

FUNDAMENTALS OF IT
(DBFIT31)
(BACHELOR OF BUSINESS
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ACHARYA NAGARJUNA UNIVERSITY

CENTRE FOR DISTANCE EDUCATION

NAGARJUNA NAGAR,

GUNTUR

ANDHRA PRADESH

UNIT 1 : INTRODUCTION TO INFORMATION TECHNOLOGY

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1.0 INTRODUCTION

This unit introduces you to information technology and its use in business. It first explains the fundamentals of computers including its characteristics and its basic anatomy. Information technology (IT) is closely related with computers, because IT is the study, design, development and implementation of computer-based information systems.

This unit will also explain the concept of business information. You will learn that business information can include sales reports, stock statements and financial analysis reports. You will also learn how information technology is applied in business. Business organizations can also use flexible systems to increase the efficiency in operating the business. In this unit, you will learn about the different flexible systems used in business organizations.

- Business organizations can also use information systems to collect, process, store and distribute information for effective decision-making in an organization. You will learn about the different types of information systems in an organization. Finally, you will analyse the importance of information technology in modern organizations.

1.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Describe the fundamentals of computers
- Explain the relationship between information technology and computers
- Explain the concept of information technology in business
- Interpret the role of information technology in business
- Explain the different flexible systems in business organizations
- Explain the different information systems used in organizations
- Describe the use of information technology in modern business organizations

1.2 FUNDAMENTALS OF COMPUTERS

A computer can be defined as an electronic device that takes some input data from the user, processes it and provides some pre-defined output. A computer literally means something that computes or calculates. The dictionary definition of a computer is as follows: ‘An automatic electronic apparatus for making calculations or controlling operations that are expressible in numerical or logical terms.’

Thus, the computer is an electronic device that processes raw data by performing mathematical calculations and operations on it. The processed data, which is produced by the computer, is called information. The raw data can be figures and texts that are fed as input to the computer by the end-user.

The computer contains hardware and software that enable the processing of raw data. Hardware is constituted by the physical components of the computer and software is the set of instructions and programs that are necessary for the functioning of a computer. Programs instruct the computer to perform various operations. These operations are:

- Accepting data
- Processing data
- Generating output data
- Storing data

Computers are used to perform these operations because of their high reliability, speed and ability to store data.

1.2.1 Characteristics of Computers

Computer is an electronic device, which is used to process various processes related to different fields such as science, accounts, entertainment, business and studies. Various features of computers have contributed to increase its popularity. These features are as follows:

- Speed
- Accuracy
- Diligence
- Versatility
- Intelligence
- Storage

1.2.1.1 Speed

Internal processes of computers operate at the speed of light, limited only by the programs that control these processes, and the quantum of data under process. The speed with which computers perform is way beyond

human capabilities. To express it differently, a computer does a specific task in one minute that you could take a lifetime to do.

While referring to the speed of computers, it is not measured in terms of seconds or even milliseconds (10^{-3}). The units of speed are in microseconds (10^{-6}), nanoseconds (10^{-9}), and even picoseconds (10^{-12}). A powerful computer is capable of processing about 3-4 million simple instructions per second.

1.2.1.2 Accuracy

The accuracy of a computer is consistently high. Errors can occur, but these are almost always due to human error rather than technological weaknesses. Imprecise thinking by the programmer, inaccurate data, or poorly-designed systems can be the origins of error. Computer errors arising due to incorrect data input or unreliable programs are often referred to as Garbage-In-Garbage-Out (GIGO).

1.2.1.3 Diligence

Unlike human beings, a computer does not suffer from limitations associated with human beings such as tiredness and lack of concentration, and hence can work for hours at a stretch without errors arising from the above non-existent faults. As a result, computers score over human beings in performing routine tasks, which require a high degree of accuracy. If a million calculations need to be performed, a computer will perform the millionth calculation with exactly the same accuracy and speed as the first one.

1.2.1.4 Versatility

Computers are capable of performing almost any task, provided the task can be reduced to a series of logical steps. For example, a task such as preparing a payroll can be broken down into a logical sequence of operations and is therefore ideal for computerized processing.

The computer by itself has only limited ability and actually performs only four basic operations, which are as follows:

- Exchange of information with the outside world via Input/Output (I/O) devices
- Transfer of data internally within the Central Processing Unit (CPU)
- Performance of basic arithmetic operations
- Performance of operations of comparison

In one sense, the computer is not versatile because it is limited to the above mentioned basic functions. Yet, since so many everyday activities can be reduced to interplay between these functions, it means that computers are effective, highly ingenious and versatile devices.

1.2.1.5 Intelligence

A computer does not possess any intelligence of its own. It can perform only those tasks that can be broken down into a series of logical steps. Therefore, it needs to be told what it has to do and in what sequence.

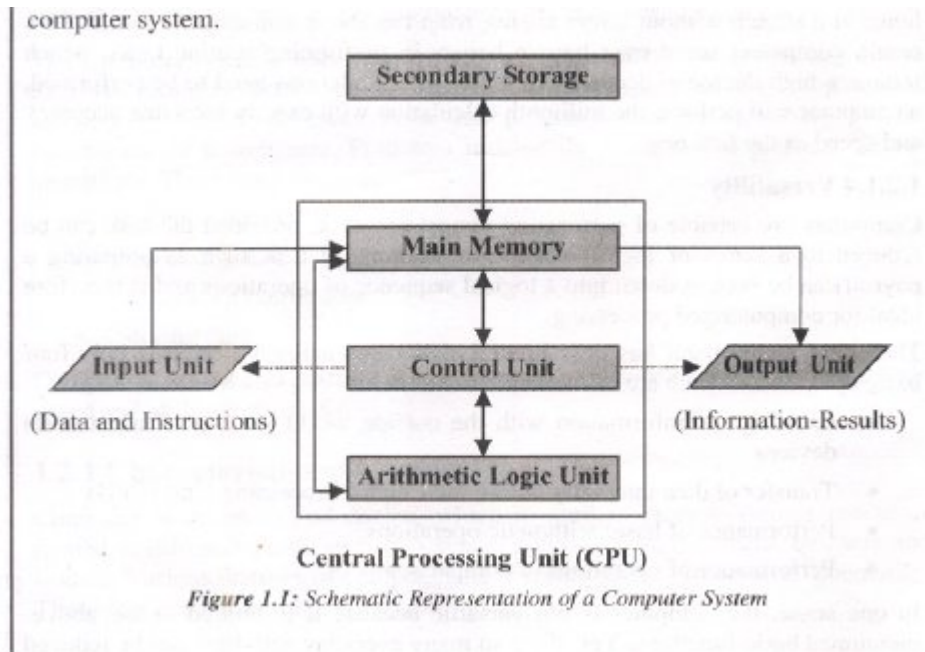
1.2.1.6 Storage

The speed with which computers can process large amounts of information has led to the large-scale information generation, resulting in the information explosion. Storage of information in a human brain and a computer happens differently. Using its intelligence, the human brain subconsciously sifts through new knowledge and selects what it feels is important and retains it in the memory, and the unimportant information is relegated to the back of the mind or just forgotten. Computers, on the other hand, can store and recall any amount of information by using the secondary storage capability. Information can, therefore, be retained as long as desired and recalled as and when required.

1.2.2 Basic Anatomy of the Computer

The size, shape, cost, and performance of computers have changed over the years, but the basic logical structure has not changed. Any computer system essentially consists of four important parts, namely input device, Central Processing Unit (CPU), output device and main memory. The CPU itself consists of arithmetic logic unit and control unit.

In addition to the five basic parts mentioned above, computers also use secondary storage devices, which are also referred to as auxiliary storage or backing storage devices. These secondary storage devices are used to store data and instructions on a long-term basis. Figure 1.1 shows the basic anatomy of a computer system.



All computer systems perform five basic operations for converting raw data into relevant information. These operations are as follows:

1. **Inputting:** The process of entering data and instructions into the computer system is called inputting
2. **Storing:** It is the process of saving data and instructions so that they are available for use as and when required.
3. **Processing:** It is the process of performing arithmetic or logical operations on data to convert them into useful information. Arithmetic operations include operations such as add, subtract, multiply and divide. Logical operations are operations of comparison such as equal to, less than and greater than.
4. **Outputting:** This is the process of providing the results to the user. The result could be in the form of visual display and/or printed reports.
5. **Controlling:** It refers to directing the sequence and manner in which all the above operations are performed.

1.2.2.1 Input unit

Both program and data need to be in the computer system before any kind of operation can be performed. Program refers to the set of instructions, which the computer needs to carry out and data is the information on which these instructions are to operate. For example, if the task is to rearrange a list of telephone subscribers in the alphabetical order, the sequence of instructions that guides the computer through this operation is the program, whilst the list of names to be sorted is the data.

The input unit performs the process of transferring data and instructions from the external environment into the computer system. Regardless of the form in which the input unit receives data, it converts these instructions and data into a form which is acceptable by the computer, which is the binary code. It then supplies the

converted data and instructions to the computer system for further processing.

1.2.2.2 Main memory (Primary Storage)

Data and instructions should be in the main memory of the computer system before the arithmetic logic unit (ALU) can process them. Once the processing is complete, the final results are again stored in the primary storage till they are released to an output device. Also, any intermediate results generated by the ALU are temporarily transferred back to the primary storage until needed at a later time. Thus, data and instructions may move many times back and forth between the primary storage and the ALU before the processing is completed.

1.2.2.3 Arithmetic Logic Unit (ALU)

The ALU is used to perform arithmetic as well as logical operations in the computer system. The four basic arithmetic operations performed by the ALU are addition, subtraction, multiplication and division. The logical/comparison operations performed by the ALU can be equal to, less than and greater than.

1.2.2.4 Output unit

Computers can only work with the binary data and the results produced by the computer system are also in the binary form. The basic function of the output unit, therefore, is to convert these results into a form which can be deciphered by human beings, before providing the output through various output devices such as terminals and printers.

1.2.2.5 Control unit

It is the function of the control unit to ensure that, the right operation is done on the right data at the right time, according to the stored instructions. It is the control unit that obtains instructions from the program stored in the main memory, interprets them, and ensures that the other units of the system execute them in the desired order. In effect, the control unit is comparable to the central nervous system of the human body.

1.2.2.6 Central Processing Unit (CPU)

The control unit, arithmetic logic unit along with the main memory are together known as the central processing unit (CPU). It is the brain of any computer system.

1.2.2.7 Secondary storage

The storage capacity of the primary memory of a computer system is limited. Often, it is necessary to store large amounts of data in the computer system. Therefore, additional memory called secondary storage or auxiliary memory is used in most computer systems. Secondary storage is storage other than the primary storage. These are peripheral devices connected to and controlled by the computer to enable permanent storage of user data and programs. Typically, hardware devices such as magnetic tapes and magnetic disks fall under this category .

1.3 INFORMATION TECHNOLOGY AND COMPUTERS

Computers can be used with information systems to store and process business data. The collected and processed business data can then be used by management of business organizations to take business decisions. You need to have the knowledge of application programming for using computers in business organization. Application programming is an art of making a computer work according to the user requirements to get the desired result. It consists of a sequence of commands, which are given to the computer to achieve an objective. An application program is a set of instructions given to a computer in the binary language to perform a particular task. The binary language is very difficult for the human beings to comprehend. Therefore,

an intermediate language is used to translate the human data into its binary form. There are various intermediate languages such as C, C++, Java, FORTRAN and COBOL

All programs can be structured in the following four ways:

- **Sequence:** A program should maintain a strict step-by-step sequence. Violation of this sequence causes error in the program. Figure 1.2 shows the sequence of instructions.

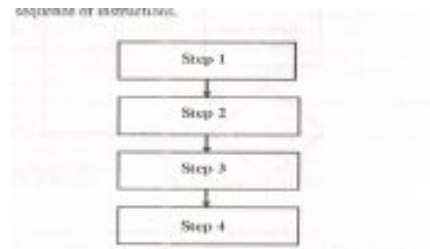


Figure 1.2: Sequence of Instruction

Branches: It means a program has to follow decision instructions given by a programmer. Example: If condition one is true, then follow path 1 if condition two is true, then follow path 2. Figure 1.3 shows the branches.

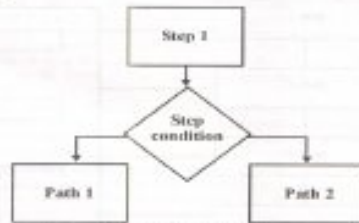


Figure 1.3: The Branches

Repetition: This means that the steps in the program are repeated.

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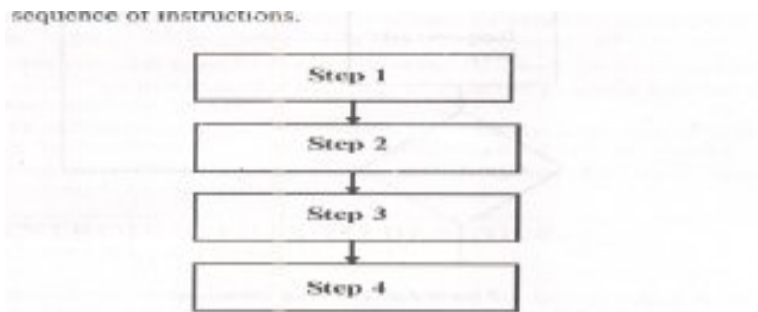


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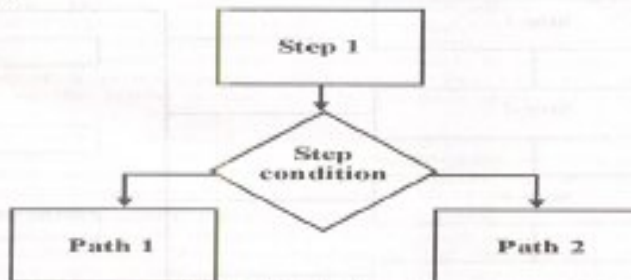


Figure 1.3: The Branches

Repetition: This means that the steps in the program are repeated.

● **Loops:** This means that the steps in the program are repeated continuously until some test condition is reached. Figure 1.4 shows the loop structure.

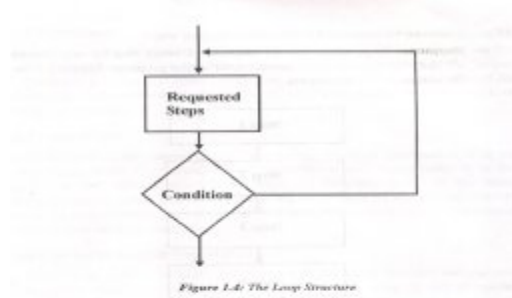


Figure 1.4: The Loop Structure

• **Modules:** The program performs an identical sequence of actions, several times. For convenience, these common actions are placed in a module which is a kind of mini program that can be executed from within the main program. Examples of such modules are subroutine, procedure or function. Figure 1.5 shows the structure of modules.

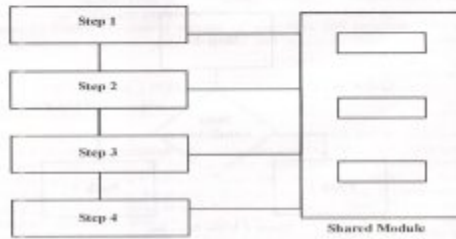


Figure 1.5: The Structure of Modules

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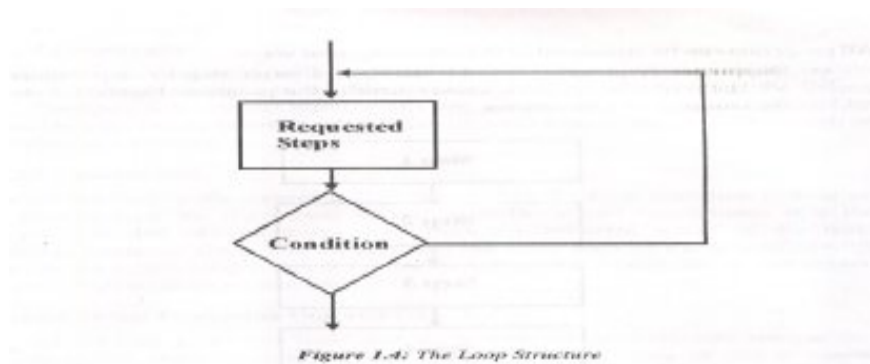


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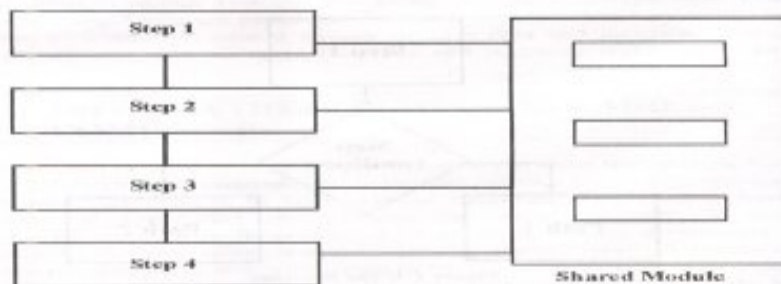


Figure 1.5: The Structure of Modules

An application program is run through an executable file which is stored in the computer and can be run repeatedly to perform a specific task. In addition, an application program is written by a programmer using

a specific programming language. As a result, an application program can only be modified by a programmer. Generally, the programmer writes a program in high-level language, which is converted into the byte code by an interpreter. The computer can understand only the byte code. The code written by programmer is called source code and the code, which is generated by the interpreter, is called object code.

An application program must have the following elements for its execution:

- **Loader:** The function of a loader is to load the program into the memory of the computer system.
- **Data definitions:** A user needs to define exactly what type of data will be used for the source code so that it becomes easier to understand the code.
- **Statements:** These are the basics of a program. The main function of statements is to manipulate the data.

1.4 INTRODUCTION TO BUSINESS INFORMATION

Business information is the information related to the business conducted by an organization. The business information can include sales reports, stock statements and financial analysis report. There can be many types of business information, which need to be provided for better planning and achieving organizational objectives. The various types of business information are described as follows:

- **Action versus no-action information:** The information which induces action is called action information. The information, which communicates only the Status of a situation, is no-action information.
- **Recurring versus non-recurring information:** The information generated at regular intervals is a recurring information. Information such as the monthly sales reports, the stock statements and the trial balance, are recurring information. The information, which is generated at irregular intervals, is a non-recurring information. For example, the financial analysis or the report in the market research study is a non-recurring information.
- **Internal versus external information:** The information generated through the internal sources of the organization is termed as internal information; while the information generated through government reports and industry surveys is termed as external information.
- **Planning information:** Certain standards, norms and specifications are used in the planning of an activity. Hence, such information is called the planning information. The time standards, the operational standards and the design standards are examples of the planning information.
- **Control information:** Reporting the status of an activity through a feedback mechanism is called the control information. When such an information shows a deviation from the goal or the objective, it will induce a decision or an action leading to control.
- **Knowledge information:** A collection of information through library reports and research studies to build up a knowledge base as a information source for decision-making is known as knowledge information.

1.4.1 Value and Cost of Information

Value of information is determined on the basis of the benefits that are derived from the information. Consider an example where two products A and B are developed. The benefits derived from product A evaluates to 20 and the benefits derived from product B evaluates to 30. The difference between the benefits of the two products is 10 units.

