      | 2000-01-03 | 554.0 | NULL   |
| IC16-005 | CLEMENT XESS          | 1996-02-12 | 252.0 | NULL   |
| IA16-006 | BISMAY PRADHAN        | 1997-05-15 | 452.0 | NULL   |
| IC16-006 | PRIYANKA PATRA        | 1999-11-14 | 352.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI     | 1999-10-30 | 552.0 | NULL   |
| IA17-001 | Trupti Biswal         | 2000-05-27 | 555.0 | Female |
| IA17-002 | Kiran Behera          | 1999-02-01 | 594.0 | Male   |
| IC17-001 | Nibedita Behera       | 2001-05-15 | 414.0 | Female |
+----------+-----------------------+------------+-------+--------+
12 rows in set (0.03 sec)
```

Let's arrange the students in the above table according to their Mark and then as per their Names. For that purpose we have to use the following SELECT statements;

```
mysql> SELECT*FROM Student ORDER BY Mark;
+----------+-----------------------+------------+-------+--------+
| Roll     | Name                  | DoB        | Mark  | Gender |
+----------+-----------------------+------------+-------+--------+
| IC16-005 | CLEMENT XESS          | 1996-02-12 | 252.0 | NULL   |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 342.0 | NULL   |
| IS16-003 | SARAH SMRUTI          | 1999-06-15 | 351.0 | NULL   |
| IC16-006 | PRIYANKA PATRA        | 1999-11-14 | 352.0 | NULL   |
| IC17-001 | Nibedita Behera       | 2001-05-15 | 414.0 | Female |
| IA16-006 | BISMAY PRADHAN        | 1997-05-15 | 452.0 | NULL   |
| IA16-001 | ASHIMA MISHRA         | 1998-12-27 | 540.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD         | 1999-11-23 | 551.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI     | 1999-10-30 | 552.0 | NULL   |
| IS16-005 | AGNAJITA PATNAIK      | 2000-01-03 | 554.0 | NULL   |
| IA17-001 | Trupti Biswal         | 2000-05-27 | 555.0 | Female |
| IA17-002 | Kiran Behera          | 1999-02-01 | 594.0 | Male   |
+----------+-----------------------+------------+-------+--------+
12 rows in set (0.08 sec)
```

```
mysql> SELECT*FROM Student ORDER BY Name;
+----------+-----------------------+------------+-------+--------+
| Roll     | Name                  | DoB        | Mark  | Gender |
+----------+-----------------------+------------+-------+--------+
| IS16-005 | AGNAJITA PATNAIK      | 2000-01-03 | 554.0 | NULL   |
| IA16-001 | ASHIMA MISHRA         | 1998-12-27 | 540.0 | NULL   |
| IA16-006 | BISMAY PRADHAN        | 1997-05-15 | 452.0 | NULL   |
| IC16-005 | CLEMENT XESS          | 1996-02-12 | 252.0 | NULL   |
| IA17-002 | Kiran Behera          | 1999-02-01 | 594.0 | Male   |
| IC17-001 | Nibedita Behera       | 2001-05-15 | 414.0 | Female |
| IC16-006 | PRIYANKA PATRA        | 1999-11-14 | 352.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI     | 1999-10-30 | 552.0 | NULL   |
| IS16-003 | SARAH SMRUTI          | 1999-06-15 | 351.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD         | 1999-11-23 | 551.0 | NULL   |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 342.0 | NULL   |
| IA17-001 | Trupti Biswal         | 2000-05-27 | 555.0 | Female |
+----------+-----------------------+------------+-------+--------+
12 rows in set (0.00 sec)
```

As shown above, the default sorting order is ascending one; if not specified in the statement, the sorting done in ascending order. However, we can sort in descending order by using DESC key word with ORDER BY clause in a SELECT statement as given below;

```
mysql> SELECT*FROM Student ORDER BY Mark DESC;
+----------+-----------------------+------------+-------+--------+
| Roll     | Name                  | DoB        | Mark  | Gender |
+----------+-----------------------+------------+-------+--------+
| IA17-002 | Kiran Behera          | 1999-02-01 | 594.0 | Male   |
| IA17-001 | Trupti Biswal         | 2000-05-27 | 555.0 | Female |
| IS16-005 | AGNAJITA PATNAIK      | 2000-01-03 | 554.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI     | 1999-10-30 | 552.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD         | 1999-11-23 | 551.0 | NULL   |
| IA16-001 | ASHIMA MISHRA         | 1998-12-27 | 540.0 | NULL   |
| IA16-006 | BISMAY PRADHAN        | 1997-05-15 | 452.0 | NULL   |
| IC17-001 | Nibedita Behera       | 2001-05-15 | 414.0 | Female |
| IC16-006 | PRIYANKA PATRA        | 1999-11-14 | 352.0 | NULL   |
| IS16-003 | SARAH SMRUTI          | 1999-06-15 | 351.0 | NULL   |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 342.0 | NULL   |
| IC16-005 | CLEMENT XESS          | 1996-02-12 | 252.0 | NULL   |
+----------+-----------------------+------------+-------+--------+
12 rows in set (0.00 sec)
```

```
mysql> SELECT*FROM Student ORDER BY Name DESC;
+----------+-----------------------+------------+-------+--------+
| Roll     | Name                  | DoB        | Mark  | Gender |
+----------+-----------------------+------------+-------+--------+
| IA17-001 | Trupti Biswal         | 2000-05-27 | 555.0 | Female |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 342.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD         | 1999-11-23 | 551.0 | NULL   |
| IS16-003 | SARAH SMRUTI          | 1999-06-15 | 351.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI     | 1999-10-30 | 552.0 | NULL   |
| IC16-006 | PRIYANKA PATRA        | 1999-11-14 | 352.0 | NULL   |
| IC17-001 | Nibedita Behera       | 2001-05-15 | 414.0 | Female |
| IA17-002 | Kiran Behera          | 1999-02-01 | 594.0 | Male   |
| IC16-005 | CLEMENT XESS          | 1996-02-12 | 252.0 | NULL   |
| IA16-006 | BISMAY PRADHAN        | 1997-05-15 | 452.0 | NULL   |
| IA16-001 | ASHIMA MISHRA         | 1998-12-27 | 540.0 | NULL   |
| IS16-005 | AGNAJITA PATNAIK      | 2000-01-03 | 554.0 | NULL   |
+----------+-----------------------+------------+-------+--------+
12 rows in set (0.00 sec)
```

Sorting on Column Alias names:

A Column Alias means giving a different name to a column on an ad hoc basis. If a Column alias is defined on a column, we can use it for displaying rows in an ascending or descending order using ORDER BY clause. Column alias is given by using AS key word. In the following example we have given an alias name 'MarkX' to 'Mark' column and sort on 'MarkX'. In the SELECT statement we have retrieved Name field besides the alias field from Student table.

```
mysql> SELECT Name,Mark AS MarkX
    -> FROM Student
    -> ORDER BY MarkX;
+----------------------+-------+
| Name                 | MarkX |
+----------------------+-------+
| CLEMENT XESS         | 252.0 |
| SUDHANSU SEKHAR SAHOO | 342.0 |
| SARAH SMRUTI         | 351.0 |
| PRIYANKA PATRA       | 352.0 |
| Nibedita Behera      | 414.0 |
| BISMAY PRADHAN       | 452.0 |
| ASHIMA MISHRA        | 540.0 |
| SARFRAZ AHMAD        | 551.0 |
| SAIMA KHAN QUADRI    | 552.0 |
| AGNAJITA PATNAIK     | 554.0 |
| Trupti Biswal        | 555.0 |
| Kiran Behera         | 594.0 |
+----------------------+-------+
12 rows in set (0.05 sec)
```

Sorting on multiple columns:

Sometimes it may so happen that, more than one record may contain same value in a particular field; in those cases, we try to sort on another field in addition to the former to get a better report. This is called as 'multiple column sorting'. Go through the following sorting command:

```
mysql> SELECT*FROM Student ORDER BY Mark,Name;
+---------+----------------------+------------+-------+--------+
| Roll    | Name                 | DoB        | Mark  | Gender |
+---------+----------------------+------------+-------+--------+
| IC16-005 | CLEMENT XESS        | 1996-02-12 | 252.0 | NULL   |
| IS16-003 | SARAH SMRUTI        | 1999-06-15 | 351.0 | NULL   |
| IC16-006 | PRIYANKA PATRA      | 1999-11-14 | 352.0 | NULL   |
| IC17-001 | Nibedita Behera     | 2001-05-15 | 414.0 | Female |
| IA16-006 | BISMAY PRADHAN      | 1997-05-15 | 452.0 | NULL   |
| IS16-005 | AGNAJITA PATNAIK    | 2000-01-03 | 540.0 | NULL   |
| IA16-001 | ASHIMA MISHRA       | 1998-12-27 | 540.0 | NULL   |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 1999-07-05 | 540.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD       | 1999-11-23 | 551.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI   | 1999-10-30 | 552.0 | NULL   |
| IA17-001 | Trupti Biswal       | 2000-05-27 | 555.0 | Female |
| IA17-002 | Kiran Behera        | 1999-02-01 | 594.0 | Male   |
+---------+----------------------+------------+-------+--------+
12 rows in set (0.05 sec)
```

We have given sorting order on the basis of 'Mark' first and then on the basis of 'Name'. You can verify the same from the above table. Look at the Mark=540; the corresponding records have been sorted according to their names! (Of course in ascending order, this is the default sorting order). If you

change the order, like 'ORDER BY Name, Mark; and then sorting will be done according to Name and then Mark. The following table shows exactly that; where we have tried to restrict the number of records and columns by using WHERE clause in the SELECT statement.

```
mysql> SELECT Roll,Name,Mark FROM Student WHERE Mark>500
    -> ORDER BY Name,Mark;
+----------+----------------------+-------+
| Roll     | Name                 | Mark  |
+----------+----------------------+-------+
| IS16-005 | AGNAJITA PATNAIK     | 540.0 |
| IA16-001 | ASHIMA MISHRA        | 540.0 |
| IA17-002 | Kiran Behera         | 594.0 |
| IS16-010 | SAIMA KHAN QUADRI    | 552.0 |
| IA16-005 | SARFRAZ AHMAD        | 551.0 |
| IC16-002 | SUDHANSU SEKHAR SAHOO | 540.0 |
| IA17-001 | Trupti Biswal        | 555.0 |
+----------+----------------------+-------+
7 rows in set (0.00 sec)
```

Manipulating Data in a table:

In a data table, it requires many a times to insert new records, delete records (on many grounds), change (update) the values stored in a field, etc. All these operations may be called as manipulation of data. In MySQL, we use the following commands to do the job;

1. INSERT INTO to add new records
2. UPDATE to change the existing data in fields
3. DELETE to remove rows (records) from a table

Inserting Rows

We have already used the INSERT INTO statement to add new rows to a table. It requires three values:

- ✓ the name of the table
- ✓ the names of the columns in the table which have to be populated (optional)
- ✓ Corresponding values for the columns.

Syntax:

```
INSERT INTO <tablename>[<column list>] VALUES
            (<value>, <value>…);
```

Example:

```
mysql> INSERT INTO Student VALUES
       ('IA17-001','Trupti Biswal','2000-05-27',
555,'Female');
Query OK, 1 row affected (0.18 sec)
```

In the above example note that the column names for which data values are populated are not specified. We can omit the column names if values have to be inserted for every column in a table but in such a case the data values for each column must match exactly the default order in which they appear in the table (as shown in the DESCRIBE statement), and a value must be provided for each column.
As mentioned above the column names could have been specified as the following statement shows:

```
INSERT INTO Student(Roll,Name,DoB,Mark,Gender) VALUES
       ('IA17-001','Trupti Biswal','2000-05-27',
555,'Female');
```

Suppose we know the Roll Number and Mark of a student, and we want to insert it in to the table immediately without waiting for other information like Name, Date of Birth, etc. It can be done by using the following statement:

```
INSERT INTO Student (Roll, Mark) VALUES ('IC17-009', 405);
```

Those columns that are not specified in the list will have the default values (if defined) else NULLs will be inserted. The following table verifies the appearance of default values.

```
mysql> INSERT INTO Student (Roll, Mark) VALUES
    -> ('IC17-009',405);
Query OK, 1 row affected (0.17 sec)

mysql> SELECT*FROM Student WHERE Roll='IC17-009';
+----------+------+------+-------+--------+
| Roll     | Name | DoB  | Mark  | Gender |
+----------+------+------+-------+--------+
| IC17-009 | NULL | NULL | 405.0 | NULL   |
+----------+------+------+-------+--------+
1 row in set (0.01 sec)
```

We can also explicitly add NULL value by using the NULL keyword in the VALUES list for those columns that can hold null values.

```
INSERT INTO Student VALUES ('IC17-009', NULL, NULL, 405, NULL);
```

Note: *A NULL value means no value has been entered for that column i.e. the value for that column is not known.*

While inserting data in to a table, we must remember;

- ✓ Text values must be enclosed in quotes.
- ✓ Standard date format is "yyyy-mm-dd".
- ✓ Standard time format is "hh:mm:ss".
- ✓ Quotes are required around the standard date and time formats.

UPDATE statement:

After populating a data table, later it is found that some field values need to be changed; how can we do it? MySQL provides UPDATE command to take care of such situations. The syntax for an UPDATE statement is;

```
UPDATE <table_name>
SET <column name> = <value>, [<column name> = <value>, …]
[WHERE <condition>];
```

The statement can be used to update one or more columns together. 'WHERE' clause helps in updating the field value of a particular record (row) in a table.

a) The following statement sets the Mark of all the rows in Student table to 594.

```
UPDATE Student SET Marks1 = 94;
```

b) The following statement sets the Mark of the row with Roll as 'IC16-002' to 540.

```
UPDATE Student SET Mark = 540 WHERE Roll ='IC16-002';
Query OK, 1 row affected (0.03 sec)
Rows matched: 1 Changed: 1 Warnings: 0
```

c) The following statement corrects the Name and updates Mark of the student bearing Roll Number 'IC16-005' to 'CLEMENT SAMARIA' and 351 respectively in the Student table. This updation is shown below.

```
mysql> SELECT Roll, Name, Mark from Student
-> WHERE Roll='IC16-005';
+----------+--------------+-------+
| Roll     | Name         | Mark  |
+----------+--------------+-------+
| IC16-005 | CLEMENT XESS | 252.0 |
+----------+--------------+-------+
1 row in set (0.00 sec)

mysql> UPDATE Student SET Name='Clement Samaria',
-> Mark=351 WHERE Roll='IC16-005';
Query OK, 1 row affected (0.16 sec)
Rows matched: 1  Changed: 1  Warnings: 0

mysql> SELECT Roll, Name, Mark from Student
-> WHERE Roll='IC16-005';
+----------+-----------------+-------+
| Roll     | Name            | Mark  |
+----------+-----------------+-------+
| IC16-005 | Clement Samaria | 351.0 |
+----------+-----------------+-------+
1 row in set (0.02 sec)
```

DELETE statement:

Sometimes students leave institution or an employee leaves an organization. Their records (rows) have to be deleted from the table. DELETE statement is used to delete rows from a table. It removes the entire row, not the individual column values. Care must be taken while using this statement as accidentally important data may get deleted.

Syntax:

```
mysql> DELETE FROM < tablename> [ Where < condition>];
```

Following statement deletes the information of the student bearing the Roll Number IC16-002 from the Student table.

```
DELETE FROM Student WHERE Roll='IC16-002';
```

After removal of the record of the student having Roll Number IC16-002, the new Student table is shown below. (Compare it with the earlier table to verify the deletion!)

```
mysql> DELETE FROM Student WHERE Roll='IC16-002';
Query OK, 1 row affected (0.17 sec)

mysql> SELECT*FROM Student;
+----------+------------------+------------+-------+--------+
| Roll     | Name             | DoB        | Mark  | Gender |
+----------+------------------+------------+-------+--------+
| IA16-001 | ASHIMA MISHRA    | 1998-12-27 | 540.0 | NULL   |
| IS16-003 | SARAH SMRUTI     | 1999-06-15 | 351.0 | NULL   |
| IA16-005 | SARFRAZ AHMAD    | 1999-11-23 | 551.0 | NULL   |
| IS16-005 | AGNAJITA PATNAIK | 2000-01-03 | 540.0 | NULL   |
| IC16-005 | Clement Samaria  | 1996-02-12 | 351.0 | NULL   |
| IA16-006 | BISMAY PRADHAN   | 1997-05-15 | 452.0 | NULL   |
| IC16-006 | PRIYANKA PATRA   | 1999-11-14 | 352.0 | NULL   |
| IS16-010 | SAIMA KHAN QUADRI| 1999-10-30 | 552.0 | NULL   |
| IA17-001 | Trupti Biswal    | 2000-05-27 | 555.0 | Female |
| IA17-002 | Kiran Behera     | 1999-02-01 | 594.0 | Male   |
| IC17-001 | Nibedita Behera  | 2001-05-15 | 414.0 | Female |
| IC17-009 | NULL             | NULL       | 405.0 | NULL   |
+----------+------------------+------------+-------+--------+
12 rows in set (0.03 sec)
```

```
DELETE FROM Student;
```

The statement given above deletes all the rows from the Student table. Use it very carefully; because further data entry may not be easy!

Restructuring of table:

A Table consists of rows and columns. We can insert new rows by using INSERT command and remove existing rows by DELETE command and modify the field values by UPDATE command. However, to add / remove columns (fields) or changing the data types of a column can be done by using ALTER TABLE statement; a lot of which have already been discussed. Let's have some simple syntaxes of this statement.

1. **ALTER TABLE <table_name> ADD <column_name> [datatype];**
2. **ALTER TABLE <table_name> DROP <column_name> [datatype];**
3. **ALTER TABLE <table> MODIFY <column> <new_definition>;**

The 1st statement adds a new column [with specified data types] to the table.

The 2nd statement removes a column as specified in it.

The 3rd statement modifies the data types of an existing column the table.

Functions in MySQL

In mathematics, a function makes calculation over one or more of its arguments and generates a single definite value. Every function is generally given a name for easy comprehension these are the most powerful tools in any computer language. MySQL also uses these functions, through we can find sum of values stored in a column or convert all characters of a name to lowercase or round off salaries in a column to two decimal places and so on. MySQL supports many functions to manipulate data. We can broadly categorize functions into two types:

1. Single Row functions
2. Multiple Row Functions.

Single row functions operate on a single value to return a single value. They can accept one or more arguments but return only one result per row. When applied on a table, they return a single result for every row of the queried (using SELECT statement) table. They are further categorized into:

i. String functions
ii. Numeric / Mathematical functions
iii. Date and Time functions

Multiple row functions operate on a set of rows to return a single value. Examples include MAX ( ), MIN ( ), SUM ( ), AVG ( ), COUNT ( ), etc. These are also called as Aggregate functions, which are discussed in Unit-3A of this book.

i) String (Character) functions:

String functions operate on character type data. String functions are used to extract, change, format or alter character strings. They return either character or numeric values. The syntax (function_name and their argument) and result of various Character functions of MySQL are described below.

a) **ASCII (*string*):** This function operates over its argument, which is a string (a group of characters) and returns the ASCII value of the left most character of the string. If the sring is empty, it returns 0; if it is NULL, the return value is also NULL.
A string is always enclosed within quotation marks; except NULL.

