BCA-14

Vardhaman Mahaveer Open University, Kota

Computer Applications in Corporate World

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Computer Applicaions in Corporate World

Preface

We feel great in bringing out this material "**Computer Applications in Corporate World" w**hich meets the requirement of the students of BCA Part - III. This material is written entirely according to the syllabus of Vardhaman Mahaveer Open University, Kota.

It covers the various usage and techniques of computer applications for computer world. It gives basic knowledge about softwares, Communication and connectivity information systems, multimedia, e-commerce and bluetooth concepts.

It also gives knowledge about accounting package, statistical packages and about the features for data analysis useful for business purposes.

We have worked hard to make this course reader friendly. We shall be grateful for any suggestions for the improvement.

Unit - 2 : COMMUNICATION AND CONNECTIVITY

Structure of the Unit

2.0 Objective

After going through this unit, you will be able to learn the basic elements of data communication system:

- describe communication protocols and data transmission modes
- explain the use of computer network
- describe different components of computer network
- identify different types of network

2.1 Introduction

Today computer is available in many offices and homes and therefore there is a need to share data and programs among various computers. With the advancement of data communication facilities the communication between computers has increased and thus it has extended the power of computer beyond the computer room. Now a user sitting at one place can communicate with computers of any remote site through communication channel. The aim of this lesson is to introduce you the various aspects of computer network.

2.2 Data Communication

We all are acquainted with some sorts of communication in our day to day life. For communication of information and messages we use telephone and postal communication systems. Similarly data and information from one computer system can be transmitted to other systems across geographical areas. Thus data transmission is the movement of information using some standard methods. These methods include electrical signals carried along a conductor, optical signals along an optical fibers and electromagnetic areas.

Suppose a manager has to write several letters to various clients. First he has to use his PC and Word Processing package to prepare the letter, if the PC is connected to all the client's PC through networking, he can send the letters to all the clients within minutes. Thus irrespective of geographical areas, if PCs are connected through communication channel, the data and information, computer files and any other programs can be transmitted to other computer systems within seconds. The modern form of communication like e-mail and Internet is possible only because of computer networking.

2.3 Basic Elements of a Communication System

The basic elements that form a communication system are :-

The transmitter :

which processes the input signal to produce a transmitted signal suited to the characteristics of the transmission channel. Signal processing for transmission almost always includes modulation and may include coding.

The transmission channel :

which is the electrical medium that bridges the distance from source to destination.It may be a pair of wires, coaxial cable, or a radio wave or laser beam.Every channel experiences some amount of transmission loss or attenuation, so the signal power progressively decreases with increasing distance.

The receiver :

operates on the output signal from the channel in preparation for delivery to the transducer at the destination. Receiver operations include amplification to compensate for transmission loss, and demodulation and decoding to reverse the signal-processing performed at the transmitter. Filter is another important function of the receiver.

In data communication four basic terms are frequently used. They are:

Data : A collection of facts in raw forms that become information after processing.

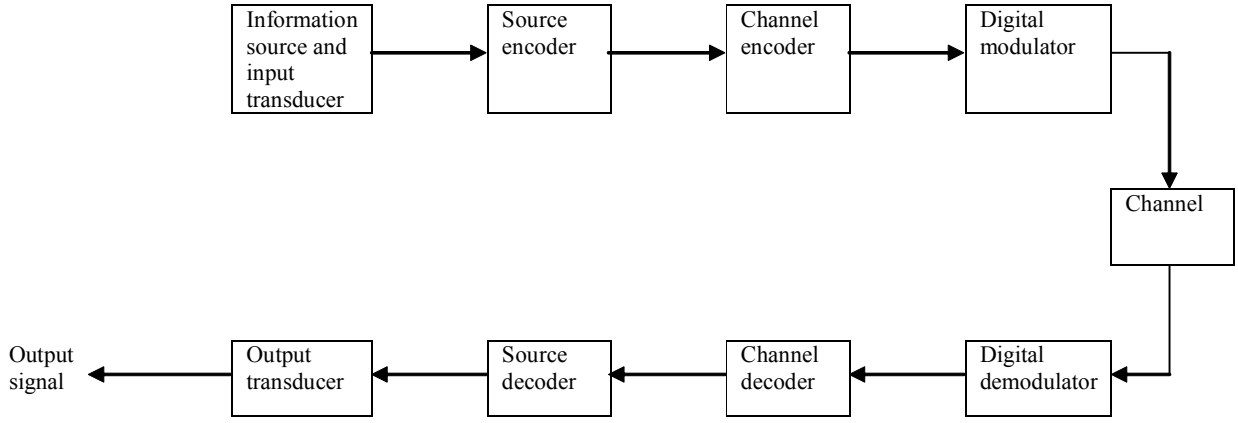
Signals : Electric or electromagnetic encoding of data.

Signaling : Propagation of signals across a communication medium.

Transmission : Communication of data achieved by the processing of signals.

2.4 Elements of a Digital Communication System

Following figure illustrates the functional diagram and the basic elements of a digital communication system.



Basic elements of a digital communication system.

The source output may be either an analog signal, such as an audio or video signal, or a digital signal, such as the output of a teletype machine, that is discrete in time and has a finite number of output characters.

In a digital communication system, the messages produced by the source are converted into a sequence of binary digits.

The process of efficiently converting the output of either an analog or digital source into a sequence of binary digits is called source encoding or data compression.

The sequence of binary digits from the source encoder, which we call the information sequence, is passed to the channel encoder.

The purpose of the channel encoder is to introduce, in a controlled manner, some redundancy in the binary information sequence that can be used at the receiver to overcome the effects of noise and interference encountered in the transmission of the signal through the channel.

This increase the reliability of the received data and improves the fidelity of the received signal.

The binary sequence at the output of the channel encoder is passed to the digital modulator, which serves as the interface to the communication channel.

Since nearly all the communication channels encountered in practice are capable of transmitting electrical signals (waveforms), the primary purpose of the digital modulator is to map the binary information sequence into signal waveforms.

To elaborate on this point, let us suppose that the coded information sequence is to be transmitted one bit at a time at some uniform rate R bits per second (bits/s). The digital modulator may simply map the binary digit 0 into a waveform so(t) and the binary digit 1 into a waveform s, (t). In this manner, each bit from the channel encoder is transmitted separately. We call this binary modulation.

Alternatively, the modulator may transmit 6 coded information bits at a time by using M = 2h distinct waveforms so(t), i = 0, 1, ..., M - 1, one waveform for each of the 26 possible b-bit sequences. We call this M-ary modulation (M > 2).

Note that a new b-bit sequence enters the modulator every b/R seconds. Hence, when the channel bit rate R is fixed, the amount of time available to transmit one of the M waveforms corresponding to a b-bit sequence is b times the time period in a system that uses binary modulation.

The *communication channel* is the physical medium that is used to send the signal from the transmitter to the receiver. In wireless transmission, the channel may be the atmosphere (free space).

On the other hand, telephone channels usually employ a variety of physical media, including wire lines, optical fiber cables, and wireless (microwave radio).

Whatever the physical medium used for transmission of' the information, the essential feature is that the transmitted signal is corrupted in a random manner by a variety of possible mechanisms, such as additive *thermal noise* generated by electronic devices; manmade noise, e.g., automobile ignition noise; and atmospheric noise, e.g., electrical lightning discharges during thunderstorms.

At the receiving end of a digital communication system, the digital demodulator processes the channel -corrupted transmitted waveform and reduces the waveforms to a sequence of numbers that represent estimates of the transmitted data symbols (binary or M -ary).

This sequence of numbers is passed to the channel decoder, which attempts to reconstruct the original information sequence from knowledge of the code used by the channel encoder and the redundancy contained in the received data.

A measure of how well the demodulator and decoder perform is the frequency with which errors occur in the decoded sequence. More precisely, the average probability of a bit-error at the output of the decoder is a measure of the performance of the demodulator decoder combination.

In general, the probability of error is a function of the code characteristics, the types of waveforms used to transmit the information over the channel, the transmitter power, the characteristics of the channel (i.e., the amount of noise, the mature of the interference), and the method of' demodulation and decoding.

The source decoder accepts the output sequence from the channel decoder and, from knowledge of the source encoding method used, attempts to reconstruct the original signal from the source.

Because of channel decoding errors and possible distortion introduced by the source encoder, and perhaps, the source decoder, the signal at the output of the source decoder is an approximation to the original source output The difference or some function of the difference between the original signal and the reconstructed signal is a measure of the distortion introduced by the digital communication system.

2.5 Communication Protocols

A **communication protocol** is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications. A protocol may have a formal description.

Protocols may include signaling, authentication and error detection and correction capabilities.

A protocol definition defines the syntax, semantics, and synchronization of communication; the specified behavior is typically independent of how it is to be implemented. A protocol can therefore be implemented as hardware or software or both.

The data transmission software or protocols perform the following functions for the efficient and error free transmission of data.

1. **Data sequencing:** A long message to be transmitted is broken into smaller packets of fixed size for error free data transmission.

2. **Data Routing :** It is the process of finding the most efficient route between source and destination before sending the data.

3. **Flow control :** All machines are not equally efficient in terms of speed.
Hence the flow control regulates the process of sending data between fast sender and slow receiver.

4. **Error Control :** Error detecting and recovering is the one of the main functions of communication software. It ensures that data are transmitted without any error.

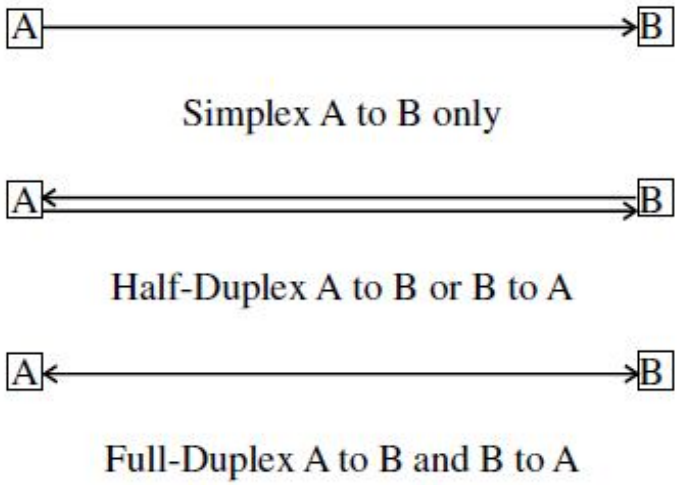
2.6 Data Transmission Modes

There are three ways for transmitting data from one point to another as shown in Fig. 2.2

1. Simplex : In simplex mode the communication can take place in one direction. The receiver receives the signal from the transmitting device. In this mode the flow of information is Uni-directional. Hence it is rarely used for data communication.

2. Half-duplex : In half-duplex mode the communication channel is used in both directions, but only in one direction at a time. Thus a half-duplex line can alternately send and receive data.

3. Full-duplex : In full duplex the communication channel is used in both directions at the same time. Use of full-duplex line improves the efficiency as the line turnaround time required in half-duplex arrangement is eliminated. Example of this mode of transmission is the telephone line.

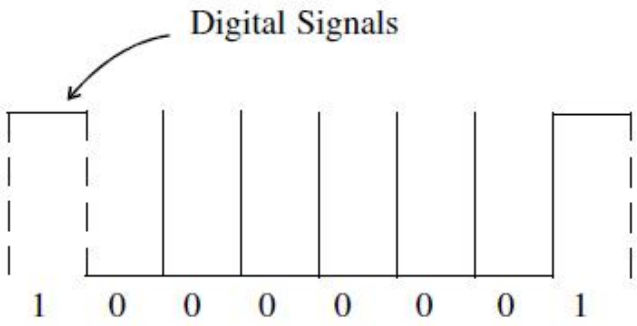


Simplex, Half-Duplex and Full-Duplex.

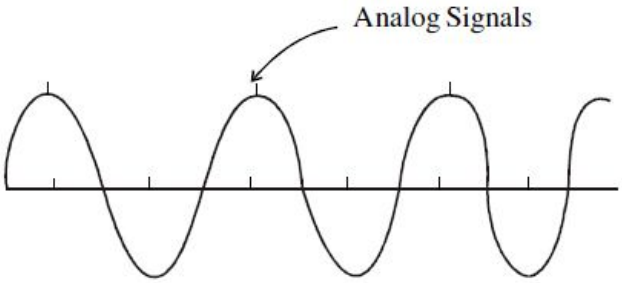
2.6.1 Digital and Analog Transmission

Data is transmitted from one point to another point by means of electrical signals that may be in digital and analog form. So, one should know the fundamental difference between analog and digital signals. In analog signal the transmission power varies over a continuous range with respect to sound, light and radio waves.

On the other hand, a digital signal may assume only discrete set of values within a given range (see figure below). Examples are computer and computer related equipment. Analog signal is measured in Volts and its frequency is in Hertz (Hz). A digital signal is a sequence of voltage represented in binary form. When digital data are to be sent over an analog form the digital signal must be converted to analog form. So the technique by which a digital signal is converted to analog form is known as modulation. And the reverse process, that is the conversion of analog signal to its digital form, is known as demodulation. The device, which converts digital signal into analog, and the reverse, is known as modem.



Digital Signal



Analog Signal

2.6.2 Asynchronous and Synchronous Transmission

Data transmission through a medium can be either asynchronous or synchronous. In asynchronous transmission data is transmitted character by character as you go on typing on a keyboard. Hence there is irregular gaps between characters. However, it is cheaper to implement, as you do not have to save the data before sending. On the other hand, in the synchronous mode, the saved data is transmitted block by block. Each block can contain many characters. Synchronous transmission is well suited for remote communication between a computer and related devices like card reader and printers.

2.7 Types of Communication Services

A term used to describe the data-handling capacity of a communication service is bandwidth. Bandwidth is the range of frequencies that is available for the transmission of data. A narrow range of frequencies in a communication system is analogous to a garden hose with a small diameter. The flow of information in such a system its data rate is restricted, just as is the flow of water in the narrow hose. Wider bandwidths permit more rapid information flow. The communication data transfer rate is measured in a unit called baud. Baud is identical to bits per second. Therefore, a rate of 300 baud is 300 bits per second.

Communication companies such as American Telephone and Telegraph (AT&T) and Western Union are called common carriers, and they provide three general classes of service for both voice and data communication:

1. Narrowband handles low data volumes. Data transmission rates are from 45 to 300 baud. The low-speed devices might use narrow band communications.
2. Voiceband handles moderate data transmission volumes between 300 and 9600 baud. They are used for applications ranging from operating a CRT to running a line printer. Their major application is for telephone voice communication hence, the term voiceband.

3. Broadband handles very large volumes of data. These systems provide data transmission rates of 1 million baud or more. High-speed data analysis and satellite communications are examples of broadband communication systems.

2.8 Transmission Media

Digital data can be transmitted over many different types of media. Selecting a transmission medium is guided by comparing transmission requirements against the medium's characteristics. Four important criteria influence the choice:

1. **Bandwidth.** Bandwidth is the maximum frequency range that can be practically supported by a medium. This is usually expressed in kilo Hz (kHz) or mega Hz (MHz). For example, analog transmission of human speech typically requires a bandwidth of 4 kHz. Also related, is the notion of data rate, which denotes the maximum number of bits per second (bps) that can be transmitted. For example, a data rate of 10 mbps means that 10 million bits of data can be transmitted in each second. Because of their obvious relationship, the terms bandwidth and data rate are sometimes used interchangeably. Because of distortion factors, bandwidth and data rate are usually inversely proportional to the communication distance.
2. **Cost.** Two types of cost are relevant: (i) the cost of installing the medium, including the medium-specific equipment that may be needed, and (ii) the cost of running and maintaining the medium and its equipment. There is usually a need for tradeoff between cost, bandwidth, and distance.
3. **Reliability.** Some media, by their physical nature, transmit data more reliably than others. Low reliability translates into a higher number of errors, which needs to be balanced against the potential cost of recovering from the errors (e.g., retransmission, more complex hardware and software).
4. **Coverage.** The physical characteristics of a medium dictate how long a signal can travel in it before it is distorted beyond recognition. To cover larger areas, repeaters are needed to restore the signal, and this increases the costs.

Transmission media may be classified into the following categories:

- **Copper Wire.** This is the oldest form of electronic transmission medium. Its use dates back to the development of telegraph in the 1800s and earliest telephone systems. Early installations used open wires, but these were superseded by twisted pairs, which consist of a pair of insulated and twisted wires. Twisted pairs are superior because of reduced crosstalk (Crosstalk is the unwanted coupling effect between two or more signal paths, which causes signal distortion). They are very effective for relatively short distances (a few hundred feet), but can be used for up to a few kilometers. A twisted pair has a bandwidth to distance ratio of about 1 MHz per kilometer. The performance of the twisted pair can be substantially improved by adding a metallic shield around the wires. Shielded wires are much more resistant to thermal noise and crosstalk effects. Twisted pairs used for long distance connections (e.g., telephone lines) are usually organized as a much larger cable containing numerous twisted pairs.
- **Coaxial Cable.** A coaxial cable consists of four concentric cylinders: an inner conductor, surrounded by an insulating cylinder, surrounded by an outer conductor, surrounded by a final protective cover. This combination is called a coax. Coaxial cables are superior to twisted pairs both in terms of bandwidth and communication distance, and can provide bandwidth to distance ratios in order of 10s of MHz per kilometer. Like twisted pairs, multiple coaxes are usually housed within one cable, which may also contain twisted pairs. Coaxial cables are extensively used in LANs and long distance telephone trunk lines.

- **Optical Fiber.** An optical fiber consists of two concentric cylinders: an inner core surrounded by a cladding. Both the core and the cladding are made of transparent plastic or glass material. The core is used for guiding a light beam, whereas the cladding (which has a different refractive index) acts as a reflector to prevent the light from escaping from the core. Because optical fiber uses a light signal instead of electrons, it does not suffer from the various noise problems associated with electromagnetic signals. The signal is usually generated by a laser or Light Emitting Diode (LED). Optical fibers can provide bandwidth to distance ratios in order of 100s of MHz per kilometer. Like other cables, hundreds of optical fibers are usually housed within one cable. They are being increasingly used by telecommunication carriers for long distance digital trunk lines. Current trends promise that they will replace twisted pair residential loops in the near future.

- **Radio.** Radio signals have been used for a long time to transmit analog information. They are particularly attractive for long distance communication over difficult terrain or across the oceans, where the cost of installing cables can be too prohibitive. A minimum radio system consists of a transmitter and a receiver. It may operate at a variety of frequency bands, ranging from hundreds of Hz to hundreds of giga Hz (GHz). A huge range of transmission bandwidths are therefore possible. Microwave is by far the most widely used form of radio transmission. It operates in the GHz range with data rates in order of 100s of mbps per channel. Telecommunication carriers and TV stations are the primary users of microwave transmission.

  An important form of microwave system is a satellite system, which is essentially a microwave system plus a large repeater in the sky. The signals transmitted by earth stations are received, amplified, and retransmitted to other earth stations by the satellite. Like other microwave systems, the bandwidth is subdivided into channels of 10s of MHz each, providing data rates in order of 100s of mbps. Because of their high bandwidths, satellites are capable of supporting an enormous number and variety of channels, including TV, telephone, and data. The satellite itself, however, represents a major investment and typically has a limited lifetime (at most a few decades).

  Another increasingly-popular form of radio is **cellular radio,** which is currently being used by carriers for providing mobile telephone networks. These operate in the VHF band and subdivide their coverage area into conceptual cells, where each cell represents a limited area which is served by a low-power transmitter and receiver station. As the mobile user moves from one cell area to another, its communication is handed over from one station to another.

- Infra-red. Infra-red signals are suitable for transmission over relatively short distances (the signal is easily reflected by hard objects). The signal is generated and received using optical transceivers. Infra-red systems represent a cheap alternative to most other methods, because there is no cabling involved and the necessary equipment is relatively cheap. Data rates similar to those of twisted pairs are easily possible. However, applications are limited because of distance limitations (of about one kilometer). One recent use of infra-red has been for interfacing hand-held and portable computing devices to LANs.

Medium	Bandwidth	Data Rates	Cost	Reliability	Coverage
Copper Cable	1 MHz	1-10 mbps	Medium/km	Low-Medium	Kilometers
Coaxial Cable	10s of MHz	10-100 mbps	High/km	Medium-High	10s of Kilometers
Optical Fiber	100s of MHz	100s of mbps	High/km	Very High	10s of Kilometers
Radio	100s of MHz	100s of mbps	Very High	Very High	1000s of Kilometers
Infra-red	1 MHz	1-10 mbps	Low	Low-Medium	Kilometer

Relative comparison of transmission media.

2.9 Computer Network

A computer network is interconnection of various computer systems located at different places. In computer network two or more computers are linked together with a medium and data communication devices for the purpose of communication data and sharing resources. The computer that provides resources to other computers on a network is known as server. In the network the individual computers, which access shared network resources, are known as nodes.

2.10 Types of Networks

There are many different types of networks. However, from an end user's point of view there are two basic types:

- **Local-Area Networks (LANs)**
  The computers are geographically close together (that is, in the same building).
- **Metropolitan Area Network (MAN)**
- **Wide-Area Networks (WANs)**

  The computers are farther apart and are connected by telephone lines or radio waves.

In addition to these types, the following characteristics are also used to categorize different types of networks.

- **Topology**

  The geometric arrangement of a computer system. Common topologies include bus, star, and ring.

- **Protocol**

  The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.

- **Architecture**

  Networks can be broadly classified as using either peer-to-peer or client/server architecture. Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers.

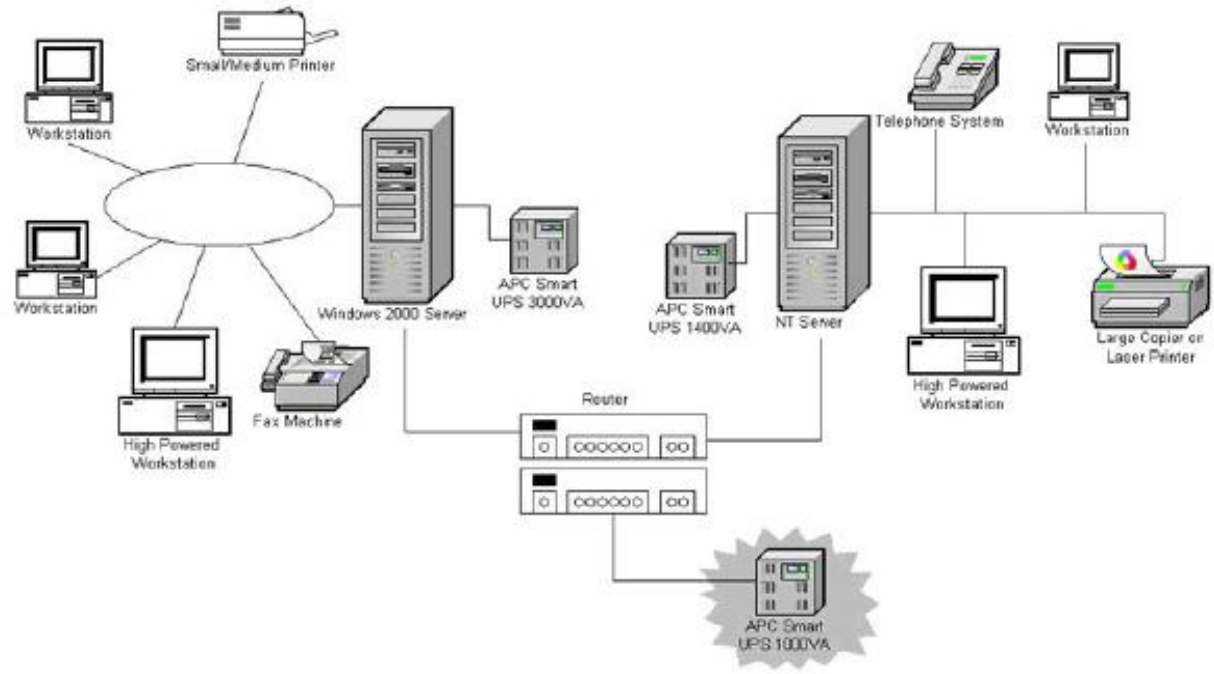
- **Local Area Network (LAN)**

  LAN is a computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANS over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Most LANs as shown in figure connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it is also able to access data and devices anywhere on the LAN.

This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chart sessions.

There are many different types of LANs-token-ring networks, Ethernents, and ARCnets being the most common for PCs.

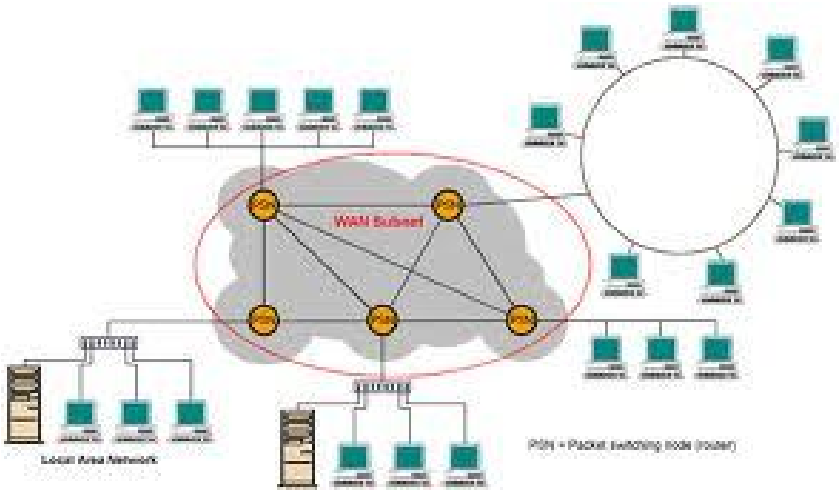


Local Area Network

LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distance are limited, and there is also a limit on the number of computers that can be attached to a single LAN.

Wide Area Network (WAN)

A WAN is a computer network that spans a relatively large geographical area. Typically, A WAN consists of two or more local-area networks (LANs). Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet. A typical WAN set up is shown in the figure below:



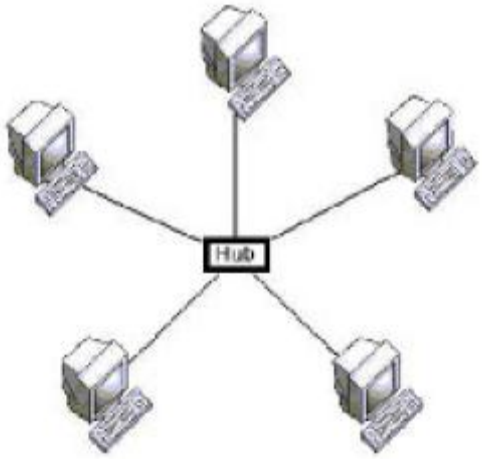
Wide Area Network

Network Topologies

As we have seen earlier, topology is the geometric arrangement of the computers in a network. Common topologies include star, ring and bus.

Star Network

The star network as shown in figure is frequently used to connect one or more small computers or peripheral devices to a large host computer or CPU. Many organizations use the star network or a variation of it in a time-sharing system, in which several users are able to share a central processor.



Star Topology

In a time-sharing setup, each terminal receives a fixed amount of the CPU's time, called a time slice. If you are sitting at a terminal and cannot complete your task during the time slice, the computer will come back to you to allow you to do so. Actually, because the CPU operates so much faster than terminals, you will probably not even notice that the CPU is away.

By establishing time-sharing, many people in a large organization can use a centralized computing facility. Time-sharing can also be purchased from an outside service, which is an economical way to operate for a small company that cannot afford its own large computer.

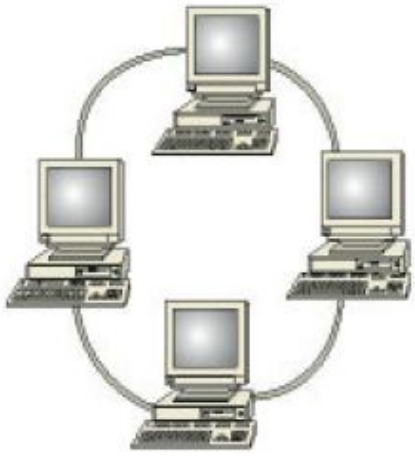
Star network is frequently used in a LAN to connect several microcomputers to a central unit that works as a communications controller. If the user of one microcomputer wants to send a document or

message to a user at another computer, the message is routed through the central communications controller. Another common use of the star network is the feasibility of connecting several microcomputers to a mainframe computer that allows access to an organization's database.

Access and control of star network typically is maintained by a polling system. Polling means that the central computer, or communications controller "polls" or asks each device in the network if it has a message to send and then allows each in turn to transmit data.

Ring Network

The ring network (see figure below) is a Local Area Network (LAN) whose topology is a ring - can be as simple as a circle or point-to-point connections of computers at dispersed locations, with no central host computer or communications controller. That is, all of the nodes are connected in a closed loop. Messages travel around the ring, with each node reading those messages addressed to it. One of the advantages of ring networks is that they can span larger distance than other types of networks, such as bus networks, because each node regenerates messages as they pass through it.



Ring Topology

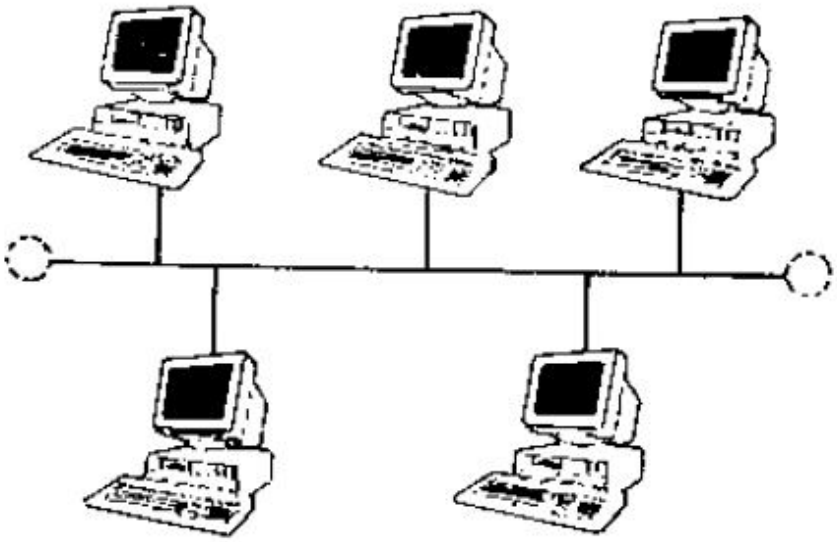
Access and control of ring networks are typically maintained by a "token-passing" system. IBM's Token-Ring network is thought by some observers to be a watershed event comparable to the development of the IBM PCV itself, because the Token-Ring network is designed to link all types of computers together, including not only personal computers but also possible mini computes and mainframes.

A Token-Ring network as shown in figure above resembles a merry-go-round. To deliver a message, you would hand over your addressed note to a rider (the token) on the merry-go-round, who would drop it off at the appropriate place.

Bus Network

Bus networks (see figure below) are similar to ring network that the ends are not connected. All communications are carried on a common cable or bus and are available to each device on the network.

Access and control of bus networks are typically maintained by a method called contention, whereby if a line is unused, a terminal or device can transmit its message at will, but if two or more terminals initiate messages simultaneously, they must stop and transmit again at different intervals.



Bus Network

2.11 Network Protocols

A protocol is an agreed-upon format for transmitting data between two devices. The protocol determines the following :

- The type of error checking to be used.
- Data compression method, if any
- How the sending device will indicate that it has finished sending a message
- How the receiving device will indicate that it has received a message

There are a variety of standard protocols from which programmers can choose. Each has it own particular advantages and disadvantages; for example, some are simpler than the others, some are more reliable, and some are faster.

From a user's point of view, the only interesting aspect about protocols is that your computer or device must support the right ones if you want to communicate with other computers. The protocol can be implemented either in hardware or in software. Some of the popular protocols are TCP/IP, HTTP, FTP, SMTP, POP, Token-Ring, Ethernet, Xmodem, Kermit, MNP, etc.

2.12 Network Architecture

The term architecture can refer to either hardware or software, or a combination of hardware and software. The architecture of a system always defines its broad outlines, and may define precise mechanisms as well.

An open architecture allows the system to be connected easily to devices and programs made by other manufacturers. Open architectures use off-the-shelf components and conform to approved standards. A system with a closed architecture, on the other hand, is one whose design is proprietary, making it difficult to connect the system to other systems. As we have seen before, network architectures can be broadly classified as using either peer-to-peer or client/server architecture.

Peer-to-peer Architecture

This is a type of network in which each workstation has equivalent capabilities and responsibilities. This differs from client/server architecture, in which some workstations are dedicated to serving the others.

Peer-to-peer networks are generally simpler and less expensive, but they usually do not offer the same performance under heavy loads.

Client / Server Architecture

This is a network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processors dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are less powerful PCs workstations on which users run applications. Clients rely on servers for resources, such as files, devices, and even processing power.

2.13 Important terms used in Networking

(a) Internet

The newest type of network to be used within an organisation is an internet or internet web. Such networks enable computers (or network) of any type to communicate easily. The hardware and software needs are the same as for the internet, specifically TCP/IP, server and browser software used for the World Wide Web. Because most organisations have a need for more dynamic ways to link people and information, the internet market is expanding day by day. Moreover, there is no need to adjust the network when a new user joins in. With the help of Internet, all computers of an organisation can work as stand-alone systems, connected to a mainframe, or part of a LAN or WAN.

(b) E-Mail

E-mail stands for electronic mail. This is one of the most widely used features of Internet. Mails are regularly used today where without the help of postage stamp we can transfer mails anywhere in the world. With electronic mail the service is similar. But here data is transmitted through Internet and therefore within minutes the message reaches the destination may it be anywhere in the world. Therefore the mailing system through e-mail is excessively fast and is being used widely for mail transfer.

(c) Voice Messaging

It is a new communication approach which is similar to electronic mail except that it is audio message rather than text messages that are processed. A sender speaks into a telephone rather than typing, giving the name of the recipient and the message. That sender's voice signal is then digitised and stored. The system can then either deliver the message at a specified time in future or it can be retrieved from a database by the recipient. The message is reconverted back into its analog format when it is delivered or retrieved so that the recipient hears it as the original sender's voice on a telephone. Voice messaging requires a computer with an ability to store the audio messages in digital form and then convert them back in an audio form upon verification. Each user has a voice mailbox in secondary storage and special equipment converts the audio message to and from the digital form. The main advantage of voice mail over electronic mail is that the sender does not have to type. Voice mail also makes it easy to include people in the firm's environment in an communication network.

(d) E-Commerce

Electronic commerce or e-commerce as it is popularly known refers to the paperless exchange of business information using Electronic Data Interchange, Electronic mail, Electronic Bulletin Boards, Electronic Fund Transfer and other network based technologies. Electronic Commerce (EC) not only automates manual process and paper transactions, but it also helps organisations to move into a fully electronic environment and change the way they usually operate. Few organisations have recently started conducting EC over Internet, the network of networks. Internet has also helped EC to boost up because it is a low cost alternative to the proprietary networks. EC standards are however under development. Electronic Data Interchange (EDI) is still the dominant part of EC.

Information Technology has transformed the way people work. Electronic Commerce (EC) has unearthed yet another revolution which is changing the way business houses buy and sell products and services. EC is associated with buying and selling of products and services over computer communication networks.

EC transfers information electronically from computer to computer in autonomous way. EC has, in fact, transformed the way organisations operate.

(e) Electronic Data Interchange (EDI)

EDI is the computer-to-computer exchange of business documents in a standard format. These formats look much like standard forms and are highly structured.

(f) Teleconferencing

It refers to electronic meetings that involve people who are at physically different sites. Telecommunication technology allows participants to interact with one another without travelling to the same location.

2.14 Summary

Data transmission is the movement of information using some standard methods. These methods include electrical signals carried along a conductor, optical signals along an optical fibers and electromagnetic areas.

The basic elements that form a communication system are Transmitter, Transmission channel and receiver.

A **communications protocol** is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications.

The data transmission software or protocols perform the following functions for the efficient and error free transmission of data.

1. Data sequencing
2. Data Routing
3. Flow control
4. Error Control

There are three ways for transmitting data from one point to another :

1. **Simplex :** In simplex mode the communication can take place in one direction.
2. **Half-duplex :** In half-duplex mode the communication channel is used in both directions, but only in one direction at a time.
3. **Full-duplex :** In full duplex the communication channel is used in both directions at the same time.

Data transmission through a medium can be either *asynchronous* or *synchronous*. In asynchronous transmission data is transmitted character by character as you go on typing on a keyboard. Hence there is an irregular gap between characters. On the other hand, in the synchronous mode, the saved data is transmitted block by block. Each block can contain many characters.

Transmission media may be classified into the following categories like *Copper Wire, Coaxial Cable, Optical Fiber, Satellite* and *Infra-red.*

Network can be of the following types :

1. LAN (Local Area Network)
2. MAN (Metropolitan Area Network)
3. WAN (Wide Area Network)

Network topology is the geometric arrangement of the computers in a network. Common topologies include star, ring and bus.

A network protocol is an agreed-upon format for transmitting data between two devices. The protocol determines the following :

- The type of error checking to be used.
- Data compression method, if any
- How the sending device will indicate that it has finished sending a message
- How the receiving device will indicate that it has received a message

2.15 Self Assessment Questions

1. What is computer network? What are its main objectives?
2. Distinguish between analog and digital transmission of data.
3. Explain in brief different transmission media.
4. What is the difference between simplex, half-duplex and full-duplex transmission?
5. Explain network architecture briefly.
6. What is communication protocol?
7. What is the difference between asynchronous and synchronous transmission?
8. Distinguish between LAN and WAN.
9. What are the different types of network topology?

2.16 Further Readings

1. De Noia (1987), Martin and Leben (1988), Tanenbaum (1989), and Halsall (1992) are all useful readings.
2. Hughes (1992) is an introductory text with emphasis on practice.
3. Stamper (1991) is a well-illustrated introduction with excellent examples.
4. Black (1989) and Stallings (1994) are examples of highly detailed texts, covering a wide range of protocols.

Unit - 1 : INTRODUCTION TO SOFTWARE

Structure of the Unit

1.0 Objective

After going through this unit student will be able to:

- Understand the meaning of Softwares.
- Understand the about the types of Softwares.
- Understand about Computer Software Licensing.
- Understand about the Computer Programming Languages.
- Understand about the general purpose application softwares.

1.1 Introduction

Software, by definition, is the collection of computer programs, procedures and documentation that performs different tasks on a computer system. The term 'software' was first used by John Turkey in 1958. At the very basic level, computer software consists of a machine language that comprises groups of binary values, which specify processor instructions. The processor instructions change the state of computer hardware in a predefined sequence. Briefly, computer software is the language in which a computer speaks. There are different types of computer software.

1.2 Types of Softwares

Collection of programs is Software. The Software is those components which make the task of a user complete, as it is that component which helps a user to give set of instructions. The Software is categorized on the basis of functions they are:

1. System Software
2. Application Software

1.2.1 System Software:

It helps in running computer hardware and the computer system. System software refers to the operating systems; device drivers, servers, windowing systems and utilities. System software helps an application programmer in abstracting away from hardware, memory and other internal complexities of a computer. An operating system provides users with a platform to execute high-level programs. Firmware and BIOS provide the means to operate hardware.

System Software controls all processing activities and makes sure that the resources and the power of the computer are used in most efficient manner. The System software can categorized in to

(a) Operating System
(b) Language Processors (Assemblers, Compilers, Interpreters)
(c) Device Drivers
(d) Utility Programs etc.

The System software as a package which consists of various programs required for the functioning of the computer itself. It is also needed for translation, loading, controlling and running of the program.

The system software basically serves two major purposes.

a. It controls the execution of programs on the computer.
b. It helps the development of software.

(a) Operating System

This is set of programs that controls and support hardware and provide various services which are used for better performance of computer. The major functions of O.S are

1. It assigns processors to tasks
2. It manages memory and other storage areas
3. It acts as a command interpreter
4. File management
5. Input-Output Management
6. Establishing data security & Integrity
7. Maintains account of processor time for billing purposes.
8. Provides data and time services etc.

The Operating systems can be classified as Single user and Multiuser (number of users working on it at a given point of time) and Multitasking operating systems,

Single user Operating systems - MSDOS
Multi-user Operating System - UNIX, Linux etc.
Multitasking Operating System - Windows

(b) Language Processors

Translators: As the computer accepts digits and characters as input, such input to be conversed into machine language. The Software which makes conversion possible and increases the productivity of the programmer are called Translators.

There are three basic types of translators they are -

i. Compilers
ii. Interpreters
iii. Assembler

i. Compilers: - A compiler is a software that will convert the high level instructions into equivalent Machine level instructions at a time.
ii. Interpreters:- A Interpreter is a software that will convert the high level instructions into equivalent Machine level instructions step by step.
iii. Assembler:- Assembler is a software that will convert the high level instructions into equivalent Machine level instructions but here, the input programs are in assembly language. The output is in machine language.

(c) Device Drivers

These are special programs which are used to enhance the capability of operating systems, so that it can support many input/output devices like mouse, joysticks, printers etc.

(d) Utility Programs

These are also known as service routine, utility software helps in the management of computer hardware and application software. It performs a small range of tasks. Disk defragmenters, systems utilities and virus scanners are some of the typical examples of utility software. These software programs are used to manage data like Directory and File management utilities.

1.2.2 Application Software

It enables the end users to accomplish certain specific tasks. Business software, databases and educational software are some forms of application software. Different word processors, which are dedicated to specialized tasks to be performed by the user, are other examples of application software.

This is that software which serves specific purposes and allows the user to create applications which are for a given purpose like financial accounting, payroll examinations, human resources management etc. These software can be further classified, depending upon the source of development as well as the users:

i) Pre written application software
ii) User written application software

i) Pre written application software.

These are those software packages which are developed by group of people or an individual to be used by others. The most commonly available prewritten application software are:

(a) Word processing software
(b) Electronic spreadsheets
(c) Database management software
(d) Graph generator
(e) Report generator
(f) Communication software

i) *Word processing Software* : These are those software, which usually automate the day today documentation work of an organization.

ii) *Electronic spreadsheets* : Electronic spreadsheets are like sheets are of paper with rows and columns. Electronic spreadsheets allow numbers, characters, formulas and all other types of data which has to be entered in a tabular form into rows or columns. Some of the significant advantages are:-

(a) It provides flexibility and it is easy to incorporate changes.
(b) Automation of various calculations.
(c) Flexibility to size and resize columns.

Some of the most commonly available and used spreadsheets are Lotus-1, 2, 3, MS-Excel, Super Calc etc.

Database management software: Database is an organized collection of data, which is logically related.

Graph generator: As graphical representation of data is much more easy to understand as well is appearing, when the data presented in graphical from like Bar graphs, Pie charts, Line graphs etc. is called Graph generator.

Some of the graphics generators are Lotus 123, Oracle graphics, MS Excel etc.

iii) *Report generator*: There is always a need in day to day operations that timely reports of various activities have to be used, so as to depict, a situation or helping decision making.

iv) *Communication Software*: Communication is the essence of all operations. Effective communication i.e., sending and receiving data plays a key role in the smooth running of any organization.

Some of the other types of software are also available like :

Programming Software: This is one of the most commonly known and popularly used types of computer software. These software come in the form of tools that assist a programmer in writing computer programs. Computer programs are sets of logical instructions that make a computer system perform certain tasks. The tools that help programmers in instructing a computer system include text editors, compilers and interpreters. Compilers translate source code written in a programming language into the language which a computer understands (mostly the binary form). Compilers generate objects which are combined and converted into executable programs through linkers. Debuggers are used to check code for bugs and debug it. The source code is partially or completely simulated for the debugging tool to run on it and remove bugs if any. Interpreters execute programs. They execute the source code or a precompiled code or translate source code into an intermediate language before execution.

Malware: Malware refers to any malicious software and is a broader category of software that are a threat to computer security. Adware, spyware, computer viruses, worms, trojan horses and scareware are malware. Computer viruses are malicious programs which replicate themselves and spread from one computer to another over the network or the Internet. Computer worms do the same, the only difference being that viruses need a host program to attach with and spread, while worms don't need to attach themselves to programs. Trojans replicate themselves and steal information. Spyware can monitor user activity on a computer and steal user information without their knowledge.

Adware: Adware is software with the means of which advertisements are played and downloaded to a computer. Programmers design adware as their tool to generate revenue. They do extract user information like the websites he/she visits frequently and the pages they like. Advertisements that appear as pop-ups on your screen are the result of adware programs tracking you. But adware is not harmful to computer security or user privacy. The data it collects is only for the purpose of inviting user clicks on advertisements.

There are some other types of computer software like inventory management software, ERP, utility software, accounting software among others that find applications in specific information and data management systems. Let's take a look at some of them.

Inventory Management Software: This type of software helps an organization in tracking its goods and materials on the basis of quality as well as quantity. Warehouse inventory management functions encompass the internal warehouse movements and storage. Inventory software helps a company in organizing inventory and optimizing the flow of goods in the organization, thus leading to improved customer service.

Data Backup and Recovery Software: An ideal data backup and recovery software provides functionalities beyond simple copying of data files. This software often supports user needs of specifying what is to be backed up and when. Backup and recovery software preserve the original organization of files and allow an easy retrieval of the backed up data.

1.3 Software and their Licensing

A software license determines the way in which that software can be accessed and used. Depending on the software licensing, the end users have rights to copy, modify or redistribute the software. While some software has to be bought, some are available for free on the Internet. Some licenses allow you to use, copy and distribute the software while others allow only one of the three operations. In some software, the source code is made available to the end users, while in others it is not. Here we will see the ways in which different types of software are distributed to users.

Custom Software: Software that is developed for a specific user or organization is custom software. Since it is built for a specific user, its specifications and features are in accordance with the user's needs.

Off-the-Shelf Software: As opposed to custom software, off-the-shelf software is standard software bought off the shelf. It has predefined specifications that may or may not cater to any specific user's requirements. When you buy it, you agree to its license agreement.

Free Software: Software that a user is free to use, modify and distribute is known as free software. Free software generally comes free of cost but charges may be involved in distribution, servicing and maintenance. The term free refers to freedom of copying, distributing and modifying.

Open Source and Closed Source Software: In a closed source model, the source code is not released to public, while the source code is available for modification and use in open source software. Open source software is available in its source code form and the rights to change, improve and sometimes distribute its code are given under a software license. Software developed by an individual or an organization, where the source code is closed from public (not available openly) is referred to as closed source software.

Proprietary Software: In proprietary software, legal rights remain exclusively with the copyright holder. Most proprietary software are available in the closed source form. Some vendors distribute proprietary software source code to the customers, however, with restricted access. Proprietary software is provided as shareware or demoware wherein users do not have to pay for use and it is distributed as trialware. There are no packaging costs involved. However the programmer may ask you to pay a small fee after which you are entitled to receive assistance and updates of that software.

Shareware and Retail Software: While shareware is provided as a trial version to users, retail software is sold to end users. With the increasing availability of shareware and freeware on the web, the retail market is changing. Developers and vendors have started offering their software over the Internet. At times, shareware is made available as crippleware, wherein its main features do not work after the trial period has ended. In other words, such shareware has to be purchased to enable its crippled features. Though shareware is a very popular form in which software is distributed, retail software is not obsolete. Microsoft Office, for example, is a retail software package that has to be bought. Retail software may be given as an Original Equipment Manufacturer (OEM) Pack. Here, the software developer gives a licensed copy of the software to a computer manufacturer who installs it on computers before they are sold. In the Box Pack form, a licensed copy of the software is bought from an authorized retail outlet.

This was an overview of the major types of software and their ways of distribution. Computer software are widely popular today and we cannot imagine computers without them. We would not have been able to use computers with so much ease, if not for software. What is fascinating about computers is that they have their own languages and their own ways of communicating with us humans. And their means to communicate are these different types of computer software.

1.4 Programming Languages

Programming languages for computers are developed with the primary objective of facilitating a large number of persons to use computers without the need to know in detail the internal structure of a computer. Languages are matched to the type of applications which are to be programmed using the language. The ideal language would be one which expresses precisely the specification of a problem to be solved, and converts it into a series of instructions for a computer. It is not possible to achieve this ideal as a clear specification of a problem is often not available and developing an algorithm from specifications requires subject knowledge and expertise. In actual practice, a detailed algorithm to solve a problem is the starting point and it is expressed as a program in a programming language. A large number of languages, over a thousand, exist each catering to a different class of applications. All modern programming languages (with one exception) are designed to be machine independent. In other words, the structure of the programming language would not depend upon the internal structure of a specified computer; one should be able to execute a program written in the programming language on any computer regardless of who manufactured it or what model it is. Such languages are known as high level machine independent programming languages.

1.4.1 Assembly Language

The first step in the evolution of programming languages was the development of what is known as an assembly language. In an assembly language, mnemonics are used to represent operations to be performed by the computer and strings of characters to represent addresses of locations in the computer's memory where the operands will be stored. Thus the language is matched to a particular computer's processor structure and is thus machine dependent. A translator called an assembler translates a program written in assembly language to a set of machine instructions, which can be executed by a computer. Now-a-days programs are written in assembly language only in applications which are cost sensitive or time critical as efficiency of machine code is of paramount importance in these types of applications. A cost sensitive application is one in which microprocessors are used to enhance the functionality of consumer items such as washing machines or music systems. In these cases the program is stored in a read only memory and its size is small. Thus code optimization is important. A time-critical application is use of microprocessors in aircraft controls where real time operation of the system is required. Here again the number of machine instructions executed should be minimised.

1.4.2 High Level Languages

During the evolution of computers, till about 1955, computers were slow and had a small memory. Thus programming efficiency was very important and assembly language was dominant. With improvements in technology, computers were designed with larger memory capacity, higher speed and improved reliability.

The tremendous potential of computer applications in diverse areas was foreseen. It was evident that this potential could be realised only if a non-expert user could effectively use the computer to solve problems. It was thus clear that a user should be concerned primarily with the development of appropriate algorithms to solve problems and not with the internal logical structure of a computer. Consequently a good notation to express algorithms became an essential requirement. For algorithms to be executed by computers, the notation to express them should be simple, concise, precise and unambiguous. The notation should also match the type of algorithm. For example, programming languages to solve science and engineering problems should support arithmetic using wide ranging, high precision real and complex numbers and should have features to express operations with arrays and matrices. On the other hand, algorithms for processing business data would have operations to be performed on massive amounts of organised data known as files. The notation, in this case, must facilitate describing files and formatting and printing intricate reports. Such notations to express algorithms are known as high level, machine independent,

programming languages. High level programming languages are further classified as procedural and non-procedural. Languages which express step-by-step algorithms written to solve a problem are known as *procedural languages* whereas those which express specifications of a program to be solved are known as *nonprocedural*. We will first discuss the common features of procedural languages.

1.4.3 Procedural Languages

Procedural languages have facilities to:

i) specify data elements such as real, integer, boolean, characters and data structures such as arrays, matrices, stacks, records, sets, strings of characters, lists, trees, etc.,

ii) control structures to sequence operations to be performed.

An if then else structure is necessary to allow programs to follow different sequences of statements based on testing a condition.

For example, the following statement:

```
if ( a > b ) then
        x = y + z ;
        p = q + t
else
        x = y – z ;
        p = q * t
endif
```

commands that the statements x = y + z and p = q + t are to be executed if (a > b) is true. If (a > b) is false x = y – z and p = q * t are executed.

iii) Repetition structures which carry out a group of statements again and again while a condition is true as shown below

```
while (a > b ) do
        x = y – z ;
        p = q * r
end while
```

iv) Statements to input and output data.

Procedural languages are designed using a set of syntax rules, which precisely specify the 'words' of the language, and how they may be combined legally. The rules of syntax are specified using a notation called Backus–Naur Form (BNF) which recursively defines various syntactic units of the language. These rules are similar to the ones used by the great Sanskrit grammarian Panini. A sample BNF definition of a variable name is

```
< variable name > : = < letter >
< variable name > : = < letter > < digit >
< variable name > : = < variable name > < variable name >
```

where < letter > is any upper case English letter A to Z and < digit > is any digit between 0 and 9.

Observe the third line in the above definition, which is a recursive definition.

Besides rules of syntax each language has semantic rules. Each syntactically correct structure should have one and only one semantic interpretation.

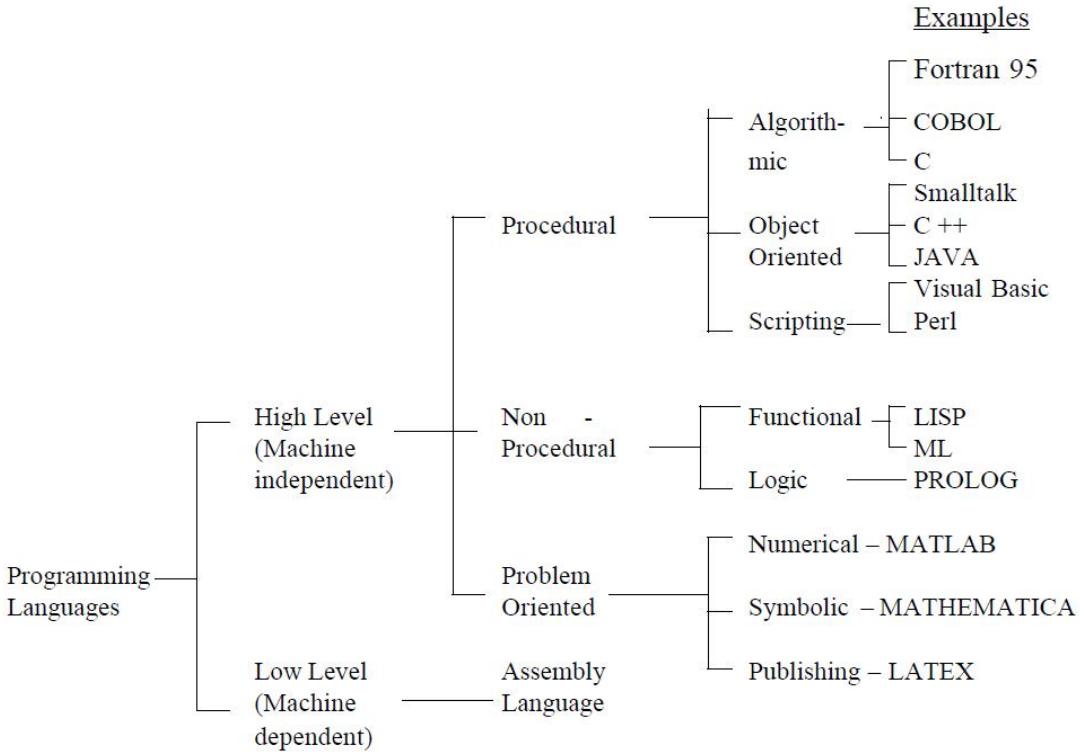
Associated with each high level language is an elaborate computer program which translates it into the machine language of the computer in which it is to be executed. There are two types of translators.

One of them takes each statement of the high level language, translates it and immediately executes it. This is called an interpreter. Interpreters are easy to write but the translated programs' execution is slow. The other approach is to scan the whole program and translate it into an equivalent machine language program. Such a translator is called a compiler.

A compiler is a complex program but the compiled machine code takes lesser time to execute compared to an interpreted program.

1.4.4 A Classification of Programming Languages

We give in Fig.1 a classification of programming languages. We have classified high level machine independent languages into three groups, namely, procedural, non-procedural and problem-oriented. Procedural languages have as their starting point an algorithm to solve the problem. Languages such as FORTRAN, COBOL and C are purely algorithmic. These languages provide a methodology to break up a large job into a number of tasks and programming the tasks independently as functions or subroutines. These functions or subroutines are then combined to form a program. The general idea is to simplify debugging a program and to reuse the procedures in other programs which may need them. Over the years it was realised that this was not sufficient to enable re-use of programs. Subroutines and functions are too rigid. They require the specification of the type of data to be used a priori and the data to be passed to them in a pre-specific order. As the cost of programming continually increased it was realised that 'building' programs using a library of reusable 'components' was imperative. This led to the emergence of the so-called object-oriented languages. In these languages the concept of subroutine/functions is extended to that of an object. An object models a complex real world or an abstract object. A real world object, for example, is a student whereas an abstract object is a course taken by a student. In an object oriented (OOP) program an object is modelled by a collection of data structures and a set of procedures that can be performed on this data structure. A program consists of a collection of objects, each object providing a service when it is invoked and all the objects co-operating to get the job done. Objects are invoked by sending messages to them and objects return messages when the job is done.

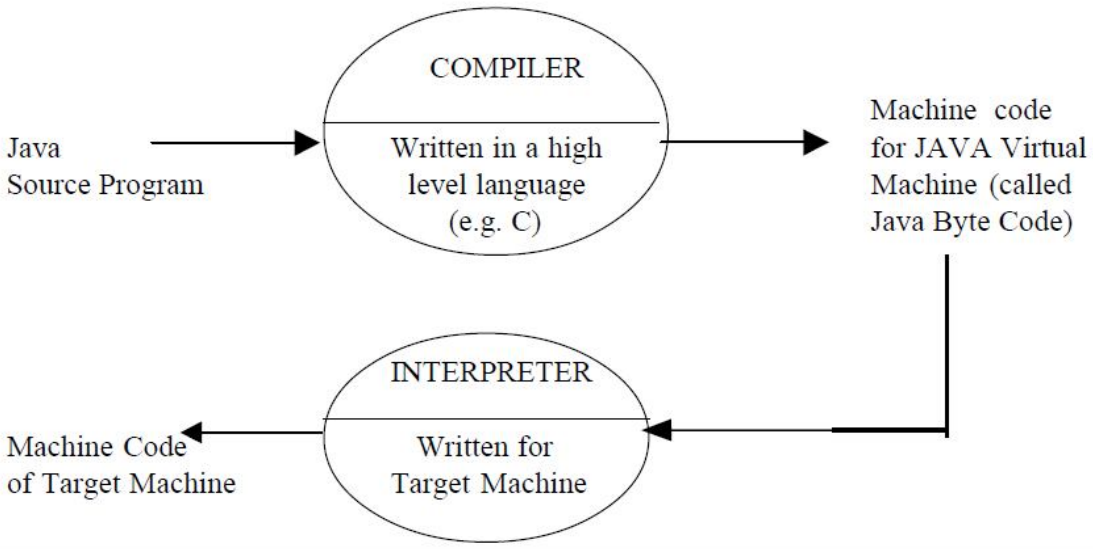


Classification of Programming Languages.

The action performed in response to a message can vary depending on the data and type of parameters. This is called polymorphism. Objects form class hierarchy with super class (parent) and subclass (child) relationship. An object can use procedures and data defined on objects in its superclass through inheritance.

The advantages of object oriented programming (OOP) accrue only when a large software project is undertaken – also known as 'programming in the large'. The methodology of OOP enables a programmer to remain close to the conceptual higher level model of the real world problem. One of the earliest OOP languages to be developed was Smalltalk. It, however, did not become popular. Currently an object oriented version of C known as C++ is the most popular OOP language.

Another development, which has taken place in the last few years, is the internet – an international network of a very large number of national computer networks. The technology developed in creating the internet has been adapted for networking computers within an organization. A computer network within an organization using protocols and providing services similar to an internet is called an intranet. In both inter and intranet small application programs (agents or objects to perform some services – known as applets) may be developed at any one of the computers connected to the network. One would like to create a new application by using these applets by either importing them to one's own computer or using them via the network. A language known as JAVA, which is an object oriented language achieves this. This language achieves machine independence by defining a JAVA virtual machine for which the compiler is written. The JAVA code compiled for the virtual machine is then executed on any machine by an interpreter which generates machine code from the compiled code. This technique makes it easy to port JAVA language to any machine quickly (see Fig. 2). JAVA is getting wide acceptance now as a programming language to write applications for a network of heterogeneous computers.



Illustrating portability of JAVA.

Scripting Languages: Programming languages such as C and JAVA are also known as system programming languages as they have been used to develop large systems. For example C has been used to write the Unix operating system. System programming languages are strongly typed, that is, each variable must be declared as a particular type – real, integer, pointer etc. Typing is used both for easy readability and enabling more efficient compilation and error detection. Another class of languages, which are gaining wider acceptance is called scripting language. Scripting languages assume that a collection of useful programs, each performing a task, already exists in other languages. It has facilities to combine these components to perform a complex task. A scripting language may be thus thought of as a gluing language, which glues together components. One of the earliest scripting languages is Unix Shell. Unix

shell filter programs, read a stream of bytes from an input and write a stream of bytes on to an output. Any two programs can be connected by attaching the output of one program to the input of the other. The following shell commands stack three filters to count the number of lines in the selection that contains the word 'language'.

select | grep language | wc

The program select reads the given text that is currently on the display and prints the text on its output; the grep program reads its input and prints as its output the lines containing the word 'language'; the wc program counts the number of lines on its input. Each of these programs select, grep and wc are independent programs which could be combined with other programs also in many ways. Another popular scripting language is Visual Basic, which is used to develop Graphical User Interfaces (GUI) on the screen of a Visual Display Unit. It is expected that with increasing complexity of applications it will be more cost effective to glue together existing 'program components' using scripting languages. In Table 1 we give a comparison of some of the languages.

	Assembly	System Programming (e.g. C)	Scripting (e.g. PERL)
No. of instructions per statement of language	1	5	100
Degree of typing	None	Strong	Weak
Applications	Time Critical, Cost Critical	Routine Applications	GUI Gluing Components

Comparison of Languages.

Non-procedural Languages: In procedural languages (also known as imperative languages) each statement causes the values stored in one or more memory locations to change. Program design consists of writing a sequence of statements, which transform the 'state' of the memory from an initial state to a final state which is the solution to the problem.

Non-procedural functional languages solve a problem by applying a set of functions to the initial variables in specific ways to get the answer. The syntax of such languages is similar to

fn (fn–1 (fn–2 .....f1 (data))......)

where f's are the successive function applications which transform their arguments which, at the start, is the initial data. LISP and ML are two languages in use which support this model. LISP has been widely used to program artificial intelligence applications.

Another non-procedural class of languages is called rule based languages or logic programming languages. A logic program is expressed as a set of atomic sentences (known as facts) and Horn clauses (if then rules). A query is then posed. Execution of the program now begins and the system tries to find out if the answer to the query is true or false for the given facts and rules. PROLOG is the best known language of this type.

Problem Oriented Languages: Problem oriented languages are designed to solve a narrow class of problems. A user of such a language need not express in detail the procedure used to solve a problem. Readymade procedures are pre-programmed. The user merely presents the data in a flexible 'language'. MATLAB is a very popular language among scientists and engineers to solve a wide class of problems in digital signal processing, control systems, modelling systems described by differential equations, matrix computations etc.

Another class of problem oriented languages is for symbolic manipulation, for example, simplifying a complex algebraic expression or getting the indefinite integral of a complex expression. MATHEMATICAL is a popular language of this type.

1.4.5 Classification based on Applications

Another method of classifying computer languages is by applications. The major applications of computers are in the following areas:

i. Business Data Processing where large files are to be processed. COBOL has been the dominant language in this area. We have seen, however, the emergence of spreadsheet based 'languages' for answering 'what if' type questions. Languages known as 4GLs (Fourth Generation Languages) are also used which provide query languages to access data from data bases and manipulate them. 4 GLs also have special features like 'fill in the blanks' to obtain answers to queries and for designing good looking forms.

ii. Scientific applications require numeric intensive computing such as those used to solve problems in science and engineering. Fortran 90 is the dominant language in this area. C is making inroads. Recently Fortran 95 standard has been published which incorporates features to write Fortran programs for parallel computers.

iii. System programs such as those used to write compilers and operating systems. In this area C and more recently C++ dominate. A language known Ada was specially designed to write programs for these applications but did not become popular.

iv. Scripting programs: Another class of applications is to combine 'program components' to build large programs. Examples of these are: commands to 'back up' files at specified times, sending replies automatically to email messages and invoking certain processes automatically when some conditions are satisfied. Languages have been developed to specify such tasks and sequence them to execute automatically. In UNIX operating system the user command language is called the shell and command programs as shell scripts. This class of languages is called scripting languages. One such language is called PERL (Practical Extraction and Report Language). Visual Basic is used to develop graphical user interfaces.

v. Artificial intelligence applications are characterised by algorithms, which search large data spaces for specific patterns.

   Typical examples are chess playing programs which generate many potential moves and search for the 'best' move within a given time using heuristic rules. LISP and Prolog are preferred languages in this area.

vi. Publishing has become an important application of computers. Languages for word-processing are proliferating and have special formatting commands, print commands etc. TEX is a popular language used to typeset material with complicated mathematical equations. The TEX translator produces a program in the Postscript page description language for printing the material using a laser printer.

1.5 General Purpose Application Softwares

There are general purpose application software and customized application software. General purpose application softwares are developed by software vendors keeping a large set of user, all around the world, in mind. Eg: MS-Word. Customized application softwares are softwares developed for a specific user according to his requirements. Eg: a personalized accounting system for a firm.

Application Software

There are two kinds of software. **System software** works with end users, application software, and computer hardware to handle the majority of technical details. **Application software** can be described as end user software. It is used by end users to accomplish a variety of different tasks.

Application software in turn can be divided into two categories. One category is basic applications. These programs, also known as general-purpose applications and productivity applications, are widely used in nearly every discipline and occupation. They include word processors, spreadsheets, database management systems, and presentation graphics. The other category, specialized applications, also known as special purpose applications, includes thousands of other programs that are more narrowly focused on specific disciplines and occupations. Some of the best known are graphics programs, audio/video editors, multimedia creation programs, Web authoring, and virtual reality programs.

Features

A user interface is the portion of the application that you work with. Most applications use a graphical user interface (GUI) that displays graphical elements called icons to represent familiar objects and a mouse. The mouse controls a pointer on the screen that is used to select items such as icons. Another feature is the use of windows to display information.

A window is simply a rectangular area that can contain a document, program, or message. More than one window can be opened and displayed on the computer screen at one time. For example, one window might contain a graphics program, another a spreadsheet program, and yet another a word processing program.

Almost all software programs have menus to present commands. Typically, menus are displayed in a menu bar at the top of the screen. When one of the menu items is selected, a pull-down or drop-down menu appears. This is a list of options or commands associated with the selected menu. Selecting one of these options may display an additional list of menu options or a dialog box that provides additional information and requests user input. One of the commands on the menu bar is Help. This option provides access to a variety of Help features and acts as an online reference manual for the application. It is an invaluable resource for learning and using application programs.

Toolbars typically are below the menu bar. They contain small outlined areas called buttons that provide shortcuts for quick access to commonly used commands. For example, the standard toolbar contains a variety of buttons that are common to most applications including those to open, save, and print files. All Microsoft Office applications have a common user interface, including similar commands and menu structures.

Word Processors

Word processors create text-based documents and are one of the most flexible and widely used software tools. All types of people and organizations use word processors to create memos, letters, and faxes. Organizations create newsletters, manuals, and brochures to provide information to their customers. Students and researchers use word processors to create reports. Word processors can even be used to create personalized Web pages. The three most widely used word processing programs are Microsoft Word, Corel WordPerfect, and Lotus Word Pro.

Features

Word processors provide a variety of features to make entering, editing, and formatting documents easy. One of the most basic features for entering text is word wrap. This feature automatically moves the

insertion point to the next line once the current line is full. As you type, the words "wrap around" to the next line.

There are numerous features designed to support editing or modifying a document. One of these is a Thesaurus which provides synonyms, antonyms, and related words for a selected word or phrase. You can quickly locate and replace selected words using the find and replace feature. Spelling and grammar checkers look for misspelled words and problems with capitalization, punctuation, and sentence structure. You can use the AutoCorrect feature to automatically make corrections for you. Using AutoText, previously specified words or phrases can be directly inserted into a document upon the user's request. Or as the user begins to enter the specified words or phrases, AutoComplete will complete the text and enter it into the document at the user's request.

There are numerous features designed to improve the format or appearance of a document. These features include:

- *Font* Also known as a typeface, a font is a set of characters with a specific design. Most word processors offer many different fonts.
- *Font size* The height of a character is its font size. It is typically measured in points with each point being approximately 1D 72 inch.
- *Character effects* The appearance of characters can be enhanced using such character effects as bold, italic, shadow, and colors.
- *Alignment* Text can be aligned or positioned on a line. There are four basic types of alignment: left, center, right, and justified.
- *Bulleted and numbered lists* Presenting information in bulleted or numbered lists makes the information easy to read. A sequence or list of topics can be presented as a bulleted list. A sequence of steps or topics can be organized as a numbered list.

Frequently more than one person is involved in creating a document. This is called collaboration and many word processors include features to support this activity. One feature is tracking changes in which changes to the original document are identified.

Spreadsheets

Spreadsheet programs organize, analyze, and graph numeric data such as budgets and financial reports. Once used exclusively by accountants, spreadsheets are widely used by nearly every profession. Students and teachers record grades and calculate grade point averages. Marketing professionals analyze sales trends. Financial analysts evaluate and graph stock market trends. The three most widely used spreadsheet programs are Microsoft Excel, Corel Quattro Pro, and Lotus 1-2-3.