If you add some information, the benefits derived from product A increases by 20 points, i.e., from 20 to 40. The actual value of information needs to be calculated by simple mathematics. The cost of information increases by 20 units. You need to subtract the cost involved in obtaining the information to determine the actual value of the information.

Cost of information determines the cost involved in obtaining the information, which includes the following:

- .Cost of acquiring the data
- Cost of maintaining the data
- Cost of generating the information
- Cost of communicating the information

The cost is estimated from the point the information is generated to the point the information is retrieved by an information system. The cost of obtaining accurate and complete information is more as compared to the cost generally retrieved from the system.

1.5 INFORMATION TECHNOLOGY IN BUSINESS

IT and computers are very much related to each other. It depends on the hardware and software capacity of the computer to store information. The hardware and the software can be changed or managed as per the requirement of the organization. For example, some organizations may need a small database, while others may need a large database. Organizations having many branches may need to store information in one computer with which all the other computers are connected.

The ability of the computer hardware to store large volumes of data, access data when required, sort and manage data and finally the ability to compute large volumes of data helps in the proper management of data and information. There is no need of maintaining large number of files and working on them manually. Personnel from any department can access the required information as and when needed. Also, computers provide security facilities such as protecting the information stored or denying access to unknown users. The information of any organization is very important and it is very necessary to protect it from others. The important files and folders in the computer can be given passwords so that it is not accessible to everyone or they can be made READ ONLY so that no one can update the information. The user can only view the information with the READ ONLY facility.

Software is an integral part of a computer, which makes all the hardware parts to function. It helps in the processing of procedural and non-procedural data. For example, if you need to do additions, then you need to install the software that is able to calculate. Today, there is software available for every kind of job. You can have software as per requirement of the organization. For example, if you need software for the accounting department that can help in bookkeeping which includes maintaining the profit and loss account, balance sheets and trial balance, you can install the software named tally.

Computers are used for performing many tasks such as storing business data and manipulating the stored business data. Computers can store large amount of data in its main memory and secondary memory. Computers also help in organizing the business data in a specific manner such as in the ascending or the descending order. Business organizations can use Relational Database Management System software such as MS Access, Oracle and SQL Server for storing large amount of data. These RDBMS software allows business organizations to organize business data, so that it can be easily retrieved and manipulated. Organizing business data through RDBMS software helps in efficient and easy searching of information related to business conducted by an organization. Searching of relevant information helps in proper planning and management of business activities. Searching of business information is also important because it helps the management of an organization in taking appropriate business related decisions. The tasks of storing, organizing and searching business data are necessary for the effective functioning of a business organization and the achievement of business goals.

Business organizations can also use computers to perform word processing tasks such as formatting data and entering data in a document. Computers are employed in business for the purpose of online meetings, which are held through Internet. Various groups participate in these online meetings for discussion on specific business issues. Other uses of computers in business include e-commerce, e-business and e-banking. Computers can be used for multimedia related tasks, which include photo editing, sound editing and making movies. Another application of computers in business is office automation in which computers and various communication technologies are used to manage information. Office automation basically helps automate different activities such as generating reports, storing business data, processing data, accounting and managing

inventory. People who are involved in office automation include managers, supervisors, analysts and executives. In office automation, e-mails related to business are sent to other business associates, customers and suppliers. Office automation systems comprise many different subsystems, which are text management systems, business analysis systems, document management systems and network and communications systems. A text management system is a computer system, which is used to work on text document. This type of subsystem helps perform tasks such as editing and formatting text. A text management system includes various typewriters, word processing computer systems and desktop publishing computer systems. These types of systems are used for writing memos, notes, letters and short documents. A business analysis system is a computer system that provides appropriate data with the help of appropriate software for understanding the business processes conducted by an organization. Document management systems are computer systems, which help manage different types of documents, which can be paper-based, computer-based or electronic documents. Communication management systems are systems, which help in the effective communication of business information. The communication systems include telephone and fax machines.

1.6 FLEXIBLE SYSTEMS IN BUSINESS ORGANIZATIONS

Business organizations can use flexible systems to increase efficiency in conducting the business. Flexible systems are those systems that are used by the organizations according to their requirements. For example, an organization can use the Internet according to its requirement to collaborate with business associates, customers and suppliers. The various flexible systems that can be used in a business organization are:

- Client -server computing system
- Collaborating computing system
- Collaboration through Internet

1.6.1 Client-Server Computing System

In client-server computing system, there are a number of clients and a server, which processes the request of the clients. The clients and the server are connected to each other through Local Area Network (LAN) or Wide Area Network (WAN). The client sends request to the server for processing specific data. The server, on the other hand, receives the request of the clients and processes the data. After processing the data, the server sends the result to the client.

In a client- server computing system, a client computer may also perform data processing. The server in this case stores the data related to the business conducted by an organization. To store and organize data, relational database management system software such as SQL Server and Oracle are installed on the server. Thus, the server works as a back-end in this type of client-server computing system, where the client may also have certain processing power. The client, on the other hand, performs processing tasks such as validation of data and manipulation of data. The client, thus, works as a front end. Figure 1.6 shows a simple client-server computing system in which multiple clients are connected to the server.

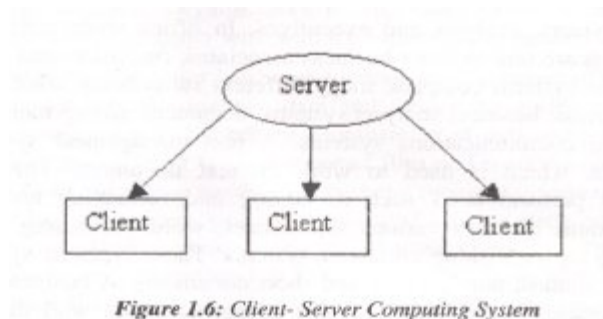


Figure 1.6: Client- Server Computing System

figure shows that the clients and the server can be conr

The above figure shows that the clients and the server can be connected to each other through either LAN or WAN network.

In a client-server computing system, processing of data is performed in a centralized manner. This is because the server has all the data required for processing and the client requests the server for data. The client-server computing system works in a distributed environment, because the server provides data to all clients.

1.6.2 Collaborating Computing System

In collaborating computing systems, employees of a business organization share business data with each other through a network, which is a group of computers connected to each other through network cables. The computers used by employees are connected to each other in a LAN, WAN or Metropolitan Area Network (MAN). In the collaborating computing system, the files containing the business data are shared among the employees of the organization. Different employees perform different computing tasks on the shared data. The result of computing the data is also shared among the employees through the network.

Business organizations can also use software such as Content Management System (CMS) and Share Point Portal Server that allow sharing of files. Organizations can have their own e-mail systems and instant messaging software to allow employees to send e-mail messages and instant messages to each other for sharing business information.

1.6.3 Collaboration through Internet

Business organizations collaborate with their business associates, customers and suppliers through the Internet. Internet is the internetworking, which is a collection of computers all over the world connected to each other. It is used by all small and large business organizations. The Internet allows business organizations to send e-mails to their business associates, customers and suppliers for providing business-related information. Business organizations can develop digital firms on the internet for interacting with the customers and suppliers. Digital firms also help identify opportunities for new products and services. In addition, the digital firms help customize existing products of an organization.

Internet also allows business organizations to collaborate with customers through online chatting, which can be either voice chatting or text chatting, for identifying their needs. Instant messaging through Internet allows business organizations to share business information with their customers and business associates by sending and receiving instant messages.

Internet also allows business organizations to perform e-commerce for marketing and selling their products. E-commerce is a business transaction through which organizations sell and purchase products and raw materials. Organizations perform e-commerce for the following purposes:

- Provide information about the products manufactured by them
- Identify the needs of customers
- Buy products from suppliers
- Deliver electronically the products ordered by customers
- Supply services to customers electronically

On the basis of the nature of the participants in the e-commerce transactions, e-commerce applications are divided into three major categories, which are as follows:

- **Business-to-Consumer (B2C)e-commerce:** In this type of e-commerce, consumers deal directly with an organization, and thus, there are no interme- diaries, for example, Amazon.com.

- **Business-to-Business (B2B) e-commerce:** In B2B e-commerce, the participants are various organizations, for example, Neoforma.com.

- **Consumer-to-Consumer (C2C) e-commerce:** This category of e-commerce involves consumers selling goods and services directly to other consumers through the websites. For example, eBay.com, which is a large Web auction site, allows people to sell their goods to other consumers by auctioning off the merchandise to the highest bidder.

Besides these three main categories of e-commerce, Business-to-Government (B2G) and e-Government applications also apply the concept of e-commerce. With the advancements in communication technology, websites can be accessed through cell phones and other wireless handheld digital appliances. The use of handheld wireless devices for purchasing goods and services is known as mobile commerce or m-commerce.

1.7 INFORMATION SYSTEMS IN ORGANIZATION

An information system can be defined technically as a set of interrelated components that collect, process, store and distribute information to support decision-making and control in an organization. In addition to this, information systems may also help managers and workers to analyse problems, visualize complex subjects and create new products. Information systems contain information about significant people, places and things within the organization or in the environment surrounding it.

In other words, information is the data which has been shaped into a form that is meaningful and useful to human beings. Data, in contrast, are streams of raw facts representing events occurring in organizations or the physical environment, before they have been organized and arranged into a form that people can understand and use.

There are specific types of information systems that correspond to each organizational level. The organization has Executive Support System (ESS) at the strategic level that helps senior management tackle and address strategic issues and long-term trends, both in the firm and in the external environment. Their principal concern is matching changes in the external environment with the organizational capability. Management Information System (MIS) and Decision Support System (DSS) at the management level serve the monitoring, controlling, decision-making and administrative activities of middle managers. Management level systems typically provide periodic reports rather than instant information on operations, while some management level systems support no routine decision-making. They tend to focus on less structured decisions for which information requirements are not always clear. Transaction Processing System (TPS) at the operational level support operational managers by keeping track of elementary activities and transactions of the organization such as sales, receipts, cash deposits, payroll and the flow of materials in the factory. The principal purpose of systems at this level is to answer routine questions and to track the flow of transactions through the organization. Examples of operational level systems include a system to record bank deposits from Automatic Teller Machines (ATMs).

1.7.1 Executive Support System

Senior managers use Executive Support System (ESS) to help them make decisions. ESS serves the strategic level of the organization. ESS is designed to change data according to external events. An ESS filters, compresses and tracks critical data, displaying the data of greatest importance to the senior managers. ESS employs the most advanced graphics software and can present graphs and data from many sources. Often, the information is delivered to senior executives through a portal, which uses a web interface to present integrated personalized business content from a variety of sources. ESS is not designed primarily to solve specific problems, rather it provides a generalized computing and communications capacity that can be applied to changing array of problems. ESS tends to make less use of analytical models. Figure 1.7 shows the interrelationships among the system.

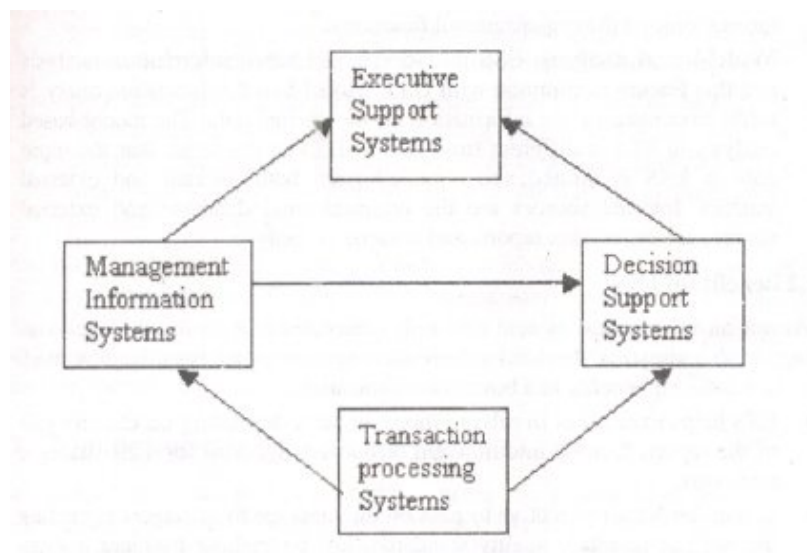


Figure 1.7: Interrelationships among the Systems

The above figure shows how the systems serving different levels in the

The above figure shows how the systems serving different levels in the organization are related to one another. Transaction processing systems are typically a major source of data for other systems, whereas ESS are primarily a recipient of data from lower-level systems. The other types of systems may exchange data with each other as well. Data may also be exchanged among systems serving different functional areas. It is definitely advantageous to integrate these systems, so that information can flow easily between different parts of the organization and provide the management with an overall view of how the organization is performing. But, integration costs money and integrating many different systems is extremely time consuming and complex.

1.7.1.1 Application of ESS

The various applications of ESS are as follows:

- **Executive Briefing:** ESS offers up-to-date information for the executive's interest to improve the performance of the organizational functions. The briefing is related to analysing the performance of various operations and status reports of the organization. In ESS, the information is automatically downloaded periodically from databases in the form of finished reports. This automatic downloading ensures that executives do not remain out of touch with the information for a long time during the days of extreme pressure of workload.
- **Personalized analysis:** ESS offers facilities for data analysis using the models of user's choice such as spreadsheets and statistical techniques. ESS not only helps the user in analysing data, but also in the interpretation of the outcome of the analysis.
- **Forecast reporting:** An important application of ESS is to forecast reporting of an organizational function. ESS helps to solve the organizational functions effectively and forewarns the executives about the outcome of the organizational functions.
- **Model-based analysis:** ESS provides model-based information analysis and this feature is common with DSS. Model-based information analysis refers to computing the information for the desired data. The model-based analysis in ESS is different from that in DSS in the sense that the input data in ESS is limited and obtained from both internal and external sources. Internal sources are the organizational database and external sources are the market reports and customers analysis.

1.7.1.2 Benefits of ESS

ESS is not an information system that only generates reports for the decision-making; it also supports the total information system in an organization. ESS offers the following benefits to a business organization:

- ESS helps executives in relying more on facts depending on the analysis of the reports than on intuition and business judgement for their strategic decisions.
- It is easier for an executive to pass on the message to managers regarding the need to maintain quality standards, just by making frequent queries using ESS.
- ESS provides an opportunity to the top management to understand the benefits of information systems in strategic decision-making. ESS also promotes understanding between top management and information technology (IT) professionals and improves communication among them, which leads to the development of the organization.
- Successful ESS, which improves the functionality of organizational operations can provide visibility and credibility to information systems and helps in implementing other information systems in the organization.

1.7.1.3 Problems in ESS implementation

ESS provides first-hand knowledge to top executives regarding the potential benefits of information systems in the organization. Therefore, it is necessary to ensure that ESS, once planned, must be implemented successfully. The various problems that occur during the implementation of ESS are as follows:

- **Difficulty in system specification:** The intended users of ESS generally have no idea about their specific information requirement and the time to chalk out the specifications of the information system. The users, thus, deserve a few options to try out before they are able to specify the services required by the system.

● **Large volumes of data:** A user in ESS usually accesses a large volume of information by using queries. The satisfaction of such queries may require use of statistical tools to process bulk data, before it can meet the requirement of information in the query. This can take time and the response of the system can be slow.

● **Conflicts from lower levels:** The reports generated by ESS are likely to face conflicts from the people at almost all the levels. The top-level management accesses the updated information using ESS regarding the day-to-day functioning in each department before the departmental heads have gone through and understood this information.

● **Support to management styles:** Some top executives do not favour the use of information systems in decision-making. They have more confidence in their business judgement and wish to leave data analysis either to their subordinates or to the domain experts who assist them.

● **Increased size and cost:** If the manager finds ESS useful, he expects his subordinates also to use it. Those who do not use ESS, find it very difficult to keep it upto the expectations of their boss. Thus, the ESS gets overloaded and the cost increases because the number of users grows in geometric proportions.

Thus, ESS should be implemented carefully. It is advisable to select a favourable time for implementation. People resist changes more when the functions are going is smooth and are more willing to try out something new in crisis. Therefore, the most favourable time of ESS implementation is when people are searching for new solutions to their problems.

1.7.2 Management Information System

Management Information System (MIS) serves the management level of the organization, providing managers with reports and often online access to the organization's current performance and historical records. Typically, MIS are oriented almost exclusively to internal, not environmental or external events. MIS primarily serves the functions of planning, controlling and decision-making at the management level. Generally, they depend on underlying transaction processing systems of their data. MIS summarizes and reports on the company's basic operations. MIS transforms transaction level data from inventory, production, and accounting into MIS files that are used to provide managers with reports. MIS usually serves managers primarily interested in weekly, monthly and yearly results. MIS generally provides answers to routine questions that have been specified in advance and have a pre-defined procedure for answering them. MIS systems are generally not flexible and have little analytical capability. Most MIS use simple routines such as summaries and comparisons, rather than sophisticated mathematical models or statistical techniques.

1.7.2.1 Goals of MIS

MIS is the most common type of management support systems. The various goals of MIS in an organization are as follows:

- To provide information to managerial end-users to support their day-to-day decision-making needs
- To produce reports for specific time periods designed for managers responsible for specific functions in an organization, for example, departmental expense reports and performance reports
- To provide correct information to the concerned manager at the right time
- To help in carrying out regular and routine operations
- To control, organize and plan better business operations

1.7.2.2 Role of MIS

MIS is the heart of any organization. Thus, MIS is very essential for the survival and success of any organization. The information in MIS provides all the necessary data that are required for the Proper management of organizations. The system makes sure that all the information is collected properly and sent to the respective departments for further processing. MIS helps in satisfying the various requirements of departments through a number of systems such as Query Systems, Analysis Systems, Modelling Systems

and Decision Support System. These systems help in strategic planning, management control and transaction processing.

MIS helps the personnel at all levels of management in performing their jobs efficiently. It provides the junior management personnel with operational data for planning, scheduling and controlling that helps them in Lite decision-making procedure. It provides the middle management personnel in short-term planning, target setting and controlling the business functions. Finally, it helps the top management personnel in target setting, strategic planning and evolving the business plans and their implementation.

1.7.2.3 Impact of MIS

MIS has a big impact on the functions, performance and productivity of an organization. It helps in the proper functioning of all activities and also helps in the proper management of marketing, finance, production and personnel departments, which are the essential parts of an organization.

The impact of MIS on the functions of an organization reflects from the impact on the management. The information that the MIS provides helps in the planning and decision-making activities, which ultimately aims for the achievement of the organization goals. With the use of MIS in organizations, the managers are informed about the progress, achievements and drawbacks of the organization. The managers can then act accordingly so as to maintain their organizations' standard in the market.

MIS has its impact on the production of an organization. The production managers are duly provided feedback about the performance and the quality of the products that help them to improve the product value.

Another impact of MIS, as discussed above, is on the performance of an individual. MIS uses databases and transaction-processing systems for the storage of data and information. The overall MIS system is computerized that helps in reducing the manual work. This helps individuals to reduce their workload and pay more attention on other work that need more of manual work such as planning and decision-making. If all the personnel of an organization are involved in information processing, searching and arranging the information, then there is no time to analyse the performance of the organization, and hence, there is no time for achieving the organizational goals. In a computerized MIS system, the information is arranged in such a way that it is easy to retrieve the required data.