```
mysql> SELECT ASCII('99');
+-------------+
| ASCII('99') |
+-------------+
|          57 |
+-------------+
1 row in set (0.05 sec)
ASCII value of 9 is 57
```

```
mysql> SELECT ASCII('IT');
+-------------+
| ASCII('IT') |
+-------------+
|          73 |
+-------------+
1 row in set (0.00 sec)
ASCII value of I is 73
```

```
mysql> SELECT ASCII(NULL);
+-------------+
| ASCII(NULL) |
+-------------+
|        NULL |
+-------------+
1 row in set (0.00 sec)
```

```
mysql> SELECT ASCII('');
+-----------+
| ASCII('') |
+-----------+
|         0 |
+-----------+
1 row in set (0.00 sec)
```

b) **CHAR (*N1, N2,…*):** This function interprets each argument *N* as an integer and returns a string consisting of the characters given by the code values of those integers. NULL values are skipped.

```
mysql>  SELECT CHAR(65,83,72,65);
+-------------------+
| CHAR(65,83,72,65) |
+-------------------+
| ASHA              |
+-------------------+
1 row in set (0.00 sec)
```

c) CONCAT (*str1, str2, …*): This function returns the string that results from concatenating the arguments. May have one or more arguments. If all arguments are non-binary strings, the result is a non-binary string. If the arguments include any binary strings, the result is a binary string. A numeric argument is converted to its equivalent binary string form.

d) **CONCAT_WS (*separator, str1, str2,...*):** It stands for Concatenate With Separator and is a special form of CONCAT(). The first argument is the separator for the rest of the arguments. The separator is added between the strings to be concatenated. The separator can be a string, as can the rest of the arguments. If the separator is NULL, the result is NULL.

```
mysql>  SELECT CONCAT('State-','Odisha');
+--------------------------+
| CONCAT('State-','Odisha') |
+--------------------------+
| State-Odisha             |
+--------------------------+
1 row in set (0.03 sec)
```

```
mysql>  SELECT CONCAT_WS('-','dd','mm','yy');
+-------------------------------+
| CONCAT_WS('-','dd','mm','yy') |
+-------------------------------+
| dd-mm-yy                      |
+-------------------------------+
1 row in set (0.03 sec)
```

e) **INSTR (***str, substr***):** This function **r**eturns the position of the first occurrence of substring *substr* in the string *str*. This is the same as the two-argument form of another function LOCATE ( ), except that the order of the arguments is reversed.

```
mysql>  SELECT
INSTR('Mrunalinee','line');
+---------------------------+
| INSTR('Mrunalinee','line') |
+---------------------------+
|                         6 |
+---------------------------+
1 row in set (0.06 sec)
```

```
mysql>  SELECT
INSTR('Information','far');
+---------------------------+
| INSTR('Information','far') |
+---------------------------+
|                         0 |
+---------------------------+
1 row in set (0.00 sec)
```

f) LCASE (*str*) or **LOWER** (*str*): This function converts all the characters of the string to lowercase.

```
mysql>  SELECT
LCASE('INFORMation');
+---------------------+
| LCASE('INFORMation') |
+---------------------+
| information         |
+---------------------+
1 row in set (0.03 sec)
```

```
mysql>  SELECT
LOWER('INFORMation');
+---------------------+
| LOWER('INFORMation') |
+---------------------+
| information         |
+---------------------+
   1  row in set (0.00 sec)
```

g) UCASE (*str*) or **UPPER** (*str*): This function converts all the characters of the string to UPPERCASE.

```
mysql>  SELECT
UCASE('INFORMation');
+----------------------+
| UCASE('INFORMation') |
+----------------------+
| INFORMATION          |
+----------------------+
1 row in set (0.03 sec)
```

```
mysql>  SELECT
UPPER('INFORMation');
+----------------------+
| UPPER('INFORMation') |
+----------------------+
| INFORMATION          |
+----------------------+
   1  row in set (0.00 sec)
```

h) **LENGTH (*str*):** This function returns the length of the string *str*, measured in bytes. For example: `LENGTH ('at least')` returns `8`. Note that, the blank space is also being counted.

i) LTRIM (*str*): This function removes spaces, if any from the left side of the string *str*. For example: `LTRIM ('  least')` returns `least.`

j) RTRIM (*str*): This function removes spaces, if any from the right side of the string *str*. For example: `LTRIM ('least  ')` returns `least.`

k) TRIM (*str*): This function removes both leading and trailing spaces, if any from the string *str*. For example: `TRIM ('  least  ')` returns `least.`

l) SUBSTR (*str, m, n*) or **MID (*str, m, n*):** This function returns the specified number of characters from the middle of the string. There are three arguments. The first argument is the source string. The second argument is the position of first character to be displayed. The third argument is the number of characters to be displayed.

m) REVERSE (*str*): It reverse the string *str*.

```
mysql>  SELECT
REVERSE('Odisha');
+------------------+
| REVERSE('Odisha') |
+------------------+
| ahsidO           |
+------------------+
1 row in set (1.00 sec)
```

n) LEFT (*str, n*): It returns *n* number of characters from the left side of the string *str*.

o) RIGHT (*str, n*): It returns *n* number of characters from the right side of the string *str*.

ii) Numeric / Mathematical functions:

These functions perform operations on numeric values and return numeric values. Some of these functions and their functionalities are outlined below.

a) **POWER(*x,y*) or POW(*x,y*):** This function returns the value of ***x*** raised to the power of ***y***.

```
mysql> SELECT POW(2,4);
+----------+
| POW(2,4) |
+----------+
|       16 |
+----------+
1 row in set (0.05 sec)
```

```
mysql> SELECT POW(2,-4);
+-----------+
| POW(2,-4) |
+-----------+
|    0.0625 |
+-----------+
   1  row in set (0.00 sec)
```

b) **ROUND(*x,d*):** This function rounds the argument ***x*** to ***d*** decimal places.

c) **ROUND(*x*):** This function rounds the argument ***x*** to the nearest integer.

```
mysql> SELECT
ROUND(2.553,1);
+----------------+
| ROUND(2.553,1) |
+----------------+
|            2.6 |
+----------------+
1 row in set (0.06 sec)
```

```
mysql> SELECT ROUND(2.553);
+--------------+
| ROUND(2.553) |
+--------------+
|            3 |
+--------------+
   1  row in set (0.00 sec)
```

d) **TRUNCATE(*x,d*):** This function returns the number ***x*** truncated to ***d*** decimal places. If ***d*** is 0, the result has no decimal point or fractional part. If ***d*** is negative, it causes ***d*** digits left of the decimal point of the value ***x*** to become zero. The examples given below, illustrates the functionality of this function.

Example:

```
mysql> SELECT TRUNCATE (2.456, 1);     Result: 2.4
mysql> SELECT TRUNCATE (5.656, 0);     Result: 5
mysql> SELECT TRUNCATE (456, -2);      Result: 400
```

Note: This function does not round a number, rather chops off digits from a number.

iii) Date & Time functions:

These functions allow us to perform different types of tasks relating to DATE type data; like: to calculate the age of a person, to know the day of any given date, carry out addition or subtraction of days, months & years, etc. We discuss few of such functions and their return values here. It is left to the user of these functions, how he/she wants to utilize them in different applications. The default date format in MySQL is YYYY-MM-DD.

a) CURDATE ( ): It returns current date in YYYY-MM-DD format or YYYYMMDD format depending on whether the function is used in a string or in numeric context.

```
mysql> SELECT CURDATE();
+------------+
| CURDATE()  |
+------------+
| 2017-04-23 |
+------------+
1 row in set (0.08 sec)
```

```
mysql> SELECT CURDATE()+100;
+---------------+
| CURDATE()+100 |
+---------------+
|      20170523 |
+---------------+
1 row in set (0.06 sec)
```

Look at the 2nd cell of the table; the current date behaves as a decimal number ***yyyymmdd***.

b) DATE (*expr*): It extracts the date part from date or datetime expression

Example:
```
mysql> SELECT DATE ('2016-04-05 10:10:07')
        Result: '2016-05-04'
```

c) MONTH (*date*): It returns the month number (in the range of 0 and 12) of its ***date*** argument.

Example:
```
mysql> SELECT MONTH ('2017-04-22')
        Result: 4
mysql> SELECT MONTH ('2017-00-22')
        Result: 0
```

d) DAYOFMONTH (*date*): It returns the day of the month (in the range of 0 and 31) of its ***date*** argument.

Example: **mysql> SELECT DAYOFMONTH ('2017-04-23')**

Result: **23**

e) DAYOFWEEK (*date*): It returns the day of week (in the range of 1 and 7; as 1 for Sunday, 2 for Monday and so on) of its ***date*** argument.

f) DAYOFYEAR (*date*): It returns the day of a year (in the range of 1 and 366) of its ***date*** argument.

```
mysql> SELECT DAYOFWEEK
    ->('2017-04-27');
+-------------------------+
| DAYOFWEEK('2017-04-27') |
+-------------------------+
|                       5 |
+-------------------------+
1 row in set (0.62 sec)
```

```
mysql> SELECT DAYOFYEAR
    ->('2017-04-27');
+-------------------------+
| DAYOFYEAR('2017-04-27') |
+-------------------------+
|                     117 |
+-------------------------+
   1  row in set (0.03 sec)
```

g) DAYNAME (*date*): It returns the day name of its ***date*** argument.

```
mysql> SELECT DAYNAME('1989-07-19');
+-----------------------+
| DAYNAME('1989-07-19') |
+-----------------------+
| Wednesday             |
+-----------------------+
   1  row in set (0.06 sec)
```

h) NOW ( ): It returns current date & time in YYYY-MM-DD HH:MM:SS format, when used as a string. In numeric context it becomes a decimal number of the form ***yyyymmddhhmmss***.

```
mysql> SELECT NOW();
+---------------------+
| NOW()               |
+---------------------+
| 2017-04-23 11:12:14 |
+---------------------+
1 row in set (0.00 sec)
```

```
mysql> SELECT NOW()+100;
+----------------+
| NOW()+100      |
+----------------+
| 20170423111314 |
+----------------+
   1  row in set (0.00 sec)
```

i) SYSDATE ( ): Its return value is exactly similar to the NOW ( ) function.

Note: SYSDATE ( ) returns the time at which the **function executes**; whereas NOW ( ) returns a constant time that indicates the time at which

the **statement began to execute**. To understand the difference between these two similar functions, let's invoke another function **SLEEP (*n*);** which pauses the time for ***n*** number of seconds.