Features

Unlike word processors which manipulate text and create text documents, spreadsheet programs manipulate numeric data and create workbook files. Workbook files consist of one or more related worksheets. A worksheet, also known as a spreadsheet or sheet, is a rectangular grid of rows and columns. For example, the columns are identified by letters and the rows are identified by numbers. The intersection of a row and column creates a cell. For example the cell D8 is formed by the intersection of column D and row 8. A cell can contain text or numeric entries. Text entries or labels provide structure to a worksheet by describing the contents of rows and columns.

A numeric entry can be a number or a formula. A formula is an instruction to calculate or process. For example the cell F15 contains the formula =E5-E13. This formula will calculate a value and display that value in cell F15 (Net). The value is calculated by taking the value in cell E5 (Wages) and subtracting the value in cell E13 (Total Expenses). Functions are prewritten formulas provided by the spreadsheet program that perform calculations such as adding a series of cells. For example, the cell E13 contains the function SUM(D8:D12) which adds the values in the range from D8 to D12. A range is a series of continuous cells. In this case the range includes D8, D9, D10, D11, and D12 and displays the sum in cell E13. Spreadsheet programs typically provide a variety of different types of functions including financial, mathematical, statistical, and logical functions.

Analytical graphs or charts are visual representations of data in a worksheet. You can readily create graphs in a spreadsheet program by selecting the cells containing the data to be charted and then selecting the type of chart to display. If you change one or more numbers in your spreadsheet, all related formulas will automatically recalculate and charts will be recreated. This is called recalculation. The process of observing the effect of changing one or more cells is often referred to as what-if analysis. For example, to analyze the effect of a rent increase in the Monthly Budget worksheet, all you would need to do is replace the contents in cell D9. The entire worksheet including any charts that had been created would be automatically recalculated. There are numerous chart and analysis features.

Database Management Systems

A database is a collection of related data. It is the electronic equivalent of a file cabinet. A database management system (DBMS) or database manager is a program that sets up, or structures, a database. It also provides tools to enter, edit, and retrieve data from the database. All kinds of individuals use databases from teachers recording grades to police officers checking criminal histories. Colleges and universities use databases to keep records on their students, instructors, and courses. Organizations of all types maintain employee databases. Three of the most widely used database management systems designed for microcomputers are Microsoft Access, Corel Paradox, and Lotus Approach.

Features

The relational database is the most widely used database structure. Data is organized into related tables. For example, an organization's personnel database might contain three tables: Employee, Location and Position, and Pay Rate. The Employee table contains basic information, such as employee identification number, first name, and last name. The Location and Position table contains work location information and job title. The Pay Rate table contains employee pay rate and hours worked. All of this data could be contained in one large table; however, smaller tables make the data easier to work with and faster to process.

Each table is made up of rows called records and columns called fields. Each record contains fields of data about some specific person, place, or thing. For example, the Employee table contains several fields including ID, Last Name, and First Name. Every record has at least one primary key or primary field that uniquely identifies the record. Social security numbers, student identification numbers, and employee identification numbers are common primary keys. Tables can be linked or joined by their common fields. The tables are linked by the common field ID. When a database is set up, each field is assigned a field size and data type. Field size is the maximum number of characters that can be entered into the field. Data type defines the kind of data that can be entered.

DBMS provides a variety of tools to create and use databases. A sort tool will quickly rearrange a table's records according to a selected field. For example, the Employee table could be sorted alphabetically by last name. A filter will locate and display records from a table that fit a set of limiting

conditions or criteria. For example, a filter could be used to locate all employees that live in a particular city.

The greatest power of a DBMS, however, comes from its ability to quickly find and bring together information stored in separate tables using queries, forms, and reports.

- A query is a question or a request for specific data contained in a database. Queries are used to view data in different ways, to analyze data, and even to change existing data. For example referring to the Personnel database, a query could be used to locate all employees living in a particular city and working at a specific location. This query would use data contained in Employee table and the Location and Position table.
- Database forms look similar to traditional printed forms. These electronic forms are displayed on the computer monitor and typically reflect the contents for one record in a table. They are primarily used to enter new records and to make changes to existing records.
- Data from tables and queries can be printed in a variety of different report formats. Reports can be a simple listing of an entire field in a table or a list of selected fields based on a query involving several tables. Typical database reports include sales summaries, phone lists, and mailing labels.

Presentation Graphics

Research shows that people learn better when information is presented visually. A picture is indeed worth a thousand words or numbers. Presentation graphics are programs that combine a variety of visual objects to create attractive, visually interesting presentations. They are excellent tools to communicate a message and to persuade people.

People in a variety of settings and situations use presentation graphics programs to make their presentations more interesting and professional. For example, marketing managers use presentation graphics to present proposed marketing strategies to their superiors. Sales people use these programs to demonstrate products and encourage customers to make purchases. Students use presentation graphics programs to create high-quality class presentations. Three of the most widely used presentation graphics programs are Microsoft PowerPoint, Corel Presentations, and Lotus Freelance Graphics.

Features

An electronic presentation consists of a series of slides. The slides can be presented either in the layout view, or the normal view, which is used to create individual slides or the slide show view, which is used to present the slides. The slides can be presented in a variety of ways called presentation styles. These styles include onscreen presentations, Web presentations, overhead slides, and 35mm slides.

Presentation programs include a variety of features to help you create effective dynamic presentations. Most include a wizard such as Microsoft's AutoContent wizard that steps you through the process of creating a presentation. Other features include tools to select alternative color schemes, slide layouts, special effects, design templates, and master slides.

- Color schemes are combinations of complementary colors to apply to a slide's background, text, and other elements.
- Each slide in a presentation can have a different slide layout or arrangement of items.
- Special effects such as animation, transitions, and builds add interest and motion to a presentation. Animation adds action to text and graphics and interest with prerecorded sounds. Transitions control how one slide moves off the screen and the next one appears. Builds are used to display

each bullet point, text, paragraph or graphic independently of the other text or objects on the slide.

- Design templates provide professionally selected combinations of color schemes, slide layouts, and special effects.
- The master slide is a special slide that does not appear in a presentation but controls all the format and placement of all slides in a presentation. The design template for a presentation can be easily changed for an entire presentation using the master slide.

Integrated Packages

An integrated package is a single program that provides the functionality of a word processor, spreadsheet, database manager, and more. The primary disadvantage of an integrated package is that the capabilities of each function (such as word processing) are not as extensive as in the individual programs (such as Microsoft Word). The primary advantages are cost and simplicity. The cost of an integrated package is much less than the cost of the individual powerful, professional grade application programs discussed thus far in this chapter. Because an integrated package is a single program, using and switching between functions is very easy and convenient.

Integrated packages are popular with many home users who are willing to sacrifice some advanced features for lower cost and simplicity. For this reason, integrated packages are sometimes classified as personal or home software. The most widely used integrated packages are Microsoft Works and AppleWorks.

1.6 Summary

Software, by definition, is the collection of computer programs, procedures and documentation that performs different tasks on a computer system.

The Software is categorized on the basis of functions are *System Software* and *Application Software*.

System Software helps in running computer hardware and the computer system. System software refers to the operating systems; device drivers, servers, windowing systems and utilities.

The System software can categorized in to *Operating System, Language Processors (Assemblers, Compilers, Interpreters), Device Drivers* and *Utility Programs* etc.

Application Software enables the end users to accomplish certain specific tasks. Business software, databases, word processors and educational software are some forms of application software. These software can be further classified, depending upon the source of development as well the users:

i) Pre written application software

ii) User written application software

A software license determines the way in which that software can be accessed and used. Different types of ways software are distributed to users are *Custom Software, Off-the-Shelf Software, Free Software, Open Source and Closed Source Software, Proprietary Software, Shareware and Retail Software*.

Programming languages can be further divided into following categories like *Assembly Language, High Level Language* and *Procedural Languages*.

General purpose application softwares are developed by software vendors keeping a large set of user, all around the world, in mind. Eg: Word Processor, Spreadsheet, Database Management System etc.

1.7 Self Assessment Questions

1. What do you mean by Software? Explain different types of Softwares.
2. What are System Softwares? How they are different than Application Softwares?
3. What do you mean by Software Licensing? Discuss different types of ways softwares are distributed to users.
4. What are Programming Languages? Why they are required? Discuss different types of programming languages.
5. What are General Purpose Application Softwares? Discuss some of the general purpose application softwares and their features.

1.8 Further Readings

1. Pratt T W and Zelkowitz M V. Programming Languages. (3rd edition), Prentice Hall of India, New Delhi, 1996.
2. Bird R and Wadler P. Introduction to Functional Programming. Prentice Hall Inc., Englewood–Cliffs, N J, USA, 1988.
3. Ousterhout J K. Scripting: High level Programming for the 21st Century. Computer. (IEEE, U.S.A), Vol.31, No.3, 23–30, March 1998.
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Unit - 2 : COMMUNICATION AND CONNECTIVITY

Structure of the Unit

2.0 Objective

After going through this unit, you will be able to learn the basic elements of data communication system:

- describe communication protocols and data transmission modes
- explain the use of computer network
- describe different components of computer network
- identify different types of network

2.1 Introduction

Today computer is available in many offices and homes and therefore there is a need to share data and programs among various computers. With the advancement of data communication facilities the communication between computers has increased and thus it has extended the power of computer beyond the computer room. Now a user sitting at one place can communicate with computers of any remote site through communication channel. The aim of this lesson is to introduce you the various aspects of computer network.

2.2 Data Communication

We all are acquainted with some sorts of communication in our day to day life. For communication of information and messages we use telephone and postal communication systems. Similarly data and information from one computer system can be transmitted to other systems across geographical areas. Thus data transmission is the movement of information using some standard methods. These methods include electrical signals carried along a conductor, optical signals along an optical fibers and electromagnetic areas.

Suppose a manager has to write several letters to various clients. First he has to use his PC and Word Processing package to prepare the letter, if the PC is connected to all the client's PC through networking, he can send the letters to all the clients within minutes. Thus irrespective of geographical areas, if PCs are connected through communication channel, the data and information, computer files and any other programs can be transmitted to other computer systems within seconds. The modern form of communication like e-mail and Internet is possible only because of computer networking.

2.3 Basic Elements of a Communication System

The basic elements that form a communication system are :-

The transmitter :

which processes the input signal to produce a transmitted signal suited to the characteristics of the transmission channel. Signal processing for transmission almost always includes modulation and may include coding.

The transmission channel :

which is the electrical medium that bridges the distance from source to destination.It may be a pair of wires, coaxial cable, or a radio wave or laser beam.Every channel experiences some amount of transmission loss or attenuation, so the signal power progressively decreases with increasing distance.

The receiver :

operates on the output signal from the channel in preparation for delivery to the transducer at the destination. Receiver operations include amplification to compensate for transmission loss, and demodulation and decoding to reverse the signal-processing performed at the transmitter. Filter is another important function of the receiver.

In data communication four basic terms are frequently used. They are:

Data : A collection of facts in raw forms that become information after processing.

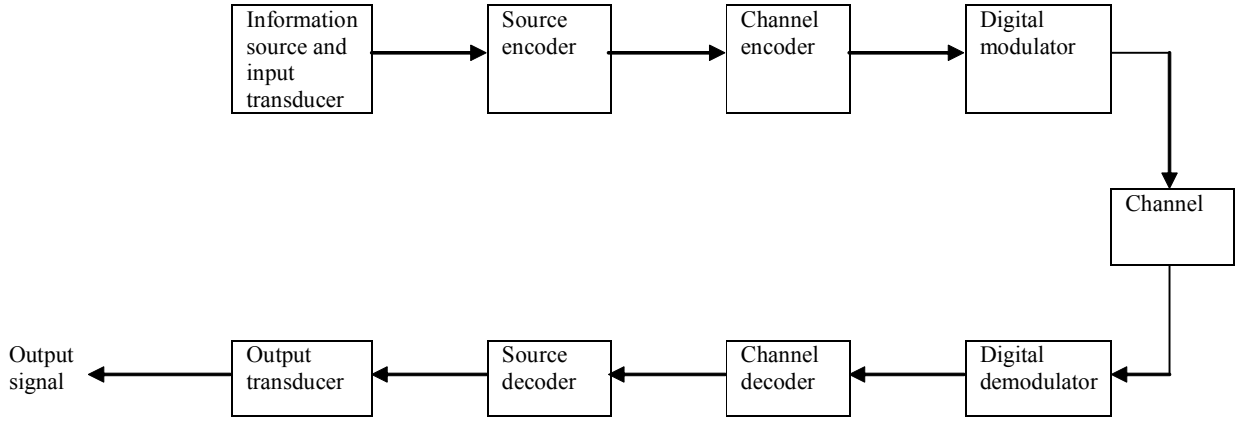
Signals : Electric or electromagnetic encoding of data.

Signaling : Propagation of signals across a communication medium.

Transmission : Communication of data achieved by the processing of signals.

2.4 Elements of a Digital Communication System

Following figure illustrates the functional diagram and the basic elements of a digital communication system.



Basic elements of a digital communication system.

The source output may be either an analog signal, such as an audio or video signal, or a digital signal, such as the output of a teletype machine, that is discrete in time and has a finite number of output characters.

In a digital communication system, the messages produced by the source are converted into a sequence of binary digits.

The process of efficiently converting the output of either an analog or digital source into a sequence of binary digits is called source encoding or data compression.

The sequence of binary digits from the source encoder, which we call the information sequence, is passed to the channel encoder.

The purpose of the channel encoder is to introduce, in a controlled manner, some redundancy in the binary information sequence that can be used at the receiver to overcome the effects of noise and interference encountered in the transmission of the signal through the channel.

This increase the reliability of the received data and improves the fidelity of the received signal.

The binary sequence at the output of the channel encoder is passed to the digital modulator, which serves as the interface to the communication channel.

Since nearly all the communication channels encountered in practice are capable of transmitting electrical signals (waveforms), the primary purpose of the digital modulator is to map the binary information sequence into signal waveforms.

To elaborate on this point, let us suppose that the coded information sequence is to be transmitted one bit at a time at some uniform rate R bits per second (bits/s). The digital modulator may simply map the binary digit 0 into a waveform so(t) and the binary digit 1 into a waveform s, (t). In this manner, each bit from the channel encoder is transmitted separately. We call this binary modulation.

Alternatively, the modulator may transmit 6 coded information bits at a time by using M = 2h distinct waveforms so(t), i = 0, 1, ..., M - 1, one waveform for each of the 26 possible b-bit sequences. We call this M-ary modulation (M > 2).

Note that a new b-bit sequence enters the modulator every b/R seconds. Hence, when the channel bit rate R is fixed, the amount of time available to transmit one of the M waveforms corresponding to a b-bit sequence is b times the time period in a system that uses binary modulation.

The *communication channel* is the physical medium that is used to send the signal from the transmitter to the receiver. In wireless transmission, the channel may be the atmosphere (free space).

On the other hand, telephone channels usually employ a variety of physical media, including wire lines, optical fiber cables, and wireless (microwave radio).

Whatever the physical medium used for transmission of' the information, the essential feature is that the transmitted signal is corrupted in a random manner by a variety of possible mechanisms, such as additive *thermal noise* generated by electronic devices; manmade noise, e.g., automobile ignition noise; and atmospheric noise, e.g., electrical lightning discharges during thunderstorms.

At the receiving end of a digital communication system, the digital demodulator processes the channel -corrupted transmitted waveform and reduces the waveforms to a sequence of numbers that represent estimates of the transmitted data symbols (binary or M -ary).

This sequence of numbers is passed to the channel decoder, which attempts to reconstruct the original information sequence from knowledge of the code used by the channel encoder and the redundancy contained in the received data.

A measure of how well the demodulator and decoder perform is the frequency with which errors occur in the decoded sequence. More precisely, the average probability of a bit-error at the output of the decoder is a measure of the performance of the demodulator decoder combination.

In general, the probability of error is a function of the code characteristics, the types of waveforms used to transmit the information over the channel, the transmitter power, the characteristics of the channel (i.e., the amount of noise, the mature of the interference), and the method of' demodulation and decoding.

The source decoder accepts the output sequence from the channel decoder and, from knowledge of the source encoding method used, attempts to reconstruct the original signal from the source.

Because of channel decoding errors and possible distortion introduced by the source encoder, and perhaps, the source decoder, the signal at the output of the source decoder is an approximation to the original source output The difference or some function of the difference between the original signal and the reconstructed signal is a measure of the distortion introduced by the digital communication system.

2.5 Communication Protocols

A **communication protocol** is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications. A protocol may have a formal description.

Protocols may include signaling, authentication and error detection and correction capabilities.

A protocol definition defines the syntax, semantics, and synchronization of communication; the specified behavior is typically independent of how it is to be implemented. A protocol can therefore be implemented as hardware or software or both.

The data transmission software or protocols perform the following functions for the efficient and error free transmission of data.

1. **Data sequencing:** A long message to be transmitted is broken into smaller packets of fixed size for error free data transmission.

2. **Data Routing :** It is the process of finding the most efficient route between source and destination before sending the data.

3. **Flow control :** All machines are not equally efficient in terms of speed.
Hence the flow control regulates the process of sending data between fast sender and slow receiver.

4. **Error Control :** Error detecting and recovering is the one of the main functions of communication software. It ensures that data are transmitted without any error.

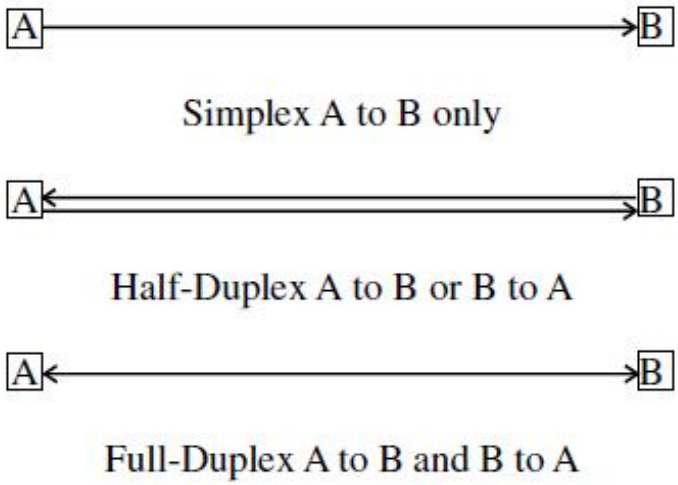
2.6 Data Transmission Modes

There are three ways for transmitting data from one point to another as shown in Fig. 2.2

1. Simplex : In simplex mode the communication can take place in one direction. The receiver receives the signal from the transmitting device. In this mode the flow of information is Uni-directional. Hence it is rarely used for data communication.

2. Half-duplex : In half-duplex mode the communication channel is used in both directions, but only in one direction at a time. Thus a half-duplex line can alternately send and receive data.

3. Full-duplex : In full duplex the communication channel is used in both directions at the same time. Use of full-duplex line improves the efficiency as the line turnaround time required in half-duplex arrangement is eliminated. Example of this mode of transmission is the telephone line.

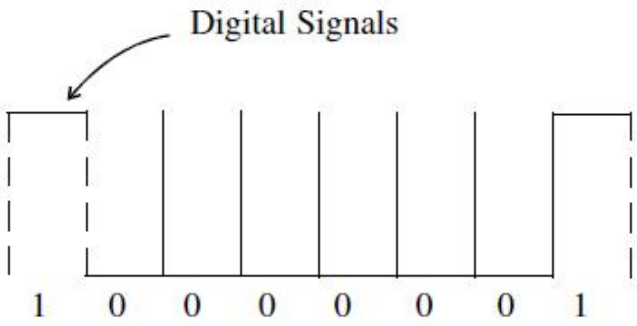


Simplex, Half-Duplex and Full-Duplex.

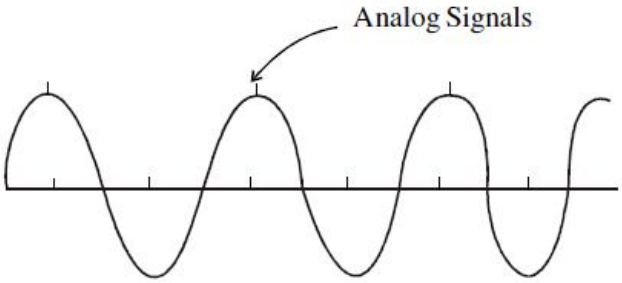
2.6.1 Digital and Analog Transmission

Data is transmitted from one point to another point by means of electrical signals that may be in digital and analog form. So, one should know the fundamental difference between analog and digital signals. In analog signal the transmission power varies over a continuous range with respect to sound, light and radio waves.

On the other hand, a digital signal may assume only discrete set of values within a given range (see figure below). Examples are computer and computer related equipment. Analog signal is measured in Volts and its frequency is in Hertz (Hz). A digital signal is a sequence of voltage represented in binary form. When digital data are to be sent over an analog form the digital signal must be converted to analog form. So the technique by which a digital signal is converted to analog form is known as modulation. And the reverse process, that is the conversion of analog signal to its digital form, is known as demodulation. The device, which converts digital signal into analog, and the reverse, is known as modem.



Digital Signal



Analog Signal

2.6.2 Asynchronous and Synchronous Transmission

Data transmission through a medium can be either asynchronous or synchronous. In asynchronous transmission data is transmitted character by character as you go on typing on a keyboard. Hence there is irregular gaps between characters. However, it is cheaper to implement, as you do not have to save the data before sending. On the other hand, in the synchronous mode, the saved data is transmitted block by block. Each block can contain many characters. Synchronous transmission is well suited for remote communication between a computer and related devices like card reader and printers.

2.7 Types of Communication Services

A term used to describe the data-handling capacity of a communication service is bandwidth. Bandwidth is the range of frequencies that is available for the transmission of data. A narrow range of frequencies in a communication system is analogous to a garden hose with a small diameter. The flow of information in such a system its data rate is restricted, just as is the flow of water in the narrow hose. Wider bandwidths permit more rapid information flow. The communication data transfer rate is measured in a unit called baud. Baud is identical to bits per second. Therefore, a rate of 300 baud is 300 bits per second.

Communication companies such as American Telephone and Telegraph (AT&T) and Western Union are called common carriers, and they provide three general classes of service for both voice and data communication:

1. Narrowband handles low data volumes. Data transmission rates are from 45 to 300 baud. The low-speed devices might use narrow band communications.
2. Voiceband handles moderate data transmission volumes between 300 and 9600 baud. They are used for applications ranging from operating a CRT to running a line printer. Their major application is for telephone voice communication hence, the term voiceband.

3. Broadband handles very large volumes of data. These systems provide data transmission rates of 1 million baud or more. High-speed data analysis and satellite communications are examples of broadband communication systems.

2.8 Transmission Media

Digital data can be transmitted over many different types of media. Selecting a transmission medium is guided by comparing transmission requirements against the medium's characteristics. Four important criteria influence the choice:

1. **Bandwidth.** Bandwidth is the maximum frequency range that can be practically supported by a medium. This is usually expressed in kilo Hz (kHz) or mega Hz (MHz). For example, analog transmission of human speech typically requires a bandwidth of 4 kHz. Also related, is the notion of data rate, which denotes the maximum number of bits per second (bps) that can be transmitted. For example, a data rate of 10 mbps means that 10 million bits of data can be transmitted in each second. Because of their obvious relationship, the terms bandwidth and data rate are sometimes used interchangeably. Because of distortion factors, bandwidth and data rate are usually inversely proportional to the communication distance.
2. **Cost.** Two types of cost are relevant: (i) the cost of installing the medium, including the medium-specific equipment that may be needed, and (ii) the cost of running and maintaining the medium and its equipment. There is usually a need for tradeoff between cost, bandwidth, and distance.
3. **Reliability.** Some media, by their physical nature, transmit data more reliably than others. Low reliability translates into a higher number of errors, which needs to be balanced against the potential cost of recovering from the errors (e.g., retransmission, more complex hardware and software).
4. **Coverage.** The physical characteristics of a medium dictate how long a signal can travel in it before it is distorted beyond recognition. To cover larger areas, repeaters are needed to restore the signal, and this increases the costs.

Transmission media may be classified into the following categories:

- **Copper Wire.** This is the oldest form of electronic transmission medium. Its use dates back to the development of telegraph in the 1800s and earliest telephone systems. Early installations used open wires, but these were superseded by twisted pairs, which consist of a pair of insulated and twisted wires. Twisted pairs are superior because of reduced crosstalk (Crosstalk is the unwanted coupling effect between two or more signal paths, which causes signal distortion). They are very effective for relatively short distances (a few hundred feet), but can be used for up to a few kilometers. A twisted pair has a bandwidth to distance ratio of about 1 MHz per kilometer. The performance of the twisted pair can be substantially improved by adding a metallic shield around the wires. Shielded wires are much more resistant to thermal noise and crosstalk effects. Twisted pairs used for long distance connections (e.g., telephone lines) are usually organized as a much larger cable containing numerous twisted pairs.
- **Coaxial Cable.** A coaxial cable consists of four concentric cylinders: an inner conductor, surrounded by an insulating cylinder, surrounded by an outer conductor, surrounded by a final protective cover. This combination is called a coax. Coaxial cables are superior to twisted pairs both in terms of bandwidth and communication distance, and can provide bandwidth to distance ratios in order of 10s of MHz per kilometer. Like twisted pairs, multiple coaxes are usually housed within one cable, which may also contain twisted pairs. Coaxial cables are extensively used in LANs and long distance telephone trunk lines.

- **Optical Fiber.** An optical fiber consists of two concentric cylinders: an inner core surrounded by a cladding. Both the core and the cladding are made of transparent plastic or glass material. The core is used for guiding a light beam, whereas the cladding (which has a different refractive index) acts as a reflector to prevent the light from escaping from the core. Because optical fiber uses a light signal instead of electrons, it does not suffer from the various noise problems associated with electromagnetic signals. The signal is usually generated by a laser or Light Emitting Diode (LED). Optical fibers can provide bandwidth to distance ratios in order of 100s of MHz per kilometer. Like other cables, hundreds of optical fibers are usually housed within one cable. They are being increasingly used by telecommunication carriers for long distance digital trunk lines. Current trends promise that they will replace twisted pair residential loops in the near future.

- **Radio.** Radio signals have been used for a long time to transmit analog information. They are particularly attractive for long distance communication over difficult terrain or across the oceans, where the cost of installing cables can be too prohibitive. A minimum radio system consists of a transmitter and a receiver. It may operate at a variety of frequency bands, ranging from hundreds of Hz to hundreds of giga Hz (GHz). A huge range of transmission bandwidths are therefore possible. Microwave is by far the most widely used form of radio transmission. It operates in the GHz range with data rates in order of 100s of mbps per channel. Telecommunication carriers and TV stations are the primary users of microwave transmission.

  An important form of microwave system is a satellite system, which is essentially a microwave system plus a large repeater in the sky. The signals transmitted by earth stations are received, amplified, and retransmitted to other earth stations by the satellite. Like other microwave systems, the bandwidth is subdivided into channels of 10s of MHz each, providing data rates in order of 100s of mbps. Because of their high bandwidths, satellites are capable of supporting an enormous number and variety of channels, including TV, telephone, and data. The satellite itself, however, represents a major investment and typically has a limited lifetime (at most a few decades).

  Another increasingly-popular form of radio is **cellular radio,** which is currently being used by carriers for providing mobile telephone networks. These operate in the VHF band and subdivide their coverage area into conceptual cells, where each cell represents a limited area which is served by a low-power transmitter and receiver station. As the mobile user moves from one cell area to another, its communication is handed over from one station to another.

- Infra-red. Infra-red signals are suitable for transmission over relatively short distances (the signal is easily reflected by hard objects). The signal is generated and received using optical transceivers. Infra-red systems represent a cheap alternative to most other methods, because there is no cabling involved and the necessary equipment is relatively cheap. Data rates similar to those of twisted pairs are easily possible. However, applications are limited because of distance limitations (of about one kilometer). One recent use of infra-red has been for interfacing hand-held and portable computing devices to LANs.

Medium	Bandwidth	Data Rates	Cost	Reliability	Coverage
Copper Cable	1 MHz	1-10 mbps	Medium/km	Low-Medium	Kilometers
Coaxial Cable	10s of MHz	10-100 mbps	High/km	Medium-High	10s of Kilometers
Optical Fiber	100s of MHz	100s of mbps	High/km	Very High	10s of Kilometers
Radio	100s of MHz	100s of mbps	Very High	Very High	1000s of Kilometers
Infra-red	1 MHz	1-10 mbps	Low	Low-Medium	Kilometer

Relative comparison of transmission media.

2.9 Computer Network

A computer network is interconnection of various computer systems located at different places. In computer network two or more computers are linked together with a medium and data communication devices for the purpose of communication data and sharing resources. The computer that provides resources to other computers on a network is known as server. In the network the individual computers, which access shared network resources, are known as nodes.

2.10 Types of Networks

There are many different types of networks. However, from an end user's point of view there are two basic types:

- **Local-Area Networks (LANs)**
  The computers are geographically close together (that is, in the same building).
- **Metropolitan Area Network (MAN)**
- **Wide-Area Networks (WANs)**

  The computers are farther apart and are connected by telephone lines or radio waves.

In addition to these types, the following characteristics are also used to categorize different types of networks.

- **Topology**

  The geometric arrangement of a computer system. Common topologies include bus, star, and ring.

- **Protocol**

  The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.

- **Architecture**

  Networks can be broadly classified as using either peer-to-peer or client/server architecture. Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers.

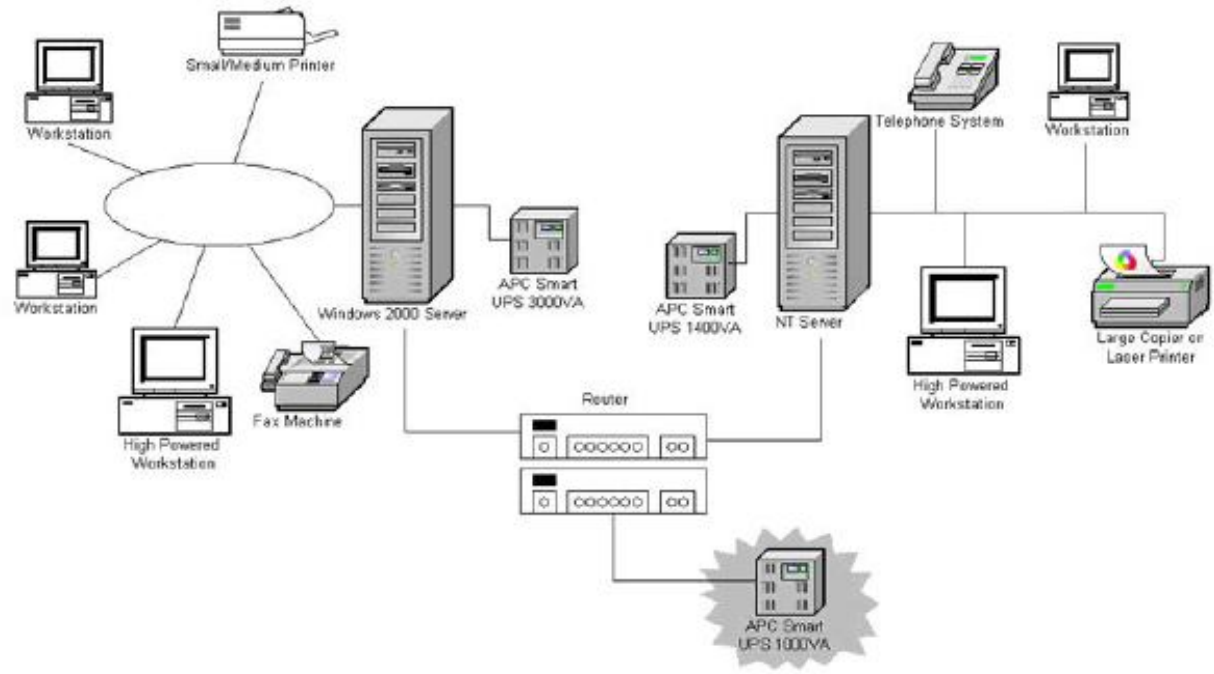
- **Local Area Network (LAN)**

  LAN is a computer network that spans a relatively small area. Most LANs are confined to a single building or group of buildings. However, one LAN can be connected to other LANS over any distance via telephone lines and radio waves. A system of LANs connected in this way is called a wide-area network (WAN).

Most LANs as shown in figure connect workstations and personal computers. Each node (individual computer) in a LAN has its own CPU with which it executes programs, but it is also able to access data and devices anywhere on the LAN.

This means that many users can share expensive devices, such as laser printers, as well as data. Users can also use the LAN to communicate with each other, by sending e-mail or engaging in chart sessions.

There are many different types of LANs-token-ring networks, Ethernents, and ARCnets being the most common for PCs.

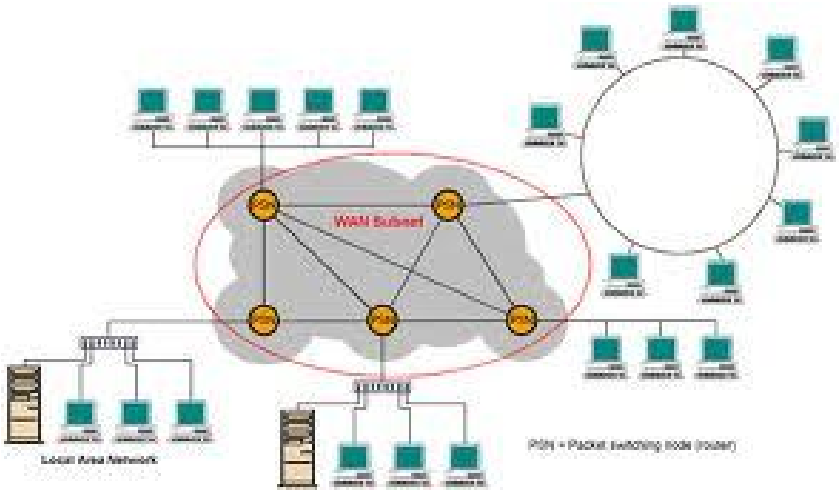


Local Area Network

LANs are capable of transmitting data at very fast rates, much faster than data can be transmitted over a telephone line; but the distance are limited, and there is also a limit on the number of computers that can be attached to a single LAN.

Wide Area Network (WAN)

A WAN is a computer network that spans a relatively large geographical area. Typically, A WAN consists of two or more local-area networks (LANs). Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites. The largest WAN in existence is the Internet. A typical WAN set up is shown in the figure below:



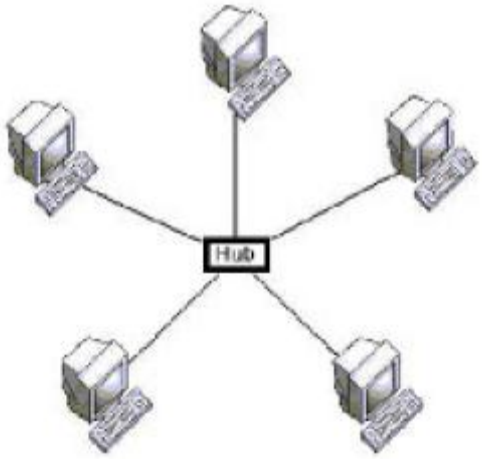
Wide Area Network

Network Topologies

As we have seen earlier, topology is the geometric arrangement of the computers in a network. Common topologies include star, ring and bus.

Star Network

The star network as shown in figure is frequently used to connect one or more small computers or peripheral devices to a large host computer or CPU. Many organizations use the star network or a variation of it in a time-sharing system, in which several users are able to share a central processor.



Star Topology

In a time-sharing setup, each terminal receives a fixed amount of the CPU's time, called a time slice. If you are sitting at a terminal and cannot complete your task during the time slice, the computer will come back to you to allow you to do so. Actually, because the CPU operates so much faster than terminals, you will probably not even notice that the CPU is away.

By establishing time-sharing, many people in a large organization can use a centralized computing facility. Time-sharing can also be purchased from an outside service, which is an economical way to operate for a small company that cannot afford its own large computer.

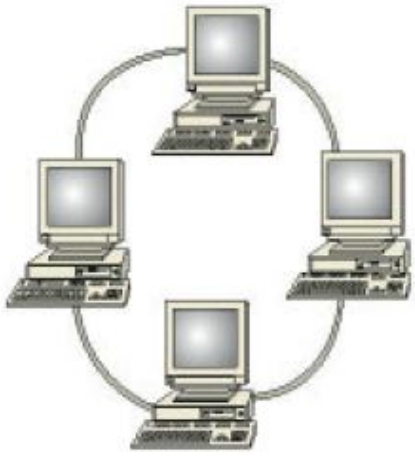
Star network is frequently used in a LAN to connect several microcomputers to a central unit that works as a communications controller. If the user of one microcomputer wants to send a document or

message to a user at another computer, the message is routed through the central communications controller. Another common use of the star network is the feasibility of connecting several microcomputers to a mainframe computer that allows access to an organization's database.

Access and control of star network typically is maintained by a polling system. Polling means that the central computer, or communications controller "polls" or asks each device in the network if it has a message to send and then allows each in turn to transmit data.

Ring Network

The ring network (see figure below) is a Local Area Network (LAN) whose topology is a ring - can be as simple as a circle or point-to-point connections of computers at dispersed locations, with no central host computer or communications controller. That is, all of the nodes are connected in a closed loop. Messages travel around the ring, with each node reading those messages addressed to it. One of the advantages of ring networks is that they can span larger distance than other types of networks, such as bus networks, because each node regenerates messages as they pass through it.



Ring Topology

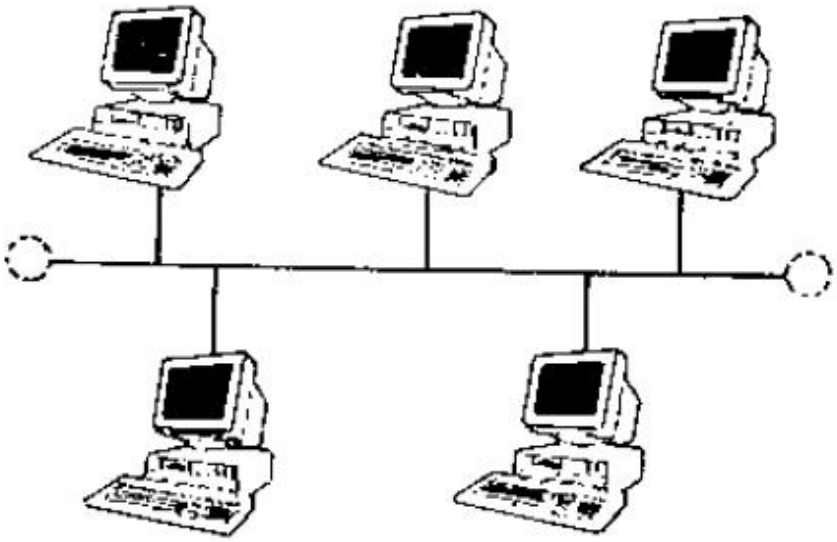
Access and control of ring networks are typically maintained by a "token-passing" system. IBM's Token-Ring network is thought by some observers to be a watershed event comparable to the development of the IBM PCV itself, because the Token-Ring network is designed to link all types of computers together, including not only personal computers but also possible mini computes and mainframes.

A Token-Ring network as shown in figure above resembles a merry-go-round. To deliver a message, you would hand over your addressed note to a rider (the token) on the merry-go-round, who would drop it off at the appropriate place.

Bus Network

Bus networks (see figure below) are similar to ring network that the ends are not connected. All communications are carried on a common cable or bus and are available to each device on the network.

Access and control of bus networks are typically maintained by a method called contention, whereby if a line is unused, a terminal or device can transmit its message at will, but if two or more terminals initiate messages simultaneously, they must stop and transmit again at different intervals.



Bus Network

2.11 Network Protocols

A protocol is an agreed-upon format for transmitting data between two devices. The protocol determines the following :

- The type of error checking to be used.
- Data compression method, if any
- How the sending device will indicate that it has finished sending a message
- How the receiving device will indicate that it has received a message

There are a variety of standard protocols from which programmers can choose. Each has it own particular advantages and disadvantages; for example, some are simpler than the others, some are more reliable, and some are faster.

From a user's point of view, the only interesting aspect about protocols is that your computer or device must support the right ones if you want to communicate with other computers. The protocol can be implemented either in hardware or in software. Some of the popular protocols are TCP/IP, HTTP, FTP, SMTP, POP, Token-Ring, Ethernet, Xmodem, Kermit, MNP, etc.

2.12 Network Architecture

The term architecture can refer to either hardware or software, or a combination of hardware and software. The architecture of a system always defines its broad outlines, and may define precise mechanisms as well.

An open architecture allows the system to be connected easily to devices and programs made by other manufacturers. Open architectures use off-the-shelf components and conform to approved standards. A system with a closed architecture, on the other hand, is one whose design is proprietary, making it difficult to connect the system to other systems. As we have seen before, network architectures can be broadly classified as using either peer-to-peer or client/server architecture.

Peer-to-peer Architecture

This is a type of network in which each workstation has equivalent capabilities and responsibilities. This differs from client/server architecture, in which some workstations are dedicated to serving the others.

Peer-to-peer networks are generally simpler and less expensive, but they usually do not offer the same performance under heavy loads.

Client / Server Architecture

This is a network architecture in which each computer or process on the network is either a client or a server. Servers are powerful computers or processors dedicated to managing disk drives (file servers), printers (print servers), or network traffic (network servers). Clients are less powerful PCs workstations on which users run applications. Clients rely on servers for resources, such as files, devices, and even processing power.

2.13 Important terms used in Networking

(a) Internet

The newest type of network to be used within an organisation is an internet or internet web. Such networks enable computers (or network) of any type to communicate easily. The hardware and software needs are the same as for the internet, specifically TCP/IP, server and browser software used for the World Wide Web. Because most organisations have a need for more dynamic ways to link people and information, the internet market is expanding day by day. Moreover, there is no need to adjust the network when a new user joins in. With the help of Internet, all computers of an organisation can work as stand-alone systems, connected to a mainframe, or part of a LAN or WAN.

(b) E-Mail

E-mail stands for electronic mail. This is one of the most widely used features of Internet. Mails are regularly used today where without the help of postage stamp we can transfer mails anywhere in the world. With electronic mail the service is similar. But here data is transmitted through Internet and therefore within minutes the message reaches the destination may it be anywhere in the world. Therefore the mailing system through e-mail is excessively fast and is being used widely for mail transfer.

(c) Voice Messaging

It is a new communication approach which is similar to electronic mail except that it is audio message rather than text messages that are processed. A sender speaks into a telephone rather than typing, giving the name of the recipient and the message. That sender's voice signal is then digitised and stored. The system can then either deliver the message at a specified time in future or it can be retrieved from a database by the recipient. The message is reconverted back into its analog format when it is delivered or retrieved so that the recipient hears it as the original sender's voice on a telephone. Voice messaging requires a computer with an ability to store the audio messages in digital form and then convert them back in an audio form upon verification. Each user has a voice mailbox in secondary storage and special equipment converts the audio message to and from the digital form. The main advantage of voice mail over electronic mail is that the sender does not have to type. Voice mail also makes it easy to include people in the firm's environment in an communication network.

(d) E-Commerce

Electronic commerce or e-commerce as it is popularly known refers to the paperless exchange of business information using Electronic Data Interchange, Electronic mail, Electronic Bulletin Boards, Electronic Fund Transfer and other network based technologies. Electronic Commerce (EC) not only automates manual process and paper transactions, but it also helps organisations to move into a fully electronic environment and change the way they usually operate. Few organisations have recently started conducting EC over Internet, the network of networks. Internet has also helped EC to boost up because it is a low cost alternative to the proprietary networks. EC standards are however under development. Electronic Data Interchange (EDI) is still the dominant part of EC.

Information Technology has transformed the way people work. Electronic Commerce (EC) has unearthed yet another revolution which is changing the way business houses buy and sell products and services. EC is associated with buying and selling of products and services over computer communication networks.

EC transfers information electronically from computer to computer in autonomous way. EC has, in fact, transformed the way organisations operate.

(e) Electronic Data Interchange (EDI)

EDI is the computer-to-computer exchange of business documents in a standard format. These formats look much like standard forms and are highly structured.

(f) Teleconferencing

It refers to electronic meetings that involve people who are at physically different sites. Telecommunication technology allows participants to interact with one another without travelling to the same location.

2.14 Summary

Data transmission is the movement of information using some standard methods. These methods include electrical signals carried along a conductor, optical signals along an optical fibers and electromagnetic areas.

The basic elements that form a communication system are Transmitter, Transmission channel and receiver.

A **communications protocol** is a system of digital message formats and rules for exchanging those messages in or between computing systems and in telecommunications.

The data transmission software or protocols perform the following functions for the efficient and error free transmission of data.

1. Data sequencing
2. Data Routing
3. Flow control
4. Error Control

There are three ways for transmitting data from one point to another :

1. **Simplex :** In simplex mode the communication can take place in one direction.
2. **Half-duplex :** In half-duplex mode the communication channel is used in both directions, but only in one direction at a time.
3. **Full-duplex :** In full duplex the communication channel is used in both directions at the same time.

Data transmission through a medium can be either *asynchronous* or *synchronous*. In asynchronous transmission data is transmitted character by character as you go on typing on a keyboard. Hence there is an irregular gap between characters. On the other hand, in the synchronous mode, the saved data is transmitted block by block. Each block can contain many characters.

Unit - 3 : INFORMATION TECHNOLOGY AND SYSTEM CONCEPTS

Structure of the Unit

3.0 Objective

In this unit, We will learn about Information Technology concepts and System concepts. Understand the need, scope and Impact of IT in human life, about data, Information and Information system, about the different type of systems.

Systems have been in use for the last thousands of years. Peoples freely talk of different types of systems in daily life. Systems today are very helpful in running the business efficiently. But a system can function in an effective way only if the users such as the accountants, business managers and other responsible individuals within the organization make it function in a proper way. It is, therefore necessary that these potential systems analysts should clearly understand many other things such as what a system is, what its objectives are, what kinds of systems are there, what are their costs and benefits and how to analyze and monitor systems.

3.1 Information Technology (I.T.): Introduction

This on IT will help the reader to know about the Information Age by learning the definition and characteristics of computers. Now a days, every user using computers directly or indirectly for their routine work, even if they do not have a home computer or do not use a computer at work. For example, when you perform your banking transaction either by ATM or through bank counter desk or when you use a bank debit or credit card in any departmental store or shop, or when you order for any item through Internet, you are using a computer to perform your transactions. You must have also been exposed to many computer advertisements. You can access information anytime, anywhere by using computers everywhere such as libraries, airports, railway stations, banks, etc.

IT is a precise term manually applied to broad area of activities and technologies associated with the use of computers and communication. It implies the application of computers to store, process, use of information particularly in the field of commerce and now more into E-commerce and E-business. We have entered into the era of pervasive computing it is a time for hand held computers, like wireless pagers and micro sized cell phones. These technologies let you access not just general information but also your personal information such as your electronic correspondence, documents, appointments, photos, songs, money matters, stock market and much more. Information Technology also known as "InfoTech" which means it is a process that combines computing with high speed communication links carrying data, sound

and video. IT enables you to provide access to right information at right time, with the use of computer, communication, telephone, Internet, etc., for sharing information as a strategic resource.

IT has been recognized as a potential enabler of business for companies which have been invariably growing their business by looking at new markets and products. India has been best positioned to offer IT services and IT solutions. Many foreign companies are outsourcing their software requirement to retain their competitive edge on others and our country has been considered as an emerging superpower in IT. Information technology field is now emerged as the largest employment provider.

The basic idea of this study is to help the learner to become computer literate. To become computer literate, you should be aware of the importance of the computers and be able to use them to accomplish daily routine tasks. You probably have a sound knowledge towards computer literacy, but let us take a close look in the field of IT. As technology changes, the differences between the types of machines become more and more significant and accordingly learning also needs to be updated regularly. An important aspect of IT is that it can be applied any area. The impact of IT has not only changed the working at offices but also the lifestyle of people at home. IT has now showed that it is essential for every person irrespective of their age.

The Influence of I.T. at Place of Work

The working at offices, where book-keeping (Accounts, Inventory etc.) was previously done manually has been now switched to electronic working. The initial objective of office automation was paperless office, but that objective is still to be achieved. The term "electronic office" (office automation) includes the application of Computer and Communication Technology to improve the productivity at all levels in office and all types of work including clerical, administrative, professional and executive.

The impact of IT in the business is considered in the manner the business is conducted and the technology used is known as electronic commerce or e-commerce. Implementing IT at place of work not only improves the productivity of employees but also enables to achieve business objectives which include:

- Increase in business opportunities
- Reduces the communication cost
- Improves company image
- Improves relationship with customer and supplier
- Provides fast money transaction
- Provides wide area for advertisement

The Influence of I.T. in Life Style

The computer and communication controls the routine tasks such as banking transaction, television, washing machines, microwave, communication electronically with friends and relatives through cellular phones, via Internet e-mail, sale purchase of goods, online information of stock, etc. World Wide Web is another contribution of IT to the world. Anyone can keep track of the information about world, politics, weather, medical information, etc. It helps the children by providing information about school projects and also helps the others to get information on their related topics.

Required Study in Information Technology

Information Technology is changing the working of old jobs and inventing new ones. To flourish this environment, we need to combine traditional education with training in computers and communications, to understand the principal trends in Information Age. Information Technology has been included in the curriculum of commerce student because of the recent and rapid growth in IT. There is a considerable demand for people trained in IT; information processing has become eminent from other related courses. While studying, it may be treated as a separate course, but the use of IT is for all the courses because IT is actually application oriented course and its scope is unlimited.

Information Technology refers to the technological aspect of an information system, i.e., computers and communications. It primarily includes the following:-

- **Hardware -** Hardware in IT is a set of physical devices of the computer system which accepts data, process and generates information and displays it.
- **Software -** Set of programs which make Hardware in working position, i.e., operating system, utility software and application software.
- **Problem solving Skills –** To solve any problem through computer system, the concept of flowcharting and decision tables is used as a strategic decision making tool for problem solving.
- **Network –** It comprises of devices like routers that connect the systems and allows the sharing of resources by different computers from remote locations.
- **Office productivity tools -** Word, Excel, PowerPoint, accounting packages and other computer assisted auditing techniques are the softwares used to exploit the capabilities of hardware in business environment, for example, Inventory control and Production Planning, Payroll, Personnel Information System, Financial Accounting Package, etc.
- **Database -** It is a collection of related files that store data and relation among them depending upon the application chosen.
- **Internet, e-commerce and cyber laws -** IT has been a major catalyst of new world of E-commerce. In this, most of the peoples use computers connected to a global networked environment known as Internet, where the issues of security in E-commerce are governed by cyber laws provided by the Government of India.

3.2 Information Technology for Business

Information Technology is generally a application of computer to storage, retrieval, processing and dissemination of data, particularly in the field of commerce. Information Technology is a term generally applied to activities and technologies associated with the use of computer and communication. Information Technology for business is identified by "Business Review" as-

- Technique for processing large amount of information rapidly,
- The application of statistical and mathematical method to decision making problems, and
- Simulation of high order thinking through computer program.

There is no formal design for Information Technology as offered or Implied. But the use of Information Technology is burgeoning, large accounting firms have IT departments, there are specialist IT lawyers, Some Governments have Ministries of IT, Universities have established IT faculties, IT journalist of region and self-styled IT professionals abroad. The purpose of using IT in business helps in reducing cost, improving communication, better overall management, administrative processes and better relationship with suppliers and customers.

3.3 Basic Concepts of Information Technology

IT is a system which enables its user to gather, processes and distribute the information. IT comprises of Computer Technology and Communication Technology. Thus, the major trends observed in computer development are:

- **Speed -** Today's machines provide faster processing speed and more data storage capacity.
- **Miniaturization -** From the era when computers were originated till today miniaturization is a continuous process.

- **Affordability -** The cost of the processor is reduced very significantly, as compared to what it used to be 20 years ago.

The major trends observed in communication development are:

- **Connectivity -** It is the outcome of computer networks expansion that has made possible to connect computers to one another by communications lines so as to provide easy access to on line information.
- **Interactivity -** It refers to two way communication. That is, there is an exchange or dialogue between the users/computers.
- **Multimedia -** It refers to technology that presents information in more than medium such as text, video, pictures, sound and animation. The development of World Wide Web expanded the Internet to include multimedia.

The major developments in IT:

- **Convergence:** It has led to the convergence of various industries such as computers, communications, electronics entertainment, mass media and consumer.
- **Portability:** Being small, powerful, wireless, personal electronic devices have brought the mobility in computing.
- **Personalization:** These days information is created to tailor the user preferences. For example, companies involved in E-business send messages to their customers/consumers about forthcoming products based on their pattern of purchases usage and other criteria.

Because of high technological revolution, these days large quantity of information can be stored, retrieved and communicated at a very high speed with accuracy. As Information Technology is the synthesis of computers and communication, it also covers the science of processing information. Earlier computers were number crunchers. They were stand alone systems, and then it was thought over that if people could communicate with one another through telephones, so could through computers. This led to the concept of networks, LAN, MAN, WAN and finally the Internet. In this, IT emerged as most widely applied and influential technology as it can be easily affordable by everyone in the recent years.

Thus, to begin with concepts of IT in further readings, user must know "what is data and what is information"?

DATA

Data were raw facts, for example the sale of a DVD, or the temperature in Jaipur on 12th October 2007. Data may require translation or transcription prior to entry into the system. This can affect the accuracy of the data. Information was data that had been processed in some way, for example the weekly average temperature in Jaipur for the month of October 2007. Knowledge was the way in which information could be used to make a decision, for example Product A is selling well, but Product B is not. Therefore we need to promote B with an aggressive marketing campaign.

To have any sense or meaning, data has to be ordered; scraps of data on little bits of paper are no good. So data tends to be grouped into meaningful collections called a record. A record would have the customer's unique ID, their name, address, and telephone number. A file would contain the records of the customers.

In a business system, data will arise naturally as transactions occur. For example each time a book is sold, the barcode is read into a barcode scanner, and the sale is logged onto the company's computer. Other operations such as when a weekly stock check program may well generate data about sales of product lines. The method of collecting data depends very much on the application.

Data Capture

Data is captured automatically at the point of origin or source document - such as a bar code system in a departmental store. Other methods of data capture include:

- Magnetic stripe cards.
- Smart cards which have a chip on them;
- MICR used on cheques;
- Concept keyboard (which may have a number of products. Each has its own key which is pressed when a sale is made).
- Electronic data interchange where computers in different companies can connect to each other to interrogate stock levels and place orders instantaneously. University results are sent to colleges in encrypted form a couple of days before the release date. A password is sent at midnight on the release date to unlock the data.

Data Preparation

Data is manually copied (transcribed) from the source document to a computer in readable format. An example of this would be order forms in a mail order warehouse.

- This is done off-line.
- It is slow.
- It is mind-numbingly boring.
- Also operators can get RSI (repetitive strain injury).
- Data preparation introduces the real possibility of transcription errors and this stage would normally be followed by verification.

Data preparation methods are tedious and error prone, so verification and validation techniques need to be present to prevent errors. These are expensive.

- Verification processes check for transcription errors introduced when data is copied from one format to another. This is particularly used when manual data preparation takes place but it is also used whenever data is copied from one medium to another. Source documents should be manually checked before being submitted for data preparation or OCR input.
- Validation checks are there to ensure that the data are in the right format and to eliminate errors.

DDE (Direct data entry) Data is keyed in as the transaction takes with details being checked on screen. An example would be when a holiday booking is made. When you order a product at an internet store, you key in your details, and check them before you press a submit button.

On line DDE systems can display data on screen for checking before processing takes place. If a holiday were booked then entering the code number for the package would bring up details on the screen. These could be checked before confirming the data for processing or even printed off and given to the customer to check.

If there is a large volume of data to be collected and the structure is similar then data capture or data preparation methods will be used.

Automatic methods are increasingly being used to reduce the chance of transcription errors. Data captures through barcode scanners are very reliable, and the scanners are getting less expensive all the time. Many companies now identify invoice details with a bar code printed on the invoice. These details

are read in by a hand scanner when the customer returns the invoice with his or her payment. The amount paid can be keyed in using DDE. The scanning takes a lot less time than manual entry, and fewer clerks are needed. (Data preparation is also a mind-numbingly boring occupation)

Errors in data will lead to errors in processing and output (GIGO – garbage in, garbage out). Such errors can be annoying or worse. Sometimes they are hard to find and rectify. It is therefore essential that inputs be monitored closely to identify and correct erroneous data.

INFORMATION

In its broadest and non-technical sense, information consists of facts and ideas. Information in all, organization is required for several reasons. It is used to tell people in the organization what the goals are and to instruct them in the policies and procedures required to achieve those goals. Basically entities, events and data define information. An entity is a person, place, or a thing. It is important not to confuse an entity with its name.

Entities may be used in different ways or have different relationships to an organization; a single entity may be categorized in several different ways.

An event is that which occurs during the course of doing business.

Information about events is necessary for financial, legal, and management purposes. An event is something that happens at a particular time.

Data are the facts which describe events and entities. Data is a plural word referring to more than one fact. A single fact is referred to as an item of data or a data-item. Data are communicated by various types of symbols such as letters of an alphabet, numbers, speech patterns, dots and dashes, hand signals, pictures, and so forth. These symbols can be arranged and rearranged to represent facts in various combinations. When they are arranged in a usable form, they are called information.

Information is organized data that is processed and summarized for use in decision-making. It understands management information needs: the concept of relevance and methods of interpretation. Information has many characteristics and can be classified in many ways. Examples include:

- Source - internal, external, primary, secondary
- Nature - quantitative, qualitative, formal, informal
- Level - strategic, tactical, and operational
- Time - historical, current, future
- Frequency - real-time, hourly, daily, monthly
- Use - planning, control, decision
- Form - written, visual, aural, and sensory
- Type - disaggregated, aggregated, sampled.

Discuss the value of information in aiding the decision making process. Understand the difference between internal and external information requirements. Describe the characteristics of good information and delivery, e.g. relevant; accurate; complete; user confidence; to right person; at right time; in right detail; via correct channel of communication; understandable. Describe the advantages and characteristics of good information within an applications context.

Information provided to management must be relevant. It should not only relate to the particular manager's job, but also its level of detail should be appropriate. Information that is not relevant or that contains too little or too much detail will hinder the decision making process.

In the early days of computers they were used for applications such as payrolls, where accurate calculation was important. Now a days computers can make decision making much easier. Information can be:

- At the operational level, for example the day-to-day running of a business, such as payroll, and invoicing.
- For middle management, tactical information is needed for effective management. Examples include how well a product is selling, and whether a special promotion is needed.
- Senior managers need strategic information, such as new businesses opening up, employment patterns outside the company. These can build computer models on the information as well as historical company data to assess how well the company would perform if key strategic decisions were made.

Quality information should be:

- Brief – vital facts in summary form without lots of extraneous detail. Exception reports list items on which there needs to be action.
- Accurate – inaccurate data leads to poor decisions. Some decisions may be based on probability. A farmer harvesting a crop does so after hearing that the weather forecast is good, but a local thunderstorm may come on that was not forecast.
- Up-to-date information is essential if a customer needs to know if a particular item is in stock. Argos stores have small key-pads in which a customer keys in a numerical stock code to interrogate the database to check if the item is available. However a theatre manager looking at the overall success of a show might not be too concerned about the previous night's sales.
- Timely – reports should be with the right person at the right time.
- Right level of detail – often it is better to report only items that need action. Too much detail might make it hard to make sense. However too little detail can lead to a simplistic response.
- In an appropriate format. Large tables of figures are meaningless.

The method used to present the information is important. Tables are good for providing detail, particularly when individual numerical values are likely to be required, but lots of numbers can be confusing. There are different ways of presenting numerical data in picture form:

- A line graph is more appropriate when trying to identify trends.
- Pie charts are useful for showing relative values.
- Where there are too many categories for a pie chart, a bar chart could be used to show relative values.

Management may need historical data, for example comparing current performance with previous years and certainly information based on current data will be required. Information that is out of date may well be worthless.

In addition predictions of future situations based on trends and the present are also required. Managers also need to be able to make predictions based on a variety of possible current actions so that they can gain some idea of what effect their decisions may have.

The information provided by a system can be classified in various ways as detailed below:

Source

- Internal - From within the organisation - possibly from data processing

- External- Possibly purchased or found in the public domain
- Primary - Information from original data.
- Secondary - From data that has been output by processing other data Secondary data is not reliable as sometimes it has been processed from primary data that is not up to date.

Nature

- Quantitative - Providing numerical values
- Qualitative - Using words to describe situations.
- Formal - Information provided according to some organisational procedure.
- Informal - This type of information will usually move through an informal route such as conversation, newspaper report, e-mail.

Level

- Strategic - Information relating to long term goals and performance - e.g. predicted market share compared to competitors over the next five years
- Tactical - Information relating to shorter-term management - e.g. summary sales information for a particular branch of a supermarket.
- Operational - Short term information relating to day to day operation of one part the organisation - e.g. list of items that must be re-ordered.

Time

- Historical - Information based on data collected over some period in the past - e.g. sales figures for the past year. Whether or not information is historical depends on how quickly the underlying data is changing.
- Current - Based on the latest data
- Future - Information based on predicted or possibly known future data values. Predicted data values could be based on current data modified by historical data. Sometimes predictions are little more than guesses and must be viewed with a great deal of care.

Frequency

- Real Time - Real time information will be based on current data in a transaction processing application such as a supermarket. The information could be changed as the underlying data is updated. For example at the start of the day there may be 42 bottles of a particular red wine in stock. Immediately a bottle is sold, the stock level is changed to one less.
- Periodic – how often the information is put together - e.g. annual report, quarterly sales report. The longer the period, the more likely it is that the information will be strategic rather than operational.
- Use – Is it for strategic, tactical or operational use?
- Planning – Information intended to help plan some future action
- Control - Information used to control some process - e.g. the data output of sensors shows how an industrial plant is operating.
- Decision - Information used to support decision-making - e.g. the holiday rota would be used to decide if a particular employee could take time off.

Form

The form that information is presented in will often be decided by the mechanism that is used to transmit it through the organisation:

- Written – Information is typed onto a piece of paper, a hard copy. It is low tech, but really quite reliable. The paperless office has been long promised but never delivered.
- Visual – Presentation of sales trends in the form of a chart, or line graph.
- Aural – at its simplest, this means listening to a senior person in the organisation droning on. You will find out that it's not just teachers who drone on. Aural presentation is often forgotten almost as soon as it's received. Some organisations record presentations onto tape so that people can listen to the tape while driving into work.
- Sensory – Often when a new product is released, people in the organisation want to see it, touch it, and feel it for themselves. Communication is often at its most effective if all the senses are involved.

Type

- Detailed - Information based on all the data.
- Aggregated - Summary information bringing data together from a variety of sources - e.g. summary sales information for all the branches in a supermarket chain.
- Sampled - Information based on a sample of all data. For example temperature readings are taken in many locations throughout Europe. However we may wish to take information from a weather station in Sheffield and one in Amiens.

Value of Information

Good quality information is accurate, up to date, and complete. However it does need to be passed through the right people with the right procedures if it is to have credibility. Credible information must have evidence to back it up. If it is to be acted on, it must be available at the right time.

A recent example of this was the British Government's unpopular decision to back the American war in Iraq. Information on weapons of mass destruction that appeared to be credible and compelling was found to have no foundation in fact. At the time of writing, the politicians have tried very hard to distance themselves from that information, in preference talking about the removal of one of the world's most odious dictators, something that few people would question.

These factors affect the value of information:

- **Detail** - The amount of detail must be sufficient to convey the information required but it must not be allowed to become excessive so that the meaning is obscured. Most people just want to be aware of the summary, although that does need to be based on relevant detail.
- **Purpose** – Information should be relevant for the purpose. A factory foreman will need to know the work assignment for each of the workers that he is responsible for. The managing director needs to know the productivity of each department.
- **Confidence** – To be credible, the information must be accurate, up to date, and complete. It must be from a reliable source and be able to be evidenced. Without this, the user would not be truly confident in its worth and would be reluctant to act on it. Sometimes, however, correct information does come from unreliable sources, but the lack of credibility may lead to its being ignored.

- **Format** – Large blocks of text with tables of figures do not make compelling reading, and even worse presentations. They say a picture is worth a thousand words, so charts and graphs are a more compelling way of presenting lots of numerical information.
- **Style -** The way in which the information is presented is important. Too often people look for the entertainment value in a presentation, and there is the risk that it can be "dumped down". This can lead to the information losing its impact and being less authoritative. However very formal presentations can be plain boring, so it is important that the presenter uses techniques to engage a wide range in the audience. These might include pictograms (an example of which are different sizes of bottles indicating the amount of wine drunk).
- **Manner** – A report circulated informally may not have the same impact as a report presented at a formal meeting. However circulating a report before a meeting may well lead to more informed and productive discussion.
- **Timing** - If information is to be effective it must be presented at the right time. It must be available at a time when the knowledge gained from the information can be used to influence the decisions to be made.
- **Channel** – Information has to be sent using the proper procedures, so that it can be checked where necessary. Credible sources are essential. Generally the more experienced a person is, the more credible that person becomes. However one piece of wrong information can wreck many years spent building up a reputation for reliability.
- **Destination** - For information to be of use, it must reach the right person. This will be the person who has the power needed to make decisions based on the information.
- **Understandable** - Finally the information must be understandable. If all the above factors are present but the information itself is not understandable - perhaps because of the use of jargon, or bad grammar, or axes missed off graphs then it will not be used.

Effective Presentation

The impact of presented information is affected greatly by the way the presentation occurs. A sloppy and amateurish performance that is unprepared will cause at best cynical amusement or at worst a walkout by the audience. So many organisations and individuals use presentation graphics (e.g. PowerPoint) to enhance their presentations.

Large companies will spend a great deal of money producing very slick multimedia presentations that are based on expensively produced promotional videos; especially if they are after your money. However if the presentation is over the top, it will lose impact. A charity might well opt for a more low key effect.

Advertising is a specialist area of presentation for which no expense is spared. And nothing is too moronic.

The environment for a presentation is important. Hotels make a great deal of income from letting out rooms to corporate functions.

- The room must be comfortable and warm.
- Often mineral water is supplied; it's a well-known fact that sipping water improves the brain's function.
- Often boiled sweets are provided; the brain uses sugar for energy.
- If the presentation is a long one, coffee and lunche on may well be provided.

In short, if you want your presentation to go down well, you look after your audience and treat them as guests.

Good presentations will:

- Be pitched at the right level for the audience; they will not be patronised, nor will it be way over their head.
- Use a variety of presentation styles. We are all different kinds of learner. (I am a very visual learner. I like lots of pictures and colours, and do not remember long passages of speech at all well.)
- Be no more than about 40 minutes per session. Even adults cannot concentrate for more than 40 minutes.
- Make the points clearly.
- Be appropriate to the occasion. A comical approach would not go down well, if the meeting were to be making a decision to close a plant down with several hundred redundancies. However a little humour would generally make most presentations go down well.
- Involve the audience, possibly with short activities.
- Be delivered by somebody who had practical experience of the material being presented, rather than some one who has simply prepared it from a book, or even several resources.

Bad Presentation

Bad use of presentation graphics can detract from the impact if there are too many juvenile distractions, such as tyre-screeching noises made each time a slide is changed. Also there have been many instances where the design has been badly thought out, for example, black print on a dark blue background.

Other mistakes made with presentation graphics software include:

- Too much text;
- Too small a font;
- Too many shapes on a slide;
- Too many animations;
- Lists and lists of bullet points;
- The presenter simply reading out the bullet points.

The worst must be the presenter who prepares his slides on PowerPoint then prints them out onto overhead projector.

Teacher training seems to be a rich ground for bad presentation. One example shows particularly about the presentation:

- It was after school and the audience were tired;
- No refreshments were provided – except for the Headmaster and the advisor who was leading the training;
- The training took place in the school library, which was a large L-shaped room, with a screen and an overhead projector in one corner.

- The presenter (a highly paid advisor who had charged the school several hundred rupees for visit) read off a closely-typed OHP;
- Presenter did not even face the audience, except to have a bite of sandwiches, and biscuits and then he/she spoke with mouth full. It was always considered as very rude;
- Presenter spoke with little conviction and even less enthusiasm;
- Other than that presenter tries to teach teachers how to teach, Nobody can say that teaching of all teachers or patterns of teaching is worse except the presenter.

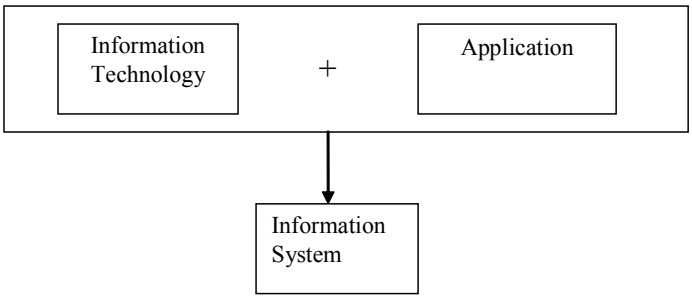
The absolute unprecedented presentation horrors were again in the context of teachers training. Teachers were sat in a big circle on plastic chairs in the sixth-form centre. The facilitator told all the teachers that we were the experts, and that we were there to brainstorm our ideas. All teachers were given a thick felt tip pen and wrote down inane one-liners on flip-chart paper. She then lovingly displayed all the flip-chart paper around the room, cooing about each one as she stuck it up on the walls with blutack. Everybody wants to be taught by someone who knows what they are on about.