1.7.2.4 MIS and academics

The foundation of MIS is the subject management. The MIS follows the principles and practices of management theory to provide a flexible system in the organization. One of the subjects of management that is taken into account for developing a MIS system is the operations research. Operations research is used in MIS for solving management problems. Inventory control, queuing theory and resource programming are used in MIS for incorporating the decision support systems that is helpful for decision-making processes. The network theory is used for planning and controlling small and large projects.

MIS uses the subject of accounting and the accounting principles to ensure that the information fed is correct and reliable. The principles of accounting used in MIS are the double-entry bookkeeping for balancing the accounts, trial balance and balance sheets for generating accounting methodology.

MIS uses the communication theory and the principles of feedback while in the analysis and reporting systems. While generating the formats for reports, special attention is paid in order to avoid noise and distortion in the communication process. The decision theory helps in MIS decision-making and helps in taking decisions under risk and uncertainty.

MIS uses database management system to store data and information. It makes use of the data structures such as the hierarchical and network structure to store information in certain levels. The relational database management helps in maintaining the relationship between the information stored in the database.

1.7.2.5 MIS and user

MIS touches every aspect in the organization, and thus, is naturally used by every individual at all levels that comprise the organization. This user can be a clerk, an assistant, an officer, an executive or even a manager. The MIS meets the needs of all these individuals.

For example, a clerk has to search through the data and make statements to submit to the higher authorities. For this purpose, MIS can be used to carry out a quick search and report the same to the higher level authority. Similarly, an assistant needs to collect and organize the data to conduct a rudimentary analysis. In this case, MIS offers various tools to execute the necessary tasks. It facilitates an officer in integrating the data from different systems and reporting the analysis in a proper format. It provides the decision support system to an executive who has to plan for achieving targets and goals of the organization. A manager can use MIS to prepare a structured or unstructured format of activities and functions of top management. Thus, MIS caters to the ever-changing needs of several individuals in an organization.

The MIS, however, has certain negative effects on individual employees. Since it takes away the drudgery of search, collection, writing and reporting the data, the work vacuum, so created is not easily filled, and therefore, a sense of security emerges. Especially in the case of lower-level employees, the importance of the person is lost, thus giving rise to fear of non-recognition in the organization. In the case of an officer and an executive, since MIS facilitates the job of data integration, the concerned data is transferred from an individual to MIS, and thus made available to all in the organization. This creates a sense of being neglected for knowledge information and especially advice. MIS also creates a feeling of challenge and exposure for the manager, since information is available to the middle management. As these employees can easily access this information and interpret according to their abilities, the top-level managers have to face competition and the fear that their decisions may be questioned or proved wrong.

MIS can yet create a positive influence on the organization's personnel in several ways. Individual employees become more efficient operators. Their time and efforts are concentrated on more productive work than before and involves using analytical skills and knowledge. This is possible due to the information support offered by MIS: Moreover, the managers can tackle complicated cases in the organization more effectively as a result of their increased decision-making ability. They can use the systems and the models in MIS for trying several alternatives in a given problem situation. Thus, the MIS plays a crucial role in organization's efficiency by collectively increasing the ability level of a number of individual employees simultaneously.

1.7.2.6 Limitations of MIS

There are fundamental weaknesses in the organization such as improper management and unclear organizational functions. When the organization decides an MIS, these problems directly affect and limit an MIS. The various limitations of MIS are as follows:

- **Organizational Framework:** Some managers think that they can solve a company's shortcomings using MIS. MIS does not help to achieve this goal without good planning and control within the framework of an organizational structure.

- **Generation of Information:** The lack of managerial and operational applications to the MIS makes a great impact, because it implies that the process of management is not being performed well to generate the information. The information is the raw material of decision-making for MIS, and if information is not being generated, disseminated and used for management, then no system-manual or computer will be able to solve the organizational problems.

- **Managerial Participation:** The most striking characteristic of any successful organization is that MIS development has been viewed as a responsibility of the management. Their success is attributed directly to the fact that managers are required to become involved in the design of their own systems. This includes both top management and operating line management. Moreover, the presidents need to take a personal interest and participate directly in defining what work the computer should do for the company.

1.7.3 Decision Support System

Decision support systems also serve the management level of the organization. DSS help managers make decisions that are unique and rapidly changing. They address problems, where the procedure for arriving at a solution may not be fully pre-defined in advance. Although DSS use internal information from the transaction processing system and management information system, they often bring in information from external sources such as current stock prices or product prices of competitors. DSS have more analytical power than other systems. They use a variety of models to analyse the data or they condense large amounts of data into a

form in which they can be analysed by the decision-makers. DSS are designed in such a manner so that the user can work with them directly; these systems include user-friendly software. DSS is a voyage estimating system. A voyage estimating system calculates financial and technical voyage details. Financial calculations include ship/time costs, whereas a technical detail includes ship cargo capacity, speed and port distances. This voyage estimating systems draws heavily on analytical models.

1.7.3.1 Features of DSS

DSS helps to solve unstructured business problems. Unstructured problems are those problems which require unprogrammed decisions. DSS has the following features, which makes it distinct from other types of information systems:

- DSS does not aim at any specific type of decisions. It has the flexibility of using unexpected decision situations, which are not predetermined and not known to the managerial level.
- The user-friendly interface of DSS makes it different from other types of information systems.
- The software tools such as report generators and graphic facilities in DSS provide better ways of presenting the information.
- DSS offers complete control over the information systems. A user can control the input, method of processing and output of the information using DSS interactive interface.

1.7.3.2 Benefits of DSS

DSS helps in generating information to assist in reporting and managerial decision-making process. The various benefits that a DSS can offer include the following:

- Evaluation of a larger number of alternatives in DSS reduces the time and effort in collecting and analysing the data for different operations.
- Modeling and forecasting becomes easy for managers to get more insight into the business processes using DSS.
- It is useful in intra-group and inter-group communication, because the information it derives regarding the solution to a problem is easily understood by others.
- It facilitates quicker analysis of data, thereby improving the speed of response in unexpected decision-making situations.
- DSS provides in-depth analysis of data, and therefore, data can be used more effectively to take decisions.

1.7.3.3 Application of DSS

DSS helps the top management of an organization in various application areas such as support in making decisions, training managers and a variety of decision-making situations. The areas of application of DSS in production and finance are described as follows:

- **Production:** DSS helps in various areas of production such as cost estimation and analysis, production planning and scheduling, make or buy product decisions, inventory planning and control of manpower.
- **Finance:** DSS helps in various areas of finance such as capital budgeting, financial planning and analysis, tax planning, strategic financial planning, budgeting, cash and working capital management, debt and equity financing analysis, foreign exchange risk management, financial performance analysis and variance analysis.
- **Future Decision-Making:** DSS help managers to activate simulation models to access the required information from the database for decision-making. The simulation model is an interactive activity where the manager can experiment and see projected results for the planned action that are to be implemented in future.

1.7.3.4 Interactive system for DSS

Interactive system for DSS helps a decision-maker to evaluate the result of a particular course of action to solve a business problem. If a shortcoming exists in the solution then the decision-maker can modify the solution or try another solution. In this way, the interactive system of DSS helps in providing the best solution

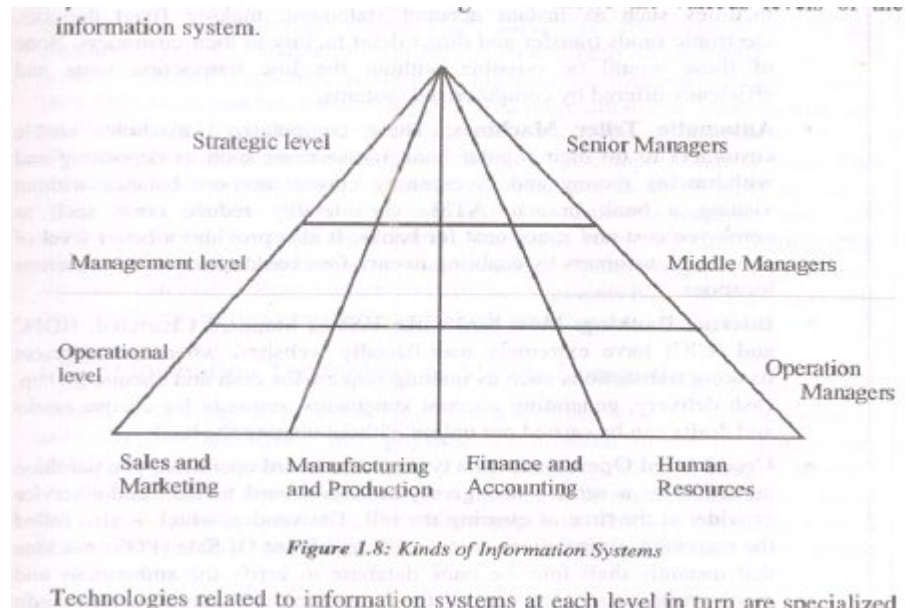
to a particular problem that can be applied in the concerned department of the organization. Interactive system for DSS is created using various query and high-level programming languages such as SQL, COBOL and FORTRAN. These languages prompt and help a user to make commands to retrieve the information with a user-friendly interface.

1.7.4 Transaction Processing System

A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to conduct business. Different examples of transaction processing system are sales order entry, hotel reservation systems, payroll, employee record keeping and shipping. At the operational level, tasks, resources, and goals are pre-defined and highly structured. TPS has a payroll system which is a typical accounting transaction processing system found in most firms. A payroll system keeps track of the money paid to employees. The master file is composed of discrete pieces of information called data elements. Data is keyed into the system, updating the data elements. The elements on the master file are combined in different ways to make up reports of interest to management and government agencies and to send pay cheque to employees. These TPS can generate other report combinations of existing data elements. TPS are often so central to a business that TPS failure for a few hours can lead to a firm's demise and perhaps that of other firms linked to it. Managers need TPS to monitor the status of internal operations and firm's relation with the external environment. TPS are also the major producers of information for the other types of systems.

1.8 INFORMATION TECHNOLOGY IN MODERN ORGANIZATIONS

IT refers to the study, design, development, implementation and management of information system, which is based on computers using special software. In other words, IT enables you to convert, store, protect, process, transmit and retrieve data from the information system using electronic computers and its related technologies. It also serve the major business functions such as sales and marketing, manufacturing and production, finance and accounting and human resources. A typical organization has operational, management and strategic level systems for each functional area. Figure 1.8 shows the various levels of the information system.



Technologies related to information systems at each level in turn are specialized to serve each of the major functional areas of an organization.

Today, IT is used in almost every field of business for faster and efficient processing of data and information. Information technology plays an important role in the working of modern organizations.

1.8.1 Information Technology in Banking

Today, all major banks have branches in numerous locations and they need to recruit more and more staff to cope with the increasing number of customers. The accepted wisdom is that cost is the main basis for competition among different banks, and so the banks are making more efforts to reduce operational costs by computerizing customer accounts. Computerization in banks has led to cost reductions by saving a lot of back office work, but banks still need to employ a large number of front office staff to deal with customers.

The development of ATMs is a boon to the customers. They allow the customers to take advantage of specific banking services, twenty-four hours a day and seven days a week. ATMs make it easy to deposit and withdraw money, check balance, request statements, etc. Coupled with the added advantage of round-the-clock availability, they not only reduce staff workload, but also give the customers hassle-free banking. Some of the areas where banks typically use computers as well as IT are:

- **Back-office Computerization:** Nowadays, almost all Indian and international banks run on fully integrated and online systems, where all back-office operations like accounts posting, reconciliation and clearing house operations are completely automated.

- **Front-office Computerization:** All banks provide various types of facilities such as instant account statement, making fixed deposits, electronic funds transfer and direct debit facility to their customers. None of these would be possible without the low transaction costs and efficiency offered by computerized systems.

- **Automatic Teller Machines:** These computerized machines enable customers to do their regular bank transactions such as depositing and withdrawing money and ascertaining current account balance without visiting a bank branch. ATMs considerably reduce costs such as employee cost and space cost for banks. It also provides a better level of service to customers by enabling twenty-four banking access at numerous locations.

- **Internet Banking:** Most banks like HSBC, Standard Chartered, HDFC and ICICI have extremely user-friendly websites, where the different banking transactions such as making request for cash and cheque pickup, cash delivery, generating account statements, requests for cheque books and drafts can be carried out online without visiting the bank.

- **Credit Card Operations:** In a typical credit card operation, you purchase an article or a service and give your credit card to the vendor/service provider at the time of clearing the bill. The vendor, which is also called the merchant, swipes your credit card on a Point Of Sale (POS) machine that instantly dials into the bank database to verify the authenticity and credit worthiness of the card. If the transaction is covered by your credit card limit agreed between you and the bank, then the POS prints an authentication receipt. The authentication receipt authorizes the merchant to collect the transaction amount from the bank instead of collecting it from the customers. Credit cards obviate the necessity of carrying huge amounts of cash, and an option of spending more than one current cash status. On the other hand, banks earn money by charging a transaction fee from the merchant and interest on the credit facility. This entire operation is critically dependent on IT.

1.8.2 Information Technology in Hospital Management

Today, computers are revolutionizing the medical field. IT plays a very important role in patient monitoring and automated drug administration. In the hospitals, computers are used to record the data of the patient and their status. The pharmacists use computers to keep track of what type of medication should be given to the patient.

IT supports Magnetic Resonance Imaging (MRI), which uses radio waves and strong magnetic field to scan the patient's body. IT converts this information into pictures which can be used to detect any abnormalities in the internal organs of the patient. IT also supports Automated Imaging Technique (ATI), which produces pictures of internal organs more clearly as compared to the standard X-ray films. The most common example of ATI is Computerized Axial Tomography (CAT) scans. The use of telemedicine enables the patients to get high quality medical care irrespective of their physical location.

1.8.3 Information Technology in Insurance Companies

Like banking, the insurance sector has also to deal with a lot of routine paperwork such as insurance policies, claims filed, surveyor investigation reports and payment receipts. Computers can be of much help in reducing costs and processing times. Typically, insurance companies use computerized databases to keep track of all insurance policies, generating premium due statements, premium received receipts, lodging claims for insurance recovery, etc. Basically, all kind of transactions are recorded and processed through computerized systems. This enables insurance companies to provide quicker and more efficient service to their clients. It also allows the insurance companies to minimize risks and maximize profits by enabling complex financial, economic and demographic analyses of their customers. Using sophisticated computer programs, an insurance company can easily determine which customer segments have the highest growth rate, which are the most profitable and which are more risky than others.

1.8.4 Information Technology in Mobile Computing

Mobile computing is a technology which enables you to use information technology without using any physical transmission media for connection. Mobile phone is a good example of mobile computing. Communication between two mobile phones is possible through a base station, which consists of a tower and a small building containing the radio equipment. Through switching devices in landline telephone exchanges, mobile phone users can also access the global landline network.

The mobile phone industry owes its growth to information technology, which plays a central and pivotal role in any mobile system. Technologies like Personal Communications Services (PCS), Time Division Multiple Access (TDMA), Global System for Mobile communication (GSM) and Code Division Multiple Access (CDMA) are often associated with mobile phones.

PCS is a wireless phone service and it is similar to cellular telephone service. It is sometimes referred to as digital cellular. Like cellular, PCS is for mobile users and requires a number of antennas to blanket an area of coverage. As a user moves around, the user's phone signal is picked up by the nearest antenna and then forwarded to a base station that connects to the wired network.

TDMA is a technology used in digital cellular telephone communication that divides each cellular channel into three time slots in order to increase the amount of data that can be carried.

GSM is a digital mobile telephone system that is widely used in Europe and other parts of the world. GSM uses a variation of TDMA and is the most widely used of the three digital wireless telephone technologies TDMA, GSM, and COMA. GSM digitizes and compresses data then sends it down a channel with two other streams of user data, each in its own time slot. GSM is, in fact, the de facto wireless telephone standard in Europe.

Some of the popular functions of mobile computing that are based upon IT are the following:

- Short Messaging Service (SMS): SMS can be exchanged between people who do not believe in long verbal conversations over I communication channels.
- Address book: Address book is a store of contact information maintained on the mobile handset or the central server. Thus, it prevents the need of maintaining a hard copy address book and allows the phone user to access phone numbers whenever required
- Schedules: You can store a list of important tasks that you wish to accomplish in your mobile phones. Most mobile phones have software recording appointments schedules and reminders associated with these tasks.
- Get information updates: All mobile service providers now provide add-on facilities for their subscribers to receive regular updates on news, entertainment and stock market prices. This can be accomplished by integrating the web-based databases with the mobile user's database. Service providers also use this capability to advertise new products, services and schemes.

All of the above facilities are based upon the usage of electronic computer databases and intelligent computer software available on the mobile phone. Due to the global trend of convergence, the dividing line between

information technology and telecommunications technology is getting increasingly blurred. Today's computers combine phone, fax, television, VCD/DVD drives and stereo in one seamless bundle.

1.9 SUMMARY

In this unit, you have learned about information technology and its use in business organizations. Information technology and computers are closely related to each other. Computers are electronic devices that take some input data from the user, process it and provide some pre-defined output. You have learned that the different characteristics of computers are speed, accuracy, diligence, versatility, intelligence and storage. Information technology can be defined as the process of acquiring, storing, processing and distributing information with the help of computers.

You have also learned about business information that is, information related with business. It can include sales reports, stock statements and financial analysis reports. Business organizations can also use flexible systems to improve the efficiency of business. You have learned that the different types of flexible systems used by business organizations include:

- Client-server computing system
- Collaborating computing system
- Collaboration through Internet

Organizations can also make use of information systems. The unit described that information system generally refers to the computer systems used by organizations to provide information about business operations. You also got to know that the different types of information systems used by the organizations include:

- Executive support system
- Management information system
- Decision support system.
- Transaction processing system

In addition, you learned about the impact of information technology in modern organizations including banks, hospitals, insurance companies and tele-communication companies.

1.10 KEY TERMS

● **Computer:** It can be defined as an electronic device that takes some input data from the user, processes it and provides some pre-defined output.

● **Flexible systems:** These are systems that are used by organizations according to their requirements. For example, an organization can use the Internet according to its requirements to collaborate with business associates, customers and suppliers.

● **Hardware:** Hardware is the term used to refer to the physical parts of the computer.

● **Information system:** An information system can be defined technically as a set of interrelated components that collect, process, store and distribute information to support decision-making and control in an organization.

● **Software:** It is the set of instructions and programs that are necessary for the functioning of a computer.

1.11 ANSWERS TO 'CHECK YOUR PROGRESS'

1. A computer can be defined as an electronic device that takes some input data from the user, processes it and provides some pre-defined output.

2. The following are the different characteristics of computers:

- A. Speed
 - B. Accuracy
 - C. Diligence
 - D. Versatility
 - E. Intelligence
 - F. Storage
3. Business information is the information related to the business conducted by an organization. The business information can include sales reports, stock statements and financial analysis report.
4. The different types of business information are:
- A. Action versus no-action information
 - B. Recurring versus non-recurring information
 - C. Internal versus external information
 - D. Planning information
 - E. Control information
 - F. Knowledge information
5. Business organizations can use flexible systems to increase efficiency in conducting their business. Flexible systems are those systems that are used by the organizations according to their requirements.
6. An information system can be defined technically as a set of interrelated components that collect, process, store and distribute information to support decision-making and control in an organization.
7. The different types of information systems are:
- A. Executive support system
 - B. Management information system
 - C. Decision support system
 - D. Transaction processing system
8. The following are the different features of DSS:
- A. DSS does not aim at any specific type of decisions. It has the flexibility of using unexpected decision situations, which are not predetermined and not known at the managerial level.
 - B. The user-friendly interface of DSS makes it different from other types of information systems.
 - C. The software tools such as report generators and graphic facilities in DSS provide better ways of presenting the information.
 - D. DSS offers complete control over the information systems. A user can control the input, the method of processing and the output of the information using DSS interactive interface.
9. A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to conduct business.