```
mysql> SELECT SYSDATE(),SLEEP(30),SYSDATE();
+---------------------+-----------+---------------------+
| SYSDATE()           | SLEEP(30) | SYSDATE()           |
+---------------------+-----------+---------------------+
| 2017-04-23 11:34:23 |         0 | 2017-04-23 11:34:53 |
+---------------------+-----------+---------------------+
1 row in set (30.22 sec)
mysql> SELECT NOW(),SLEEP(30),NOW();
+---------------------+-----------+---------------------+
| NOW()               | SLEEP(30) | NOW()               |
+---------------------+-----------+---------------------+
| 2017-04-23 11:35:56 |         0 | 2017-04-23 11:35:56 |
+---------------------+-----------+---------------------+
1 row in set (30.02 sec)
```

Above table shows that, SYSDATE ( ) does not pause, where as NOW ( ) does pause for 30second.

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. MySQL is a /an

   a. Relational Database b. Database

   c. RDBMS d. Table

2. USE <databasename> command

   a. is not used in MySQL b. is given before quitting MySQL

   c. opens a table d. opens a database

3. Which of the following is a DML command?

   a. CREATE b. DELETE

   c. ALTER d. DROP

4. A database

   a. Contains tables b. Is a part of a table

   c. Is same as a table d. Removes data from a table

5. GRANT and REVOKE are _____ commands.

   a. DDL b. DML

   c. DCL d. TCL

6. ORDER BY clause is used to sort data

   a. in ascending order b. in descending order

   c. both (a) and (b) d. None of the above

7. A table can have

   a. Only one candidate key b. Only one primary key

   c. Only one alternate key d. No alternate key

8. Wild card characters are used

   a. In LIKE clause b. In ORDER BY clause

   c. In BETWEEN clause d. In IN clause

9. DDL is

   a. a part of SQL
   b. a part of DML
   c. a part of DCL
   d. None of the above

10. LIKE clause is used

    a. For pattern matching
    b. For table matching
    c. For inserting similar data in a table
    d. For deleting data from a table

11. Expand the use of following SQL functions:
    ASCII ( ), CONCAT ( ), INSTR ( ), TRIM ( ), REVERSE ( ), LENGTH ( ), ROUND ( ), DAYNAME ( ), CURDATE ( ), SYSDATE ( ).

LONG ANSWER TYPE QUESTIONS :

1. Explain sorting of data in a table by using ORDER BY clause.
2. Explain the use of UPDATE statements in manipulating data in a table.
3. Distinguish between NOW ( ) and SYSDATE ( ).
4. Write down the syntax of at least four String based functions of MySQL with examples.
5. Write down the syntax of at least three Numeric functions of MySQL with examples.
6. How do you deal with NULL values in a database table?
7. Explain the use of ALTER TABLE statements in restructuring a table.
8. How many types of single row functions are there in MySQL? Explan with examples.

■ ■ ■

UNIT - 4

IT APPLICATIONS

CHAPTER - 8

ELECTORNIC BUSINESS

Introduction:

In the previous class, we have already discussed about few categories of IT applications, such as; e- Governance & e-Learning. In this section we try to learn briefly about Electronic Business, which involves applications dealing with buying and selling of products and services. E-Commerce is a major part of e-Business. We shall delve in to this topic briefly along with the feature, scope and challenges of e-Business in contemporary society. The social impact of information and communication technology will be discussed at the end of this chapter.

Electronic Business or e-Business is the term used to describe the information systems and applications that support and drive business processes, most often using web technologies (intranets & extranets) and related standards (HTTP, HTML, XML, etc.). It is more than just buying and selling products online. It includes the entire online process of developing, marketing, selling, delivering, servicing and paying for products and services; servicing customers; processing payments; managing production control; collaborating with business partners; sharing information; running automated employee services; recruiting; and much more. It uses Internet technology to improve productivity and profitability of a business.

E-Business allows companies to link their internal and external processes more efficiently and effectively, and work more closely with suppliers and partners to better satisfy the needs and expectations of their customers, leading to improvements in overall business performance. While a website is one of the most common implementations, e-Business is much more than just a web presence. There is a vast array of internet technologies

all designed to help businesses work smarter not harder. Think about collaboration tools, mobile and wireless technology, Customer Relationship Management and social media to name a few. Every business can be benefitted in some way or the other by using Internet technology to,

- Improve external product promotion and internal communication through effective e-marketing.
- Increase sales through effective deployment of e-commerce technologies.
- Streamline business processes with integrated back office systems.
- Reduce communication and travel costs using online meeting tools and shared workspaces.
- Maximise lead conversion by using CRM (Customer Relationship Management) systems to track and monitor interactions with prospects and clients.
- Improve supplier relations and productivity through collaborative tools and workspaces.
- Benefit from license-free open source software alternatives to proprietary software.

Features of an E-Business

E-businesses use the Internet to access a virtually unlimited supply of money and clients or buyers. To start a small business, an electronic version is definitely a viable option. Understanding the key features of such a venture reveals the benefits and provides guidance for such an endeavour.

a) **Medium:** One thing that makes an e-business smart is the online niche it occupies. E-business encompasses a broad variety of businesses, but the basic premise is its reliance on the Internet for commerce. The organization uses online media to promote, buy and sell various products and services. Additionally, being solely online allows an e-business to access the entire world market with ease.

b) Website: Although many businesses have websites, which may be optional to them; but for an e-business it is a must. To show its virtual presence to the world and perform transactions, the organization requires a website. While websites are advantageous for any business, an e-business cannot exist without this tool.

c) Location: Another key feature of an e-business is its versatility. While conventional businesses require an office or store, e-businesses can be run without this added expense. In fact, many e-businesses are home-based. This makes it easy for entrepreneurs to work from home at much lower cost than traditional businesses. However, this also means that e-businesses are much more focused, competing only with similar businesses in their niche.

d) Communication: Communication is crucial for any business, but the seamless nature of online communication makes it a key feature in e-business. By placing your business online, you can provide all the necessary contact information to your clients. In turn, the business has instant access to both current and potential clients through electronic-mail, and other social media like 'facebook' or 'whatsapp'.

e) Access: Access is always a useful feature, one that an e-business greatly benefits from. By focusing so heavily online, the organization is always open and selling its products or services. In short, customers do not have to worry about operating hours. Similarly, it is easy for e-business owners to quickly interact with and receive feedback from clients through online questionnaires or surveys. Frequently Asked Questions (FAQ) answers minimize the customer doubts.

f) Virtuality: E-Businesses offer online storefronts, complete with virtual shopping carts and wish lists that can be emailed to friends and family. Besides, e-businesses often have an electronic chat function that is used for technical and customer support. Virtual computer systems allow businesses to remotely access their customers' computers to correct problems or navigate software and hardware specifications. E-business extends from these features to work with internal processes like product development, risk management, production and inventory management, among other things.

Advantages of e-Business:

a) Advantages to Vendors

E-businesses have distinct advantages over brick and mortar stores. First, they can be found with search engines without the use of pricey advertising campaigns. Beyond this, e-business allows vendors to track purchases and preferences of customers, leading to marketing catered to each individual. Advantages for e-commerce, which also extend to e-business, are great monetary savings (because of fewer employees and low overhead) and the ability to reach consumers across the globe.

b) Advantages to Consumers

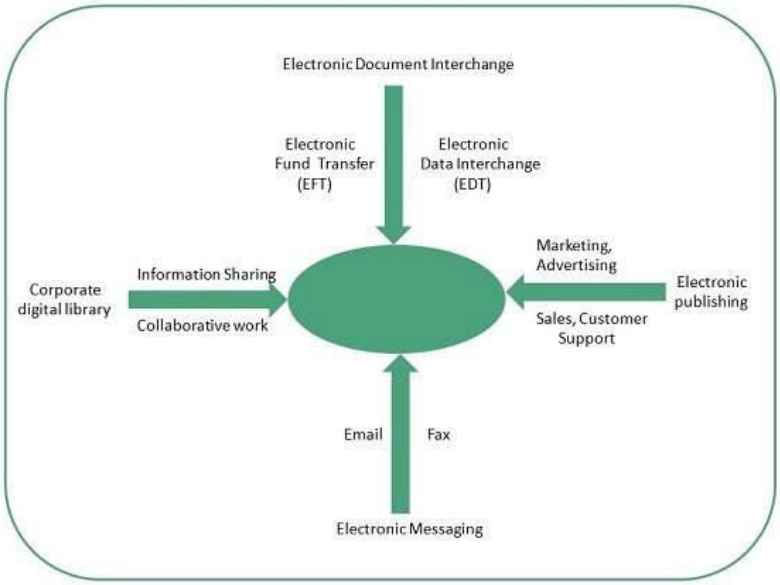
Consumers can access e-commerce and e-businesses at any time of the day or night, from their workplace or in their pajamas. Consumers can search through countless products and services using online databases. Prices are quickly compared online to find the business that offers the best products at the best prices. Consumers are quickly exposed to e-business because it uses more targeted marketing and offers more in-depth education compared to traditional businesses.

In most cases, e-business refers exclusively to Internet businesses, but it may also refer to any business that uses Internet technology to improve productivity and profitability. Business transactions that involve the exchange of money are covered by the term e-commerce.

E-Commerce:

Electronics Commerce is the buying and selling of goods and services on the Internet or other computer network. Any brick and mortar store can become an e-commerce business by adding a virtual storefront with an online catalog. It is a methodology of modern business which addresses the need of business organizations, vendors and customers to reduce cost and improve the quality of goods and services while increasing the speed of delivery. E-commerce refers to paperless exchange of business information using following ways.

- Electronic Data Exchange (EDI)
- Electronic Mail (e-mail)
- Electronic Bulletin Boards
- Electronic Fund Transfer (EFT)
- Other Network-based technologies
- On-line social media platforms



Features of electronic commerce:

a) **Cashless payment:** E-Commerce enables use of credit cards, debit cards, smart cards, electronic fund transfer via net banking, e-wallets other modes of electronics payment.

b) **24×7 service availability:** E-commerce automates business of enterprises and services provided by them to customers are available anytime, anywhere. Here 24×7 refers to 24 hours a day and seven days of a week means any time!

c) **Advertising / marketing:** E-commerce increases the reach of advertising of products and services of businesses. It helps in better marketing management of products / services.

d) **Improved sales:** Using E-Commerce, orders for the products can be generated anytime, anywhere without any human intervention. By this way, dependencies to buy a product reduce at large and sales increases.

e) **Support:** E-Commerce provides various ways to provide pre sales and post sales assistance to provide better services to customers.

Types of e-Commerce:

Electronic-Commerce which deals with selling and buying of goods and services by using on-line platforms may be categorized in terms of Licensing model, Business model and Data exchange model.

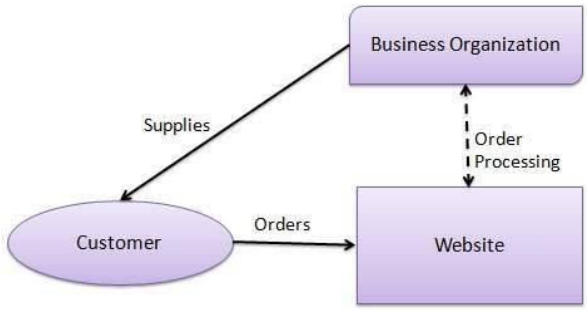
a) Licensing model: Under this model, we can have three types of e-commerce; such as:

1) **On-premise e-Commerce:** This kind of eCommerce software requires an initial one time purchase investment (licensing fees), as a rule. The customer will also have to invest some money in hardware and installation services. But that's not all. Data migration and on-going maintenance, as well as yearly fees for software updates and support, should be taken into account. On-premise e-Commerce platforms are easy to customize, and are secure and reliable in terms of performance. But they demand considerable initial investment, self-maintenance and technical knowledge.

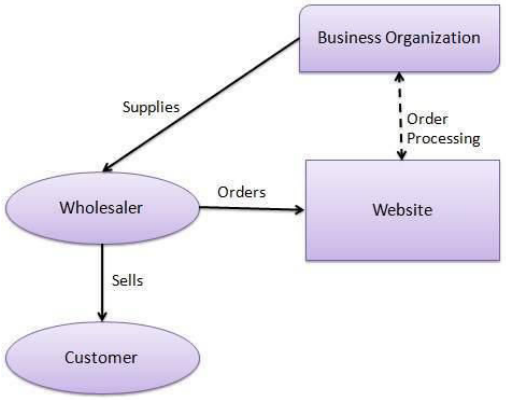
2) **Software as a service (SaaS) e-Commerce:** SaaS is a cloud based delivery model, where each application is hosted and managed in a service provider's datacenter. It is paid for on a subscription basis. Unlike on-premise e-Commerce, SaaS is affordable, hosted and upgraded by an e-Commerce provider and easily scalable. As a result, its integration with back-end systems is limited; it lacks data security and doesn't provide full control over the system.

3) **Open source e-Commerce:** Every developer knows that open source e-Commerce is a free platform allowing users to install, maintain, secure and configure the software on their own servers. To set up an open source platform, you need basic technical expertise in web design and development fields. The source code of software products labeled as open source can be accessed and modified by users. The main advantages of open source e-Commerce are that it's free of charge; there is a wide variety of different add-ons (plug-ins, extensions) available to boost its functionality; plus it provides better flexibility with a customizable source code. The website's performance depends on hosting costs and it has no standard integration with back-end system.

b) Business model: Under this model, we can have following types of e-commerce; such as:

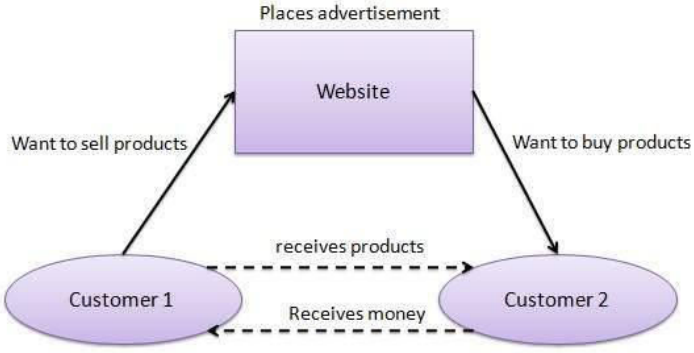


1) Business - to - Business (B2B): Website following B2B business model sells its product to an intermediate buyer who then sells the product to the final customer. As an example, a wholesaler places an order from a company's website and after receiving the consignment, sells the end product to final customer who comes to buy the product at wholesaler's retail outlet.

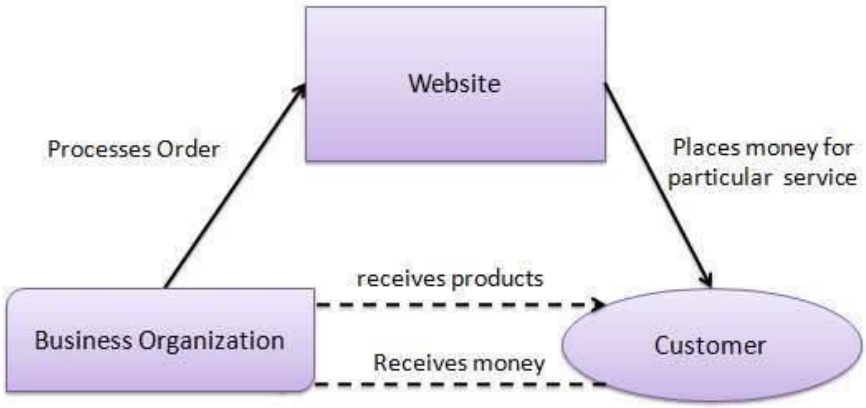


2) **Business - to - Consumer (B2C):** Website following B2C business model sells its product directly to a customer. A customer can view products shown on the website of business organization. The customer can choose a product and order the same. Website will send a notification to the business organization via email and organization will dispatch the product/goods to the customer.

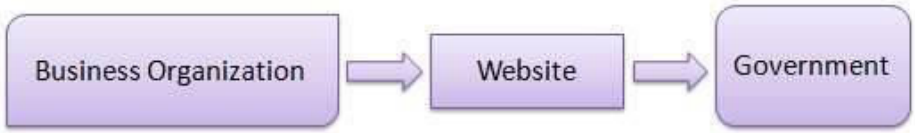
3) **Consumer - to - Consumer (C2C):** Website following C2C business model helps consumer to sell their assets like residential property, cars, motorcycles etc. or rent a room by publishing their information on the website. Website may or may not charge the consumer for its services. Another consumer may opt to buy the product of the first customer by viewing the post/advertisement on the website.



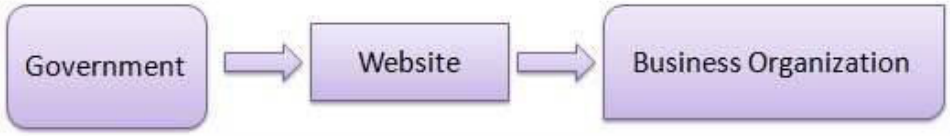
4) **Consumer - to - Business (C2B):** In this model, a consumer approaches website showing multiple business organizations for a particular service. Consumer places an estimate of amount he/she wants to spend for a particular service. For example, comparison of interest rates of personal loan/ car loan provided by various banks via website. Business organization who fulfills the consumer's requirement within specified budget approaches the customer and provides its services.



5) **Business - to - Government (B2G):** B2G model is a variant of B2B model. Such websites are used by government to trade and exchange information with various business organizations. Such websites are accredited by the government and provide a medium to businesses to submit application forms to the government.



6) **Government - to - Business (G2B):** Government uses B2G model website to approach business organizations. Such websites support auctions, tenders and application submission functionalities.



7) **Government - to - Citizen (G2C):** Government uses G2C model website to approach citizen in general. Such websites support auctions of vehicles, machinery or any other material. Such website also provides services like registration for birth, marriage or death certificates. Main objectives of G2C website are to reduce average time for fulfilling people requests for various government services.

c) Data Exchange model: It's a well-known fact that e-Commerce software retrieves information from a dedicated back-end system. For example; an Enterprise Resource Planning (ERP) or Customer Relationship Management (CRM) system is stored in the relevant system's database. The Business logic includes all of the business rules defining the way data is *stored, created, displayed, calculated and recreated inside an ERP or CRM system*. For instance: different product discounts are applied for different customer accounts. Two types of data exchange are taken into account to retrieve the information.

1) **Integrated e-Commerce:** In integrated e-Commerce, a part of the software solution is installed into the back-end system. This

way connection between the business logic and database of a back-end system is configured automatically. Information available in the back-end system is re-used and displayed in the front/back end of the e-Commerce system. An integrated e-Commerce software product doesn't require any investments in the re-creation of a separate database or business logic. It re-uses those of the back-end system instead. Integrated e-Commerce software is often used in B2B and B2C scenarios.