3.4 Components of Information System

An information system is a component of a business system in the same way as a nervous system is a component of a human body. Its purpose is to gather information from within and outside an organization, make it available to all other components of an organization and outside organization as and when they need. An information system has three major types of components:

- Data
- Data processing system
- Communication channels.

Relationship between Information Technology and Information System



3.5 Technological Trends

The trends in Information Technology including computer, communication and information can be summarized in the following manner:

1. **Graphical and user friendly interface**: The trend is to make interface between user and computer as simple and interactive as possible. Therefore GUI has replaced the difficult command syntax in PCs. GUI creates user-friendly interface with icons, pull-down menus, windows and mouse with audio effects, so that general user can utilize the power of the computers.
2. **Memories and storage**: Besides the existing storage devices i.e., floppy diskette, Hard disks, Tapes, now optical storage devices i.e. CD-ROMs, DVDs allow a large amount of information such as multi-media data which include Audio, Video, text that can be stored and retrieved easily.

3. **Cost performance ratio**: As computers perform most of the routine tasks these days, therefore, demand is increasing as per the time passing. The cost of computer has decreased and performance in terms of processing speed, memory, etc. has increased significantly. For example, most of the office jobs in India and in other countries are automated i.e. almost every jobs are in the form of digital data and can be processed in very efficient manner.

4. **Data warehous**e: Huge amount of data and information stored as 'warehouse' in terabytes, can be accessed by user. For example, Warehouses may be integrated with Internet; thus, it can be accessed from any location at any time by the users according to their rights.

5. **Multi-media an effective reality**: Computers plays a very important role to integrate various media such as test, graphics, voice, animation etc. It helps to improve education, training, advertising, communication, entertainment and decision-making (by the use of 3D Graphics and other multimedia softwares).

6. **Object Oriented Programming Environment**: The object oriented environment allows real world events in information system. OOPS significantly reduces the cost of building and maintaining information system.

7. **Artificial Intelligent system**: Combination of hardware and software (Expert Systems, Natural Language Processing) increases the productivity in complex tasks, which was not possible earlier.

8. **Compactness**: Over a period of time the size of the computer is decreasing and the performance is increasing. Small size computers like laptops can work very fast and stores large amount of data.

3.6 System

The word "SYSTEM" covers a very broad spectrum of concepts. This is derived from the Greek word 'systema', which means an organised relationship among the functioning units or components. In our routine life, we use different systems such as telephone systems, railway systems, banking systems etc. Similarly, business systems are the means by which business organizations achieve their pre-determined goals. Essentially, a business system represents an organized way of achieving the pre-determined objective of an organization.

There are various definitions of the word system, but most of them seem to have a common idea that suggests that a system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific goal. The word component may refer to physical parts (Tables, Chairs etc.), managerial steps (planning, organizing. controlling) or a sub-system with multi-level structure. The components may be simple or complex, elementary or advanced. In either case, each component is a part of the total system and has to do its own share of work for the system to achieve the desired goal.

Characteristics of a System

Based on the definition of a system, it is observed that following characteristics are present in all systems:

a) **Organization:-** Organization implies structure and order. It is the arrangement of components that helps to achieve objectives. In the design a business System, the hierarchical relationships starting with the president on top and leading downward to the managers, officers, clerks and workers which represents the organization structure.

b) **Interaction**:- It refers to the procedure in which each component functions with each component functions of the system. In an organization, for example, purchasing must interact with production,

advertising with sales and payroll with personnel. In a computer system also, the central processing unit must interact with other units to solve a problem.

c) **Interdependence**:- It means that component of the organization or computer system depend on one another. They are coordinated and linked together in a planned way to achieve an objective.

d) **Integration**:- It is concerned with how a system is tied together with all of its components. It is more than sharing a physical part. It is a way of explanation that how the parts of the system work together within the system even though each part performs a unique function. Successful integration will typically produce a better result as a whole rather than if each component works independently.

e) **Central Objective**:- It is the last characteristic of a system. Objectives may be real or stated. Although a stated objective may be the real objective, it is quite common that organization may set one objective and operate to achieve another. The important point is that users must be aware about the central objective well in advance.

3.7 Types of System

Systems can be classified in the following ways:-

a) **Physical or Abstract System:-** Physical systems are real entities that may be static or dynamic in nature. Abstract systems are conceptual or non-real entities which may be as straight forward as formulas of relationships among sets of variables or models which conceptualize the physical situations.

b) **Open or closed Systems:-** An open system continuously interacts with its environments. It receives inputs from outside and delivers outputs to the outside. An information system can be considered in this category since it must adapt the changing needs of the user. Closed systems are isolated from the environmental influences. Closed systems are very rare.

c) **Deterministic or Probabilistic systems:-** A deterministic system is the one in which the occurrence of all events are predictable. If we receive the description of the system state at a particular time, the next state can be easily predictable. Probabilistic system are those in which the occurrence of events cannot be perfectly predictable.

d) **Man made Information Systems:-** An information system is the basis for interaction between the user and the analyst. It determines the nature of relationship among decision makers. It may be viewed as a decision centre for personnel at all levels. Therefore, we can say, an information system may be defined as a set of devices, procedures and operating systems designed around user-based criteria to produce information and communicate it to the user for planning, control and performance. The major information systems are :-

- **Formal Information System**:- It is based on the organization represented by the organization chart. The chart represents the positions and their authority relationships, indicated by boxes and connected by straight lines. It is concerned with the authority, communication and work flow.
- **Informal Information System**:- It is an employee-based system designed to meet personnel and vocational needs and to help in the solution of work-related problems. It also transfers information upward through indirect channels. It is considered to be a useful system because it works within the framework of the business and its policies.
- **Computer Based Information System:-** This system mainly depends on the computer for handling business applications. Different types of systems like Railway reservation system,

airlines system etc. are the example of computer based information systems(CBIS). CBIS can be classified in the following categories:-

i. Transaction Processing System (TPS)
ii. Management Information Systems (MIS)
iii. Decision Support Systems (DSS)
iv. Office Automation Systems (OAS)

3.8 Summary

IT is a precise term manually applied to broad area of activities and technologies associated with the use of computers and communication. It implies the application of computers to store, process, use of information particularly in the field of commerce and now more into E-commerce and E-business. We have entered into the era of pervasive computing it is a time for hand held computers, like wireless pagers and micro sized cell phones. These technologies let you access not just general information but also your personal information such as your electronic correspondence, documents, appointments, photos, Songs, money matters, stock market and much more.

Information Technology refers to the technological aspect of an information system, i.e., computers and communications. These are some of the components of IT :

- Hardware
- Software
- Problem solving Skills
- Network
- Office productivity tools
- Database
- Internet, e-commerce and cyber laws

The major developments in the field of IT are Convergence, Portability and Personalization.

Data are the raw facts which describe events and entities. A single fact is referred to as an item of data or a data-item. Data are communicated by various types of symbols such as letters of an alphabet, numbers, speech patterns, dots and dashes, hand signals, pictures, and so forth. These symbols can be arranged and rearranged to represent facts in various combinations. When they are arranged in a usable form, they are called information.

Information is organized data that is processed and summarized for use in decision-making.

Quality information should contain these characteristics :

- Brief
- Accurate
- Up-to-date
- Timely
- Right level of detail
- In an appropriate format

An information system is a component of a business system which gathers information from within and outside an organization, makes it available to all other components of an organization and outside organization as and when they need. An information system has three major types of components Data, Data processing system and Communication channels.

A **System** is an orderly grouping of interdependent components linked together according to a plan to achieve a specific goal.

A system should have the following characteristics :

- Organization
- Interaction
- Interdependence
- Integration
- Central Objective

Systems can be classified in the following ways:

- Physical or Abstract System
- Open or closed Systems
- Deterministic or Probabilistic systems
- Man made Information Systems
  - § Formal Information System
  - § Informal Information System
  - § Computer Based Information System

3.9 Self Assessment Questions

1. What do you understand by Information Technology? Discuss some of the components of Information Technology.
2. How IT helps in the growth of a business organization? Explain.
3. What are the factors responsible for the revolution of IT?
4. What are Data, Information, and Information System? Explain.
5. What are the major attributes of Information Systems?
6. What are the technological trends that support the acceptability of Information Technology in organizations?
7. What is a System? Explain the characteristics of the system. Also explain different types of systems with suitable examples.

Unit - 4 : Computer Based Information System

Structure of the Unit

4.0 Objective

This unit provides a general overview of Information system implemented by using computer technologies. By using these Computer based Information systems how organization gets benefit in their business activities. This unit aims to provide basic concepts regarding the various transactions systems available with their uses in different areas. It also focus on the process cycle of the transaction and its use in various environments. We will cover the above mentioned topics in this unit.

4.1 Introduction

Any electronic (computer) system that stores information for later retrieval and manipulation is known as Computer based Information System. It could be as simple as your home computer on its own, or networked computers accessing data from a common source either private or public, to supercomputers with very limited access by authorized persons only.

The usage is vast and ranges everything from your home computer connected to the internet and accessing the data stored on say Google, wiki, itunes, facebook, school, university etc. servers,

To companies gathering and using the information on customers accounts - banks, shops, insurances, credit cards, loyalty bonus with data stored in collections of servers known as a data warehouse etc. or companies gathering and using their own private data like accounting, human resources, marketing, engineering, biotechnology, R&D, geology etc.

Government organizations gathering and using data for taxation, traffic control, energy consumption, crime prevention, defense, environment pollution, education, healthcare, galleries, museums, libraries etc.

Scientific organizations collecting vast amounts of data from deep space probes, earth monitoring satellites, weather and climate, nuclear physics experiments etc.

Complex systems in which computers play a major role. While complex physical systems and sophisticated software systems can help people to lead healthier and more enjoyable lives, reliance on these systems can also result in loss of money, time, and life when these systems fail.

Much of the complexity of these systems is due to integration of information technology into physical and human activities. Such integration dramatically increases the interdependencies among components, people, and processes, and generates complex dynamics not taken into account in systems of previous generations. Engineers with detailed understanding both of the application domain and computer electronics, software, human factors, and communication are needed to provide a holistic approach to system development so that disasters do not occur.

The computer-based system consists of all components necessary to capture, process, transfer, store, display, and manage information. Components include software, processors, networks, buses, firmware, application-specific integrated circuits, storage devices, and humans (who also process information).

Embedded computer-based systems interact with the physical environment through sensors and actuators, and also interact with external computer-based systems

The computer-based systems engineer must have a thorough understanding of the system in which the computer-based system is embedded, for example an automobile, medical diagnostic system, or stock exchange.

The use of models can reduce the number of errors in the design and thus the system, reduce engineering effort, and preserve knowledge for future efforts. During the later stages of system development and testing, significant schedule pressure makes it difficult to keep the models and manually developed software consistent.

4.2 Transaction Processing System (TPS)

Definition: A Transaction Processing System (TPS) is a type of information system that collects, stores, modifies and retrieves the data transactions of an enterprise.

A transaction is any event that passes the ACID test in which data is generated or modified before storage in an information system

Computerized system that performs and records the daily routine transactions necessary to conduct the business; these systems serve the operational level of the organization. Information system used to support and record transactions.

Online Transaction Processing (OLTP)

Online Transaction Processing (OLTP) is a class of program that supports, facilitates and manages high-transaction-oriented applications. The term may be ambiguous because some understand a "transaction" in the context of computer or database transactions, while others define it in terms of business or commercial transactions. OLTP may also refer to processing in which the system responds immediately to user requests, such as a bank's automatic teller machine (ATM). For our purposes, we use the first definition.

The primary features of OLTP are immediate client feedback and a high volume of individual transactions. For that reason it is typically used for data entry and retrieval transactions in industries that rely heavily on processing a large number of client transactions efficiently. These include banking, airlines, online retailers, supermarkets, and manufacturers.

Online Transaction Processing has two key benefits: simplicity and efficiency. Examples of how OLTP makes things simpler for businesses are reduced paper trails and faster, more accurate forecasts for revenues and expenses.

OLTP frequently employs client/server processing and brokering software that allows transactions to run on different computer platforms in a computer network involving several companies. Database systems that support OLTP are usually decentralized to avoid single points of failure and to spread the volume among multiple servers.

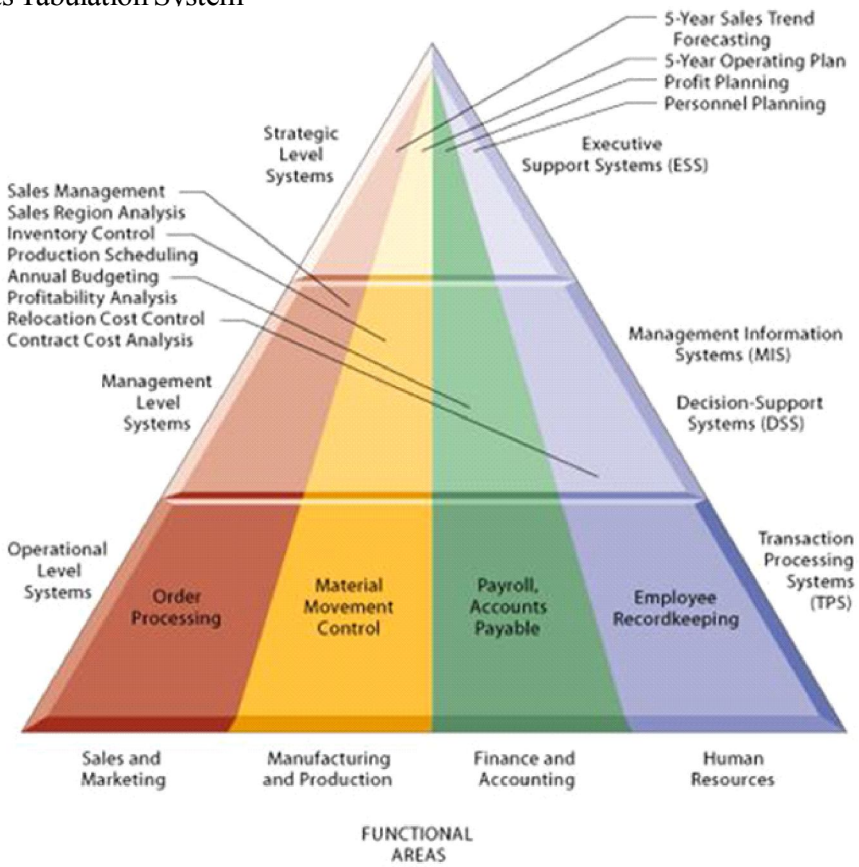
Online Transaction Processing systems must provide atomicity—the A in ACID—which means being able to process an order fully or undo an order completely. In these transactions, partial processing is never an option. When a rental car is booked, atomicity combines the two system actions of reserving and paying for the car and both actions must happen together or not at all.

In large applications, efficient OLTP may depend on sophisticated transaction management software and/or database optimization tactics for processing a heavy volume of concurrent updates to an OLTP-oriented database. For even more demanding, decentralized database systems, OLTP brokering programs can distribute transaction processing among multiple computers on a network.

Online Transaction Processing systems can be adversely affected because web services and service-oriented architectures often have OLTP integrated into them. If an enterprise depends on OLTP, a system stoppage or breakdown can severely impact operations and revenues. This may happen due to failure of a server or communication channels, data corruption or maintenance downtime.

Some other examples of Transaction Processing System are :-

- Airline Reservation System
- Payroll Processing System
- Transport Ticket Reservation System
- Purchase Order Entry System
- Markets Tabulation System



Advantages

The advantages of computer-based information systems are that, they are much faster than manual systems, can store a lot more data, and the scope of errors is relatively smaller. So much focus on the use of technology has naturally created a demand for people trained in Computer Information Systems.

Disadvantages

Computer based information system have some limitations also like they cannot take decisions on their own, they do not have their own IQ, so any decision or situation which is not pre feeded in the system if that occurs Computer based information system is not able to take proper decision.

4.3 Types of Information Systems

Transaction Processing Systems (TPS) - System that performs or records daily routine transactions such as sales order entry, payroll, employee record keeping, and shipping.

Management Information Systems (MIS) - It designates a specific category of information to middle management. It is to monitor and control the business and predict future performance.

An MIS can be defined as a combination of people, computers and procedures for collecting and organizing information to facilitate decision making. In any organization a reasonable amount of time and effort is devoted to data collection, documenting, processing and communication. Every individual looks for information that is relevant to her duties. Thus, information is people oriented and varies with the nature of people's work in the organization.

An organized approach to the study of the information needs of an organization's management at every level in making operational, tactical, and strategic decisions. Its objective is to design and implement procedures, processes, and routines that provide suitably detailed reports in an accurate, consistent, and timely manner.

In a management information system, modern, computerized systems continuously gather relevant data, both from inside and outside an organization. This data is then processed, integrated, and stored in a centralized database (or data warehouse) where it is constantly updated and made available to all who have the authority to access it, in a form that suits their purpose.

Decision-Support Systems (DSS) - Support nonroutine decision making for middle management. Example of a nonroutine decision: What would be the impact on production schedules if we were to double sales in the month of December?

Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present would be:

Accessing all of your current information assets, including legacy and relational data sources, cubes, data warehouses, and data marts. Comparative sales figures between one week and the next. Projected revenue figures based on new product sales assumptions. The consequences of different decision alternatives, given past experience in a context that is described

Executive Support Systems (ESS) - Help Senior management to address strategic issues and long-term trends, both in the firm and in the external environment. Examples: What will employment levels be in five years? What products should we be making in five years?

An Executive Support System is a class of information systems that supports business and organizational decision-making activities. It is an interactive software-based system made to help decision makers compile useful information from a combination of raw data to identify and solve problems and make decisions. Key points of Executive Support System are It Improves personal efficiency, Speed up the progress of problems solving in an organization, Facilitates interpersonal communication, Promotes learning or training, Increases organizational control, Generates new evidence in support of a decision, Creates a competitive advantage over competition, Encourages exploration and discovery on the part of the decision maker, Reveals new approaches to thinking about the problem space, Helps automate the managerial processes.

It supports the following: -

1. An inventory of all of your current information assets
2. Comparative sales figures between one week and the next
3. Projected revenue figures based on new product sales assumptions.

Functional Areas of Information System

Here are some of the functions within the Information Systems Department, to give you an idea of the range of work that we do in support of our integrated health network:

- Applications Development
- Clinical Informatics Research & Development
- Clinical and Quality Analysis
- Clinical Systems
- Connected Health
- Finance & Administration
- Health Information Services
- IS Administration
- Medical Imaging (IS Radiology)
- Integrated Network Communication
- Support Services
- Continuing Care Services
- Research Computing
- Technology Planning
- Technical Services and Operations

Applications Development

Applications Development directs the development of clinical, financial, administrative and infrastructure applications that support the business of Partners HealthCare.

Clinical Informatics Research & Development

CIRD is responsible for leading the development of clinical systems strategy for Partners Healthcare, conducting applied informatics research and development, and key design issues in Partners enterprise clinical systems (especially those involving complex clinical workflows, usability, controlled terminology, knowledge management, and clinical decision support).

Clinical and Quality Analysis

The Clinical and Quality Analysis, Information Systems (CQA) group in Partners IS evaluates information systems across the Partners' network. The CQA team does both analyses intended to improve operations internally, as well as research analyses intended for publication. These analyses focus on the benefits, costs, and net impact of clinical information systems.

CQA collaborates closely with many of the IS departments as well as with clinicians Partners-wide, health service professionals, informaticians, and researchers at Harvard Medical School and the Harvard School of Public Health.

Clinical Systems

Clinical Systems is responsible for the planning, implementation, and support of clinical applications for Partners HealthCare. This division supports both entity level and enterprise-wide clinical systems.

Connected Health

Connected Health is responsible for the establishment of Telemedicine and Connected Health facilities and applications that will improve the cost effectiveness, as well as improve the quality and convenience, of care to Partners' patients. The Center is also chartered to establish sources of revenue for Partners through the expansion of Connected Health services to new patient populations. Connected Health is responsible for programs encompassing activities in remote education, clinical research, and remote consultation domestically and internationally.

Finance & Administration

Finance & Administration is responsible for the planning and implementation of Financial and Administrative systems to support the operations of PHS Finance, Human Resources, Materials Management, Development, and Real Estate.

Health Information Services

Health Information Services is responsible for the development and management of health information standards and health information department operations for Partners and the urban sites. Central services include the oversight of coding, transcription services, electronic record management and confidentiality policies and procedures.

IS Administration

IS Administration is responsible for Finance Management, Human Resources, Project Management, Contract Management and Facilities Management for the Information Systems Department. IS Administration's scope of responsibility spans market research and moves, payroll processing and workforce development, intellectual property and the IS intranet, solutions delivery and Connected Work.

Medical Imaging (IS Radiology)

Medical Imaging directs the coordination and delivery of radiology systems across Partners entities, including core radiology systems support and new initiatives such as the Picture Archiving

and Communication System. Additional areas of responsibility are Radiology Decision Support and Radiology Order Entry (MGH), as well as newer and investigatory imaging informatics areas. An example of a newer area is integration work with the Research Patient Data Registry.

Integrated Network Communication

Integrated Network Communication is responsible for the development, implementation, and provision of technical services and operations to support the voice and data network needs of the overall Partners HealthCare System. Telecommunications includes the management of voice technology, related systems, large scale project/call center/vendor management, future technology designs, and related business operations such as revenue generation, and billing and paging.

Network Engineering includes support of wired and wireless network, network security, related systems, large scale project management, vendor management, and future technology designs.

Support Services

Support Services is responsible for directing all support services activities and functions. This includes the centralized help desk, email and accounts administration, remote access, procurement, desktop support, IT training, configuration management, asset management, and problem management. IT involves a varied mix of technology, direct user support services, and project management.

Continuing Care Services

Continuing Care Services provides a variety of non-acute services in home care, rehabilitation and long-term care settings. It enables Partners to provide the patient with the entire spectrum of care. The continuing care group is comprised of the following facilities: Partners HealthCare at Home, Spaulding Rehabilitation Hospital Boston, Spaulding Hospital for Continuing Medical Care Cambridge, Spaulding Hospital for Continuing Medical Care North Shore, Spaulding Rehabilitation Hospital Cape Cod, and Long Term Care Facilities. The continuing care group also develops and supports the Partners transition of care application 4Next.

Research Computing

Research Computing is responsible for the IT strategic planning, support and coordination of the Partners Research Enterprise including basic and Clinical Research. This includes the support of non-standard infrastructure, development and support of research administrative systems, development and support of Genetic IT infrastructure (including the Personalized Medicine IT Roadmap), the development and support of the Research Patient Data Registry, i2b2 Clinical Research Chart, and Pharmacovigilence discovery.

Technology Planning

Technology Planning is responsible for defining, articulating, and maintaining a coherent information technology architecture and strategy for Partners HealthCare.

Technical Services and Operations

Technical Services and Operations is responsible for all operations systems and support for Partners HealthCare and its organizational entities. This includes the back office server team, operating systems support, database administration, data center operations, disaster recovery, and information security.

4.4 Features of Transaction Processing Systems

The success of commercial enterprises depends on the reliable processing of transactions to ensure that customer orders are met on time, and that partners and suppliers are paid and can make payment. The field of transaction processing, therefore, has become a vital part of effective business management, led by such organizations as the Association for Work Process Improvement and the Transaction Processing Performance Council.

Transaction processing systems offer enterprises the means to rapidly process transactions to ensure the smooth flow of data and the progression of processes throughout the enterprise. Typically, a TPS will exhibit the following characteristics:

Rapid Processing

The rapid processing of transactions is vital to the success of any enterprise – now more than ever, in the face of advancing technology and customer demand for immediate action. TPS systems are designed to process transactions virtually instantly to ensure that customer data is available to the processes that require it.

Reliability

Similarly, customers will not tolerate mistakes. TPS systems must be designed to ensure that not only do transactions never slip past the net, but that the systems themselves remain operational permanently. TPS systems are therefore designed to incorporate comprehensive safeguards and disaster recovery systems. These measures keep the failure rate well within tolerance levels.

Standardization

Transactions must be processed in the same way each time to maximize efficiency. To ensure this, TPS interfaces are designed to acquire identical data for each transaction, regardless of the customer.

Controlled Access

Since TPS systems can be such a powerful business tool, access must be restricted to only those employees who require their use. Restricted access to the system ensures that employees who lack the skills and ability to control it cannot influence the transaction process.

4.5 Transactions Processing Qualifiers

In order to qualify as a TPS, transactions made by the system must pass the ACID test. The ACID tests refers to the following four prerequisites:

Atomicity

Atomicity means that a transaction is either completed in full or not at all. For example, if funds are transferred from one account to another, this only counts as a bonafide transaction if both the withdrawal and deposit take place. If one account is debited and the other is not credited, it does not qualify as a transaction. TPS systems ensure that transactions take place in their entirety.

Consistency

TPS systems exist within a set of operating rules (or integrity constraints). If an integrity constraint states that all transactions in a database must have a positive value, any transaction with a negative value would be refused.

Isolation

Transactions must appear to take place in isolation. For example, when a fund transfer is made between two accounts the debiting of one and the crediting of another must appear to take place simultaneously. The funds cannot be credited to an account before they are debited from another.

Durability

Once transactions are completed they cannot be undone. To ensure that this is the case even if the TPS suffers failure, a log will be created to document all completed transactions.

These four conditions ensure that TPS systems carry out their transactions in a methodical, standardized and reliable manner.

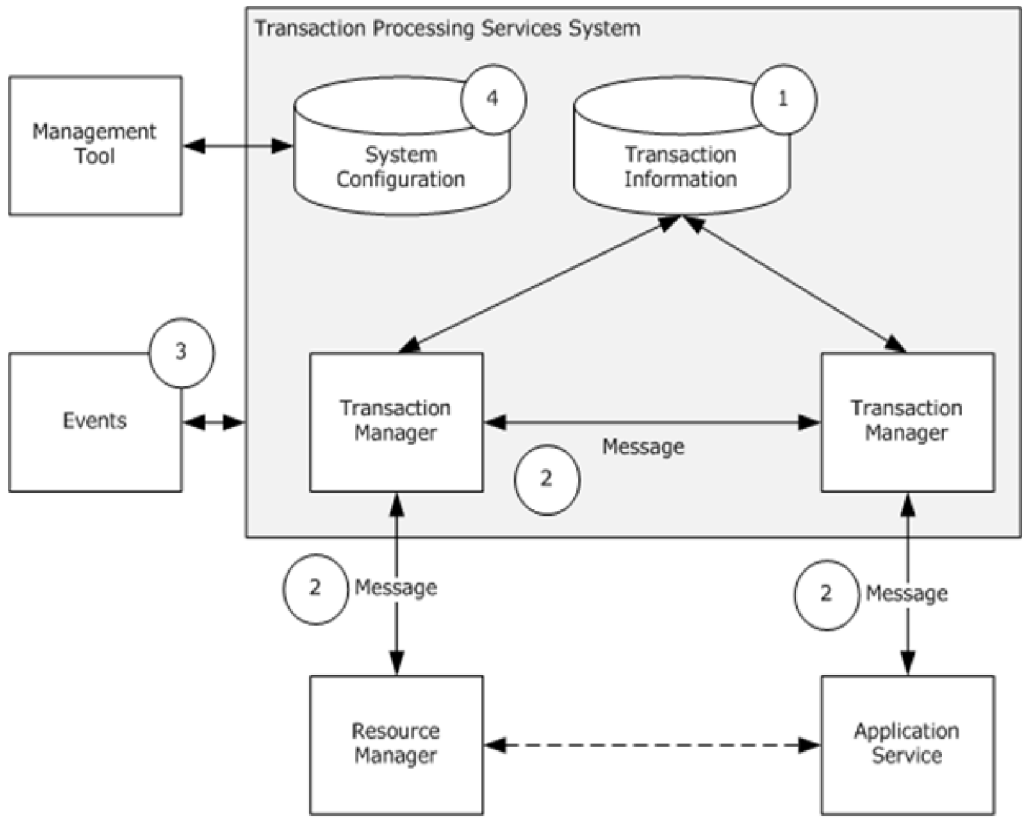
Compensating transaction

In systems where commit and rollback mechanisms are not available or undesirable, a compensating transaction is often used to undo failed transactions and restore the system to a previous state.

ACID criteria (Atomicity, Consistency, Isolation, Durability)

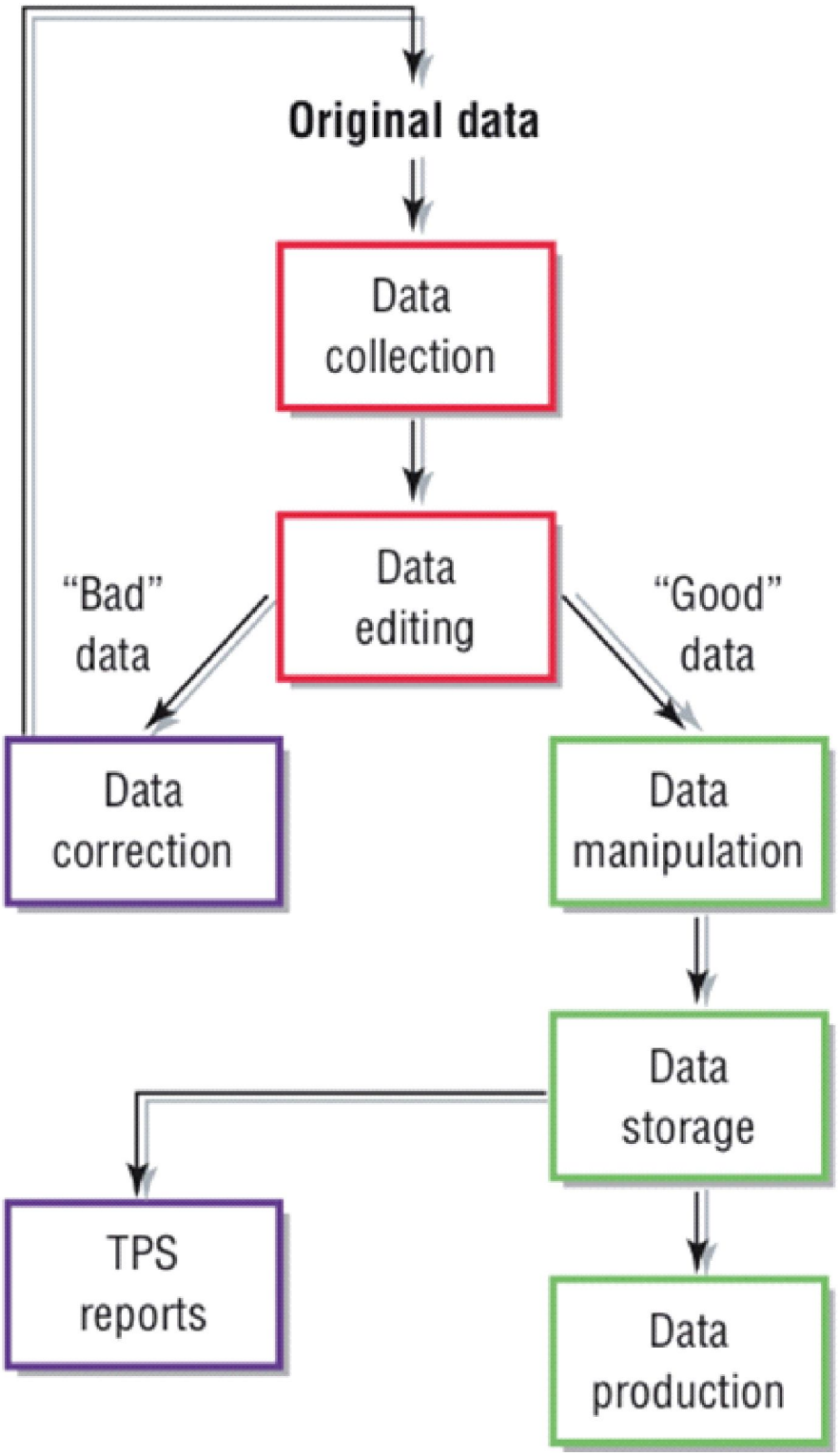
Transaction processing has these benefits:

- It allows sharing of computer resources among many users.
- It shifts the time of job processing to when the computing resources are less busy.
- It avoids idling the computing resources without minute-by-minute human interaction and supervision.
- It is used on expensive classes of computers to help amortize the cost by keeping high rates of utilization of those expensive resources.



4.6 Transaction Processing Cycle

1. Data collection : The process of capturing transaction related data.
2. Data editing : Checking the validity of data entered.
3. Data correction : Implemented if an error is found in the entered data.
4. Data manipulation : Processing transaction data.
5. Data storage : Altering databases to reflect the transaction.



4.7 Types of Transactions

While the transaction process must be standardized to maximize efficiency, every enterprise requires a tailored transaction process that aligns with its business strategies and processes. For this reason, there are two broad types of transaction:

Batch Processing

Batch processing is a resource-saving transaction type that stores data for processing at pre-defined times. Batch processing is useful for enterprises that need to process large amounts of data using limited resources.

Examples of batch processing include credit card transactions, for which the transactions are processed monthly rather than in real time. Credit card transactions need only be processed once a month in order to produce a statement for the customer, so batch processing saves IT resources from having to process each transaction individually.

Benefits

Batch processing has these benefits:

- It allows sharing of computer resources among many users and programs.
- It shifts the time of job processing to when the computing resources are less busy.
- It avoids idling the computing resources with minute-by-minute manual intervention and supervision.
- By keeping high overall rate of utilization, it better amortizes the cost of a computer, especially an expensive one.

An example of batch processing is the way that credit card companies process billing. The customer does not receive a bill for each separate credit card purchase but one monthly bill for all of that month's purchases. The bill is created through batch processing, where all of the data are collected and held until the bill is processed as a batch at the end of the billing cycle.

Real Time Processing

In many circumstances the primary factor is speed. For example, when a bank customer withdraws a sum of money from his or her account it is vital that the transaction be processed and the account balance updated as soon as possible, allowing both the bank and customer to keep track of funds.

Benefits

- There is no significant delay for response.
- Information is always up-to-date.
- Output from the computer may be used to adjust and improve the input.
- There will be (in most cases) no processing lag caused by the system.

An example of a traffic light system is a real-time system but it only needs to process data relatively slowly. On the other hand, controlling a car engine has to deal with input events happening every thousandth of a second so a very fast computer is needed to do this - but both the traffic-light and the car engine computers are carrying out 'real-time' processing.

Other Examples:

- Heart rate monitoring
- Aircraft control

- Computer games
- Controlling robots

The user interface of a real-time system may use specialist input devices to provide data input.. For example, a car driver will be providing input data to the onboard computer with throttle and brake pedals. A gamer may be using a joystick or hand held control to interact with the real-time game. A traffic light system may sense the car at the lights using a buried inductive loop.

Methodology

The basic principles of all transaction-processing systems are the same. However, the terminology may vary from one transaction-processing system to another, and the terms used below are not necessarily universal.

Rollback

Transaction-processing systems ensure database integrity by recording intermediate states of the database as it is modified, then using these records to restore the database to a known state if a transaction cannot be committed. For example, copies of information on the database *prior* to its modification by a transaction are set aside by the system before the transaction can make any modifications (this is sometimes called a *before image*). If any part of the transaction fails before it is committed, these copies are used to restore the database to the state it was in before the transaction began.

Roll forward

It is also possible to keep a separate journal of all modifications to a database (sometimes called *after images*). This is not required for rollback of failed transactions but it is useful for updating the database in the event of a database failure, so some transaction-processing systems provide it. If the database fails entirely, it must be restored from the most recent back-up. The back-up will not reflect transactions committed since the back-up was made. However, once the database is restored, the journal of after images can be applied to the database (*rollforward*) to bring the database up to date. Any transactions in progress at the time of the failure can then be rolled back. The result is a database in a consistent, known state that includes the results of all transactions committed up to the moment of failure.

Deadlocks

In some cases, two transactions may, in the course of their processing, attempt to access the same portion of a database at the same time, in a way that prevents them from proceeding. For example, transaction A may access portion X of the database, and transaction B may access portion Y of the database. If, at that point, transaction A then tries to access portion Y of the database while transaction B tries to access portion X, a *deadlock* occurs, and neither transaction can move forward. Transaction-processing systems are designed to detect these deadlocks when they occur. Typically both transactions will be cancelled and rolled back, and then they will be started again in a different order, automatically, so that the deadlock doesn't occur again. Or sometimes, just one of the deadlocked transactions will be cancelled, rolled back, and automatically re-started after a short delay.

Deadlocks can also occur between three or more transactions. The more transactions involved, the more difficult they are to detect, to the point that transaction processing systems find there is a practical limit to the deadlocks they can detect.

4.8 Summary

In this unit we have discussed the various types of transaction processing systems and their characteristics. How information systems are associated with transaction processing systems. We also

have discussed the various examples of transaction processing system and information systems, with their benefits. How ACID criteria are important for transactions is discussed with examples. Transaction processing cycle shows how Data collection, editing, correction, manipulation and storage is performed in the cycle.

4.9 Self Assessment Questions

1 What is Transaction Processing System. Explain with suitable examples?

2 What are the features of Transaction Processing System?

3 Explain the ACID property in context of Transactions?

4 What is Transaction Processing cycle?

5 Explain different types of Transactions with example?

6 What do you mean by types of Information explain?

7 What are the functional areas of Information System?

4.10 Further Readings

1. Management Information System: Author: D. P. Goyal, Macmillan Publisher
2. Information Systems for Modern Management: Author: Robert G. Murdick, Joel E. Ross, James R. Claggett, PHI publisher
3. en.wikipedia.org
4. wiki.answers.com
5. www.webopedia.com
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7. in.answers.yahoo.com

Unit - 5 : MIS : Management Information System

Structure of the Unit

5.0 Objective

This unit provides a general overview of Management Information System. We will discuss the issues related to implementation of Management Information System, its use and how it is implemented in the organization. We will discuss the minimum requirements needed for implementation of MIS in organization. What are the pitfalls and constraints of Management Information System. How implementation of Management Information System improves the performance of organization. These are the issues which we will discuss and learn in this unit.

5.1 Introduction

A management information system (MIS) provides information that is needed to manage organizations efficiently and effectively. Management information systems are not only computer systems - these systems encompass three primary components: technology, people (individuals, groups, or organizations), and data/information for decision making. Management information systems are distinct from other information systems in that they are designed to be used to analyze and facilitate strategic and operational activities in the organization. Academically, the term is commonly used to refer to the study of how individuals, groups, and organizations evaluate, design, implement, manage, and utilize systems to generate information to improve efficiency and effectiveness of decision making, including systems termed decision support systems, expert systems, and executive information systems.

History

Kenneth and Jane Laudon identify five eras of MIS evolution corresponding to five phases in the development of computing technology:

1. Mainframe and minicomputer computing
2. Personal computers
3. Client/server networks

4. Enterprise computing
5. Cloud computing.

The first (mainframe and minicomputer) era was ruled by IBM and their mainframe computers; these computers would often take up whole rooms and require teams to run them - IBM supplied the hardware and the software. As technology advanced these computers were able to handle greater capacities and therefore reduce their cost. Smaller, more affordable minicomputers allowed larger businesses to run their own computing centers in-house.

The second (personal computer) era began in 1965 as microprocessors started to compete with mainframes and minicomputers and accelerated the process of decentralizing computing power from large data centers to smaller offices. In the late 1970s minicomputer technology gave way to personal computers and relatively low cost computers were becoming mass market commodities, allowing businesses to provide their employees access to computing power that ten years before would have cost tens of thousands of dollars. This proliferation of computers created a ready market for interconnecting networks and the popularization of the Internet.

As the complexity of the technology increased and the costs decreased, the need to share information within an enterprise also grew, giving rise to the third (client/server) era in which computers on a common network were able to access shared information on a server. This allowed for large amounts of data to be accessed by thousands and even millions of people simultaneously.

The fourth (enterprise) era enabled by high speed networks, tied all aspects of the business enterprise together offering rich information access encompassing the complete management structure.

The fifth and latest (cloud computing) era of information systems employs networking technology to deliver applications as well as data storage independent of the configuration, location or nature of the hardware. This, along with high speed cellphone and wifi networks, led to new levels of mobility in which managers access the MIS remotely with laptops, tablet PC's, and smartphones.

5.2 Various types of Systems in MIS

Types of the System in the Management Information Systems are as follows:

1. Conceptual Systems

a. Are theoretical and explanatory in the nature.
b. Provide the much needed clarification.
c. Provide theoretical framework for which there may or may not be any real life counterpart.
d. E.g. of such systems can be philosophy, theology etc.

2. Empirical Systems

a. Are very practical, specific and also very operational in the nature.
b. Can be based on the conceptual system.
c. Examination system, surgery act as very good examples of the empirical systems.

3. Open Systems

a. Involve continuous interaction with the environment.
b. So exchanges the information, material, energy with the environment.
c. Is open and also self organizing in the nature.
d. Is also adoptive or adaptive to the changing environment as it is flexible.

4. **Closed Systems**
   a. Shuts any kind of the exchange with the environment.
   b. Is rigid in nature.
   c. Is not at all amenable to the change.
   d. Is also self contained.
   e. Is somewhat isolated in the nature.
   f. Is having a well defined boundary.
   g. Is not at all adaptive in the nature.

5. **Natural Systems**
   a. Such systems exist and also abound in the nature.
   b. Are also not at all the results of the human endeavors.
   c. Rivers, mountains, minerals etc. are the major examples of the natural Systems.

6. **Artificial Systems**
   a. Are manufactured (man made).
   b. Examples of such Systems are dams, canals, roads, machines, factories etc.

7. **Probabilistic Systems**
   a. Based on the predictability of the behavior or the outcome.

8. **Deterministic Systems**
   a. In such Systems, the interaction of the elements is known.
   b. As the behavior of the elements is pre determined, it becomes possible to work upon the reaction well in the advance.

Most management information systems specialize in particular commercial and industrial sectors, aspects of the enterprise, or management substructure.

- **Management information systems (MIS)**, per se, produce fixed, regularly scheduled reports based on data extracted and summarized from the firm's underlying transaction processing systems to middle and operational level managers to identify and inform structured and semi-structured decision problems.
- **Decision support systems (DSS)** are computer program applications used by middle management to compile information from a wide range of sources to support problem solving and decision making.
- **Executive information systems (EIS)** is a reporting tool that provides quick access to summarized reports coming from all company levels and departments such as accounting, human resources and operations.
- **Marketing information systems** are MIS designed specifically for managing the marketing aspects of the business.
- **Office automation systems (OAS)** support communication and productivity in the enterprise by automating work flow and eliminating bottlenecks. OAS may be implemented at any and all levels of management.
- **School management information systems (MIS)** cover school administration, and often including teaching and learning materials.

- ***Accounting management information systems***: All accounting reports are shared by all levels of accounting managers.
- ***Financial management information systems*:** The financial management information system provides financial information to all financial managers within an organization including the chief financial officer. The chief financial officer analyzes historical and current financial activity, projects future financial needs, and monitors and controls the use of funds over time using the information developed by the MIS department.
- ***Manufacturing management information systems*:** More than any functional area, operations have been impacted by great advances in technology. As a result, manufacturing operations have changed. For instance, inventories are provided just in time so that great amounts of money are not spent for warehousing huge inventories. In some instances, raw materials are even processed on railroad cars waiting to be sent directly to the factory. Thus there is no need for warehousing.
- ***Marketing management information systems*:** A marketing management information system supports managerial activity in the area of product development, distribution, pricing decisions, promotional effectiveness, and sales forecasting. More than any other functional area, marketing systems rely on external sources of data. These sources include competition and customers.
- ***Human resources management information systems*:** Human resources management information systems are concerned with activities related to workers, managers, and other individuals employed by the organization. Because the personnel function relates to all other areas in business, the human resources management information system plays a valuable role in ensuring organizational success. Activities performed by the human resources management information systems include, work-force analysis and planning, hiring, training, and job assignments.

Role of MIS

1. Helps in quantitative as well as qualitative decision making process.
2. Helps in minimizing the element of surprise.
3. MIS helps decision maker to give a certain response, which may be either re – active or pro – active in nature.
4. Acts as a defensive mechanism as well as functions as a weapon for an offence.
5. Helps in creating a work culture based on information, in an organization.

5.3 Characteristics of MIS

To function effectively as an interacting, interrelated, and interdependent feedback tool for management and staff, MIS must be "useable." The five elements of a useable MIS system are: timeliness, accuracy, consistency, completeness, and relevance. The usefulness of MIS is hindered whenever one or more of these elements are compromised. Developing quality characteristics for gathering information is essential to making solid management decisions.

Timeliness

To simplify prompt decision making, an institution's MIS should be capable of providing and distributing *current* information to appropriate users. Information systems should be designed to expedite reporting of information. The system should be able to quickly collect and edit data, summarize results, and be able to adjust and correct errors promptly.

Accuracy

A sound system of automated and manual internal controls must exist throughout all information systems processing activities. Information should receive appropriate editing, balancing, and internal control checks. A comprehensive internal and external audit program should be employed to ensure the adequacy of internal controls.

MIS information should be accurate and avoid any inclusions of estimates or probable costs. Making decisions based on estimates can lead to cost overruns or lower profits from future operations.

Consistency

To be reliable, data should be processed and compiled consistently and uniformly. Variations in how data is collected and reported can distort information and trend analysis. In addition, because data collection and reporting processes will change over time, management must establish sound procedures to allow for systems changes. These procedures should be well defined and documented, clearly communicated to appropriate employees, and should include an effective monitoring system.

Completeness

Decision makers need complete and pertinent information in a summarized form. Reports should be designed to eliminate clutter and voluminous detail, thereby avoiding "information overload." Relevance Information provided to management must be relevant. Information that is inappropriate, unnecessary, or too detailed for effective decision making has no value. MIS must be appropriate to support the management level using it. The relevance and level of detail provided through MIS systems directly correlate to what is needed by the board of directors, executive management, departmental or area mid-level managers, etc. in the performance of their jobs.

Relevance

Information should be relevant to the strategic decision that company management is currently reviewing. Because companies may review several business opportunities at one time, avoiding information not relating to the decision is essential.

Exhaustive

MIS information gathering should resemble an upside-down triangle. The early stages of information gathering should be exhaustive, including all types of company information. As management narrows its decision-making process, the information is refined to include only the most relevant pieces.

Cost-Effective

The MIS needs to be a cost-effective and efficient system for gathering information. Most of these systems are developed internally, creating costs that cannot be passed to clients.

Other Characterstics

- Provides reports with fixed and standard formats
- Hard-copy and soft-copy reports
- Uses internal data stored in the computer system
- End users can develop custom reports
- Requires formal requests from users

Management Information Systems for Competitive Advantage

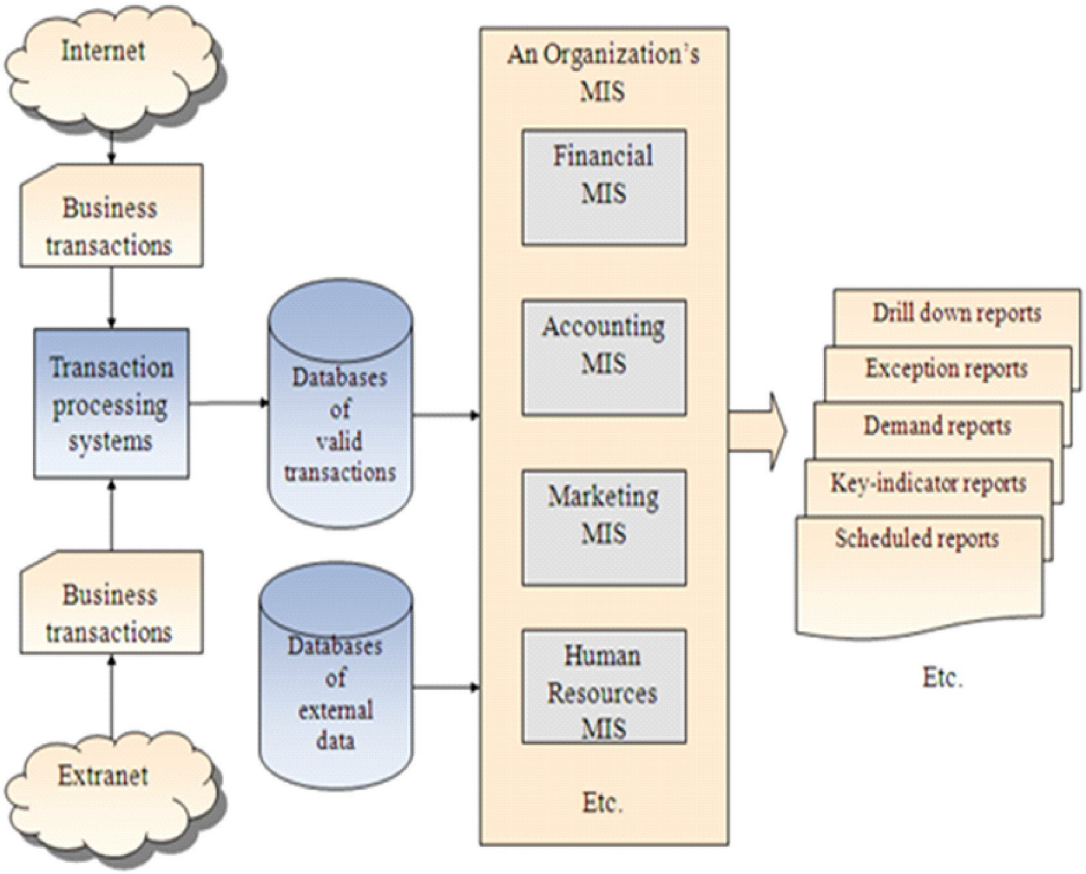
- Provides support to managers as they work to achieve corporate goals
- Enables managers to compare results to established company goals and identify problem areas and opportunities for improvement

MIS and Web Technology

- Data may be made available from management information systems on a company's intranet
- Employees can use browsers and their PC to gain access to the data

Functional Aspects

- MIS is an integrated collection of functional information systems, each supporting particular functional areas.



5.4 Pitfalls of Management Information System (MIS)

Cost of Technology Upgrades

Implementing a new MIS or new MIS procedures can prove to be a difficult process for older computer mainframe systems or business software applications. Because modern technology can change rapidly in a short amount of time, companies must maintain current hardware and software systems in their company. Business hardware is an additional overhead expense companies usually pass on to consumers. Failing to recoup these infrastructure costs can leave companies with a large capital expense on their financial statements.

Mainframe systems or business software applications. Because modern technology can change rapidly in a short amount of time, companies must maintain current hardware and software systems

in their company. Business hardware is an additional overhead expense companies usually pass on to consumers. Failing to recoup these infrastructure costs can leave companies with a large capital expense on their financial statements.

Training Needs

Training managers and employees on a new MIS may be a process that takes a lot of time and effort. Companies may not be prepared to train their managers and employees on such a large scale business system. Additionally, older employees may take longer to train since they are usually less familiar with current business technology. The company size and number of departments needing the new MIS may also create training difficulties for the company. Companies may need to shut down operations during the training period, creating a potential for lost profits.

MIS as Distraction

MIS processes may provide little benefit as a management tool if they are allowed to get out of hand. This may happen if companies spend more time designing, implementing, reviewing and controlling the MIS. Companies should view the MIS as a behind-the-scenes operation; allowing it to become a major distraction in the decision-making process cheapens the value of the MIS. It may also be a distraction when companies attempt to expand their current operations.

Misconceptions

Companies may not need a completely new MIS process or renovation. Simple tweaks may be sufficient to ensure the current MIS operates smoothly. Business software packages can quickly become overpriced when new hardware and maintenance agreements are included. This expense may be avoided if company management simply review their current MIS processes and determine where any flaws or errors exist. Correcting these issues may breathe new life into the current MIS.

Too Much Information

MIS processes are designed to gather and collect pertinent information for business decisions. Creating an MIS that collects too much information can lead to the management problem known as the "paralysis of analysis." This management theory is based on the principles of so much information is gathered that it leads to the inability of making a decision. Management information must be timely, relevant and accurate. Information that does not meet these guidelines may not be necessary for making business decisions.

5.5 Advantages of Management Information Systems (MIS)

Modern businesses have been leveraging management information systems (MIS) to manage, order, organize and manipulate the gigabytes and masses of information generated for various purposes. MIS helps businesses optimize business processes, address information needs of employees and various stakeholders and take informed strategic decisions. However, budget allocation and monitoring issues can affect the efficacy of MIS. It has its advantages and disadvantages depending on organizational deployment and usage.

Management information systems have changed the dynamics of running businesses efficiently. Decentralization is one of the biggest advantages; it allows monitoring of operations at low levels and frees up resources for departmental managers to devote time to strategic activities. Coordination of specialized projects and activities is much better and decision makers in the organization are aware of issues and problems in all departments. Another advantage of MIS is that it minimizes information overload, which can be quite common with conventional businesses in the modern era.

Better Planning and Control

MIS has to be designed and managed in such way that it aggregates information, monitors the company's activities and operations and enhances communication and collaboration among employees. This ensures better planning for all activities and better ways to measure performance, manage resources and facilitate compliance with industry and government regulations. Control helps in forecasting, preparing accurate budgets and providing the tools and vital information to employees, top management and business partners.

Aid Decision Making

The purpose of MIS is to generate synthesized and processed information from computerized/ automated and certain manual systems. Information distribution to all levels of corporate managers, professionals and key executives becomes quite seamless with streamlined MIS. Managers are able to make quick, timely and informed decisions. Top management and board members can take strategic decisions, plan future growth and business expansion activities based on the data and information generated by MIS.

An MIS provides the following advantages.

1. **It Facilitates planning** : MIS improves the quality of plants by providing relevant information for sound decision - making . Due to increase in the size and complexity of organizations, managers have lost personal contact with the scene of operations.
2. **In Minimizes information overload** : MIS change the larger amount of data in to summarized form and there by avoids the confusion which may arise when managers are flooded with detailed facts.
3. **MIS Encourages Decentralization** : Decentralization of authority is possibly when there is a system for monitoring operations at lower levels. MIS is successfully used for measuring performance and making necessary change in the organizational plans and procedures.
4. **It brings Co ordination** : MIS facilities integration of specialized activities by keeping each department aware of the problem and requirements of other departments. It connects all decision centers in the organization .
5. **It makes control easier** : MIS serves as a link between managerial planning and control. It improves the ability of management to evaluate and improve performance . The used computers has increased the data processing and storage capabilities and reduced the cost .
6. **MIS assembles**, process , stores , Retrieves , evaluates and Disseminates the information.
7. Improves personal efficiency
8. Expedites problem solving(speed up the progress of problems solving in an organization)
9. Facilitates interpersonal communication
10. Promotes learning or training
11. Increases organizational control
12. Generates new evidence in support of a decision
13. Creates a competitive advantage over competition
14. Encourages exploration and discovery on the part of the decision maker
15. Reveals new approaches to thinking about the problem space
16. Helps automate the Managerial processes.

5.6 Disadvantages of Management Information Systems (MIS)

A management information system is an approach a company uses when making various business decisions. Business owners and managers are responsible for operational, technical and strategic decisions. Using an information system helps these individuals gather pertinent documents that will help them make the best decision possible. While these systems were manual in previous decades, business technology allows companies to implement electronic systems. Some disadvantages can exist when using a management information system in a company.

Depending on organization deployment, usage and extraneous factors, some disadvantages related to Management Information Systems can come to the fore. Allocation of budgets for MIS upgrades, modifications and other revisions can be quite tricky at times. If budgets are not allocated uniformly or as per immediate requirements, key functionalities might get effected and benefits might not be realized consistently. Integration issues with legacy systems can affect the quality of output and vital business intelligence reports.

Constant Monitoring Issues

Change in management, exits or departures of department managers and other senior executives has a broad effect on the working and monitoring of certain organization practices including MIS systems. Since MIS is a critical component of an organization's risk management strategy and allied systems, constant monitoring is necessary to ensure its effectiveness. Quality of inputs into MIS needs to be monitored; otherwise consistency in the quality of data and information generated gets effected. Managers are not able to direct business, operational and decision-making activities with the requisite flexibility.

1. Highly senstive requires constant monitoring.
2. Buddgeting of MIS extremely difficult.
3. Quality of outputs governed by quality of inputs.
4. Lack of flexiblity to update itself.
5. Effectiveness decreases due to frequent changes in top management
6. Takes into account only qualitative factors and ignores non-qualitative factors like morale of worker, attitude of worker etc.
7. Expensive

   Installing a management information system can be expensive for a company. Information technology—while cheaper today than previous years—can represent a significant expense, especially for larger organizations. These systems may also require ongoing support or upgrade fees, which can represent future fixed cash outflows. Companies must create a budget to pay for these items to ensure the information system stays current with business technology. Attempting to integrate these systems with technology currently in use can also increase expenses.

8 Maintenance

   Companies may need to hire maintenance individuals to help keep an electronic information system running smoothly. These individuals often need experience in computer science functions and other business topics. Not only does this increase labor costs, but it also requires additional training and ongoing education for these individuals. Business technology can change frequently, creating an environment where companies must have trained individuals who can properly maintain computers, websites, servers and other equipment in use by the management information system.

9 Ineffective

Management information systems have the potential to become ineffective in a company's operations. As with all computer systems, the management information system is only as good as the programmer. Gathering unimportant or non-essential information can delay business decisions because managers must request additional input. Spending too much time reprogramming or correcting issues can also increase the time spent in the decision-making process. Business owners and managers may also need extensive training on new systems, creating a learning curve that will hopefully diminish over time

10 Employee Training

Properly trained employees are a critical part of an MIS. Employees are at the front lines of business operations and create or manage the daily activities of the company. If an MIS finds a system flaw or management decides to change a process based on the MIS information, re-training employees will usually be required. The length and depth of the training may vary, making it difficult to estimate the cost of this training. Management will also have to account for the lost productivity during this training period.

5.7 Flexibility of Management Information System (MIS)

Once an MIS is created and installed in a company, it may prove to be an inflexible system. Making changes quickly to reflect fluctuating business operations may not be possible depending on the MIS style and functionality. While correcting policies such as internal controls or operating procedures may be easy, company-wide changes such as service changes, production enhancements or marketing strategy may not be simple. Major business changes will require major changes to the MIS, leading to increased costs and downtime of information reporting.

Information Flaws

The MIS is designed to provide information to management so sound decisions can be made regarding company operations. The biggest flaw an MIS can have is pulling incorrect or inadequate information for management. This problem results in wasted time and money for the company, leading to another review of the MIS to correct the information flaws.

Unemployment - While information technology may have streamlined the business process it has also created job redundancies, downsizing and outsourcing. This means that a lot of lower and middle level jobs have been done away with causing more people to become unemployed.

Privacy - Though information technology may have made communication quicker, easier and more convenient, it has also bought along privacy issues. From cell phone signal interceptions to email hacking, people are now worried about their once private information becoming public knowledge.

Lack of job security - Industry experts believe that the internet has made job security a big issue as since technology keeps on changing with each day. This means that one has to be in a constant learning mode, if he or she wishes for their job to be secure.

Dominant culture - While information technology may have made the world a global village, it has also contributed to one culture dominating another weaker one. For example it is now argued that US influences how most young teenagers all over the world now act, dress and behave. Languages too have become overshadowed, with English becoming the primary mode of communication for business and everything else.

5.8 Input and Outputs of MIS

- Inputs: Information from the Transaction Processing System
- Outputs: hard and softcopy reports
  - Scheduled reports
  - On-demand reports
  - Key-indicator (business fundamentals)
  - Exception reports

MIS acts as a multi – disciplinary subject, depending heavily upon the various disciplines like management accounting, management science, organizational behavior, operations research, computer science etc.

Nowadays MIS is totally based on the computers, but in the beginning it started with the electronic data processing, then it moved to the information systems, decision support systems, executive support systems etc.

When MIS came into being, it was just a single integrated system but now it is a combination of sub systems, which include production, inventory, finance, etc. These sub systems are of two types:-

1. **Functional subsystems**: – These subsystems include the following :-
   - Marketing – Sales planning after sales forecasting, customer analysis and sales analysis.
   - Manufacturing – Planning and scheduling of the production to be carried out.
   - Personnel – Identifying and then planning the various personnel requirements, performance analyzation.
   - Finance and Accounting – Designing plans for getting the capital that is required in the business, measuring and analyzing the incomes.
   - Information Processing – Information system planning plays a very key role in MIS.
   - Top Management – Strategic planning.

2. **Activities sub system** : It includes
   - Transaction Processing – Deals with orders, shipments, receipts and then their processing.
   - Operational Control – Proper scheduling control of the activities to be performed during the operation process.
   - Management Control – Budget formulation.
   - Strategic planning – Planning strategically by forming certain objectives and then trying to achieve them.

5.9 Summary

This unit describes about Management Information System. This unit tells us about the early system of Management and its basic implementation. We have learnt about the characteristics of Management Information System. Apart from having useful role of Management Information System it also have some pitfalls which are discussed with examples in this unit. This in turn leads to the various advantages and disadvantages of the MIS. This unit also provides brief introduction regarding the inputs and outputs produced by the Management Information System.

5.10 Self Assessment Questions

1. What is Management Information System? Explain
2. Explain different types of Systems, along with example?
3. What are the characteristics of Management Information System?
4. Explain Advantages and disadvantage of MIS?
5. What are the pitfalls of MIS?

5.11 Further Readings

- Management Information System: W.S. Javadekar
- Management Information System: D.P. Goyal
- http://en.wikipedia.org
- http://blog.maia-intelligence.com
- http://wiki.answers.com
- http://www.ehow.com

UNIT - 6 : ERP: ENTERPRISE RESOURCE PLANNING SYSTEMS

Structure of the Unit

6.0 Objective

This unit provides the overview of :-

- Enterprise Resource Planning
- Evolution of ERP
- ERP System Architecture
- ERP vendors
- Future of ERP

6.1 Introduction

Understanding the critical success factors in implementing Enterprise Resource Planning (ERP) systems has been a challenging process for many organizations worldwide. An ERP system enables an organization to integrate all the primary business process in order to enhance efficiency and maintain a competitive position. However, without successful implementation of the system, the projected benefits of improved productivity and competitive advantage would not be forthcoming.

In its basic definition, ERP is an enterprise-wide information system that integrates and controls all the business processes in the entire organization. According to Nah and Lau (2001) ERP is "a packaged business software system that enables a company to manage the efficient and effective use of resources (materials, human resources, finance, etc.) by providing a total, integrated solution for the organization's information-processing needs". This software facilitates, if well implemented, the integration of all the functional information flows across the organization into a single package with a common database. Therefore, it allows easy and immediate access to information regarding inventory, product or customer data, and prior history information.

ERP initially covered all routine transactions within an organization only. However, it was later expanded to cover external customers and suppliers. Nah and Lau stated that most ERP systems now have the functionality and the capability to facilitate the flow of information across all business processes internally and externally. Furthermore, ERP systems have the capability to "reach beyond their own corporate walls to better connect with suppliers, distributors and customers to engage in e-business".

Today, many public and private organizations worldwide are implementing ERP systems in place of the functional legacy systems that are not anymore well-compatible with modern business environment. However, according to Kroenke (2008), the process of moving from functional applications to an ERP system is difficult and challenging. Additionally, the switch to ERP system is expensive and it requires development of new procedures, training and converting Data.

6.2 ERP: Introduction and Definition

ERP is a software architecture that facilitates the flow of information among the different functions within an enterprise. Similarly, ERP facilitates information sharing across organizational units and geographical locations. It enables decision-makers to have an enterprise-wide view of the information they need in a timely, reliable and consistent fashion.

ERP provides the backbone for an enterprise-wide information system. At the core of this enterprise software is a central database which draws data from and feeds data into modular applications that operate on a common computing platform, thus standardizing business processes and data definitions into a unified environment. With an ERP system, data needs to be entered only once. The system provides consistency and visibility or transparency across the entire enterprise. A primary benefit of ERP is easier access to reliable, integrated information. A related benefit is the elimination of redundant data and the rationalization of processes, which result in substantial cost savings.

The integration among business functions facilitates communication and information sharing, leading to dramatic gains in productivity and speed. Cisco Systems, for example, harnessed ERP to help it become the market leader in the global networking industry. Cisco's ERP system was the backbone that enabled its new business model Global Networked Business based on the use of electronic communications to build interactive, knowledge-based relationships with its customers, business partners, suppliers and employees. In the process, Cisco doubled in size each year and reaped hundreds of millions of dollars in both cost savings and revenue enhancements.

Autodesk, a computer-aided design software company, reported a decrease in its order fulfillment times from two weeks to 24 hours after installing an ERP system. Similar examples abound in today's business environment.

Based on the promise of tightly-integrated corporate functions, globally optimized decisions and fast and easy access to accurate information, enterprise software has become an essential part of the operations of large businesses in many industries. By 1998, over 20,000 firms around the world spent $17 billion on enterprise software, following annual growth rates that ranged from 30% to 50%.

In addition to direct spending on the software itself, companies often spend a multiple of licensing costs on services related to implementation and maintenance. Companies are beginning use enterprise software to automate front-office activities such as sales and marketing, call center operations, product configuration, lead-tracking and customer relationship management.

Definition

ERP (enterprise resource planning) is an industry term for the broad set of activities that helps a business manage the important parts of its business. The information made available through an ERP

system provides visibility for key performance indicators (KPIs) required for meeting corporate objectives. ERP software applications can be used to manage product planning, parts purchasing, inventories, interacting with suppliers, providing customer service, and tracking orders. ERP can also include application modules for the finance and human resources aspects of a business. Typically, an ERP system uses or is integrated with a relational database system.

ERP is one of the most widely implemented business software systems in a wide variety of industries and organizations. ERP is the acronym of Enterprise Resource Planning. ERP is just not only a software. ERP definition refers to both; ERP software and business strategies that implement ERP systems.

ERP implementation utilizes various ERP software applications to improve the performance of organizations for :-

1. resource planning,
2. management control and
3. operational control.

ERP software consists of multiple software modules that integrate activities across functional departments - from production planning, parts purchasing, inventory control and product distribution to order tracking. Most ERP software systems include application modules to support common business activities like finance, accounting and human resources.

6.3 History of ERP

Enterprise Resource Planning (ERP) is the evolution of Manufacturing Requirements Planning (MRP) II in 1980s, which was mainly related to Manufacturing Industry and was designed to control manufacturing process and planning the required production with efficient output. Where as MRP is the evolution of Inventory Management & Control conceived in 1960s, which was mainly designed for management of Stocks in any particular industry. ERP has expanded from coordination of manufacturing processes to the integration of enterprise-wide backend processes like production planning and scheduling of delivery. In terms of technology, ERP has evolved from legacy implementation to more flexible tiered client-server architecture.

6.4 ERP System

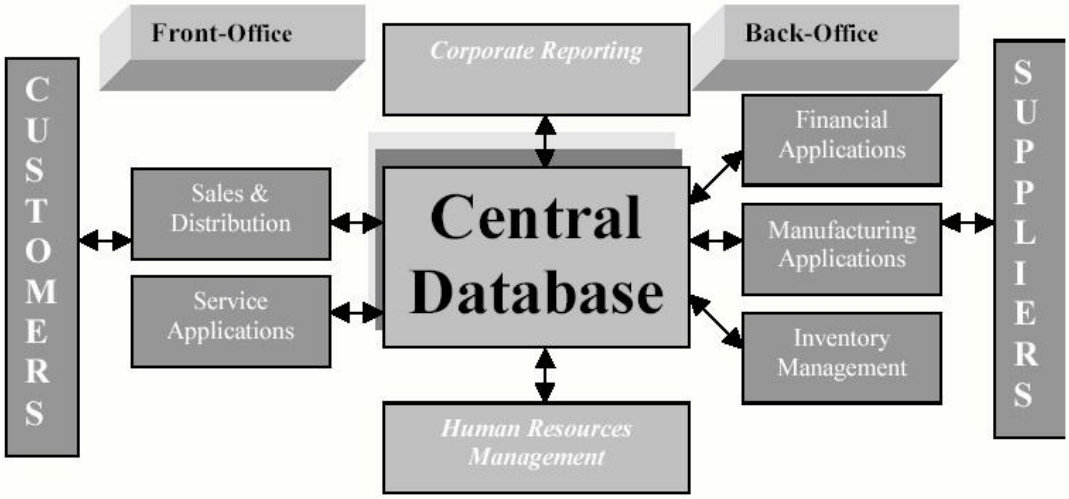
ERP is much more than just a computer software. An ERP System includes ERP Software, Business Processes, Users and Hardware that run the ERP software. An ERP system is more than the sum of its parts or components. Those components interact together to achieve a common goal - streamline and improve organizations' business processes. Most important factor for ERP system is the users. Successful implementation of any ERP System more depends on intelligent users who are going to use them, because any standard ERP Software would consist hundreds of input information for any particular business activity. Thus good knowledge of each entity of system to the users is most important factor in ERP Software.