1.12 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the characteristics of a computer?
2. What are the different operations of computers?
3. Explain how computers and information technology are related.
4. What is business information?
5. What do you mean by information system?

Long-Answers Questions

1. Explain the various types of business information.

2. What do you mean by information technology in business? Elaborate.
3. Explain the different types of flexible systems.
4. Explain the different types of information systems.

1.13 FURTHER READING

Rajaraman, V., *Introduction to Information Technology*. New Delhi: Prentice- Hall of India.

Unit- I:

COMPUTER HARDWARE

Structure

2.0 Introduction

2.1 Unit Objectives

2.2 Memory Units

2.2.1 Read Only Memory (ROM);

2.2.2 Random Access Memory (RAM);

2.2.3 Cache Memory

2.3 Storage Devices

2.3.1 Magnetic Tapes;

2.3.2 Magnetic Disks;

2.3.3 Floppy Disks;

2.3.4 Hard Disks;

2.3.5 Compact Disks with Read Only Memory (CD-ROM)

2.4 Mass Storage Devices

2.4.1 Disk Arrays; 2.4.2 Tape Libraries; 2.4.3 CD-ROM Jukeboxes

2.5 Input Devices

2.5.1 Keyboard; 2.5.2 Mouse; 2.5.3 Trackball; 2.5.4 Joystick;

2.5.5 Light Pen; 2.5.6 Touch Screen; 2.5.7 Scanning Devices;

2.5.8 Voice Recognition Devices; 2.5.9 Vision Input Devices

2.6 Output Devices ,

2.6.1 Display Devices; 2.6.2 Printers; 2.6.3 Plotters; 2.6.4 Projectors;

2.6.5 Computer Output Microfilm (COM)

2.7 Summary

2.8 Key Terms

2.9 Answers to 'Check Your Progress'

2.10 Questions and Exercises

2.11 Further Reading

2.0 INTRODUCTION

In this unit, you will learn about the hardware components of the computer. Major components of the computer are storage devices, input devices and output devices. The unit introduces you to the different memory units. Storage devices are used to store data and instructions permanently. In this unit, you will study about some of the commonly used storage devices, namely magnetic disks, floppy disks and optical disks. You will also learn about mass storage devices.

You will learn that input devices are used to provide data to the computer for processing and that output devices are used to display the output obtained after a computer completes the task of processing data. You will learn the characteristics of some of the commonly employed output devices.

2.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Explain the different types of memory and their storage capacities
- Describe the different kinds of storage devices
- Describe the input devices that are based on point and draw functionality
- Explain the role of output devices in providing and displaying information to the users

2.2 MEMORY UNITS.

Data, instructions for processing data, intermediate results of processing and processed data are stored in the memory unit of a computer. Memory consists of a set of locations, with each location occupying eight bits. Each bit in the memory is identified by a unique address. Data is stored in the machine-understandable binary form in these memory locations. Binary data is a combination of 0s and 1s. This means that information such as numbers, characters and instruction codes are represented in terms of 0s and 1s to be stored in the memory.

2.2.1 Read Only Memory (ROM)

ROM is the permanent memory of the computer that stores data and instructions, even when the computer is switched off. The contents of ROM cannot be read or modified by an end-user. ROM is a chip that is inserted into the motherboard. It stores the Basic Input/Output System (BIOS), which performs the Power On Self Test (POST). POST is performed at the time of booting the system. The test checks whether the computer components such as memory, input devices and output devices, are fully functional or not. After performing the POST, BIOS displays a message that includes information such as memory size and hard disk type. Figure 2.1 shows the structure of ROM.

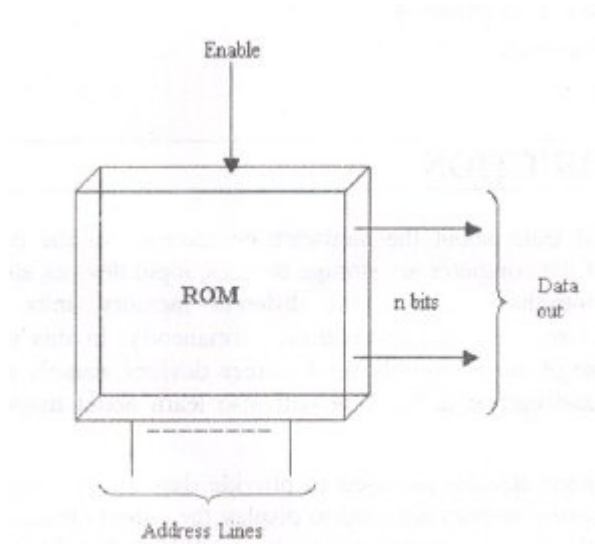


Figure 2.1: Structure of ROM

ROM is used to store fixed programs such as application software that does not require modifications. The following are the various types of available ROM:

- **Programmable ROM (PROM):** It enables the users to write information to it only once. The user cannot modify the information, once written in PROM. PROMs are used for the programs that are permanent and do not require regular updating.

- **Erasable PROM (EPROM):** It allows the erasing of information written in the ROM more than once by exposing EPROM to high intensity ultraviolet rays. EPROMs are widely used to store programs that are permanent but require regular updating.

- **Electrically Erasable PROM (EEPROM):** It allows the erasing of information written in the ROM more than once by using electric signals. EEPROMs are also used to store programs that are permanent but require frequent updating.

2.2.2 Random Access Memory (RAM)

RAM is the read/write memory unit, which is volatile in nature. Information is retained in RAM only as long as there is regular power supply. When the power supply is interrupted or switched off, the information

stored in the RAM is lost. RAM temporarily stores data and applications as long as they are in use. When the use of data or the application is over, the content in RAM is erased. Figure 2.2 shows the basic structure of RAM.

e basic structure of RAM.

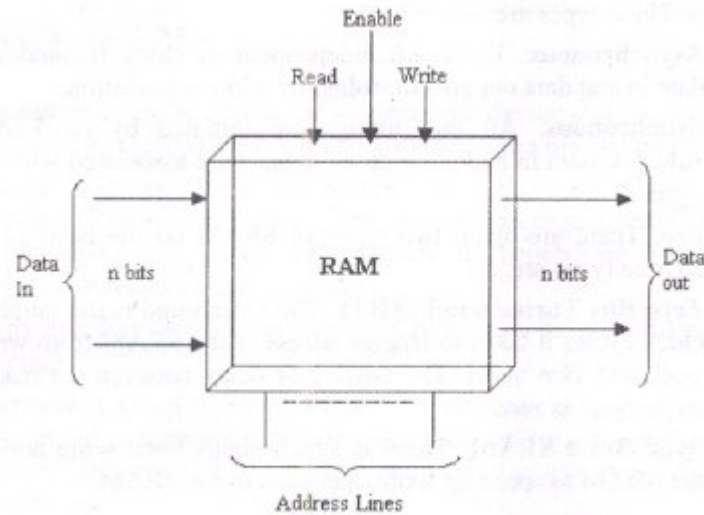


Figure 2.2: Structure of RAM

The RAM is soldered to the motherboard, at the time of computer manufacturing. There are connectors on the motherboard that enable an end-user to connect additional RAM, as per the requirements. The additional RAM is required in a computer to perform multitasking and to operate large application software such as Adobe Photoshop. Multitasking refers to the ability of a computer to execute multiple application programs, simultaneously. RAM chips are available as chips with 4MB-128MB memory size. The different types of RAM are:

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

2.2.2.1 Static RAM

SRAM stores information without the need for any refreshing circuit to restore it. In SRAM, a form of flip-flop which never has to be refreshed holds each bit of memory. A flip-flop for a memory cell takes 4 or 6 transistors along with some wiring. A SRAM is faster than a DRAM as refreshment is not required. However,

SRAM takes more space in a chip as it has more parts than a DRAM. Therefore, you get less memory per chip and that makes SRAM more expensive than DRAM. Therefore, SRAM is used to create the speed-sensitive cache of CPU, while DRAM forms the larger system RAM space. The various types of modes in SRAM are standby mode, read mode and write mode.

SRAM is categorized under different types based on various elements such as the transistor type and the function. These elements are as follows:

- **By transistor type:** There are two types of transistors used in a computer based on which SRAM can be categorized. These types are:
 - **Bipolar Junction Transistor (BJT):** These are very fast but consume a lot of power. These are used in Transistor-Transistor Logic (TTL) and Emitter Coupled Logic (ECL).
 - **Metal Oxide Semiconductor Field Effect Transistor (MOSFET):** It consumes less power and is used in Complementary Metal-Oxide Semiconductor (CMOS).
- **By function:** SRAM can be categorized into two types based on their functions. These types are:
 - **Asynchronous:** These are independent of clock frequency and data in and data out are controlled by address transition.

- o **Synchronous:** All the timings are initiated by clock edges. Address, data in and other clock signals are associated with clock signals.

- **By feature:** There are again two types of SRAM on the basis of their features. These types are:

- o **Zero Bus Turnaround (ZBT):** The turnaround is the number of clock cycles it takes to change access to the SRAM from write to read, and vice versa. The latency or delay between the read and write cycle is zero.
- o **Sync Burst SRAM:** There is synchronous burst write access to the SRAM to speed up write operation to the SRAM.

The power consumption of SRAM varies widely depending on how frequently it is accessed. It may be very power hungry when used at high frequencies, while it may draw very little power when used at lower frequencies. It draws negligible power when sitting idle.

2.2.2.2 Dynamic RAM

DRAM is the most common type of memory in use today. In a DRAM chip, each memory cell holds one bit of information and is made up of two parts—a transistor and a capacitor. The capacitor holds the bit of information, i.e., a 0 or a 1. The transistor acts as a switch that lets the control circuitry on the memory chip read the capacitor or change its state.

A capacitor is able to store electrons. To store a 1 in the memory cell, the capacitor is filled with electrons. To store a 0, it is emptied. For dynamic memory to work, either the CPU or the memory controller has to come along and recharge all the capacitors holding a 1 before they discharge. For this, the memory controller reads the memory and then writes it back. This refresh operation repeats automatically thousands of times per second. DRAM has to be refreshed all the time or it forgets what it is holding. Hence, it slows down the memory.

There are many variations of DRAM. Some of them are described as follows:

- **Asynchronous DRAM:** This is the basic form from which all the other variations are derived. It has power connections, some address lines and a few bidirectional lines. There are four active low control signals in

asynchronous DRAM:

- o **Row Address Strobe (/RAS):** The address inputs are captured on the falling edge of /RAS and select a row to open. The row is held open as long as /RAS is low.

- o **Column Address Strobe (/CAS):** The address inputs are captured on the falling edge of /CAS and select a column from the currently open row to read and write.

- o **Write Enable (/WE):** This signal determines whether a given falling edge of /CAS is a read or write. If it is high, then it indicates a read operation and if it is low, then it indicates a write operation and the data inputs are captured on the falling edge of /CAS.

- o **Output Enable (/OE):** This is an additional signal that controls output to the data input/output pins. The data pins are driven by the DRAM chip if /RAS and /CAS is low, /WE is high and /OE is low.

- **Video DRAM (VRAM):** It is a dual-ported version of DRAM, formerly used as the bit map in graphic adapters. It was invented at IBM Research by F.Dill, D Ling and R.Matick in 1980 and patent issued in 1985. It was responsible for the advancement of graphics from poor quality, low resolution single green colour screens of computers to the high resolution, multicolour displays of Super Video Graphics Array (SVGA) and other higher features. It brought personal computers to the masses by introducing Windows, Spreadsheets and high quality graphics at a very affordable price.

- **Fast Page Mode DRAM (FPM DRAM):** It is also called Page Mode Memory, where a row of the DRAM can be kept 'open' by holding /RAS low, while performing multiple reads or writes with separate pulses of /CAS, so that successive reads or writes within the row do not suffer the delay of precharge and accessing the row. This increases system performance while reading or writing bursts of data. There are two types of variant of page modes:

- o **Static column:** In static column, there is no need to strobe the column address, rather the address inputs may be changed with /CAS held low and the data output will be updated accordingly a few nanoseconds later.

- o **Nibble mode:** In nibble mode, four consecutive pulses of /CAS access four sequential locations within the row. The address inputs are generated internally starting with the address supplied for the first /CAS edge.

- **Window RAM (WRAM):** Developed by Samsung and marketed by Micron Technology, it is an obsolete type of semiconductor designed to replace VRAM in graphic adapters. WRAM has dual port DRAM structure, with one parallel port and one serial port, but has extra features enabling fast block copies and block fills.

- **Extended Data Out (EDO) DRAM:** It is similar to Fast Page Mode DRAM with an additional feature that a new access cycle can be started, while keeping data output of the previous cycle active. This allows pipelining, thus increasing the speed.

- **Burst EDO (BEDO) DRAM:** It could process four memory addresses in one burst, saving an additional three clocks over optimally designed EDO memory.

- **Multibank DRAM (MDRAM):** It allows the interleaving technique for main memory to cache memory to provide a cheaper and faster alternative to SRAM. The chip splits its memory capacity into small blocks of 256 KB and allows operations to two different banks in a single clock cycle.

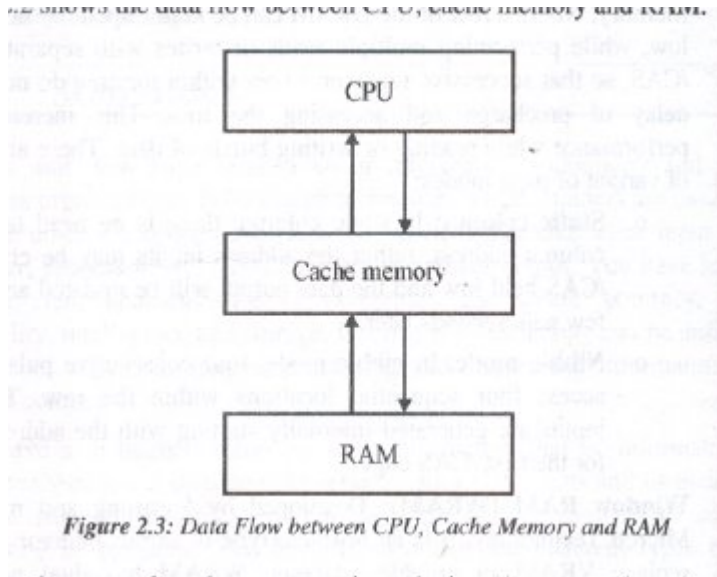
- **Synchronous Graphic RAM (SGRAM):** It is a specialized form of SDRAM for graphic adapters. It adds functions such as bit masking and block write. It has single port, but it can open two memory pages at once, which simulates the dual-port nature of other video RAM technologies.

2.2.3 Cache Memory

Cache memory is a memory unit that stores data and the related application that was last processed by the CPU. The CPU copies the last processed data and instructions from the RAM into the cache memory. The cache memory can be either soldered into the motherboard or are available as a part of RAM.

When the processor performs processing, it first searches the cache memory and then the RAM, for an instruction. The processor checks the cache memory for instructions first. If the instruction is found in this memory, the time spent by the processor in searching the cache memory and RAM is reduced. As a result, the use of cache memory reduces the time required to perform the processing.

The cache memory transfers the blocks of data extracted from RAM to CPU. Figure 2.2 shows the data flow between CPU, cache memory and RAM.



The effectiveness of cache memory in reducing the processing time can be measured by the parameter called hit ratio. A CPU produces a hit, when its search for an instruction in the cache memory is successful. The CPU produces a miss if the instruction that it searches for in the cache memory is not found. The hit ratio can be defined as the ratio of the number of hits to the total number of times the CPU has searched the cache memory.

2.3 STORAGE DEVICES

Storage devices are connected to the computer to provide a non-volatile memory source in addition to the primary memory of the computer. A storage device is either located in the CPU casing of the computer or is connected externally to the computer. The storage devices are used to store information that is not in use currently. Storage devices are also called secondary memory. Storage devices can also be used to store all system programs and system software. Some of the commonly used storage devices are magnetic tapes, magnetic disks, floppy disks and hard disks.

2.3.1 Magnetic Tapes

Magnetic tapes are used for storing files of data that are sequentially accessed or are not used very often and are stored off-line. They are typically used as back-up storage for archiving data. In case of magnetic tapes, a tape (plastic ribbon usually 1/2 inch or 1/4 inch wide and 50 to 2400 feet long) is wound on a spool and its other end is threaded manually on a take-up spool. A metal foil called marker is used to determine the Beginning of Tape (BOT). When a write command is given, a block of data (records are usually grouped in blocks of two or more) is written on the tape. The next block is then written after a gap called Inter Block Gap (IBG). A series of blocks are written in this manner. The End of Tape (EOT) is indicated by an end-of-tape marker which is a metal foil stuck in the tape. After the data is written, the tape is rewound and kept ready for reading. Figure 2.4 shows a magnetic tape and data organization on a magnetic tape.

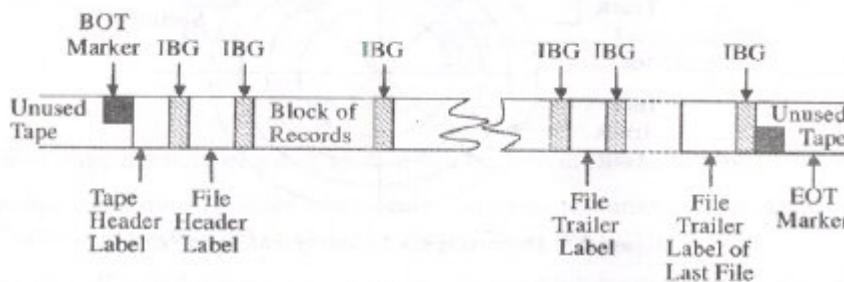


Figure 2.4: Data Organization on a Magnetic Tape

The tape is read sequentially, i.e., data can be read in the order in which the data has been written. This implies that if the desired record is at the end of the tape, all the earlier records have to be read before it is reached. A typical example of a tape can be seen in a music tape cassette, where to listen to the fifth song one must listen to, or traverse, the earlier four songs. The access time of information stored on tape is, therefore, very high as compared to that stored on a disk.

The storage capacity of the tape depends on its data recording density and the length of the tape. The data recording density refers to the amount of data that can be stored or the number of bytes that can be stored per linear inch of tape. The data recording density is measured in Bytes Per Inch (BPI).