2) **Interfaced e-Commerce:** In interfaced e-Commerce, the software solution is installed on top of the back-end system. So, the connection between the business logic and database of a back-end system is set up manually. Information available in the back-end system is duplicated into the e-Commerce software. Interfaced e-Commerce software products have their own database and business logic that is synchronized constantly through a connection to a certain back-end system. Interfaced e-Commerce is mostly used in a B2C scenario.

Electronic-Commerce facilitates the growth of online business in the fields of;

1. Online marketing
2. Online advertising
3. Online sales
4. Product delivery
5. Product service
6. Online billing
7. Online payments

The e-commerce concept relates to business or financial transactions that facilitate electronic payments of items purchased from online stores and service vendors. E-commerce covers a broad range of business activities, from

digital content used for online consumption to conventional orders of online merchandise. Online banking is another form of e-commerce. E-commerce transactions are conducted between businesses, businesses and consumers, businesses and government, businesses and employees and consumers and businesses.

Online shopping is an e-commerce format, in which real-time sales transactions occur as a consumer purchases an item or service from an online store. This may be explained as an interactive collaboration between a consumer and merchant. In online shopping, there is no intermediary - just the interaction between the online buyer and store/service provider. Here, electronic financial transactions are conducted securely. E-commerce also describes the exchange of data between the financing, billing and payment aspects of electronic business transactions

Benefits of e-Commerce:

Electronic-Commerce being an evolving process does have a lot of benefits or advantages in different spectrum of our society. Here we are limiting our deliberation only in three key areas, like benefit to organizations, customers and contemporary society.

Organizations

- Using E-Commerce, organization can expand their market to national and international markets with minimum capital investment. An organization can easily locate more customers, best suppliers and suitable business partners across the globe.
- E-Commerce helps organization to reduce the cost to create process, distribute, retrieve and manage the paper based information by digitizing the information.
- E-commerce improves the brand image of the company.
- E-commerce helps organization to provide better customer services.
- E-Commerce helps to simplify the business processes and make them faster and efficient.

- E-Commerce reduces paper work a lot.
- E-Commerce increased the productivity of the organization. It supports "pull" type supply management. In "pull" type supply management, a business process starts when a request comes from a customer and it uses just-in-time manufacturing way.

Customers

- Customer can do transactions for the product or enquiry about any product/services provided by a company anytime, anywhere from any location.
- E-Commerce application provides user more options and quicker delivery of products.
- E-Commerce application provides user more options to compare and select the cheaper and better option.
- A customer can put review comments about a product and can see what others are buying or see the review comments of other customers before making a final buy.
- E-Commerce provides option of virtual auctions.
- Readily available information. A customer can see the relevant detailed information within seconds rather than waiting for days or weeks.
- E-Commerce increases competition among the organizations and as result organizations provides substantial discounts to customers.

Society

- Customers need not to travel to shop a product thus less traffic on road and low air pollution.
- E-Commerce helps reducing cost of products so less affluent people can also afford the products.
- E-Commerce has enabled access to services and products to rural areas as well which are otherwise not available to them.

- E-Commerce helps government to deliver public services like health care, education, social services at reduced cost and in improved way

E-Business Websites and their salient features:

E-commerce, in its initial form of commercial transactions, came about in the late 1970s. At this point, businesses began to send commercial documentation electronically to other businesses. The general public was introduced to the Internet in 1994, but it took an additional four years to create the security protocols necessary for a ready Internet connection. By 2000, businesses in America and Western Europe were presenting their goods and services online. This is when e-commerce became online buying and selling, and e-business was born. **Amazon** and **eBay** (customer to customer) were two of the first e-businesses to allow electronic transactions.

Back in India, the e-business is one of the biggest things that have taken the business by storm. It is creating an entire new economy, which has a huge potential and is fundamentally changing the way businesses are done. It has advantages for both buyers as well as sellers and this win-win situation is at the core of its phenomenal rise. Rising incomes and a greater variety of goods and services that can be bought over the internet is making buying online more attractive and convenient for consumers all over the country.

Electronic commerce is presently an essential ingredient of India's trade facilitation policy. Since 1991, after economic reforms explicitly took place in India as a result of opening of the economy with a view to integrate itself with the worldwide economy, the need to facilitate international trade both through policy and procedure reforms has become the foundation stone of India's trade and fiscal policies. Resultantly, last few years have witnessed a technological revolution accompanied by the wide spread use of the Internet, web technologies and their applications. Electronic Business (e-commerce) as part of the information technology revolution became widely used in the world trade in general and Indian economy in particular. Advent of 'Jan-Dhan Accounts, Aadhaar Number and Mobile phones (JAM)' has transformed the Indian Diaspora to take a plunge in to the future digital revolution including e-Business.

To reach the customers and business associates in an effective and fast manner business houses (now a days many small shops like snacks corners and paan shops also) provide their services on the net. These ICT enabled counters are used to get orders and feedbacks from the customers and also for inter-business transactions. This helps the businesses to widen their customer base. Here we give some websites related to e-business in Indian context. Web Portals are continuously being introduced, updated, and withdrawn depending upon various reasons; students need to keep track of contemporary sites at large.

1. Government e Marketplace (https://gem.gov.in):

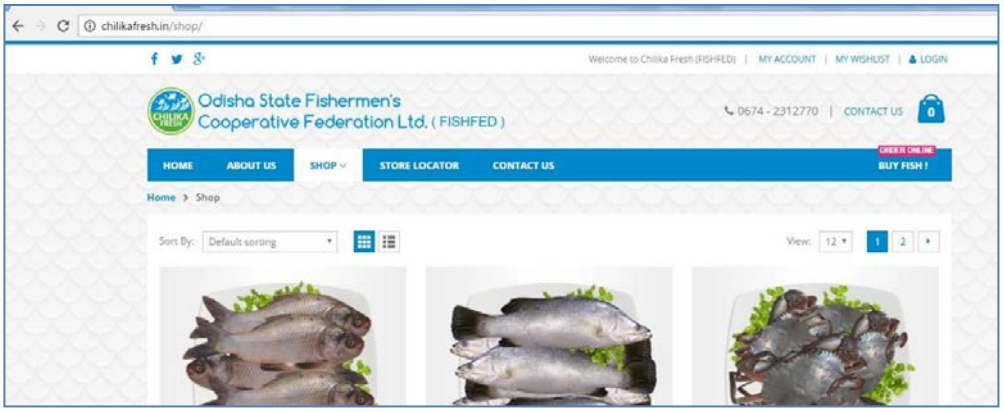
It is a Central Government initiative to bring in the Manufacturers, Wholesalers, Retailers and Customers on to a common on-line platform. The process of searching the product, placing orders, competitive pricing mechanism, product and service delivery, cashless payment, etc; all business related activities have been taken care of very meticulously. Privacy of authentic stake holders have been taken care of through Log in-Password mechanism and on-line fund transfer has been secured up to international standard. This portal simplifies the tedious process of tendering / quotation calling, comparative statement preparation, order placing and payment system and almost eliminates the paper-work. It ensures speed, transparency, competitive pricing, and good quality product delivery. At present this site is opened to government and public sector units to carry out their procurement as the end user; however it is open to all as 'merchants'.

2. Odisha State Co-operative Milk producers' Federation limited (OMFED):

OMFED sells its dairy product to its customers through its shopping portal **http://omfed.in**.

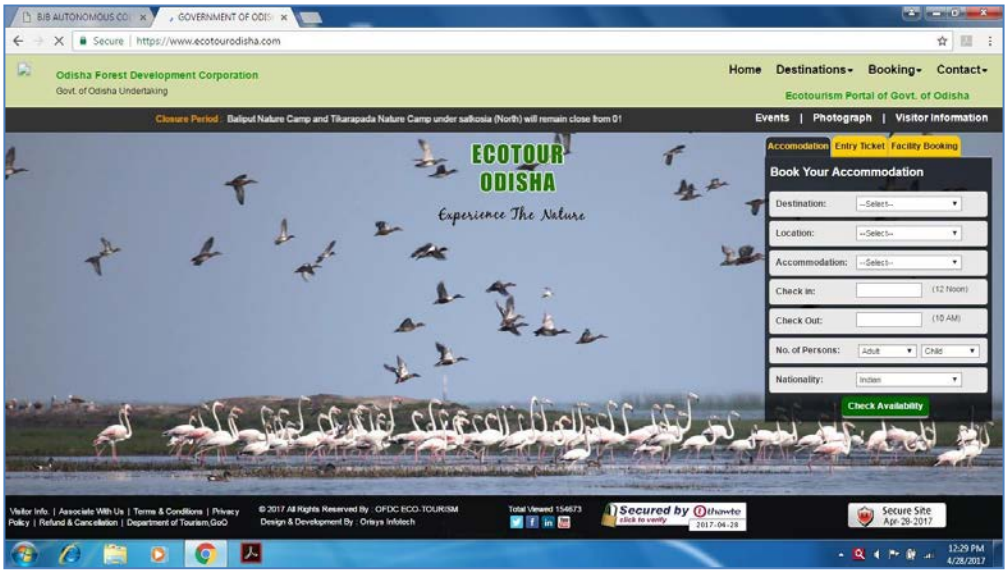
3. Odisha State Fishermen's Co-operative Federation limited (FISHFED):

FISHFED sells its fresh fish and poultry products through its shopping portal **https://chilikafresh.in**.



4. Odisha Forest Development Corporation (OFDC):

Forest department of Government of Odisha promotes eco-tourism at different places in the state through its website **https://www.ecotourodisha.com.** Nature lovers across the globe can book for lodging and boarding at their choicest place on-line in cashless mode.



5. Department of Handlooms, Textiles and Handicrafts, Govt of Odisha:

This Government Deptt promotes and sells Odisha's famous Sambalpuri Sarees, and other textile products through its website **www.boyanika.com.**

Ebay and Amazon are the market leaders in online shopping in the world. However local Shopping deal site are more popular in India. Here is a list of popular websites offering Online shopping in India.

Amazon.in: World leader in e-commerce market recently started operation in India, Now Indians can buy Books, CDS and Electronic at cheaper price from Amzon.in. For limited time they offering free shipping.

Flipkart.com: Founded in 2004 this online platform sells Books, mobile phones & mobile accessories, laptops, computer accessories, cameras, movies, music, televisions, refrigerators, air-conditioners, washing-machines,

clothing, footwear, mp3 players and products from a host of other categories. After takeover of other e-commerce players, flipkart is now the largest player of e-commerce of India.

Snapdeal.com: SnapDeal offers everything from local daily deals on restaurants, spas, travel to online products deals. They offer you best price with free shipping.

Paytm.com: Started with Mobile Recharge and Bill Payment website now Paytm selling everything from Home Decor, Clothing, Laptops to Mobile at killer price. In very short time Paytm has grown very fast and able to become one of the premier Indian Shopping site.

ebay.in: It is the Indian version of the popular online shopping portal eBay.com – world's online marketplace. Ebay has a diverse and passionate community of individuals and small businesses. It offers used and fresh items with a wide network of international shipping.

Myntra.com: Myntra.com is leading online retailer of lifestyle and fashion products. Myntra offers T-shirts, Shoes, watches and more at discounted price.

Shopclues.com: Shopclues is famous for their heavily discounted deals. It is one of the best online stores that offers a wide variety of Cameras, Computer accessories, Mobile phones, Gift items, Jewellery, Cosmetics, toys, clothes, books and bag.

Homeshop18.com: Here you find large range appliances, kitchen, cameras, mobiles, laptops, apparel, and much more, HomeShop18 is a venture of theNetwork18 Group, India's fastest growing media and entertainment Group. Network18 operates India's leading business news television channels – CNBC TV18 and CNBC Awaaz. HomeShop18 has also launched India's first 24 hour Home Shopping TV channel. The website has received the 'Best shopping site" award from PC World Magazine in 2008.

Shopping.indiatimes.com :- Shopping.Indiatimes.com has a wide array of products that range from electronic items to products related to health & beauty, home appliances, fashion, music, movies and games.

Naaptol.com: Perhaps the oldest shopping site, it offers clothing, foot wear, mobiles, tablets and computers, home and kitchen appliances, jewellery and watches, home décor, automobiles, consumer electronics, toys and nursery items, health and beauty products. Sports and fitness goods, gifts & stationeries and many more on its on-line platform.

Social impact of Electronic-Business

Like everything else that is used by common man, ICT (Information and Communication Technology) also has impacted the society. ICT has impacted the society in a much wider way than any other technology. Most of these impacts are positive, though there are some negative impacts also. Electronic-Business is just another application based on this technology.

E-Business, of which E-Commerce is a part, has actually impacted the society at large.

- Strategy and decision making process in businesses has become fast and efficient, owing to intranet facility and video-conferencing.
- Books & study materials are available both in soft (websites) and physical forms (on-line shopping).
- Tourism, Handicraft and other geographically specific objects have found a strong market place through e-business initiatives.
- Utility Bill payments by senior citizens have come down to the click of a mouse.
- Banking services have been reorganized through core-banking and on-line monetary transactions have unburdened the employees of the banking sectors.

- With websites and applications and blogs, there are people behind all of this who are making money by simply going online and doing said tasks.
- One of the negative impacts of the electronic business is the financial transaction fraud, through fraudulent entities like shell companies.
- On-line social media, which help a business to grow, sometimes make the employees addictive, unproductive and lethargic!
- One more negative effect would be the privacy problems that come into the social impact on e-business as people can post whatever they like on whoever they want and the scary part in which people fear is that, literally anyone would be able to see it.
- The other problem faced by managers on the social media is the negative review of their products.

Challenges in e-Business:

The rapidly changing business environment has led several companies to adopt e-commerce. E-Business brings about a lot of changes in the way firms work. It also throws up challenges that they have to meet in order to reap the benefits of e-commerce. The various challenges to businesses include technological challenges, legal and regulatory challenges, behavioral and educational challenges, and other miscellaneous challenges. Various issues pertaining to the implementation of new technology include security issues, choice of Internet payment instrument and its inter-operability, inter-operability of technology and technological application, comparative buying capabilities, richness and depth of information available over the Internet, lack of reliable network infrastructure, lack of e-commerce standards, deployment of public key infrastructure to enable identity authentication, technical integration of new technology with existing applications, and high cost of bandwidth. Challenges associated with legal and regulatory framework include the difficulty in regulating and enforcing standards, due to lack of consistent rules and policies; customs and taxation uncertainties; and government intervention.

Changes in attitudes of consumers result in behavioral challenges to businesses. These challenges include lack of trust of customers and their fear of intrusion of privacy which makes them reluctant to involve in e-transactions. In addition, the rampant frauds taking place over the Internet and lack of awareness of customers about the availability of services poses a challenge to businesses. Miscellaneous challenges such as channel conflict, the problem of attracting and retaining a critical mass of customers, and the need to improve the order fulfillment process, are the other aspects that have become a cause of worry to businesses

Some of these challenges in Indian context are as follows:

1. Return much of the commodities purchased online.

E business in India has many first time buyers. This means that they have not yet made up their mind about what to expect from e-business websites. As a result, buyers sometimes fall prey to hard sell. But by the time the product is actually delivered, they reveal remorse and return the goods. Though consumer remorse is a global problem, but it is all the more prevalent in our country, where much of the growth comes from new buyers. Returns are expensive for e-business companies, as reverse logistics presents unique challenges. This becomes all the more complex in cross border e-business.

2. Cash on delivery is the preferred payment mode.

Low credit card access and low trust in online transactions has led to cash on delivery (CoD) being the preferred payment choice in India. Unlike electronic payments, manual cash collection is painstaking, risky, and expensive.

3. Payment gateways have a high failure rate.

As if the preference for cash on delivery was not bad enough, Indian payment gateways have an unusually high failure rate by global standards. E-business companies using Indian payment gateways are losing out on business, as several customers do not attempt making payment again after a

transaction fails. Introduction of Unified Payment Interface by National Payments Corporation of India has been designed to meet this challenge.

4. Internet penetration is low.

Internet penetration in India is still a small fraction of what is there in a number of western countries. On top of that, the quality of connectivity is poor in several regions. But both these problems are on their last legs. The day is not far when connectivity issues would not feature in a list of challenges to e-business in India.