Enterprise resource planning systems or enterprise systems are software systems for business management, encompassing modules supporting functional areas such as planning, manufacturing, sales, marketing, distribution, accounting, financial, human resource management, project management, inventory management, service and maintenance, transportation and e-business. The architecture of the software facilitates transparent integration of modules, providing flow of information between all functions within the enterprise in a consistently visible manner. Corporate computing with ERPs allows companies to implement a single integrated system by replacing or reengineering their mostly incompatible legacy information systems. American Production and Inventory Control Society (2001) has defined ERP systems as "a method for the effective planning and controlling of all the resources needed to take, make, ship and account for

customer orders in a manufacturing, distribution or service company." We quote several definitions from the published literature to further explain the concept:

"ERP (enterprise resource planning systems) comprises of a commercial software package that promises the seamless integration of all the information flowing through the company–financial, accounting, human resources, supply chain and customer information" (Davenport, 1998). "ERP systems are configurable information systems packages that integrate information and information-based processes within and across functional areas in an organization" (Kumar & Van Hillsgersberg, 2000). "One database, one application and a unified interface across the entire enterprise" (Tadjer, 1998).

"ERP systems are computer-based systems designed to process an organization's transactions and facilitate integrated and real-time planning, production, and customer response" (O'Leary, 2001). The concept of the ERP system can be illustrated, following Davenport (1998), with the diagram in figure given below:



ERP system concepts

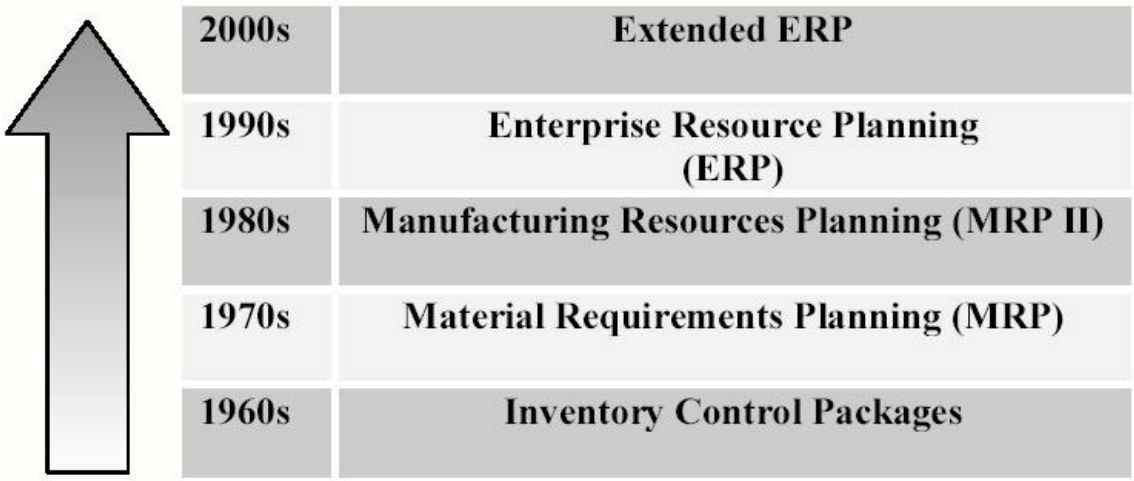
6.4.1 Evolution of ERP Systems

The evolution of ERP systems closely followed the spectacular developments in the field of computer hardware and software systems. During the 1960s most organizations designed, developed and implemented centralized computing systems, mostly automating their inventory control systems using inventory control packages (IC).

These were legacy systems based on programming languages such as COBOL, ALGOL and FORTRAN. Material requirements planning (MRP) systems were developed in the 1970s which involved mainly planning the product or parts requirements according to the master production schedule. Following this route new software systems called manufacturing resources planning (MRP II) were introduced in the 1980s with an emphasis on optimizing manufacturing processes by synchronizing the materials with production requirements. MRP II included areas such as shop floor and distribution management, project management, finance, human resource and engineering. ERP systems first appeared in the late 1980s and the beginning of the 1990s with the power of enterprise-wide inter-functional coordination and integration. Based on the technological foundations of MRP and MRP II, ERP systems integrate business processes including manufacturing, distribution, accounting, financial, human resource management, project management, inventory management, service and maintenance, and transportation, providing accessibility, visibility and consistency across the enterprise.

During the 1990s ERP vendors added more modules and functions as "add-ons" to the core modules giving birth to the "extended ERPs." These ERP extensions include advanced planning and

scheduling (APS), e-business solutions such as customer relationship management (CRM) and supply chain management (SCM). Following figure summarizes the historical events related with ERP.



ERP Evolution

6.5 ERP Systems Architecture

ERP vendors, mostly experienced from the MRP and financial software services fields, realized the limitations of the old legacy information systems used in large enterprises of the 1970s and 1980s. Some of these old systems were developed in-house while others were developed by different vendors using several different database management systems, languages and packages, creating islands of non compatible solutions unfit for seamless data flow between them. It was difficult to increase the capacity of such systems or the users were unable to upgrade them with the organization's business changes, strategic goals and new information technologies.

An ERP system is required to have the following characteristics:

- Modular design comprising many distinct business modules such as financial, manufacturing, accounting, distribution, etc.
- Use centralized common database management system (DBMS)
- The modules are integrated and provide seamless data flow among the modules, increasing operational transparency through standard interfaces
- They are generally complex systems involving high cost
- They are flexible and offer best business practices
- They require time-consuming tailoring and configuration setups for integrating with the company's business functions
- The modules work in real time with online and batch processing capabilities
- They are or soon they will be Internet-enabled

Different ERP vendors provide ERP systems with some degree of specialty but the core modules are almost the same for all of them. Some of the core ERP modules found in the successful ERP systems are the following:

- Accounting management
- Financial management
- Manufacturing management

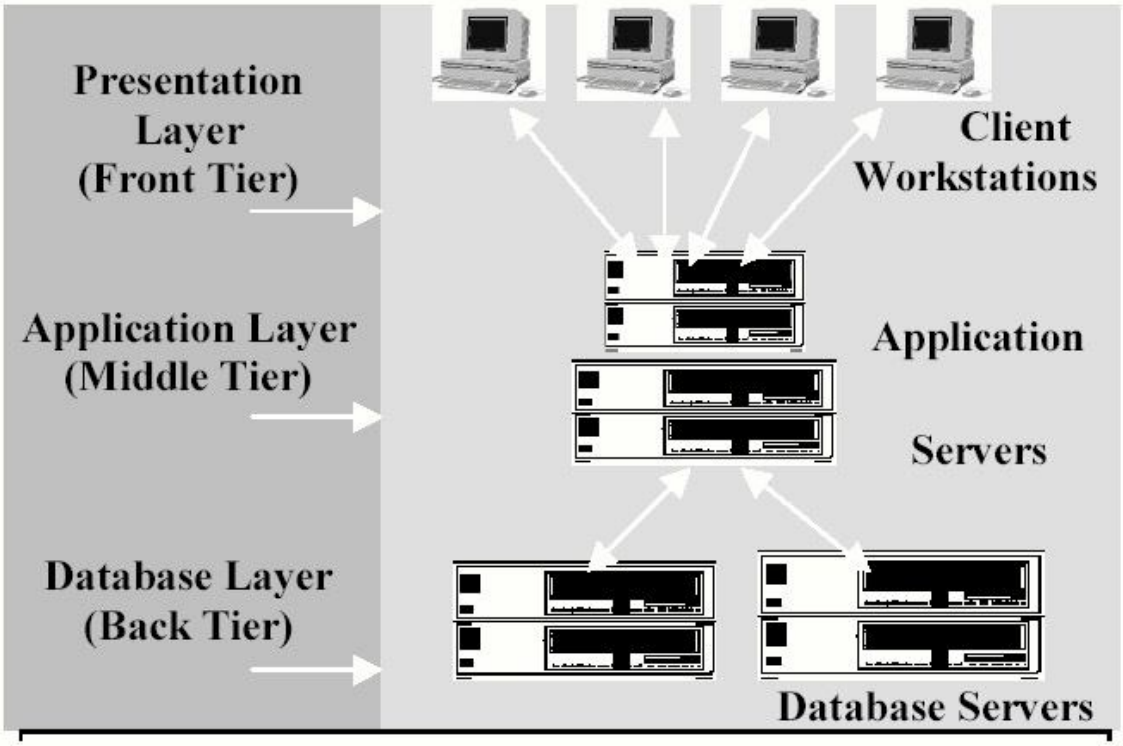
- Production management
- Transportation management
- Sales & distribution management
- Human resources management
- Supply chain management
- Customer relationship management
- E-Business

The modules of an ERP system can either work as stand-alone units or several modules can be combined together to form an integrated system. The systems are usually designed to operate under several operating platforms such as UNIX, MS Windows NT, Windows 2000, IBM AIX, and HP-UX systems. SAP AG, the largest ERP vendor, provides a number of modules with its famous R/3 ERP system, which are shown in Table. New modules are introduced by SAP and other vendors in response to the market and technological demand such as the Internet technology.

Table 6.1 :- Some of the modules of SAP's R/3					
Financial Accounting	**FI**	**Controlling**	**CO**	**Asset management**	AM
Project System	PS	Workflow	WF	Industry solutions	IS
Human resources	HR	Plant maintenance	PM	Quality management	QM
Production planning	PP	Materials mgmt.	MM	Sales & distribution	SD
Investment management	IM	Enterprise controlling	EC	treasury	TR
Modules of Internet version mySAP.com					
mySAP Supply chain management mySAP customer relationship mgmt. mySAP Financials		mySAP product lifecycle mgmt. mySAP business intelligence mySAP mobile business		mySAP human resources mySAP marketplace by SAPmarkets mySAP hosted solutions mySAP technology	

Enterprise systems employ thin client/server (C/S) technology or client/ fat server (C/FS) architecture, creating a decentralized computing environment. In a C/S system a number of client devices operated by end users such as desktop PCs request services from application servers, which in turn get the request[ ] service-related information from the database servers. The requests may be simple data files, data values,communication services, transaction processing or master file updates. The genera practiceis to have three-tier architecture such as in showes in figure below . In this three-tier system the user interface runs on the client. To run ERP systems relatively powerful PCs (clients) and powerful servers are required where most of the hundreds of thousands of operations are performed. The client/server system functions are performed following three layers of logic:

- Presentation Layer: Graphical user interface (GUI) or browser for data entry or accessing system functions
- Application Layer: Business rules, functions, logic, and programs acting on data received/transferred from/to the database servers
- Database Layer: Management of the organization's operational or transactional data including metadata; mostly employs industry



Three tier ERP system architecture

This logical arrangement helps the ERP user interface to run on the clients, the processing modules to run on the middle-tier application servers, and the database system to run on the database servers.

6.6 ERP Software Vendors

6.6.1 SAP AG

The leading ERP package vendor, with a 32% market share in 1999, is SAP AG (SAP stands for "Systeme, Anwendungen, und Prudukte in Datenverarbeltung" or Systems, Applications and Products in Data Processing). SAP AG was founded in Germany in 1972 by five engineers who wanted to produce integrated business application software for the manufacturing enterprise. Seven years later, the company launched its first enterprise software, R/2, which was designed around a centralized, mainframe-based database. SAP's client/software product, R/3, was introduced in 1992 and quickly came to dominate the ERP software market.

In 1999, SAP AG was the third-largest independent software vendor in the world, serving over 11,000 customers (with more than 20,000 installations) in over 100 countries.

Leveraging its leading position in the ERP market, SAP developed vertical, industry-specific business solutions for 19 industries. These industry "solution maps" provide functionality from SAP and its partners for complete, end-to-end industry specific processes.

SAP followed the lead of focused niche players, and in 1999 it extended its ERP offering to include customer relationship management, data warehousing and supply chain management modules. SAP recast its entire set of offerings around the Internet, borrowing the "business portal" concept (called mySAP.com Workplace in SAP parlance) to organize all information around the user's role in the enterprise, and adding functionality for business-to-business and business-toconsumer electronic commerce. SAP started the mySAP.com Marketplace, an electronic inter-company trading community for buying, selling and collaborating within and across industries.

6.6.2 Oracle

The heavyweight of the database software market, Silicon-Valley-based Oracle is the world's second largest software company. It has built a solid enterprise applications business, which accounted for $2.5 billion of the firm's $9.3 billion 1999 revenues.

Second to SAP in the enterprise software market, Oracle applications serve over 5,000 customers in 140 countries. Oracle has been a leader in refocusing its ERP solutions around the Internet, and it launched a barrage of electronic-commerce and Internet-based business-to-business software applications while the other JBOPS companies were slow to react to the changing marketplace. Further, Oracle was the first JBOPS company to integrate front-office applications with its ERP offering.

6.6.3 PeopleSoft

Started as a software firm for human resource management in 1987, Pleasanton-based PeopleSoft gradually expanded its software to cater to other corporate functions. The company's revenues grew to $1.3 billion in 1998 up forty-fold from $32 million in 1992 (sales are expected to remain flat in 1999). PeopleSoft's ERP system provides enterprise solutions for finance, materials management, distribution, supply chain planning, manufacturing and human resources. In 1996, PeopleSoft acquired Red Pepper, a producer of supply chain management software, and in 1999 it acquired Vantive for its customer relationship management offerings.

6.6.4 Microsoft Dynamics

The Microsoft has introduced Navision (NAV) and Axapta (AX). The Microsoft Dynamics Axapta (AX) is a business management solution to organize the business practices. The Microsoft Dynamics Navision (NAV) is designed basically for medium size or small companies. It's a cost effective solution which are customizable by organizations.

6.7 Advantages of ERP System

1. Complete **visibility** into all the important processes across various departments of an organization (especially for senior management personnel).
2. Automatic and coherent **work-flow** from one department / function to another to ensure smooth transition/ completion of processes.
3. A unified and single **reporting** system to analyze the statistics/ numbers/ status etc in real time, across all the functions / departments.
4. Since **same software** is used across all departments – this can avoid individual departments having to buy and maintain their own software systems.

5. Certain ERP vendors can extend their ERP systems to provide **Business Intelligence** functionalities as well.
6. Advanced **e-commerce integration** is possible with ERP systems that can handle web based order tracking/ processing.
7. There are **various modules** in an ERP system like Finance/ Accounts, Human Resource Management, Manufacturing, Marketing / Sales, Supply Chain / Warehouse Management, CRM, Project Management, etc.
8. Since ERP is a **modular software** system, its possible to implement either a few modules (or) many modules based on the requirements of an organization. If more modules implemented, the integration between various departments might be better.
9. Single Database is implemented on the back-end to store all the information required by the ERP system and that enables**centralized storage** / back-up of all enterprise data.
10. ERP systems are more **secure** as centralized security policies can be applied to them and all the transactions happening via the ERP systems can be tracked.
11. ERP systems provide visibility and hence enable better/ faster **collaboration** across all the departments.
12. It is possible to integrate other systems (like bar-code reader, for example) to the ERP system through an **API** (Application Programing Interface).
13. ERP systems make it **easier** for order tracking, inventory tracking, revenue tracking, sales forecasting and related activities.
14. ERP systems are a boon for managing **globally dispersed** enterprise companies.

6.8 Disadvantages of ERP System

1. The **cost** of ERP Software, planning, customization, configuration, testing, implementation, etc is too high.
2. ERP deployments take **1-3 years** to get completed and fully functional.
3. Too little **customization** may not integrate the ERP system with the business process & too much customization may slow down the project and make it difficult to upgrade.
4. The **cost savings/ payback** may not be realized immediately after the ERP implementation & it is quite difficult to measure the same.
5. The **participation** of users is very important for successful implementation of ERP projects – So, exhaustive user training and simple user interface might be critical. But ERP systems are generally difficult to use (and learn).
6. There maybe additional **indirect costs** like new IT infrastructure, upgrading the WAN links, etc.
7. **Migration** of existing data to the new ERP systems is always difficult to achieve as with integrating ERP systems with other stand alone software systems.
8. ERP implementations are difficult to achieve in **decentralized organizations** with disparate business processes and systems.
9. Once an ERP systems is implemented it becomes a **single vendor lock-in** for further upgrades, customizations etc.

6.9 Summary

The future of the ERP is very bright. Today the internet allows us to reach more people in more places in a time frame that was previously inconceivable .Where it once took mature companies thirty, forty, even fifty years to penetrate new, international markets. Today, a tiny start-up can establish a global presence on the web virtually overnight.

ERP forms a foundation for successfully meeting your e-business needs. But in today's internet age, ERP systems alone will not do. ERP systems have to be integrated with the internet, WWW and technologies like SCM, CRM, business intelligence etc. this integrated ERP is named ERP II by the Gartner Group. The need for speed and flexibility has been just one by product of the internet age.

6.10 Self Assessment Questions

1. What is the impact of Internet and World Wide Web on ERP products?
2. Why do ERP implementations fail?
3. ERP Systems are superior to any legacy system. Explain?
4. List some ERP Vendors and their product.
5. Explain the ERP system architecture.

UNIT - 7 : EIS: EXECUTIVE INFORMATION SYSTEMS

Structure of the Unit

7.0 Objectives

This unit provides a general overview of

- What is Executive Information System
- Types of Executive Information System
- Components of Executive Information System
- Characteristics and usage of Executive Information System
- Examples
- Case Study

7.1 Introduction

The productivity of work is not the responsibility of the worker but of the manager. A Manager is responsible for the application and performance of knowledge.

A manager can do the wrong thing the right way. In this manner he or she is efficient but not effective. An Executive Information System (EIS) can help a manager to make bette decisions, but if the manager is on the wrong track, will the EIS system detect and correct this situation.

An Executive Information System (EIS) is an information system that provides corporate information, such as financial conditions, market share, and organisational performance in graphic form, with drill-down capability for detail. An EIS is also defined as a computer system that presents a summary of a company's important data. Executive Information Systems are intended to aid the executive manager to better decision making. An Executive Information System (EIS) can be defined as a computerised system that provides executives with information that is relevant to their work.

7.2 Definition

Executive Information System (EIS) is a set of management tools supporting the information and decision-making needs of management by combining information available within the organisation with external information in an analytical framework.

Management targeted EIS because needs to quickly assess the status of a business or section of business. These packages are aimed firmly at the type of business user who needs instant and up to date understanding of critical business information to aid decision making. Information behind the EIS can be collated and displayed to the user without manipulation or further processing. The user can then quickly see the status of his chosen department or function, enabling them to concentrate on decision making. Generally an EIS is configured to display data such as order backlogs, open sales, purchase order backlogs, shipments, receipts and pending orders. This information can then be used to make executive decisions at a strategic level.

Executive Information Systems come in two distinct types: ones that are data driven, and second that are model driven. Data driven systems interface with databases and data warehouses. They collate information from different sources and present them to the user in an integrated dashboard style screen. Model driven systems use forecasting, simulations and decision tree like processes to present the data. As with any emerging and progressive market, service providers are continually improving their products and offering new ways of doing business. Modern EIS systems can also present industry trend information and competitor behavior trends if needed.

They can filter and analyse data; create graphs, charts and scenario generations; and offer many other options for presenting data. There are a number of ways to link decision making to organizational performance. From a decision maker's perspective these tools provide an excellent way of viewing data. Outcomes displayed include single metrics, trend analyses, demographics, market shares and a myriad of other options.

The simple interface of EIS makes it quick and easy to navigate and call the information required. For a system that seems to offer business so much, it is used by relatively few organizations. Current estimates indicate that as few as 10% of businesses use EIS systems. One of the reasons for this is the complexity of the system and support infrastructure. It is difficult to create such a system and populate it effectively. Combining all the necessary systems and data sources can be a daunting task, and seems to put many businesses off implementing it. The system vendors have addressed this issue by offering turnkey solutions for potential clients. Companies like Actuate and Oracle are both offering complete out of the box Executive Information Systems, and these aren't the only ones. Expense is also an issue.

Once the initial cost is calculated, there is the additional cost of support infrastructure, training, and the means of making the company data meaningful to the system. An effective Executive Information System isn't something you can just set up and leave it to do its work. Its success depends on the support and timely accurate data it gets to be able to provide something meaningful. It can provide the information executives need to make educated decisions quickly and effectively.

An EIS can provide a competitive edge to business strategy that can pay for itself in a very short space of time.

7.3 History

Traditionally, executive information systems were developed as mainframe computer-based programs. The purpose was to package a company's data and to provide sales performance or market research statistics for decision makers, such as financial officers, marketing directors, and chief executive officers, who were not necessarily well acquainted with computers. The objective was to develop com-

puter applications that would highlight information to satisfy senior executives' needs. Typically, an EIS provides data that would only need to support executive level decisions instead of the data for all the company.

Today, the application of EIS is not only in typical corporate hierarchies, but also at personal computers on a local area network. EIS now cross computer hardware platforms and integrate information stored on mainframes, personal computer systems, and minicomputers. As some client service companies adopt the latest enterprise information systems, employees can use their personal computers to get access to the company's data and decide which data are relevant for their decision makings. This arrangement makes all users able to customize their access to the proper company's data and provide relevant information to both upper and lower levels in companies.

7.4 Types of Executive Information System

1. **Corporate Management:** Responsible for business and fiscal planning, budgetary control, as well as for ensuring the corporate information technology need met in a co-ordinate and cost effective manner. E.g. management functions, human resources, financial data correspondence, performance measures, etc.
2. **Technical information Dissemination:** For the purpose of disseminating the latest information on relevant technologies, products, processes and markets e.g. energy, environment, aerospace, whether, etc.

7.5 Components

Hardware:

When talking about hardware for an EIS environment, we should focus on the hardware that meet the executive's needs. The executive must be put first and the executive's needs must be defined before the hardware can be selected. The basic computer hardware needed for a typical EIS includes four components:

1. Input data-entry devices. These devices allow the executive to enter, verify, and update data immediately;
2. The central processing unit (CPU), which is the kernel because it controls the other computer system components;
3. Data storage files. The executive can use this part to save useful business information, and this part also help the executive to search historical business information easily;
4. Output devices, which provide a visual or permanent record for the executive to save or read. This device refers to the visual output device or printer.

In addition, with the advent of local area networks (LAN), several EIS products for networked workstations became available. These systems require less support and less expensive computer hardware. They also increase access of the EIS information to many more users within a company.

Software:

Choosing the appropriate software is vital to design an effective EIS. Therefore, the software components and how they integrate the data into one system are very important. The basic software needed for a typical EIS includes four components:

1. Text base software. The most common form of text are probably documents;
2. Database. Heterogeneous databases residing on a range of vendor-specific and open computer platforms help executives access both internal and external data;

3. Graphic base. Graphics can turn volumes of text and statistics into visual information for executives. Typical graphic types are: time series charts, scatter diagrams, maps, motion graphics, sequence charts, and comparison-oriented graphs (i.e., bar charts);

4. Model base. The EIS models contain routine and special statistical, financial, and other quantitative analysis.

Perhaps a more difficult problem for executives is choosing from a range of highly technical software packages. Ease of use, responsiveness to executives' requests, and price are all reasonable considerations. Further, it should be considered whether the package can run on existing hardware.

User Interface:

An EIS needs to be efficient to retrieve relevant data for decision makers, so the user interface is very important. Several types of interfaces can be available to the EIS structure, such as scheduled reports, questions/answers, menu driven, command language, natural language, and input/output. It is crucial that the interface must fit the decision maker's decision-making style. If the executive is not comfortable with the information questions/answers style, the EIS will not be fully utilized. The ideal interface for an EIS would be simple to use and highly flexible, providing consistent performance, reflecting the executive's world, and containing help information.

Telecommunication:

As decentralizing is becoming the current trend in companies, telecommunications will play a pivotal role in networked information systems. Transmitting data from one place to another has become crucial for establishing a reliable network. In addition, telecommunications within an EIS can accelerate the need for access to distributed data.

Applications:

EIS enables executives to find those data according to user-defined criteria and promote information-based insight and understanding. Unlike a traditional management information system presentation, EIS can distinguish between vital and seldom-used data, and track different key critical activities for executives, both which are helpful in evaluating if the company is meeting its corporate objectives. After realizing its advantages, people have applied EIS in many areas, especially, in manufacturing, marketing, and finance areas.

7.6 Characteristics of EIS

Executive information systems can be compared to that of a project planner for executives. While project planner helps to schedule the work to be done for a particular project EIS help them to schedule them for the company as a whole. Moreover project planner is just for one project. The subsequent projects will have different project planners depending on the requirements and nature of the project. However when it comes to enterprise information systems they are fundamental to the enterprise operation not only in the current scenario but also in the future. The way they work may undergo change but the purpose and objectives will remain one and the same.

This is a system which is directly handled by the managers. They don't have to rely on the assistance of technical persons for every minute issue. It has been designed in such a way that the managers can operate it easily with some prior guidance. Whenever major functions have to be changed for operating the system they may have to approach the persons with technical expertise. Otherwise they will be able to handle small problems by themselves as the complexities are not much. Another important feature of executive information systems is that they are customizable to the needs of the individual user. A manger may have own preferences in handling and making strategic decisions. They may not necessarily have to

be akin with other managers of the same organization. This does not necessarily affect the performance of anyone. As said earlier management information systems are easier to handle and adjust. Therefore each manager can tune things to solely suit his convenience and working pattern.

7.7 Usage of EIS

Executive Information Systems (EIS) are designed to enhance the managerial roles of executives, including other senior managers, in organizations. Despite reported growth in the popularity of EIS, there are reports of low usage of these systems that, in part, contributes to their failures in organizations. The majority of prior EIS research has focused on documenting the features, benefits, development methodologies, and implementation of the systems. However, very few research studies address the problem of low EIS usage from behavioral point of the user. This chapter reports on a research on the use of EIS in organizational settings. The primary focus of the research is to investigate factors that explain users' behavior towards using EIS. It is also aimed at identifying the relative importance of those factors that determine the use of EIS. The research model is based on Triandis' theoretical framework, a model from organizational behavior. The research model is used to hypothesis that EIS use (behavior) is determined by EIS experience and ability to use EIS (habits); subjective norms, roles, values and social situations (social factors); perceived usefulness of EIS (consequences); user satisfaction with EIS information, system, support, and plan (affect); and EIS development processes, management processes and organizational environment (facilitating conditions).

7.8 Advantages of EIS

1. As more executives come up through the ranks, they are more familiar with and rely more on technology to assist them with their jobs. Executive Support Systems don't provide executives with ready- made decisions. They provide the information that helps them make their decisions. Executives use that information, along with their experience, knowledge, education, and understanding of the corporation and the business environment as a whole, to make their decisions.
2. Executives are more inclined to want summarized data rather than detailed data (even though the details must be available). ESS rely on graphic presentation of information because it's a much quicker way for busy executives to grasp summarized information
3. It provides timely delivery of company summary information.
4. It provides better understanding of information
5. It filters data for management.
6. It provides system for improvement in information tracking
7. It offers efficiency to decision makers

7.9 Disadvantage of EIS

1. Functions are limited, cannot perform complex calculations.
2. Hard to quantify benefits and to justify implementation of an EIS.
3. Executives may encounter information overload
4. System may become slow, large, and hard to manage.
5. Difficult to keep current data.
6. May lead to less reliable and insecure data.
7. Small companies may encounter excessive costs for implementation
8. Highly skilled personnel requirement cannot be fulfilled by the small business.

7.10 EIS Features

EIS are intended as decision support tools for senior managers. Since these strategic decisions are based on a wide range of input information, they always need to be well integrated with operational systems in a business. Some important features of executive support system include the fact that:

1. They provide summary information to monitoring of business performance. This is often achieved through measures known as 'critical success factors' or 'key performance indicators' (KPIs). These will be displayed in an easy-to-interpret form such as a graph showing their variation through time. If a KPI falls below a critical preset value, the system will notify the manager through a visible or audible warning.
2. They are used mainly for strategic decision making, but may also provide features that relate to tactical decision making.
3. They provide a drill-down feature which gives a manager the opportunity to find out more information necessary to take a decision or discover the source of a problem. E.g. a manager with multinational manufacturing problem might find from the EIS that a particular country is underperforming in production. He could drill down to see which particular factory was responsible for this.
4. They provide analysis tools.
5. They must be integrated with other facilities to help manage the solving of problems and the daily running of the business. These include electronic mail and scheduling and calendar facilities.
6. They integrate data from a wide range of information sources, including company and external sources such as market and competitor.
7. They have to be designed according to the needs of managers who do not use computers frequently. They should be intuitive and easy to learn.

All these facilities require integration with operational data. Since this information is commonly stored in the ERP systems, these are often integrated with EIS or have EIS functions built in.

7.11 EIS Applications

EIS enables executives to find those data according to user-defined criteria and promote information-based insight and understanding. Unlike a traditional management information system presentation, EIS can distinguish between vital and seldom-used data, and track different key critical activities for executives, both which are helpful in evaluating if the company is meeting its corporate objectives. After realizing its advantages, people have applied EIS in many areas, especially, in manufacturing, marketing, and finance areas.

Manufacturing

Basically, manufacturing is the transformation of raw materials into finished goods for sale, or intermediate processes involving the production or finishing of semi-manufactures. It is a large branch of industry and of secondary production. Manufacturing operational control focuses on day-to-day operations, and the central idea of this process is effectiveness and efficiency. To produce meaningful managerial and operational information for controlling manufacturing operations, the executive has to make changes in the decision processes. EIS provides the evaluation of vendors and buyers, the evaluation of purchased materials and parts, and analysis of critical purchasing areas. Therefore, the executive can oversee and review purchasing operations effectively with EIS. In addition, because production planning and control depends heavily on the plant's data base and its communications with all manufacturing work centers, EIS also provides an approach to improve production planning and control.

Marketing

In an organization, marketing executives' role is to create the future. Their main duty is managing available marketing resources to create a more effective future. For this, they need make judgments about risk and uncertainty of a project and its impact on the company in short term and long term. To assist marketing executives in making effective marketing decisions, an EIS can be applied. EIS provides an approach to sales forecasting, which can allow the market executive to compare sales forecast with past sales. EIS also offers an approach to product price, which is found in venture analysis. The market executive can evaluate pricing as related to competition along with the relationship of product quality with price charged. In summary, EIS software package enables marketing executives to manipulate the data by looking for trends, performing audits of the sales data, and calculating totals, averages, changes, variances, or ratios. All of these sales analysis functions help marketing executives to make final decisions.

Financial

A financial analysis is one of the most important steps to companies today. The executive needs to use financial ratios and cash flow analysis to estimate the trends and make capital investment decisions. An EIS is a responsibility-oriented approach that integrates planning or budgeting with control of performance reporting, and it can be extremely helpful to finance executives. Basically, EIS focuses on accountability of financial performance and it recognizes the importance of cost standards and flexible budgeting in developing the quality of information provided for all executive levels. EIS enables executives to focus more on the long-term basis of current year and beyond, which means that the executive not only can manage a sufficient flow to maintain current operations but also can figure out how to expand operations that are contemplated over the coming years. Also, the combination of EIS and EDI environment can help cash managers to review the company's financial structure so that the best method of financing for an accepted capital project can be concluded. In addition, the EIS is a good tool to help the executive to review financial ratios, highlight financial trends and analyze a company's performance and its competitors.

Traditional EIS Software

1. Major Commercial EIS Software Vendors
   - Comshare Inc. (www.comshare.com)
   - Pilot Software Inc. (www.pilotsw.com)
2. Development Tools
   - In-house components
   - Comshare Commander tools
   - Pilot Software's Command Center Plus and Pilot Decision Support Suite
3. Data access
4. Data warehousing
5. OLAP
6. Multidimensional analysis
7. Presentations
8. Web

7.12 Case Study of EIS

Executive Information System Mini Case Study

Situation: Gold Rush Corporation relies heavily on its sales trends to predict future demand for the high quality gold watches that it manufactures and sells to jewelry and watch stores around the country.

In the past the sales information has been passed on to production managers, sometimes up to month after large orders for popular watch styles have been ordered.

Problem: The production managers are grateful for the information they do receive from the sales department because they base most of their production estimates on these numbers. However, the production managers could avoid costly production overruns as well as shortages in product if they had the information readily available to them.

Solution: Gold Rush Corporation decides to implement an executive information system available to all of its senior level managers, including the production managers, that possesses information regarding real time sales and orders of Gold Rush's products. Thanks to this new system production managers are able to more accurately estimate the inventory levels they must realize in order to achieve demand. As an added benefit, production managers have decided that the executive information system provides them with such valuable and accurate real time information that they hope to move to a just in time inventory model to cut down on holding costs.

Like the case study indicates, open dissemination of information through the executive information system can really enhance the efficiency of the corporation. As the company realizes better efficiency levels its bottom line should improve. Often times large corporations struggle with widespread distribution of information, however, utilizing an executive information system can help eradicate some of the problems that accompany large companies.

7.13 Future Trends

The future of executive info systems will not be bound by mainframe computer systems. This trend allows executives escaping from learning different computer operating systems and substantially decreases the implementation costs for companies. Because utilizing existing software applications lies in this trend, executives will also eliminate the need to learn a new or special language for the EIS package. Future executive information systems will not only provide a system that supports senior executives, but also contain the information needs for middle managers. The future executive information systems will become diverse because of integrating potential new applications and technology into the systems, such as incorporating artificial intelligence (AI) and integrating multimedia characteristics and ISDN technology into an EIS. EIS - timely, efficient and effective in supporting the decision making process

7.14 Summary

Executive Information Systems meet the needs of corporate executives by providing them with vast amounts of information quickly and in graphical form to help them make effective decisions. EIS must be flexible, easy to use, and contain both internal and external sources of information.

7.15 Self Assessment Questions

1. What is Executive Informaiton System (EIS)? Explain its features.
2. What are the components of EIS?
3. What are the advantages and disadvantages of EIS?
4. What are the application areas of EIS?

Unit - 8 : INTELLIGENT SYSTEMS

Structure of the Unit

8.0 Objective

This unit provides a general overview of

- Intelligent Systems
- Artificial Intelligence
- Knowledge Based Systems
- Expert Systems
- Neural Networks

8.1 Introduction

Intelligent systems (IS) provide a standardized methodological approach to solve important and fairly complex problems and obtain consistent and reliable results over time. Extracting from diverse dictionaries, intelligence means the ability to comprehend; to understand and profit from experience. There are, of course, other meanings such as ability to acquire and retain knowledge; mental ability; the ability to respond quickly and successfully to a new situation; etc.

The definition of intelligent systems is a difficult problem and is subject to a great deal of debate. From the perspective of computation, the intelligence of a system can be characterized by its flexibility, adaptability, memory, learning, temporal dynamics, reasoning, and the ability to manage uncertain and imprecise information.

Independently from the definition, there is not much doubt that artificial intelligence (AI) is an essential basis for building intelligent systems. According to, AI consists of two main directions. One is humanistic AI (HAI) that studies machines that think and act like humans. The other one is rationalistic AI (RAI) that examines machines that can be built on the understanding of intelligent human behavior. Here are some illustrative explanations from where references to their original sources can also be found.

Intelligent systems as seen now a days have more to do with rationalistic than with humanistic AI. In addition to HAI features, IS admits intelligent behavior as seen in nature as a whole; think, for example, on evolution, chaos, natural adaptation as intelligent behavior. Moreover, IS are motivated by the need to solve complex problems with improving efficiencies.

An intelligent system is a system that emulates some aspects of intelligence exhibited by nature. These include learning, adaptability, robustness across problem domains, improving efficiency (over time and/or space), information compression (data to knowledge), extrapolated reasoning.

The development of digital computers made possible the invention of human engineered systems that show intelligent behavior or features. The branch of knowledge and science that emerged together and from such systems is called artificial intelligence . Instead of using this general name to cover practically any approach to intelligent systems, the AI research community restricts its meaning to symbolic representations and manipulations in a top-down way . In other words, AI builds up an intelligent system by studying first the structure of the problem (typically in formal logical terms), then formal reasoning procedures are applied within that structure.

A system is called computationally intelligent if it deals only with numerical (low-level) data, has a pattern recognition component, and does not use knowledge in the AI sense; and additionally, when it (begins to) exhibit (i) computational adaptivity; (ii) computational fault tolerance; (iii) speed approaching human-like turnaround, and (iv) error rates that approximate human performance.

8.2 Artificial Intelligence

Artificial Intelligence, or AI for short, is a combination of computer science, physiology, and philosophy. AI is a broad topic, consisting of different fields, from machine vision to expert systems. The element that the fields of AI have in common is the creation of machines that can "think".

Artificial Intelligence (AI) is the area of computer science focusing on creating machines that can engage on behaviors that humans consider intelligent. The ability to create intelligent machines has intrigued humans since ancient times, and today with the advent of the computer and 50 years of research into AI programming techniques, the dream of smart machines is becoming a reality. Researchers are creating systems which can mimic human thought, understand speech, beat the best human chess player, and countless other feats never before possible. Find out how the military is applying AI logic to its hi-tech systems, and how in the near future Artificial Intelligence may impact our lives.

Artificial Intelligence has come a long way from its early roots, driven by dedicated researchers. The beginnings of AI reach back before electronics, to philosophers and mathematicians such as Boole and others theorizing on principles that were used as the foundation of AI Logic. AI really began to intrigue researchers with the invention of the computer in 1943. The technology was finally available, or so it seemed, to simulate intelligent behavior. Over the next four decades, despite many stumbling blocks, AI has grown from a dozen researchers, to thousands of engineers and specialists; and from programs capable of playing checkers, to systems designed to diagnose disease.

AI has always been on the pioneering end of computer science. Advanced-level computer languages, as well as computer interfaces and word-processors owe their existence to the research into artificial intelligence. The theory and insights brought about by AI research will set the trend in the future of computing. The products available today are only bits and pieces of what are soon to follow, but they are a movement towards the future of artificial intelligence. The advancements in the quest for artificial intelligence have, and will continue to affect our jobs, our education, and our lives.

By John McCarthy, The modern definition of **artificial intelligence** (or **AI**) is "the study and design of intelligent agents" where an intelligent agent is a system that perceives its environment and takes actions which maximizes its chances of success.

AI research uses tools and insights from many fields, including computer science, psychology, philosophy, neuroscience, cognitive science, linguistics, operations research, economics, control theory, probability, optimization and logic.AI research also overlaps with tasks such as robotics, control systems, scheduling, data mining, logistics, speech recognition, facial recognition and many others.

8.2.1 Approaches of AI

Conventional AI mostly involves methods now classified as machine learning, characterized by formalism and statistical analysis. This is also known as symbolic AI, logical AI, neat AI and Good Old Fashioned Artificial Intelligence (GOFAI). (Also see semantics.) Methods include:

- Expert systems: apply reasoning capabilities to reach a conclusion. An expert system can process large amounts of known information and provide conclusions based on them.
- Case based reasoning: stores a set of problems and answers in an organized data structure called cases. A case based reasoning system upon being presented with a problem finds a case in its knowledge base that is most closely related to the new problem and presents its solutions as an output with suitable modifications.
- Bayesian networks
- Behavior based AI: a modular method of building AI systems by hand.

Computational intelligence involves iterative development or learning (e.g., parameter tuning in connectionist systems). Learning is based on empirical data and is associated with non-symbolic AI, scruffy AI and soft computing. Subjects in computational intelligence as defined by IEEE Computational Intelligence Society mainly include:

- Neural networks: trainable systems with very strong pattern recognition capabilities.
- Fuzzy systems: techniques for reasoning under uncertainty, have been widely used in modern industrial and consumer product control systems; capable of working with concepts such as 'hot', 'cold', 'warm' and 'boiling'.
- Evolutionary computation: applies biologically inspired concepts such as populations, mutation and survival of the fittest to generate increasingly better solutions to the problem. These methods most notably divide into evolutionary algorithms (e.g., genetic algorithms) and swarm intelligence (e.g., ant algorithms).

With hybrid intelligent systems, attempts are made to combine these two groups. Expert inference rules can be generated through neural network or production rules from statistical learning such as in ACT-R or CLARION (see References below). It is thought that the human brain uses multiple techniques to both formulate and cross-check results. Thus, systems integration is seen as promising and perhaps necessary for true AI, especially the integration of symbolic and connectionist models (e.g., as advocated by Ron Sun).

Conventional AI research focuses on attempts to mimic human intelligence through symbol manipulation and symbolically structured knowledge bases. This approach limits the situations to which conventional AI can be applied. Lotfi Zadeh stated that "we are also in possession of computational tools which are far more effective in the conception and design of intelligent systems than the predicate-logic-based methods which form the core of traditional AI." These techniques, which include fuzzy logic, have become known as soft computing. These often biologically inspired methods stand in contrast to conventional AI and compensate for the shortcomings of symbolicism.These two methodologies have also been labeled as neats vs. scruffies, with neats emphasizing the use of logic and formal representation of knowledge while scruffies take an application-oriented heuristic bottom-up approach.

8.2.2 Applications of AI

- **Game playing**

  You can buy machines that can play master level chess for a few hundred dollars. There is some AI in them, but they play well against people mainly through brute force computation—looking at hundreds of thousands of positions. To beat a world champion by brute force and known reliable heuristics requires being able to look at 200 million positions per second.

- **Speech recognition**

  In the 1990s, computer speech recognition reached a practical level for limited purposes. Thus United Airlines has replaced its keyboard tree for flight information by a system using speech recognition of flight numbers and city names. It is quite convenient. On the the other hand, while it is possible to instruct some computers using speech, most users have gone back to the keyboard and the mouse as still more convenient.

- **Understanding natural language**

  Just getting a sequence of words into a computer is not enough. Parsing sentences is not enough either. The computer has to be provided with an understanding of the domain the text is about, and this is presently possible only for very limited domains.

- **Computer vision**

  The world is composed of three-dimensional objects, but the inputs to the human eye and computers' TV cameras are two dimensional. Some useful programs can work solely in two dimensions, but full computer vision requires partial three-dimensional information that is not just a set of two-dimensional views. At present there are only limited ways of representing three-dimensional information directly, and they are not as good as what humans evidently use.

- **Expert systems**

  A "knowledge engineer" interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task. How well this works depends on whether the intellectual mechanisms required for the task are within the present state of AI. When this turned out not to be so, there were many disappointing results. One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments. It did better than medical students or practicing doctors, provided its limitations were observed. Namely, its ontology included bacteria, symptoms, and treatments and did not include patients, doctors, hospitals, death, recovery, and events occurring in time. Its interactions depended on a single patient being considered. Since the experts consulted by the knowledge engineers knew about patients, doctors, death, recovery, etc., it is clear that the knowledge engineers forced what the experts told them into a predetermined framework. In the present state of AI, this has to be true. The usefulness of current expert systems depends on their users having common sense.

- **Heuristic classification**

  One of the most feasible kinds of expert system given the present knowledge of AI is to put some information in one of a fixed set of categories using several sources of information. An example is advising whether to accept a proposed credit card purchase. Information is available about the owner of the credit card, his record of payment and also about the item he is buying and about the establishment from which he is buying it (e.g., about whether there have been previous credit card frauds at this establishment).

8.3 Knowledge based Systems

A knowledge-based system (KBS) is one of the major family members of the AI group. With the availability of advanced computing facilities and other resources, attention is now turning to more demanding tasks that might require intelligence. Society and industry are becoming knowledge-oriented and relying on different experts' decision-making abilities to solve problems. A KBS can act as an expert on demand, anytime and anywhere. A KBS can save money by leveraging experts, allowing users to function at a higher level and promoting consistency. A KBS is a productive tool that offers collective knowledge of one or more experts.

KBS is an example of fifth-generation computer technology. Some of its objectives are as follows:

- Provides a high intelligence level
- Assists people in discovering and developing unknown fields
- Offers a vast amount of knowledge in different areas
- Aids in management of knowledge stored in the knowledge base
- Solves social problems in a better way than the traditional computer-based information systems.

Traditional Computer-Based Information System (CBIS)	**Knowledge-Based System (KBS)**
Gives a guaranteed solution and concentrates on efficiency	Adds power to the solution and concentrates on effectiveness without any guarantee of solution
Data and/or information processing approach	Knowledge and/or decision processing approach
Assists in activities related to decision making and routine transactions; supports need for information	Transfer of expertise; takes a decision based on knowledge, explains it, and upgrades it, if required
Examples are TPS, MIS, DSS, etc.	Examples are expert systems, CASE-based systems, etc.
Manipulation method is numeric and algorithmic	Manipulation method is primarily symbolic/connectionist and non algorithmic
These systems do not make mistakes	These systems learn by mistakes
Need complete information and/or data	Partial and uncertain information, data, or knowledge will do
Works for complex, integrated, and wide areas in a reactive manner	Works for narrow domains in a reactive and proactive manner

- Acquires new perceptions by simulating unknown situations
- Offers significant software productivity improvement
- Significantly reduces cost and time to develop computerized systems

The KBS consists of a knowledge base and a search program called an inference engine (IE). The IE is a software program that infers the knowledge available in the knowledge base. The knowledge base can be used as a repository of knowledge in various forms. This may include an empty workspace to store temporary results and pieces of information or knowledge. Because an expert's power lies in his or her explanation and reasoning capabilities, the expert system's credibility

also depends on the explanation and reasoning of the decision made or suggested by the system. Human beings can learn new things and sometimes forget knowledge that is not in regular use. Simulation of such learning is an essential component of a KBS. The life span of a KBS may vary according to the degree of such simulation. A KBS may be either manually updated (manual update) or automatically updated by a machine (machine learning). Ideally, the basic frame of a KBS rarely needs to be modified.

Categories of KBS:

According to the classifications by Tuthhill and Levy (1991), five main types of KBSs exist:

1. Expert systems
2. Linked systems
3. CASE-based systems
4. Database in conjunction with an intelligent user interface
5. Intelligent tutoring systems

8.4 Expert Systems

Expert systems are meant to solve real problems which normally would require a specialized human expert (such as a doctor or a minerologist). Building an expert system therefore first involves extracting the relevant knowledge from the human expert. Such knowledge is often heuristic in nature, based on useful "rules of thumb" rather than absolute certainties. Extracting it from the expert in a way that can be used by a computer is generally a difficult task, requiring its own expertise. A *knowledge engineer* has the job of extracting this knowledge and building the expert system *knowledge base*.

A first attempt at building an expert system is unlikely to be very successful. This is partly because the expert generally finds it very difficult to express exactly what knowledge and rules they use to solve a problem. Much of it is almost subconscious, or appears so obvious they don't even bother mentioning it. *Knowledge acquisition* for expert systems is a big area of research, with a wide variety of techniques developed. However, generally it is important to develop an initial prototype based on information extracted by interviewing the expert, then iteratively refine it based on feedback both from the expert and from potential users of the expert system.

In order to do such iterative development from a prototype it is important that the expert system is written in a way that it can easily be inspected and modified. The system should be able to explain its reasoning (to expert, user and knowledge engineer) and answer questions about the solution process. Updating the system shouldn't involve rewriting a whole lot of code - just adding or deleting localized chunks of knowledge.

The most widely used knowledge representation scheme for expert systems is rules. Typically, the rules won't have certain conclusions - there will just be some degree of certainty that the conclusion will hold if the conditions hold. Statistical techniques are used to determine these certainties. Rule-based systems, with or without certainties, are generally easily modifiable and make it easy to provide reasonably helpful traces of the system's reasoning. These traces can be used in providing explanations of what it is doing.

The primary goal of expert systems research is to make expertise available to decision makers and technicians who need answers quickly. There is never enough expertise to go around — certainly it is not always available at the right place and the right time. Portable with computers loaded with in-depth knowledge of specific subjects can bring decades worth of knowledge to a problem. The same systems can assist supervisors and managers with situation assessment and long-range planning.

These knowledge-based applications of artificial intelligence have enhanced productivity in business, science, engineering, and the military. With advances in the last decade, today's expert systems clients can choose from dozens of commercial software packages with easy-to-use interfaces. Each new deployment of an expert system yields valuable data for what works in what context, thus fueling the AI research that provides even better applications.

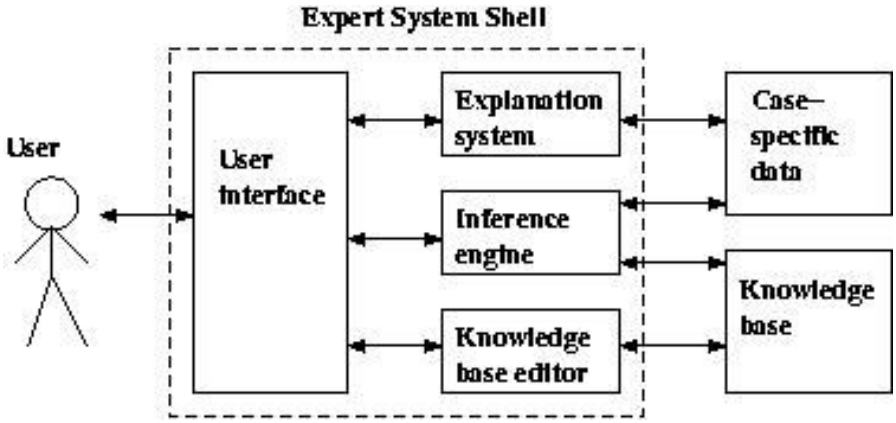
Expert systems have been used to solve a wide range of problems in domains such as medicine, mathematics, engineering, geology, computer science, business, law, defense and education. Within each domain, they have been used to solve problems of different types. Types of problem involve *diagnosis* (e.g., of a system fault, disease or student error); *design* (of a computer systems, hotel etc); and *interpretation* (of, for example, geological data). The appropriate problem solving technique tends to depend more on the problem type than on the domain. Whole books have been written on how to choose your knowledge representation and reasoning methods given characteristics of your problem.

Some examples of Expert systems are:

- ART - An early general-purpose programming language used in the development of expert systems
- CADUCEUS (expert system) - Blood-borne infectious bacteria
- CLIPS - Programming language used in the development of expert systems
- Dendral - Analysis of mass spectra
- Dipmeter Advisor - Analysis of data gathered during oil exploration
- Informavores Firefly - Browser based expert systems environment built using flow charts and used in the development of expert systems
- Jess - Java Expert System Shell. A CLIPS engine implemented in Java used in the development of expert systems
- Mycin - Diagnose infectious blood diseases and recommend antibiotics
- NEXPERT Object - An early general-purpose commercial backwards-chaining inference engine used in the development of expert systems
- Prolog - Programming language used in the development of expert systems
- R1 (expert system)/XCon - Order processing
- SHINE Real-time Expert System - Spacecraft Health INference Engine
- STD Wizard - Expert system for recommending medical screening tests
- PyKe - Pyke is a knowledge-based inference engine (expert system)

8.4.1 Expert System Architecture

Following figure shows the most important modules that make up a rule-based expert system. The user interacts with the system through a *user interface* which may use menus, natural language or any other style of interaction). Then an *inference engine* is used to reason with both the *expert knowledge* (extracted from our friendly expert) and data specific to the particular problem being solved. The expert knowledge will typically be in the form of a set of IF-THEN rules. The *case specific data* includes both data provided by the user and partial conclusions (along with certainty measures) based on this data. In a simple forward chaining rule-based system the case specific data will be the elements in *working memory*.



Almost all expert systems also have an explanation subsystem, which allows the program to explain its reasoning to the user. Some systems also have a knowledge base editor which help the expert or knowledge engineer to easily update and check the knowledge base.

One important feature of expert systems is the way they (usually) separate domain specific knowledge from more general purpose reasoning and representation techniques. The general purpose bit (in the dotted box in the figure) is referred to as an expert system shell. As we see in the figure, the shell will provide the inference engine (and knowledge representation scheme), a user interface, an explanation system and sometimes a knowledge base editor. Given a new kind of problem to solve (say, car design), we can usually find a shell that provides the right sort of support for that problem, so all we need to do is provide the expert knowledge.

8.4.2 Application of expert systems

Expert systems are designed and created to facilitate tasks in the fields of accounting, medicine, process control, financial service, production, human resources etc.Foundation of a successful expert system depends on a series of technical procedures and development that may be designed by certain technicians and related experts.

While expert systems have distinguished themselves in AI research in finding practical application, their application has been limited. Expert systems are notoriously narrow in their domain of knowledge—as an amusing example, a researcher used the "skin disease" expert system to diagnose his rustbucket car as likely to have developed measles—and the systems were thus prone to making errors that humans would easily spot. Additionally, once some of the mystique had worn off, most programmers realized that simple expert systems were essentially just slightly more elaborate versions of the decision logic they had already been using. Therefore, some of the techniques of expert systems can now be found in most complex programs without any fuss about them.

An example, and a good demonstration of the limitations of, an expert system used by many people is the Microsoft Windows operating system troubleshooting software located in the "help" section in the taskbar menu. Obtaining expert / technical operating system support is often difficult for individuals not closely involved with the development of the operating system. Microsoft has designed their expert system to provide solutions, advice, and suggestions to common errors encountered throughout using the operating systems.

Another 1970s and 1980s application of expert systems — which we today would simply call AI — was in computer games. For example, the computer baseball games Earl Weaver Baseball and Tony

La Russa Baseball each had highly detailed simulations of the game strategies of those two baseball managers. When a human played the game against the computer, the computer queried the Earl Weaver or Tony La Russa Expert System for a decision on what strategy to follow. Even those choices where some randomness was part of the natural system (such as when to throw a surprise pitch-out to try to trick a runner trying to steal a base) were decided based on probabilities supplied by Weaver or La Russa. Today we would simply say that "the game's AI provided the opposing manager's strategy."

Advantages and disadvantages

Advantages:

1. Provides consistent answers for repetitive decisions, processes and tasks
2. Holds and maintains significant levels of information
3. Encourages organizations to clarify the logic of their decision-making
4. Never "forgets" to ask a question, as a human might

Disadvantages:

- Lacks common sense needed in some decision making
- Cannot make creative responses as human expert would in unusual circumstances
- Domain experts not always able to explain their logic and reasoning
- Errors may occur in the knowledge base, and lead to wrong decisions
- Cannot adapt to changing environments, unless knowledge base is changed

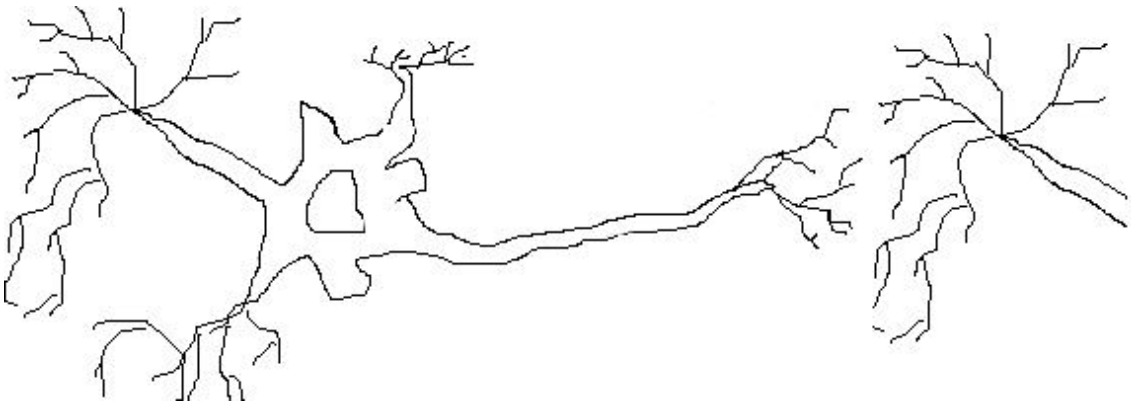
8.5 Neural Networks

A series of algorithms that attempt to identify underlying relationships in a set of data by using a process that mimics the way the human brain operates. Neural networks have the ability to adapt to changing input so that the network produces the best possible result without the need to redesign the output criteria.

In the quest to create intelligent machines, the field of Artificial Intelligence has split into several different approaches based on the opinions about the most promising methods and theories. These rivaling theories have lead researchers in one of two basic approaches; bottom-up and top-down. Bottom-up theorists believe the best way to achieve artificial intelligence is to build electronic replicas of the human brain's complex network of neurons, while the top-down approach attempts to mimic the brain's behavior with computer programs.

Neural Networks and Parallel Computation:

The human brain is made up of a web of billions of cells called neurons, and understanding its complexities is seen as one of the last frontiers in scientific research. It is the aim of AI researchers who prefer this bottom-up approach to construct electronic circuits that act as neurons do in the human brain. Although much of the working of the brain remains unknown, the complex network of neurons is what gives humans intelligent characteristics. By itself, a neuron is not intelligent, but when grouped together, neurons are able to pass electrical signals through networks.



The neuron "firing", passing a signal to the next in the chain.

Research has shown that a signal received by a neuron travels through the dendrite region, and down the axon. Separating nerve cells is a gap called the synapse. In order for the signal to be transferred to the next neuron, the signal must be converted from electrical to chemical energy. The signal can then be received by the next neuron and processed.

A century earlier the true / false nature of binary numbers was theorized in 1854 by George Boole in his postulates concerning the Laws of Thought. Boole's principles make up what is known as Boolean algebra, the collection of logic concerning AND, OR, NOT operands. For example according to the Laws of thought the statement: (for this example consider all apples red)

- *Apples are red*— is **True**
- *Apples are red AND oranges are purple*— is **False**
- *Apples are red OR oranges are purple*— is **True**
- *Apples are red AND oranges are NOT purple*— is also **True**

Boole also assumed that the human mind works according to these laws, it performs logical operations that could be reasoned. Ninety years later, Claude Shannon applied Boole's principles in circuits, the blueprint for electronic computers. Boole's contribution to the future of computing and Artificial Intelligence was immeasurable, and his logic is the basis of neural networks.

McCulloch and Pitts, using Boole's principles, wrote a paper on neural network theory. The thesis dealt with how the networks of connected neurons could perform logical operations. It also stated that, one the level of a single neuron, the release or failure to release an impulse was the basis by which the brain makes true / false decisions. Using the idea of feedback theory, they described the loop which existed between the senses —> brain —> muscles, and likewise concluded that Memory could be defined as the signals in a closed loop of neurons. Although we now know that logic in the brain occurs at a level higher then McCulloch and Pitts theorized, their contributions were important to AI because they showed how the firing of signals between connected neurons could cause the brains to make decisions. McCulloch and Pitt's theory is the basis of the artificial neural network theory.

Using this theory, McCulloch and Pitts then designed electronic replicas of neural networks, to show how electronic networks could generate logical processes. They also stated that neural networks may, in the future, be able to learn, and recognize patterns. The results of their research and two of Weiner's books served to increase enthusiasm, and laboratories of computer simulated neurons were set up across the country.

Two major factors have inhibited the development of full scale neural networks. Because of the expense of constructing a machine to simulate neurons, it was expensive even to construct neural networks with the number of neurons in an ant. Although the cost of components have decreased, the computer would have to grow thousands of times larger to be on the scale of the human brain. The second factor is

current computer architecture. The standard Von Neuman computer, the architecture of nearly all computers, lacks an adequate number of pathways between components. Researchers are now developing alternate architectures for use with neural networks.

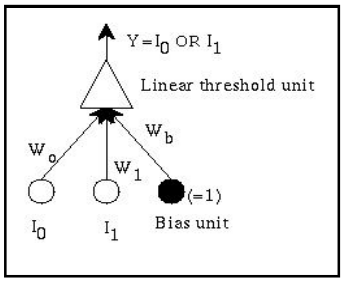
Even with these inhibiting factors, artificial neural networks have presented some impressive results. Frank Rosenblatt, experimenting with computer simulated networks, was able to create a machine that could mimic the human thinking process, and recognize letters. But, with new top-down methods becoming popular, parallel computing was put on hold. Now neural networks are making a return, and some researchers believe that with new computer architectures, parallel computing and the bottom-up theory will be a driving factor in creating artificial intelligence.

Neural Networks are a different paradigm for computing:

- von Neumann machines are based on the processing/memory abstraction of human information processing.
- neural networks are *based on the parallel architecture of animal brains*.

Neural networks are a form of multiprocessor computer system, with

- simple processing elements
- a high degree of interconnection
- simple scalar messages
- adaptive interaction between element



A biological neuron may have as many as 10,000 different inputs, and may send its output (the presence or absence of a short-duration spike) to many other neurons. Neurons are wired up in a 3-dimensional pattern. Real brains, however, are orders of magnitude more complex than any artificial neural network so far considered.

Example: A simple single unit adaptive network:

The network has 2 inputs, and one output. All are binary. The output is

1 if $W_0 * I_0 + W_1 * I_1 + W_b > 0$

0 if $W_0 * I_0 + W_1 * I_1 + W_b <= 0$

We want it to learn simple OR: output a 1 if either I_0 or I_1 is 1.

8.5.1 Applications of neural networks

- Character Recognition - The idea of character recognition has become very important as hand held devices like the Palm Pilot are becoming increasingly popular. Neural networks can be used to recognize handwritten characters.
- Image Compression - Neural networks can receive and process vast amounts of information at once, making them useful in image compression. With the Internet explosion and more sites using more images on their sites, using neural networks for image compression is worth a look.
- Stock Market Prediction - The day-to-day business of the stock market is extremely complicated. Many factors weigh in whether a given stock will go up or down on any given day. Since neural

networks can examine a lot of information quickly and sort it all out, they can be used to predict stock prices.

- Traveling Saleman's Problem - Interestingly enough, neural networks can solve the traveling salesman problem, but only to a certain degree of approximation.
- Medicine, Electronic Nose, Security, and Loan Applications - These are some applications that are in their proof-of-concept stage, with the acception of a neural network that will decide whether or not to grant a loan, something that has already been used more successfully than many humans.
- Miscellaneous Applications - These are some very interesting (albeit at times a little absurd) applications of neural networks.

Advantages:

There is no need to assume an underlying data distribution such as usually is done in statistical modeling.

- Neural networks are applicable to multivariate non-linear problems.
- The transformations of the variables are automated in the computational process.

Disadvantages:

Minimizing overfitting requires a great deal of computational effort.

- The individual relations between the input variables and the output variables are not developed by engineering judgment so that the model tends to be a black box or input/output table without analytical basis.
- The sample size has to be large.

8.6 Summary

Intelligent systems (IS) provide a standardized methodological approach to solve important and fairly complex problems and obtain consistent and reliable results over time. Extracting from diverse dictionaries, intelligence means the ability to comprehend; to understand and profit from experience. There are, of course, other meanings such as ability to acquire and retain knowledge; mental ability; the ability to respond quickly and successfully to a new situation; etc.

Artificial Intelligence (AI) is the area of computer science focusing on creating machines that can engage on behaviors that humans consider intelligent. The ability to create intelligent machines has intrigued humans since ancient times, and today with the advent of the computer and 50 years of research into AI programming techniques, the dream of smart machines is becoming a reality. Researchers are creating systems which can mimic human thought, understand speech, beat the best human chess player, and countless other feats never before possible. Find out how the military is applying AI logic to its hi-tech systems, and how in the near future Artificial Intelligence may impact our lives.

A knowledge-based system (KBS) is one of the major family members of the AI group. With the availability of advanced computing facilities and other resources, attention is now turning to more demanding tasks that might require intelligence. Society and industry are becoming knowledge-oriented and relying on different experts' decision-making abilities to solve problems. A KBS can act as an expert on demand, anytime and anywhere.

Expert systems are meant to solve real problems which normally would require a specialized human expert (such as a doctor or a minerologist). Building an expert system therefore first involves

extracting the relevant knowledge from the human expert. Such knowledge is often heuristic in nature, based on useful "rules of thumb" rather than absolute certainties. Extracting it from the expert in a way that can be used by a computer is generally a difficult task, requiring its own expertise.

A series of algorithms that attempt to identify underlying relationships in a set of data by using a process that mimics the way the human brain operates. Neural networks have the ability to adapt to changing input so that the network produces the best possible result without the need to redesign the output criteria.

8.7 Self Assessment Questions

1. What do you mean by an intelligent system? Explain in detail
2. Explain the role of AI in modern age.
3. What are the different approaches of AI?
4. What are the various applications of AI?
5. What do you mean by Knowledge based systems?
6. Compare knowledge-based systems with computer information systems.
7. What is an Expert System? Explain the role and importance of expert systems in detail.
8. What do you mean by neural networks? Explain.

8.8 Further Readings

- Artificial Intelligence. Entry in The Columbia Encyclopedia, Sixth Edition. 2001. Available from Bartleby.
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- Expert Systems Building Tools: Definitions. By H. Penny Nii.
- Expert System Glossary. From expertise2go.com.

Unit - 9 : MULTIMEDIA

Structure of the Unit

9.0 Objective

This unit provides a general overview of

- Multimedia system
- Uses of Multimedia
- Desktop Publishing Basics
- Computer Animations

9.1 Introduction

Multimedia means that computer information can be represented through audio, video, and animation in addition to traditional media (i.e., text, graphics drawings, images).

A good general definition is:

Multimedia is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally.

A *Multimedia Application* is an Application which uses a collection of multiple media sources e.g. text, graphics, images, sound/audio, animation and/or video.

Multimedia comes in many different formats. It can be almost anything you can hear or see like text, pictures, music, sound, videos, records, films, animations, and more.

On the Internet you can often find multimedia elements embedded in web pages, and modern web browsers have support for a number of multimedia formats. Hypermedia can be considered as one of the multimedia applications.

9.1.1 Multimedia Formats

Multimedia elements (like sounds or videos) are stored in media files.

The most common way to discover the media type is to look at the file extension. When a browser sees the file extensions .htm or .html, it will assume that the file is an HTML page. The .xml extension indicates an XML file, and the .css extension indicates a style sheet. Picture formats are recognized by extensions like .gif and .jpg.

Multimedia elements also have their own file formats with different extensions like .swf, .wmv, .mp3, and .mp4.

Video Formats

The MP4 format is the new and upcoming format for internet video. It is supported by YouTube, Flash players and HTML5.

Format	File	Description
AVI	.avi	The AVI (Audio Video Interleave) format was developed by Microsoft. The AVI format is supported by all computers running Windows, and by all the most popular web browsers. It is a very common format on the Internet, but not always possible to play on non-Windows computers.
WMV	.wmv	The Windows Media format is developed by Microsoft. Windows Media is a common format on the Internet, but Windows Media movies cannot be played on non-Windows computer without an extra (free) component installed. Some later Windows Media movies cannot play at all on non-Windows computers because no player is available
MPEG	.mpg .mpeg	The MPEG (Moving Pictures Expert Group) format is the most popular format on the Internet. It is cross-platform, and supported by all the most popular web browsers.
QuickTime	.mov	The QuickTime format is developed by Apple. QuickTime is a common format on the Internet, but QuickTime movies cannot be played on a Windows computer without an extra (free) component installed.
RealVideo	.rm .ram	The RealVideo format was developed for the Internet by Real Media. The format allows streaming of video (on-line video, Internet TV) with low bandwidths. Because of the low bandwidth priority, quality is often reduced.
Flash	.swf .flv	The Flash (Shockwave) format was developed by Macromedia. The Shockwave format requires an extra component to play. But this component comes preinstalled with web browsers like Firefox and Internet Explorer.
Mpeg-4	.mp4	Mpeg-4 (with H.264 video compression) is the new format for the internet. In fact, YouTube recommends using MP4. YouTube accepts multiple formats, and then converts them all to .flv or .mp4 for distribution. More and more online video publishers are moving to MP4 as the internet sharing format for both Flash players and HTML5.

Sound Formats

Format	File	Description
MIDI	.mid .midi	The MIDI (Musical Instrument Digital Interface) is a format for electronic music devices like synthesizers and PC sound cards. MIDI files do not contain sound, but digital musical instructions (notes) that can be played by electronics (like your PC's sound card). Since MIDI format only contains instructions (notes), MIDI files are extremely small. The example above is only 23K in size but it plays for nearly 5 minutes. MIDI is supported by many software systems over a large range of platforms. MIDI is supported by all the most popular Internet browsers.
RealAudio	.rm .ram	The RealAudio format was developed for the Internet by Real Media. The format also supports video. The format allows streaming of audio (on-line music, Internet radio) with low bandwidths. Because of the low bandwidth priority, quality is often reduced.
Wave	.wav	The Wave (waveform) format is developed by IBM and Microsoft. It is supported by all computers running Windows, and by all the most popular web browsers (except Google Chrome).
WMA	.wma	The WMA format (Windows Media Audio), compares in quality to MP3, and is compatible with most players, except the iPod. WMA files can be delivered as a continuous flow of data, which makes it practical for use in Internet radio or on-line music.
MP3	.mp3 .mpga	MP3 files are actually the sound part of MPEG files. The MPEG format was originally developed for video by the Moving Pictures Experts Group. MP3 is one of the most popular sound formats for music. The encoding system combines good compression (small files) with high quality. Expect future software systems to support it.

9.1.2 Multimedia Applications

Examples of Multimedia Applications include:

- World Wide Web
- Hypermedia courseware
- Video conferencing
- Video-on-demand
- Interactive TV
- Groupware
- Home shopping
- Games
- Virtual reality
- Digital video editing and production systems
- Multimedia Database systems

9.2 Multimedia Elements

Major elements of multimedia include **text, video, sound, graphics, and animation**. The elements used in multimedia have all existed before. Multimedia simply combines these elements into a powerful new tool.

Out of all of the elements, text has the most impact on the quality of the multimedia interaction. Generally, text provides the important information. Text acts as the keystone tying all of the other media elements together.

Sound is used to provide emphasis or highlight a transition from one page to another. Sound synchronized to screen display, enables teachers to present lots of information at once. Sound used creatively, becomes a stimulus to the imagination; used inappropriately it becomes a hindrance or an annoyance.

The representation of information by using the visualization capabilities of video can be immediate and powerful. While this is not in doubt, it is the ability to choose how we view, and interact, with the content of digital video that provides new and exciting possibilities for the use of digital video in education. Video can stimulate interest if it is relevant to the rest of the information on the page, and is not 'overdone'. One of the most compelling justifications for video may be its dramatic ability to elicit an emotional response from an individual.