Thus

Storage capacity of a tape = Data recording density x Length of tape

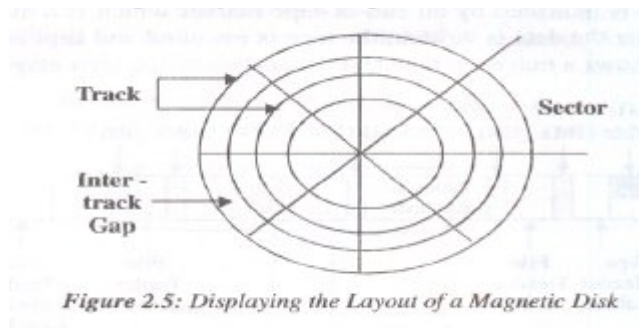
It is worth noting that the actual storage capacity for storing user data is much less owing to the file header labels, file trailer labels, BOT and EOT markers, and the use of IBGs. Some commonly used magnetic tapes are:

- 1/2 inch tape reel
- 1/2 inch tape cartridge
- 1/4 inch streamer tape
- 4 mm Digital Audio Tape (DAT)

2.3.2 Magnetic Disks

Magnetic disks are direct-access medium and so they are the most popular online secondary storage devices. Direct-access devices are also called random-access devices because information is literally available at random or in any order. Access to any location on the device is direct and so approximately equal access time is required for each location. An example of this is a music CD, where if you wish to listen to the fifth song, you can directly select the fifth track. It does not require you to fast forward the previous four songs.

A magnetic disk is a circular plate made of metal or plastic, coated with magnetized material. Often, both sides of the disk are used. Data is recorded on the disk in the form of magnetized and non-magnetized spots representing Is and Os. Figure 2.5 shows logical layout of a magnetic disk.



Data is stored in concentric rings or tracks. To minimize the interference of magnetic fields, the adjacent tracks are separated by inter-track gaps. Tracks are commonly divided into sections called sectors. In most systems, the minimum quantity of information that can be transferred is a sector. Usually eight or more sectors per track are found.

A track in a given sector near the circumference is longer than the track near the centre of the disk. If bits were recorded with equal density, some tracks would contain more bits than the other tracks. To ensure that each sector can store equal amounts of data, some disks use variable recording density with higher density on tracks near the centre than on tracks near the circumference.

Multiple disks are usually stacked and used together to create disk storage systems having large capacities. In this case, multiple disks are fixed on a central shaft, one below the other to form a disk pack. This is then

mounted on a disk drive that has a motor to rotate this disk pack about its axis. The disk drive also has an access arm assembly with a separate read/write head for each surface of the disk pack. The access arms for all the disks surfaces move together. A disk system, is thus, addressed by the disk number, the disk surface, the sector number and the track within the sector.

Usually, the upper surface of the topmost disk and the lower surface of the bottom-most disk are not used, since these are prone to getting scratched easily. For faster access of data from disk packs, a concept called cylinders is used. A set of corresponding tracks on all the recording surfaces of the disk pack together to form a cylinder. Thus, if there are 100 tracks on each disk surface, there are 100 cylinders in the disk pack.

Cylinder-based organization provides faster data access. The related records of the file can be stored on the same cylinder (on multiple disks of a disk pack) and subsequently with one movement of the access arm, all records on, say cylinder 5, (fifth track of every recording surface) can be simultaneously read. Figure 2.6 shows a disk pack with four disks.

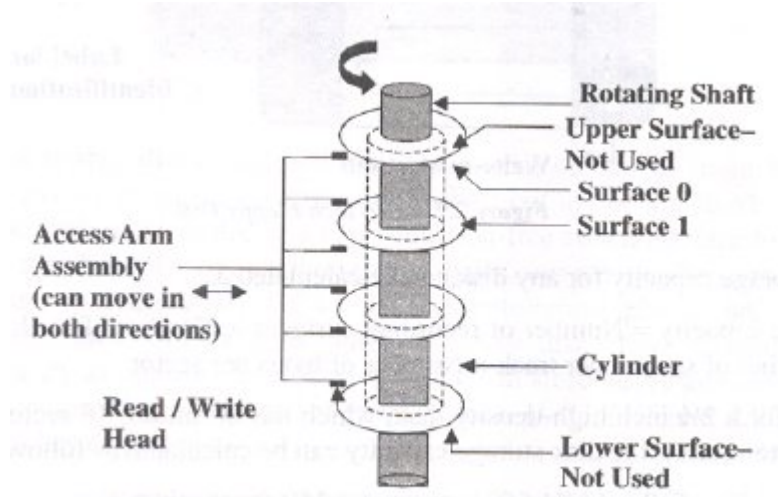


Figure 2.6: Displaying a Disk Pack

The storage capacity of a disk system can be determined as follows:

$$\text{Storage capacity} = \text{Number of recording surfaces} \times \text{Number of tracks per surface} \times \text{Number of sectors per track} \times \text{Number of bytes per sector}$$

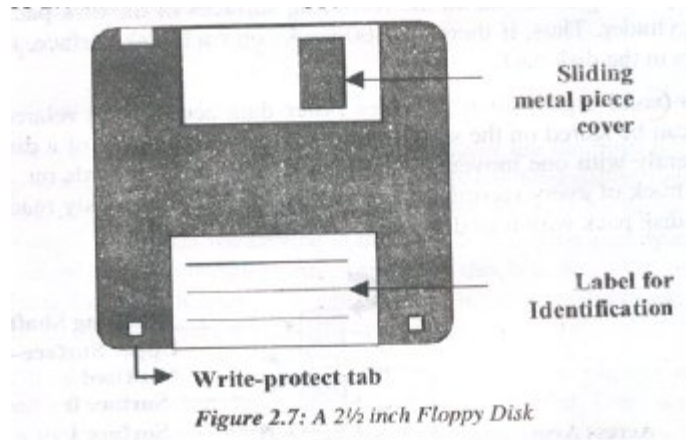
Example: If a disk pack consists of four plates each having 2655 tracks with 125 sectors per track. Also, each sector can store 512 bytes, then

$$\text{Storage capacity} = 6 \times 2655 \times 125 \times 512 = 1,01,95,20,000 \text{ bytes} = 1 \times 10^9 \text{ bytes approximately or 1 GB or 1 Gigabyte}$$

Note: There are six recording surfaces because of the presence of four disk plates.

2.3.3 Floppy Disks

The disks used with a floppy disk drive are small removable disks made of plastic coated with magnetic recording material. The data in a floppy disk is stored in tracks that contain sectors. The read/write head of the floppy disk drive also rotates and can move to any location on the disk surface, to read or write data to the floppy disk. The floppy disk contains an oval shaped hole called the write-protect notch, through which the read/write head accesses the floppy disk. The end-user cannot read or write data to a floppy disk, if the right access to the floppy disk is protected. The storage capacity of floppy disks ranges from 720 K to 2.88 MB. The most commonly used floppy disk has diameter equal to 2½ inches. The floppy disk having diameter equal to 2½ inches can store data on both sides of the disk, therefore, they are also called double-sided disks. These disks come in three different capacities -double density, high density and very high density. These are smaller and can store more data than the 5¼ inch disks can. Figure 2.7 shows a 2½ inch floppy disk.



The storage capacity for any disk can be calculated as:

Storage capacity = Number of recording surfaces x Number of tracks per surface x Number of sectors per track x Number of bytes per sector

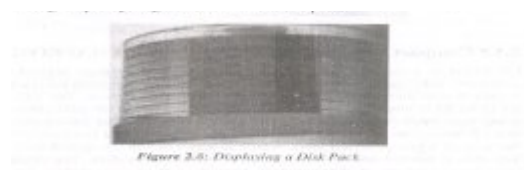
Thus, for a 2 1/2 inch high-density disk, which has 80 tracks, 18 sectors/track, and 512 bytes/sector, the disk storage capacity can be calculated as follows:

$$2 \times 80 \times 18 \times 512 = 14,74,560 \text{ bytes or } 1.4 \text{ MB (approximately)}$$

2.3.4 Hard Disks

Hard disk consists of a metallic or plastic disk, coated with a magnetic material. In hard disks, data is stored in concentric circles, which are known as tracks. A track is made up of a collection of sectors. The hard disk drive contains disks that are placed one above the other on a shaft known as spindle. The spindle is placed inside a dust-proof casing. The shaft rotates at the speed of 2400 revolutions per minute. Each disk contains two surfaces- upper surface and lower surface. Each surface has a read/write head that is attached to a moveable arm. Information is stored on the surfaces of a disk in such a manner that no information is stored on the upper surface of the first disk and the lower surface of the second disk. The disks in the hard disk drive rotate simultaneously with the movement of the shaft. Address bits are used for labelling the hard disk. Address bits are a sequence of bits that indicate the disk number, disk surface, sector number and track in the sector. When the read/write head is placed at a track, the computer system waits for performing the read or write operation, till the sector indicated in the read/write head, is reached. Hard disks can be classified into the following categories:

- **Disk packs:** Disk packs consist of two or more hard disks mounted on a single central shaft. Because of this, all disks in a disk pack rotate at the same speed. It consists of separate read/write heads for each surface. Disk packs are removable in the sense that they can be removed and kept offline when not in use. They have to be mounted on the disk drive before they can be used. Thus, different disk packs can be mounted on the same disk drive at different instances, thereby providing virtually unlimited storage capacity. Figure 2.8 shows a disk pack.

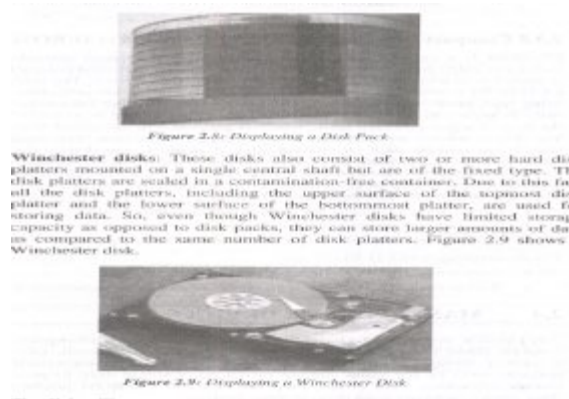


Winchester disks: These disks also consist of two or more hard disk platters mounted on a single central shaft but are of the fixed type. The disk platters are sealed in a contamination-free container. Due to this fact all the disk platters, including the upper surface of the topmost disk platter and the lower surface of the bottommost platter, are used for storing data. So, even though Winchester disks have limited storage capacity as opposed to disk packs, they can store larger amounts of data as compared to the same number of disk platters. Figure 2.9 shows a Winchester disk.

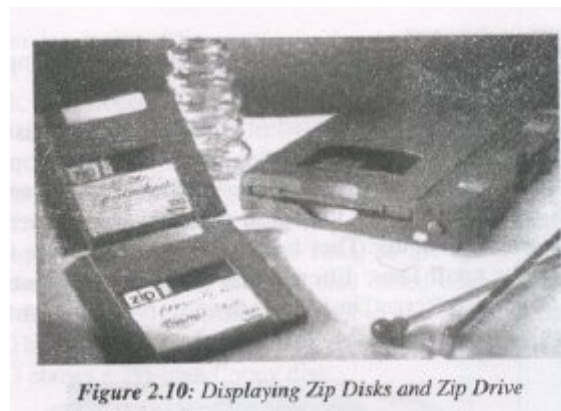


- **Winchester disks:** These disks also consist of two or more hard disk platters mounted on a single central shaft but are of the fixed type. The disk platters are sealed in a contamination-free container. Due to this fact all the disk platters, including the upper surface of the topmost disk platter and the lower surface of the bottommost platter, are used for storing data. So, even though Winchester disks have limited storage capacity as opposed to disk packs, they can store larger amounts of data as compared to the same number of disk platters.

Figure 2.9 shows a Winchester disk.



- **Zip disks:** These are very common today. Zip disks consist of a single hard disk platter encased in a plastic cartridge. Such a disk typically has a capacity of about 100 MB. Further, the zip drive can be fixed or portable. The fixed zip drive is permanently connected to the computer system, while the portable ones can be carried around and connected to any computer system for the duration of its use; Figure 2.10 shows a zip disk.



2.3.5 Compact Disks with Read Only Memory (CD-ROM)

CD-ROM is a circular optical disk, which is used to store textual, graphical, audio and video content. It is usually made from a resin named polycarbonate that is coated with aluminium to form a highly reflective surface. The information on a CD-ROM is stored as a series of microscopic pits on the reflective surface by using high-intensity laser beam. The process of recording information on these disks is known as mastering. The information is retrieved from a CD-ROM with the help of a low-powered laser, which is generated in an optical disk drive unit. The disk is rotated and the laser beam is aimed at the disk. The intensity of the laser beam changes as it encounters a pit. A photo-sensor detects the change in intensity, thus recognizing the digital signals recorded on the surface of the CD-ROM and converts them into electronic signals of Is and Os. CD-ROMs are very useful for distributing large amounts of information to a large number of users. The following are the advantages of CD-ROMs:

- Large storage capacity for storing data and information
- Fast and inexpensive mass replication
- Suitable for archival storage since they are removable disks

The disadvantages of CD-ROMs are:

- They are read-only and cannot be updated.
- Access time of CD-ROM is greater than that of a magnetic disk.

2.4 MASS STORAGE DEVICES

Any physical storage media has a limit to its capacity and performance. There is a constant effort towards improving such media and as a result, larger capacity secondary storage devices have emerged. These are characterized by using multiple units of the same storage media, as a single unit, to provide higher storage capacities. Disk arrays, tape libraries and CD-ROM jukeboxes are the three most commonly used mass storage devices.

Mass data storage devices are characterized by relatively slow access time. This is because additional time in terms of first locating the desired disk, tape, or CD-ROM needs to be accounted for. However, they are more cost effective in case of applications that require huge storage capacity and for which rapid access to data is not the prime consideration. They can also be used for offline or archival storage of information/data, since they can support huge volumes of information/data to be backed up.

2.4.1 Disk Arrays

RAID is an acronym for a disk array and consists of a number of hard disks and disk drives with a controller in a single box. The basic idea of RAID was to combine multiple small, inexpensive disk drives into an array of disk drives, which will yield performance exceeding that of a Single Large Expensive Drive (SLED). Additionally, this array of drives appears to the computer as a single logical storage unit or drive.

The concept was pioneered through academic research funded by Digital Equipment Corporation and has now become a standard in the computing industry for applications requiring fast and reliable storage of large volumes of data.

There are several different types of RAID configurations that are described in terms of 'levels'. The various levels of RAID storage are as follows:

- **RAID 0:** Data is split across drives, resulting in higher data throughput. Since no redundant information is stored, performance is very good, but the failure of any disk in the array results in data loss. This level is commonly referred to as striping.
- **RAID 1:** It provides redundancy by writing all data to two or more drives. The performance of a level 1 array tends to be faster on reads and slower on writes compared to a single drive, but if either drive fails, no data is lost. This level is commonly referred to as mirroring. Mirroring is the most expensive RAID option, but it is highly reliable.
- **RAID 0+1:** It is a combination of striping and mirroring. This configuration provides optimal speed and reliability, but possesses the same cost problem as RAID 1.
- **RAID 5:** It employs a combination of striping and parity checking. The use of parity checking provides redundancy without the overhead of having to double disk capacity. Simply put, parity checking involves determining whether each given block has an odd or even value. These values are summed across the stripe sets to obtain a parity value. With this parity value, the contents of a failed disk can easily be determined and rebuilt on a spare drive.

There are other RAID configurations in addition to the ones described, but these are the ones most commonly used in the industry. As can be noticed, RAID configurations result in higher reliability due to the use of multiple disks. In addition to this, both mirroring and striping also result in speeding up the read process since different parts of the same file, residing on different disks, can be read at the same time.

2.4.2 Tape Libraries

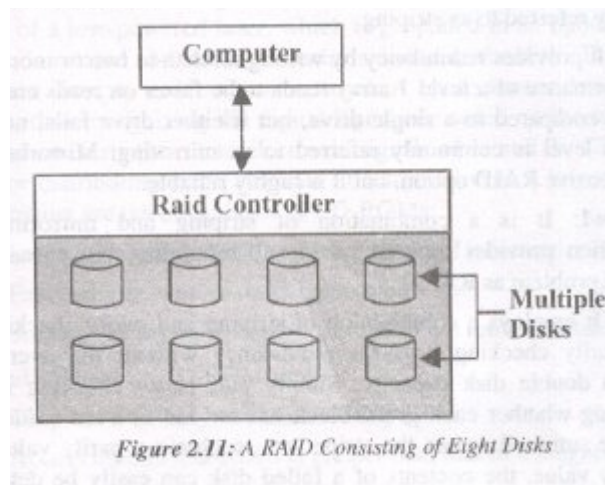
Network administrators are hungry for technologies that will allow them to efficiently and economically manage the explosive growth in data stored on networks. As the amount of data increases, the back-up process takes longer time. Simply adding another tape drive to reduce the back-up time does not really help.

Further, systems operated in this manner represent one of the largest operational costs of a data centre and also typically represent the predominant need for human intervention.

The solution to this problem is the multi-drive automated tape library. These libraries consist of a set of magnetic tapes with a controller mounted in a single unit. The unit may have one or more tape drives to read and write data on the tapes in the tape library. Automated tape libraries allow random access to large numbers of tape cartridges and concurrent use of two or more drives, rather than manually loading one tape after another. The unit typically has robotic arms to retrieve the appropriate tape from the tape library and mount it on one of the tape drives for processing.

Automated tape libraries can be designed to provide extremely precise control “and support for tape drives. Properly implemented, library automation can significantly enhance the operational reliability of tape drives by eliminating the highly variable human/machine interface. In this particular case, the objective of the system design is to avoid failures rather than to tolerate them, as is the case in RAID systems.

Automated tape libraries are typically used for data archiving purposes and as an online data back-up device for automated back-up. Figure 2.11 shows a RAID consisting of eight disks.



2.4.3 CD-ROM Jukeboxes

The CD-ROM jukebox is much like the automated tape library, but consists of a set of CD-ROM disks instead of the magnetic tapes. The set of CD-ROM disks along with a controller are mounted on a single unit. Once again, the unit can have one or more drives to read data from the disks in the jukebox. The unit has robotic arms to retrieve the appropriate CD and mount it on one of the CD-ROM drives for processing. At the end of processing, the CD is automatically returned to the appropriate slot.

CD-ROM jukeboxes are typically used for archiving read-only data that can be accessed online, e.g., online encyclopaedias, online directories, etc. A large CD-ROM jukebox may consist of hundreds of disks providing a storage capacity of terabytes.

2.5 INPUT DEVICES

An input device accepts data from the outside world and transforms it into a form, which the computer can interpret. Keyboards are the most commonly used input devices. Point-and-draw devices are used to point to, and select menu items or icons displayed on screen. They provide a means for Graphical User Interface (GUI). The mouse, trackball, joystick, light pen and touch screen are commonly used point-and-draw devices. However, scanning devices that provide direct data input from source documents are of two types -CONTACT and LASER. Electronic card readers read the data encoded on electronic cards and convert it to machine-readable form, for further processing. This unit also describes other voice recognition devices that input data in the form of human voice, thereby providing an easy means of data input.

This can be explained with a very common scenario where the average marks of a student need to be calculated, based on the marks obtained in various subjects by the student. The marks would typically be

available in the form of a document containing the student's name, roll number and marks scored in each subject. This data must first be stored in the computer's memory after converting it into machine-readable form. The data will then be processed and sent from the memory to tile output unit, which will present the data in a form that can be read by users.

Figure 2.12 shows the role of I/O devices in a computer system.