5. Feature phones still rule the roost.

Though the total number of mobile phone users in India is very high, a significant majority still use feature phones, and not smart phones. As a result, this consumer group is unable to make e-business purchases on the move. Though India is still a couple of years away from the scales tipping in favor of smart phones, the rapid downward spiral in the price of entry-level smart phones is an encouraging indication.

EXERCISE

MULTIPLE CHOICE QUESTIONS :

1. On-line selling and buying of products is categorizes as
   a) e-Commerce b) e-Business
   c) e-Store d) None of these

2. Which of the following process comes under Electronic Document Interchange?
   a) Electronic Fund Transfer b) Electronic Publishing
   c) Electronic Messaging d) Corporate Digital Library

3. Open Source electronic Commerce comes under
   a) Licensing Model b) Business Model
   c) Data Exchange Model d) None of these

4. Business to Business electronic Commerce comes under
   a) Licensing Model b) Business Model
   c) Data Exchange Model d) None of these

5. Interfaced electronic Commerce comes under
   a) Licensing Model b) Business Model
   c) Data Exchange Model d) None of these

6. Which of the following is a Government of India website?
   a) omfed.in b) boyanika.com
   c) chilikafresh.in d) gem.gov.in

7. Which of the following is the largest e-Commerce player of India?
   a. Amazon.in b. Snapdeal.com
   c. e-bay.in d. Flipkart.com

8. Which of the following e-Commerce site does not sell electronics products?
   a. Shopclues.com b. Shopping.indiatimes.com
   c. Myntra.com d. None of these

9. Which of the of the following Public Sector Unit has the largest online-commercial transactions in India?
   a. Bharat Sanchar Nigam Limited
   b. National Thermal Power Corporation
   c. Indian Railways Catering & Tourism Corporation
   d. Bharat Heavy Electronics Limited

10. Which of the following site deals with Customer to Customer e-Commerce?
   a. Amazon. in
   b. Homeshop18.com
   c. e-bay.in
   d. Flipkart.com

LONG ANSWER TYPE QUESTIONS :

1. What is an electronic business; how does it differ from electronic commerce?
2. Define electronic commerce. Describe different types of e-Commerce.
3. Discuss some features of e-Business.
4. Discuss the social impacts of e-Business..
5. What are the challenges of electronic business in Indian context?
6. Discuss at least four public organisation of Odisha doing their transactions on-line.

■ ■ ■

CHAPTER - 9

FRONT-END INTERFACE

Introduction

A user interface is a collection of techniques, styles etc. to interact with something generate by font-end software to provide user friendly as a means of viewing data or collecting data that with user to input. The font end is an application, where user interacts directly with an application for issuing queries.

These queries are used for back-end processing. One of available API is used to interact your application to database for supporting for back-end processing. So back-end indirect support to the font-end. Back-end query are related to database which are generated using front –end interface. The font end is composed of GUI and the input forms. The common example of font-end interface is a client / server model.

The client part is the font-end and the server part is the back-end. Where client sends a request having some input data / queries to the server. Server handles this request involving database as back-end processing and responds to the user using font-end interface. The goal of user interface is to make the user interaction simple and efficient. Font-end interface is mainly divided into two parts:-

1. Command line Interface **(CLI)**
2. Graphical User Interface**.(GUI)**

1. Command Line Interface[CLI].

It is a type of human interface (i.e. a way for human to interact with computers) that relies solely on textual input and output. That is the entire display screen on the current active potion of it, show only characters (and no image) and input is usually performed entirely with a keyboard.

The CLI gets its name from the fact that it is an interface, which contains command lines. A command line is a space on the display screen in which commands (i.e. instructions telling a computer to do somethings) are typed by the user. e.g. the most familiar example of a CLI used by many people is **MS-DOS**.

Advantages

- ✶ Easy to integrate with scripting and other programmatic interfaces.
- ✶ CLI offers over access through GUI is the ability to execute task quickly.
- ✶ A CLI does not require windows to run.
- ✶ If the user knowns the correct commands then this type of interfaces can be much faster than any other type of interface.

Disadvantages

- ✶ CLI are not user friendly because they require the user to remember a lots of command.
- ✶ The user has no other way to perform a specified task than typing in the right command and parameters.
- ✶ Commands have to be typed precisely. If there is a spelling error then command will be fail.

2. Graphical User Interface (GUI)

A Graphical User Interface (GUI) is a way for the humans to interact with computers (human computer interface). A GUI application is created with the help of components. These components are considered as objects which have some properties, behaviour and identities.

While interacting with a GUI, user performs certain actions on objects to perform specific task. GUI stands in sharp contrast to Command Line Interface (CLI), which uses only text and is accessed only by a keyboard.

e.g. MS-Windows and LINUX. Commands in GUI are provided by using mouse, touchpad. First move a pointer on the screen, the icon, menu item or window of interest in order to select that object.

Advantages of GUI

- ✶ It makes computer operation easier to learn and use. E.g. much easier for a new user to move a file from one directory to another by dragging its icons with mouse.
- ✶ GUI allows user to take full advantage of the powerful multi-tasking (the ability for multiple programs or multiple instances of single program to run simultaneously) capabilities of modern operating systems, by allowing such multiple programs to be displayed simultaneously.
- ✶ It helps the user to operate and understand easily as user friendly and speeds up the user's work. User remembers his work also.
- ✶ The most interesting areas of exploration is GUI that provide the user with the illusion of navigating through a three-dimensional space.
- ✶ The good GUI helps us in providing a proper visual feedback. It also helps us by providing a proper guidance.
- ✶ A good GGI make the front-end for the user very simple to use ";than uncluttered look.

Dis advantages of GUI

Graphical User Interface need large amount of memory and fast processors to display the images and manipulate them interactively.

Contents of the Font-end.

The front-end interface has various graphical controls in GUI. These graphical controls are also called **graphical objects**. An object is a logical entity that an application displays or manipulates. These graphical objects have properties that can be changed and by changing these properties the user views changes.

The front-end interface considers that all the contents should work in efficient and user friendly manner. In GUI based Java (Swing API) applications, we use components according to their properties.

Content of a front-end mainly considers what all user-interface objects should be arranged on the interface so that interface works efficiently in user-friendly manner. As you develop GUI applications based on Java Swing API, while designing front-end, you should consider swing components, their types and utility.

Types of Swing contents

The Swing controls or components can be broadly categorised into following two categories:

1. Swing container
2. Swing components

1. Swing container

A container is a special type of component that can hold other components. Some Swing Containers are ***JPanel, JFrame, JApplet, JWindow, JDialog and JlnternalFrame***. The components contained in a container are called child components. A container and all of its child components can be moved, hidden , shown, etc. in a single operation e.g., if you move a container then its child components also move with it ; if you hide a container then all of its child controls also get hidden, and so on. Containers, themselves, are of two types

a) Top-level containers, can be displayed directly on a desktop.
b) Non-top-level containers, can be displayed within the context of another top level container. These can be general-purpose or special-purpose containers.

Every GUI application must have at least one top-level container, and mostly it is JFrame. A container is also called parent container.

Steps to create a]Frame container:

Step-1 : In the Projects window, right click Project Name and choose New→ Other.

Step-2 : In the New File dialog box, choose the swing GUI Forms category and the Click on JFrame Form file type.

Step-3 : Enter the desired name for the class name.

Step-4 : Enter a name for the package.

Step-5 : Click Finish.

2. Swing components

Swing was developed to provide a more sophisticated set of GUI components than the earlier Abstract Window Toolkit (AWT). In addition to familiar components such as buttons, 1eckboxes, labels, etc. Swing provides several advanced components such as tabbed panel, scroll panes, trees, tables and lists.

Swing components are written entirely in Java and therefore are platform independent.The term "lightweight" is used to describe an element. Swing toolkit has a wide range of components. Such as ***JButton, JList, JCheckBox, JComboBox, JTextArea, JTable, Jlable***etc .

Some commonly used controls used on the front-ends developed in Java Swing API

1. ***JFrame*** provides the basic attributes and behaviours of a window. A frame isdisplayed as a separate window with its own title bar.
2. **JLabel** allows un-editable text (i.e., that users cannot change) or icons to be displayed.
3. **JTextfield**allows users input, can also be used to display text. As it can be edited, you can also call it edit field.

4. **JButton**provides button capabilities. An Action Event is generated when button is pushed.
5. **JCheckBox** provides check box. Checkboxes are used to allow users select multiple choices, e.g., a student can select 5 subjects out of 17 subject-choices. A check box shows a X in box in front of it when selected.
6. **JList**is a list of items from which a selection can be made. From a list, multiple elements can be selected.
7. **JComboBox**provides a drop-down list of items from which a selection can be made or new items can be added. It is a combination of text field and a list.
8. **JPanel** is a supporting container that cannot be displayed on its own but must be added to another container. Panels can be added to the content pane of a frame. They help to organize the components in a GUI.
9. **JRadioButton**provides radio buttons. Radio buttons are option buttons that can be turned on or off. The radio buttons provide mutually exclusive options.

Features of front-end

The features of front-end can be divided into two categories described below:Include all types of widgets, such as dialog boxes and other controls to enhance user-friendliness of the application. The highly effective front-ends are generally designed and share common characteristics. We are discussing here:

Display Features

a) Conventional use of icon To make an application effective, it is necessary to use of icon so that user can easily recognise their function. There are so many reserved icon for representing their functionality.

b) Rare use of audible feedback Studies have shown that after frequent usage, the users become either ignorant of audible feedback or get

irritated. Thus, an effective front-end interface should avoid use of audible. It should be included at places where it can not be avoided.

c) Use of conventionally reserved words There are so many reserved words, those are used to develop an effective front-end interface like New is used to take new document. There are some reserved words given here Ok, Cancel, Save, Close, Exit, Help, etc.

d) Use of controls In front-end interface, controls are the visible elements, which are used to interact with the application. These controls are used for specific purpose. An effective front-end try to keep the basic behaviour and placement of these controls consistent throughout the application.Some of commonly used controls are given here CheckBox, RadioButton, ListBox, Table, TextField, TextArea, etc.

e) Use of visual feedback An effective front-end interface provides a visual feedback time to time. A visual feedback must be given if any task is taking time to be completed. e.g. when we copy a file into hard disk, a dialog box appears showing estimated time to be completed and with a progress bar.

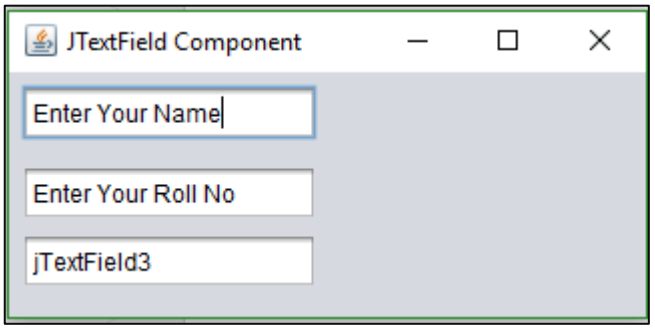
Functionality Features

a) Provides keyboard support an effective front-end provides keyboard support that user can easily select or work with menu items and controls while working. This feature helps to users who prefer to work with keyboard.
b) Provides validation feature An effective front-end provides validation features for performing a task in effective manner. This feature can be applied to a text field to check that value for it can not be blank or for it formatting.
c) Security feature Security feature is used to authenticate user log-in by providing a proper log-in screen that allows a limited number of log-in trials.

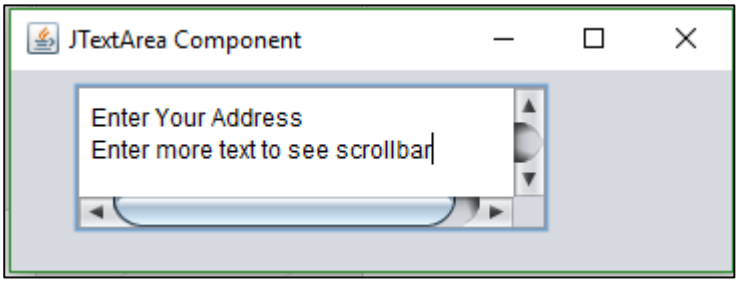
Identifying Validation & displays (Text Box, Radio Button, Check Box, list Box etc..)

To create a front-end various components, like those studied in Java GUI application development, are used. Some of the most commonly used components are discussed below.

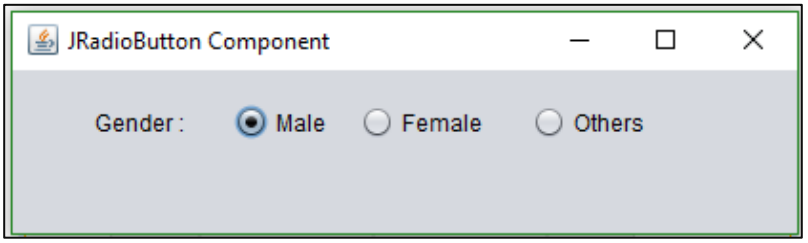
Text Field: Text Field is used to get small textual information like Name, Roll No, email address, quantity, etc. Disabled / Uneditable Text Fields are also used to display such information.



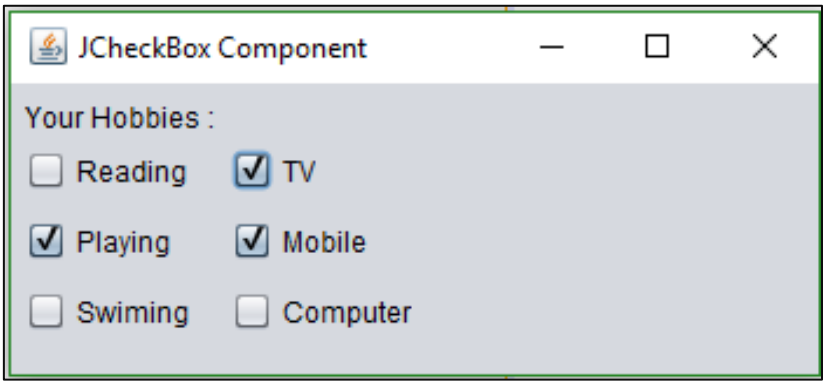
Text Area: Text Area is used to get long textual information which may span multiple lines of text. E.g. to get Address, Complaint, Suggestion etc. Disabled / Uneditable Text Areas are also used to display such information.



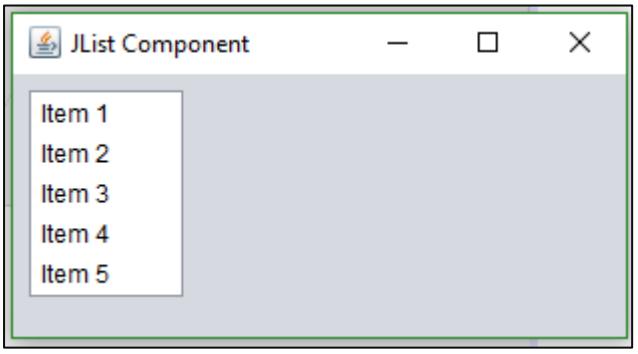
Radio Button: Radio buttons are used to get an option out of several mutually exclusive (out of which only one can be selected) options. Examples of such options are Gender (Male or Female or Other), Type of Credit Card (Master or Visa or Other), Type of internet connection (Dial Up or Braodband), etc.



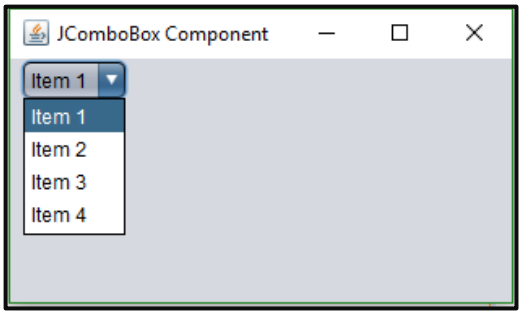
Checkbox: Check boxes are used to get one or more options out of several given options which are not mutually exclusive. These are the cases where multiple options are given to the user and the user can select zero or more out of the given options. Examples of such options are Hobbies (a user may have zero or more hobbies), Magazines to subscribe for (a user may subscribe to zero or more of the given magazines) etc.



List: A list is used to get one or more options out of several given options which may or may not be mutually exclusive. This may seem to be the case where Check Boxes are to be used, but the difference is in the number of options available. If the number of options is small, then Check Boxes can be used. In case of large number of options, using Check Boxes may take up a lot of space on the form and it may also be inconvenient for the user to select the desired options. In such cases Lists are preferred over checkboxes. Examples of such cases are: To select cities out of a given list of cities, to select magazines out of a given list of magazines, etc.



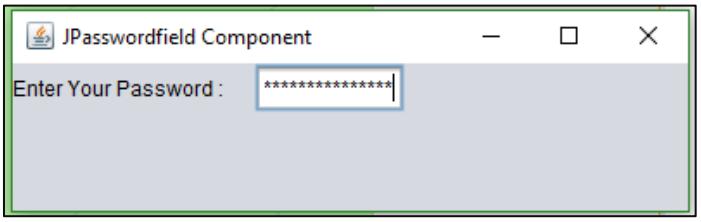
Combo Box: A Combo Box is used to get an option out of several given options which are mutually exclusive. This may seem to be the case where Radio Buttons are to be used, but the difference is in the number of options available. If the number of options is small, then Radio Buttons can be used. In case of large number of options, using Radio Buttons may take up a lot of space on the form and it may also be inconvenient for the user to select the desired option. In such cases Combo Boxes are preferred over radio buttons. Examples of such cases are: To select a city out of a given list of cities, to select a train out of a given list of trains, etc.



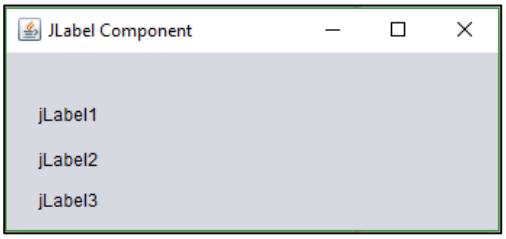
When the options are mutually exclusive, then a List can also be used instead of a Combo Box. It all depends on the space available on the form (a Combo Box consumes less space as compared to a List) and the look of the form (which the form designer has to decide).

Password Field: A Password Field is used to get some secret textual information like

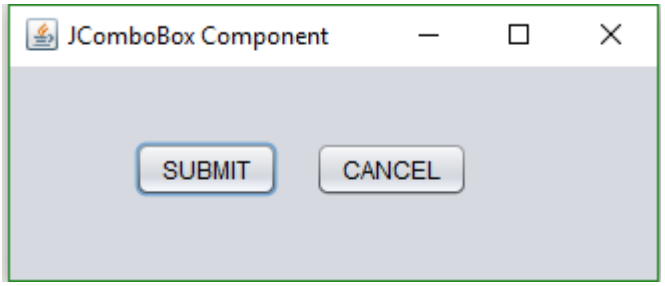
Password, CVV number of a credit card etc.



Label: Label component is very simple components for displaying the text and images. It displays uneditable information.



Button: Button component generally represents a button and when it clicked by user, carries out a particular action.