Animation is used to show changes in state over time, or to present information slowly to students so they have time to assimilate it in smaller chunks. Animations, when combined with user input, enable students to view different versions of change over time depending on different variables. Animations are primarily used to demonstrate an idea or illustrate a concept. Video is usually taken from life, whereas animations are based on drawings.

Graphics provide the most creative possibilities for a learning session. They can be photographs, drawings, graphs from a spreadsheet, pictures from CD-ROM, or something pulled from the Internet. With a scanner, hand-drawn work can be included. Standing commented that, "the capacity of recognition memory for pictures is almost limitless". The reason for this is that images make use of a massive range of cortical skills: color, form, line, dimension, texture, visual rhythm, and especially imagination.

Best interactive multimedia always consists of all the five basic types of media, there must be a proper balance between them. While creating an interactive multimedia, investigate about when is sound more meaningful than a picture.

9.3 Hardware Requirements for Multimedia

In developing a multimedia system, the participants need to consider the type of hardware as well as software used. The hardware must be capable of supplying the needs of the multimedia system. These needs are:

- **Primary and secondary storage capabilities** – which will enable bit depth and color to be represented and also enabling the audio data to be sampled.
- **Processing speed** – which will enable video data and frames rates to be maintained, the processing of images such as morphing and distorting as well as animation.
- **Display devices** – which are capable of displaying good pixel and resolution quality.

In order for hardware to cope with this demand, several components need to be installed. Such items as additional memory, both VRAM and RAM, as well as additional hard disk space. The hardware

itself must have a high processing speed to enable the number crunching involved in processing the data, which can range from video and audio back to word processing. The monitor or VDU should be capable of displaying a large resolution capacity to enable it to display the digital data accurately.

9.4 Uses of Multimedia

Multimedia is media that uses multiple forms of information content and information processing like text, audio, graphics, animation, video, interactivity) to inform or entertain the audience. Multimedia also refers to the use of electronic media to store and experience multimedia content. Multimedia is similar to traditional mixed media in fine art, but with a broader scope. The term "rich media" is synonymous for interactive multimedia. Multimedia means that computer info can be represented through audio, graphics, image, video and animation in addition to traditional media (text and graphics). Hypermedia can be considered one particular multimedia application.

Multimedia finds its application in various areas including, but not limited to, advertisements, art, education, entertainment, engineering, medicine, mathematics, business, scientific research and spatial temporal applications. Below are the several examples as follows:

- **Entertainment and fine arts**

Multimedia is heavily used in the entertainment industry, especially to develop special effects in movies and animations. Multimedia games are a popular pastime and are software programs available either as CD-ROMs or online. Some video games also use multimedia features.

Multimedia applications that allow users to actively participate instead of just sitting by as passive recipients of information are called Interactive Multimedia.

In the Arts there are multimedia artists, whose minds are able to blend techniques using different media that in some way incorporates interaction with the viewer. One of the most relevant could be Peter Greenaway who is melding Cinema with Opera and all sorts of digital media. Another approach entails the creation of multimedia that can be displayed in a traditional fine arts arena, such as an art gallery. For the most part these artists are using materials that will not hold up over time.

- **Education**

In Education, multimedia is used to produce computer-based training courses (popularly called CBTs) and reference books like encyclopedia and almanacs. A CBT lets the user go through a series of presentations, text about a particular topic, and associated illustrations in various information formats. Edutainment is an informal term used to describe combining education with entertainment, especially multimedia entertainment.

- **Engineering**

Software engineers may use multimedia in Computer Simulations for anything from entertainment to training such as military or industrial training. Multimedia for software interfaces are often done as collaboration between creative professionals and software engineers.

- **Industry**

In the Industrial sector, multimedia is used as a way to help present information to shareholders, superiors and coworkers. Multimedia is also helpful for providing employee training, advertising and selling products all over the world via virtually unlimited web-based technologies.

- **Mathematical and Scientific Research**

In Mathematical and Scientific Research, multimedia is mainly used for modelling and simulation.

For example, a scientist can look at a molecular model of a particular substance and manipulate it to arrive at a new substance. Representative research can be found in journals such as the Journal of Multimedia.

- **Medicine**

In Medicine, doctors can get trained by looking at a virtual surgery or they can simulate how the human body is affected by diseases spread by viruses and bacteria and then develop techniques to prevent it.

"Graphic Design" encompasses a whole range of media services. Website Outsourcing is your one stop shop for all kinds of graphic designing services. With many years of experience designing high quality professional graphics and advertising material, we are well suited to be your long-term graphics partner. As your company grows and therefore you graphics needs, you will find it makes more sense to associate your firm with a vendor who is experienced in all aspects of graphics designing.

9.4.1 Images

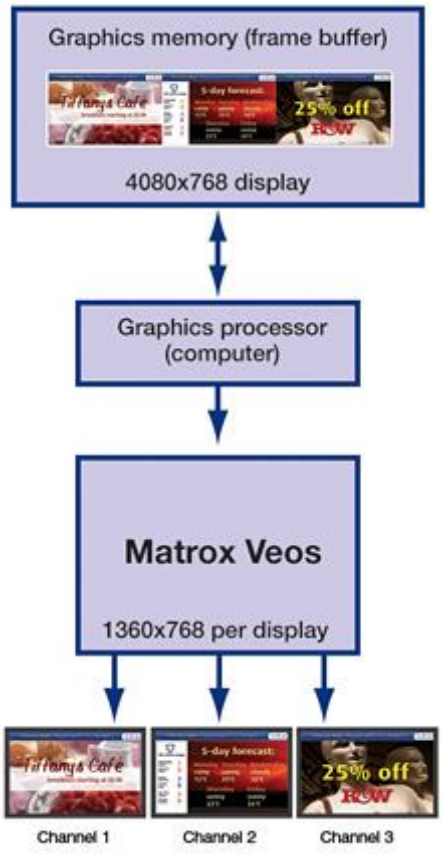
An image is composed of individual pixels. In an typical VDU screen for a PC, there are about 500 000 to well over 1 000 000 pixels. Each pixel in most graphics systems is controlled by data stored in the systems video RAM or frame buffer.

Image Characteristics

High resolution (HIRES) and low resolution (LORES) are often used to describe graphic images and graphic display systems. However, due to the development in display technology, these terms no longer have a clear definition. In the early 1990s, a screen with resolution 640 x 480 used to be a HIRES but is now considered as a LORES. The amount of pixels affects the resolution of an image, which affects its quality. More pixels in the display image mean that each pixel is smaller and that much more information and detail can be shown. Increasing the number of pixels also means that more storage is required.

Bit depth plays a roll once color is included and it is important to keep in mind that color includes shades of gray. Because the bit depth is no longer a 1 or a zero it plays an important part in the formula.

Bit Depth (Bits Per Pixel)	Number of Colours or Tones	Where do # of Colours Come From?
1	2	$2^1=2$
2	4	$2^2=4$
3	8	$2^3=8$
4	16	$2^4=16$
6	64	$2^6=64$
8	256	$2^8=256$
16	65 536	$2^{16}=65\ 536$
24	16 777 216	$2^{24}= 16\ 777\ 216$
32	4 294 967 296	$2^{32}= 4\ 294\ 967\ 296$



Frame buffer

Image Display

A palette is the number of available colors for a graphic display or image. The size of the palette depends on the image bit depth. The maximum number of colors available in a display system, or a system palette, is fixed by the graphics display hardware. Individual images can have much smaller image palettes by selecting and utilizing only some of the colors available in the system palette.

GIF uses an image palette of up to 256 different colors. Data describing those colors are stored as a color table inside the image file. Each color in the image palette has its own code number in the color table. For example, a 256 color GIF image would then have a color table with 256 values (from 0 to 255).

Color System	Meaning	Description
RGB	red green blue	matches the video signals used in VDUs
HSL	hue stauration lightness	alternative to RGB
CYMK	cyan yellow magenta black	matches the color inks used in traditional printing

In some graphics software packages, HSL is called HSV (Hue Saturation Value) or HSL (Hue Luminosity Saturation). In the HSL system, there are 360 color values, called hues. Each has a value that indicates its angle around the color wheel. Saturation is expressed as a percentage. It is the level of purity or brightness of a hue. If an image is in black and white, its saturation is 0 per cent. Lightness (Luminosity

or Value) is the amount of white added to a hue and ranges from 100 per cent (pure white) to 0 per cent (pure black). Grey scales are the shade of grey between black and white in a graphic display system. They are stored as RGB values. Greys are created when red, green, and blue values are equal. And since there are 256 values for each of these three colors, there must be 256 shades of grey (including black and white). The light shades of grey have high RGB values (closer to white) while dark greys have low RGB values (close to black).

9.4.2 Audio & Video

Audio file formats

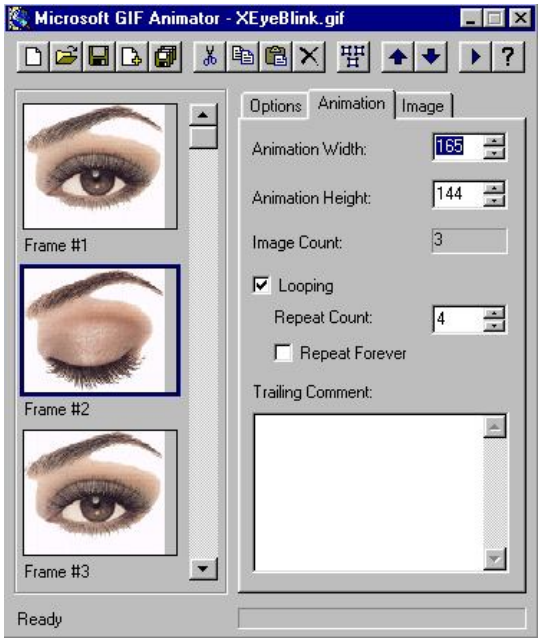
Different formats for storing audio in multimedia: WAV (waveform), MIDI, MP3 and RealAudio. New formats are constantly being introduced. A waveform is frequently displayed on a VDU in the shape of a wave. This allows the wave-like characteristics of the sound to be seen and altered by the user.

Wave Characteristics:

- Amplitude - wave height which gives the sound its volume
- Wavelength - the spacing between waves which gives the sound its pitch or note. The pitch of a sound is normally expressed as a frequency, which is the number of wavelengths that pass in one second

A MIDI file is not a digitized sound file and cannot be played directly through speakers or displayed and altered in the same way as a waveform file. It contains instructions for musical instruments.

Video and Animations



GIF animation software

Creating a multimedia video is like audio where it is the process of recording and storing many samples of a signal. The signal represents visual data - light intensity levels and colors. In multimedia, creating a high quality video is not as easy as it is for audio. Here are two main problems in using video in multimedia systems:

1. A single full screen (800x600) video frame in 24-bit true color need 1.4 megabytes of storage space. A single second of video played at full speed (30 frames per second) would need over 40 megabytes of storage. Video require a fairly large amount of storage space.
2. The video data has to be transferred from secondary storage (e.g. hard disk, DVD) into RAM. It must then be processed and moved into the frame buffer without affecting the quality of the display. Video also makes big demands on the system's processing abilities.

Making compromises to overcome these problems allow a smooth full motion effect, reduction of storage space and processing power needed to play the video. Here are the two most common compromises:

1. Reduced screen size - instead if using the entire screen area to replay the digitized video, a smaller playback area is used
2. Reduced speed - instead of using the VDU screen refresh rate (often 30 frames per second), a much slower playback speed of 10 or even fewer frames per second is used.

The most popular multimedia file storage formats for video images are AVI, QuickTime, and MPEG. For animations, files are stored as GIF. Multimedia animations are rarely full screen, are usually played at a reduced speed and almost always use a reduced color palette. Resulting to only minimal problems. The best known example of multimedia animation would be the animated GIFs used on the Web, many are small icon-sized animations. Methods of animating:

Cell-based Animation - This is the most common method in animating images. Each picture is a frame called a cell. The graphic artist must create each cell separately, although most animation software packages have tools that will speed up this process. For example, the graphic artist may create the background (all the stationary parts of the image) first and then copy it into all the cells. The moving objects can then be created and placed separately in each individual cell. This types of animation gives the animator complete control over every frame of animation.

Path-Based Animation - In this animation the graphic artist describes the path or every movement of every object. The system then creates the animation frames with each object drawn in its correct position. Each frame is created by the system. Path-based animation is faster to create that cell-based however the animator does not have the same level of control over the animation.

9.5 Desktop Publishing Basics

Desktop publishing is a term coined after the development of a specific type of software. It's about using that software to combine and rearrange text and images and creating digital files.

Before the invention of desktop publishing software the tasks involved in desktop publishing were done manually, by a variety of people and involved both graphic design and prepress tasks which sometimes leads to confusion about what desktop publishing is and how it is done.

Desktop publishing is the use of the computer and software to create visual displays of ideas and information. Desktop publishing documents may be for desktop or commercial printing or electronic distribution including PDF, slide shows, email newsletters, epub, and the Web.

Things To Do With Desktop Publishing

Desktop publishing is or can be:

- designing print communications such as brochures, fliers, ads, and posters
- designing print communications such as catalogs, directories, and annual reports
- designing logos, business cards, and letterhead
- designing and publishing newsletters, magazines, and newspapers
- designing books and booklets
- converting print communications to formats including Web and smart devices such as tablets and phones
- creating resumes and business forms (including invoices, inventory sheets, memos, and labels)
- self-publishing (books, newsletters, ebooks, etc.)
- designing and publishing blogs and Web sites
- designing slides shows, presentations, and printing handouts creating and printing greeting cards, banners, postcards etc.
- making digital scrapbooks and print or digital photo albums
- creating decorative labels, envelopes, trading cards, calendars, and charts
- designing packaging for retail merchandise from wrappers for bars of soap to software boxes
- designing store signs, highway signs, and billboards
- taking work designed by others and putting into the correct format for digital or offset printing or for publishing online.

9.5.1 Page Layout Programs

Page layout is the process of placing and arranging and rearranging text (text composition) and graphics on the page to produce documents such as newsletters, brochures, books, etc.

Page layout also refers to the actual document page and its composition. The primary software programs for desktop publishing are called page layout applications or page layout software.

Desktop publishing *is* page layout. Designers *do page layout* by arranging text and images on the page to create an attractive and effective *page layout*.

Examples:

Before designers had desktop publishing software, page layout was often done by pasting blocks of typed or typeset text and images cut from special *clip art* books onto sheets of paper.

Adobe PageMaker was the first desktop publishing or page layout program that made it easy to arrange and rearrange text and graphics on screen — no more scissors or messy glue.

9.6 Graphics for DTP

Graphics come in many flavors but not all file formats are suitable for all purposes. How do you know which is best? In general, there are graphics formats suitable for printing and those for on-screen viewing or online publishing. Within each group there are also formats that are better than others for the same task.

In desktop publishing we work with text and graphics. If text is the characters, words, phrases, sentences, and paragraphs that we read, it would be easy to say that anything that is not text is graphics.

But what about graphics that are pictures of text characters and words? We read them, so they must be text not graphics, right?

Text, as used in desktop publishing, is a special kind of file format — or many formats — that the computer is able to read.

In desktop publishing we use many different kinds of graphics. Our use of graphics is dependent not only on the type of graphic and its content but also on the graphics format. Words rendered in one of these graphics formats becomes a graphic, not text.

Typically, graphics are considered pictures. They can be realistic, cartoonish, or stylized drawings of people, places, or objects. Graphics can be photographs taken with a digital camera or scanned from print photos. A decorative border around a page, the bullet symbols in front of a list of items, icons, a graph, or a pie chart are all graphics. A textured background designed to look like tree bark, marble, or crumbled tissue paper and a horizontal or vertical line used to separate items on a page are types of graphics. The terms clip art and graphics are often used interchangeably even though clip art is usually a more specific type of non-photographic image.

Use GIF, PNG, and JPG for online publishing. Use EPS and TIFF for print publishing. If all your printing is sent to your desktop printer, you may be able to use other formats including CGM and PCX with acceptable results; however, for high-resolution output EPS and TIFF will provide the least hassles and the best quality. They are the standards for high-resolution printing.

In addition to the formats in the chart, below, there are proprietary graphics file formats. These are bitmap or vector formats used by specific graphics programs. Although some desktop publishing software will recognize the more common formats such as PSD from Adobe Photoshop (bitmap) or CDR from CorelDRAW (vector) it is generally best to convert these images to TIF or EPS or other common graphics file formats.

This simple chart outlines the best use for several common formats. Match the format to your job either by starting with graphics in that format or by converting other artwork to the desired format.

Format:	Designed for:	Top choice for:
BMP	Screen display under Windows	Windows Wallpaper
EPS	Printing to PostScript printers/Imagesetters	High resolution printing of illustrations
GIF	Screen display, especially the Web	Online publishing of non-photographic images
JPEG, JPG	Screen display, especially the Web	Online publishing of photographic images
PNG	Replacement for GIF and, to a lesser extent, JPG and TIF	Online publishing of illustrations with lots of colors and transparency Intermediate image-editing stages for JPG or TIF images
PICT	Screen display on Macintosh or printing to non-PostScript printer	
TIFF, TIF	Printing to PostScript printers	High resolution printing of images
WMF	Screen display under Windows or printing to non-PostScript printer	Transfer vector images via the clipboard

9.7 Computer Animation

Animation has historically been produced in two ways. The first is by artists creating a succession of cartoon frames, which are then combined into a film. A second method is by using physical models, e.g. King Kong, which are positioned, the image recorded, then the model is moved, the next image is recorded, and this process is continued.

Computer animation can be produced by using a rendering machine to produce successive frames wherein some aspect of the image is varied. For a simple animation this might be just moving the camera or the relative motion of rigid bodies in the scene. This is analogous to the second technique described above, i.e., using physical models. More sophisticated computer animation can move the camera and/or the objects in more interesting ways, e.g. along computed curved paths, and can even use the laws of Physics to determine the behavior of objects.

Animation is used in Visualization to show the time dependent behavior of complex systems.

A major part of animation is motion control. Early systems did not have the computational power to allow for animation preview and interactive control. Also, many early animators were computer scientists rather than artists. Thus, scripting systems were developed. These systems were used as a computer high level language where the animator wrote a script (program) to control the animation. Whereas a high level programming language allows for the definition of complex data types, the scripting languages allowed for the definition of "actors", objects with their own animation rules.

Later systems have allowed for different types of motion control. One way to classify animation techniques is by the level of abstraction in the motion control techniques. A low-level system requires the animator to precisely specify each detail of motion, whereas a high-level system would allow them to use more general or abstract methods. For example, to move a simple rigid object such as a cube, requires six degrees of freedom (numbers) per frame. A more complex object will have more degrees of freedom, for example a bird might have over twenty degrees of freedom. Now think about animating an entire flock of birds.

Therefore, a Control Hierarchy is required, so that high level control constructs can be specified which are then mapped into more detailed control constructs. This is analogous to high level computer languages with complex control structures or data types which are translated at runtime into low level constructs.

9.7.1 Types of Animation Systems

- **Scripting Systems**

  Scripting Systems were the earliest type of motion control systems. The animator writes a script in the animation language. Thus, the user must learn this language and the system is not interactive. One scripting system is ASAS (Actor Script Animation Language), which has a syntax similar to LISP. ASAS introduced the concept of an actor, i.e., a complex object which has its own animation rules. For example, in animating a bicycle, the wheels will rotate in their own coordinate system and the animator doesn't have to worry about this detail. Actors can communicate with other actors be sending messages and so can synchronize their movements. This is similar to the behavior of objects in object-oriented languages.

- **Procedural Animation**

  Procedures are used that define movement over time. These might be procedures that use the laws of physics (Physically - based modeling) or animator generated methods. An example is a motion that is the result of some other action (this is called a "secondary action"), for example throwing a ball which hits another object and causes the second object to move.

- **Representational Animation**

  This technique allows an object to change its shape during the animation. There are three subcategories to this. The first is the animation of articulated objects, i.e., complex objects composed of connected rigid segments. The second is soft object animation used for deforming and animating the deformation of objects, e.g. skin over a body or facial muscles. The third is morphing which is the changing of one shape into another quite different shape. This can be done in two or three dimensions.

- **Stochastic Animation**

  This uses stochastic processes to control groups of objects, such as in particle systems. Examples are fireworks, fire, water falls, etc.

- **Behavioral Animation**

  Objects or "actors" are given rules about how they react to their environment. Examples are schools of fish or flocks of birds where each individual behaves according to a set of rules defined by the animator.

9.8 Summary

Multimedia is the field concerned with the computer-controlled integration of text, graphics, drawings, still and moving images (Video), animation, audio, and any other media where every type of information can be represented, stored, transmitted and processed digitally.

The most common way to discover the media type is to look at the file extension. When a browser sees the file extensions .htm or .html, it will assume that the file is an HTML page. The .xml extension indicates an XML file, and the .css extension indicates a style sheet. Picture formats are recognized by extensions like .gif and .jpg.

Major elements of multimedia include **text, video, sound, graphics, and animation**. The elements used in multimedia have all existed before. Multimedia simply combines these elements into a powerful new tool.

Multimedia is media that uses multiple forms of information content and information processing like text, audio, graphics, animation, video, interactivity) to inform or entertain the audience. Multimedia also refers to the use of electronic media to store and experience multimedia content. Multimedia is similar to traditional mixed media in fine art, but with a broader scope. The term "rich media" is synonymous for interactive multimedia. Multimedia means that computer info can be represented through audio, graphics, image, video and animation in addition to traditional media (text and graphics). Hypermedia can be considered one particular multimedia application.

Desktop publishing is the use of the computer and software to create visual displays of ideas and information. Desktop publishing documents may be for desktop or commercial printing or electronic distribution including PDF, slide shows, email newsletters, epub, and the Web.

9.9 Self Assessment Questions

1. What do you mean by Multimedia? What are the different multimedia elements?
2. Explain the hardware requirements for multimedia systems.
3. Explain the uses and role of multimedia.
4. What are the different image formats are available?
5. Explain the different audio and video formats.
6. What id DTP? Explain DTP basics in detail.
7. What is Computer animations? Explain its role.

9.10 Further Readings

- Multimedia making it work Tay Vaughan Tata McGrawHill, Delhi
- Multimedia – Technology and applications David Hillman Galgotia Publications, Delhi
- Chisholm, Wendy, Gregg Vanderheiden, and Ian Jacobs, eds. 1999.
- CPB/WGBH National Center for Accessible Media.Rich media resource center.

Unit - 10 : Data Analysis-I

Structure of the unit

10.0 Objective

This unit provides the overview of:

- Understand the MS Excel environment
- The various operations that can be performed on MS Excel sheet.
- The cell navigation
- The moving and copying operation on cells
- Learn the function and formula concept
- The cell references

10.1 Introduction

A spreadsheet program designed for IBM-compatible personal computers by Lotus Corporation in 1982. Lotus 1-2-3 was the first publicly available program to combine graphics, spreadsheet functions and data management (three functions, hence the name). Its relative ease of use and flexibility made it an enormous success and contributed to the acceptance of personal computers in business.

What are spreadsheets used for?

Spreadsheets make ideal business tools as they offer an easy way of producing accounts, sales analysis, stock analysis, product lists and much more. Once you have data in a spreadsheet it can be changed to give reports in various different ways shown as either a table or in a graph. Spreadsheets can be used to easily alter data files from one business system into a format readable by a different system.

Data from different systems can also be easily reconciled against using each other with the use of formulas to check for errors, especially useful if you are migrating to a new system.

IBM's Lotus SmartSuite

IBM's Lotus SmartSuite an alternative in the Office Suite market with a vision toward the twenty-first century. IBM's Lotus SmartSuite Millennium Edition is Year 2000 compliant and ready to provide you with better value than its competitors and a superior way to work the Web. SmartSuite Millennium Edition prepares you for a new era in computing.

It contains eight innovative applications: the Lotus 1-2-3 spreadsheet app., the new FastSite intranet publisher, Organizer time and contact manager, Word Pro word processor, Freelance Graphics presentation graphics, Approach database, ScreenCam multimedia software, SmartCenter Internet information manager, and integrated speech recognition from IBM's ViaVoice. Encounter the newest member of SmartSuite, the Lotus FastSite Intranet document publisher. FastSite makes Internet/intranet publishing fast and easy. Designed for desktop application users, it automatically converts groups of existing SmartSuite or Microsoft Office files to Web formats. With integrated IBM ViaVoice speech recognition softwareUse ViaVoice to dictate directly into a Word Pro document, or enter data into a 1-2-3 spreadsheet and turn your work into fun. Then there's Lotus 1-2-3, the spreadsheet that revolutionized the business world—and is doing it again. It's all there with the latest features such as Web Tables, which lets you incorporate live Web-based data into your spreadsheets.SmartSuite fits right into your complicated computing environment. It efficiently shares data with Lotus eSuite, The most popular desktop applications like Microsoft Office, and integrates with enterprise databases and applications Including Oracle, SAP, PeopleSoft, Lotus Notes, and Domino.

Microsoft Excel 2007

Microsoft Excel 2007 is an electronic spreadsheet software package that allows you to organize data in a tabular format, perform mathematical calculations, and analyze data. This software includes functions, formulas, and charts. It is commonly used in business, engineering, mathematics, and statistics. This unit covers the basic functionality of the software.

Microsoft Excel is a commercial spreadsheet application written and distributed by Microsoft for Microsoft Windows and Mac OS X. It features calculation, graphing tools, pivot tables, and a macro programming language called Visual Basic for Applications. It has been a very widely applied spreadsheet for these platforms, especially since version 5 in 1993, and it has almost completely replaced Lotus 1-2-3 as the industry standard for spreadsheets. Excel forms part of Microsoft Office. The current versions are 2010 for Microsoft Windows and 2011 for Mac OS X.

Microsoft Excel has the basic features of all spreadsheets.

- It uses a grid of cells arranged in numbered rows and letter-named columns to organize data manipulations like arithmetic operations etc. It has library of supplied functions to answer statistical, engineering and financial needs.
- In addition, it can display data as line graphs, histograms and charts, and with a very limited three-dimensional graphical display.
- It allows sectioning of data to view its dependencies on various factors for different perspectives (using pivot tables and the scenario manager).

- It has a programming aspect, Visual Basic for Applications, allowing the user to employ a wide variety of numerical methods, for example, for solving differential equations of mathematical physics, and then reporting the results back to the spreadsheet.
- It also has a variety of interactive features allowing user interfaces that can completely hide the spreadsheet from the user, so the spreadsheet presents itself as a so-called application, or decision support system (DSS), via a custom-designed user interface, for example, a stock analyzer, or in general, as a design tool that asks the user questions and provides answers and reports.
- In a more elaborate realization, an Excel application can automatically poll external databases and measuring instruments using an update schedule, analyze the results, make a Word report or Power Point slide show, and e-mail these presentations on a regular basis to a list of participants.

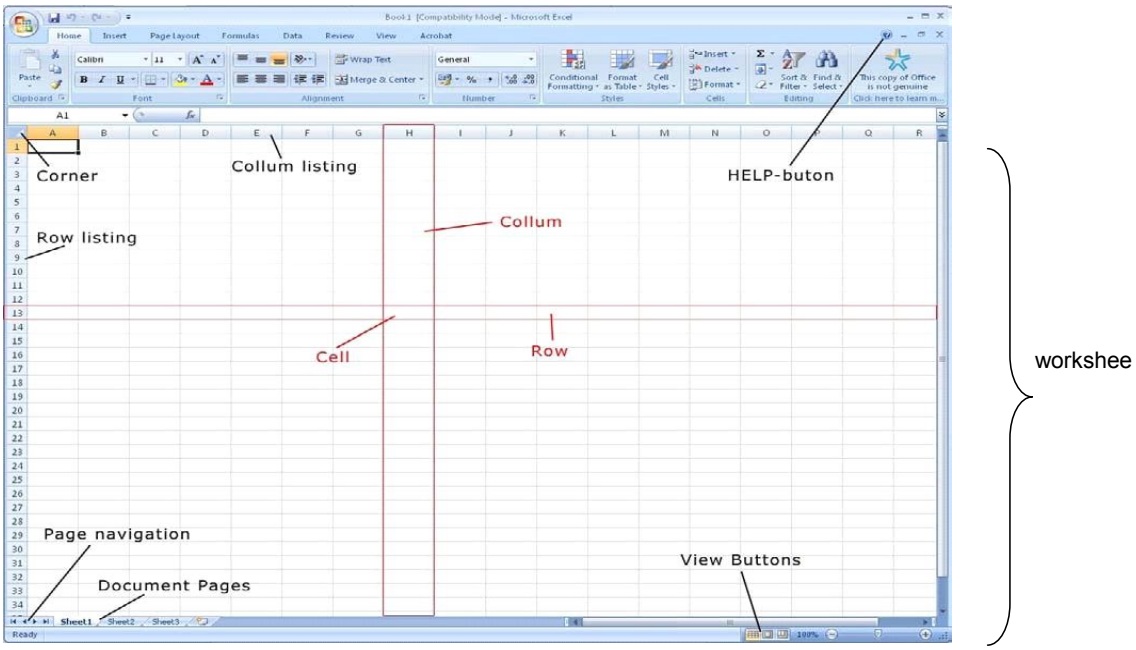
10.2 Starting MS Excel

To start MS Excel click on the Start Menu on the bottom left corner of your desktop as shown in following figure and select -

Start → All Programs → Microsoft Office → Microsoft OfficeExcel 2007.

10.3 Elements of the MS Excel Window

Microsoft Excel is an electronic spreadsheet. You can use it to organize your data into rows and columns. You can also use it to perform mathematical calculations quickly. This lesson will introduce you to the Excel window. You use the window to interact with Excel. The following figure shows how the MS Excel window look like. The main work area is called a worksheet where you can create your data using functions, formulas, and charts. The highlighted cell as shown in the following figure is called the active cell and is the current place where you can enter a value or a formula.



Note: Your screen will probably not look exactly like the screen shown. In Excel 2007, how a window displays depends on the size of your window, the size of your monitor, and the resolution to which your monitor is set. Resolution determines how much information your computer monitor can display. If you use a low resolution, less information fits on your screen, but the size of your text and images are larger. If you use a high resolution, more information fits on your screen, but the size of the text and images are smaller. Also, settings in Excel 2007, Windows Vista, and Windows XP allow you to change the color and style of your windows.

The different parts of the excel window are given in the following sections.

i. The Microsoft Office Button

In the upper-left corner of the Excel 2007 window is the Microsoft Office button. When you click the button, a menu appears. You can use the menu to create a new file, open an existing file, save a file, and perform many other tasks.

ii. The Quick Access Toolbar

Next to the Microsoft Office button is the Quick Access toolbar. The Quick Access toolbar gives you immediate access to commands you frequently use. By default, Save, Undo, and Redo appear on the Quick Access toolbar. You can use Save to save your file, Undo to roll back an action you have taken, and Redo to reapply an action you have rolled back.

iii. The Title Bar

Next to the Quick Access toolbar is the Title bar. On the Title bar, Microsoft Excel displays the name of the workbook you are currently using. At the top of the Excel window, you should see "Microsoft Excel - Book1" or a similar name.

iv. The Ribbon

You use commands to tell Microsoft Excel what to do. In Microsoft Excel 2007, you use the Ribbon to issue commands. The Ribbon is located near the top of the Excel window, below the Quick Access toolbar. At the top of the Ribbon are several tabs as shown in above figure; clicking a tab displays several related command groups. Within each group are related command buttons. You click buttons to issue commands or to access menus and dialog boxes. You may also find a dialog box launcher in the bottom-right corner of a group. When you click the dialog box launcher, a dialog box makes additional commands available.

i. The Formula Bar

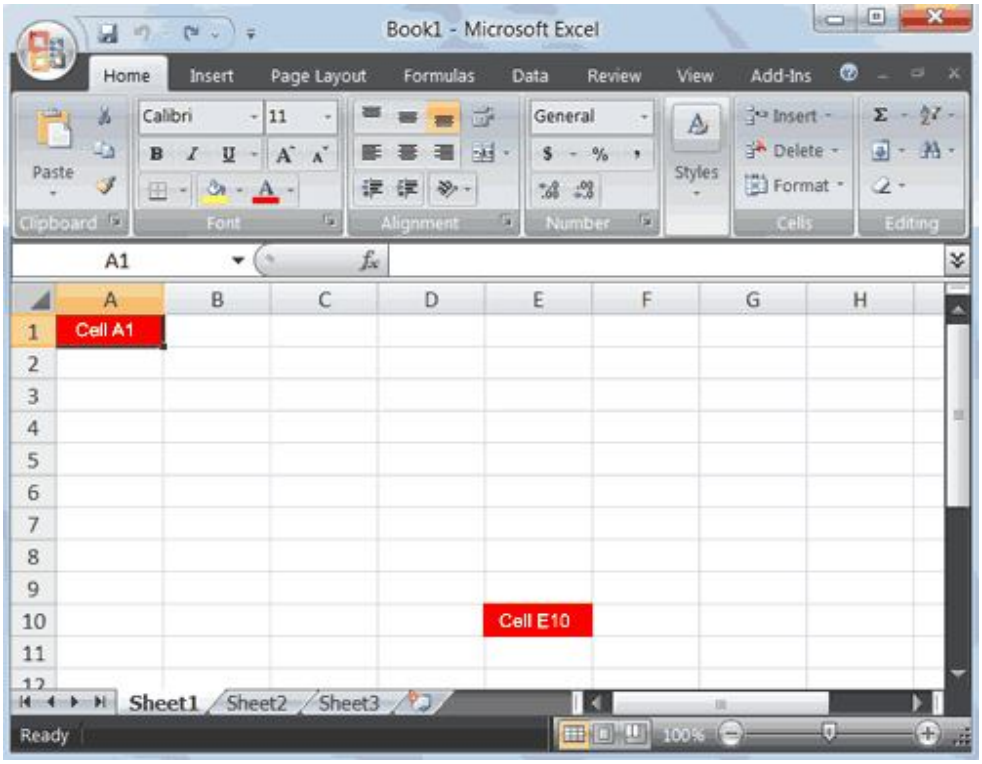
Formula Bar

If the Formula bar (as shown in above figure) is turned on, the cell address of the cell you are in displays in the Name box which is located on the left side of the Formula bar. Cell entries display on the right side of the Formula bar. If you do not see the Formula bar in your window, perform the following steps:

1. Choose the View tab.
2. Click Formula Bar in the Show/Hide group. The Formula bar appears.

Note: The current cell address displays on the left side of the Formula bar.

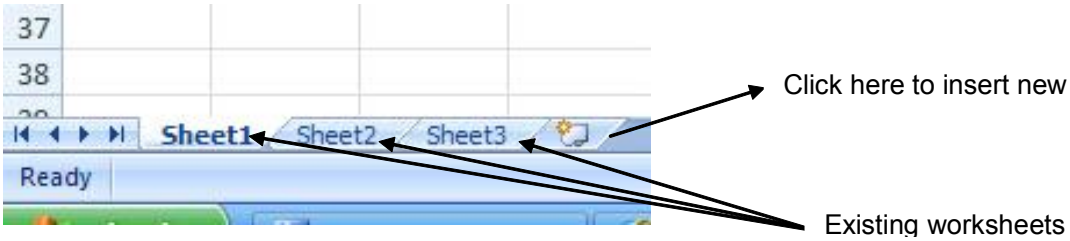
vi. Worksheets



Microsoft Excel consists of worksheets. Each worksheet contains columns and rows. The columns are lettered A to Z and then continuing with AA, AB, AC and so on; the rows are numbered 1 to 1,048,576. The number of columns and rows you can have in a worksheet is limited by your computer memory and your system resources.

The combination of a column coordinate and a row coordinate make up a cell address. For example, the cell located in the upper-left corner of the worksheet is cell A1, meaning coloumn A, row 1. Cell E10 is located under column E on row 10. You enter your data into the cells on the worksheet.

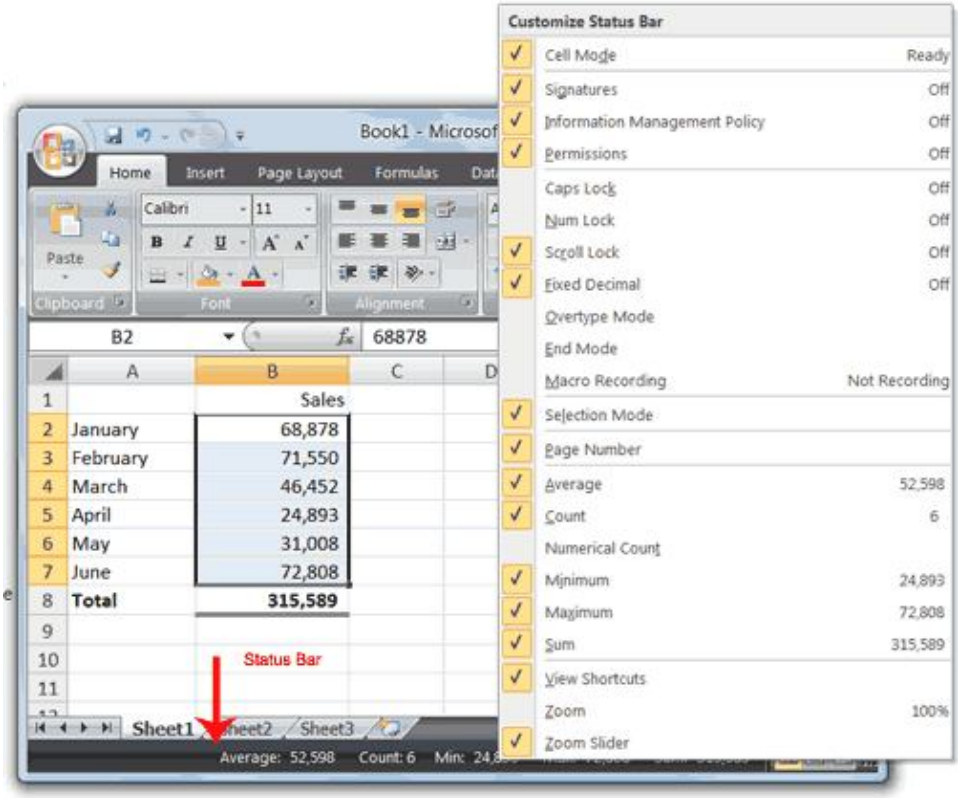
Workbook vs. Worksheet – when you open Excel, a new file is created called Book 1 (until you name it differently). It is called "Book" because it is a Workbook that is initially made up of three Worksheets accessible from the tabs in the lower left corner of your excel window (see following figure). Think it of as a three ring binder with three sheets of paper in it.



As with a binder, you can:

- **Add sheets** to your Workbook: Insert > Worksheet, or click on the new worksheet tab to the right of the tabs for your existing worksheets as shown in above figure.
- **Delete worksheets**: by right-clicking on the tab of the worksheet and then selecting "delete" option from the popup menu you can delete the worksheet.
- **Re-arrange** them: by clicking on the worksheet tab and dragging it to the location you desire, You can rearrange them.
- Rename **worksheets: by double-clicking on the worksheet title.**

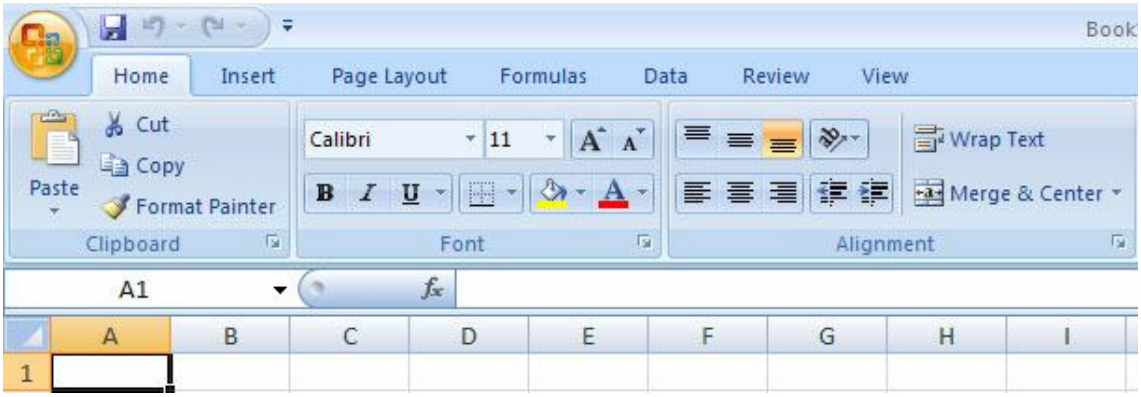
vi. The Status Bar



The Status bar appears at the very bottom of the Excel window and provides such information as the sum, average, minimum, and maximum value of selected numbers. You can change what displays on the Status bar by right-clicking on the Status bar and selecting the options you want from the Customize Status Bar menu (as shown in above figure). You click a menu item to select it. You click it again to deselect it. A check mark next to an item means the item is selected.

10.4 Three Commonly Used Tabs In the Ribbon

All MS Excel commands are organized into groups of related commands called ribbons. Each ribbon is displayed by clicking its tab found below the title bar. Each collection of commands found in a ribbon is further grouped into sections. A command is invoked by clicking on its hot button. The settings for a command are chosen by either using a drop-down menu or clicking on the Dialog Box launcher button



The Home Tab:

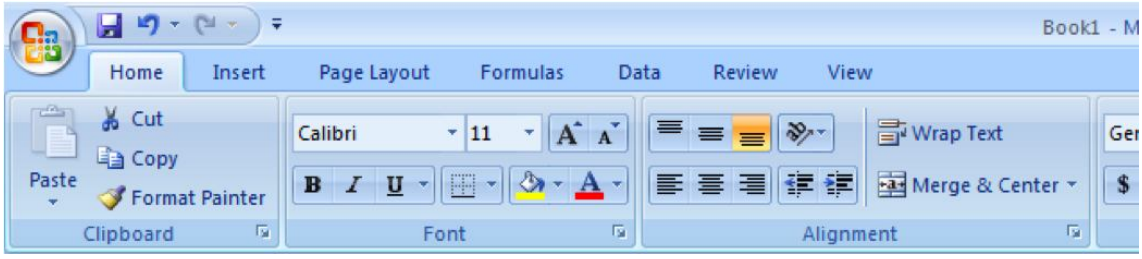


Figure Home Tab.

This is one of the most common tabs used in Excel. You are able to format the text in your document, cut, copy, and paste information. Change the alignment of your data, insert, delete, and format cells. The Home Tab also allows you to change the number of your data (i.e. currency, time, date).

The Insert Tab:

Figure Insert Tab.

This tab is mainly used for inserting visuals and graphics into your document. There are various different things that can be inserted from this tab such as pictures, clip art, charts, links, headers and footers, and word art.

The Page Layout Tab:

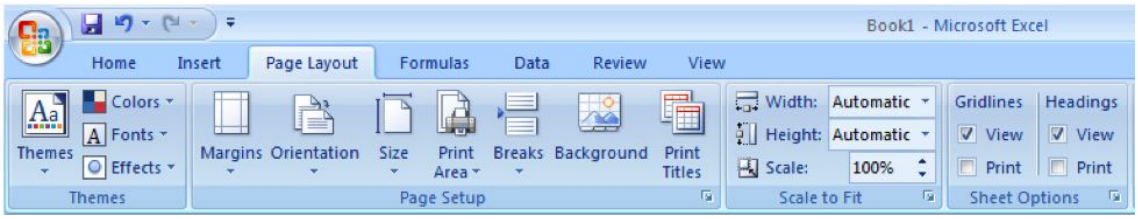


Figure Page Layout Tab.

Here you are able to add margins, themes to your document, change the orientation, page breaks, and titles. The scale fit of your document is also included as a feature within this tab, if needed.

10.5 Moving Around a Worksheet

By using the arrow keys, you can move around your worksheet. You can use the down arrow key to move downward one cell at a time. You can use the up arrow key to move upward one cell at a time. You can use the Tab key to move across the page to the right, one cell at a time. You can hold down the Shift key and then press the Tab key to move to the left, one cell at a time. You can use the right and left arrow keys to move right or left one cell at a time. The Page Up and Page Down keys move up and down one page at a time. If you hold down the Ctrl key and then press the Home key, you move to the beginning of the worksheet.

Following table summarizes the navigation keys between the cells.

Navigating Cells

To select:	***Do this (If you are left-handed use Right click in place of Left):***
a single cell	Left click on it
a range of adjacent cells	Drag from the first cell to the last cell, or click on the first cell, hold the Shift key and click on the last cell (scrolling if necessary)
non-adjacent cells or ranges	Hold CTRL (Windows) or Command (Mac) key and click or drag
an entire row or column	Left click on the row or column heading
all cells	Left click on the blank header in the upper left corner
the next cell to the right	Use the Tab key
the next cell down the column	Use the Enter key
the A1 Home cell	Press Ctrl + Home keys together
the last cell in a sheet	Press Ctrl + End keys together
the cells around the active cell	Press Ctrl + Shift + 8 keys together (Select Region)

EXERCISE 1

Move Around the Worksheet

The Down Arrow Key

- Press the down arrow key several times. Note that the cursor moves downward one cell at a time.

The Up Arrow Key

- Press the up arrow key several times. Note that the cursor moves upward one cell at a time.

The Tab Key

1. Move to cell A1.
2. Press the Tab key several times. Note that the cursor moves to the right one cell at a time.

The Shift+Tab Keys

- Hold down the Shift key and then press Tab. Note that the cursor moves to the left one cell at a time.

The Right and Left Arrow Keys

1. Press the right arrow key several times. Note that the cursor moves to the right.
2. Press the left arrow key several times. Note that the cursor moves to the left.

Page Up and Page Down

1. Press the Page Down key. Note that the cursor moves down one page.
2. Press the Page Up key. Note that the cursor moves up one page.

The Ctrl-Home Key

1. Move the cursor to column J.
2. Stay in column J and move the cursor to row 20.
3. Hold down the Ctrl key while you press the Home key. Excel moves to cell A1.

Go To Cells Quickly

The following are shortcuts for moving quickly from one cell in a worksheet to a cell in a different part of the worksheet.

EXERCISE 2

Go to — F5

The F5 function key is the "Go To" key. If you press the F5 key, you are prompted for the cell to which you wish to go. Enter the cell address, and the cursor jumps to that cell.

1. Press F5. Then Go To dialog box opens.
2. Type **J3** in the Reference field.
3. Press Enter. Excel moves to cell J3.

Go to — Ctrl+G

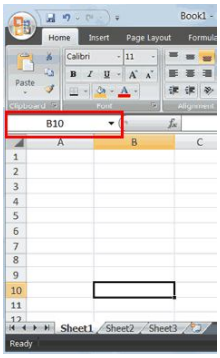
You can also use Ctrl+G to go to a specific cell.

1. Hold down the Ctrl key while you press "g" (Ctrl+g). The Go To dialog box opens.
2. Type **C4** in the Reference field.
3. Press Enter. Excel moves to cell C4.

The Name Box

You can also use the Name box to go to a specific cell. Just type the cell you want to go to in the Name box and then press Enter.

1. Type **B10** in the Name box.



Press Enter. Excel moves to cell B10

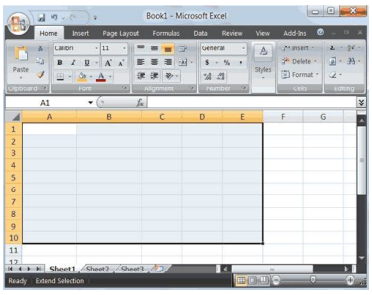
Selecting the Cells

If you wish to perform a function on a group of cells, you must first select those cells by highlighting them. The exercises that follow teach you how to select.

EXERCISE 3

Select Cells

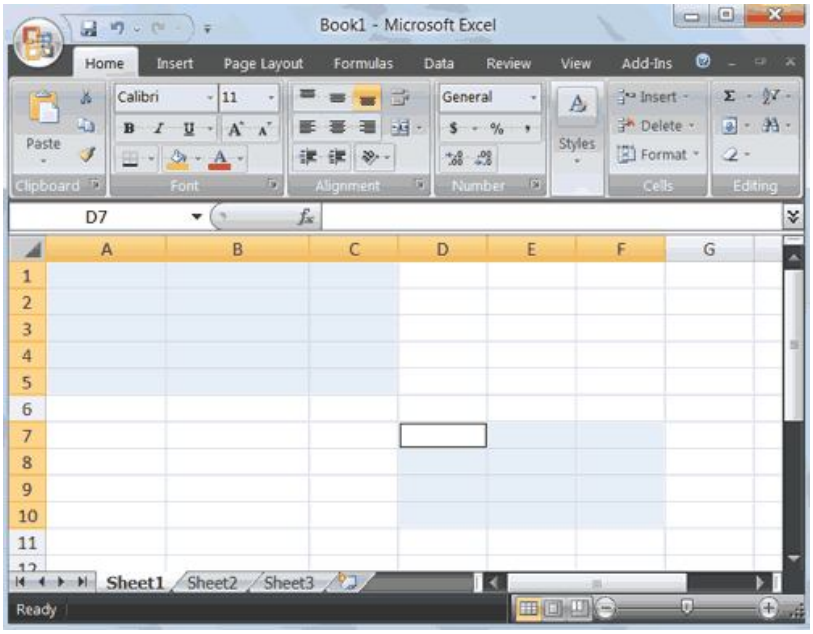
To select cells A1 to E1:



1. Go to cell A1.
2. Press the F8 key. This anchors the cursor.
3. Note that "Extend Selection" appears on the Status bar in the lower-left corner of the window. You are in the Extend mode.
4. Click in cell E7. Excel highlights cells A1 to E7.
5. Press Esc and click anywhere on the worksheet to clear the highlighting.

Alternative Method: Select Cells by Dragging

You can also select an area by holding down the left mouse button and dragging the mouse over the area. In addition, you can select noncontiguous areas of the worksheet by doing the following:



1. Go to cell A1.
2. Hold down the Ctrl key. You won't release it until step 9. Holding down the Ctrl key enables you to select noncontiguous areas of the worksheet.
3. Press the left mouse button.
4. While holding down the left mouse button, use the mouse to move from cell A1 to C5.
5. Continue to hold down the Ctrl key, but release the left mouse button.
6. Using the mouse, place the cursor in cell D7.
7. Press the left mouse button.
8. While holding down the left mouse button, move to cell F10. Release the left mouse button.
9. Release the Ctrl key. Cells A1 to C5 and cells D7 to F10 are selected.
10. Press Esc and click anywhere on the worksheet to remove the highlighting.

10.6 Working with Worksheets

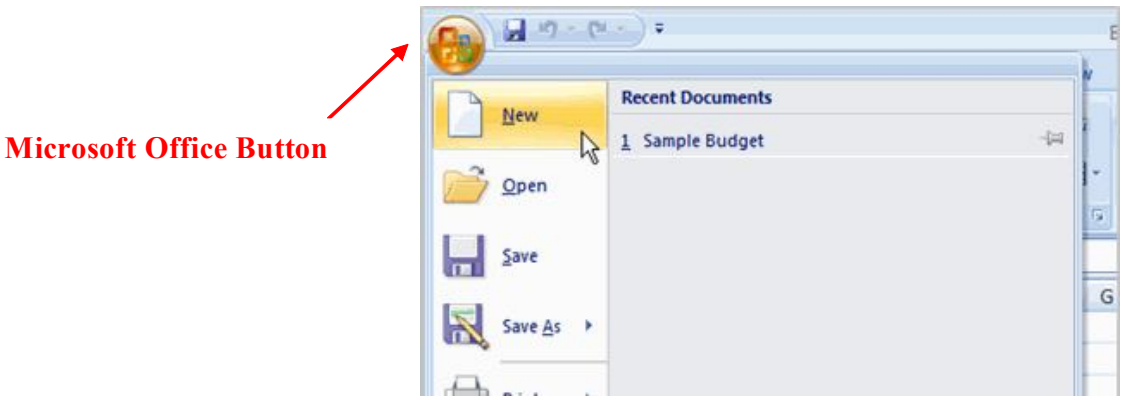
In this section we will learn the following different operation which can be performed on a worksheet.

- Creating a new workbook
- Saving a Workbook
- Opening a Workbook
- Closing a Workbook

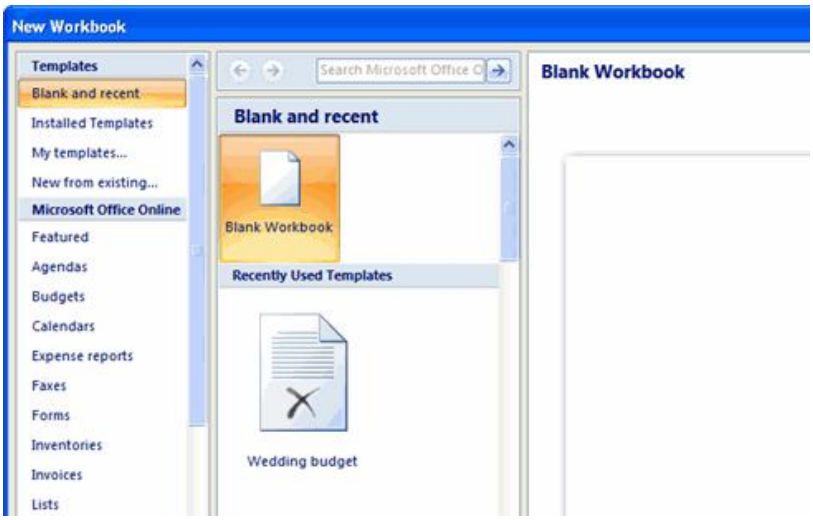
I. Creating a new workbook

To open Ms Excel, Go to Start > All Programs > Applications > Microsoft Office > MicrosoftExcel. This will open MS Excel window on the screen.

- Now Left-click the **Microsoft Office Button**.
- Select **New** as shown below.



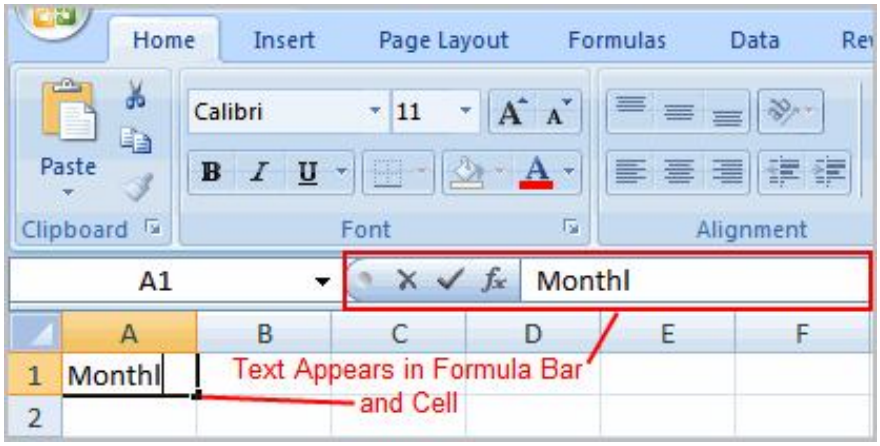
- The New Workbook dialog box opens as shown below and Blank Workbook is highlighted by default.
- Click **Create** button in this dialog box. A new, blank workbook appears in the window.



- When you first open Excel, the software opens to a new, blank workbook.

To insert text in the workbook

- Left-click a **cell** to select it. Each **rectangle** in the worksheet is called a **cell**. As you select a cell, the **cell address** appears in the **Name Box**.
- Enter **text** into the **cell** using your keyboard. The text appears in the cell and in the **formula bar** as given in following figure.

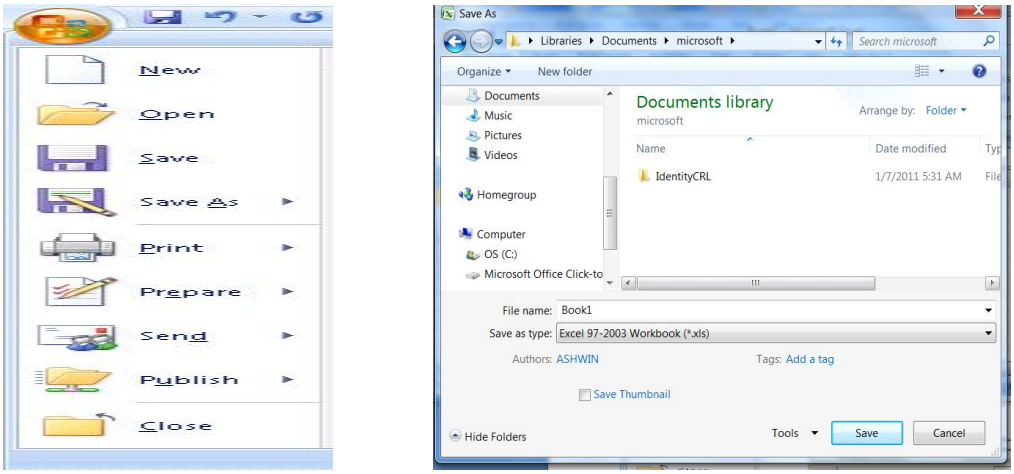


ii. Saving a Workbook

For the first time

To save your document for the first time, click the **Microsoft Office Button** and select the **Save As > Excel Workbook** command. Fill in the following entries for the Save As pop-up window which appears on screen as shown in following figure and click the Save button when you are done:

- **Save in:**Choose the location to place your file, i.e. to your desktop, a folder on the hard disk, flash drive, etc.
- **File name:**Choose a name for your file. Note, do not include a file extension.
- **Save as type:**Make sure MS Excel Workbook appears here. Otherwise, select it in the drop down menu.



Saving dialog box

Saving later

After you have initially saved your blank document under a new name, you can begin your project. However, you will still want to periodically save your work as insurance against a computer freeze or a power outage. To save press the shortcut key CTRL + S.

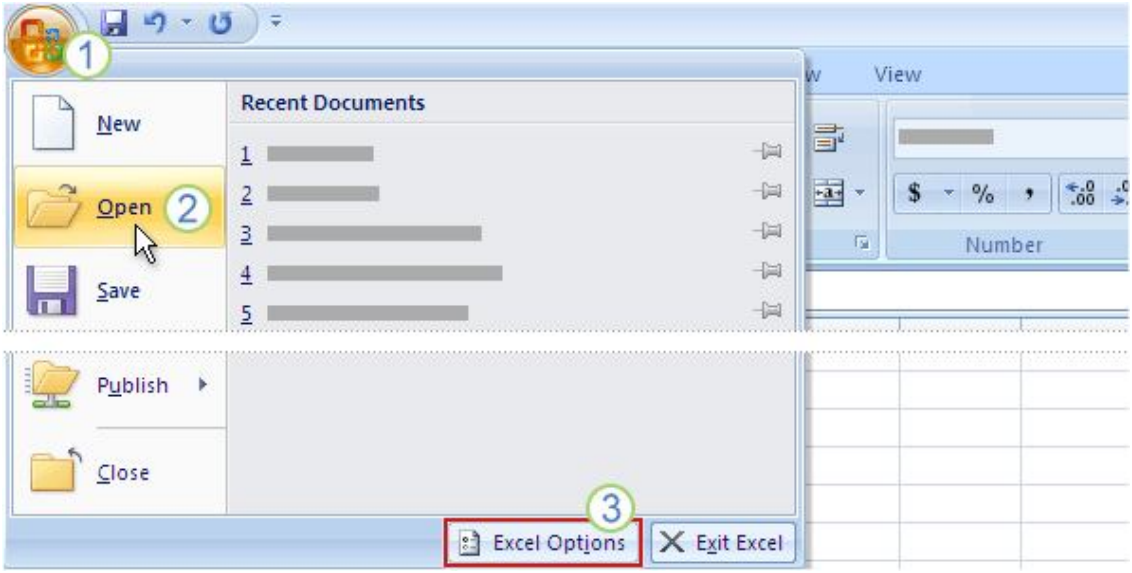
MS Excel 1997-2003 File Format Compatibility

MS Excel 2007 is backwards compatible because you are able to edit and save your MS Excel 1997-2003 document files. When an MS Excel 1997-2003 file is opened for editing using the MS Excel 2007 software, the windows title bar will indicate this by displaying [Compatibility Mode] next to the file name (see figure below). The document will be saved using the MS Excel 1997-2003 file format when you use the Save command.

You can save an MS Excel1997-2003 document to the new MS Excel 2007 file format using the **Save As>Excel Workbook** command. Note, you can save an MS Excel 2007 document to the older MS Excel 1997-2003 file format using the **Save As>'Excel 97-2003Workbook** command (see above figure).

iii. Opening a new workbook

If You want to open an existing workbook created in a previous version of Excel. Click the **Microsoft Office Button** in the upper-left corner of the window. There you'll get the same commands you've used in the past to open and save your workbooks.



1. Click the Microsoft Office Button to open this menu.
2. In the menu, click Open command and then select file to open in an existing workbook.
3. Or click Excel Options at the bottom of the menu, to set excel window while opening it.

iv. Closing Excel

Following are the steps to close Microsoft Excel.

1. Click the Office button. A menu appears.
2. Click Close.
3. Current Excel worksheet get closes.

10.7 Working with Cells

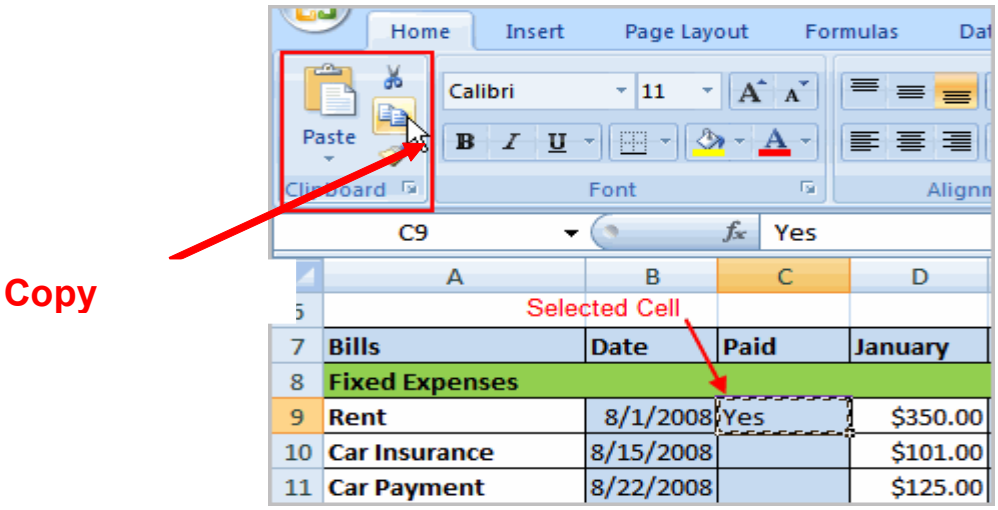
It is important to know how to **move information** from one cell to another in Excel. Learning the various ways will **save your time** and make working with Excel easier. Certain methods are more appropriate depending on how much information you need to move and where it will reside on the spreadsheet. In this section you will learn the following cell operations.

- **Copy** and **paste** Cell Contents.
- **Cut** and **paste** Cell Contents or moving cell contents.
- **Drag** and **drop** cell information.

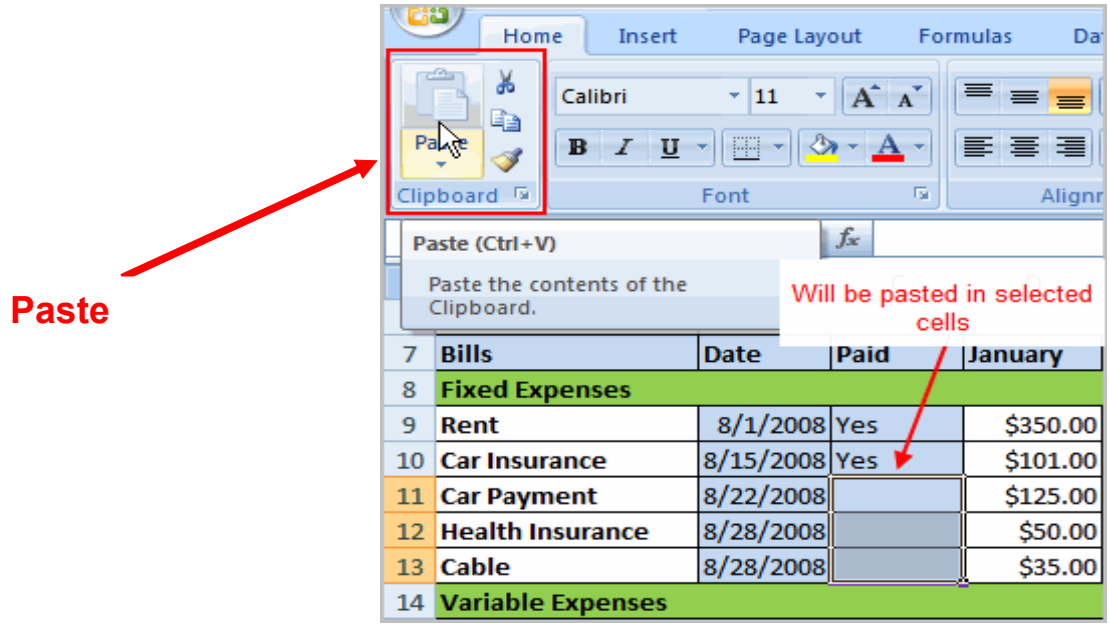
10.7.1 To Copy and Paste Cell Contents:

- Select the **cell or cells** whose content you wish to **copy**.

Click the **Copy** command in the Clipboard group on the Home tab as shown in figure given below. The border of the selected cells will change appearance to a dotted border.



- Select the **cell or cells** where you want to **paste** the information.
- Click the **Paste** command on Home tab as shown in figure given below. The copied information will now appear in the new cells.

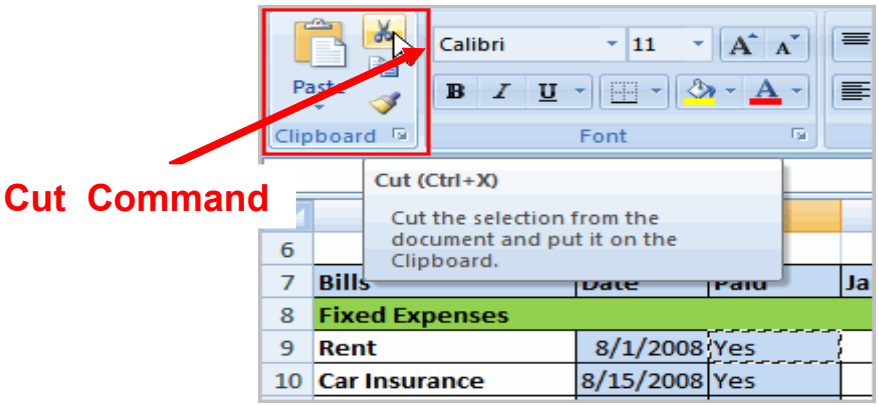


To select **more than one adjoining cell**, left-click one of the cells, drag the cursor until all the cells are selected, and release the mouse button.

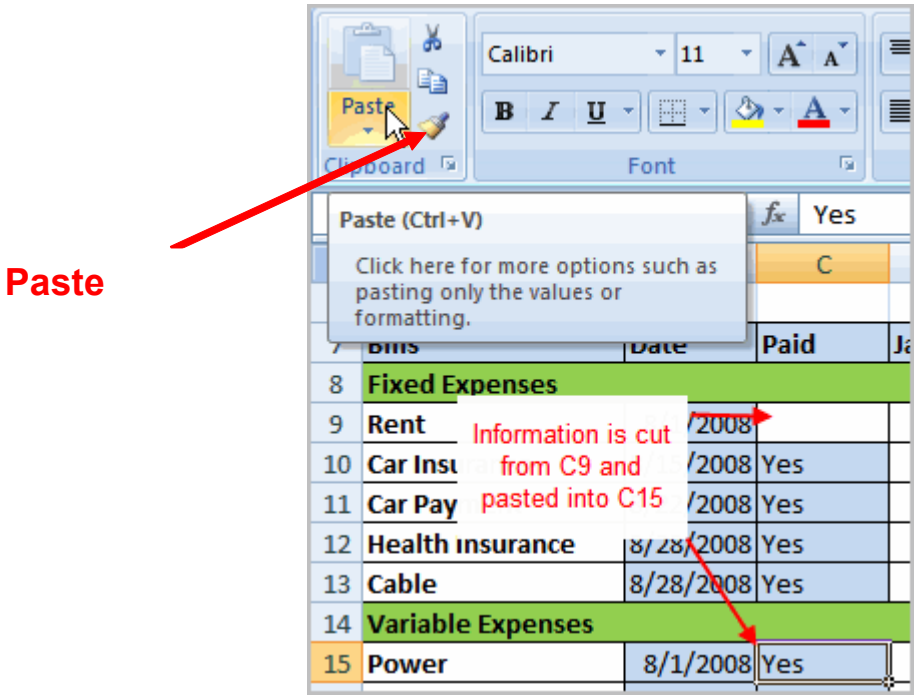
The copied cell will **stay selected** until you perform your next task, or you can double-click the cell to **deselect** it.

10.7.2 To Cut and Paste Cell Contents or to move the cell contents:

- Select the **cell or cells** whose content you wish **to** move from one place to another within the worksheet.
- Click the **Cut** command in the Clipboard group on the Home tab as shown below. The border of the selected cells will change appearance.