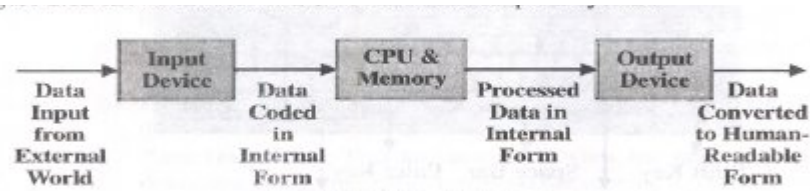


Figure 2.12: Roles of I/O Devices

Input devices, which provide a means of communication between the computer and the outside world, are known as peripheral devices. This is because they surround the CPU and the memory of a computer system. While input devices are used to enter data from the outside world into the primary storage, output devices are used to provide the processed results from primary storage to users. The following are the examples of input devices, which are used for different types of multimedia applications:

- Keyboard
- Mouse
- Trackball
- Joystick
- Light Pen
- Touch Screen
- Scanning Devices
- Voice Recognition Devices
- Vision Input Devices

2.5.1 Keyboard

Keyboard devices allow input into the computer system by pressing a set of keys, mounted on a board connected to the computer system. Keyboard devices can be classified into the following categories:

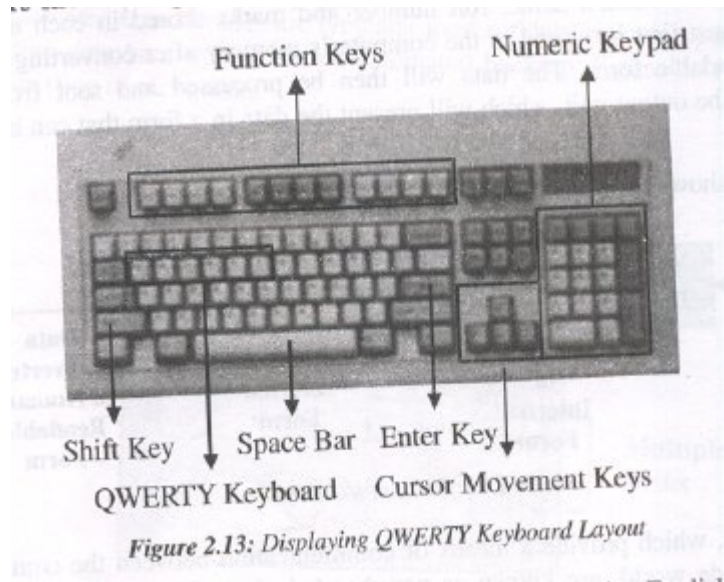
- General-purpose keyboards
- Special-purpose keyboards

2.5.1.1 General-purpose keyboards

The most familiar means of entering information into a computer is through a typewriter-like keyboard that allows a person to enter alphanumeric information directly.

The most popular keyboard used today is the 101-keys with a traditional QWERTY layout, having an alphanumeric keypad, 12 function keys, a variety of special-function keys, numeric keypad and dedicated cursor-control keys. It is so called because the arrangement of its alphanumeric keys in the upper left row.

Figure 2.13 shows the QWERTY keyboard layout.



- **Alphanumeric Keypad:** This contains keys for the English alphabets such as a to z or A to Z, numeric numbers such as 0 to 9 and special characters like *, +, -and |.

- **Twelve Function Keys:** These are keys labeled F1, F2 ...F12 and are a set of user programmable function keys. The actual function assigned to a

function key differs from one software package to another. These keys are also called soft keys since their functionality can be defined by the software.

- **Special Function Keys:** Special function keys have special functions assigned to each of these keys. Special keys include:

- **Shift key:** This key is used to enter capital letters or special characters defined above the number keys.
- **Spacebar key:** This key is used to enter a space at the cursor location.
- **Ctrl key:** This key is used in conjunction with other keys to provide added functionality on the keyboard.
- **Alt key:** This key is the same as Ctrl key and it is used to expand the functionality of the keyboard.
- **Tab key:** This key is used to move the cursor to the next tab position defined.
- **Backspace key:** This key is used to move the cursor one position to the left and also delete the character in that position.
- **Caps Lock key:** This key is used to toggle between the capital letter lock feature. When 'on', it locks the keypad for capital letters input.
- **Num Lock key:** This key is used to toggle the number lock feature on and off. When 'on', it inputs numbers when you press the numbers on the numeric keypad.
- **Insert key:** This key is used to toggle between the insert and overwrite mode during data entry -when 'on', entered text is inserted at the cursor location.
- **Delete key:** This key is used to delete the character at the cursor location.
- **Home key:** This key is used to move the cursor to the beginning of the work area which could be the line, screen or document depending on the software being used.
- **End key:** This key is used to move the cursor to the end of the work area.
- **Page Up:** This key is used to display the previous page of the document being currently viewed on the screen.

- o **Page Down key:** This key is used to view the next page of the document being currently viewed on the screen.
- o **Escape key:** This key is usually used to negate the current command.
- o **Print Screen key:** This key is used to print what is being currently displayed on the screen.
- o **Numeric Keypad:** It consists of keys having numbers 0 to 9 and mathematical operators such as +, -, *, and / defined on them. It is usually located on the right side of the keyboard and supports quick entry of numerical data.
- o **Cursor-control key:** This includes keys defined by the arrow keys used to move the cursor in the direction indicated by the arrow.

2.5.1.2 Special-purpose keyboards

These are stand-alone data entry systems used for computers deployed for specific applications. These typically have special purpose keyboards to enable faster data entry. A very typical example of such keyboards can be seen at the Automatic Teller Machines or the ATMs, where the keyboard is required for limited functionality by the customers. Point-of-Sale or POS terminals at fast food joints, Air/Railway reservation counters are some other examples of special-purpose keyboards. These keyboards are specifically designed for special types of applications only.

2.5.2 Mouse

A mouse is a small device that a computer user pushes across a desk surface in order to point to a place on a display screen and to select one or more actions possible from that position. The mouse first became a widely used computer tool when Apple Computer made it a standard part of the Apple Macintosh. Today, the mouse is an integral part of GUI of any personal computer. The mouse apparently got its name by being about the same size and shape as a toy mouse. Figure 2.14 shows a mouse.



Fig2.14: Mouse

The most conventional kind of mouse has two buttons on top: the left one is used most frequently. In the windows operating systems, it lets the user click once to send a 'Select' indication that provides the user with feedback that a particular position has been selected for further action. The next click on a selected position or two quick clicks on it causes a particular action to take place on the selected object. For example, in Windows operating systems, it causes a program associated with that object to be started. The second button, on the right, usually provides some less-frequently needed capability. For example, when viewing a Web page, you can click on an image to get a pop-up menu that, among other things, lets you save the image on your hard disk. Some models have a third button for additional capabilities. Some mouse manufacturers also provide a version for left-handed people.

2.5.3 Trackball

The trackball is a pointing device that is much like an inverted mouse. It consists of a ball inset in a small external box, or adjacent to-and in the same unit as-the keyboard of some portable computers. Figure 2.15 shows a trackball.



Figure 2.15: Displaying a Trackball

It is more convenient and requires much less space than the mouse, since here the whole device is not moved as in the case of a mouse. The trackball comes in various shapes but supports the same functionality. Typical shapes used are a ball, a square and a button.

2.5.4 Joystick

The joystick is a vertical stick that moves the graphic cursor in the direction the stick is moved. It consists of a spherical ball, which moves within a socket, and has a stick mounted on it. The user moves the ball with the help of the stick that can be moved left or right, forward or backward, to move and position the cursor in the desired location. Joysticks typically have a button on top that is used to select the option pointed by the cursor. Video games, training simulators and control panels of robots are some common uses of a joystick. Figure 2.16 shows a joystick.

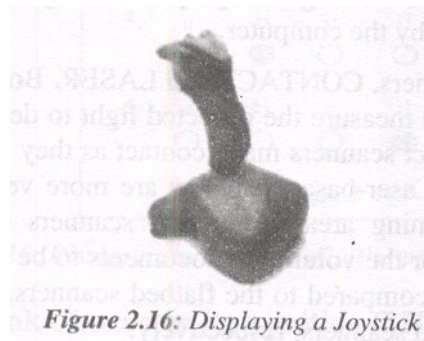


Figure 2.16: Displaying a Joystick

2.5.5 Light Pen

The light pen is a pen-shaped device allowing natural movement on the screen. It is made up of a light sensitive cell and a lens assembly designed in such a way that it focuses onto itself any light in its field of view. The pen contains a light receptor and is activated by pressing the pen against the display screen. The receptor is the scanning beam that helps in locating the pen's position (X and Y coordinates on the screen). Suitable system software is provided to initiate the desired action once the area on the display screen is located with the help of the light pen. Light pens are typically used in Computer Aided Design (CAD) applications to directly draw on screen. Figure 2.17 shows a light pen.



Figure 2.17 shows a light pen

2.5.6 Touch Screen

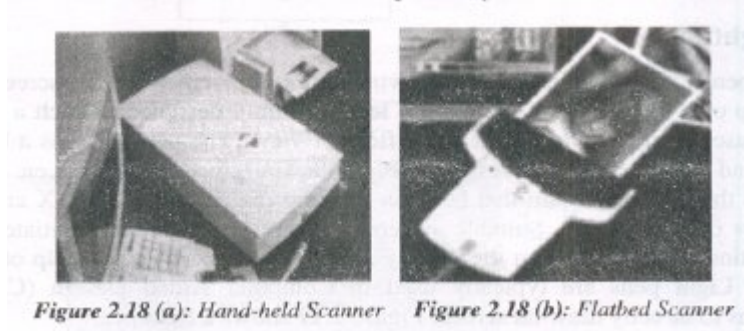
A touch screen is probably one of the simplest and most intuitive of all input devices. It uses optical sensors in, or near, the computer screen that can detect the touch of a finger on the screen. Once the user touches a particular position on the screen, sensors communicate the position to the computer. This is then interpreted by the computer in order to understand the user choice for input. The most common usage of touch screens is in information kiosks, where users can receive information at the touch of a screen. These devices are becoming increasingly popular today.

2.5.7 Scanning Devices

Scanning devices are input devices used for direct data entry from the source document into the computer system. Scanners facilitate the capturing of information and storing it in a graphical format for displaying it

back on the graphical screen. They consist of two components, one to illuminate the page so that the optical image can be captured and the other to convert the graphical image into a digital format for storing. The graphical images thus scanned can be ; seen and processed directly by the computer.

There are two types of scanners, CONTACT and LASER. Both bounce a beam of light off an image, and then measure the reflected light to determine the value of the image. Hand-held contact scanners make contact as they are brushed over the printed matter to be read. Laser-based scanners are more versatile and can read data passed near the scanning area. Hand-held scanners are used where the information to be scanned or the volume of documents to be scanned is very low. They are much cheaper as compared to the flatbed scanners. Figure 2.18 (a), (b) shows hand-held and flatbed scanners, respectively.



Capturing information using scanners reduces the possibility of human error typically seen during large data entry. The reduction in human intervention improves the accuracy of data and provides for timeliness of the information processed.

Most recent trends for data input are towards source data automation. The equipment used for source data automation capture data as a by-product of a business activity, thereby completely eliminating manual input of data. Some common examples of these are described below.

2.5.7.1 Optical Mark Recognition (OMR)

OMR devices can sense marks on computer readable paper. This kind of devices are typically used by academic institutions to grade aptitude tests, where candidates need to mark the correct option from a number of alternatives, on a special sheet of paper. These answer sheets can then be directly read by the optical mark recognition device and can be used for further processing by the computer.

The actual technique used by an OMR device once again involves focusing a light on the page being scanned, thereby detecting the reflected light pattern for the marks. Pencil marks made by the user reflect the light determining which responses are marked. Figure 2.19 shows an example of a pre-printed answer sheet that can be read by an OMR device.

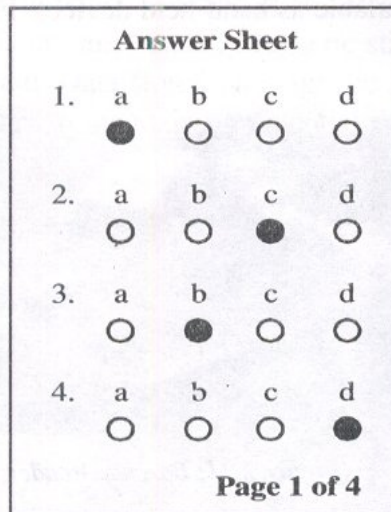


Figure 2.19: Displaying an Example of a Pre-printed Answer Sheet

2.5.7.2 Magnetic Ink Character Recognition (MICR)

MICR is similar to optical mark recognition and is used exclusively by the banking industry. MICR devices are used by the banking industry to read the account numbers on cheques directly and subsequently do the necessary processing.

Banks using the MICR technology print cheque books on special types of paper. The necessary details of the bank are pre-printed on the cheques using ink that contains iron oxide particles that can be magnetized. MICR readers are used to read and sort cheques and deposits. An MICR reader- sorter reads the data on the cheques and sorts the cheques for distribution to other banks and customers or for further processing. Figure 2.20 shows a bank cheque using MICR technology.

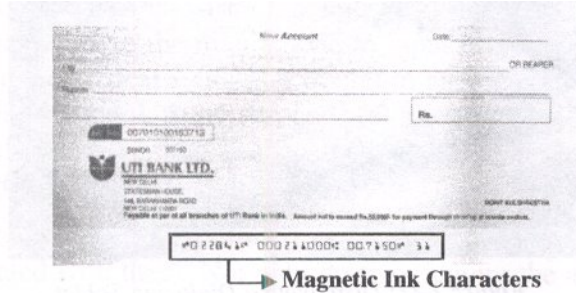


Figure 2.20: Displaying a Bank Cheque using MICR Technology

2.5.7.3 Optical Bar Code Reader (OBR)

Data coded in the form of small vertical lines forms the basis of bar coding. Alphanumeric data is represented using adjacent vertical lines called bar codes. These are of varying widths and the spacing between them is used to uniquely identify books, merchandise in stores, postal packages, etc.

A barcode reader uses laser beam technology. The laser beam is moved across the pattern of bars in a bar code. These bars reflect the beam in different ways. The reflected beam is then sensed by a light-sensitive detector, which then converts the light patterns into electrical pulses, thereby transmitting them to logic circuits for further conversion into the alphanumeric value.

Barcode devices are available as hand-held devices. Figure 2.21 shows a barcode reader.

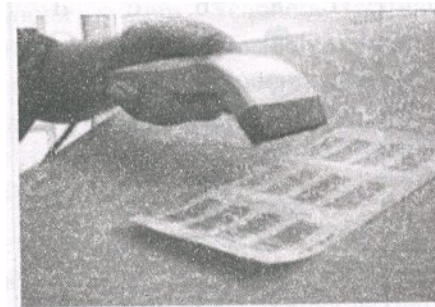


Figure 2.21: Barcode Reader

2.5.7.4 Digitizers

Digitizers are used to convert drawings or pictures and maps into a digital format for storage in the computer. A digitizer consists of a digitizing or graphics tablet, which is a pressure sensitive tablet, and a pen with the same X and Y coordinates as on the screen. Some digitizing tablets also use a crosshair device instead of a pen. The movement of the pen or crosshair is reproduced simultaneously on the display screen. When the pen is moved on the tablet, the cursor moves simultaneously to the corresponding position on the computer screen. This allows the user to draw sketches directly or input the existing sketched drawings easily. Digitizers are most commonly used by architects and engineers as a tool for Computer Aided Designing (CAD). Figure 2.22 shows a digitizing tablet.



Figure 2.22: Displaying a Digitizing Tablet

2.5.7.5 Electronic-card reader

Card readers are devices that also allow direct data input into a computer system. The electronic-card reader is connected to an electronic card and transfers it to the computer system for further processing.

Electronic cards are plastic cards with data encoded on them and meant for a specific application. Typical examples of electronic cards are the plastic cards issued by banks to their customers for use in Automatic Teller Machines or ATMs. Electronic cards are also used by many organizations for controlling access of various types of employees to physically secured areas.

Depending on the manner in which the data is encoded, electronic cards may be either magnetic strip cards or smart cards. Magnetic strip cards have a magnetic strip on the back of the card. Data stored on magnetic strips cannot be read with the naked eye, a useful way to maintain confidential data. Figure 2.23 shows an access card security system.



Figure 2.23: Displaying an Access Card Security System

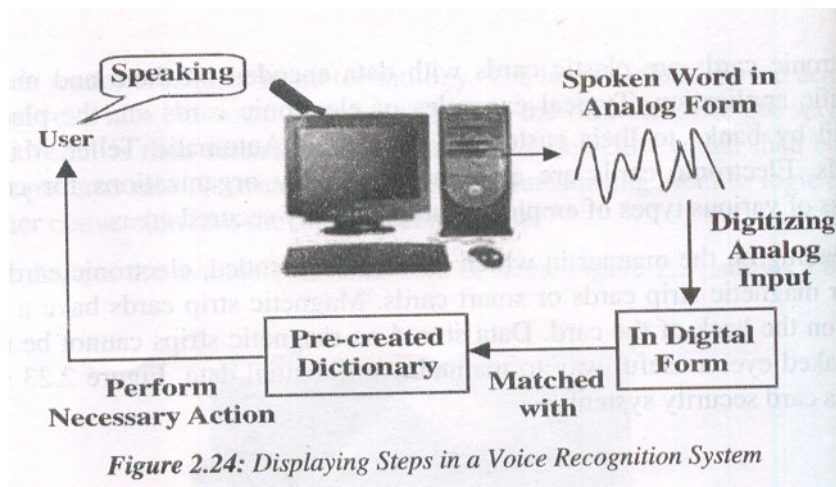
2.5.7.6 Smart cards

Smart cards, going a stage further, have a built-in microprocessor chip where data can be permanently stored. They also possess some processing capability making them suitable for a variety of applications. For example, to gain access, an employee inserts a card or badge in the reader. This device reads and checks the authorization code before permitting the individual to enter a secured area. Since smart cards can hold more information as compared to magnetic strip cards, they are gaining popularity.

2.5.8 Voice Recognition Devices

Voice recognition devices consist of a microphone attached to the computer system. A user speaks into the microphone to input data. The spoken words are then converted into electrical signals. A digital-to-analog converter then converts the analog form to digital form (0s and 1s) that can be interpreted by the computer. The digitized version is then matched with the existing pre-created dictionary to perform the necessary action.

Voice recognition devices have limited usage today because they have several problems associated with them. Not only do they require the ability to recognize who is speaking, but also what is being said. This difficulty arises primarily because people speak with different accents and different tone pitches. The computer requires a large vocabulary to be able to interpret what is being said. Today's voice recognition systems are, therefore, successful in a limited domain. They are limited to accepting words and tasks within a limited scope of operation and can handle only small quantities of data. Figure 2.24 shows the different steps in a voice recognition system.



Most speech-recognition systems are speaker-dependent, that is, they respond to the unique speech of a particular individual, a feature not necessarily inconvenient, but nevertheless limiting in generalized applications. It, therefore, requires creating a database of words for each person using the system.

2.5.9 Vision Input Devices

Vision input devices allow data input in the form of images. It usually consists of a digital camera, which focuses on the object whose picture is to be taken. The camera creates the image of the object in digital format, which can then be stored within the computer. The system then compares the digitized image to be interpreted to the pre-recorded digitized images in the computer's database; much like a speech-recognition system does with voice input. The computer identifies the image by matching the structure of the input image with those images in the database. Based on whether or not the match is found, the appropriate action is taken.

Video input or capture is the process of entering full-motion recording into a computer and storing the video on a hard disk or some other medium. Video capture cards are needed for entering video information in the computer. The video files thus created usually take up huge amounts of space on a hard disk and so are usually compressed before storage. The most popular standard used for compression is the Motion Pictures Expert Group (MPEG). Web cameras and Video Cameras are most commonly used to input visual data.