Front-end interface is the face of any application. In most of the cases, the front-end decides whether the application will be easily accepted or not. If the front-end is convenient and unambiguous for the user, then the user will like to use it and hence the application will be given positive reviews. If the front-end interface is inconvenient for the user, then the user will not like to use the application. Therefore, front-end of an application must be user-friendly.

Front-end Database Connectivity

Introduction

Front -end and database connectivity means the interaction between the front-end and back-end. The database connectivity, which is implemented in a Java application, is known as **Java Database Connectivity (JDBC)**. JDBC is a technology from Oracle Corporation. This technology is an API for the Java programming language that defines how a client may access a database.

Database Connectivity

It refers to a programming interface that lets a front-end access a database, on a back-end via some means. You only require JD BC drivers to

develop a JDBC application which allow you to connect your application to database.

Database Connectivity in Java

Database connectivity in Java can be done using one of the following available drivers.

Type 1	JDBC-ODBC Bridge.
Type 2	Native API Protocol.
Type 3	Network Protocol APL
Type 4	Thin Driver (Pure Java Driver).

Requirement and Benefits

The requirement and benefits of database connectivity using DBMS are as follows:

(a) Controlling Redundancy

The appearance of the same data in more than one table or field causes some distortion and anomalies in the result. Secondary storage space is wasted when the same data is stored repeatedly. Therefore, database is very useful in controlling redundancy, which is achieved by normalisation means dividing one table into its subtable.

(b) Restricting Unauthorised Access

The database helps us to restrict the unauthorised access of database from any user who does not have the privilege to access it.

(c) Providing Persistent Storage for Program Object

The database is used to provide persistent storage for program objects and data structure. This is also one of the reason for object oriented database system.

(d) Providing Storage Structures and SearchTechniques for Efficient Query Processing

Database systems must provide capabilities for efficiently executing the queries. The DBMS provides a specialised data structures and search techniques to speed up disk search.

The query processing and optimisation module of the DBMS are responsible for choosing an efficient query execution plan for each query, which is based on storage structure.

(e) Providing Backup and Recovery

The database is also responsible for providing the backup and recovery of the data to the users, from the hardware or software failures. The backup and recovery sub-system of DBMS is responsible for recovery.

(f) Providing Multiple user Interfaces

DBMS provides a variety of user interfaces. As,

(a) Query language for casual users.

(b) Programming language interface for application programmers.

(c) Forms and command codes for parametric users. (Users, who perform the same command repeatedly).

(g) Flexibility

The database should also be flexible, so that if it is necessary to change the structure of the database we can change as per the requirement.

Limitation of Database connectivity

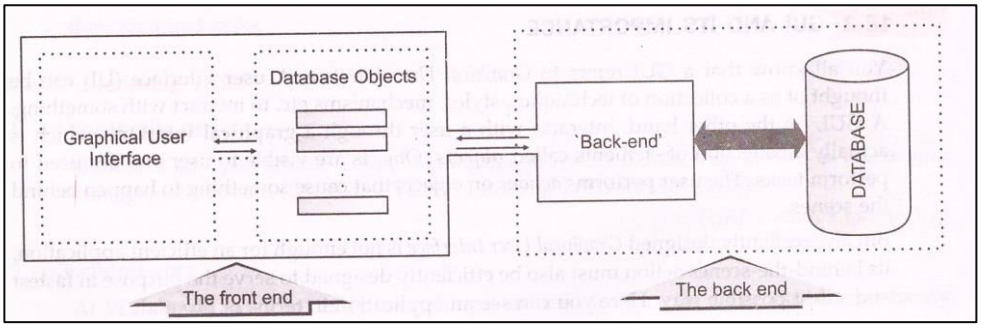
- ✶ The database systems are complex, difficult and time consuming to design.
- ✶ If database gets damaged, it affects virtually all application programs.
- ✶ Initial training is required for all programmers and users.
- ✶ If data turncation occurs during a write, a SQL data truncation exception is thrown.

Back-end Database

Introduction

A back-end database is a database, which a user can access indirectly through an external application via front-end services; usually it provides required resource to the user. In one line, we can explain the back-end database as an external database accessed by users through an external application.

The back-end, sometimes also called as a database server, performs the task such as data analysis, data manipulation, data storage, archiving and other non-user specific tasks. The role of back-end database is to store data and manipulate it through front-end by using an application. e.g. Oracle, Microsoft SQL Server, MySQL, IBM Lotus Approach, Sybase Adaptive Server IQ.



Small Database System

The term back-end database is most widely used among developers using small database programming systems, which can contain the end user application programming within the database as a single item. The developer must decide whether to include the application programming with the data in a single database or whether to separate them into two database files, according to the client/server model. For simple database applications, it is common for all programming to be stored with the data.

This result in a single files and is easier to develop at the expense of scalability and concurrency.

Enterprise Database System

Enterprise database system required enterprises to evaluate their database management strategies and enable users to manage relentless data growth. The main goal of enterprise database system is to assure that data once entered is clear and safe.

Enterprise database management ensures data quality, performance and security, which is equitable to both users internal and external. Enterprise database system provides core features of database, which are atomicity, isolation, durability and consistency.

Purpose of Database System

There are main purposes of database system:

(a) Organise data

(b) Store data

(c) Retrieve information in a proper manner, if possible

(d) Isolation problem is resolved.

Exploring the requirement of table & its essential attributes

In order to decide what all tables should be there in a database and what all attributes should be there in the tables, many different techniques are available that can be used such as

- ✶ Entity Relationship Model
- ✶ Normalization
- ✶ UML - Unified Modelling Language.

Coverage of all these techniques here is beyond the scope of the book, hence we shall explore the requirement of tables and its essential attributes through entity-relationship model only.

ENTITY RELATIONSHIP MODEL

The Entity-Relationship (E-R) model is based on a perception of a real world which consists of a set objects known as entities. An entity-relationship model is a conceptual model.It is an understanding of the organisation of data, which describes the objects as entities, attributes and relationship, diagrammatically. Relationship connects two or more entities into a relation.

An entity-relationship diagram could serve as the basis design of the database. To draw an entity-relationship model, we require some basis elements:**entity, relationships and attributes.**

1. Entity

An entity is an object which exist by itself. An entity is represented by a rectangle box. An entity can be a place, person, vehicle, etc.

Entity Relationship *(ER) model is a high level, conceptual model that describes data as entities, attributes, and relationships.*

Entity Type and Entity Instance

An entity type (also called entity set) is a set of entities of same type i.e., which share common properties. For example, the set of all persons having an account at a bank, can be defined as the entity type CUSTOMER. Similarly, STUDENT, TEACHER, and ITEM are also entity types or entity sets.

Entity instance

An entity instance is an instance of entity type i.e., an entity instance is a specific individual, thing or object; for example, “Pupuli" is an instance of entity type STUD ENT; “English" is an instance of entity type SUBJECT, and so on. We'll be denoting the entity types in upper-case letters and entity instances in upper-lower case.

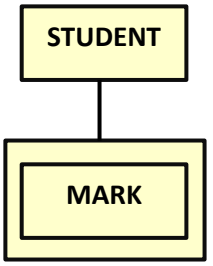
Entity Types

There are two types of entities viz. dependent entities (also called Weak entities) and independent (also called regular or strong entities) entities. A dependent entity is the one whose existence depends on the existence of another entity. Consider an entity type MARKS that represents the marks obtained by a student. Now the existence of MARKS depends upon the existence of entity type STUDENT.

An entity, say DEP is dependent upon another entity, say INDEP, when the following conditions apply

- ✓ An instance of INDEP must exist before an instance of DEP can exist.
- ✓ If INDEP ceases to exist then D EP must also cease to exist.

For example, an instance of STUDENT type, say “Sushant" can have many instances of MARKS, say English marks, Mathmarks, comp. marks etc., related to it. If the instance “Sushant" is removed then all the marks dependent upon it will also be removed. A dependent entity is depicted in a double lined rectangle (week entity), and is connected by a line to the entity on which it depends as shown in figure.



A department (week) entity

2. Relationships

A relationship is an association among several entities. For example, there is a relationship between teachers and students. This relationship represents the fact that a teacher teaches several students, and a student is taught by many teachers. You may name this relationship as **TEACHING**.

A relationship type defines the association of entity types (e.g., TEACHER-STUDENT relationship), and a relationship instance is an association of entity instances (e.g., *Subrat - Madhab* relationship). A relationship is represented diagrammatically using a **diamond** as shown in Fig.

A Relationship between TEACHER and STUDENT entities.

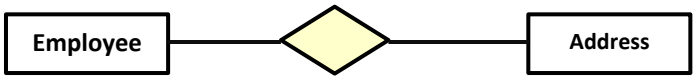
Types of Relationships

There are three types of relationships:

1. One-to-One
2. One-to-Many or Many-to-One
3. Many-to-Many

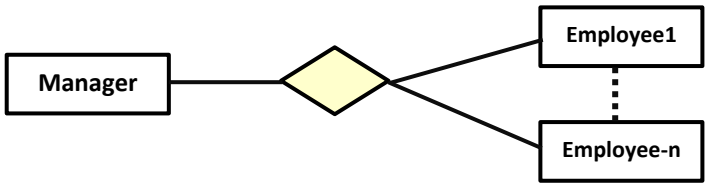
Relationship types may also have attributes in the E-R Model. When they are mapped to the relational model, the attributes become part of the relation.

One-to-One One entity is associated with another one entity.



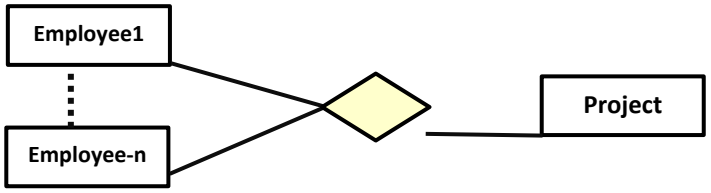
e.g. An address is associated with an employee.

One-to-Many One entity is associated with many other entities.



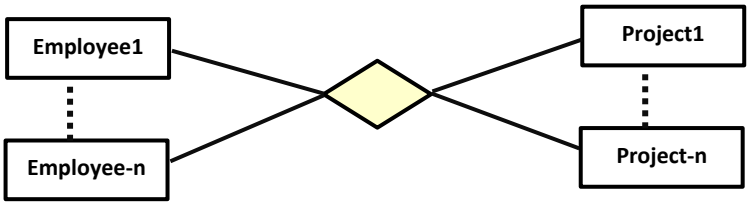
e.g. A manager is associated with all employees.

Many-to-One Many entities are associated to oneentity.



e.g. Many employees are associated with one project.

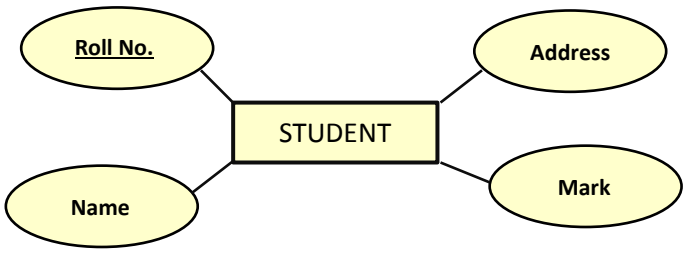
Many-to-Many Many entities are associated with many other entities.



e.g. Number of employees in a company are associated with multiple projects, same time.

3. Attributes

An entity is represented by a set of attributes. An attribute is a property of a given entity. An attribute instance is a particular property of an individual entity instance. An attribute type is a property of an entity type. For example, 'A+' is an attribute instance while GRADE is an attribute type. Attributes are represented through ellipses, labelled with the name of the property. The key attributes are underlined. As you know a keyfield (or a key attribute here) is the one that uniquely identifies an entity instance (also called primary key). The following figure shows an entity along with its attributes.



An entity along with its attributes.

Rollno is underlined because it is the key attribute. It has unique value for each student.

Composite Attribute. An attribute which can be decomposed further is a composite attribute. If an attribute is a group of properties, it is called composite attribute e.g., ***Address*** is a composite attribute as it is a group of sub-properties such as ***houseno, area, city, state*** etc.

Single-Valued and Multi-valued Attributes. Attributes can either be *single-valued* if they are capable of storing single value or be multi-valued if they are capable of storing multiple values e.g., if an entity **STUDENT** has following attributes

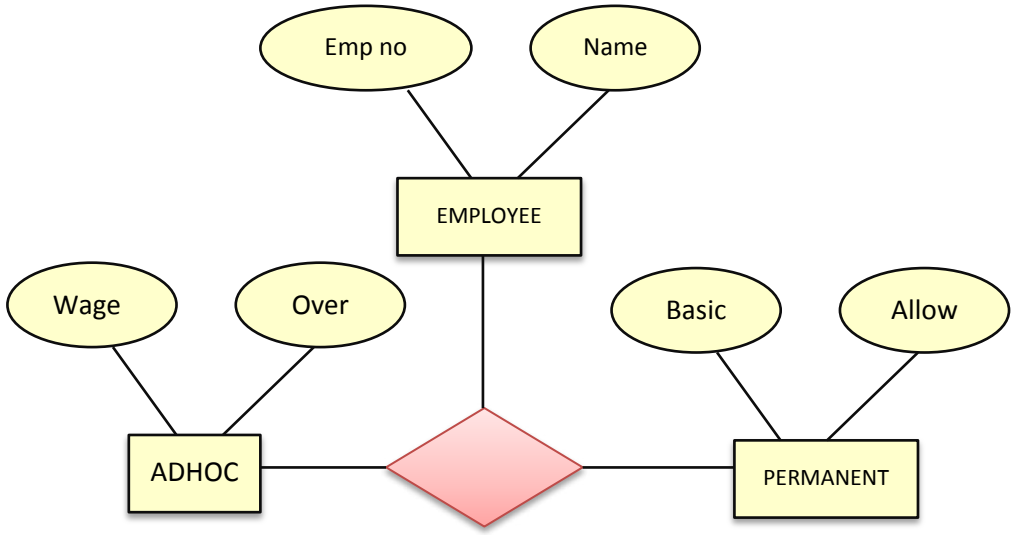
Rollno, Name, Class, Subject. Then the attribute's *Rollno, Name* and *Class* can hold one value whereas attribute Subject can hold multiple values as the student is studying multiple subjects. Thus the attribute's

Rollno, Name and Class are **Singled-valued** attributes but the attribute Subject is a **Multi-valued** attribute.

Stored versus Derived Attribute In some cases, some attributes values are related. You can calculate value of some attributes using other attribute. e.g. to calculate total salary, hr, ta, da are involved. Total salary attribute is called derived attribute and hr, ta and da are called stored attribute.

Subtype and Super type Entities Entities can further be classified into subtypes and supertypes. A subentity (or subtype) is always dependent upon the superentity for its existence. The attributes of the superentity apply to all its subentities, but the converse is not true. For example, EMPLOYEE entity can be classified into two types -PERMANENT and ADHOC. Here EMPLOYEE is a superentity type and ADHOC is the subentity type. The attributes common to both subtypes would become attributes of superentity EMPLOYEE and the attributes unique to PERMANENT subentity would remain with it, and the same applies to ADHOC subentity.

The subtypes are connected to their supertypes via an unnamed relationship. The supertype is connected to the unnamed relationship via a line containing a cross bar. The following figure illustrates this concept of supertype and subtypes.



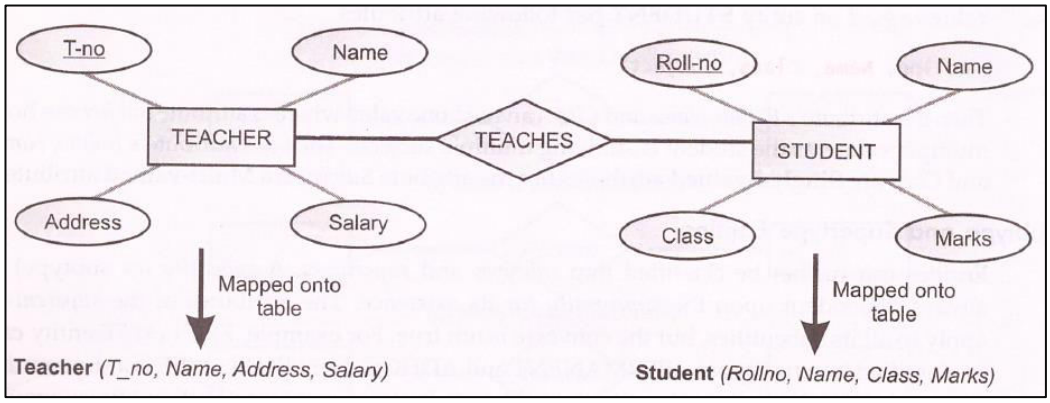
Supertype and subtypes

A database that confirms to an E/R diagram can be represented by a collection of tables in relational system. Let us now learn how to map various elements of E/R diagrams to tables.

Mapping regular entities and attributes

Regular entities (the independent entities) map onto tables. Create one table for each regular entity. Each attributes maps on to a field of the table representing its entity.

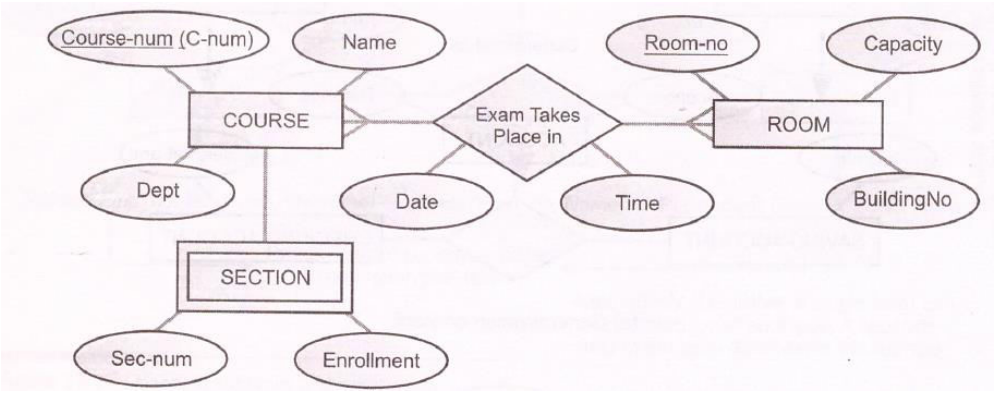
For instance, in following figure, the regular entities TEACHER and STUDENT map onto two separate tables say Teacher and Student. And the attributes of entities TEACHER and STUDENT will map onto fields in the relevant tables. The key attributes become key fields when mapped in the table.



Example . Consider a university database for scheduling of classrooms for final exams. There are exams taking place for various courses. Each course has a unique name, department and a course-number. For each course, there may be many sections. Sections have a section-number and enrollment. There are multiple rooms available in various buildings. Each room is identified with room-number, seating-capacity and building-number and is reserved for one or more, courses exam. For each exam, date and time are stored. For the above mentioned database, suggest various tables with appropriate file structures.

Solution. There are three identifiable entities viz. (i) EXAM (ii) COURSE (iii) ROOM. SECTION depends upon COURSE for its existence, thus it is a weak entity and COURSE is strong entity.

The E/R diagram for the above mentioned problem is as shown below



The tables mapped from the E/R diagram would be having the following file structures:

Course (C_num, Name, Dept) **Room**(Room_no, Capacity, BuildingNo)

Exam(C_num, Room_no, Date, Time) **section**(C_num, Sec_num, Enrollment)

Mapping Entity Relationships

In a relationship, entity mapping depends on the type of relationship. You can map all relations type entity (One-to-One, One-to-Many, Many-to-One, Many-to-Many). Mapping process of every relationship is different from each other. Here we are discussing only One-to-Many Relationship mapping.

One-to-Many Relationship

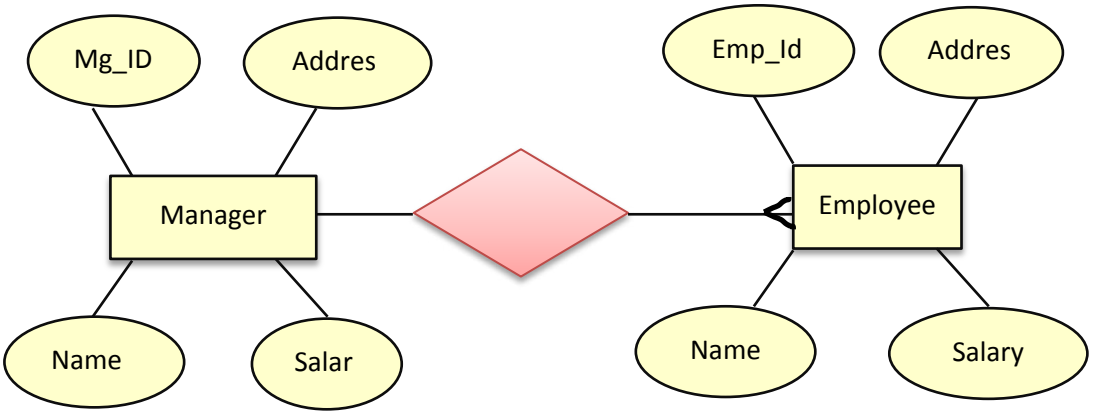


Table for Manager Manager (Mg_id, Address, name, Salary)

Primary Key

Table for Employee Employee (Emp_id, Mg_id, name, Address, Salary)

Primary Key Foreign Key

In One-to-Many relationship, one entity is associated with many entities. In figure, Manager entity is associated with more than one Employee. Every time employee instance takes the Mg_id of manager as foreign key into Employee table at the time of saving data of Employee.

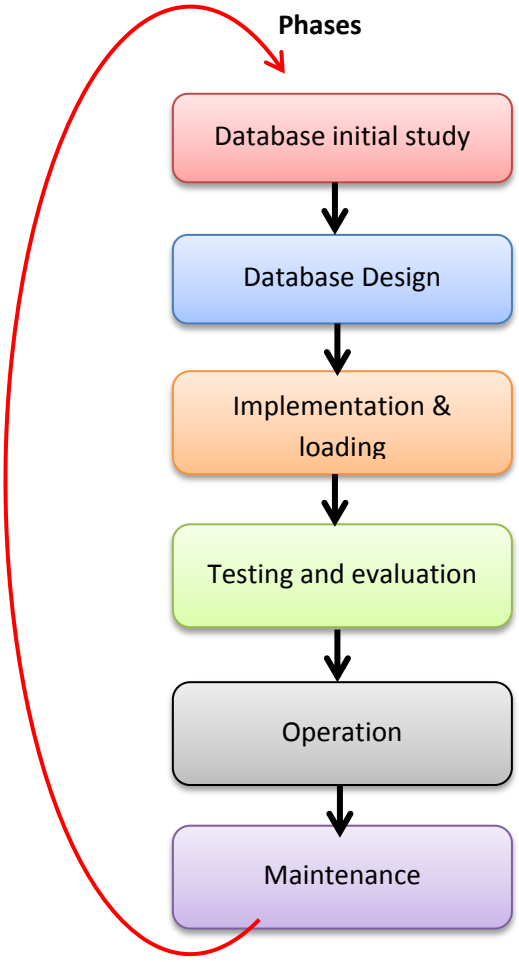
Development of Database

Developing Database for an Application

A database is very crucial and key to a successful application. A database must be designed very carefully in a systematic manner. Generally databases are developed in a systematic way, which is known as Database Development Life Cycle. In the following lines, we are going to discuss database development life cycle briefly.

Database Development Life Cycle (DDLC)

It is a structured process, which is imposed upon the development of the database portion of an application. A database developed by this structured process would be good for an effective application. On every step, database is involved and refined. The systematic approach used for developing a database is referred to as Database Development Life Cycle. With DDLC, the data elements remain more stable and make the database logically very sound.



Database Development life cycle(DDLC)

1. ***Database initial study***

Phase I Analyze the Company Situation

In this phase, we consider:

1) What are the organisation and its general environment?
2) What is its mission within that environment?
3) What is the organisation's structure?
4) What is the requirements for changing system/database?

Phase II Define Problems and Constraints

1) How does the existing system work?
2) What input does the system require?
3) How is the system output used? And, by whom?
4) What documents does the system generates?
5) What is the operational relationship among business units?