- Select the **cell or cells** where you want to **paste** the information.
- Click the **Paste** command. The cut information will be removed from the **original cells** and **now appear** in the new **cells**.



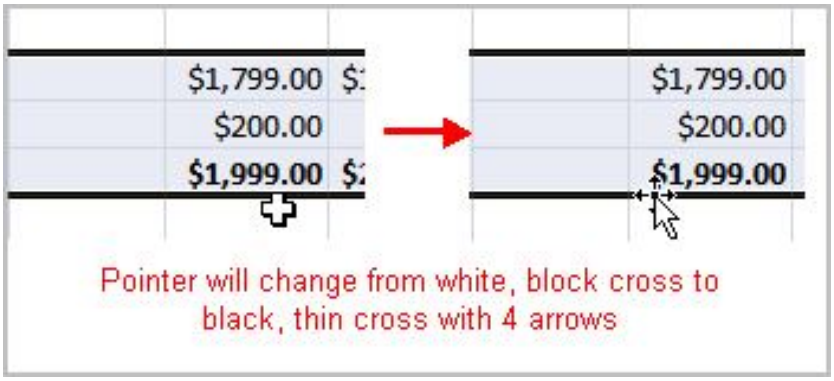
The keyboard shortcut for Cut is the **Control + X** key.

The keyboard shortcut for Copy is the **Control + C** key.

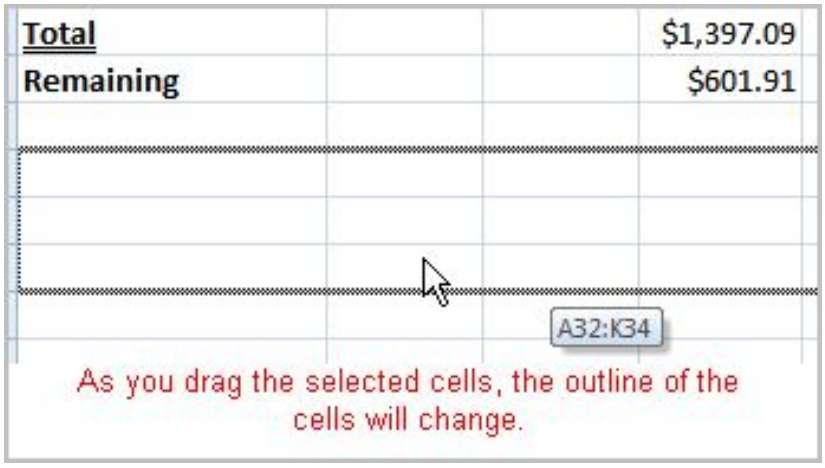
The keyboard shortcut for Paste is the **Control + V** key.

10.7.3 To Drag and Drop Information:

- Select the **cell or cells** you wish to move.
- Position your **mouse pointer** near one of the **outside edges** of the selected cells. The mouse pointer changes from a **large, white cross** to a **black cross with 4 arrows**.



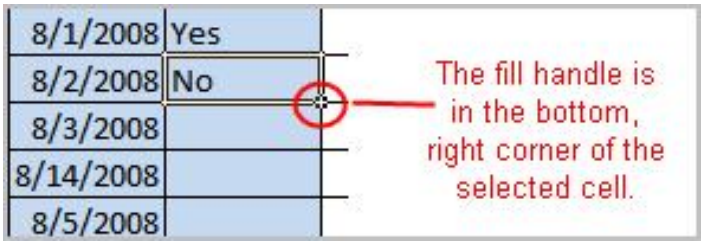
- Left-click and **hold** the mouse button and **drag** the cells to the new location.



- Release the mouse button and the information appears in the new location.

To Use the Fill Handle to Fill Cells:

- Position your cursor over the **fill handle** until the large white cross becomes a thin, black cross.



- Left-click your mouse and **drag it** until all the cells you want to fill are highlighted.

- Release the mouse button and all the selected cells are filled with the information from the original cell.

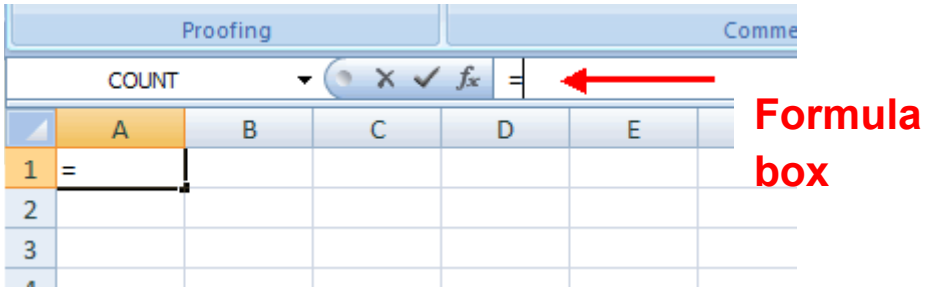
The fill handle doesn't **always** copy information from one cell directly into another cell. Depending on the data entered in the cell, it may fill the data in other ways. For example, if I have the formula =A1+B1 in cell C1, and I use the fill handle to fill the formula into cell C2, the formula doesn't appear the same in C2 as it does in C1. Instead of =A1+B1, you will see =A2+B2.

You can use the fill handle to fill cells horizontally or vertically.

10.8 Creating Simple Formulas

Ms excel can be used to calculate and analyze numerical information; however, you will need to know how to write formulas to maximize Excel's capabilities.

A formula is a set of mathematical instructions that can be used in Excel to perform calculations. Formals are written in the formula box with an = sign.



Elements of a formula

References: The cell or range of cells that you want to use in your calculation

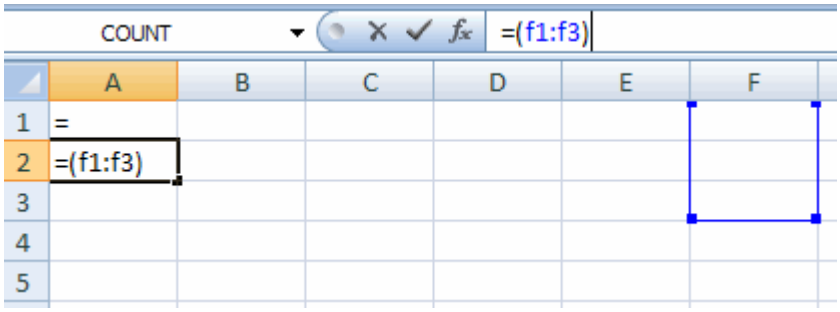
Operators: Symbols (+, -, *, /, etc.) that specify the calculation to be performed

Constants: Numbers or text values that do not change

Functions: Predefined formulas in Excel

To create a basic formula in Excel:

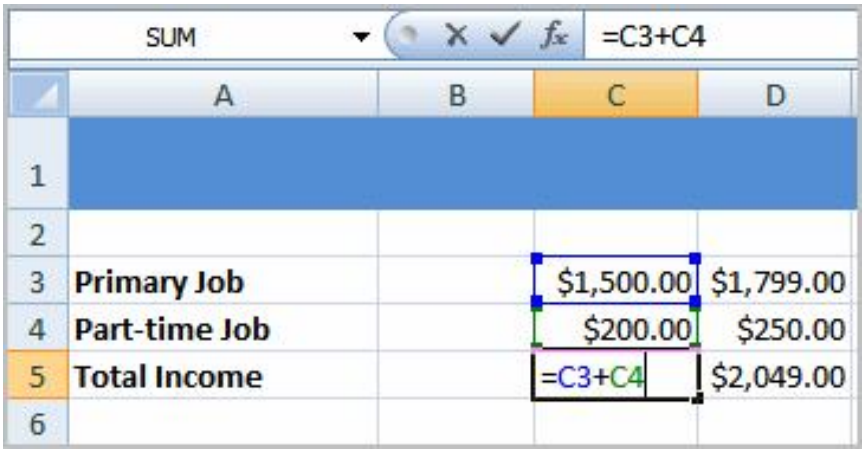
- Select the cell for the formula
- Type = (the equal sign) and the formula
- Click Enter



To Create a Simple Formula that Adds the Contents of Two Cells:

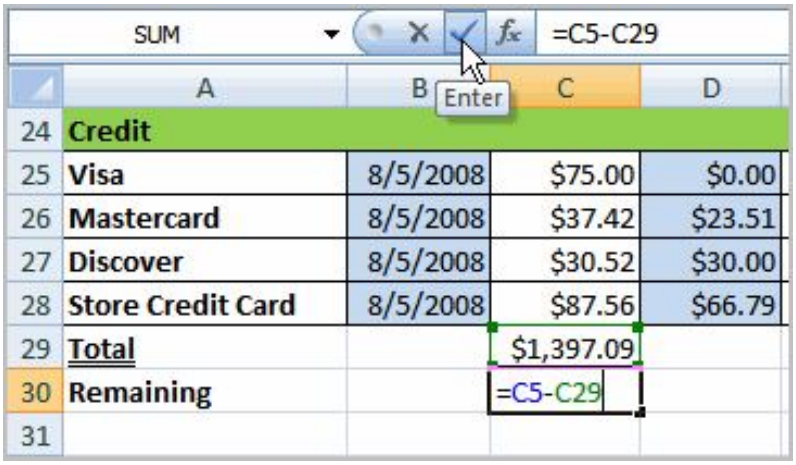
- Click the cell where the answer will appear (C5, for example).
- Type the equal sign (=) to let Excel know a formula is being defined.
- Type the cell number that contains the first number to be added (C3, for example).
- Type the **addition sign (+)** to let Excel know that an add operation is to be performed.

- Type the cell address that contains the second number to be added (C4, for example).
- Press **Enter** or click the **Enter button** on the Formula bar to complete the formula.



To Create a Simple Formula using the Point and Click Method:

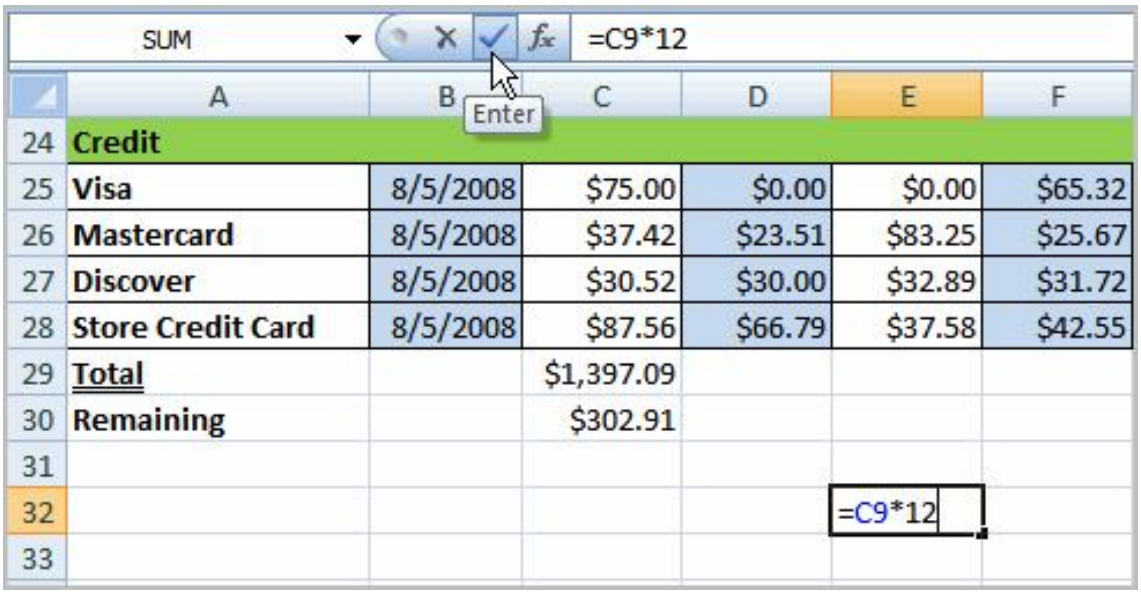
- Click the cell where the answer will appear (C30, for example).
- Type the equal sign (=) to let Excel know a formula is being defined.
- Click on the **first cell** to be included in the formula (C5, for example).
- Type the **subtraction sign (-)** to let Excel know that a subtraction operation is to be performed.
- Click on the **next cell** in the formula (C29, for example).
- Press **Enter** or click the **Enter button** on the Formula bar to complete the formula.



To Create a Simple Formula that Multiplies the Contents of Two Cells:

- Select the cell where the answer will appear (E32, for example).
- Type the equal sign (=) to let Excel know a formula is being defined.
- Click on the **first cell** to be included in the formula (C9, for example) or type a number.
- Type the multiplication symbol (*) by pressing the Shift key and then the number 8 key. The operator displays in the cell and Formula bar.
- Click on the **next cell** in the formula or type a number (12, for example).

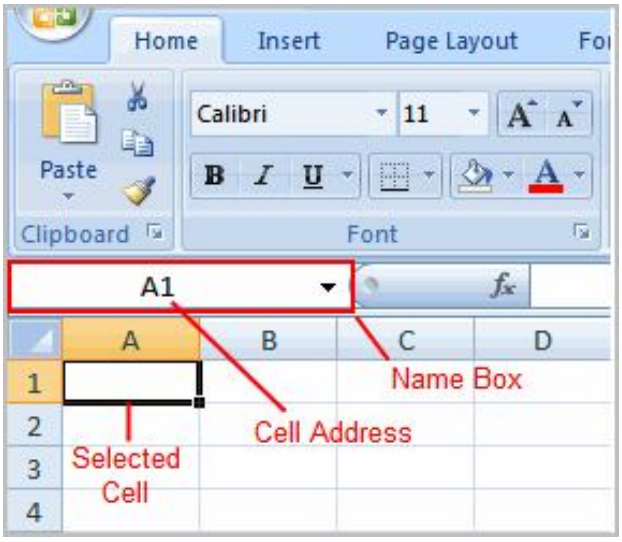
- Press **Enter** or click the **Enter button** on the Formula bar to complete the formula.



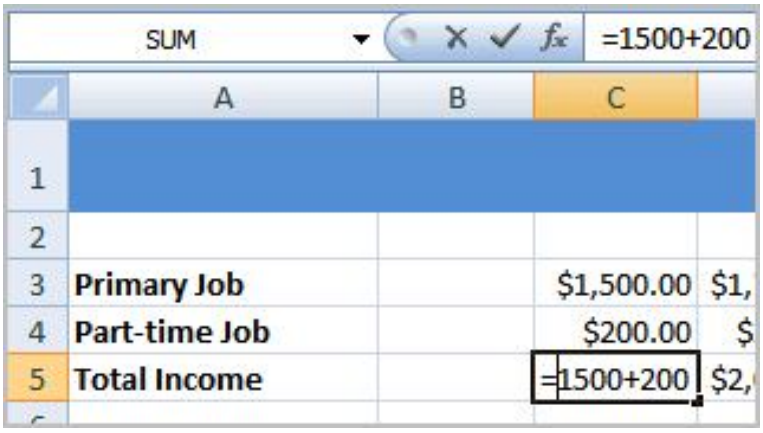
	A	B	C	D	E	F
24	**Credit**					
25	**Visa**	8/5/2008	$75.00	$0.00	$0.00	$65.32
26	**Mastercard**	8/5/2008	$37.42	$23.51	$83.25	$25.67
27	**Discover**	8/5/2008	$30.52	$30.00	$32.89	$31.72
28	**Store Credit Card**	8/5/2008	$87.56	$66.79	$37.58	$42.55
29	**Total**		$1,397.09			
30	**Remaining**		$302.91			
31						
32					=C9*12	
33						

10.9 Using Cell References

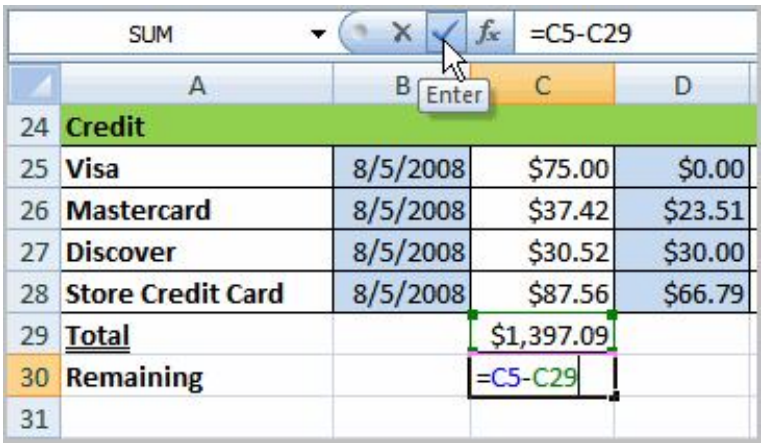
As you can see, there are many ways to create a simple formula in Excel. Most likely you will choose one of the methods that enters the cell address into the formula, rather than an actual number. The cell address is basically the name of the cell and can be found in the Name Box.



The following example uses actual numbers in the formula in C5 cell.



When a cell address is used as part of a formula, this is called a **cell reference**. It is called a **cell reference** because instead of entering specific numbers into a formula, the cell address refers to a specific cell. The following example uses cell references in the formula in C30.



Relative, Absolute and Mixed References

Relative Referencing - Calling cells by just their column and row labels (such as "A1") is called relative referencing. When a formula contains relative referencing and it is copied from one cell to another, Excel does not create an exact copy of the formula. It will change cell addresses relative to the row and column they are moved to. For example, if a simple addition formula in cell C1 "=(A1+B1)" is copied to cell C2, the formula would change to "=(A2+B2)" to reflect the new row. To prevent this change, cells must be called by absolute referencing.

Absolute Referencing - If you don't want a certain part of your cell reference to change when you copy the formula to a new cell, you need to put a $ in front of the row and/or column part of the reference.E.g.: If the formula in A3 is =$A$1+A2, when you drag that formula over to B3 the formula becomes=$A$1+B2.So,now if you want to make cell reference A2 as constant in formula written in cell A3 would be written as "=($A$1+$A$2)" if the value of cell A2 should be the sum of cells A1 and A2 and be constant. Both the column and row of both cells are absolute and will not change when copied.

Mixed referencing can also be used where only the row OR column is fixed. For example, in the formula "=(A$1+$B2)", the row number1 of cell A1 is fixed and the B column of cell B2 is fixed.

10.10 Summary

- **Spreadsheet** Microsoft Excel 2007 is an electronic spreadsheet software package that allows you to organize data in a tabular format, perform mathematical calculations, and analyze data. This software includes functions, formulas, and charts. It is commonly used in business, engineering, mathematics, and statistics
- **Elements of the MS Excel Window**
  - Δ The Microsoft Office Button- In the upper-left corner of the Excel 2007 window is the Microsoft Office Button-
  - Δ Quick Access toolbar- When you click the Next to the Microsoft Office button is the Quick Access toolbar. The Quick Access toolbar gives you with access to commands you frequently use. By default, Save, Undo, and Redo appear on the Quick
  - Δ The Title Bar- On the Title bar, Microsoft Excel displays the name of the workbook you are currently using.
  - Δ Ribbon At the top of the Ribbon are several tabs; clicking a tab displays several related command groups. Within each group are related command buttons.

- Δ The Formula Bar- The bar below the ribbon is formula bar. If the Formula bar is turned on, the cell address of the cell you are in displays in the Name box.
- Δ Worksheets - Microsoft Excel consists of worksheets. Each worksheet contains columns and rows. The combination of a column coordinate and a row coordinate make up a cell address.
- Δ The Status Bar- The Status bar appears at the very bottom of the Excel window and provides such information as the sum, average, minimum, and maximum value of selected numbers.

- By using the arrow keys, you can move around your worksheet. You can use the down arrow key to move downward one cell at a time. You can use the up arrow key to move upward one cell at a time. You can use the Tab key to move across the page to the right, one cell at a time. You can hold down the Shift key and then press the Tab key to move to the left, one cell at a time. You can use the right and left arrow keys to move right or left one cell at a time. The Page Up and Page Down keys move up and down one page at a time. If you hold down the Ctrl key and then press the Home key, you move to the beginning of the worksheet.
- If you wish to perform a function on a group of cells, you must first select those cells by highlighting them.
- File creation saving opening a new workbook and closing the existing workbook are the different operations which one can perform on a worksheet
- While working with cells you can perform the copy paste and cut paste operation on it.
- For moving cell contents from one place to another we use cut and paste command and to copy the contents of the cells from one place to another we use the copy and paste command

10.11 Self Assessment Questions

1. What is the utility of spread sheet programs?
2. What are the various elements of MSExcel window?
3. Explain how can we move information using drag n drop method?
4. What do you mean by cell navigation?
5. What is the difference between save and save as command?
6. Explain the functions and formulas in MS Excel.
7. What do you understand by cell references in MS Excel.

10.12 Further Readings

- Grauer, Scheeren & Mulbery -Exploring Microsoft Office Excel 2007 Comprehensive, 2/e Prentice Hall
- Robert Grauer Judy Scheeren, Exploring Microsoft Office Excel 2007 Volume 1 and Exploring Microsoft Excel 2007 Vol. 1 Prentice Hall
- Kathy Ivens,Conrad Carlberg Excel 2002: The Complete Reference Tata Mcgraw Hills
- Guy Hart-Davis How to Do Everything with Microsoft Office Excel 2007 By: TATA Mcgraw Hills
- John Walkenbach Excel 2007 Bible (Excel Bible)
- Gary B. Shelly, Thomas J. Cashman and Misty E. Vermaat Microsoft Office 2007: Introductory Concepts and Techniques, Windows XP Edition

Unit - 11 : DATAANALYSIS-II

Structure of the Unit

11.0 Objective

This unit provides a general overview of:

- The use of functions in MS Excel
- The different formatting operations that can be done on a worksheet.
- Creating error free worksheet
- How to insert ,delete and modify the column.
- How to insert ,delete and modify the rows and cells
- Creation and modification of charts in MSExcel.
- Utilities of goal seek

11.1 Functions in MSExcel

Functions in MSExcel are prewritten formulas. Functions differ from regular formulas in that you supply the value but not the operators, such as +, -, *, or /. For example, you can use the SUM function to add. When using a function, remember the following:

- Use an equal sign to begin a formula.
- Specify the function name.
- Enclose arguments within parentheses. Arguments are values on which you want to perform the calculation. For example, arguments specify the numbers or cells you want to add.
- Use a comma to separate arguments.

Following is an example of a function:

=SUM(2,13,A1,B2:C7)

In this function:

i. The equal sign begins the function.

ii. SUM is the name of the function.

iii. 2, 13, A1, and B2:C7 are the arguments.

iv. Parentheses enclose the arguments.

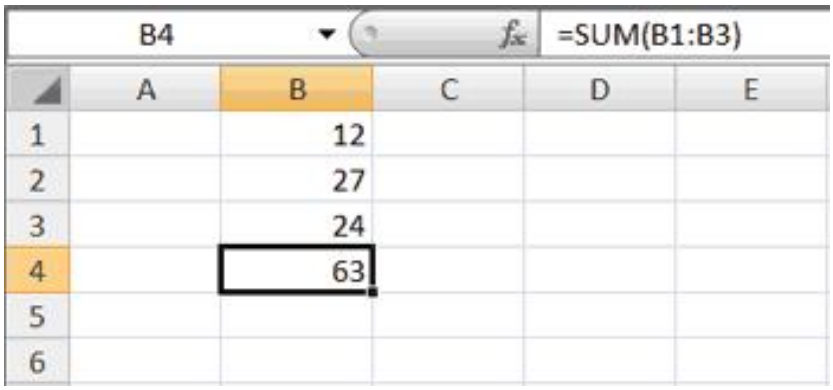
v. Commas separate the arguments.

After you type the first letter of a function name, the AutoComplete list appears. You can double-click on an item in the AutoComplete list to complete your entry quickly. Excel will complete the function name and enter the first parenthesis.

EXERCISE 1

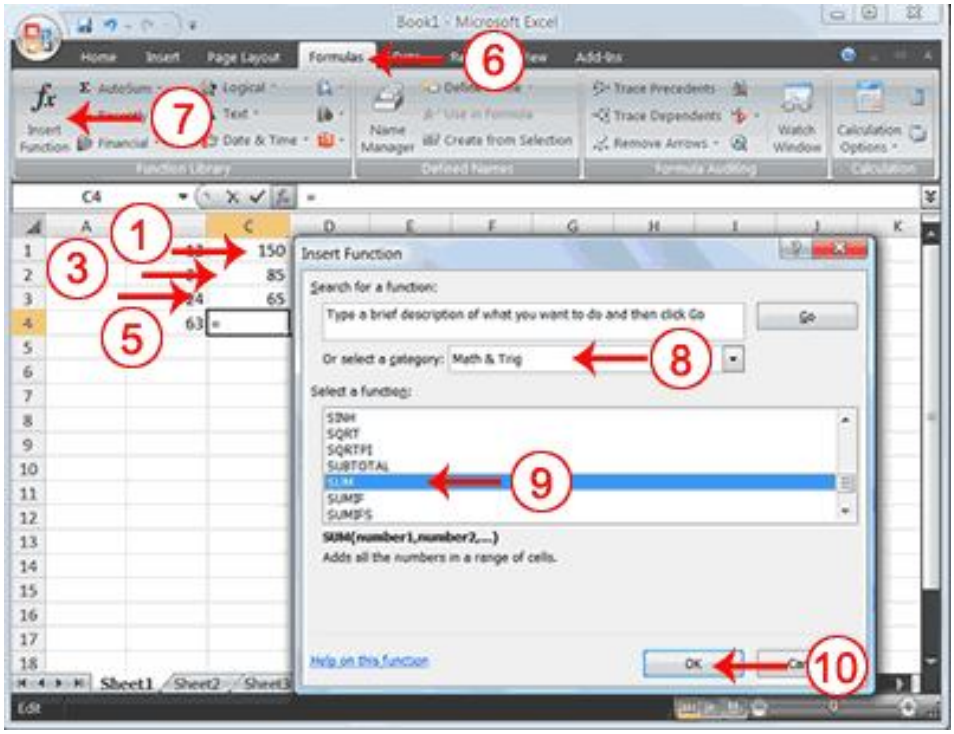
SUM Function

The SUM function adds argument values.

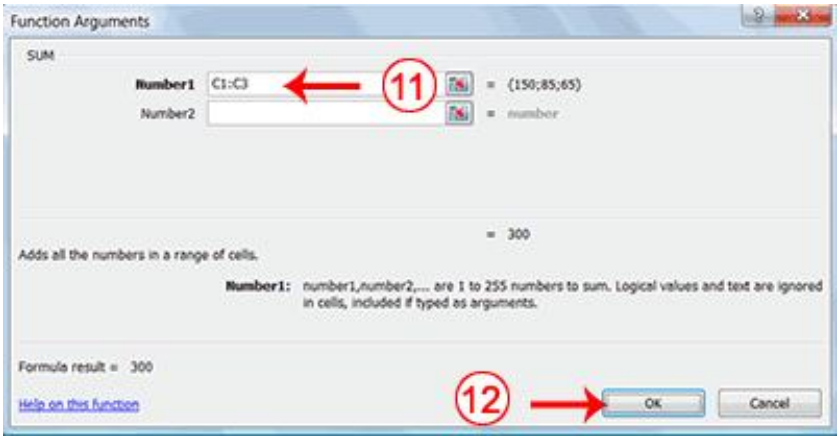


1. Open Microsoft Excel.
2. Type **12** in cell B1.
3. Press Enter.
4. Type **27** in cell B2.
5. Press Enter.
6. Type **24** in cell B3.
7. Press Enter.
8. Type **=SUM(B1:B3)** in cell B4.
9. Press Enter. The sum of cells B1 to B3, which is 63, appearsin cell B4.

Alternate Method: Enter a Function with the Ribbon



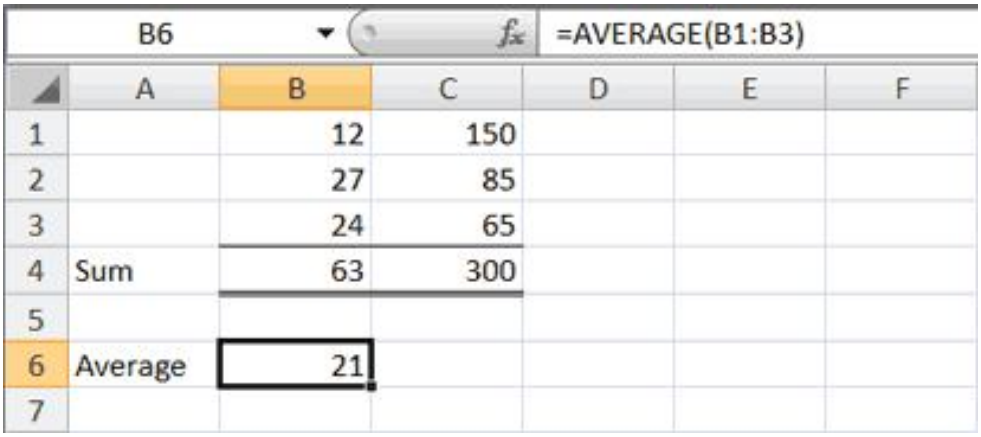
1. Type **150** in cell C1.
2. Press Enter.
3. Type **85** in cell C2.
4. Press Enter.
5. Type **65** in cell C3.
6. Choose the Formulas tab.
7. Click the Insert Function button. The Insert Function dialog box appears.
8. Choose Math & Trig in the Or Select A Category box.
9. Click Sum in the Select A Function box.
10. Click OK. The Function Arguments dialog box appears.



12. Type **C1:C3** in the Number1 field, if it does not automatically appear.
13. Click OK. The sum of cells C1 to C3, which is 300, appears.

AVERAGE function is used to Calculate an Average

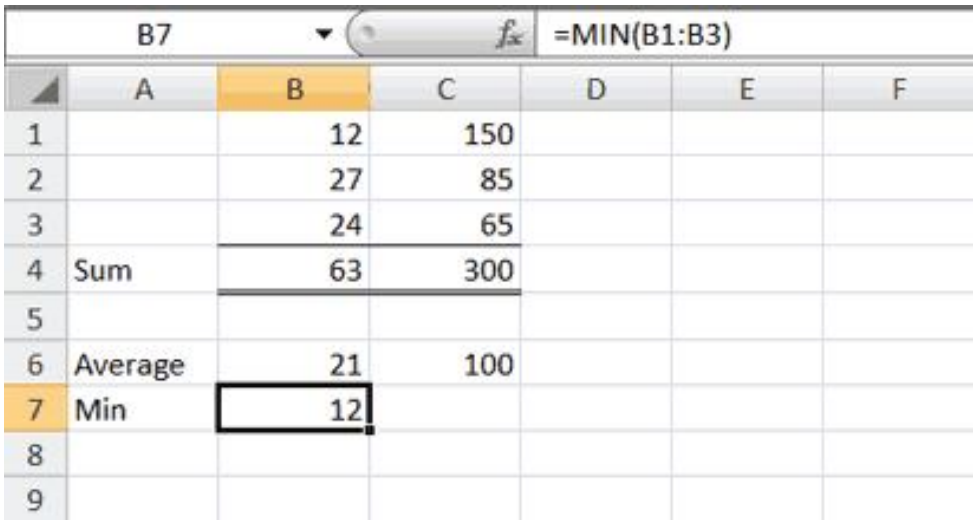
You can use the AVERAGE function to calculate the average of a series of numbers.



1. Move to cell A6.
2. Type **Average**. Press the right arrow key to move to cell B6.
3. Type **=AVERAGE(B1:B3)**.
4. Press Enter. The average of cells B1 to B3, which is 21, appears.

MIN function finds the Lowest Number

You can use the MIN function to find the lowest number in a series of numbers.

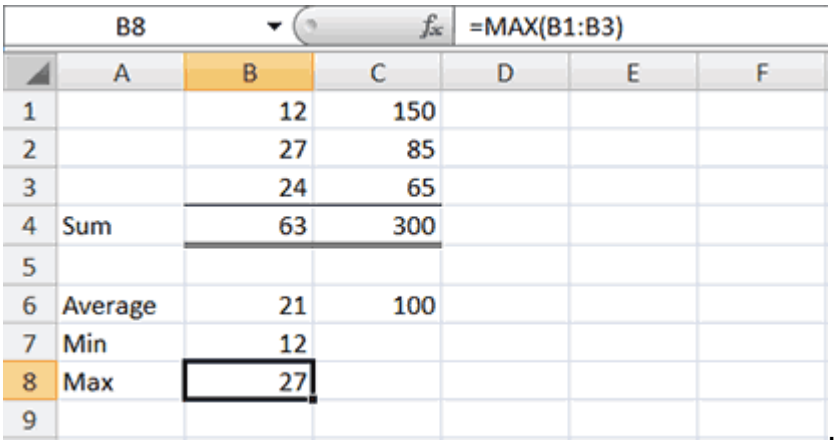


1. Move to cell A7.
2. Type **Min**.
3. Press the right arrow key to move to cell B7.
4. Type = **MIN(B1:B3)**.
5. Press Enter. The lowest number in the series, which is 12, appears.

Note: You can also use the drop-down button next to the AutoSum button Σ to calculate minimums, maximums, and counts.

MAX function find the Highest Number

You can use the MAX function to find the highest number in a series of numbers.

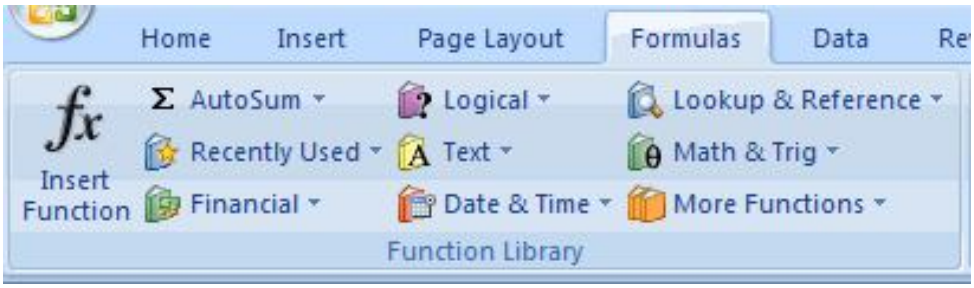


	A	B	C	D	E	F
1		12	150			
2		27	85			
3		24	65			
4	Sum	63	300			
5						
6	Average	21	100			
7	Min	12				
8	Max	27				
9						

1. Move to cell A8.
2. Type **Max**.
3. Press the right arrow key to move to cell B8.
4. Type = **MAX(B1:B3)**.
5. Press Enter. The highest number in the series, which is 27, appears

Function Library

The function library is a large group of functions on the Formula Tab of the Ribbon as shown below.



These functions include:

AutoSum: Easily calculates the sum of a range

Recently Used: All recently used functions

Financial: Accrued interest, cash flow return rates and additional financial functions

Logical: And, If, True, False, etc.

Text: Text based functions

Date & Time: Functions calculated on date and time

Math & Trig: Mathematical Functions

11.1.1 Creating Error Free Worksheet

If Excel 2007 can't properly calculate a function or formula that you enter in a cell, the program displays an *error value* in the cell as soon as you complete the formula/function entry. Excel uses several error values, all of which begin with the number sign (#).

Excel's error values

The following table shows Excel's error values along with the meaning and the most probable cause for its display. To remove an error value from a cell, you must know what caused the value to appear and then edit the formula so that Excel can complete the desired calculation.

The following table contains common errors values of excel with the errors description and the root causes of error.

Error Values in Excel

Error Value	Meaning	Causes
#DIV/0	Division by zero	The division operation in your formula refers to a cell that contains the value 0 or is blank.
#N/A	No value available	Technically, this is not an error value but a special value that you can manually enter into a cell to indicate that you don't yet have a necessary value.
#NAME?	Excel doesn't recognize a name	This error value appears when you incorrectly type the range name, refer to a deleted range name, or forget to put quotation marks around a text string in a formula.
#NULL!	You specified an intersection of two cell ranges whose cells don't actually intersect	Because a space indicates an intersection, this error will occur if you insert a space instead of a comma (the union operator) between ranges used in function arguments.
#NUM!	Problem with a number in the formula	This error can be caused by an invalid argument in an Excel function or a formula that produces a number too large or too small to be represented in the worksheet.
#REF!	Invalid cell reference	This error occurs when you delete a cell referred to in the formula or if you paste cells over the ones referred to in the formula.
#VALUE!	Wrong type of argument in a function or wrong type of operator	This error is most often the result of specifying a mathematical operation with one or more cells that contain text.

11.2 Formatting

Once you have entered information into a spreadsheet, you will need to be able to **format** it. In this section, you will learn how to

i. Use the bold, italic, and underline commands
ii. Modify the font style, size, and color.
iii. Apply borders and fill colors.
iv. To format numbers and date

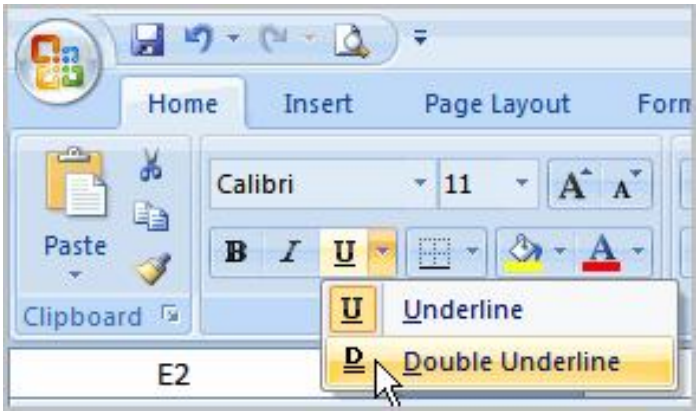
To Format Text in Bold or Italics:

- Left-click a **cell** to select it or drag your cursor over the text in the formula bar to select it.
- Click the **Bold** or **Italics** command as shown in given figure.

You can select entire columns and rows, or specific cells. To select the **entire column**, just left-click the column heading and the entire column will appear as selected. To select **specific cells**, just left-click a cell and drag your mouse to select the other cells. Then, release the mouse button.

To Format Text as Underlined:

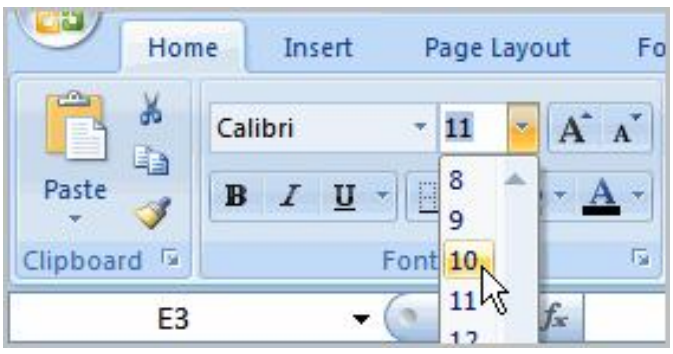
- Select the cell or cells you want to format.
- Click the drop-down arrow next to the Underline command.
- Select the **Single Underline** or **Double Underline** option as shown in given figure.



As you move over the font list, the Live Preview feature previews the font for you in the spreadsheet.

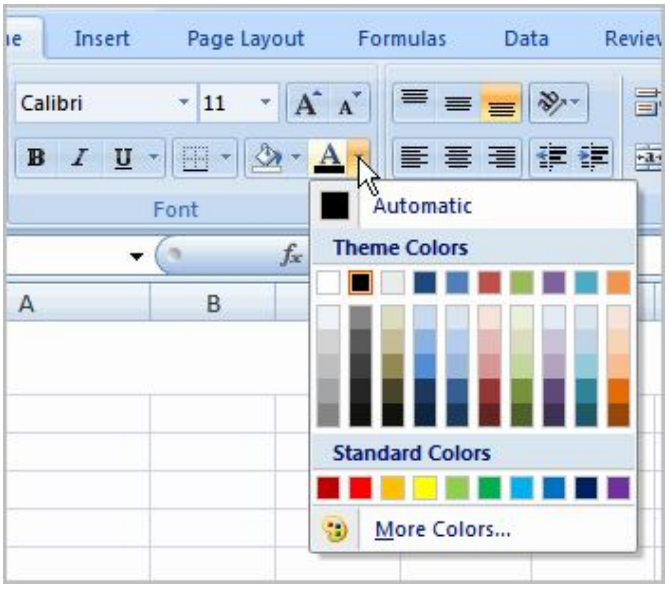
To Change the Font Style

- Select the cell or cells you want to format.
- Left-click the **drop-down arrow** next to the **Font Style** box on the Home tab.
- Select a **font style** from the list as shown in given figure.



To Change the Text Color:

- Select the cell or cells you want to format.
- Left-click the **drop-down arrow** next to the **Text Color** command. A color palette as shown in given figure will appear.
- Select a color from the palette.

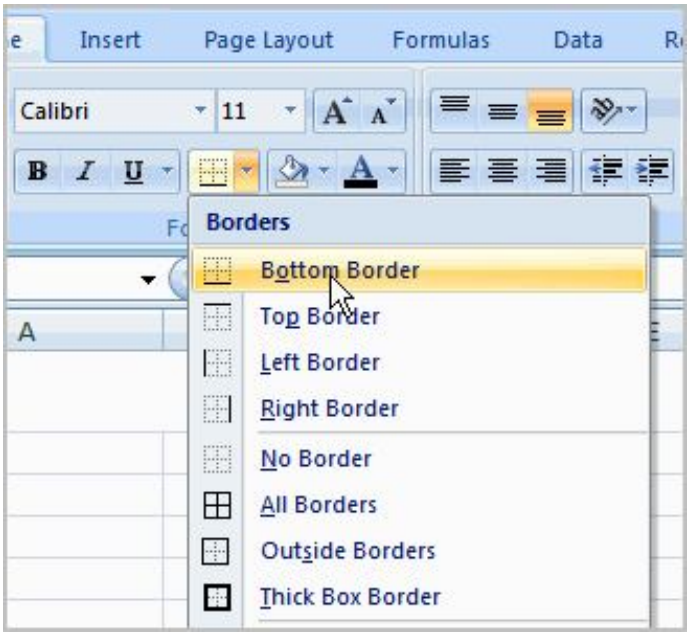


OR

- Select **More Colors option given at the last**. A dialog box will appear.
- Select specific color.
- Click **OK**.

To Add a Border:

- Select the cell or cells you want to format.
- Click the **drop-down arrow** next to the **Borders** command on the Home tab. A menu will appear with border options as shown in given figure.

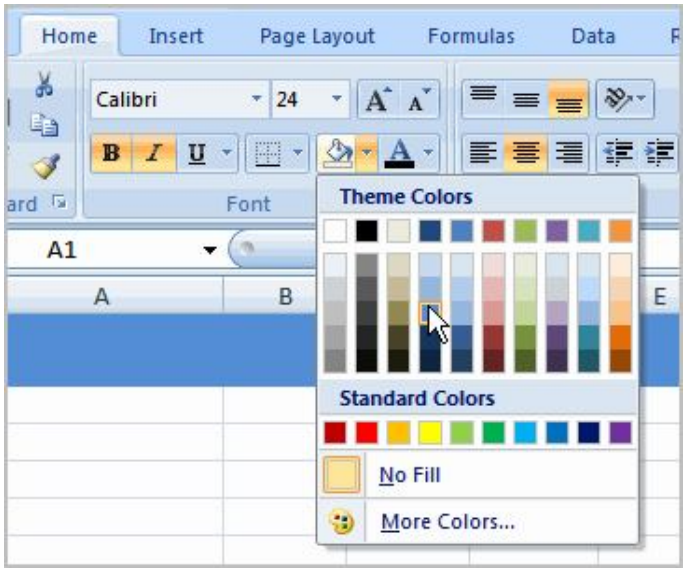


- Left-click an option from the list to select it.

You can change the **line style** and **color** of the border.

To add a background Color to cells(Fill Color):

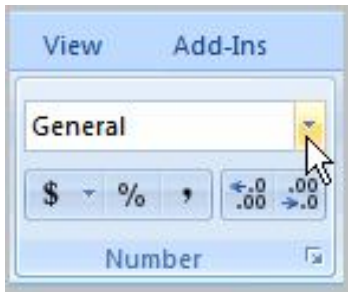
- Select the cell or cells you want to format.
- Click the **Fill command on Home tab**. A color palette as shown in given figure will appear.
- Select a color.
- Click **OK**.



You can use the **fill color feature** to format columns and rows, and format a worksheet so that it is easier to read.

To Format Numbers and Dates:

- Select the cell or cells you want to format.
- As shown in following figure Left-click the **drop-down arrow** next to the **Number Format** box in Home tab.
- Select one of the options for formatting numbers.



By default, the numbers appear in the **General** category, which means there is no special formatting.

In the Number group, you have some other options. For example, you can change the U.S. dollar sign to another currency format, numbers to percents, add commas, and change the decimal location.

11.3 Modifying Columns, Rows & Cells

When you open a new, blank workbook, the cells, columns, and rows are set to a **default size**. You do have the option to change the size of each, and to insert new columns, rows, and cells, as needed. In this section, you will learn various methods to

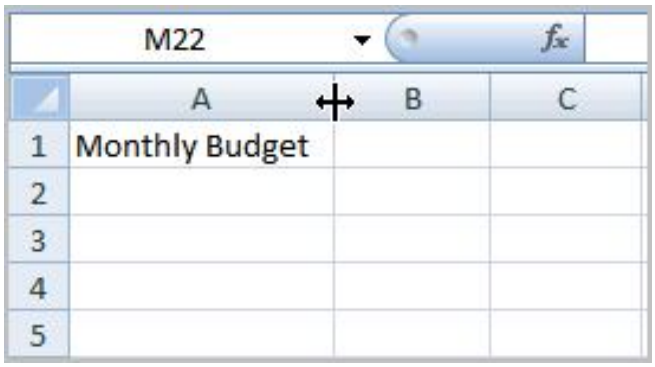
i. Modify the column width and row height.

ii. How to insert new columns, rows and cells.

iii. To Delete Rows and Columns.

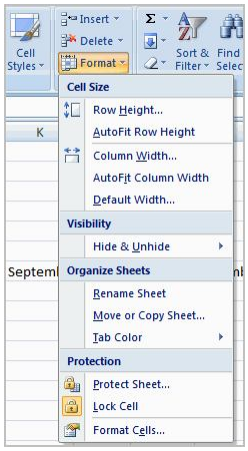
11.3.1 Modify the column width and row height

- Position the **cursor** over the **column line** in the column heading and a **double arrow** will appear.
- Left-click the mouse and **drag** the cursor to the **right** to **increase** the column width or to the **left** to **decrease**the column width.
- **Release** the mouse button.



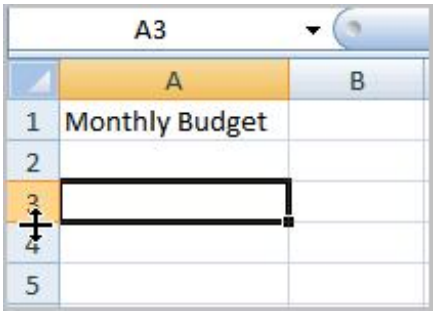
Alternate method

- Left-click the **column heading** of a column you'd like to modify. The entire column will appear **highlighted.**
- Click the **Format** command in the Cells group on the **Home** tab. A menu will appear as shown in figure given at right hand side.
- Select **Column Width** command to enter a **specific** column **measurement**.
- Select **AutoFit Column Width** to adjust the column so all the text will fit.



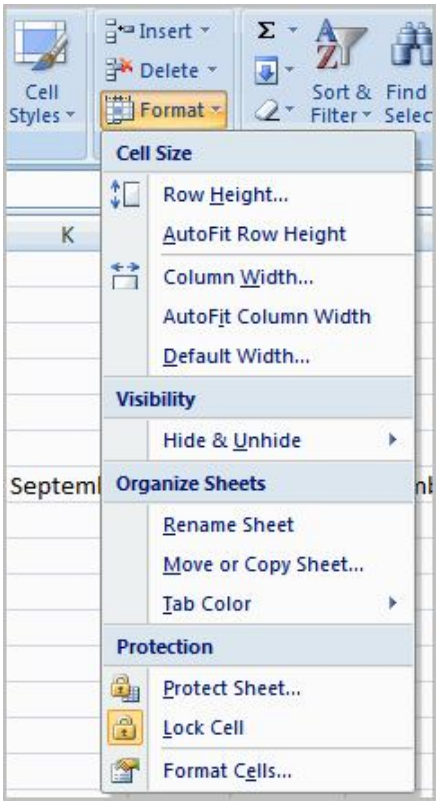
To Modify the Row Height:

- Position the **cursor** over the **row line** you want to modify and a **double arrow** will appear as shown in the figure.
- Left-click the mouse and **drag** the cursor **upward** to **decrease** the row height or **downward** to **increase** the row height.
- **Now Release** the mouse button.



Alternate method

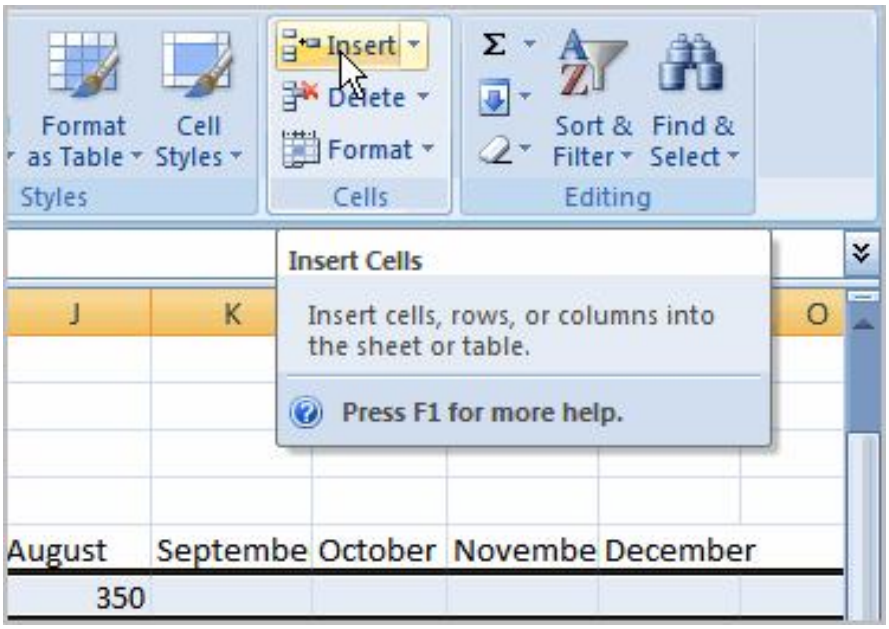
- Left-click the **Row heading number** of the row you'd like to modify. The entire column will appear **highlighted.**
- Click the **Format** command in the Cells group on the **Home** tab. A menu will appear as shown in the following figure.
- Select **Row Height** to enter a **specific** row **measurement**.
- Select **AutoFit Row Height** to adjust the row so all the text will fit.



11.3.2 How to insert new columns, rows and cells

Steps to Insert Rows:

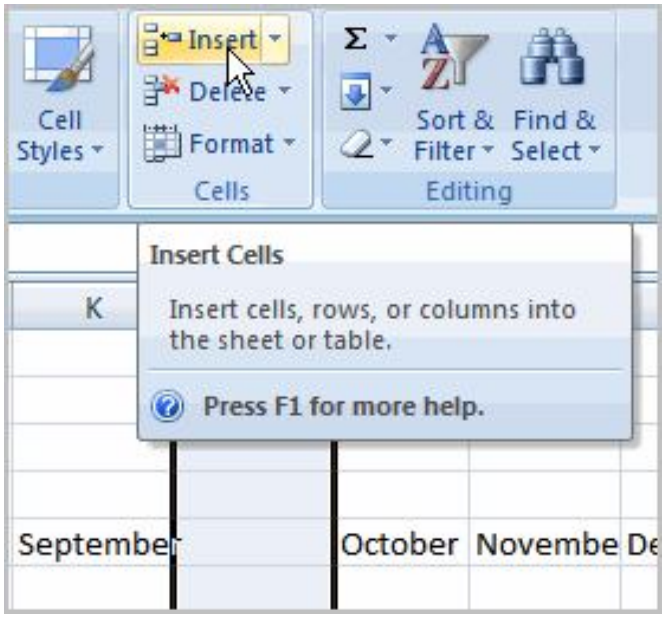
- Select the row **below** where you want the new row to appear.
- Click the **Insert** command in the Cells group on the Home tab. The row will appear.
- The new row always appears above the selected row.



Make sure that you select the **entire row** below where you want the new row to appear and **not** just the **cell**. If you select just the cell and then click Insert, only a new cell will appear.

To Insert Columns:

- Select the column from the column heading to the right of where you want the column to appear.
- Click the **Insert** command in the Cells group on the Home tab as shown in following figure. The new column will appear.
- The new column always appears to the left of the selected column. For example, if you want to insert a column between September and October, select the October column and click the Insert command.



Make sure that you select the **entire column** to the right of where you want the new column to appear and **not** just the **cell**. If you select just the cell and then click Insert, only a new cell will appear.

11.3.3 To Delete Rows and Columns

- Select the row or column you'd like to delete.
- Click the Delete command in the Cells group on the Home tab.

11.4 Working with Charts

Introduction

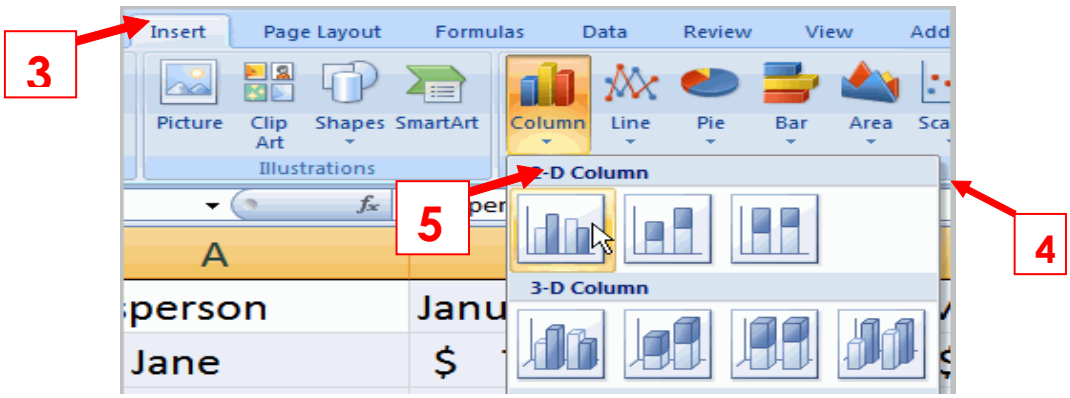
A **chart** is a tool you can use in Excel to communicate your **data graphically**. Charts allow your audience to more easily see the meaning behind the numbers in the spreadsheet, and make showing comparisons and trends a lot easier. Now you will learn how to create and modify Excel charts and see how they can be an effective tool for communicating information.

Creating a Chart

Charts can be a useful way to communicate data. When you insert a chart in Excel, it appears in the selected worksheet with the source data, by default.

To Create a Chart follow the given steps:

1. Select the worksheet you want to work with. In this example, we use the Summary worksheet.
2. Select the cells that you want to chart, including the column titles and the row labels.
3. Click the Insert tab.
4. Hover over each Chart option in the Charts group to learn more about it.
5. Select one of the Chart options. In this example, we use the Columns command.
6. Select a type of chart from the list that appears. For this example, we use a 2-D Clustered Column. The chart appears in the worksheet.

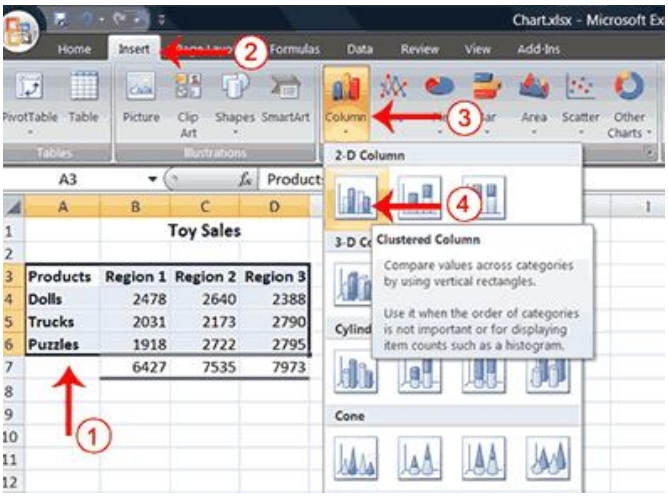


EXERCISE

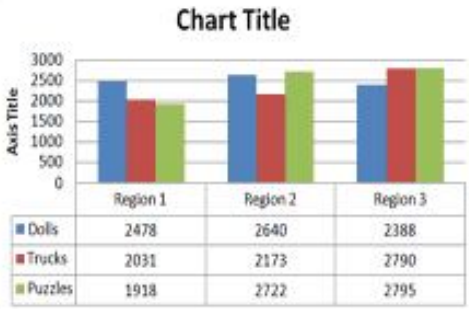
Create a Column Chart of the data given in following worksheet

	A	B	C	D	E
1			Toy Sales		
2					
3	Products	Region 1	Region 2	Region 3	
4	Dolls	2478	2640	2388	
5	Trucks	2031	2173	2790	
6	Puzzles	1918	2722	2795	
7	Total	6427	7535	7973	
8					

1. Select cells A3 to D6 as shown in following figure. You must select all the cells containing the data you want in your chart. You should also include the data labels.
2. Choose the Insert tab (see Point 2 in following figure).
3. Click the Column button in the Charts group. A list of column chart sub-types types appears (see Point 3 in following figure).
4. Click the Clustered Column chart sub-type. Excel creates a Clustered Column chart and the Chart Tools context tabs appear (see Point 4 in following figure).

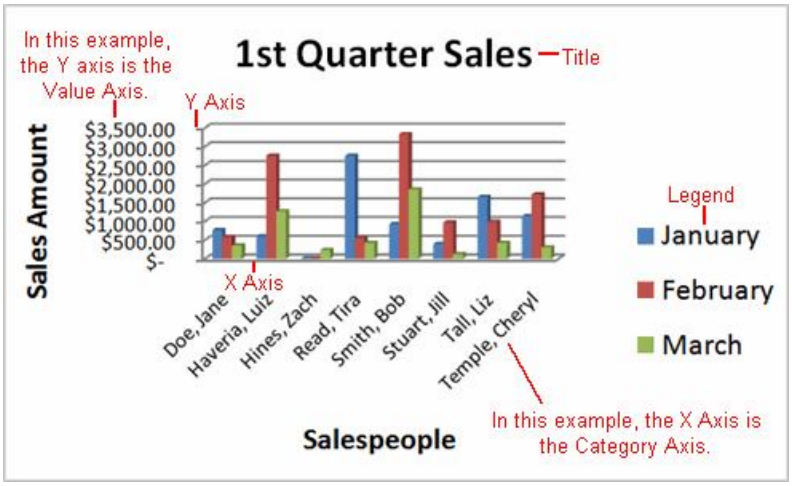


After completing the above process the charts will look like the one given below.



Identifying the Parts of a Chart

Have you ever read something you didn't fully understand but when you saw a chart or graph, the concept became clear and understandable? Charts are a **visual representation** of data in a worksheet. Charts make it easy to see comparisons, patterns, and trends in the data.



Source Data

The range of cells that make up a chart. The chart is updated automatically whenever the information in these cells change.

Title

The title or heading of the chart.

Legend

The chart key, which identifies each color on the chart represents.

Axis

The vertical and horizontal parts of a chart. The vertical axis is often referred to as the Y axis, and the horizontal axis is referred to as the X axis.

Data Series

The actual charted values, usually rows or columns of the source data.

Value Axis

The axis that represents the values or units of the source data.

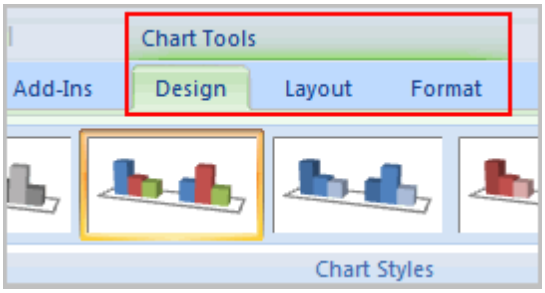
Category Axis

The axis identifying each data series

Chart Tools

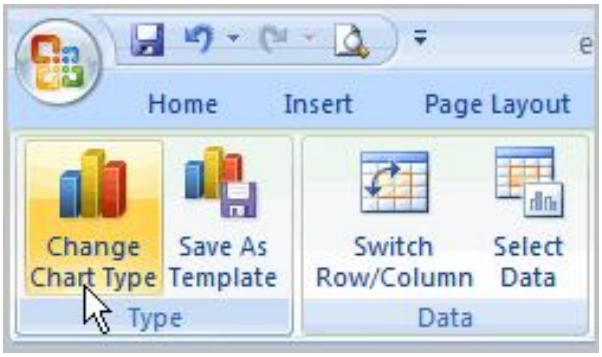
Once you insert a chart, a new set of **Chart Tools**, arranged into 3 tabs, will appear above the Ribbon.

These are only visible when the chart is selected.



To Change the Chart Type:

- Select the **Design** tab.
- Click the **Change Chart Type** command. A dialog box appear



- Select another **chart type.**
- Click OK

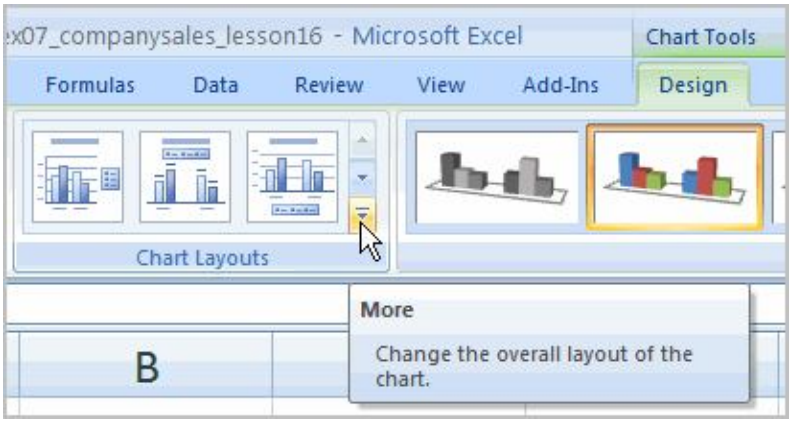
The chart in the example compares each salesperson's monthly sales to his/her other month's sales; however you can change what is being compared. Just click the **Switch Row/Column Data**

command, which will rotate the data displayed on the **x** and **y axes**. To return to the **original view**, click the Switch Row/Column command again.

To Change Chart Layout:

- select the **Design** tab
- Locate the **Chart Layouts** group

  Click the **More** arrow to view all your layout options as shown in given figure.

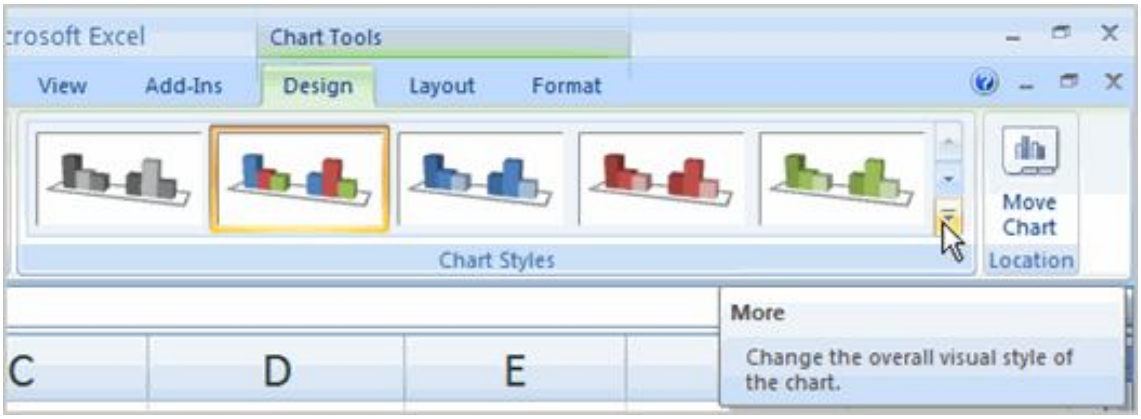


- Left-click a layout to select it.

If your new layout includes chart titles, axes, or legend labels, just insert your cursor into the text and begin typing to add your own text.

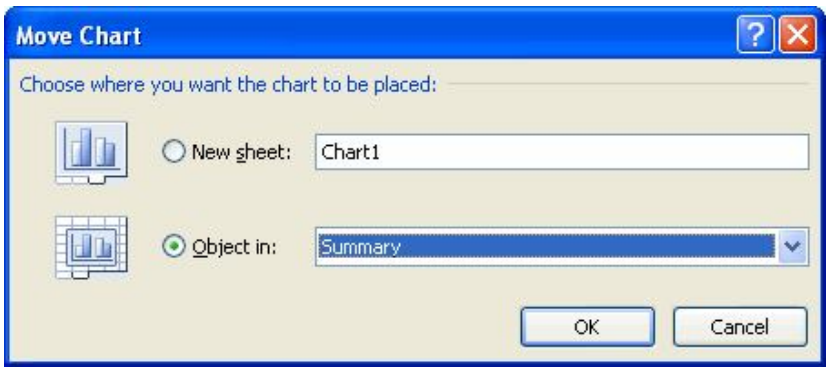
To Change Chart Style:

- Select the **Design** tab.
- Locate the **Chart Style** group.
- Click the **More** arrow as shown in given figure to view all your style options.
- Left-click a style to select it.



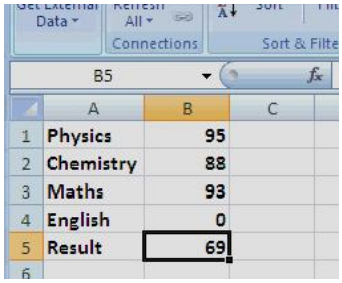
To Move the Chart to a Different Worksheet:

- Select the **Design** tab.
- Click the **Move Chart** command. A dialog box as shown below appears. The current location of the chart is selected.
- Select the desired location for the chart (i.e., choose an existing worksheet, or select New Sheet and name it).



11.5 Goal Seek

Goal seek tool is used to get the final result that you want by adjusting one of the input parameters value in a given formula . It is useful when you know the end result that you want from a formula, but not sure about the input value that the formula needs to obtain the end result. For example, use Goal Seek to change the marks in cell B4 until the value in B5 equals 80 Fig(a).



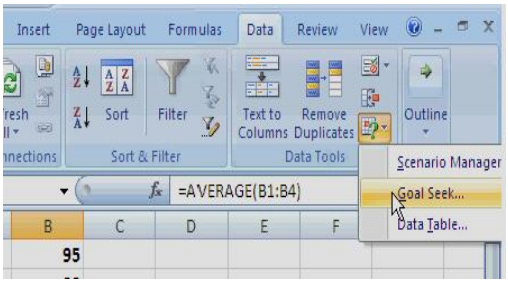
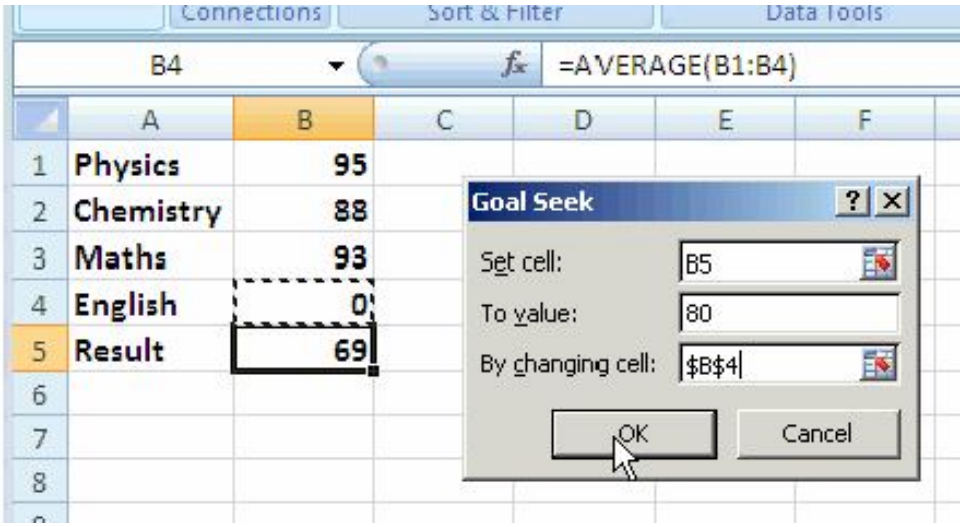
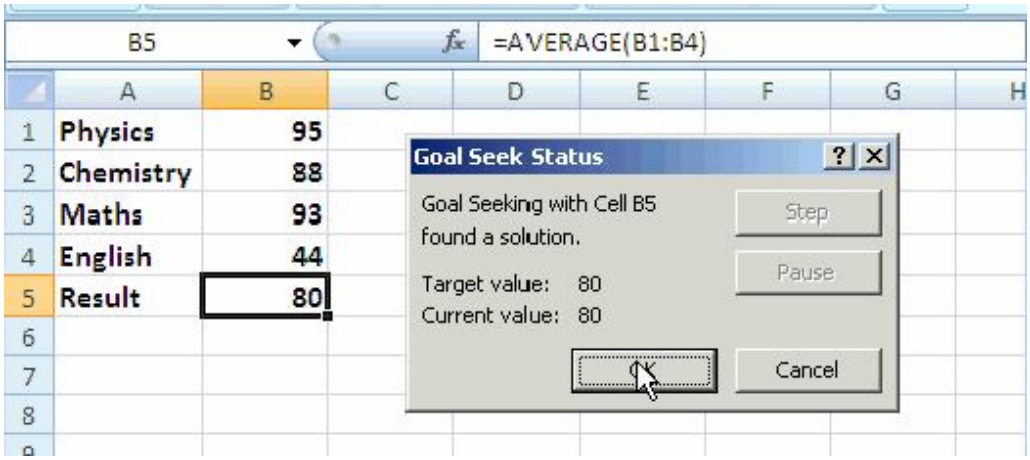


Fig (a) Fig (b)

- On the Data tab, in the Data Tools group, click What-If Analysis, and then click Goal Seek as shown above in fig (b).
- In the **Set cell** box as shown in following figure, enter the reference for the cell that contains the formula you want to resolve. In the example, this is cell B5.
- In the **To value** box as shown in following figure, type the result you want. In the example, this is 80.
- In the **By changing cell** box as shown in following figure, enter the reference for the cell that contains the value you want to adjust. In the example, this is cell B4.