2.6 OUTPUT DEVICES

The output of the processing done by the computer can be obtained on a display unit or on a paper. Other kinds of output like speech output and mechanical output are also used in certain applications. Output produced on display units or speech output that cannot be touched, is referred to as softcopy output while output produced on paper or material that can be touched, is known as hardcopy output. A wide range of output devices is available today and can be broadly classified under the categories of:

- Display devices
- Printers .Plotters
- Projectors c,
- Computer output microfilm

2.6.1 Display Devices

One of the most common and important peripherals in a computer system is the display device. Conventional computers used display terminals known as alphanumeric terminals. These used a form of multi-dot (7 x 5 or 9 x 7) array to display characters. These were used to read text information displayed on the screen. The increasing demand for displaying graphs and pictures, for visual presentation of information, brought about the advent of graphic display devices.

Graphic display is typically made up of a series of dots called 'pixels', whose pattern produces the image. Each dot on the screen can be addressed uniquely and directly. Owing to the fact that each dot can be addressed as a separate unit, it provides greater flexibility for drawing pictures. The following are the commonly

used display devices:

- Cathode Ray Tube (CRT)
- Liquid Crystal Display (LCD)
- Projection display
- Monitors

2.6.1.1 CRT

The main components of a cathode ray terminal are the electron gun, the electron beam controlled by an electromagnetic field and a display screen, which is phosphor-coated. The screen's phosphor coating is organized into a grid of dots called pixels. The electron gun emits an electron beam, which is directed towards the phosphor-coated display by the electromagnetic field, and this in turn creates the image. There are two types of CRT displays:

● **Vector CRT display:** Here, the electron beam is directed only to the places where the image is to be created.

● **Raster scan display:** Here, the image is projected on the screen by directing the electron beam across each row of the picture elements from the top to the bottom of the screen. This type of display provides a high dynamic capability since the image is continuously refreshed. It offers full colour display at a relatively low cost, and is therefore becoming increasingly popular.

The quality of display is indicated by the resolution of the display device. The number of horizontal and vertical pixels determines the resolution. Typical resolutions in graphic display range from 800 x 600 to 1024 x 1024 pixels. Based on the resolution and the number of colours supported, several standards for colour monitors have evolved. The most popular of these include:

- Colour graphics adapter (CGA) which has a resolution of 220 x 200 and supports up to 16 colours.
- Extended graphics adapter (EGA) has a resolution of 640 x 250 and supports up to 16 colours.
- Video graphics adapter(VGA) has a resolution of 640 x 480 and supports up to 256 colours.
- Super VGA having a resolution ranging 800 x 600 to 1280 x 1024 and supporting up to 256 or more colours.

Note that each one of these is implemented by installing an add-on card in the computer, commonly known as graphics adapter or the video card. This card is then connected to the appropriate monitor.

2.6.1.2 LCD

This was introduced in watches and clocks in the 1970s and is now applied in the display terminals. Here, the cathode ray tube was replaced by the liquid crystal to produce the image. It does not have colour capability and the image quality is relatively poor. The main advantage of LCD is its low energy consumption.

It finds its most common usage in portable devices, where compactness and low energy requirements are of prime importance.

2.6.1.3 Projection display

Projection display technology is characterized by replacing the personal size screen with large screens upon which the images are projected. These systems are connected to the computer, and whatever appears on the computer terminal gets enlarged and projected on a large screen. These are being used today for large group presentations.

2.6.1.4 Monitors

Monitors use CRT to display information. It resembles a television screen and is similar to it in other respects. The monitor is typically associated with a keyboard for manual input of characters. The screen displays information as it is keyed in, enabling a visual check of input before it is transferred to the computer. It is also used to display the output from the computer and hence serves both as an input and an output device. The monitor along with the keyboard is called a Visual Display Unit (VDU). This is the most commonly used input/output device today and is also known as a soft copy terminal. A printing device is usually required to provide a hard copy of the output. Figure 2.25 shows a CRT monitor.

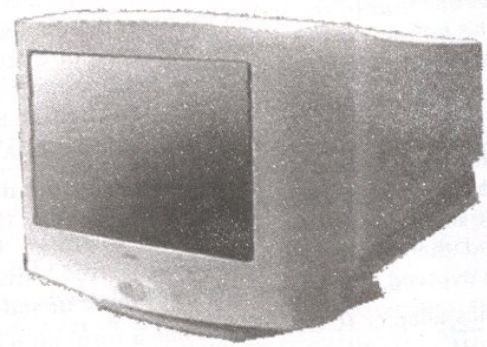


Figure 2.25: CRT Monitor

2.6.2 Printers

The printer is an output device that can be used to transfer the text displayed on the screen onto the paper. The printer is connected to the computer as an external device with the help of cables. Printers can be classified as impact or non-impact printers, based on the technology they use for producing output. Impact printers use variations of standard typewriter printing mechanism, in which a hammer is used to strike the paper through an inked ribbon. These printers have a mechanism that touches the paper in order to create an image. Dot matrix printers and character printers fall under this category. Non-impact does not touch the paper while creating the image. They use chemical, heat or electrical signals to etch symbols on paper. Many of these require special coated or treated paper. Inkjet, laser and thermal printers fall under this category of printers.

Printing quality is determined by the resolution of printing and is characterized by the number of dots that can be printed per linear inch, horizontally or vertically. It is measured in terms of Dots-Per-Inch DPI. On the basis of their printing quality, printers can be classified as Near-Letter-Quality (NLQ), Letter-Quality (LQ), Near Typeset Quality (NTQ), and Typeset-Quality (TQ) printers. NLQ printers has resolution equal to 200 DPI, LQ has resolution equal to 600 DPI, NTQ has resolution equal to 1200 DPI, and TQ has resolution equal to 2000 DPI. NLQ and LQ printers are used for ordinary printing in day-to-day activities, while NTQ and TQ printers are used to produce top-quality printing, typically required in the publishing industry. The following are the examples of commonly used printers:

- Dot matrix printers
- Inkjet printers
- Laser printers

2.6.2.1 Dot matrix printers

Dot matrix printers are the most popular impact printers used in personal computing. The dot matrix printers make use of perforated sheets to print the text. These printers use a print head consisting of a series of small pins to strike a ribbon coated with ink, causing the ink to transfer to the paper at the point of impact. Characters thus produced are in a matrix format. The shape of each character, i.e., the dot pattern, is obtained from information held electronically.

The speed, versatility, ruggedness and low cost of Dot matrix printers make such printers particularly attractive in the personal computer market. Typical printing speeds in case of dot matrix printers range between 40 - 1000 cps (characters- per-second). The one major disadvantage of this technology is that the print quality is low. Figure 2.26 shows characters formed using dots and a Dot matrix printer.

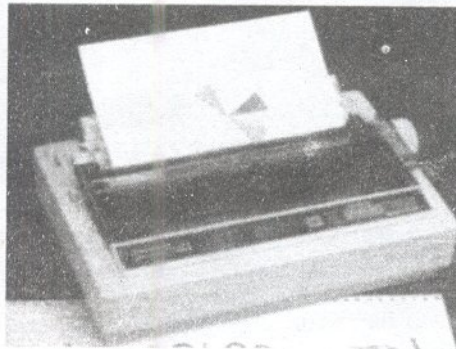


Figure 2.26 : Dot Matrix Printer

2.6.2.2 Inkjet printers

Inkjet printers use a series of nozzles to spray drops of ink directly on the paper. These, therefore, fall under the category of non-impact printers. The inkjet printers contain the ink cartridges that are attached to the printer head that moves horizontally, from left to right. The print head of an inkjet printer consists of a number of tiny nozzles that can be selectively heated up in a few microseconds by an IC register. When this happens, the ink near it vaporizes and is ejected through the nozzle to make a dot on the paper placed in front of the print head. The character is printed by selectively heating the appropriate set of nozzles as the print head moves horizontally. Figure 2.27 shows an inkjet printer.

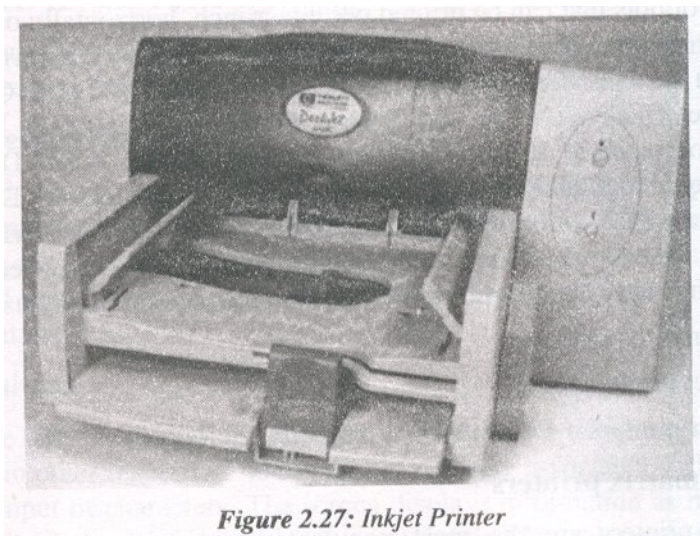


Figure 2.27: Inkjet Printer

2.6.2.3 Laser printers

Laser printers use dry ink, static electricity and heat to place and bond the ink onto the paper. They use a combination of laser and photocopier technology. Printing is achieved by deflecting laser beam onto the photosensitive surface of a drum after which the latent image attracts the toner to the image. The toner is then electro-statistically transferred to the paper and fixed into a permanent image. Figure 2.28 shows a Laser printer.



Figure 2.28: Laser Printer

Laser printers are capable of converting computer output into print, page by page. Since characters are formed by very tiny ink particles, they can produce very high quality images such as text or graphics, generally offer a wide variety of character fonts, and are silent and fast in use. Laser printers are faster in printing speed than the other printers discussed above. Their speeds can range from ten pages a minute to about 200 pages per minute, depending upon the make/model.

Laser is high quality, high speed, high volume, and non-impact technology that work on plain paper or pre-printed stationary. This technology is relatively expensive, but is becoming very popular because of the quality, speed and noiseless operations.

2.6.3 Plotters

Plotters are used to produce graphical output on paper. It is a device capable of producing charts, drawings, graphics, maps, etc. It is much like a printer but is designed to print graphs instead of alphanumeric characters.

Based on the technology used, plotters may be pen plotters or electrostatic plotters. While pen plotters have an ink pen attached to draw the images, electrostatic plotters work similar to a laser printer. Using plotters, image is produced by charging the paper with high voltage. This voltage attracts the toner, which is then melted on the paper with heat. Electrostatic plotters are fast, but the quality is generally considered to be poor when compared to pen plotters. This is why pen plotters are more extensively used as compared to electrostatic plotters. Flatbed plotters and drum plotters constitute the most commonly used plotters.

2.6.3.1 Flatbed Plotters

Flatbed plotters have a flat base like a drawing board on which the paper is laid as shown in Figure 2.29. One or more arms, each of them carrying an ink pen, moves across the paper to draw. The arm movement is controlled by a microprocessor (chip). The arm can move in two directions, one parallel to the plotter and the other perpendicular to it. With this kind of movement, it can move very precisely to any point on the paper placed below.

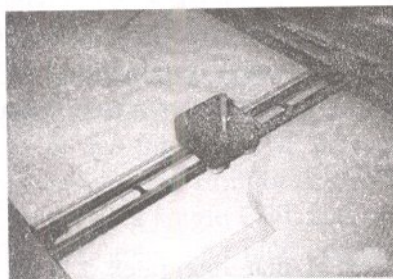


Figure 2.29: Top View of a Flatbed Plotter

The computer sends commands to the plotter which are translated into x and y movements. The arm moves in very small steps to produce continuous and smooth graphics. The size of the plot in a flatbed plotter is limited only by the size of the plotter's bed.

The advantage of flatbed plotters is that the user can easily control the graphics. He can manually pick up the arm anytime during the production of graphics and place it on any position on the paper to alter the position of graphics to his choice. The disadvantage here is that flatbed plotters occupy a large amount of space.

2.6.3.2 Drum plotters

Drum plotters use a drum revolver to move the paper during printing as shown in Figure 2.30. The arm carrying a pen moves only in one direction, perpendicular to the direction of the motion of the paper. Thus, in drum plotters the pen is moved in a single axis track and the paper itself moves on a cylindrical drum to add the other axis or dimension. The combination of the pen and paper movement creates the graphics.

The size of the graph, is therefore, limited only by the width of the drum and can be of any length. Drum plotters are very compact and lightweight as compared to flatbed plotters. This is one of the advantages of such plotters. The disadvantage, however, is that the user cannot freely control the graphics when they are being created.

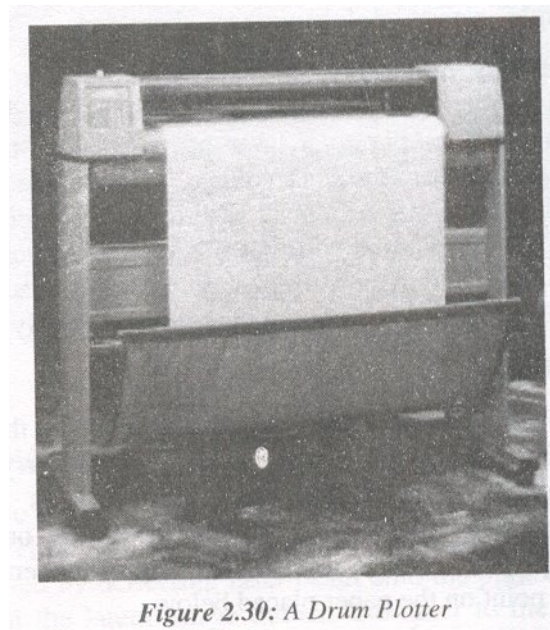


Figure 2.30: A Drum Plotter

Plotters are more expensive when compared to printers. Typical application areas for plotters include: Computer-Aided Engineering (CAE) applications like Computer-Aided Design (CAD), Computer-Aided Manufacturing (CAM) and architectural drawing.

2.6.4 Projectors

A projector is an output device that integrates a light source, optics system, electronics and display for the purpose of projecting the information from the computer or video device onto a wall or screen. Thus, the information projected by the projector can be viewed by a large number of people. A projector is a device that is connected to a computer or video in the same manner as the monitor is connected to the computer. Projectors are widely used for giving presentations. The computer can be used to prepare the audio, video, image and animation in the presentations and then the projector can be used to make these presentations more lively and interesting. Projectors are thus used to show the information to more people.

One form of the projector is video projector. A video projector is used to take the video signal from the computer or some other video device and project the corresponding image on to the wall or projection screen using a lens system. The video projects use the bright light to project the information. Video projectors can be used for conference room presentations, classroom training; and home theatre applications. Figure

2.31 shows the video projector.

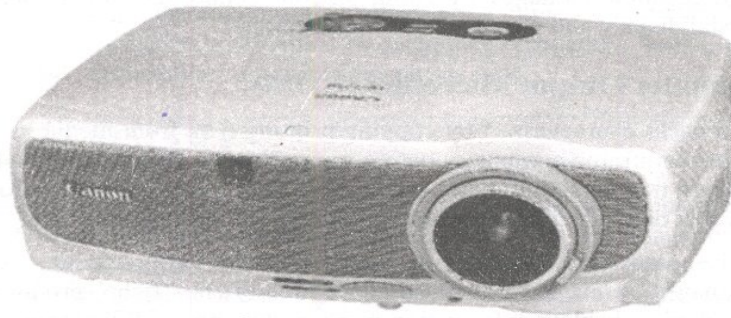


Figure 2.31: A Video Projector

Video projector can be of four types. These are described as follows:

- **LCD projector:** A Liquid Crystal Display (LCD) projector is one kind of video projector that can be used to display the images, video or computer data on a screen or other flat surface. LCD projectors display the information by sending light from a halogen lamp through three LCD panels. Each of these LCD panel is used for red, green and blue components of the video signal. The individual pixels in these panels can be opened to pass through the light or can be closed to block the light. This combination of open and closed pixels can produce a wide range of colours and shades in the projected image. Halogen lamps are used in the LCD projector, because they produce an ideal colour temperature and a wide range of colours. These lamps can also spread a large amount of light in a very small area.

- **CRT projector:** A Cathode-Ray Tube (CRT) projector is another kind of projector that displays the image by using a high-brightness picture tube. The image generated by this type of projector can be focused and enlarged by using a lens kept in front of the CRT face. Modern projectors use three CRTs instead of a single CRT and their own lenses to achieve colour images. The red, green and blue components of the video signal are processed independently and are sent to the respective CRT. The lenses of the CRT focus the images to achieve the overall picture on the screen. CRT projectors are compatible with the output of most computers as well as televisions.

- **DLP projector:** Digital Light Processing (DLP) is a technology used in video projectors. This kind of video projectors use a semiconductor chip and the image is created by microscopically small mirrors that are laid out in a matrix known as a Digital Micromirror Device (DMD). Each mirror in this projector represents one pixel in the projected image. The resolution of the corresponding image depends on the number of mirrors in the projector.

- **LCOS projector:** Liquid Crystal on Silicon (LCOS or Lcos) projectors is another kind of video projectors that uses the micro display technology. This technology is mostly used for projection televisions. The technology of these projectors is similar to DLP projects, but these projectors use liquid crystals instead of individual mirrors. LCOS projectors produce high resolution images by using silicon technology rather than liquid crystal display and plasma display technologies.

2.6.5 Computer Output Microfilm (COM)

COM is a process characterized by copying/printing data from media located on PCs, mini or mainframe computers onto a microfilm. It consists of a high-speed recorder, which transfers digital data onto a microfilm using laser technology, and a processor that develops the microfilm once exposed to the light source.

COM device translates information normally held on magnetic tape into miniature images on a microfilm (also called microfiche- 'fiche' pronounced as 'fish'). The device displays information as characters on a CRT screen and then using photographic methods records the display onto the film. Drawings and images can also be displayed along with narrative text.

A special reader/printer can subsequently be used to view the processed film. The reader operates on a 'back projection' principle displaying one frame at a time on a translucent screen, typically about A4 size. The printer can then be used selectively to produce a hard copy of what is presented on the screen. Figure

2.32 identifies the various steps in COM production.