6) What are the limits and constraints imposed on the system?

Phase Ill Define the Objective

1) Objective of the proposed system.
2) Does the system need to share the data with other system or users?
3) Will the system interface with the ocher existing or the future system in the company?

Phase IV Define Scope and Boundaries

1) Scope What is the extent (size or scale of something) of the design based on operational requirements?
2) Boundaries/Limits
   - ✶ Budget
   - ✶ Hardware and Software
   - ✶ External of organisational change is required.

2. ***Database design***

Database design is the process of producing a detailed data Model of a database. This logical data model contains all the needed ,logical and

Physical design choices and physical storage parameters, needed to generate a design in a Data Definition Language (DDL), which can then be used to create a database. A fully attributed data model contains detailed attributes for each entity. The database design is dividing in four types.

1. Conceptual Design
2. DBMS software selection
3. Logical Design
4. Physical Design

Conceptual Design

The data modeling is used to create an abstract database structure, which permits you to emphasis on the big picture without getting into details. Here, you can divide this model into small chunks for better understanding. One of the most common technique used for conceptual design is Entity Relationship Model (E-R Model). Model produced at this stage is of client world view not real world.

DBMS Software Selection

For this we need to take special care of few factors affecting the decision.

(a) Cost (purchase)
(b) Maintenance
(c) Operational
(d) License
(e) Installation
(f) Training
(g) Conversion costs

Logical Design

Logical design translates the conceptual design into the internal model for a selected DBMS. It specifies:

(a) The high level design.
(b) What tables and connections between them should exist?
(c) It recognises entities in your model and relationship between them.

(d) Dividing a table into small table and associated with relations called normalisation.

Logical design comes after conceptual design. So, it ensures:

(i) What are the columns in each cable?
(ii) It includes mapping of all objects in the model to the specific constructs used by the selected database software.
(iii) In RDBMS, the logical design includes the design of tables, indexes, views, transactions, etc.

Physical Design

Physical design is where you translate the expected schemas into actual database structure. At this time, you have to map entities to tables, relationships to foreign key, unique identifiers to unique key. Translating your schemas into actual database structures requires creating the following:

(i) Partitions
(ii) Indexes
(iii) Constraints
(iv) Access control
(iv) Implementation of some business rule chat could not be modelled earlier.

3. Implementation & loading

This phase of life cycle:

(a) Creates the database storage group.
(b) Creates the database within the storage group.
(c) Assigns the rights to use the database to a database administrator.
(d) Creates table space (storage location where the actual data underlying database objects can be kept) within the database.

(e) Creates cable(s) within the table space(s).
(f) Assigns rights to the table spaces and the cables within specified cable spaces.
(g) Loads the data.
(h) Backup and recovery

4. Testing and Evaluation

Testing and Evaluation (a way to determine the subject merit, worth and significance, using the criteria governed by a set of standards) phase occur in parallel with the application programming.

Programmers use database tools (e.g. report generators, screen painters and menu generator) to prototype the application during the coding of the programs.

If the implementation fails, then the options to enhance the system are:

(a) Fine-tuning the specific system and DBMS configuration parameters.
(b) Modify the physical design.
(c) Upgrade or change the DBMS and hardware platform.
(d) Modification of logical design.

5. Operation

After passing the evaluation stages, comes the operation phase. ln the beginning of the operational phase always start the process of system evolution, where it changes from a simple to a more complex form.

6. Maintenance

In this phase, the following points need to be performed:
(i) Preventive maintenance
(ii) Corrective maintenance
(iii) Adaptive maintenance
(iv) Assignment and maintenance of access permissions

(v) Generation of database access
(vi) Periodic security audits.

Demonstrator and development of appropriate font-end and back-end interface database for e-governance application.

We shall take example, of e-Governance to better understand the process of IT application development.

Example

The state administration wants to make ***vehicles' data (RegNo, RegDate, Owner, OwnerShipNumber, Address, HP)*** easily available to citizens. Each registration authority in-charge will regularly update the data. Citizens will be given read only access to this data.

The application development steps are given below:

Step 1: The problem is identified. Its economic and technical feasibility are discussed.It is found that the application development and implementation are technically and economically feasible. So the corresponding authority (may be the State Transport Authority) gives a green signal for application development.

Step 2: After discussion with the management and the potential users of the application, it is decided to keep the following tables in the database:

Table: Vehicle

S.No.	Field	Datatype	Remarks
1.	RegNo	Char(12)	Primary key. Resgistration Number is 10 characters long. To make it future proof, a provision of 12 characters is made.
2.	RegDate	Date	Registration date of the vehicle.
3.	VehicleType	Varchar(10)	Car/Truck/Bus/Scooter/MCycle etc.
4.	Manufacturer	Varchar(20)	Vehicle Manufacturer's Name
5.	Model	Varchar(20)	Name of the Model

Table: Owner

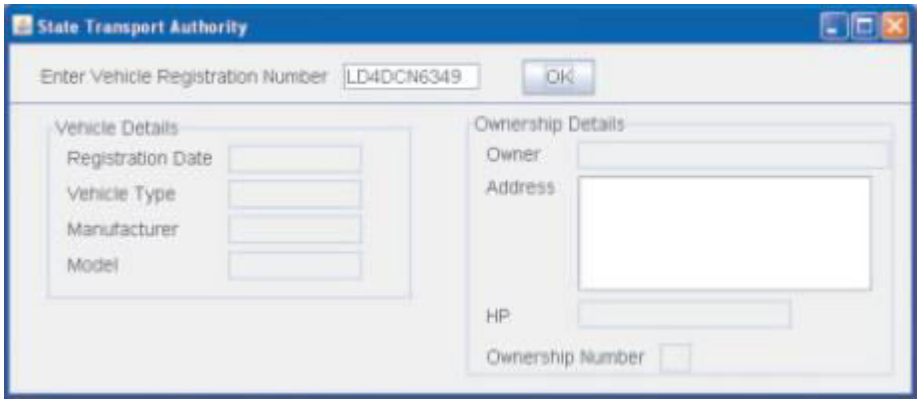
S.No.	Field	Datatype	Remarks
1.	RegNo	Char(12)	Primary Key.
3.	Owner	Varchar(25)	Owner's Name
4.	Address	Varchar(50)	Owner's address.
5.	OwnerShipNo	Int(2)	Ownership Number of the vehicle.
6.	HP	Varchar(25)	Name of the bank/institution which has financed the vehicle.

Step 3: After careful analysis, it is found that the inputs required from the user are asfollows:

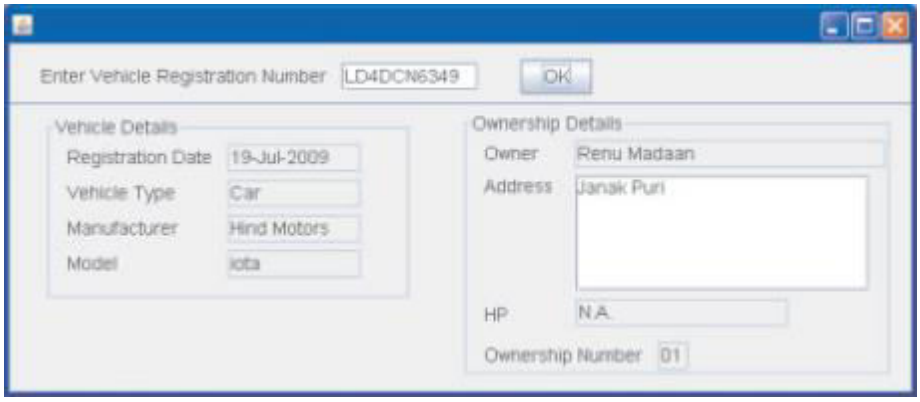
- ✶ Registration Number

All the other fields like Owner's Name and Address, HP etc. will be provided by the application from the database.

To get input from the users, following front-end interface can be designed:



Once the registration number is input, database can be searched for it and the corresponding details of the vehicle and the owner can be shown to the user in the following format:



Step 4: Data connectivity between the Front-end interface and back-end database can

be established using some scripting language like Javascript or VBScript etc.

Step 5: After development the application can be tested by entering various registration numbers. If any discrepancies are found during test, the corresponding corrections can be made in the application. After complete testing, the application can be implemented.

EXERCISE

Q1. Very short answer type question [1 Mark]

(a) Write one point of difference between front-end and back-end with one example of each.

(b) Which component should be used by a user, if he wants to insert the username in an application form?

(c) Which component should be used to submit an application form, which is a user fill?

(d) A user is developing an application form, which component should he/she use for the address part to enter?

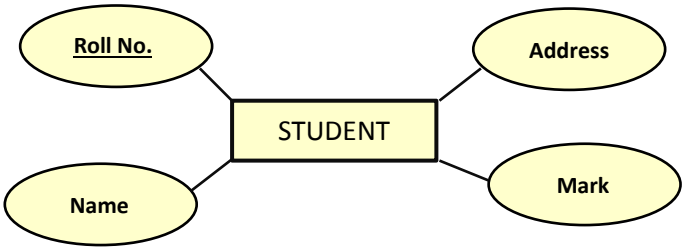
(e) Is it possible to connect more than one database at the same time in same application? Name some databases which are supported by Java.

(f) Database of an application has been damaged. How does it affect your application?

(g) Subrat Chand is working on DBMS and same time database has been crashed. Which subsystem of DBMS is used for recovery database?

(h) Which type of relation is existed among patients and doctor?

(i) In this example how many attributes are single valued and multi-valued?



(j) Which steps of DDLC is responsible for producing model of client world view not real world.

Q2. Short answer type question [2 Mark]

a) What controls would you suggest for following types of inputs?
   (i) Typed text (single line)
   (ii) Typed text (multiple lines)
   (iii) A Mouse click
   (iv) One out of many choices
   (v) Multiple choices from a set
   (vi) Typed text which should remain hidden (encrypted form).

b) Subrat Chand works for FM College. He wants to create controls on a form for the following operations. Choose appropriate controls from Text Box, Label, Radio Button, List Box, Combo Box, Check Box and Command Button.

Sl No.	Operation
1	Enter Name of Employee
2	Select Department from a list of Department names
3	Gender out of options M and F
4	Submit form

c) Mr. Shreyash Pradhan working as a manager in Vivian Enterprises wants to create a form in Net Beans to take various input from user. Choose appropriate controls from Label, Text Box, Radio Button, Check Box, List Box, Combo Box and Command Button. Write the most appropriate controls in the third column.

S.No.	Control used to	Control
1	Enter Name, Address and Salary .	
2.	Select Gender (M/F)	
3	Select Department from Available List	
4	Choose Hobbies (Singing/Dancing/ Painting/Sculpture)	

d) Which components should be used, if an application for college is being made? The appropriate controls that can be used in the below conditions.
   (i) Name of student
   (ii) Age of student
   (iii) Gender (MIF) of student
   (iv) Hobbies of student (Singing, Dancing, Playing, Reading)

(e) Draw an E-R diagram displaying the relationship between an Employee and Project. Also depict the attributes of each entity and mention the type of relationship that exists among them.

(f) Draw the E-R diagram displaying the relationship between customer and bank account. Also depict me attributes of each entity and mention the type of relationship that exists between them.

(g) How is a back-end linked to a database and server?

Q3. Short answer type question [4 Mark]

(a) Define what is meant by an entity, attributes entity seta and relationship.

(b) Write the different phases of Database initial study.

Q4. Long answer type question [6 Mark]

(a) Briefly explain Database Development Life Cycle.

(b) Explain ENTITY RELATIONSHIP MODEL

■ ■ ■

APPENDIX

Electronic (digital) Transaction in India:
-march towards a Cashless Economy:

The Digital India programme is a flagship programme of the Government of India with a vision to transform India into a digitally empowered society and knowledge economy. "Faceless, Paperless, Cashless" is one of professed role of Digital India.

Digital payment is a way of payment which is made through digital modes. In digital payments, payer and payee both use digital modes to send and receive money. It is also called electronic payment. No hard cash is involved in the digital payments. All the transactions in digital payments are completed online. It is an instant and convenient way to make payments. It promotes cashless transactions and converting India into less-cash society.

If we talk about cash payments, you have to first withdraw cash from your account. Then you use this cash to pay at shops. Shopkeeper goes to the bank to deposit the cash which he got from you. This process is time-consuming for you and also for the shopkeeper. But in digital payments, the money transfers from your account to the shopkeeper's account immediately. This process is automatic and neither you nor the shopkeeper is required to visit the bank.

Modes of Digital Payments: From commonly used cards to newly launched UPI, digital payments have many types of payment modes. Some modes meant for tech-savvy persons and some for less-technical ones. Some of these modes are outlined below; with a rider that technology evolves very fast!

1. Banking Cards (Debit / Credit / Prepaid / Cash / Travel / others):

Banking cards offer consumers more security, convenience, and control than any other payment method. The wide variety of cards available – including credit, debit and prepaid – offers enormous flexibility, as well. These cards provide **2 factor** authentications for secure payments e.g **secure PIN** and **OTP (**One Time Pass Word in your registered mobile phone**). RuPay, Visa, MasterCard** are some of the example of card payment systems. Payment cards give people the power to purchase items in stores, on the Internet, through mail-order catalogues and over the telephone. They save both customers and merchants' time and money, and thus enable them for ease of transaction.

How to get it:

- Provide KYC (Know Your Customer) information to open a new account
- Apply for Card with option of Debit / Credit Card
- Get a PIN
- Visit an ATM or through SMS activate the PIN.

Requirement for Transaction:

- Point of Sales (PoS) terminal or online payment gateway
- Present Card physically at a PoS terminal or card details for online transaction
- Provide PIN at PoS or OTP to complete online transaction for merchant website.

Transaction Cost:

- NIL to customer for merchant transactions.
- Annual fee and limits on ATM transaction by banks discretion.

- 0.50% to 2.25% paid by merchant
- Cash-out charged to customer in case of credit cards @ 1% to 3.5% of transaction value. (*The transaction costs may vary based on banks*.)

Services Offered:

- ✓ These cards can be used at PoS (Point of Sale) machines, ATMs, microATMs, Shops, wallets, online transactions, and for e-commerce websites.
- ✓ International cards can be used across globe for multiple currencies
- ✓ These Cards are interoperable; a card issued by one member bank can be used in other member bank's ATM or PoS or Payment gateway.

2. Unstructured Supplementary Service Data (USSD):

This innovative payment service *99# works on Unstructured Supplementary Service Data (USSD) channel (which has been used by the mobile phone operators for balance checking and other service related messages). It is now successfully being utilized for mobile banking transactions using feature phones without having any internet data facility.

*99# service has been launched to take the banking services to every common man across the country. Banking customers can avail this service by dialing *99#, a "Common number across all Telecom Service Providers (TSPs)" on their mobile phone and transact through an interactive menu displayed on the mobile screen. *99# service is currently offered by 51 leading banks & all GSM service providers and can be accessed in 12 different languages including Hindi & English as on 30.11.2016 (Source: NPCI). *99# service is a unique interoperable direct to consumer service that brings together the diverse ecosystem partners such as Banks & TSPs (Telecom Service Providers).

How to get it:

- Mobile Number should be linked with Bank Account
- Register for USSD/Mobile Banking
- Get MMID (Mobile Money Identifier)
- Get MPIN (Mobile PIN)

Requirement for Transaction:

- ✓ Remember MMID
- ✓ Remember MPIN
- ✓ Dial *99#
- ✓ Registered mobile number with any phone (feature or smart)
- ✓ Self Service mode

Transaction Cost:

- ❖ NIL by system
- ❖ Rs. 0.50 charged to customer

Services Offered:

- ➢ Balance enquiry
- ➢ Mini Statement
- ➢ Funds transfer
  - o MMID
  - o A/c no.
  - o Aadhaar
- ➢ Know MMID
- ➢ Change M-PIN
- ➢ Generate OTP

Funds Transfer limit:

- Rs 5,000/day
- Rs 50,000/annum

3. Aadhaar Enabled Payment Service (AEPS):

AEPS is an Aadhaar based digital payment mode. Customer needs only his or her Aadhaar number to pay to any merchant. AEPS allows bank to bank transactions. It means the money you pay will be deducted from your account and credited to the payee's account directly.

You need to link your Aadhaar number with your bank account to use AEPS. Unlike cards and USSD, AEPS does not have any charges on transactions. You can use AEPS with the help of PoS machines. You can withdraw or deposit cash, send money to another Aadhaar linked account with it. The good thing about AEPS is that it doesn't need your signature, bank account details or any password. It uses your fingerprint as a password. No one can forge your fingerprints, thus it is the most secure digital payment mode in the World!

AEPS is an online interoperable financial transaction at PoS (Point of Sale / Micro ATM) through the Business Correspondent (BC) / Bank Mitras of any bank using the Aadhaar authentication.

4. Unified Payments Interface (UPI):

It is a system that powers multiple bank accounts into a single mobile application (of any participating bank), merging several banking features, seamless fund routing & merchant payments into one hood. It also caters to the "Peer to Peer" collect request which can be scheduled and paid as per requirement and convenience. Each Bank provides its own UPI App for Android, Windows and iOS mobile platform(s).

Requirement:

An operational Bank Account, Mobile number should be linked with bank a/c, Smart Phone with internet facility, Debit Card for re-setting MPIN.

Service Activation:

Download the App for UPI > Do registration online on the App with a/c details > Create a virtual ID > Set MPIN

Requirement for Transaction:

- Smartphone with internet facility
- Registered device only
- Use registered MPIN
- Self Service Mode

Transaction Cost:

- NIL to customer by most Banks
- Customer pays for data charges

Services Offered:

- Balance Enquiry
- Transaction History
- Send / Pay Money
  - Virtual Address
  - A/c no. & IFSC code
  - Mobile no. and MMID
  - Aadhaar (to be made functional)
- Collect Money
  - Virtual Address
- Add bank account
- Change / Set MPIN
- Notifications
- A/c Management

5. Mobile Wallets *or* **e-Wallets:**

A **mobile wallet** is a way to carry cash in digital format. You can link your credit card or debit card information in mobile device to mobile wallet application or you can transfer money online to mobile wallet. Instead of using your physical plastic card to make purchases, you can pay with your Smartphone, tablet, or smart watch. An individual's account is required to be linked to the **digital wallet** to load money in it. Most banks have their e-wallets and some private companies. e.g. **Paytm, Freecharge, Mobikwik, Oxigen, mRuppee, Airtel Money, Jio Money,** SBI **Buddy, Citrus Pay,** Vodafone **M-Pesa,** Axis Bank **Lime,** ICICI **Pockets, SpeedPay** etc.

How to get it:

- Option to open Zero KYC or Full KYC wallet
- Option of Consumer vs. Merchant wallet
- Mobile Number
- An App to be downloaded in smart phone

Service Activation:

- Load money (subject to regulatory limits) using internet banking or merchant locations
    - Bank A/c
    - All Cards
    - Cash-In

Transaction requirement:

- Smartphone or internet
- Use MPIN
- Self-service and/or Assisted mode

Services Offered:

- Balance Enquiry
- Passbook/ Transaction history
- Add money
    - Bank A/c
    - All Cards
    - Cash-In
- Accept Money
- Pay money
    - Another wallet (mobile no.) with same provider
    - Pay merchant
    - Bar Code reader
- Manage Profile
- Notifications

[QR code: In case of e-Wallet or UPI payment, there is a facility for Scan & Pay. Here the person making payment don't have to type the bank details of the merchant for making payment; rather just scans a matrix code image of the merchant through the mobile camera and makes payment. The matrix-code (a 2-dimensional bar code), which keeps the bank details and routing information of the merchant is called a

Quick Response or QR code.

'QR code' is the trademark name for the two dimensional barcode system. It was originally invented in 1994 by a Japanese national Denso Wave, who holds its patent right.

The conventional one dimensional barcodes used on virtually every consumer product are mechanically scanned. That is, they're read by physically bouncing a narrow laser beam onto the code, which can be interpreted using the pattern of light reflected off the white gaps between the lines. QR codes, on the other hand, can not only hold 100 times more data than barcodes—they can also be digitally scanned. The block of smaller black and white squares is read by a smart phone's image sensor, and then interpreted by the system processor. The three large squares act as alignment targets, while the smaller square in the remaining corner acts to normalize the size and angle of the shot. The encoded data can be interpreted as one of four primary modes—numeric, alphanumeric, byte/binary, and Kanji. Other forms of data can also be displayed with the appropriate extensions.

The initial version was 21×21 pixels and held just 4 characters worth of data. The most recent version is 177×177 pixels square, and it holds 1852 characters—enough for a few pages of information, like Bank Account information and the URL of the organisation.

The QR code scanner (software which translates the image in to binary information) comes for free with mobile operating system like Android, iOS, and Windows. The scanning software is also free to download from different websites.]

6. Point of Sale terminal:

A point of sale (PoS) is the place where sales are made. On a macro level, PoS may be a market or a city. On a micro level, retailers consider PoS to be the area where a customer completes a transaction, such as a checkout counter. It is also known as a point of purchase.

Physical PoS:

Necessary conditions for service initiation:

- Handheld Device with card and /or bio-metric reader
- Merchant Bank a/c
- Internet connectivity GPRS/ Landline

Service Activation:

- Paper work with Bank for merchant bank a/c
- Deposit certain amount
- Collect device
- Configuration and training to operator

What is required for Transaction?

- Any Card
- Resident for bio-metric authentication (AEPS)
- Assisted Mode

Funds Transfer limit:

- No limit for regulator
- Merchant's Bank and payee Bank may set limit based on its own discretion

Service Available from number of operators: 14.62 lakh

- Interoperable

Mobile PoS:

Necessary conditions for service initiation:

- Smartphone, App from bank
- Integrated or external card and /or bio-metric reader
- Internet connectivity 2G/3G/4G, or Wi-Fi
- QR code and Bar code reader

Service Activation:

- Merchant Bank Account > Download App
- Register device and/or mobile with merchant bank a/c and bank
- May require training or readable instructions

What is required for Transaction?

- Any Card / Wallet account
- Resident for bio-metric auth (AEPS) for registered devices
- Scanner for reading QR Code and Bar Code
- Self-service and/or Assisted mode

Example:

A transaction was carried out at a medicine store on 01-May-2017 for Rs. 530/- in Mobile PoS mode. The steps are as follows:

- The Debit / Credit Card is swiped in the machine's (shown below) pad.
- The amount is typed in by the merchant
- Customer has to provide the mobile telephone number in which s/he wants the message (not necessarily the Registered Mobile Number).
- Customer has to key in the PIN for the card transaction.
- Transaction is over; the charge-slip (shown below) is sent to the mobile number.

mswipe

MEDI LAND

MEDI LAND

SHOP NO-1 SIDHARTH TOWER
LEVIS ROAD ADRABI TALKIS SQUARE
BHUBANESWAR ORISSA
Khorda - 751002
ODISHA
INDIA

Date/Time : 01-May-2017 17:51.22

MID: 07MS00000520104 TID: MS548744
Batch no: 000050 Invoice no: 100000035853921
Ref no:

Cash At Pos

Card Num: **** **** **** 8311 Swipe
Card type: VISA Exp date: xx/xx
SALE AMOUNT: INR 530.00
CASH PAID : INR 530.00
TIP AMOUNT: INR 0
TOTAL AMOUNT: INR 530.00
Appr Cd: 412579 Rref num: 712117869102

Pin Verified Ok

RANJAN KUMAR BAL
I agree to pay the above total amount according to the card issuer agreement.

**** CUSTOMER COPY ****

Version No : VER4.0.0

Settlement bank: CORPORATION BANK

Virtual PoS:

Necessary conditions for service initiation:

- Smartphone and /or Web browser
- Internet connectivity 2G/3G/4G, or Wi-Fi or landline
- E-payment gateway
- Virtual A/c for transactions
- May need QR code

Service Activation:

- Merchant Bank a/c with some merchant credentials
- In case of QR code for pull transactions
- May require ability to identify or authenticate user for service delivery

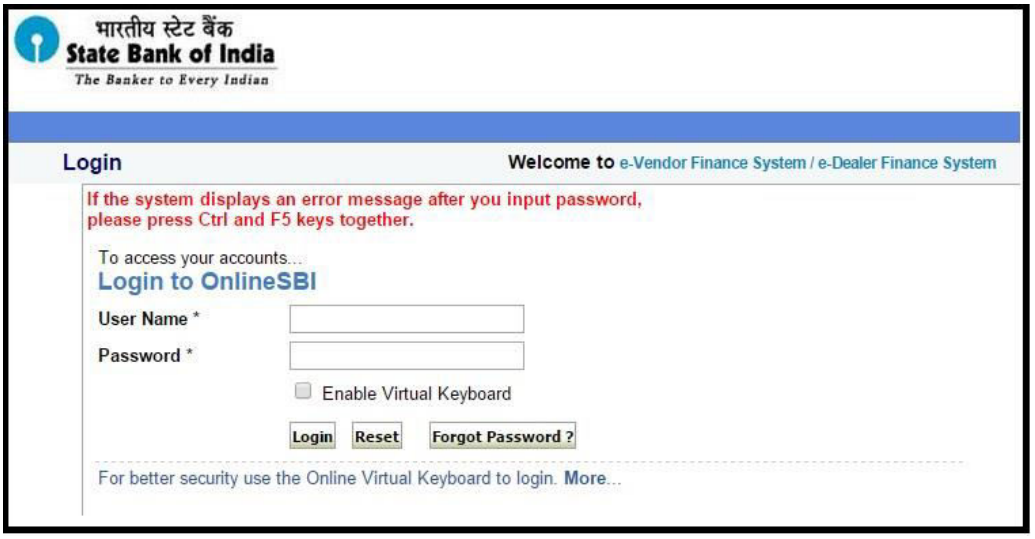
What is required for Transaction:

- Any Card
- Wallet Account
- Scanner for reading QR Code and Bar Code

Funds Transfer limit:

- No limit for regulator
- Merchant's Bank and payee Bank may set limit based on its own discretion

7. Internet Banking:



Internet banking, also known as online banking, e-banking or virtual banking, is an electronic payment system that enables customers of a bank or other financial institution to conduct a range of financial transactions through the financial institution's website.

8. Other forms of On-line Financial Transactions:

a) National Electronic Fund Transfer (NEFT)

National Electronic Funds Transfer (NEFT) is a nation-wide payment system facilitating one-to-one funds transfer. Under this Scheme, individuals, firms and corporates can electronically transfer funds from any bank branch to any individual, firm or corporate having an account with any other bank branch in the country participating in the Scheme. Individuals, firms or corporates maintaining accounts with a bank branch can transfer funds using NEFT. Even such individuals who do not have a bank account (walk-in customers) can also deposit cash at the NEFT-enabled branches with instructions to transfer funds using NEFT. However, such cash remittances will be restricted to a maximum of Rs.50,000/- per transaction. NEFT, thus, facilitates originators or remitters to initiate funds transfer transactions even without having a bank account. Presently, NEFT operates in hourly batches - there are twelve settlements from 8 AM to 7 PM on week days (Monday through Friday) and six settlements from 8 AM to 01 PM on Saturdays.

b) **Real Time Gross Settlement (RTGS)**

RTGS is defined as the real-time settlement of fund transfers individually, on an order by order basis (without netting). 'Real Time' means the processing of instructions at the time they are received rather than at some later time; 'Gross Settlement' means the settlement of funds transfer instructions occurs individually (on an instruction by instruction basis). Considering that the fund settlement takes place in the books of the Reserve Bank of India, the payments are final and irrevocable. The RTGS system is primarily meant for large value transactions. The minimum amount to be remitted through RTGS is 2 lakh. There is no

upper ceiling for RTGS transactions. The RTGS service for customer's transactions is available to banks from 9 AM to 04-30 PM on week days and from 9 AM to 02 PM on Saturdays for settlement at the RBI end. However, the timings that the banks follow may vary depending on the customer timings of the bank branches.

c) **Electronic Clearing System (ECS)**

ECS is an alternative method for effecting payment transactions in respect of the utility-bill-payments such as telephone bills, electricity bills, insurance premia, card payments and loan repayments, etc., which would obviate the need for issuing and handling paper instruments and thereby facilitate improved customer service by banks / companies / corporations / government departments, etc., collecting / receiving the payments.

d) **Immediate Payment Service (IMPS)**

IMPS offer an instant, 24×7, interbank electronic fund transfer service through mobile phones. IMPS is an emphatic tool to transfer money instantly within banks across India through mobile, internet and ATM which is not only safe but also economical both in financial and non-financial perspectives.

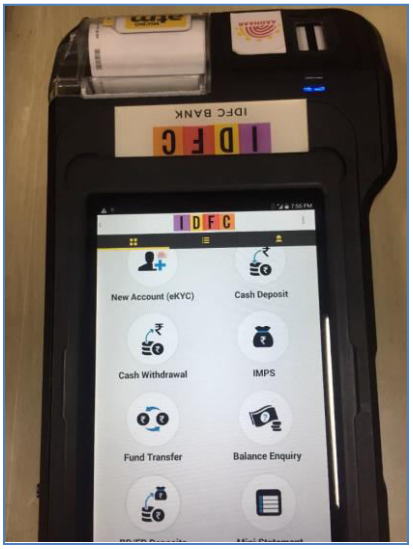
Objectives of IMPS:

a. To enable bank customers to use mobile instruments as a channel for accessing their banks accounts and remit funds
b. Making payment simpler just with the mobile number of the beneficiary
c. To sub-serve the goal of Reserve Bank of India (RBI) in digitization of retail payments
d. To facilitate mobile payment systems already introduced in India with the Reserve Bank of India Mobile Payment Guidelines 2008 to be inter-operable across banks and mobile operators in a safe and secured manner
e. To build the foundation for a full range of mobile based Banking services

9. Mobile banking:

Mobile banking is a service provided by a bank or other financial institution that allows its customers to conduct different types of financial transactions remotely using a mobile device such as a mobile phone or a tablet. It uses software, usually called an app, provided by the banks or financial institution for the purpose. Each Bank provides its own mobile banking App for Android, Windows and iOS mobile platform(s).

10. Micro ATM:



Micro ATM is a device that is being used by Business Correspondents (BC) to deliver basic banking services at the door steps of the customers, where there are no Banking facilities available. The platform enables BCs to conduct instant transactions.

These are low cost devices, which are connected to banks across the country. It enables a person to instantly deposit or withdraw funds regardless of the bank associated with a particular BC. These devices are based on a mobile phone connection and are now made available at every BC. Customers would just have to get their identity authenticated (Aadhaar finger print) and withdraw or put money into their bank accounts. This money will come from the cash drawer of the BC. Essentially, BCs act as bank for the customers and all they need to do is verify the authenticity of customer using customers' Unique Identification Details. The basic transaction types, supported by micro ATM, are Deposit, Withdrawal, Fund transfer and Balance enquiry.

A mobile wallet but inter-operable! BHIM

BHIM- Bharat Interface for Money- is developed by National Payment Corporation of India (NPCI) and uses UPI system for completing transfers and payments. Unified Payment Interface (UPI) is payment system through smartphones in both off-line and online modes but the people who are new to this digital world doesn't know how to operate BHIM. So here we provide you the step by step guide to operate BHIM.

Steps to Use BHIM App

1. Android Smartphone users can download the BHIM application from Google Play Store while iOS based Smartphone users can do it from its App Store.

2. After installation, choose your preferred language, then verify your phone number using sms and wait till the verification process is over.

3. As the verification completes, set the four digit pass-code.

4. After setting the pass-code, select your bank; application will directly link to your account with the help of your phone number. This account will be your default account for all payments.

5. Now you will be getting three options on your screen- Send, Request and Scan & Pay. Note that transactions are possible only between the verified phone numbers.

6. To send money, type the receiver's phone number; you will be asked to enter your MPIN (usually a four or six digit code) to confirm the transfer.

7. In the same way, you can 'Ask' or 'Request' for funds from your friends by entering his/her mobile phone number.

8. The last and third option is 'Scan & Pay'. Take the photograph of the QR code (a square matrix of dots) through your Smartphone for transactions. Each user is assigned with a unique QR code and tap on pay.

9. BHIM acts like a mobile wallet, but it is inter-operable as it uses the UPI mode.

10. You don't have to keep money separately in this wallet, as in case of other e-wallets; money will be in your bank account earning interest for you!

Cyber Security:

The security of digital transactions in India has been ensured through the following Notifications of the Reserve Bank of India. The details of the notifications can be read from the website: http://cashlessindia.gov.in/cyber_security.html

1) CERT-In Advisory for Secure Mobile Banking - CAID-2016-0070 December 06, 2016

2) CERT-In Advisory for Safeguarding Smart phones against Cyber Attacks - CAID-2016-0069 December 05, 2016

3) RBI eases 2-step card validation for payments less than Rs. 2,000/- December 06, 2016

4) RBI Notification on Security and Risk Mitigation measure - Technical Audit of Prepaid Payment Instrument issuers (e-Wallets) Dated December 09, 2016

Advantages of Digital Payments:

a) **Easy and convenient:** Digital payments are easy and convenient. You do not need to take loads of cash with you. All you need is your mobile phone or Aadhaar number or a Plastic Card to pay. UPI apps and e-wallets have made digital payments easier.

b) **Pay or send money from anywhere:** With digital payment modes, you can pay from anywhere anytime. Suppose your close friend's mother fell ill at night. He called you at midnight and asked some money. Don't worry, you can send money to your friend using digital payment modes such as UPI apps, USSD or e-wallets.

c) **Written record:** You often forget to note down your cash expenditure or even if you note, it takes a lot of time. But you do not need to note your spending every time with digital payments. These are automatically recorded in your passbook or inside your e-wallet app. This helps to maintain your record, track your spending and budget planning.

d) **Less Risk:** Digital payments have less risk if you use them wisely. If you lose your mobile phone or debit/credit card or Aadhaar card you don't have to worry a lot. No one can use your money without MPIN, PIN or your fingerprint in the case of Aadhaar. But it is advised that

you should get your card blocked if you lose it. Also call the helpline of your mobile-wallet to suspend the wallet account to prevent anyone from using your wallet money.

Drawbacks of Digital Payments:

Every coin has two sides so as the digital payments. Despite many advantages, digital payments have a few drawbacks also.

1) **Difficult for a non-technical person:** As most of the digital payment modes are based on mobile phones, the internet and cards, it is somewhat difficult for non-technical persons such as farmers, workers etc. The 'Aadhaar Pay' introduced on the 14th April, 2017 would get rid of this difficulty; no card, no mobile, no PIN, only finger print!

2) **The risk of data theft:** There is a big risk of data theft associated with the digital payment. Hackers can hack the servers of the bank or the e-Wallet you are using and easily get your personal information. They can use this information to steal money from your account.

3) **Overspending:** You keep limited cash in your physical wallet. Hence, you think twice before buying anything. But if you use digital payment modes, you have all your money with you always. This can result in overspending.

Whatever may be the case, the digital resolution is here to stay and continue to evolve!

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