Note: This cell must be referenced by the formula in the cell you specified in the Set cell box.



11.6 Solver

Optimizing values in an Excel spreadsheet to meet a given objective can be a laborious process. Fortunately, Microsoft offers Solver, a numerical optimization add-in tool to assist in this task. While it can't solve every problem, It can be a very useful "what-if" tool.1

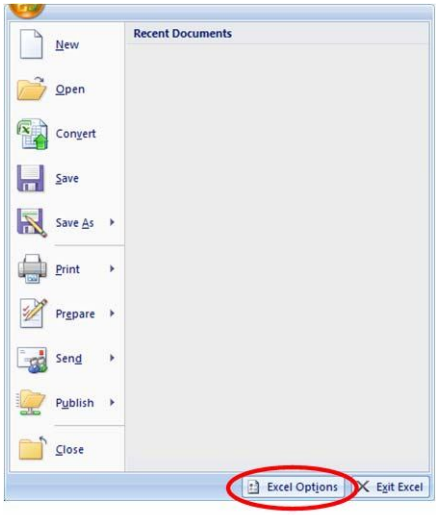
To understand the Solver, it's important to understand the basic concept of what it does and how it works. There are 3 primary components you should be familiar with while using solver.

- **Target Cell**. This is the cell that represents the goal or objective of the problem. In our example, we will be attempting to have a schedule that has no shortfall in staffing. The cell that reports any shortfall will be our **Target Cell**.
- **Variable Cells** are the cells that can be modified to arrive at the desired outcome. In our example, that will be work hours from Monday through Friday for all employees.
- **Constraints**. These are restrictions or limitations to what Solver can do to solve the problem. For example, if Employee X cannot work Tuesdays, Solver is restricted from assigning an employee work on Tuesdays.

Steps

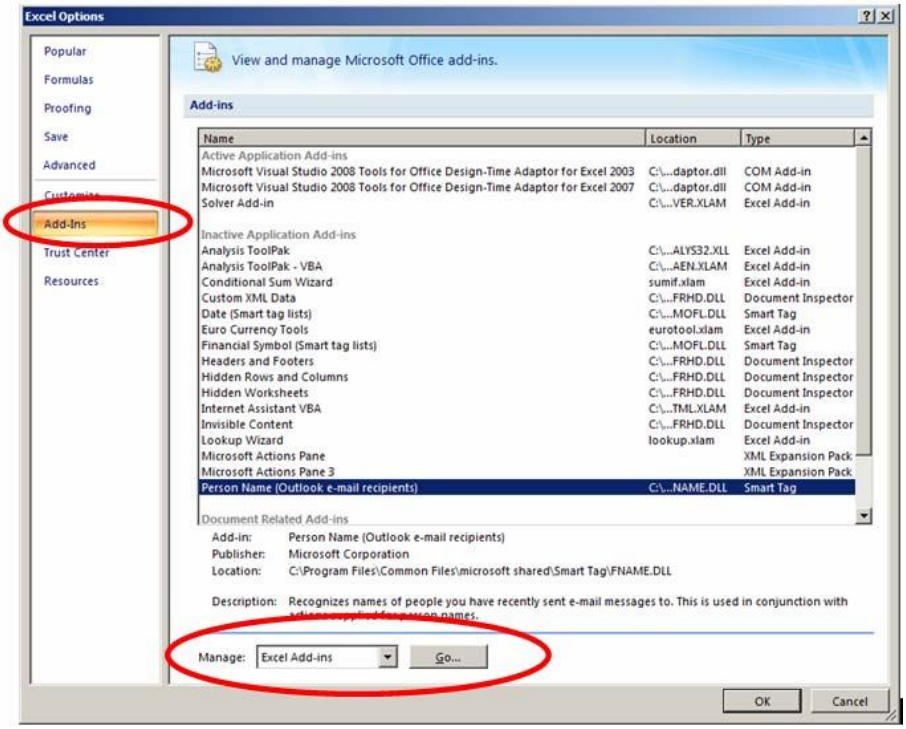
Install the Solver add-in**. If it's not already installed,** follow the next steps**:**

1. Click on the **"MicrosoftOffice"** button in the top left corner:
2. Choose "Excel Options" (See following figure)

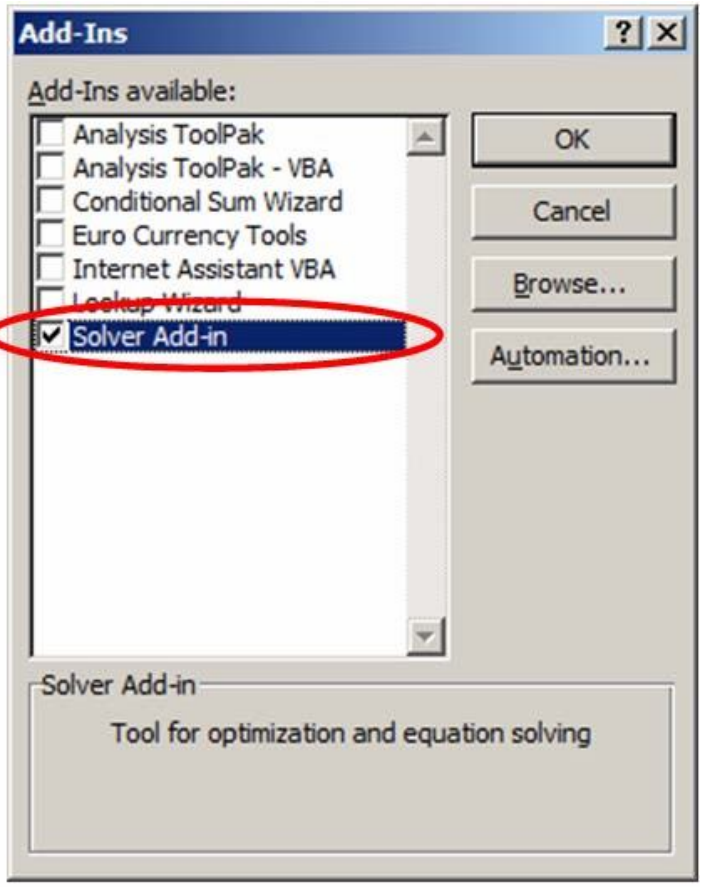


3. Choose "Add-Ins" in the vertical menu on the left (See following figure)

4. Pick "Excel Add-Ins" from the "Manage" box and click "Go…"



5. Check "Solver Add-In" as shown in following figure and press "OK".

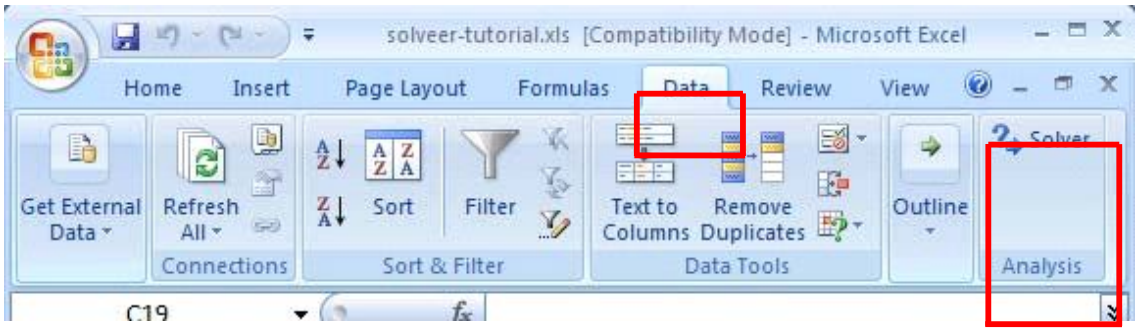


6. The Solver add-in should now appear in the Analysis toolbar on Data tab.

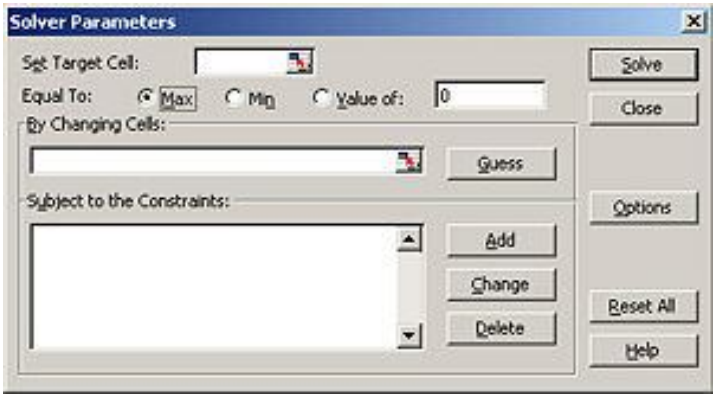
Now the solver tool will get installed on your computer. To use the Solver tool consider the following data as example and follow the given steps.

	A	B	C	D	E	F	G	H	I	J	K
4	Employee	Mon	Tue	Wed	Thu	Fri	Sat	Sun	Total Hours	Status	Notes
5	Delaney, Michael	0	0	0	0	0	0	0	0	Full-time	Can't work on Tuesday and Thursday
6	Hoddinott, Leo	0	0	0	0	0	0	0	0	Full-time	
7	Neary, Elizabeth	0	0	0	0	0	0	0	0	Full-time	
8	MacQuarrie, Prue	0	0	0	0	0	0	0	0	Full-time	Can't work on Wednesday
9	Mombourquette, Darryl	0	0	0	0	0	0	0	0	Full-time	Can't work on Friday
10	Lepore, Matthew	0	0	0	0	0	0	0	0	Full-time	Can't work on Sunday
11	Hawes, Colton	0	0	0	0	0	0	0	0	Full-time	Can't work Monday through Friday
12	Boyd, Richard	0	0	0	0	0	0	0	0	Full-time	Gone this week
13	MacEachern, Sandy	0	0	0	0	0	0	0	0	Full-time	
14	Landry, Michele	0	0	0	0	0	0	0	0	Full-time	Can't work on Saturday
15	Mildner, Mark	0	0	0	0	0	0	0	0	Full-time	
16	Munger, Mary	0	0	0	0	0	0	0	0	Full-time	
17	Moar, John	0	0	0	0	0	0	0	0	Full-time	Can't work on Friday
18	McCarron, Lori	0	0	0	0	0	0	0	0	Full-time	Can't work Wednesday through Sunda
19	Boudreau, Eilish	0	0	0	0	0	0	0	0	Part-time	Can't work Saturday and Sunday
20	MacGillivray, Nancy	0	0	0	0	0	0	0	0	Part-time	
21											
22	Attendants Scheduled	0	0	0	0	0	0	0			
23	Attendants Needed	8	8	8	8	8	11	11			
24	Difference	-8	-8	-8	-8	-8	-11	-11			
25	Total Shortfall	-62									
26											

- Click on **solver** command present on **Analysis** option under the **Data** tab as showm in following figure.
  Note: If the "Analysis" toolbar does not appear, or does not have the "Solver" button, you need to install the solver add-in as described above.



- Now the **Solver Parameters** window as shown in following figure get opens. This is where you enter the criteria needed to solve the given problem



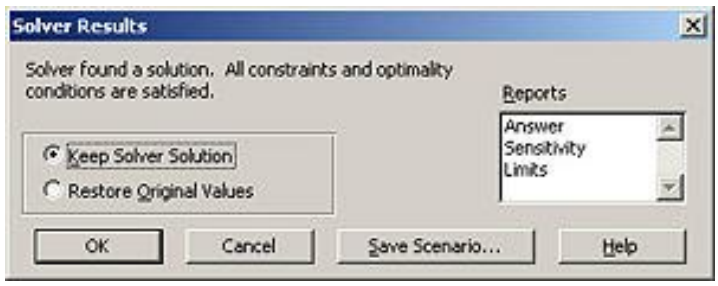
Enter the value in the **set Target Cell** box. The goal is to have no shortfall in staffing, so our target cell is**B25**, and we want to make it equal to the value of 0.

Enter the value in **By Changing cells**. Click and hold on cell **B5** and drag-select to cell **H20.**

Add constraints. In this example, there are several employees who cannot work certain days of the week, and part-time employees who do not work a normal 40-hour week. Use the constraints listed below:

- $B$11:$F$11 = 0
- $B$12:$H$12 = 0
- $B$22:$H$22 = $B$23:$H$23
- $B$5:$H$20 = binary (i.e. 1's and 0's only)
- $C$5 = 0
- $D$18:$H$18 = 0
- $D$8 = 0
- $E$5 = 0
- $F$17 = 0
- $F$9 = 0
- $G$14 = 0
- $G$19:$H$19 = 0
- $H$10 = 0
- $I$19:$I$20 <= 24
- $I$5:$I$18 <= 40

- In the constraint window, enter a constraint, then click the **Add** button. This will add your constraint to the list, and then allow you to enter another.
- Continue entering all the constraints, and after you have entered the final one on the list, click the **Cancel** button return to the main Solver window.
- **Click the Solve button**. Depending on how much memory your computer has and the processor speed, Solver may take a few seconds, or a few minutes
- When it's finished processing, Solver will either return a solution, or alert you that it was not able to do so.



- If Solver is not able to find a solution, you must think through, diagnose, and debug, your problem. First, revert to your original values.
- The two quickest fixes are to try different initial values and to add or remove constraints to the problem.

- On the right-hand side of the Solver Results dialog box, Excel presents a series of reports. The **Answer**, the **Sensitivity**, and the **Limits** reports are additional sheets inserted into the current workbook. They contain diagnostic and other information and should be selected when Solver is having trouble finding a solution.

  When Excel reports a successful run, select Keep the Solver Solution and then click OK.

11.7 Summary

- *Functions* in MSExcel are prewritten formulas. Functions differ from regular formulas in that you supply the value but not the operators, such as +, -, *, or /. For example, you can use the SUM function to add the given values.
- The function library is a large group of functions on the Formula Tab of the Ribbon. These functions include:

  AutoSum: Easily calculates the sum of a range

  Recently Used: All recently used functions

  Financial: Accrued interest, cash flow return rates and additional financial functions

  Logical: And, If, True, False, etc.

  Text: Text based functions

  Date & Time: Functions calculated on date and time

  Math & Trig: Mathematical Functions

- Once you have entered information into a spreadsheet, you will need to be able to **format** it. In this lesson, you will learn how to use the bold, italic, and underline commands; modify the font style, size, and color; and apply borders and fill colors.
- When you open a new, blank workbook, the cells, columns, and rows are set to a **default size**. You do have the option to change the column width and row height of each, and to insert new columns, rows, and cells, as needed. You can also delete the undesired rows /column if needed.
- A **chart** is a tool you can use in Excel to communicate your **data graphically**. Charts allow your audience to more easily see the meaning behind the numbers in the spreadsheet, and make showing comparisons and trends a lot easier.
- Goal seek tool is used to get the final result that you want by adjusting one of the given parameters value . It is useful when you know the end result that you want from a formula, but not the input value that the formula needs to get that result, you can use the Goal Seek feature.

11.8 Self Assessment Questions

1. What do you understand by functions also explain some popular functions of MSExcel.
2. Explain the common formula errors of MSExcel.
3. What do mean by formatting of a worksheet? What is number formatting of cell?
4. Write the process of inserting a row in a worksheet
5. Write the steps of chart creation. Also explain the different parts of a charts.
6. Write short note on:
   a. Goal seek
   b. Solver

11.9 Further Reading

- Grauer, Scheeren & Mulbery -Exploring Microsoft Office Excel 2007 Comprehensive, 2/e Prentice Hall
- Robert Grauer Judy Scheeren, Exploring Microsoft Office Excel 2007 Volume 1 and Exploring Microsoft Excel 2007 Vol. 1 Prentice Hall
- Kathy Ivens,Conrad Carlberg Excel 2002: The Complete Reference Tata Mcgraw Hills
- Guy Hart-Davis How to Do Everything with Microsoft Office Excel 2007 By: TATA Mcgraw Hills
- John Walkenbach Excel 2007 Bible (Excel Bible)
- Gary B. Shelly, Thomas J. Cashman and Misty E. Vermaat Microsoft Office 2007: Introductory Concepts and Techniques, Windows XP Edition

Unit - 12 : ACCOUNTING PACKAGES

Structure of the Unit

12.0 Objective

This Chapter provides a general overview of

- The different packages of accounting system
- Voucher and types
- Invoice & salary statements
- Know the Meaning, Purpose, Content and Format of Trading, Profit and Loss Account and Balance Sheet.
- Understand the Differences between Trading account and P&L account.
- Prepare the Final Accounts

12.1 Introduction

Accounting is a process of accumulating, summarizing and communicating financial information. Financial information can be of different types and serve different purposes, but it all comes from the same function – accounting. Accounting packages must be user friendly with on-line help facility so that user can use it without any problem. Security must be of prime importance in a good financial accounting package so that no unauthorized user can enter/modify the financial data.

12.2 Introduction of Voucher

Voucher is a very primary accounting record which shows the authenticity of the transactions. In business so many transactions take place. To record any transaction in account books, first of all a voucher is prepared by the accountant. Therefore, we call the vouchers as the base of the accounting system.

Voucher is prepared by the accountant with the help of source document. **Source document** means any proof relating to the business transactions. These documents include:- bills, cash memos, receipts, bank deposit slips, cheque book, counter foils, challans and other details which show the happening of any transaction in a business firm.

12.2.1 Preparation of Vouchers

The performa of a voucher depends from company to company but all the vouchers have almost same details which are to be shown in it. A voucher shows the following details:-

1. Type of Voucher
2. Date of Voucher
3. Debit Column
4. Credit Column
5. Amount in figures and words
6. Total Column
7. Particulars column in which brief description of the transaction is being mentioned
8. Signature of accountant
9. Signature of Manager or other authorized person.
10. In Case of Bank Payment Voucher or Cash Payment Voucher, signature of receivers is also shown.

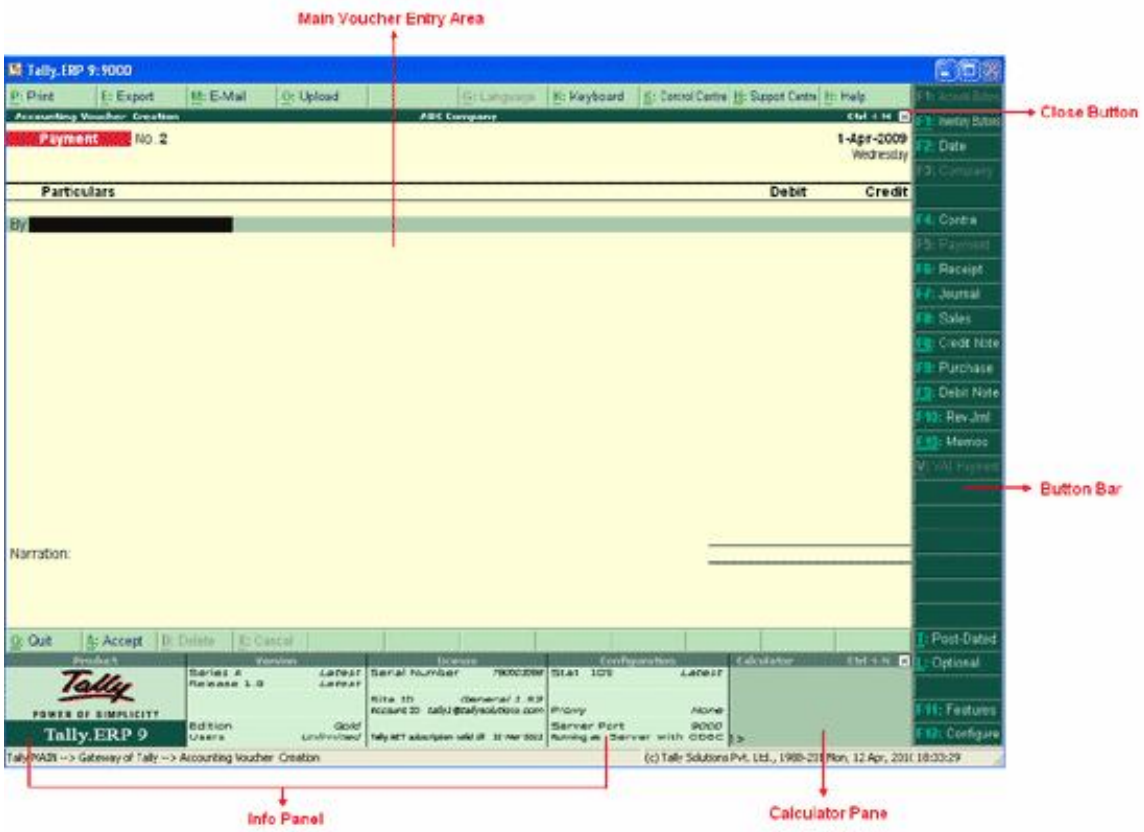
12.2.2 Rules for preparation of voucher

1. Must verify the supporting documents thoroughly in respect of date, amount, nature of transactions etc.
2. The supporting documents must be approved by an appropriate authority.
3. Then, the accountant has to select the type of voucher to be prepared for the transaction.
4. Must have thorough knowledge of accounting rules.
5. He has to make sure that the total of debit and credit side of voucher are equal.
6. The accountant must have good command over the various accounting heads which are supposed to be debited or credited.

12.2.3 Voucher Entry window

The **Voucher Entry screen** is divided into three parts:

- The Main Voucher Entry
- Button Bar
- Calculator



Voucher Entry screen Components

Main Voucher Entry Area

The Main Voucher Entry Area is where you enter all your transactions. This area has fields for Date, Ledger Name and Amount as well as additional pop-up screens that are dependent on your voucher configuration and the nature of transaction you make.

Button Bar

The Button Bar area displays buttons that provide quick links to various functions and features of Tally.ERP 9. Buttons that are relevant to the current task are enabled and the other buttons are disabled.

Calculator Area

The Calculator area provides a working space where you can enter any number of mathematical formulae for complex calculations.

12.2.4 Types of voucher

Tally is pre-programmed with a variety of accounting vouchers, each designed to perform a different job.

The standard vouchers are:

1. Payment Voucher
2. Receipt Voucher
3. Contra Voucher
4. Sales voucher

5. Purchase Voucher
6. Journal Voucher

You can alter these vouchers to suit your requirement and also create new vouchers.

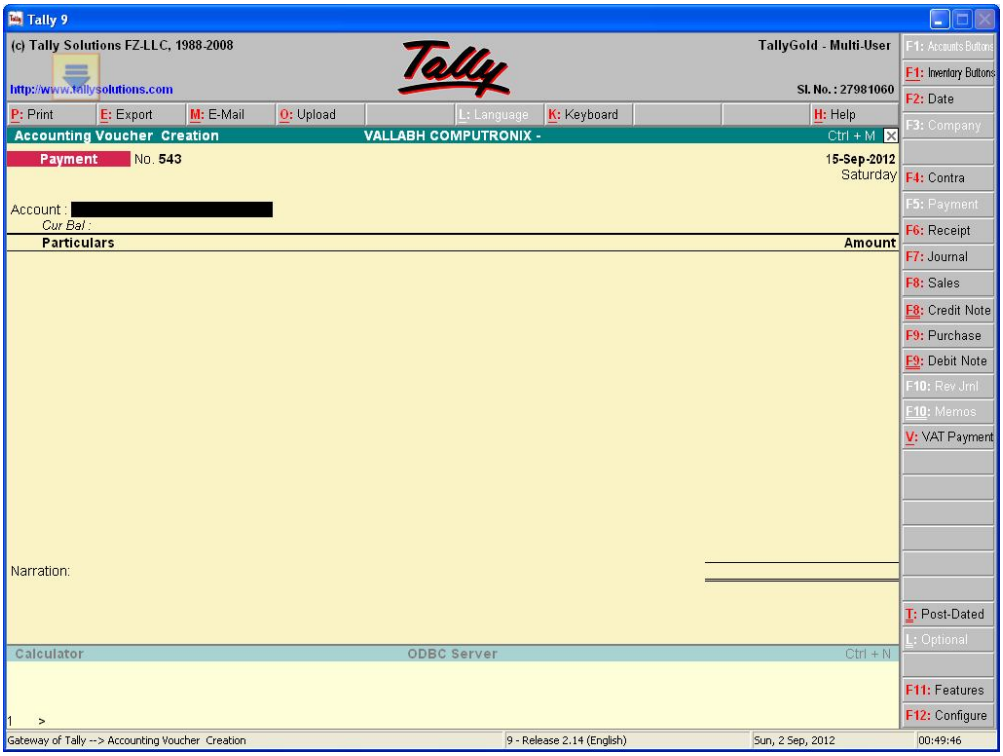
For example, if you wish to distinguish between cash and bank payments you can create vouchers to do this.

The function of each voucher type is explained below:

1) Payment : For recording payment made to any party by cash or cheque. If the payment is made to the supplier then the voucher is prepared semi-automatically using command ***Make Payment to Supplier*** .

To view the Payment Voucher entry screen:

1. Go to ***Gateway of Tally > Accounting Vouchers***
2. Select **F5: Payment** from the Button Bar or press **F5**



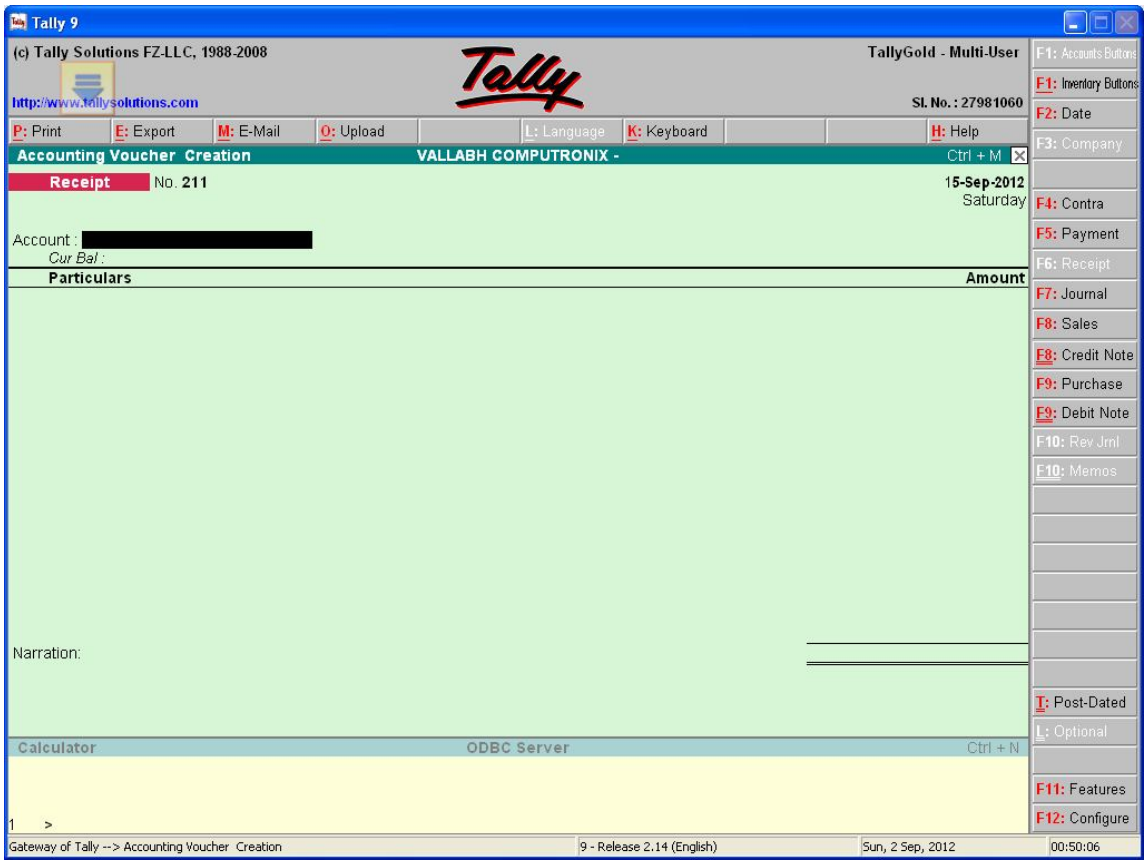
2) Receipt : For recording receipts from any party by cash or cheque. If the payment is received from the customer then the voucher is prepared semi automatically using command ***Receive Payment from customer*** .

Transactions accounting for money received are entered into Tally through the receipt voucher.

To view the Receipt Entry screen:

1. Go to ***Gateway of Tally > Accounting Vouchers***
2. Select **F6: Receipt** from the button bar or press **F6**

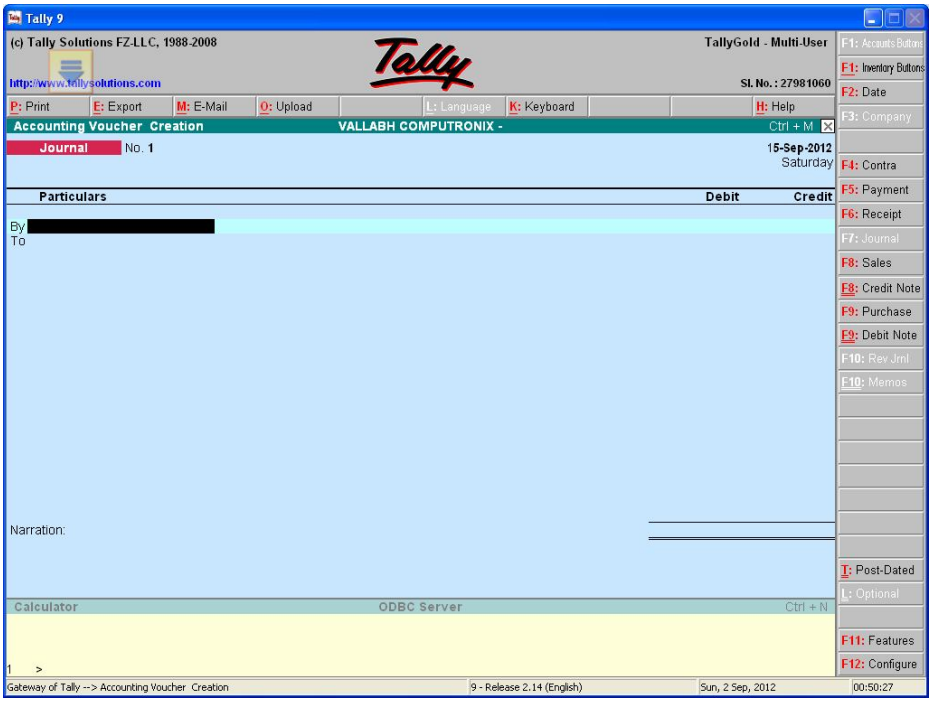
Similar to **Payment** and **Contra** vouchers, the **Single Entry Mode** appears for **Receipt Entry** as well.



3) Journal : Journal entries are used to adjust the debit and credit amounts without involving the cash or bank accounts. Hence, they are referred to as adjustment entries. Voucher where neither account head is cash or cheque can be called journal voucher.

To go to the Journal Entry Screen:

1. Go to ***Gateway of Tally > Accounting Vouchers***
2. Click on **F7: Journal** on the Button Bar or press **F7** key



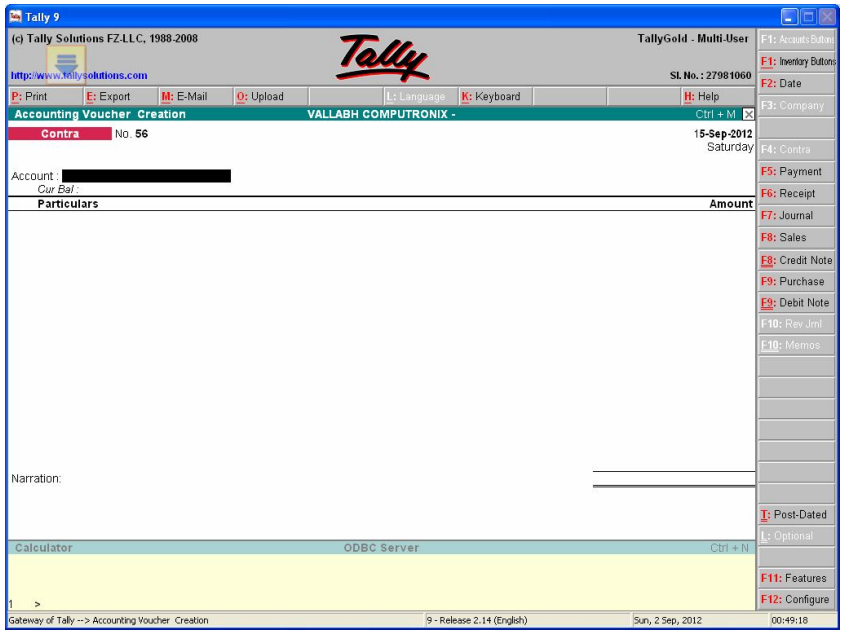
4) Contra : To cater to concept of contra entries and for treatment of cheques received and issued by the business.

According to accounting rules, Contra Entry is a transaction indicating transfer of funds from:

- Cash account to Bank account
- Bank account to Cash account
- Bank account to Bank account

To view the Contra Voucher Entry Screen:

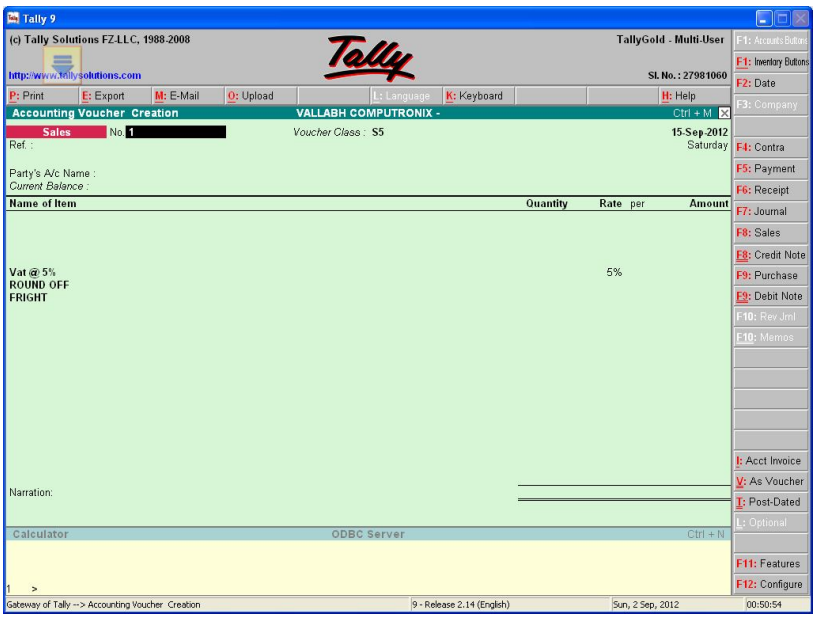
- 1. Go to ***Gateway of Tally > Accounting Vouchers***
- 2. Select **F4: Contra** from the button bar or press **F4**



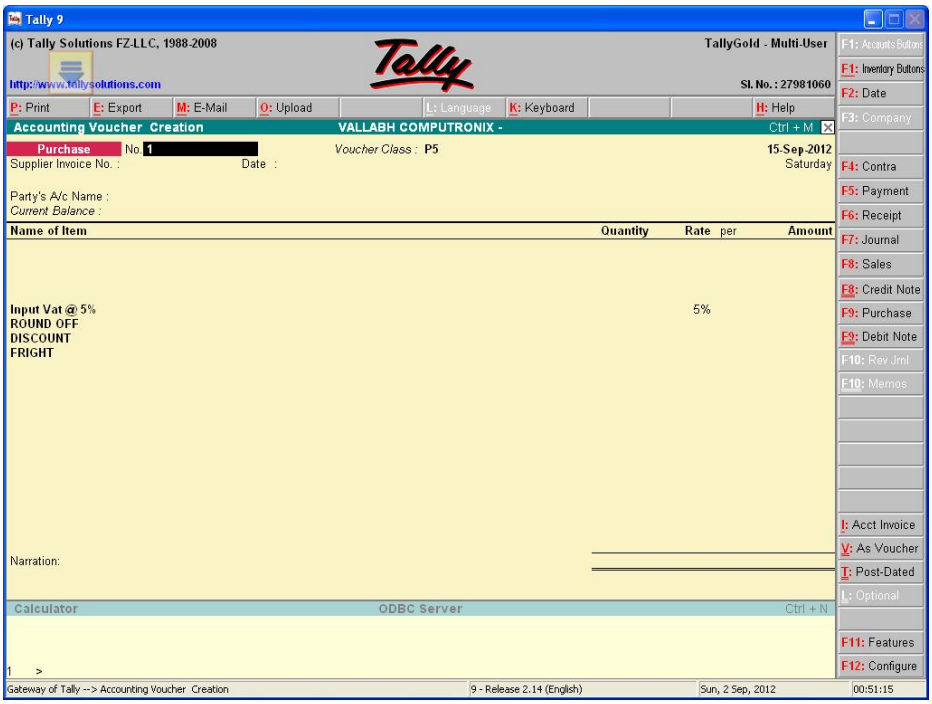
5) Sales : For regarding sales voucher means any product sale by supplier to customer or any dealing between cash or cheque .

To view the Sales Voucher Creation Screen:

Go to ***Gateway of Tally > Accounting Vouchers > Select F8: Sales***



6) Purchase : For regarding purchase voucher means any product purchase by customer to supplier or any dealing between cash or cheque.



In fact the different voucher types help in classifying the different types of transactions and they do not affect the way the voucher is posted in the ledger.

12.3 Invoice Statements

An invoice or bill is a commercial document issued by a seller to the buyer, indicating the products, quantities, and agreed prices for products or services the seller has provided the buyer.

An invoice indicates the buyer must pay the seller, according to the payment terms.

In other words, Invoice is a statement which contains the details of the qty of goods sold and price of goods/products, terms and conditions for payment particulars.

From the point of view of a seller , an invoice is a sales invoice.

From the point of view of a buyer ,an invoice is a purchase invoice.

Invoice is a statement which contains following details:

1. Invoice number
2. Invoice date
3. Name and address of the person making the invoice (Seller of goods and service)
4. Name and address of the person to whom invoice is made(Buyer of goods and service)
5. Description of goods / services involved
6. Applicable rates and taxes with percentages
7. Rate of the goods/services

8. Quantity of the goods and services
9. Price/value of the goods and services.
10. Invoice must be signed by the person making it
11. Terms and condition of making the payment

PROFORMA INVOICE

Exporter	Invoice No. & Date	Exporte's Ref
	Buyer's Order No. & Date	
	Other Refrence (s)	
Consignee	Buyer (if other than consignee)	
	Country of Origin of goods	Country of Final Destination
	Terms of Delivery and Payment	
Pre-Carriage by / Place of Receipt by Pre-Carrier		
Port of Discharge / Final Destination	Vessel /Flight No.	Port of Loading

Marks & Nos. Container No.	No. & Kind of Package	Description of Goods	Quantity	Rate	Amount
Amount Chargeable (In Words) TOTAL FOB VALUE					

Signature & Date

Declaration
We declare that Invoice shows the actual price of the goods described and that all particulars are true and correct. E & O.E

12.3.1 Employee Salary Statement

Employee salary statement is an overview of the benefits and allowances received as part of the salary by an employee from his company. It is written by an accountant under the supervision of an officer in charge of determining the salary with size able understanding of pay administration.

The statements given below provide a quick view of the salary structure of the employee is entitled to that becomes operative from the date of joining the firm. The decisions taken by the board is final and the employee cannot question them under any circumstances.

Payslip — **ABC Company** — Ctrl + M

Payslip for May-2006

Employee A

Employee Number	: Emp/1065	PF Account Number	: KA2816/14
Function	: Sales	Employee I.T. PAN	: AN239678PP
Designation	: Senior Executive	Bank Details	: 000536987456, HDFC, J.P Nagar
Location	: Bangalore	ESI Number	: ESI3456

Attendance Details	Value
Absent	1 Days
Casual Leave	

Earnings	Amount	Deductions	Amount
Basic Salary	22,000.00	Employee PF	4,012.80
DA	11,440.00	Food Coupon	500.00
HRA	13,376.00	Professional Tax	200.00
Conveyance	800.00		
Medical Allowance	1,250.00		
Total Earnings	**48,866.00**	**Total Deductions**	**4,712.80**
		Net Amount	**44,153.20**

12.4 Inventory Records

Inventory is the total amount of goods and/or materials contained in a store or factory at any given time. Store owners need to know the precise number of items they hold in-order to place orders or control losses. Factory managers need to know how many units of their products are available for customer orders.

All types of inventory transactions using goods receipt notes, delivery notes, stock journals, manufacturing journals and physical stock journals etc. are fully recorded in stock registers.

Features of inventory records are:

Manufacturers:

- Bills of materials and manufacturing journals to record material conversions
- Compound bill of materials support, for units that contain assemblies
- Multiple locations (godowns)
- Excise for manufacturers, including all documentation and invoice
- Costing for jobs

Distributors & Wholesalers:

- Multiple price lists, with effective dates of applicability
- Use multiple units of measure (say Kgs & grams)
- Dual units of measure (say Kgs and bags, to support variations, typically seen in commodities)

Traders:

- High speed billing, with support for POS printers
- Barcode support

- Automatic application of taxes
- Service billing & service tax
- Integrated sales return in bills
- Print bills (and any other documents) in the customer's language

Common:

- You can choose to de-link the computed inventory value to automatically appear in your financial statements, and enter this figure manually.
- Stock ageing reports, to identify slow and non-moving stocks
- Invoice profitability reports to keep a pulse on sales
- Multi-currency transactions –buy and sell across the world with integrated forex gain/loss calculations
- Physical stock take records to adjust physical vs. actual stocks
- Maintain batch & expiry details

Integrated/ Non-integrated accounting and inventory: With the Inventory function in Tally.ERP 9, you have the option to choose closing stock balance from inventory records or from the stock ledger account.

If accounts are not integrated with inventory, you can enter the closing stock value manually by creating Stock ledger account, for a major effect on the Balance Sheet and Profit & Loss Account. If set to **Yes**, it extracts the stock/inventory balance figures from the inventory records and provides a drill down to the Stock registers from the Balance Sheet.

If set to **No**, it ignores the inventory books figures and picks up the manually-entered closing stock balances from the ledger account created, allowing the independent maintenance of accounts and inventory.

12.4.1 Maintenance of Inventory Records

- An inventory record must be maintained either in the agreed written format or on computer provided that an adequate audit trail is maintained.
- New items, which cost in excess of Rs.1,000, or are attractive irrespective of value, should be entered immediately into the inventory.
- All details in the inventory must be recorded from the delivery note/invoice.
- Inventory records may be held on computer, provided they are in the standard format and a satisfactory control system is put in place.
- The recommended control system for computerized inventory records is as follows:
- The system to be used should be password protected and access to amend the inventory record limited to the nominated responsible officer.
- A printout of the data, transferred from the hand written inventory to the computerized version, should be produced and the accuracy of the data transfer verified by an officer, independent of the process. On completion, the print out should be both signed and dated by the verifying officer, to indicate that the computerized version is accurate, and held on file for future reference.
- A print out should be produced on a regular basis. This should be checked, signed and dated, by an appropriate member of staff and held on file for future reference. Particular attention should be given to items removed from the inventory.

- The Internal Audit Section must be consulted, if any other format or means of recording is to be used, before it is implemented.
- Inventory records may be held by type of equipment, subject department, room number or any other means approved by the Governing Body.
- The Governing Body should consider whether it is appropriate to maintain records of consumable items (e.g. materials, photocopying or other paper, wood, metal, etc.)
- If stores records are maintained, they should be kept in accordance with the procedure for inventory records.

12.5 Maintenance of Accounting Books or books of accounts

By maintaining the books of accounts ,it is possible to know the result of the business and its financial position.

- **Maintenance at Registered Office**

  Section 209 of the Companies Act states that books of account shall be maintained at the company's registered office unless the Board of Directors decide to keep them at another place in India.

- **Maintenance at Place Other Than Registered Office**

  It is a duty of the company to inform the Registrar of Companies within seven days of the decision in case the Board of Directors decides to maintain books at the place other than the registered office.

- **In Case Of Branch Office**

  Where the company has a branch office, whether in or outside India the proper books of accounts relating to the transactions effected at the branch office are kept at that office and proper summarized returns made up to date at intervals of not more than three months are prepared and sent within reasonable time to head office**.**

Requisites of Proper Books of Accounts

Every company is required to keep proper books of account showing

(i) Sales and purchases of goods

(ii) Assets and liabilities

- **Proper Books not Deemed To Be Kept**

(a) If such books are not kept as are necessary to give a *true and fair view* of the state of affairs of the company or branch office, as the case may be, and to explain its transactions.

(b) Also if such books are not kept on *accrual basis* and according to system of double entry book keeping.

In the process of maintaining the books of accounts, an accountant renders the following services:

a) Help the management in planning ,decision making and controlling .

b) Facilitate comparative study to know the efficiency or otherwise of the business.

c) In calculating the tax liability of the business.

d) To furnish evidence in court in terms of conflict.

e) To ascertain purchase price of business when it is sold to outsiders.

12.5.1 Preparation of final accounts

Financial statements summarizes the individual transactions to show total, ratios and statistics required by the users to analyze the company's financial data in a wide variety of ways.

The final accounts of business concern generally includes two parts. The first part is Trading and Profit and Loss Account. This is prepared to find out the net result of the business. The second part is Balance Sheet which is prepared to know the financial position of the Business.

(1) Trading Account

Trading means buying and selling. The trading account shows the result of buying and selling of goods.

At the end of each year, it is necessary to ascertain the net profit or net loss. For this purpose, it is first necessary to know the gross profit or gross loss. The trading account is prepared to ascertain this. The difference between the selling price and the cost price of the goods is the gross earning of the business concern. Such gross earning is called as gross profit. However, when the selling price is less than the cost of goods purchased, the result is gross loss.

General Format of Trading Account

Particulars	Rs.	Rs.	Particulars	Rs.	Rs.
To opening stock		XXX	By sales	XXX	
To purchases	XXX		Less: returns inward	XXX	XXX
Less: returns outward	XXX	XXX	By closing stock		XXX
To wages		XXX	By gross loss c/d (transferred to P&L a/c)		XXX
To freight		XXX			
To carriage inwards		XXX			
To clearing charges		XXX			
To packing charges		XXX			
To dock dues		XXX			
To power (factory)		XXX			
To octroi duty		XXX			
To gross profit c/d (transferred to P & L a/c)		XXX			
		XXX			XXX

(2) Profit and Loss Account

After calculating the gross profit or gross loss the next step is to prepare the profit and loss account. To earn net profit a trader has to incur many expenses apart from those spent for purchases and manufacturing of goods. If such expenses are less than gross profit, the result will be net profit. When total of all these expenses are more than gross profit the result will be net loss.

The aim of profit and loss account is to ascertain the net profit earned or net loss suffered during a particular period.

General Format of Profit and Loss Accounts

Particulars	Rs.	Particulars	Rs.
To Trading A/c (Gross Loss)	XXX	By trading A/c (Gross Profit)	XXX
To Salaries	XXX	By Commission earned	XXX
To Rent & rates	XXX	By Rent Received	XXX
To stationeries	XXX	By Interest received	XXX
To Postage Expenses	XXX	By Discount received	XXX
To Insurance	XXX	By Net Loss (Transferred to capital A/c)	XXX
To Repairs	XXX		
To Trading Expenses	XXX		
To office expenses	XXX		
To interest paid	XXX		
To bank Charges	XXX		
To Sundry expenses	XXX		
To commission paid	XXX		
To Discount allowed	XXX		
To Advertisement	XXX		
To Carriage outwards	XXX		
To travelling expenses	XXX		
To Distribution expenses	XXX		
To Repacking Charges	XXX		
To Bad debts	XXX		
To Depreciation	XXX		
To net Profit Profit (transferred to Capital A/c)	XXX		
	XXX		XXX

The Profit and Loss Account is a statutory report that shows the operational results for a given period of time. It lists out the Incomes and Expenditures based on the Primary Groups of Tally. The Profit & Loss Account in Tally is updated instantly with every transaction voucher that is entered and saved. No special processing is required to produce a Profit & Loss Account.

To view Profit & Loss Account:

- Go to Gateway of Tally > Profit & Loss A/c
- Click **Alt+F1** to view a detailed report

Profit & Loss A/c — Universal Enterprises — Ctrl + M

Particulars	Universal Enterprises *Actuals* 1-Apr-2008 to 31-Mar -2009	*Universal Enterprises* Expenditure Budget *1-Apr-2008 to 31-Mar -2009*
↑ ... 28 more		
Profit on Sale of Assets		
Profit on Sale of Fixed Assets		
	86,97,741.73	*24,000.00*
Indirect Expenses	**24,58,749.81**	***2,50,000.00***
Depreciation on Fixed Assets	*6,02,622.20*	
Interest & Finance Charges	*55,519.37*	
Operating Expenses	*3,33,568.75*	1,24,000.00
Salaries & Remuneration Paid	*12,79,165.00*	7,00,000.00
Selling & Distribution Expenses	*19,400.00*	5,000.00
Employer ESI Contributions	*8,668.00*	
Employer PF Contributions	*44,596.49*	
Bonus	*50,000.00*	
Business Promotion Expenses	*25,500.00*	10,000.00
Depreciation		
Discount		
Insurance Premium		
Interest Due		
Interest & Finance Charges		
Interest on Partner's Capital A/c		
Legal Fees	*16,500.00*	
Miscellaneous Expenses	*13,210.00*	8,000.00
PF Employers		
Repairs & Maintenance		3,000.00
Research & Development Expenses	*10,000.00*	
Rounding Off		
Nett Profit :	**62,38,991.92**	***(-)2,74,000.00***

(3) Balance Sheet:

This forms the second part of the final accounts. It is a statement showing the financial position of a business. Balance sheet is prepared by taking up all personal accounts and real accounts (assets and properties) together with the net result obtained from profit and loss account. On the left hand side of the statement, the liabilities and capital are shown. On the right hand side, all the assets are shown. Balance sheet is not an account but it is a statement prepared from the ledger balances. So we should not prefix the accounts with the words 'To' and 'By'.

Balance sheet is defined as 'a statement which sets out the assets and liabilities of a business firm and which serves to ascertain the financial position of the same on any particular date'.

The need for preparing a Balance sheet is as follows:

i. To know the nature and value of assets of the business

ii. To ascertain the total liabilities of the business.

iii. To know the position of owner's equity.

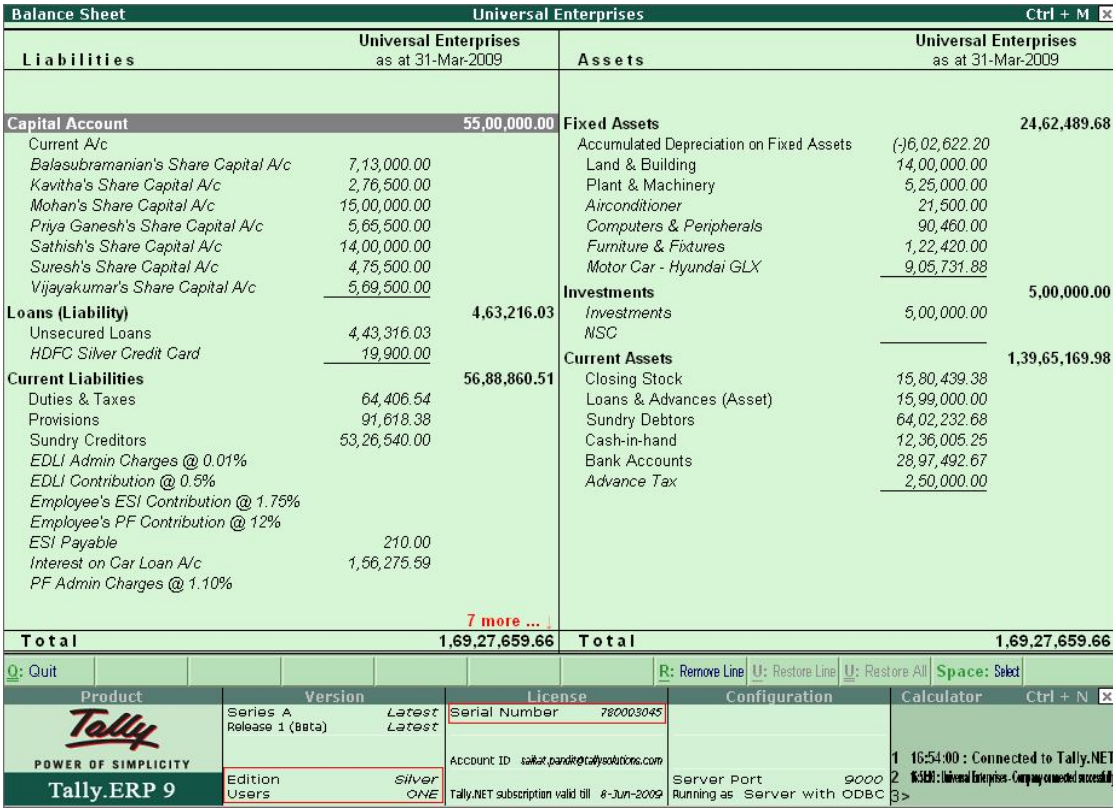
A balance sheet is a financial statement that report a firm's financial position at a specific time. It shows a balance between the assets and liabilities of a firm and the owner's funds i.e. (Assets= Liabilities+owner's equity).

General format of balance sheet

Liabilities	Rs.	Rs.	Assets	Rs.	Rs.
Sundry Creditors		XXX	Cash in hand		XXX
Bills payable		XXX	Cash at bank		XXX
Bank overdraft		XXX	Bills receivable		XXX
Outstanding		XXX	Sundry debtors		XXX
expenses			Investments		XXX
Mortgage loans		XXX	Closing stock		XXX
Reserve fund		XXX	Prepaid expenses		XXX
Capital	XXX		Furniture & fittings		XXX
Add: Net			Plant & machinery		XXX
profit(or)			Land & buildings		XXX
Less: net loss	XXX		Business premises		XXX
			Patents & trade		XXX
	XXX		marks		
Less drawings	XXX		Good will		XXX
	XXX				
Less: income tax	XXX	XXX			
		XXX			XXX

To view Balance Sheet:

- Go to Gateway of Tally > Balance Sheet
- Click **Alt+F1** to view a detailed report



Difference Between Trading A/C and Profit & Loss A/C

Some of the differences between Trading A/c and Profit & Loss A/c are as follows:

(i) Trading account is the account showing the Gross Profit of a business, whereas, the Profit & Loss Account shows the Net Profit of a business.

Gross Profit = Sales Turnover - Cost of goods sold (opening stock + purchases + carriage inwards-closing stock)

Net Profit = Gross Profit + Revenue (rent received, interest received, discount received) - Expenses

(ii) All direct expenses/revenues that are directly related to the factory or production are included in a Trading A/c. On the other hand, all Indirect Expenses/revenues that are related to the Administration & Selling are included in a P&L A/c.

(iii) The gross profit or loss, which is derived from the Trading Account, shows the trend of the business and the Profit & Loss account reflects on the management of the business and the outcomes of the concern.

12.6 Financial Report Generations

The main purpose of financial accounting is to prepare financial reports that provide information about a firm's performance to external parties such as investors, creditors, and tax authorities.

A financial statement (or financial report) is a formal record of the financial activities of a business, person or other entity. For a business enterprise, all the relevant financial information, presented in a structured manner and in a form easy to understand, is termed as the financial statements. There are four types of financial statements:

1. **Balance Sheet**: Also referred to as statement of financial position or condition, it reports on a company's assets (things of value that it owns), liabilities (its financial obligations) and ownership equity at a given point in time.

2. **Income statement**: The income statement tells us how much money a company has brought in (its revenues), how much it has spent (its expenses) and the difference between the two (its profit or loss).Income statement is also referred to as Profit and Loss statement (or a "P&L"). Profit & Loss account presents information on the operations of the enterprise. These include sales and various expenses incurred during the processing state.

3. **Statement of retained earnings**: The term 'retained earnings' implies the accumulated excess of earnings over losses and dividends. The balance shown by the Income Statement is transferred to the Balance Sheet through this statement, after making necessary appropriations. Thus, it acts as a connecting link between the Balance Sheet and the Income Statement.

4. **Statement of changes in financial position**- The Balance Sheet depicts the financial condition of a business concern at a given point of time while the Income Statement reveals the ultimate outcome of operations of business over a period of time. But, in order to gain an unmistakable understanding of the business affairs, it is important to identify the movement of working capital or cash in and out of the business. This information is made accessible in the statement of changes in financial position of the business.

Cash Flows

To View **Cash Flow Summary**, Tally.ERP 9 provides you with a cash flow statement to track the movement of cash flow i.e. cash inflows as well as cash outflows (both cash & bank included) of your business. The report also displays a net flow for any period.

Go to ***Gateway of Tally > Display > Cash/Funds Flow > Cash Flow***

Select a **month**

Cash flow statement may provide considerable information about what is really happening in a business beyond that contained in either the income statement or the balance sheet.

Format of the Cash Flow Statement

The cash flow statement is divided into three sections:

- Cash flow from operating activities: shows the results of cash inflows and outflows related to the fundamental operations of the basic line or lines of business in which the company engages. (Example: cash receipts from the sale of goods or services and cash outflows for purchasing inventory and paying rent and taxes.)
- Cash flow from investing activities: associated with purchases and sales of non-current assets (Example: building and equipment purchases or sales of investments or subsidiaries.)
- Cash flow from financing activities: associated with financing the firm (Example: selling and paying off bonds and issuing stock and paying dividends).

Exceptions :

- Short-term marketable securities are treated as long-term investments and appear in cash flow from investing activities
- Short-term debt is treated as long-term debt and appears in cash flow from financing activities
- Although dividends are handled as a cash outflow in the cash flow from financing activities section, interest payments are considered an operating outflow, despite the fact that both are payments to outsiders for using their money.

Statement of Cash Flows	
Cash Flow from Operating Activities	
Net Income	XXX,XXX
Adjustments to reconcile net income to net	
cash provided by operating activities:	
Depreciation and amortization	XX,XXX
Changes in other accounts affecting operations:	
(Increase)/decrease in accounts receivable	X,XXX
(Increase)/decrease in inventories	X,XXX
(Increase)/decrease in prepaid expenses	X,XXX
Increase/(decrease) in accounts payable	X,XXX
Increase/(decrease) in taxes payable	X,XXX
Net cash provided by operating activities	XXX,XXX
Cash Flow from Investing Activities	
Capital expenditures	(XXX,XXX)
Proceeds from sales of equipment	XX,XXX
Proceeds from sales of investments	XX,XXX
Investments in subsidiary	(XXX,XXX)
Net cash provided by investing activities	(XXX,XXX)
Cash Flow from Financing Activities	
Payments of long-term debt	(XX,XXX)
Proceeds from issuance of long-term debt	XX,XXX
Proceeds from issuance of common stock	XXX,XXX
Dividends paid	(XX,XXX)
Purchase of treasury stock	(XX,XXX)
Net cash provided by financing activities	(XX,XXX)
Increase (Decrease) in Cash	**XX,XXX**

12.7 Summary

The term Financial statement used in accounting refers to two statements which the accountant prepares at the end of a given period of time for the business enterprise. These statements are:

(i) Position Statement that is balance sheet

(ii) Income statement that is Profit and Loss account

A Balance sheet is a statement of assets and liabilities stating the financial position of an enterprise at given state.

A Profit and loss account show the net result of business operations during of an accounting period.

Salary includes wages, pension, fees, commission, advance salary, amount received on surrender of earned leave, annual accretion to the recognized provident fund and other employer in Pension Scheme.

Cash flow is a statement that shows flow of cash and cash equivalents during a given period. This statement shows the net increase or net decrease of cash and cash equivalents under each activity.

12.8 Self Assessment Question

1 Explain the purposes of a cash flow statement.

2 What are the differences between a cash flow statement and funds flow statement

3 What do you understand by Salary. What is included in perquisites and in profits in lieu of salary?

4 What is Voucher? What are the different types of vouchers.

5 Explain the maintenance of final accounts.

6 What is a Trial Balance?

7 What are the objectives of preparing a Trial Balance?

8 Write the difference between trial balance and balance sheet.

9 What is trading account? What are its uses?

12.9 Further Readings

- Hingorani N.L and Ramanathan A.R., "Management Accounting", Sultan Chand, New Delhi,
- Shukla M.C and Grewal T.S., "Advanced Accounts", S.Chand & Company, New Delhi,
- Tally Self-Learning Guide and Work Book, Volume 1, Tally Solutions Pvt Ltd., 2005
- Final Accounting Tally 7.2, Insys Tally Accounting Professional Part-1,

Unit - 13 : STATISTICAL PACKAGES

Structure of the Unit

13.0 Objective

This unit provides a general overview of

- Understand the concept of Statistical packages
- Understand different types of statistical packages and their differences
- Understanding the power of Stata as a statistical package
- Able to undertake elementary data management and statistical analyses in Stata
- Understand the different types of command in Stata
- To learn how to obtain descriptive statistics with Stata

13.1 Introduction

Statistics allow us to collect, organize, describe, quantify, and summarize data. **Statistics** is a branch of mathematics used to summarize, analyze, and interpret a group of numbers or observations. Statisticians may apply their knowledge of statistical methods to a variety of subject areas, such as biology, economics, engineering, medicine, public health, psychology, marketing, education, and sports statistics is a set of tools used to organize and analyze data.

A family counselor may use statistics to describe patient behavior and the effectiveness of a treatment program. A social psychologist may use statistics to summarize peer pressure among teenagers and interpret the causes. A college professor may give students a survey to summarize and interpret how much they like (or dislike) the course. In each case, the counselor, psychologist, and professor make use of statistics to do their job.

13.2 Statistical Packages

Statistical packages are collections of software designed to aid in statistical analysis and data exploration. The vast majority of quantitative and statistical analysis relies upon statistical packages for its execution. An understanding of statistical packages is essential to correct and efficient application of many quantitative and statistical methods. Although researchers can, and sometimes do, implement statistical analyses in generalized programming languages such as FORTRAN, C++, and Java. Statistical packages offer a number of potential advantages over such "hand coding." First, statistical packages save the researcher time and effort.Statistical packages provide software for a range of analyses that would take years for an individual programmer to re-implement. Second, statistical packages can provide a unified operating framework and common interface for data manipulation, visualization, and statistical analysis.

Statistical procedures fall loosely into two general categories: descriptive and inferential.

Descriptive statistics are procedures used to summarize, organize, and make sense of a set of scores or observations. Descriptive statistics aim to describe the prominent features within a collection of data quantitatively. It summarizes a collection of data as a description rather than using the data to learn about the field in which the data represents.

Descriptive statistics are typically presented graphically, in tabular form (in tables), or as summary statistics (single values). Descriptive Statistics are used to present quantitative descriptions in a manageable form. Descriptive statistics help us to simply large amounts of data in a sensible way. Each descriptive statistic reduces lots of data into a simpler summary.

For example, the sports sections of newspapers tend to give statistics on the performance of many players such as the amount of goals scored compared with the amount of goal attempts. This is a descriptive statistic as it summarizes the data in a quantitative manner.

Inferential statistics are procedures used that allow researchers to infer or generalize observations made with samples to the larger population from which they were selected.

Inferential statistics is the given title of a process of gaining knowledge from a set of data that are subject to random change or variation. Such data sets would render a descriptive statistic meaningless as the data changes in an unpredictable way. Therefore no knowledge would be gained about the subject that the data represents. The outcome to such a statistical method may be a prediction that can then be used to ensure practical action to be taken.

For example, it may have influence when making managerial decisions that affect the future within a business.

13.2.1 Types of Statistical Packages

Choosing a statistical software package in a company or research institution is often a strategic decision. The decision entails the investment of time and money, and you should think about the future development and compatibility of the software. The main software bundles for statistical computing are R (www.r-project.org), SAS (www.sas.com), SPSS (www.spss.com), and Stata (www.stata.com). There are many more packages in the market, some of them specialized for specific statistical problems.

Statistical software can either be used by command line or by point-and-click menus, or both. The command line usage has the invaluable advantage that all steps of the analysis, and thus all results, are

easily replicable. In contrast, menu usage might make it very difficult to replicate results, especially in larger projects.

R:

R is a free software package which is designed for use with command line only. While being a language is one of R's greatest strengths, it can make it harder to learn for those without programming experience.

R is extremely versatile in graphics, and generally good for people who really want to find out "what their data have to say".

SAS:

SAS is the second most costly package. It can be used with, both, command line and graphical user interface (GUI). SAS is particularly strong on data management (especially with large files), and good for cutting edge research. It covers many graphical and statistical tasks. The main focus is on business customers now.

SPSS:

SPSS is the first choice for the occasional user. However, it is the most expensive of the four. SPSS is clearly designed for point-and-click usage on the GUI. A command structure exists, but it is not well defined and sometimes inconsistent. SPSS is good for basic data management and basic statistical analysis, but rather weak in graphics. In the future, SPSS might be the weakest of the four packages with regard to the scope of statistical procedures it offers due to its main focus on business customers.

Stata:

Stata is designed for the usage by command line, but it also offers a GUI that allows for working with menus. The simple and consistent command structure makes it rather easy to learn. It is the cheapest of the packages that entail costs, and it offers additional reductions for the educational sector. Stata is relatively weak on ANOVA, but extraordinary on regression analysis and complex survey designs. Stata is completely focused on scholars. In the future, Stata may have the strongest collection of advanced statistical procedures.

Comparison of data analysis packages: R, Matlab, SciPy, Excel, SAS, SPSS, Stata

Name	Advantages	Disadvantages	Open source?	Typical users
R	Library support; visualization	Steep learning curve	Yes	Finance; Statistics
Matlab	Elegant matrix support; visualization	Expensive; incomplete statistics support	No	Engineering
Excel	Easy; visual; flexible	Large datasets	No	Business
SAS	Large datasets	Expensive; outdated programming language	No	Business; Government
Stata	Easy statistical analysis		No	Science
SPSS	Like Stata but more expensive and worse			

13.3 Stata

Stata is a powerful statistical package with smart data-management facilities, a wide array of up-to-date statistical techniques, and an excellent system for producing publication-quality graphs. It is relatively cheap. Stata is a powerful,fast and yet easy-to-use statistical package that runs on Windows, Macintosh and Unix platforms.

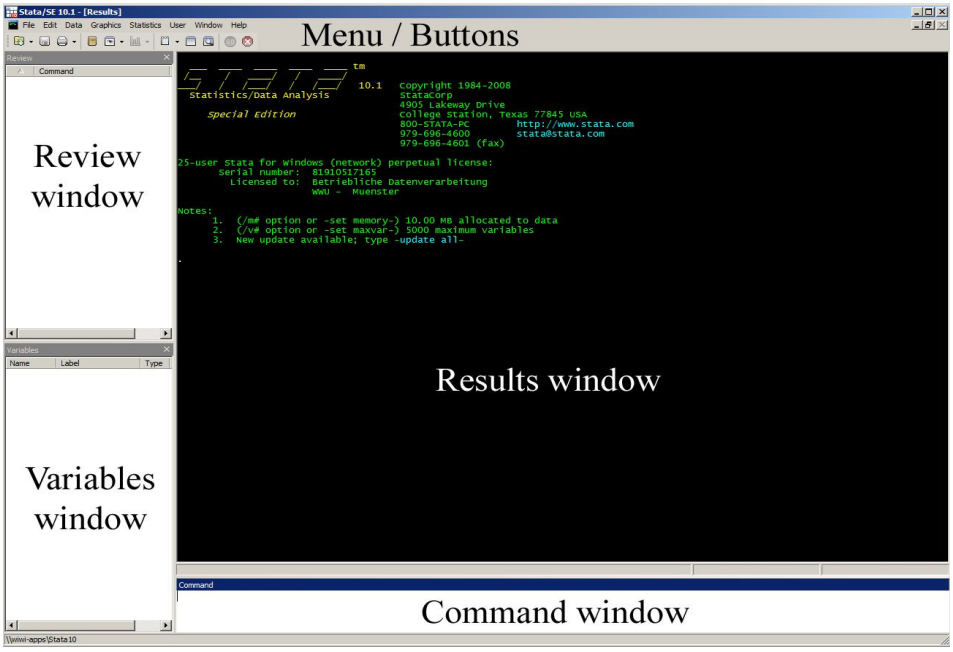
STATA is offered in four versions: Small, Intercooled Stata, Special Edition (SE). and Multi-processing (MP). Small is a student version, limited in the number of variables (99) and observations (1000), but otherwise complete in functionality. The Intercooled Version is the standard version. It supports up to 2,047 variables in a data set, with the number of observations limited by available RAM (technically, as large as 2.147 billion), as the entire data set is held in memory. Intercooled allows matrices ofup to 800 rows or columns. The SE version arose during the life of release 7.0 in response to users' needs for analyzing much larger data sets. Thus, SE allows significantly more variables in a data set (32,767) than Intercooled or Small, and supports larger matrices (up to 11,000 rows or columns). Advanced multiprocessing may be done through STATA MP version.

The Stata package is located under Start > Programs > Statistics.

13.3.1 Starting Stata

Let's get started. Click on the STATA icon to begin your session, or choose STATA 10 from your START window. Once you have started STATA, you will see a large window containing several smaller windows. At this point you can load a data set or enter data and begin the statistical analysis. These four windows correspond to four different environments, respectively:

Review Window Displays previous Stata commands entered in the current Session	**Results Window** Displays all the commands and relative results or feedbacks (for example, error messages)
Variables Window Lists all the variables in the currently open dataset	**Stata Command Window** It is where all the entered commands



Screenshot of Stata user-interface

The Menu Bar

Like most windows programs, Stata uses a set of menu items from the top bar of the window. Run through them looking at the options available to you

Results window

All outputs appear in this window. Only graphics will appear in a separate window.

Command window

This is the command line where commands are entered for execution.

Variables window

The Stata Variables window simply lists all the variables in the Stata data set that is currently open. Variable names can be added to the Command window, or to GUI procedure screens, by double-clicking variable names in this window.

Review window

Previously used commands are listed here and can be transferred to the command window by clicking on them.

Buttons

The most important button functions are the following:

- Open (use): Opens a new data file.
- Save: Saves the current data file.
- Print results: Prints the content of the results window.
- New Viewer: Opens a new viewer window, e.g. to open log-files.
- New Do-file Editor: Opens a new instance of the do-file editor (same as doedit).
- Data Editor: Opens the data editor window (same as edit).
- Data Browser: Opens the data browser (same as browse).
- Break: Allows to cancel currently running calculations.

Menu

Almost all commands can be called from the menu. We do not recommend to learn Stata using the menu commands since the command line will give the user much better control and allows for a much faster and more exact working process.

Stata is a command-driven package. You type in the commands you want rather than pick them from pull-down Windows menus. It has many in-built commands that can make easy work of complicated econometric routines. And there is also the possibility of creating your own commands to do anything that Stata is not equipped to do itself. Thus, it is a good package to learn if you intend to do any applied work in the future.

You can enter commands in either of two ways:

- Interactively: type the first command and execute it (hit <Return> or <Enter>), then the next, and so on.
- Do-file: type up a list of commands in a "do-file" (essentially a computer program) and execute the do-file.

13.4 General commands

Update

Stata offers a convenient update function over the internet. The update status of the currently installed Stata version can be compared with the one on the Stata website using update query. The actual update can then be performed with update all.

cd

Stata uses a working directory where datasets are saved if no path has been entered. The current working directory is displayed on the status bar on the bottom of the user interface. It can also be displayed in the results window by using the command pwd. The working directory can be changed by using the command cd (**c**hange **d**irectory). An example would be:

Example: cd D:/data/project1

or: cd data/project1 if you are already on drive D.

If a directory name contains spaces, the whole path has to be entered with quotation marks, e.g. cd **"**C:/Documents and Settings/Admin/My Documents/data**"**.

Use cd .. (mind the space in between) to get to the subordinate directory. The content of the current working directory can be displayed with dir.

If the directory path is long, using the menu can save a lot of time: File > Change Working Directory.

An alternative way to get to a certain working directory is to open any dataset or do-file From the directory in which you want to work. Stata then automatically sets the working directory to this path. The dataset or do-file can be closed again, but the path is retained, which is sometimes quicker than entering the whole path with the cd command.

help

The help screen for any command can be displayed in a separate window with the help command:

Syntax: help *command*

Example: help cd

For functions using parentheses, like sum() for example, the brackets also need to be entered for the help: help sum().

findit

The command findit is the best way to search for information on a topic across all sources, including the online help, the FAQs at the Stata web site, the Stata Journal, and all other Stata-related internet sources:

Syntax: findit *word* [*word*…] *Code in square brackets [] is optional*

Example: findit akash

You can look up the meaning of error messages by either clicking on the return code or by using findit rc #, whereas # stands for the number of the return code (e.g., findit rc 131).

set memory

Stata reads the whole dataset into the working memory, thus, sufficient memory has to be reserved or an error message will be displayed. Therefore, you should set the size of the working memory reserved for Stata before loading a (big) dataset with the command set memory:

Syntax: set memory *Xm* [, permanently]

Example: set memory 100m

X represents the number of megabytes and the permanently option allows for a permanent setting of the respective memory size.

display

The display command displays strings and values of scalar expressions (e.g., 2+3) in the results window. Strings have to be entered with quotation marks, e.g. display "Hello" would simply print the word *Hello* on the screen.

Syntax: display [*subcommand* [*subcommand* [...]]]

Example: display "Hello"

13.4.1 File management: keeping track of the work in Stata

Sometime it can be recommended to keep all the work needed for a project or a paper in the same directory. It is possible then to create a separate subdirectory,

For example, **HDCA sumsch** and tell Stata to save everything is done in the session in the same directory. This can be done by typing at the beginning of the session:

cd "c:\HDCAsumsch"

The subdirectory will contain all the datasets and file created and saved during each work session.

The results window displays the last command typed and the related results produced by Stata. It always possible to scroll up the results windows to see what has been done before, but it's not possible to display all the commands from the beginning of the session because the contents of the window are limited.

Log Files

Stata loads the data in the memory and does not modify the original file unless you decide to do

so. This is convenient especially when you are experimenting with the data, because it prevents the original file from getting corrupted. Retyping all the instructions every time you work in Stata can be really boring, and therefore Stata features some options that automatically keep a record of every command you type and of the results you obtain in every session.

After you open Stata type in:

- log using [your log name]

This will start a new file where Stata will save everything you type on the command window and its corresponding result. The text option tells Stata to create a text file that you can open in any the Notepad viewer or any other word processor, if you don't include this instruction Stata will create a log file in a different format (with .smcl extension) that you can only view in Stata (although you can convert it to a text file easily). The file will include the time you opened and closed your Stata session, error messages, tables, regression results, etc.

Before you finish your session, type in the command line

- log close, text

In your next session if you want to use a different log file you can do so, or you can just use an old one:

- log using [your log name], append text

This command tells Stata to open your log file and save any information added during the new session. If you don't include the instruction append Stata will try to create a new log file, and if that file already exits the program will display an error message.

13.4.2 Data management: opening, creating and saving a dataset in Stata

To perform any analysis with Stata, it's necessary to open a Stata dataset. Before doing it, it's better to clear out any other dataset currently in memory, typing:

. **clear**

To open a Stata dataset for use, type the **use** command, eventually followed by the option clear.

For example, for the Jaipur dataset:

. use Half_sample_Jaipur.dta

. use Half_sample_Jaipur.dta, clear

At the end of each session, to save a dataset in Stata (.dta file extension) use the **save** command specifying the name assigned to the database.

. save

Jaipur_Hdca.dta

It is possible to save a dataset anytime during your session and the continue working on the data and made changes. These changes are not saved in the memory and do not change data already stored on the pc. The **replace** option allows to save a changed file to the disk, replacing the original file.

. save Jaipur_Hdca.dta, replace

Methods of creating a dataset in stata

There are different method for creating a database in Stata.

1) The first and the easiest method when one have raw data, is using the Stata data editor, which is very similar an Excel spreadsheet. You can access the editor by typing:

. edit

and then enter values and press return. To change the name of the variable (originally called var1,var2, etc.), double click on the column head and change the name of the variables.

If you have data already organize in an Excel spreadsheet, it's also possible to just select, copy and paste them into the Stata editor.

2) A second way of creating dataset in Stata is to use **input** command, then enter your own data set in command window or do file editor.

input hhid sex location

10030 1 urban

10031 0 rural

10032 1 rural

End

3) The third option is to use the **insheet** command. This command is used to read data from a comma separated or tab delimited file (.csv) created by a spreadsheet (like Excel) or database program. The values in the file must be either comma or tab delimited. The names are included in the file. To use the in sheet command, the original database should appear in the following way:

hhid,sex,location

10030,1,urban

10031,0,rural

10032,1,rural

With the name of the variable in the first line and the values separated by a comma. If these data are contained in a file called Jaipur.csv, in order to transform them into a Stata dataset, type:

. clear

. insheet using jaipur.csv

If the name of variables is not included in the data, it is still possible to transform them into a Stata format using insheet command followed by the name of the variables:

. insheet hhid sex location using jaipur.csv

13.5 Organising datasets

1. rename

You may want to change the names of your variables, perhaps to make it more transparent what the variable is:

A variable can be renamed with the rename command:

Syntax: rename *old_varname new_varname*

Example: rename income hh_income

2. recode

The categories of a categorical variable can be conveniently changed with the recode command.

Syntax: recode *varlist* (*rule*) [(*rule*)...] [, generate(*newvar*)]

Rules have to be defined along the following example pattern:

3 = 1 3 recoded to 1

2 . = 9 2 and . recoded to 9

1/5 = 4 1 through 5 recoded to 4

3. drop

Variables or observations can be deleted using the drop command. Variables are deleted using the following version of drop:

Syntax: drop *varlist*

Example: drop year91-year99

Observations are deleted by applying another version of drop:

Syntax: drop if *exp* or drop in *range* [if *exp*]

Example: drop if gender == "male"

or: drop in -100/l for dropping the last 100 observations

4. keep

This command works opposite to drop as it keeps variables or observations rather than deleting them. Keeping variables is done with:

Syntax: keep *varlist*

Example: keep year91-year99

For keeping observations you use:

Syntax: keep if *exp* or keep in *range* [if *exp*]

Example: keep if gender == "male"

5. sort

For many Stata operations, it is important what order your observations are in. Data is sorted in ascending order with the sort command:

Syntax: sort *varlist*

Example: sort gender age income

Descending ordering can be done with gsort, whereas a minus in front of a *varname* invokes descending order:

Syntax: gsort [+|-] *varname* [[+|-] *varname* ...]

Example: gsort -age income

6. format

format allows you to specify the display format for variables. The internal precision of the variables is unaffected. Various format types exist for string, date, and numerical

variables (see help format):

Syntax: format *varlist %fmt*

Example: format income %9.2g

7. label

There are two ways to label variables. The first one is to label the variable itself:

Syntax: label variable *varname* ["*label*"]

Example: label variable hh_income "Household income"

The second option is to assign labels to the values of categorical variables. This is done in two steps. First, a value label has to be defined:

Syntax: label define *lblname* # "*label*" [# "*label*" ...]

Example: label define city_label 1 "Bonn" 2 "Hamburg"

Second, this value label is assigned to the respective variable:

Syntax: label values *varname* [*lblname*]

Example: label values city city_label

8. order

The order of the variables as seen in the variable window can be changed with the order command:

Syntax: order *varlist*

Example: order person_id date

The command orders variables in the variables windows in the order of *varlist*. The command order, alphabetic puts all variables in alphabetical order. A single variable can be moved to a specified position with e.g. order, before(*varname*).

13.6 Creating Variables

Stata can store data as either numbers or characters. Stata will allow you to do most analyses only on numeric data.

There are different types of numeric variables - float, binary, double, long and int . The differences among them are simply how much space they take up in the file. In most cases, you will not need to concern yourself with these differences.

Generate (gen)

The "gen … real" command will create a numeric variable based on the original string variable.

Syntax: generate [*datatype*] *newvar =exp* [if] [in]

Use this if the original was defined as a character variable "by mistake." The following command will create a new, numeric variable var1n by converting the string variable, var1:

. gen var1n=real(var1)

Often, you will need to create new variables based on the ones you have already. The two most common ways of creating new variables is by using "generate" and "egen." Here are some examples of gen:

. gen total= var1n + var2 + var3

. gen cumtot=sum(total)

In the first example, we generate a new variable called "total" which is simply the addition of var1, var2, and var3. In the next example, we create a cumulative sum of total (the value of cumtot for this observation is the sum of total for all previous observations).

· **Arithmetical operators used in Stata**

+ Addition

- Subtraction

* Multiplication

/ Division

^ Power

· **Logical operators used in Stata**

~ not

= = equal

~ = not equal

! = not equal

> greater than

> = greater than or equal

< less than

< = less than or equal

& and

| or

Extended Generate (egen)

"egen", or "extended generate" is useful when you need a new variable that is the mean, median, etc. of another variable, for all observations or for groups of observations. Egen is also useful when you need to simply number groups of observations based on some classification variables.

Syntax: egen [*datatype*] *newvar* = fcn(arguments) [if] [in] [, *options*]

Here are some examples:

. egen sumvar1 = sum(var1)

. egen meanvar1= mean(var1), by(var3)

. egen count = count(id), by(company)

. egen group = group(month year)

There are many functions that can be used with "extended generate".

13.7 Descriptive statistics with Stata

· **Summarize**

"sum", short for summarize, will give you the means, standard deviation, etc. of the variables listed. If you don't list any variables, it will give you the information for all numeric variables. If a variable you thought was numeric shows up as having 0 observations and a mean of 0, then, most likely, Stata still thinks it's a character variable.

Syntax: summarize [*varlist*] [if] [in] [*weight*] [, *options*]

Example: sum var1 var2

The "detail" option gives you additional information about the distribution of the variable.

. summ var1 , detail

· **Tabulate**

"tab", short for tabulate, will produce frequency tables. By specifying two variables, you will get a crosstab. There are other options to get the row, column and cell percentages as well as chisquare and other statistics;

Syntax: tabulate *varname* [if] [in] [*weight*] [, *options*]

· **inspect**

The inspect command provides a quick summary of a numeric variable that differs from that provided by summarize or tabulate:

Syntax: inspect [varlist] [if] [in]

It reports the number of negative, zero, and positive values; the number of integers and non-integers; the number of unique values; and the number of missing values; and it produces a small histogram. Its purpose is not analytical but it allows to quickly gain familiarity with unknown data.

13.8 Data merging

· **append**

A dataset can be appended to the end of the one currently used by using the append command. If the data types of the variables are not the same Stata will promote data types and will keep all variables when the two datasets have differing variable names:

Syntax: append using *filename*.dta [, *options*]

· **merge**

Datasets sharing the same kind of observations, but having different variables, can be joined with the merge command. Then, the currently used dataset ("master" dataset) is extended with the corresponding observations from one or more other files ("using" datasets):

Syntax: merge 1:1 *varlist* using *filename*.dta [, *options*]

One-to-one merge

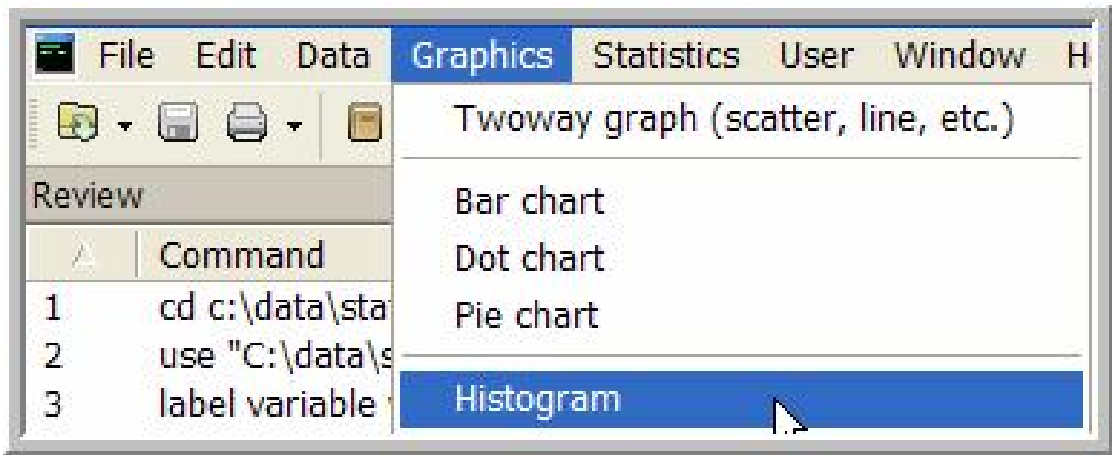
Syntax: merge m:m *varlist* using *filename*.dta [, *options*]

Many-to-many merge

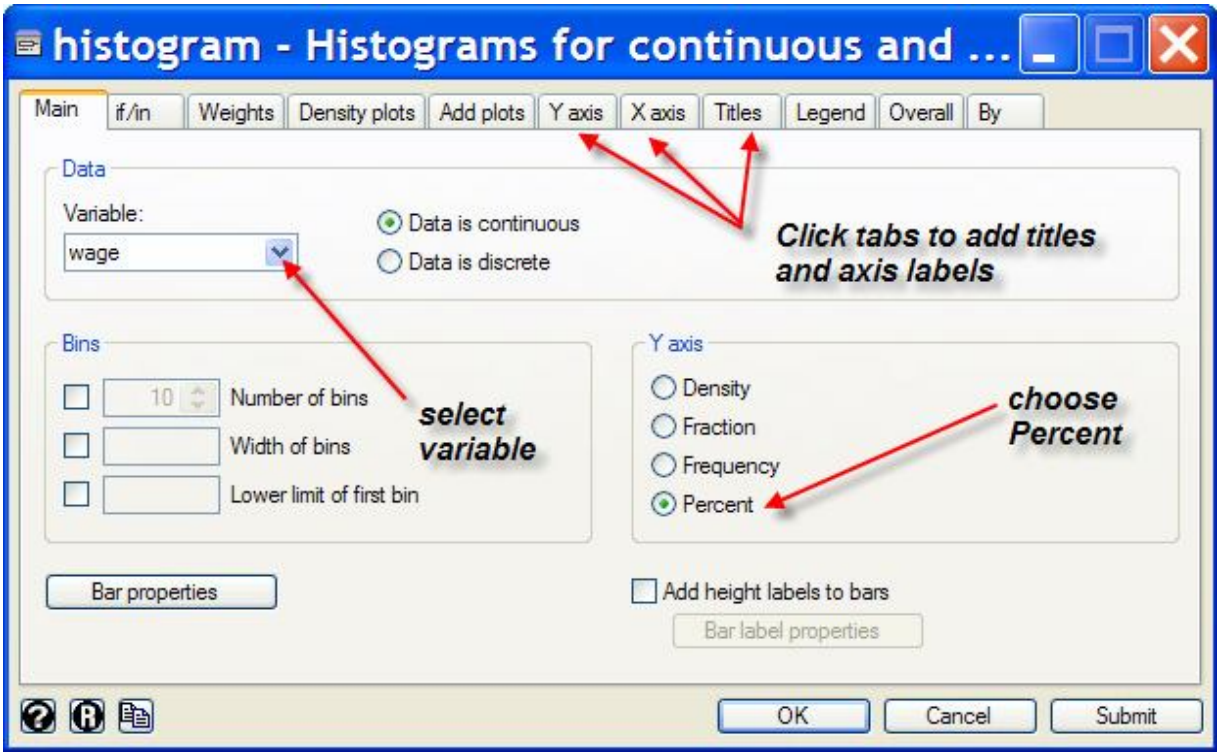
13.9 STATA GRAPHICS (Histograms)

Stata has excellent graphic facilities, accessible through the graph command. The most common graphs in statistics are X-Y plots showing points or lines. These are available in Stata through the twoway subcommand, which in turn has 31 sub-subcommands or plot types, the most important of which are scatter and line.

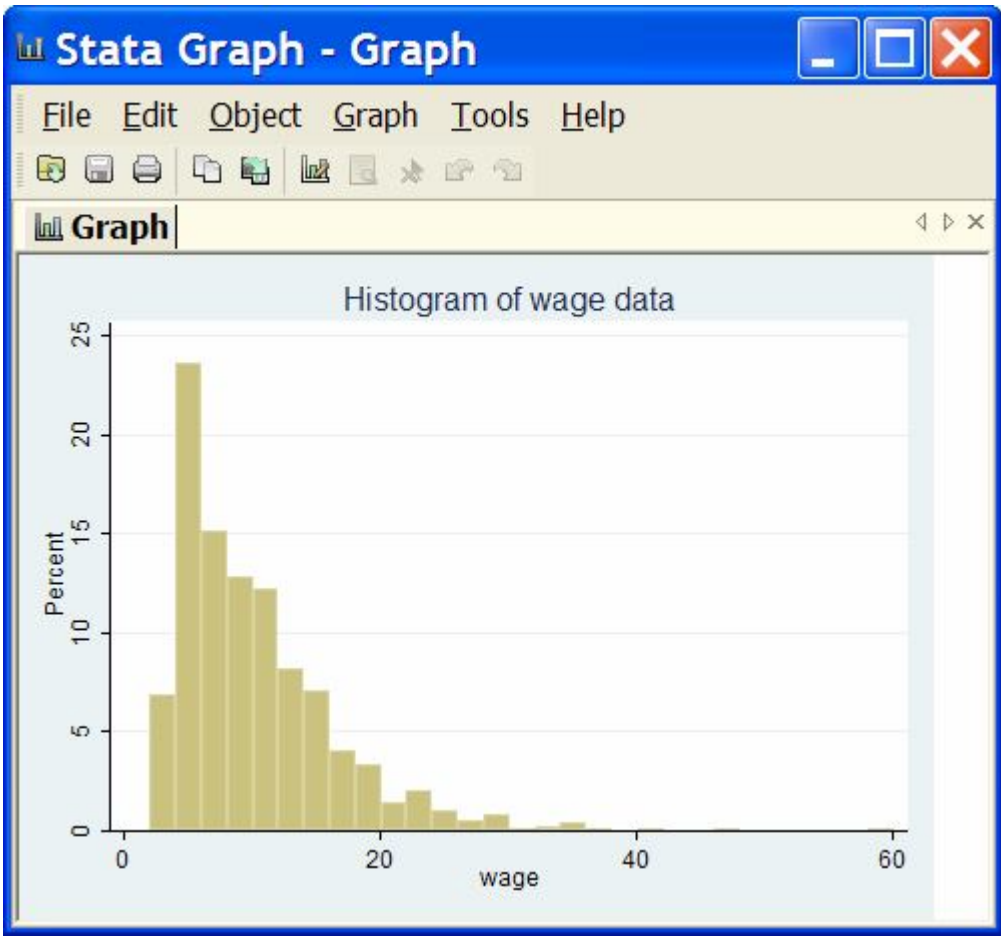
Click on **Graphics > Histogram** on the Stata menu



In the resulting dialog box there are again many options. For a simple histogram all you need to is select is the variable from the pull-down list. For illustration, we have entered a title by clicking the **Titles** tab and filling in a box. Click **OK**.



The resulting figure is



On the graph toolbar you have several options.

Click on the **Save graph** icon. The resulting dialog box shows that the graphics file will be saved into **C:\data\stata**. Attach a file name and choose the type of graphics file from the drop-down list. This book uses **png** files.

Having saved the file, in your word processor you can insert the image as a figure into a document. Alternatively, if you choose the **Copy graph** icon the figure will be copied to the clipboard, and then the figure can be pasted (**Ctrl+V**) into an open document.

13.10 Summary

It was easy to learn and was powerful enough to handle complex data. Most importantly, to use Stata when they needed to analyze their own research data. It is anticipated that, now that Stata has been added to their toolkit, participants should now be able to identify when they will use each of the four packages.Statistics in acquiring knowledge and making decisions in today's society.

13.11 Self Assessment Questions

1. Read the data into Stata using insheet.
2. Use rename to rename the variables v1 to v3 to time1 to time3. Also try doing this in a single command using for.
3. What do you understand by statistics Packages?
4. Explain different statistical packages.

5. Explain the following commands:

   (A) sort (B) recode (C) format

6. Define and differentiate each of the following:

   a. Descriptive analysis

   b. Inferential analysis

13.12 Further Readings

- Data Analysis Using Stata, Third Edition by Ulrich Kohler and Frauke Kreuter
- Thirty-three Stata Tips by H. Joseph Newton and N. J. Cox Stata Press
- Data Management Using Stata: A Practical Handbook by Michael N. Mitchell Stata Press
- *A Gentle Introduction to Stata* by Acock, Alan C. Stata Press.
- *An Introduction to Modern Econometrics Using Stata*, by Baum, Christopher F. Stata Press.
- *Statistics with Stata*, Brooks/Cole by Hamilton, Lawrence C.

Unit - 14 : E-Commerce

Structure of the Unit

14.0 Objective

This unit provides a general overview of :

- E-commerce concept
- Advantages and Disadvantages of e-commerce
- Issues related with e-commerce implementation
- Electronic Data Interchange
- Types of EDI
- Working of EDI
- Types of EDI
- Working of EDI

14.1 Introduction

Commerce is an act of trade between two parties where the exchange is negotiated under a set of jointly acceptable conditions, so that both parties come out satisfied with the result. The trade may depend on whether the two parties are prepared to trust one another. Ecommerce or electronic commerce is nothing but a business over the internet with the help of computers, which are linked to each other forming a network.

It is the process of conducting all forms of business through computer network and digital communication. The concept of e-commerce is all about using the internet to do business better and faster. It is about giving customers controlled access to ones computer systems and letting people serve themselves. To be more specific, e-commerce would be buying and selling of goods and services and transfer of funds through digital communications.

14.2 Advantages of E-commerce

General advantages are as follows:

- It not only provides faster buying/selling procedure but also provide easy way to find products.
- With the help of e-commerce, businesses can gain higher margins, more control and flexibility.
- It provides facility to buy/sell products 365X24X7.
- There are no theoretical geographic limitations in e-commerce, thus help in approaching to the large number of customers easily.
- Low operational costs and better quality of services.
- For making transactions through e-commerce, there is no need of physical company set-ups.
- E-commerce makes easy to start and manage any business.
- Eletronic marketplaces improve information sharing between merchants and customers and promote quick, just–in–time deliveries.
- With the help of e-commerce, customers can easily select products from different providers without moving around physically.
- E–commerce means better and quicker customer service. Online customer service makes customers happier. Instead of calling your company on the phone, the web merchant gives customers direct to their personal account online. This saves time and money.

14.3 Disadvantages of E-commerce

- When user makes transaction online, there is no guarantee of product quality.
- Computer or network failures can cause unpredictable effects on the total processes.
- As there is minimum chance of direct customer to company interactions, customer loyalty is always on a check.
- Security continues to be a problem for online businesses. Customers have to feel confident about the integrity of the payment process before they commit to the purchase. Not only this but also there are many hackers who look for opportunities, and thus an ecommerce site, service, payment gateways, all are always prone to attack.
- On the surface, the electronic marketplace seems to be a perfect market, where worldwide sellers and buyers share and trade without intermediaries. However, a closer look indicates that new types of intermediaries are essential to e–commerce. They include electronic malls that guarantee legitimacy of transactions. All these intermediaries add to transaction costs.
- With the help of e-commerce any one, good or bad, can easily start a business, and there are many bad sites which eat up customers' money.
- All products cannot be purchased online. For example imagine a website called furniture.com or living.com, where venture capitalists are investing millions in selling home furnishings online. In the case of a sofa, one would want to sit on it, feel the texture of the fabric etc. but in case of online shopping, it wouldn't be possible.

14.4 Applications of E-commerce

Various applications of e-commerce are continually affecting trends and prospects for business over the Internet, including e-banking, e-tailing and online publishing/online retailing. E commerce from a

business perspective offer an opportunity to cater to consumers across geographies, no operational timings, unlimited shelf space – and all this with miniscule quantity of infrastructure. For a country like India, this business model is a good way of growing the consumption driven economy.

I. E-banking

A more developed and mature e-banking environment plays an important role in ecommerce by encouraging a shift from traditional modes of payment (i.e., cash, checks or any form of paper-based legal tender) to electronic alternatives (such as e-payment systems), thereby closing the e-commerce loop.

Advantages:

- Banking from home
- One can make transfers and other changes while the bank is closed
- Most banks work through an encrypted channel with clients' information.
- Banking around the clock is no longer a remote possibility. But the banks don't have to keep their branches open 24 hours a day to provide this service. This is one of the biggest advantages of Internet banking.
- One doesn't have to go to the bank's branch to request a financial statement. You can download it from your online bank account, which shows you up-to-the-minute updated figures.
- As far as customers are concerned, their account information is available round the clock, regardless of their position. They can rearrange their future payments from their bank account while sitting thousands of miles away. They can electronically transfer money from their bank accounts or receive money in their bank accounts within seconds.
- Another advantage of Internet banking is that it is cost-effective. Thousands of customers can be dealt with at once. There is no need to have too many clerks and cashiers. The administrative work gets reduced drastically with Internet banking. Expenditures on paper slips, forms and even bank stationery have gone down, which helps raise the profit margin of the bank by a surprisingly large number.
- One can download a file that holds account information to easily reconcile his/her statement with his financial management software.
- It is easy to view recent transactions and monitor own account

However, with advantages, e-banking system is also suffered with some disadvantages. Some of these are as follows:

Disadvantages:

- In case of bank's server failure, one can't perform any transaction through it.
- Some banks charge their clients for online access.
- There's always the possibility of a cracker acquire access to clients' account..
- Internet connection of client must be working in order to have access.
- Many banks don't provide proper help regarding how to use online banking very well, and those are usually the ones with the non-intuitive interface and messy design, which makes it pretty easy for one to screw up something

I. E-tailing

E-tailing (or electronic retailing) is the selling of retail goods on the Internet. It is the most common form of business-to-consumer (B2C) transaction. The year 1997 is considered the first big year for e-tailing. This was when Dell Computer recorded multimillion dollar orders taken at its Web site.

There are a number of conventional functions which are found in all retailing applications, these include:

- Stock management: keeping track of what books are in stock and ordering titles when stocks become low;
- Payment management: paying suppliers of books for those that have been delivered.
- Customer payment management: keeping track of payments made by customers and of payments made by credit card companies and banks which correspond to the customer payments.
- Delivery: the process of sending books to customers.

Market analysis: the process of analyzing sales is market analysis. This analysis occurs at both the customer level and at a temporal level in that customer preferences are processed and the times and dates when they express these preferences are analysed; for example, in order to answer questions such as what books sell well at Christmas or at Easter?

I. Online Publishing

Electronic publishing or e-Publishing includes the digital publication of e-books and electronic articles, and the development of digital libraries and catalogues. Electronic publishing has become common in scientific publishing where it has been argued that peer-reviewed paper scientific journals are in the process of being replaced by electronic publishing. Although distribution via the Internet (also known as online publishing or web publishing when in the form of a website) is nowadays strongly associated with electronic publishing, there are many non network electronic publications such as Encyclopedias on CD and DVD, as well as technical and reference publications relied on by mobile users and others without reliable and high speed access to a network.(en.wikipedia.org)

14.5 Issues Related to E-commerce Implementation

Although, it is easy to describe e-commerce and the benefits resulting from its implementation, however, it's not so easy to develop and deploy e-commerce systems. Companies have faced significant hurdles in these efforts. There are so many factors that should be considered while implementing the e-commerce, these are as follows

Cost: E-commerce requires sophisticated, distributed systems based on new technologies that can tap many of a company's core business processes. As with all major business systems, e-commerce systems require significant investments in hardware, software, staffing, and training etc. Businesses need wide-ranging solutions that are easy to use and thus help enable cost-effective deployment. There are many reasons behind the heavy cost of e-commerce:

- High cost of Implementation
- Mistakes due to the lack of experience inflate the cost
- Justification of cost not on tangible factors and always based on intangible factors such as improved the customer service, increase the value of advertisement and gain competitive advantages.
- Accessibility the internet is still expensive

Trust: Customer trust is important such as friend recommendation, previous experience, or through transparent legislative infrastructure. Companies also need to well establish the "Brand Identity of the company.

Investment and Return: Businesses want to know the input and output of the e-commerce implementation i.e., what would be their investments in e-commerce systems that will produce a required return. They deploy e-commerce systems to achieve business objectives such as lead generation, business process automation, and cost reduction. They want to ensure that these objectives are met. Businesses also need flexible solutions so that they can easily adapt a system to meet changing business conditions.

Security related Issues: As we know, the Internet provides almost universal access; a company's assets must be protected against misuse, whether accidental or malicious. At the same time, that protection should not compromise a site's usability or performance nor make its development too complex. There is an additional security issue: Because e-commerce systems enable the collection and usage of sensitive information about individual customers, companies also need to protect the privacy of their customers. Consumers are found to be distrustful about the safety of the information. Many companies do not pay enough intention on security, that's why the companies get failed in building consumer confidence. To maintain this, network infrastructure and application systems must be continuously upgraded, fine tuned and maintained regularly.

Touch and Feel Functions: Most of the e-business working around on this limitation. Customer only buys a reasonable price on E-commerce web-sites. Customers generally avoid buying a high price product online. Therefore, web-sites still in use, for customers to conduct research on product and making comparison on price offered.

Extension of Existing Systems: Companies need to be able to connect the functionality of existing applications into e-commerce systems. Most companies new to e-commerce already use information technology to conduct business in non-Internet environments— in existing marketing, order management, billing, inventory, distribution, and customer service systems. The Internet represents an alternative and complementary way to do business. It's imperative that Internet e-commerce systems integrate existing systems in a manner that avoids duplicate function and maintains usability, performance, and reliability.

Interoperability: Interoperability here means the linking of trading partners' applications in order to exchange business documents. These systems must work together well in order to achieve business objectives. For example, the order-management application of a business partner must interoperate with the inventory applications of its suppliers. Interoperation between businesses reduces costs and improves performance. It enables the implementation of more dynamic value chains.

14.6 Electronic Data Interchange

The electronic data interchange (EDI) is a process by which exchange of business documents between companies are done from computer-to-computer. EDI replaces the faxing and mailing of paper documents. EDI documents use specific computer record formats that are based on widely accepted standards. However, each company will use the flexibility allowed by the standards in a unique way that fits their business needs.

14.6.1 Benefits of EDI

- Computer-to-computer exchange of information is much less expensive than handling paper documents as well as it reduces clerical workload

- Much less labor time is required
- Elimination of "Lost" invoices
- Reduction in form, postage, and handling expenses
- Greater emphasis on process improvements, and automated acknowledgement of data exchanged
- Better market position relative to non-EDI competitors
- Customer can dispatch payments electronically via EDI 820 transaction
- Elimination of data entry errors i.e., fewer errors occur because computer systems process the documents rather than processing by hand
- Reduction in cycle time makes business transactions flow faster.
- Faster transactions support reduction in inventory levels, better use of warehouse space, fewer out-of-stock occurrences and lower freight costs through fewer emergencies expedite.
- Paper purchase orders can take up to 10 days from the time the buyer prepares the order to when the supplier ships it. EDI orders can take as little as one day.

14.6.2 Limitations of EDI

- **Too Many Standards:** There are too many standards body developing standard documents formats for EDI. For example your company may be following the X12 standard format, while your trading partner follows the EDIFACT standard format.
- **Changing Standards**: Each year, most standards bodies publish revisions to the standards. This poses a problem to EDI users. One may be using one version of the standard while his trading partners may be still using older versions.
- **EDI is Too Expensive:** Some companies are only doing business with others who use EDI. If a company wants to do business with these organizations, they have to implement an EDI program. This expense may be very costly for small companies.
- **Costly Resources:** One more drawback to EDI is that companies must ensure that they have the resources in place to make an EDI program work; however, the need for buying and hiring these resources or outsourcing them may be offset by the increased efficiency that EDI provides.

14.6.3 Working of EDI

EDI is used in a variety of industries. Over 1,60,000 companies have made the switch to EDI to improve their efficiencies. Many of these companies require all of their partners to also use EDI. To start transactions via EDI, the first major question arises in mind is: What are the basic requirements for any company to setup EDI infrastructure? The answer is:

Requirements

EDI is simple to set up. All the Trading Partner needs to send or receive electronic transactions must have the following equipment and software capabilities:

- A mainframe, mid-tier, or personal computer.
- Translation software to format their business data into the American National Standards Institute (ANSI) X12 standard format for transmission interpretation.
- Third party service provider for processing their data if they do not have the hardware or software.

EDI Process

There are different steps of EDI transmission. The following figure shows all the steps involved in EDI Process.

Step-I

The purchase order is converted from the back-office format into EDI using some type of data transformation/mapping software or tool

Step-II

The EDI purchase order data is run through validation software that ensures it is structurally sound according to EDI standards

Step-III

The EDI data is transmitted to a Value-Added Network or other available options using some communication method (FTP, HTTP, HTTPS) that may be built into the validation software or may be another application

Step-IV

The VAN determines how to route the data and either hands it off to a different VAN used by the recipient or it is delivered to the VAN mailbox if the sender and receiver are using the same VAN service. The data has now crossed the line and is the responsibility of the recipient and their VAN service.

Step-V

The data remains in the recipients VAN mailbox until the recipient's systems check for and processes the document.

The general process flow for an EDI transmission.

The flow of information in EDI is as follows:

- Collection of data for its own operational or statistical necessities which is edited be added to its own data base
- Extraction of relevant information by the company from its database, summarized if necessary and constructed into EDI transaction sets, and finally it is transmitted to the targeted company, requiring it for valid reasons.
- The frequency of preparing this information depended upon the operational requirements of each recipient.
- A communication link for transmission is established according to the standard communication protocol.

- The receiver receives the information transmission, checks for its physical characteristics (parity check, character, transmission mode etc.), and requests for re-transmission if an error is detected in the physical character of the transmission.
- Checking the functional characteristics of the data receiver and an acknowledgement sent to the original sender for receiving the transmission and to identify any errors detected.
- To process the information received by the receiver according to its own internal procedures and timing requirements

14.6.4 Different Terms Associated of EDI Transaction

I. Mapping Data to EDI Transaction Formats

To exchange information using EDI, firstly the data must be translated into a format that fulfills with an EDI standard. Mapping is the initial process that describes how each piece of the original data, such as an invoice relates to the "EDI transaction" standard being used. The transaction software uses this mapping process to translate the EDI transactions so they can be used by the receiving Trading Partner.

II. EDI Standards

The sender and receiver must use the same standards so that everyone is speaking the same language. The American National Standards Institute (ANSI) Accredited Standards Committee (ASC) X12 defines EDI Standards. This is a cross-industry standards body with representation from many industries interested in EDI. The X12 standards serve as a common business language allowing all EDI trading partners to communicate electronically with one another.

The X.12 standard is made up of hundreds of documents called 'Transaction Sets'. Transaction sets are made up of 'Data Segments' and 'Data Elements,' of which there are hundreds, and thousands respectively, in the standards dictionary. By putting various combinations of data segments and data elements together in a structured format, one ends up with a transaction set that has meaning.

There is flexibility in how an industry or company uses the EDI standards. For example, a purchase order going from a retailer to its supplier will look very different from a purchase order going from a mining company to its supplier. The drawback is when one supplier purchase orders from five different customers, and they each structure their 850s differently. The supplier is burdened with the task of handling the five different 850 layouts.

III. Transportation of Data

Data, which is standardized through EDI software on both the Trading Partners' computer, is transmitted directly from one company's computer to the other. There may be different options available for transporting invoice data for example Value Added Network, DMZ Secured FTP (SFTP) or B2B SFTP

Value Added Network (VAN)

VAN acts much the same way as a post office except, the data is retrieved on request by the addressee directly into their computer.

DMZ Secured FTP (SFTP)

DMZ Secured FTP (SFTP) is ideal for Trading Partners that want to control pushing and pulling invoice files from receiving server.

B2B SFTP

B2B is ideal for Trading Partners that want receiving company to push and pull files from the Trading Partners server.

IV. Components of EDI

A typical EDI system converts generic EDI message format to any RDBMS format and vice-versa. RDBMS database contains the data to be translated into EDI format and where EDI data is to be converted and written. EDI configuration programs do these translations. The three main components of EDI system are as follow:

Application Service: It provides the connection between a business application and EDI. It helps us to send documents to, and receive documents from EDI systems.

Translation Service: It translates outgoing documents from an internal format to an agreed external format. It also helps in conversion of incoming documents from an external format to internal format.

Communication Service: The communication service sends and receives files to be transmitted to and from both the trading partners either directly or by using third party service called value added networks.

14.7 Summary

- Ecommerce or electronic commerce is a business over the internet with the assistance of computers, which are linked to each other forming a network.
- E-commerce not only provides faster buying/selling procedure but also provide easy way to find products.
- With the help of e-commerce, businesses can gain higher margins, more control and flexibility.
- It provides facility to buy/sell products 365X24X7.
- Various applications of e-commerce are continually affecting trends and prospects for business over the Internet, including e-banking, e-tailing and online publishing/online retailing.
- Various applications of e-commerce are continually affecting trends and prospects for business over the Internet, including e-banking, e-tailing and online publishing/online retailing.
- There are so many factors that should be considered while implementing the e-commerce like cost, trust, security etc.
- The electronic data interchange (EDI) is a process by which exchange of business documents between companies are done from computer-to-computer.
- EDI replaces the faxing and mailing of paper documents.
- There are three main components of EDI system named: Application Service, Translation Service and Communication Service

14.8 Self Assessment Questions

1. Define E-commerce and also explain different advantages and disadvantages of E-commerce.
2. Explain any two applications of E-commerce.
3. What is EDI? Explain working of EDI in detail.
4. Explain different parameters that must be considered while implementing a E-commerce.
5. Name different components of EDI system.

Unit - 15 : Bluetooth

Structure of the Unit

15.0 Objective

This unit provides a general overview of

- Concept of Bluetooth
- History of Bluetooth
- Advantages and Disadvantages of Bluetooth
- Bluetooth Architecture, profile, addresses and RF classes
- Protocols related with Bluetooth
- Bluetooth operations i.e., Discovering, connecting and pairing.
- Security provided by Bluetooth Technology

15.1 Introduction

Bluetooth is a wireless technology that is put together into many different electronic gadgets like mobile phones, laptops notebooks etc. It lets us talk and share information like music, voice, and videos wirelessly. Bluetooth technology uses radio waves just like mobile phones, television, and FM radio. The difference between those devices and Bluetooth technology is distance. Radios and television broadcast data to many people over many miles. Whereas, Bluetooth technology just sends information to one's

personal space. This personal space is called as PAN i.e., Personal Area Network. This goes up to a distance of up to 33 feet. If one finds a Bluetooth in a product's description, that means the product will have a piece of hardware or a small computer chip that contains the Bluetooth radio. It will also contain software that lets the user, the person who has the product; connect that product to other products that are also using Bluetooth technology. This connection is wireless.

Concepts of Bluetooth Technology

- *Bluetooth is a wireless personal area network - WPAN - communication system standard that gives permissions to wireless data connections to be dynamically added and removed between nearby devices.*
- *Each Bluetooth wireless network can have up to 8 active devices and is called a Piconet. Piconets can be coupled to each other (overlap) to form larger area Scatter-nets.*
- *The system directs for Bluetooth requires one device to function as the coordinating device - master - while all of the other devices are slaves. Most Bluetooth devices can work as either a master (coordinator) or slave (follower) and Bluetooth devices can reverse their roles if essential.*
- *The characteristics of Bluetooth comprise an unlicensed frequency band that varies from 2.4 GHz to 2.483 GHz. This frequency band was selected because it is available for use in most of the countries throughout the world.*
- *While the standard frequency band for Bluetooth is in the 2.400 GHz to 2.483 GHz (83 MHz) frequency band, the original Bluetooth specification had an optional smaller frequency band 23 MHz version for use in some countries.*
- *The use of a smaller frequency band does not change the data transmission rate. However, these devices are more responsive to interference (such as other Bluetooth device transmission). This interference may result in a lower overall data transmission rate.*

15.2 History of Bluetooth

The technology used by Bluetooth relates back to discoveries pioneered in the 1940's by the military. The engineers at a Swedish company called Ericsson invented the Bluetooth technology in 1994. A group of companies, in 1998, worked together to connect their products using Bluetooth technology.

Seeing that the Bluetooth technology worked, the companies formed the Bluetooth Special Interest Group (SIG). This organization is devoted to maintaining this technology. Bluetooth technology is not owned by a single company but the members of the Bluetooth SIG all work together to develop the technology.

When SIG came into existence, Bluetooth was the code word for SIG. They designed Bluetooth technology to allow collaboration between different industries. An example of this collaboration is automotive markets and mobile phones.

The Bluetooth SIG

- The name "Bluetooth" and its logo are trademarked by the privately held trade association named the Bluetooth Special Interest Group (SIG).
- It was founded in September 1998; the Bluetooth SIG is a unification of leaders in the telecommunications, computing, network, industrial automation, and automotive industries. Today, the Bluetooth SIG is responsible for encouraging and supporting research and development in Bluetooth technology.
- The Bluetooth SIG includes promoter member companies Microsoft, Ericsson, IBM, Intel, Agere, Motorola, Nokia, and Toshiba, plus thousands of Associate and Adopter member companies (BlueTomorrow.com's parent company, SP Commerce LLC, is a licensed and certified Adopter member of the Bluetooth SIG).
- The developers of this wireless technology first used the name "Bluetooth" as a code name, but as time passed, the name stuck.
- The word "Bluetooth" is taken from the 10th century *Danish King Harald Bluetooth*. King Bluetooth had been influential in uniting Scandinavian Europe during an era when the region was torn apart by wars and feuding clans.
- The founders of the Bluetooth SIG felt the name was fitting because:
  - Bluetooth technology was first developed in Scandinavia, and
  - Bluetooth technology is able to unite differing industries such as the cell phone, computing, and automotive markets.
  - Bluetooth wireless technology simplifies and combines multiple forms of wireless communication into a single, secure, low-power, low-cost, globally available radio frequency.
- A Scandinavian firm originally designed the logo at the time the SIG was formally introduced to the public. Keeping to the same origin as the Bluetooth name, the logo unites the runic alphabetic characters "H", which looks similar to an asterisk, and a "B", which are the initials for Harald Bluetooth.

Bluetooth®

Few Milestones of Bluetooth Technology

1998 - Bluetooth technology was officially introduced and the Bluetooth SIG was formed. Bluetooth technology's intended basic purpose was to be a wire replacement technology in order to rapidly transfer voice and data.

1999 - Bluetooth 1.0 Specification was introduced.

2003 - The Bluetooth SIG repaired the Bluetooth Core Specification with the announcement of Version 2.1.

2004 - Bluetooth Version 2.0 + EDR (Enhanced Data Rate) was introduced.

2005 - Devices using Version 2.0 + EDR begun to hit the market in late 2005.

2007 - Bluetooth Core Specification Version 2.1 + EDR were adopted by the Bluetooth SIG.

2009 - Bluetooth Core Specification Version 3.0 + HS (High Speed) were adopted by the Bluetooth SIG.

15.3 Advantages of Bluetooth Technology

Bluetooth technology was originally meant to be a replacement for the cables and wires between things like a mouse and a computer keyboard. Although it works great in those types of devices, Bluetooth Technology can do so much more. It can connect televisions, music players, and home care devices also.

- **Wireless Technology:** There is no need to connect two devices for transferring data using a USB data cable. Both the devices, on enabling Bluetooth are operational at a comfortable distance. This technology has reduced the requirement of wires to connect two compatible devices.
- **Connect to wide range of Devices:** As the Bluetooth technology matures, people can create connections that were not possible with cables and wires. One can now connect his/her mobile phone to car stereo, or print a picture from camera phone etc.
- **Talking while driving:** If you are one of those people who like to talk on their cell phone and drive, Bluetooth technology is working to make it safer to do so. They are developing wireless headsets and hands free car systems using Bluetooth Technology. These hands free car systems are being developed to use speech recognition, and "speech trigger," which is the ability to turn on a hands free device with a voice command.
- **Atomization at your convenience**: The Bluetooth technology saves time when one automatize to connect with enabled devices during the first time of installation, and thereafter will not require any technical person to re-install every time, and nevertheless both the devices are paired when they are falling within the limitations of thirty feet.
- **Universal To Use**: These devices are universally accepted and this only a technology for pairing devices and is not bound by brand names to limit the use of these devices. Devices carrying different brand names could also be paired with no restrictions.
- **Standard Protocol and Instant PAN:** This technology is not dependent on the model and works compatibly with all the Bluetooth enabled devices. This interoperability function comes as long as both the devices has been installed with the Bluetooth module and is enabled for functionality. In addition, this enables connecting with more than one device at time, all being located within the limitation of 30 feet distance, thereby forming a Piconet or PAN.
- **Other Uses:** other than data transmission, bluetooth technology will also help us to monitor our pulse, speed, and steps as we work out jogging, walking, or running. More than 13,000 companies are developing innovative products using Bluetooth technology. These innovative products range from wacky to wondrous and promise to make our lives more fun and easier.

Overall, the introduction of Bluetooth technology has enabled us to simulate a mini-office intranet-working environment by connecting compatible electronic devices and keeping them under our control and thereby, could be used to establish a theft free system for our work place.

15.4 Disadvantages of Bluetooth Technology

- **Heavy Manufacturing Cost:** The low end of the cellular phone hardware market is heavily price-competitive and Bluetooth silicon is still much too expensive to be included in the "gimme" phones that attract a substantial segment of cellular phones.

- **Less Range of 4-digit PIN** — Juha T. Vainio of the Helsinki University of Technology's Department of Computer Science and Engineering points out that a 4-digit PIN offers only 10,000 total possible combinations — making 4-digit PINs highly susceptible to power cracking techniques — and the problem is further intensified by the well-known user laziness factor that results in a large number of 4-digit PINs being set to 0000.
- **Security Issues:** There's also the possibility that one Bluetooth device may use its exchange of unit keys with a second device and third device to eavesdrop on their "private" conversation — or even falsely to authenticate itself to the one, hidden as the other. That's because, when the first two devices exchange unit keys, they can "decide" to use one or the other as a shared "secret" to generate their link key. When a third device then enters into a key exchange with the second device, and also opens a session with the first device, it reveals its unit key to both.
- **More Processor's Power Consumption:** Encryption, decryption and key generation all require significant processor power.

15.5 Architecture of Bluetooth

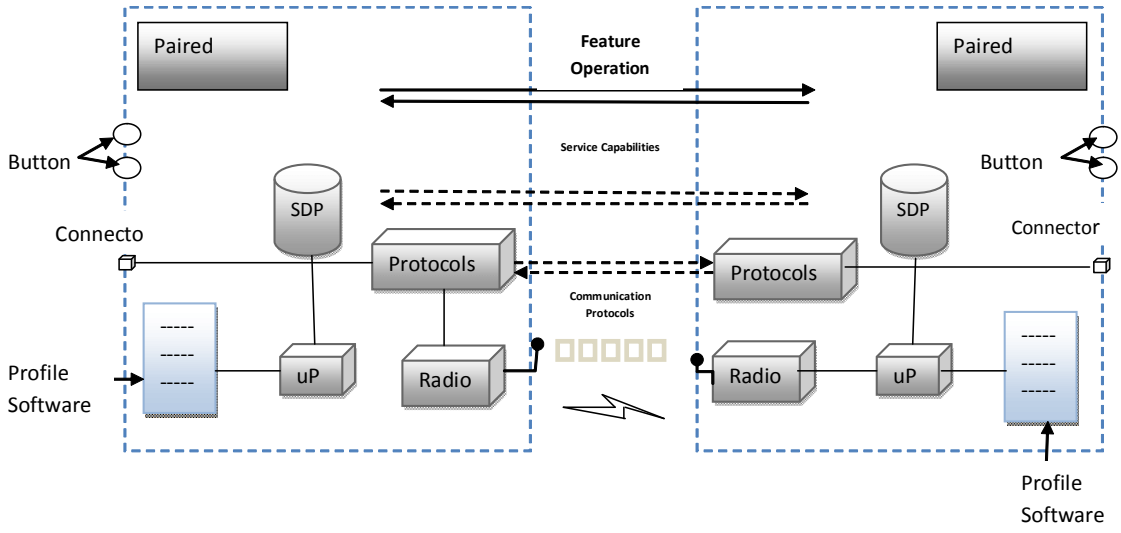
We will discuss the following topic under the following subheadings:

- Bluetooth Profile
- Bluetooth Addresses
- RF Classes
- PICONET

15.5.1 Bluetooth Profile

- Bluetooth profiles are particular implementations, processes, and to definitions of the required operations and protocols that allow Bluetooth to provide a specific service or application and they help to ensure the interoperability between Bluetooth devices.

The figure shows how profiles are used to regulate how Bluetooth devices communicate with each other independent of manufacturer of the devices. This diagram also shows that profiles include the required communication protocols, the service capabilities, and feature operation of the Bluetooth device.



Bluetooth Profile

Bluetooth profiles are particular implementations, processes, and to definitions of the required operations and protocols that allow Bluetooth to provide a specific service or application and they help to ensure the interoperability between Bluetooth devices.

- Profiles also define the required protocols and other supporting profiles (such as how to obtain general access to other Bluetooth devices) that are required to provide types of specific services or features to the user.
- The capabilities to profiles help to ensure reliable operation regardless of the manufacturer and version of Bluetooth devices are used.

15.5.2 Bluetooth Addresses

Every Bluetooth device has a unique 48-bit address in which the upper 24 bits are an organization unique identifier (OUI) and the lower 24 bits are the device specific identifier that is assigned by the manufacturer of the device. These are known as BD_ADDR (pronounced "B-D-Adder"). In addition to identifying each Bluetooth device, this address is used to determine the frequency hopping pattern that is used by the Bluetooth device.

15.5.3 RF Classes

RF classes are used to identify the transmission range of Bluetooth devices. Bluetooth devices may have different RF power classification levels. The power versions for Bluetooth include; 1 mW - class 3, 2.5 mW - class 2, and 100 mWatts - class 1.

Class	Max. Permitted Power (mW/dBm)	Range (Approx.)
Class 1	100 mW(20 d Bm)	~100 meters
Class 2	12.5 mW(4 d Bm)	~10 meters
Class 3	1 mW(0 d Bm)	~1 meters

Devices that have an extremely low power level of 1 mille-watt have a very short range of approximately 1 meter. Whereas, Bluetooth devices that have a power level of up to 100 mille-watts can provide a transmission range of approximately to 100 meters. The Bluetooth devices belonged to the high power version (class 1) are required to use dynamic power control that automatically is reduced when enough signal strength is available between Bluetooth devices.

15.5.4 PICONET

- Piconet is a temporary network created by connected Bluetooth devices. As discussed earlier that up to 8 active Bluetooth devices can attached with each other at a time. These temporary small networks are called as Piconets.
- Bluetooth allows wireless devices to be dynamically added and removed situated nearby within the Piconet. As the Bluetooth system hops over 79 channels, the probability of interfering (overlapping) with another Bluetooth system is less than 1.5%. This allows several Bluetooth Piconets to operate in the same area at the same time with negligible interference.
- After a Bluetooth device has been added to the temporary network (the Piconet), each device is assigned a specific time period to transmit and they do not collide or overlap with other units operating within the same Piconet.

- Piconets can be setup to interact with other Piconets to form larger networks called Scatternets.
- Scatternets also allow the master in one Piconet to operate as a slave in another Piconet. This allows Bluetooth devices in one Piconet to communicate with devices in another Piconet (cross-Piconet communication) easily and efficiently.
- Synchronization (and sharing of data transmission Bandwidth) also required in the Scatternets to make them more efficient.

15.6 Bluetooth Protocols

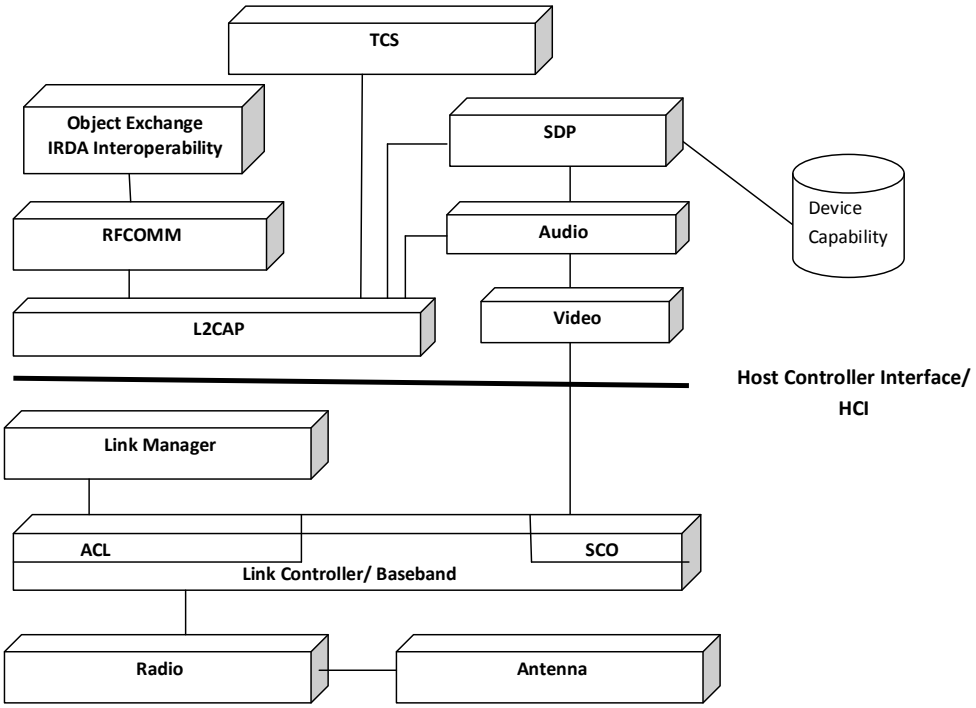
For efficient transfer of data or information through wireless communication links, services, and applications, there are sets of commands and processes that are used to manage these transfers and known as Bluetooth protocols. The Bluetooth system has not only adapted several application protocols but also created new protocols to allow for the setup and coordination of Bluetooth devices. Let's talk about application protocols:

Application Protocols – These are the commands and procedures to perform operations, used by software programs with the help of information or messages that are received from or sent to other sources (such as a user at a keyboard). Application protocols are independent of the underlying technologies and communication protocols. Some of the popular application protocols that are used in Bluetooth technology include RS-232 serial data connection, point-to-point protocol (PPP), object exchange (OBEX), and telephone call control protocol Q.931.

15.6.1 Bluetooth Protocol Layers

- Protocol layers are a hierarchical model of network or communication functions. The divisions of the hierarchy are referred to as layers, with each layer performing a specific task. The Bluetooth system divides communication functions into protocol layers.
- Each protocol layer obtains services from the protocol layer below it and performs services for the protocol layer above it.
- The Bluetooth system consists of many existing protocols that are directly used or have been adapted to the specific use of the Bluetooth system.
- Protocols are often divided into groups that are used for different levels of communication (a protocol stack).
    - Lower level protocols (such as protocols that are used to manage a radio link between specific points) are only used to create, manage, and disconnect transmission between specific points.
    - Mid-level protocols (such as transmission control protocols) are used to create, manage, and disconnect a logical connection between endpoints that may have multiple link connections between them.
    - High level protocols (application layer protocols) are used to launch, control, and close end-user applications.
- Some of the layers associated with the Bluetooth system include
    - The baseband layer (physical layer)
    - Link layer, Host controller interface (HCI)

- Logical link control applications protocol (L2CAP)
- RF Communications protocol (RFCOMM) & Object Exchange (OBEX)
- Service discovery.



Different layers and functional parts of the Bluetooth protocol reference model.

15.7 Bluetooth Data Transmission

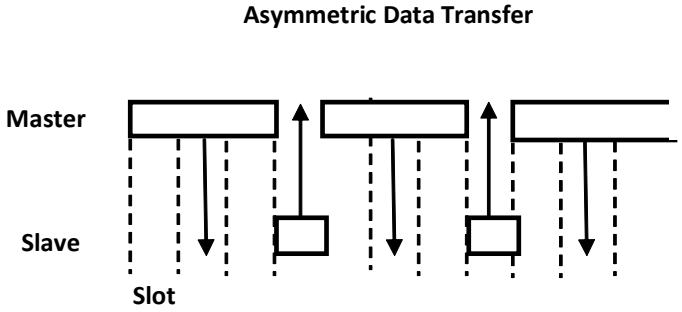
Generally, the total radio channel data transmission rate for a single Bluetooth radio channel is 1 Mbps with over 723.2 kbps available to a single user. Latest versions of the Bluetooth system have been improved to provide for higher speed data transmission services through the use of more advanced modulation technologies. This increases the total data transmission rate to 2 Mbps or 3 Mbps dependent on which modulation technology is being used.

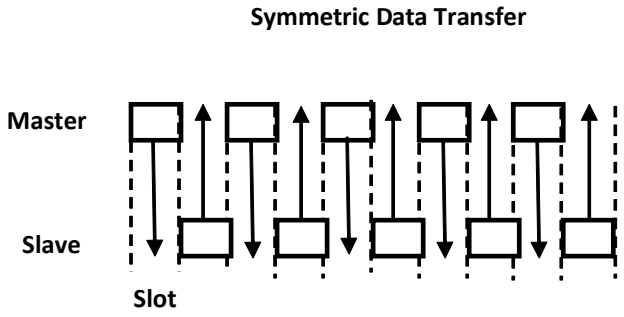
For each user, the data rate available is less than the total radio channel data transmission rate because some of the data transmission is used for functions related to control and channel management. Each of the users in a Piconet must also divide the total available data transmission rate.

The Bluetooth system provides two types of data transfer:

Asymmetrical: It allows for different rates in different directions

Symmetrical: It provides equal data rate (symmetrical rate) transmission for all.





15.8 Establishing Connections

The following operations are performed during the successful transfer of data using Bluetooth technology:

- Device Discovery
- Connecting Devices
- Device Pairing

15.8.1 Device Discovery

- Device discovery is the processes used to request and receive the identification address, name, and services of other devices. For the Bluetooth system, device discovery information that is gathered includes the device address, clock setting, class of device, used page scan mode, and names of devices.
- Devices must be setup to allow other devices to communicate with them. A discoverable device is a communication device that is within range of another communication device that will respond to an inquiry message. For the Bluetooth system, there are two types of discoverable modes: limited and general. In the first case, a device may be available for discovery for a limited period of time, during temporary conditions, or for a specific event. In the second case, a device may be available for discovery on a continuous basis.
- An inquiring device is a Bluetooth unit that sends inquiry messages to other devices operating within its communicating range. Once a device has been found (discovered), it may be possible to connect with that device (if the device owner allows this) so the services it can offer can be determined (such as printer or headset audio services).

15.8.2 Connecting Devices

- Connecting Bluetooth devices is the process of establishing a communication session between two or many devices. During this process two channels are created: physical channel and a logical channel. This involves paging, negotiating for transmission rules and regulations and accepting connection transmission parameters.
- Page Scan – this is the process of getting attention of a device want to establish a connection. Creating a connection between Bluetooth devices initiates by getting the interest of a device by paging it. Hopping is used to ensure that messages from a paging device will be received by the paged device. The paging device hops using the hopping sequence of the device that it is paging. The hopping sequence is determined by the Bluetooth address.
- Connectable devices periodically done scanning (page scan) for page messages targeted to them (brief periods). For the Bluetooth system, a page message contains its own device access code (DAC). Bluetooth devices not only periodically listen for inquiry messages, but also listen periodically for the page messages, and still have time to perform many other tasks.

- As the Bluetooth device knows the address of the Bluetooth device it wants to connect to, the connection procedure generally takes less than 1-2 seconds. The ability of a device to allow "connections" is not compulsory i.e., it is optional. Bluetooth devices can be programmed to not allow other devices to connect to them, this feature is known as "non-connectable".
- Generally one of the connecting device's Bluetooth master-unit first sends many ID packets using the hopping sequence of the recipient device. When the receiving device listens to its ID address, it instantly responds. This allows the master to send a packet that contains the master's Bluetooth Address. Now both the master and slave change their hopping sequence to the Piconet hopping sequence (determined by the master's Bluetooth Address). The master then sends out a Poll message using the new hopping sequence and the slave will typically respond with a null response.

15.8.3 Device Pairing

Device pairing is the process of associating or linking two devices with each other. During the pairing process, unique identifying information of each device is stored in the paired device. After devices have been paired, they can automatically identify each other during future communication sessions. After paring both the devices can start sharing of data, images, audios, videos etc till the session is alive.

15.9 Bluetooth Security

The Bluetooth system uses a mix of authentication - pairing, encryption, and access control - access levels - processes to ensure the operation and privacy of Bluetooth communication.

Authentication during Pairing – as discussed earlier that device pairing is the process of associating two devices with each other. During the pairing process, identifying information that is unique to each device is stored in the paired device. For each new connection between two communicating devices, they use the common link key for authentication. Authentication uses a challenge-response scheme in which a claimant's knowledge of a secret key is checked through a 2-step protocol using symmetric secret keys. The latter implies that a correct claimant/verifier pair shares the same secret key.

Encryption - Bluetooth uses a symmetric encryption scheme; therefore decryption is performed in exactly the way using the same key as used for encryption and the secret key must be exchanged in advance.

There are four entities that are used for maintaining security at the link layer:

- A Bluetooth device address BD_ADDR(48 bits)
- A secret authentication key, the Link Key (128 bits)
- A secret encryption key (8-128 bits)
- A pseudo-random number RAND (128 bits) (generated for each new transaction)

  Using the link key, an encryption key is created that can be used to modify (encrypt) user data for privacy. The encryption key used for Bluetooth communication sessions changes with each new session. During transmission, only the packet payload is encrypted; the access code and the packet header are never encrypted in data transmission through Bluetooth. Encryption is carried out with a stream cipher system which consists of three parts:
- The first part performs initialization (generation of the payload key). The payload key generator combines the input bits in an appropriate order.
- The second part generates the key stream bits and it is the main part of the cipher system, as it will also be used for initialization.
- The third part performs encryption and decryption

Access Control – Access control is the actions taken to allow or deny use of the services and features of a communication system to individual users. Authorization is the process by which a Bluetooth device determines whether or not another device is allowed access to a particular service. So we can say that access control is dependent on authentication.

Authorization incorporates two important Bluetooth security concepts:

- Trust relationships
- Service security levels

Trust Relationships

The Bluetooth specification allows for three different levels of trust between devices:

- Trusted: Device is authenticated, and its access to services on device is allowed.
- Un-trusted: Device is authenticated, but its access to services on device is restricted.
- Unknown: Device has not been authenticated and it is considered un-trusted.

Service security Levels

Service security levels control access to a device's services on a per service basis. There are three service security levels:

- Service security level 1: Authorization and authentication are required. The identity of the requesting device has to be confirmed and the requesting device has to be granted specific permission to access the service.
- Service security level 2: Only authentication is required. The identity of the requesting device need only be judged genuine in order to be granted access to the service.
- Service security level 3: Open to all devices. Access to the service will be granted to any device that is encrypting its communications.

Associated with these levels are the following security controls to restrict access to services:

- Authorization required (this always includes authentication),
- Authentication required,
- Encryption required (link must be encrypted before the application can be accessed).

15.10 Summary

- *Bluetooth is a wireless personal area network - WPAN - communication system standard that gives permissions to wireless data connections to be dynamically added and removed between nearby devices.*
- The name "Bluetooth" and its logo are trademarked by the privately held trade association named the Bluetooth Special Interest Group (SIG).
- The word "Bluetooth" is taken from the 10th century *Danish King Harald Bluetooth*.
- Bluetooth technology was originally meant to be a replacement for the cables and wires between things like a mouse and a computer keyboard. Although it works great in those types of devices, Bluetooth Technology can do so much more. It can connect televisions, music players, and home care devices also.

- Bluetooth profiles are particular implementations, processes, and to definitions of the required operations and protocols that allow Bluetooth to provide a specific service or application and they help to ensure the interoperability between Bluetooth devices.
- Every Bluetooth device has a unique 48-bit address in which the upper 24 bits are an organization unique identifier (OUI) and the lower 24 bits are the device specific identifier that is assigned by the manufacturer of the device.
- RF classes are used to identify the transmission range of Bluetooth devices. Bluetooth devices may have different RF power classification levels.
- The Bluetooth system consists of many existing protocols that are directly used or have been adapted to the specific use of the Bluetooth system.
- Protocols are often divided into groups that are used for different levels of communication (a protocol stack) i.e., Lower level protocols (such as protocols that are used to manage a radio link between specific points), Mid-level protocols (such as transmission control protocols) and High level protocols (application layer protocols).
- Three main operations are performed during the successful transfer of data using Bluetooth technology: Device Discovery , Connecting Devices, and Device Pairing
- The Bluetooth system uses a mix of authentication - pairing, encryption, and access control - access levels - processes to ensure the operation and privacy of Bluetooth communication.

15.11 Self Assessment Questions

1. Define Bluetooth.
2. Explain different applications of Bluetooth.
3. Briefly explain establishment of connections and data transmission in Bluetooth.
4. Explain different Protocol layers of Bluetooth.
5. Explain different levels of security provided by Bluetooth.