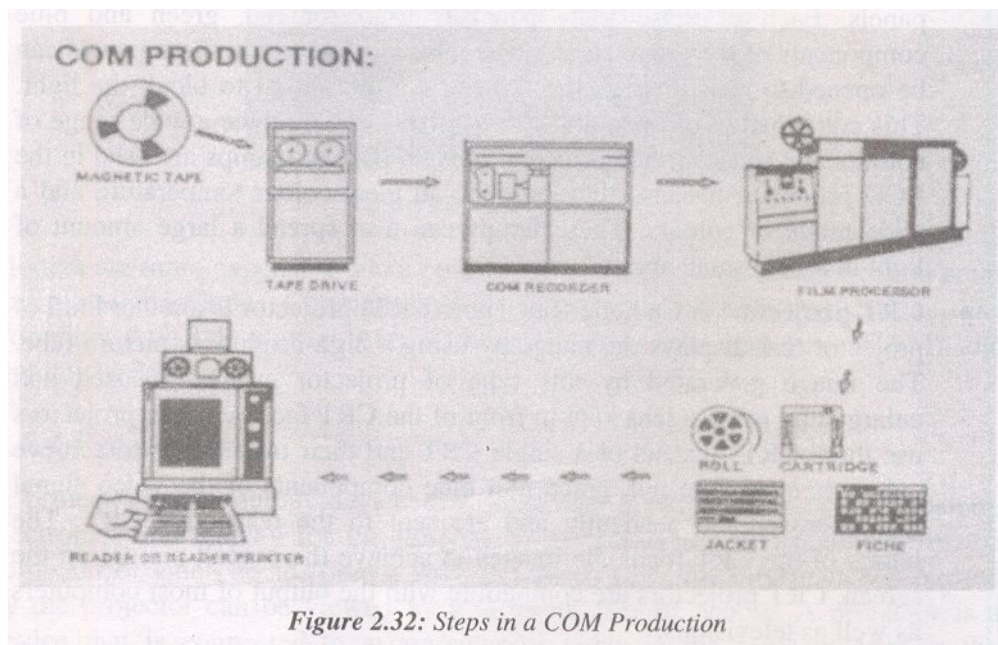


Figure 2.32: Steps in a COM Production

A COM system provides an easy and compact way of recording and storing information, and subsequently retrieving the desired pieces of information. It offers various advantages like reduction of paper, reduction in cost (since it is cheaper than most electronic media), improved quality (COM technology provides superior image quality) and electronic record retention/archiving.

COM is ideal for data that requires long-term storage, because microfilm is less volatile than magnetic media such as disks and tapes. It stores data in a very compact form; up to 270 pages can be contained in a single 4 x 6 inch fiche.

Converting magnetic tapes to microfilm is quite inexpensive for closed files. However, if the data is highly active, or requires regular updating, microfilm may be less efficient than retaining the information online. It is therefore useful for data that must be archived for long periods of time and referenced only occasionally, e.g., information that must be archived to comply with legal regulations, information maintained by insurance companies, banks, government agencies and various other organizations of this type.

2.7 SUMMARY

This unit introduced you to the hardware components of a computer. You can store information in the computer system on devices like magnetic tapes and disks. You have learned that the storage capacity of storage devices can be used to determine the amount of data that can be stored in the storage devices.

This unit also explained the input devices used to provide communication between the computer and the outside world. They are also known as peripheral devices. Finally, in this unit, you have learned about various output devices that accept data from the computer and translate it into a form that can be understood by the outside world. Thus, you now know that output can be produced in two ways -on a display unit/device, or on paper. Output produced on a display unit or device is called softcopy output while that produced on paper is referred to as hardcopy output.

2.8 KEY TERMS

- **Cache Memory:** It is the memory unit that stores the data and the related application that was last processed by the CPU.
- **CD-ROM:** It is a circular optical disk which is used to store textual, graphical, audio and visual content.

- **Hit ratio:** It can be defined as the ratio of number of hits to the total number of times the CPU has searched the cache memory.
- **Laser:** Laser is high-quality, high-speed, high-volume, and non-impact technology that work on plain paper or pre-printed stationary.
- **Light pen:** The light pen is a pen-shaped device allowing natural movement on the screen.
- **Magnetic Disk:** It is a circular plate made of metal or plastic, coated with magnetized material.
- **Mastering:** The process of recording information on the disks is known as mastering.
- **Mouse:** It is a small device that a computer user pushes across a desk surface in order to point to a place on a display screen and to select one or more actions possible from that position.
- **Peripheral Devices:** Input devices which provide a means of communication between the computer and the outside world, are known as peripheral devices.
- **Printer:** It is an output device that can be used to transfer the text displayed on the screen on to the paper.
- **Projector:** It is an output device that integrates a light source, optics system, electronics and display for the purpose of projecting the information from the computer or video device onto a wall or screen.
- **ROM:** It is the permanent memory of the computer that stores data and instructions, even when the computer is turned off.
- **RAM:** RAM is the read/write memory unit, which is volatile in nature.
- **Storage Device:** Storage devices are the devices that are connected to the computer to provide a non-volatile memory source in addition to the primary memory of the computer. Storage devices are also called secondary memory.
- **Scanning Devices:** These are input devices used for direct data entry from the source document into the computer system.
- **Tracks:** In hard disks, data is stored in concentric circles, known as tracks.
- **Trackball:** The trackball is a pointing device that is much like an inverted mouse.

2.9 ANSWERS TO ‘CHECK YOUR PROGRESS’

1. Storage devices are used to store all system programs and system software.
2. The following are examples of storage devices:
 - A. Magnetic tapes
 - B. Magnetic disks
 - C. Floppy disks
 - D. Hard disks
3. A magnetic disk is a circular plate made of metal or plastic, coated with magnetized material. Often, both sides of the disk are used. Data is recorded on the disk in the form of magnetized and non-magnetized spots representing Is and Os.
4. The following are the types of hard disks:
 - A. Disk packs .
 - B. Winchester disks
 - C. Zip disks
5. The disadvantages of CD-ROMs are:
 - A. They are read-only and cannot be updated.
 - B. Access time of a CD-ROM is greater than that of a magnetic disk.
6. The following are the most commonly used mass storage devices:
 - A. Disk arrays
 - B. Tape libraries

- C. CD-ROM jukeboxes
7. An input device accepts data from the outside world and transforms it into ~ a form the computer can interpret.
 8. The following are the examples of input devices:
 - A. Keyboard
 - B. Mouse
 - C. Trackball
 - D. Joystick
 - E. Light Pen
 - F. Touch Screen
 - G. Scanning Devices
 - H. Voice Recognition Devices
 - I. Vision Input Devices
 9. Keyboard devices can be classified into the following categories:
 - A. General-purpose keyboards
 - B. Special-purpose keyboards
 10. A mouse is a small device that a computer user pushes across a desk surface in order to point to a place on a display screen and to select one or more actions possible from that position.
 11. The following are the examples of output devices:
 - A. Display devices
 - B. Printers
 - C. Plotters
 - D. Projectors
 - E. COM
 12. The following are the types of CRT displays:
 - A. Vector CRT displays
 - B. Raster scan display
 13. The following are the types of commonly used printers:
 - A. Dot matrix printers
 - B. Inkjet printers
 - C. Laser printers
 14. Plotters are used to produce graphical output on paper. A plotter can be defined as a device capable of producing charts, drawings, graphics and maps. It is much like a printer but is designed to print graphs instead of alphanumeric characters.
 15. The following are the different types of projectors:
 - A. LCD projectors
 - B. CRT projectors
 - C. DLP projectors
 - D. LCOS projectors

2.10 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What do you mean by static :RAM?
2. What is the difference between static RAM and dynamic RAM?
3. Explain the different types of ROM.
4. Explain the organization of the data stored in magnetic tapes.
5. How is the storage capacity of the data stored on a magnetic tape calculated?
6. Explain the difference between magnetic disks and magnetic tapes.
7. What do you mean by RAID?
8. What is the difference between tape libraries and disk arrays?
9. Explain special purpose keyboards.
10. What is the function of a trackball?
11. Explain joystick.
12. What do you mean by voice recognition devices?
13. What are the main components of CRT?
14. What is the difference between LCD and CRT?
15. What do you mean by projection display?
16. Explain how an image can be created using dot matrix printers.
17. What is the difference between flatbed plotters and drum plotters?
18. Explain COM.

Long-Answer Questions

1. Explain ROM and cache memory.
2. Explain the following terms:
 - A. Hard disks
 - B. Floppy disks
 - C. CD-ROMs
3. Explain the following mass storage devices:
 - A. CD-ROM jukebox
 - B. Tape libraries
4. Describe general-purpose keyboards.
5. Describe the following input devices:
 - A. Touch screen
 - B. Scanning devices
6. Describe the different types of printers.
7. Explain the different types of projectors.

2.11 FURTHER READING

Shepherd, Robert D., *Introduction to Computers and Technology*. New Delhi: Pentagon Press, First edition.

UNIT-I

COMPUTER SOFTWARE

Structure

3.0 Introduction

3.1 Unit Objectives

3.2 What is Software?

3.3 Application Software

3.3.1 Enterprise Software

3.3.2 Business Workflow Software

3.3.3 Document Management System

3.3.4 Media and Entertainment Software

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3.4 System Software

3.4.1 Operating Systems

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3.4.4 Functions of System Software

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3.5 Programming Software

3.5.1 Text Editors

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3.5.3 Interpreters

3.5.4 Linkers

3.5.5 Debuggers

3.5.6 Visual Studio.NET IDE

3.6 Summary

3.7 Key Terms

3.8 Answers to 'Check Your Progress'

3.9 Questions and Exercises

3.10 Further Reading

3.0 INTRODUCTION

In this unit, you will learn about computer software. A computer software consists of a set of instructions that control and manage the working of a computer. You will learn about the three classes of computer software, namely application software, system software and programming software. This unit will also give you an insight into the most commonly used programming tools included in an IDE (Integrated development environment).

3.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Define software system
- Explain the various application software
- Explain the various types of system software
- Describe the different programming tools

3.2 WHAT IS SOFTWARE?

The term computer software refers to a program or a set of instructions that i controls the entire functioning of the hardware in a computer. The software instructs the Central Processing Unit (CPU) what to do and how to do, so that the hardware can read or write the data given to it. Computer software enables a computer to perform particular tasks, whereas the hardware can only perform the tasks they are mechanically designed for. The computer software can be divided into three classes, which are explained as follows:

- **Application software:** This enables the users to perform one or more specific tasks. Some examples of application software are industrial automation, business software, educational software, medical software, databases and computer games. Application software has wide range of uses in businesses, though it is now used in many other fields.
- **System software:** This enables the functioning of the computer hardware and the computer system. The objective of the system software is to isolate the application programmers from the details of the complex functioning of the computer such as the functioning of memory and various accessory devices. Operating systems, device drivers, diagnostic tools, servers, windowing systems and utilities are some of the types of system software.
- **Programming software:** This consists of the tools that help a programmer in writing computer programs and software using different programming languages in a much easier way. Some of the programming software tools are text editors, compilers, interpreters, linkers and debuggers. An Integrated Development Environment (IDE), having an advanced Graphical User Interface (GUI) merges all these tools into a software bundle, so that the programmer need not type multiple commands for the functions such as compiling, interpreting, debugging and tracing.

3.3 APPLICATION SOFTWARE

Application software is the software designed to accomplish specific tasks such as automation and education software. Application software is used to automate different functions in every field of business and human activities. Figure 3.1 shows the basic classification of software in a computer system:

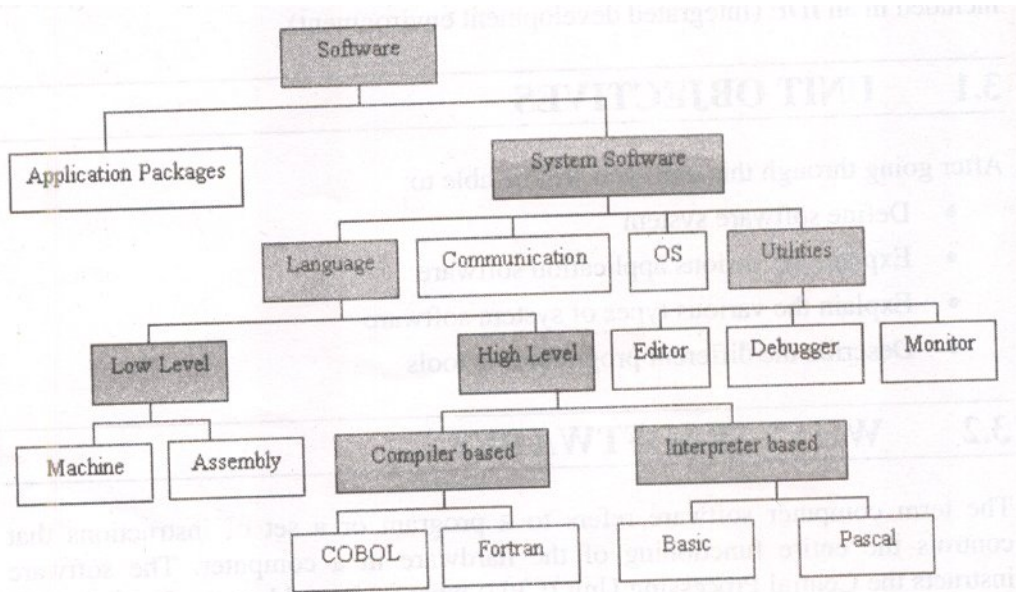


Figure 3.1: Software Classifications in a Computer System

Application software can be used for automating different tasks such as maintaining employee records and providing education to the students. Some examples of application software are:

- Enterprise Software
- Business Workflow Software
- Document Management System
- Media and Entertainment Software

- Educational Software

3.3.1 Enterprise Software

Enterprise software is used to fulfil the needs organization processes and data flow, often in large distributed ecosystems, for example, financial customer relationship management and supply chain management. As many business enterprises have similar departments and systems, enterprise software is available as a bunch of programs with helping tools to modify the common programs for specific work. Mostly these development tools are complex programming tools that require specialist capabilities. This software provides business logic support for an organization. These are typically used in commercial organizations which aim to improve productivity and efficiency. Services provided by enterprise software are business oriented such as online shopping and online payment processing and automated billing system. It performs different business functions such as accounting, production scheduling, customer information tracking and bank account maintenance. Most common examples of enterprise software are SAP, Oracle, Tally, and Microsoft Office. Enterprises software helps in maintaining and processing account transactions within functional modules such as account payable, account receivable, payroll and trial balance. As every organization needs an accounts department for various tasks, there are variety of accounting software developed for different purposes like banking, construction, medical and retail. Enterprise software like back-office software is the most common corporate software. Examples of back-office system are IT system that keeps the phone and computer running. A back-office system also keeps a record of company's sale and purchase transactions and updates the inventory as needed. Invoices, receipts and reports can also be produced by the back-office system. Enterprise software also helps the human resource department in Human Resource Management (HRM). The goal of this software is to help an organization to meet strategic goals by maintaining database of employees and their salary structure, leaves, bonus, transfers and promotions. Another significant feature of enterprise software is Customer Relationship Management (CRM). CRM provides support to business processes including sales and marketing. Each interaction with customer is generally added to customer's contact details and the customer can retrieve information from the database. CRM also helps in designing marketing campaigns to optimize effective marketing. Supply Chain Management (SCM) is another benefit of enterprise software. SCM is the process of planning to satisfy customer requirements as efficiently as possible. It manages all business activities of an organization from storage of raw material to finished goods.

3.3.2 Business Workflow Software

Business workflow software is informational software, which makes the business task easier. More specifically, workflow is the aspect, which tells how tasks are structured, who performs them, what their relative order is, how they are synchronized, what information is needed to support the tasks and how the tasks are being tracked. Workflow problems can be modelled and analysed using graph-based techniques. Workflow supports documents and imaging software as well. Workflows can be classified in two categories: scientific workflow and business workflow. Scientific workflow is mostly concerned with entering data through various algorithms, applications and services. Business workflow concentrates on scheduling task executions, which are not necessarily data-driven and may include human efforts. Scientific workflows are widely used in the fields of bioinformatics and chemical engineering to meet the need for multiple interconnected tools, handling of multiple data formats and large data quantities.

Business workflows are used for structuring and scheduling of tasks within a software application and organizing electronic document. The main advantage of business workflow is that the entrance of the work stream path is modelled in such a way as to evaluate the efficiency of the flow route to identified business characteristics. It also helps in the evaluation of resources, both physical and human, and creates smoother transitions between tasks. Workflow automation is most appropriate for work in which human involvement is limited to key data entry and decision points. In a workflow application various applications, components and people must be involved in the processing of data to complete a part of a process. For example, consider a purchase order that moves through various departments for authorization and purchase. The orders may be treated as messages, which are put into various queues for processing. Similarly, a workflow process involves constant change and update. There are two ways of developing workflow applications. The first one is to design workflow models in a dedicated language and then to link the tasks in these models. Workflow languages usually come with an associated graphical notation, but some are textual or XML-based. Another approach to develop workflow applications is to use a programming language in conjunction with libraries

and interfaces that I capture abstractions for task coordination. Examples of such libraries and interfaces are Windows Workflow Foundation and Workflow OSID.

3.3.3 Document Management System

A document management system (DMS) is a set of computer programs used to track and store electronic documents and images of paper documents. Electronic document management is content-based networking for communication infrastructure, where information is driven by the content throughout the network. The users express their interests and the senders simply input the message into the network. The network delivers all the information to the right people. DMS manages documents by creation, storage, organization, transmission, retrieval, manipulation, updating and disposition of documents to fulfil an organizational purpose.

Using DMS, all the data and information can be put in a central database/intranet, which can be used by everyone in the organization. There are different ways of improving communication tool. Suppliers can use the software to share information and make their clients (employees) to use the system. One way to do this is by introducing long-term profile of clients consisting of a number of standing queries to represent their information need. Users can easily get information in their field of interest from existing profiles. Therefore, search costs and search time for employees decrease.

DMSs commonly provide various functions, which are as follows:

- **Extraction of metadata:** The DMS may extract metadata from the document automatically or prompt the user to add metadata. The metadata is typically stored for each document. It includes the date on which the document was stored and the identity of the user who stored it.
- **Integration:** Many DMSs attempt to integrate document management directly into other applications, so that users may retrieve existing documents directly from the DMS repository, makes changes and saves the changed document back to the repository. Such integration is commonly available for e-mail or groupware software.
- **Capture:** This function involves capturing of images from paper documents using scanners or multifunction printers. Optical Character Recognition (OCR) software is often used to integrate the hardware with stand-alone software, in order to convert digital images into machine readable text.
- **Indexing:** This function involves tracking of electronic documents. It is as simple as keeping track of unique documents. Indexing exists mainly to support retrieval. One area of critical importance for rapid retrieval is the creation of an index topology.
- **Storage:** This function is used to store electronic documents. Storage of the documents often includes management of those same documents; where they are stored.
- **Retrieval:** This function involves retrieving electronic documents from storage devices. It allows the user to specify the unique document identifier, and having the system use the basic index (or a non-indexed query on its data store) to retrieve the document.

3.3.4 Media and Entertainment Software

Media and entertainment software application is provided to entertain and enhance knowledge. Media players, Web browser and Hybrid editor players are the examples of media and entertainment software application. Media player software is used for playing back multimedia files. Most software media player supports both audio and video files. Some media players focus only on audio or video and are known as audio players and video players, respectively. Some operating systems like Microsoft Windows comes with pre-loaded Windows Media Player. The latest is Windows Media Player 11. Many media players use libraries. The library is designed to organize music into categories. Few examples of media players that include media libraries are Winamp, iTunes and Real Player. Another media and entertainment software is Web browser. A Web browser is a software application that enables a user to display and interact with text, images and other information located on a Web page at a web site on the World Wide Web (WWW). Text and images on a Web page can contain hyperlinks to other Web pages at the same or different website. Web browsers allow a user to quickly and easily access information provided on many Web pages. Web browsers use Hyper Text Markup Language (HTML) code. Some of the Web browsers available for personal computers include Internet Explorer, Mozilla Firefox, Safari, Opera and Netscape.

Web browsers communicate with Web servers using Hypertext Transfer Protocol HTTP to fetch Web pages. HTTP allows Web browsers to submit information to Web servers as well as fetch Web pages from them. Pages are located by means of a Uniform Resource Locator (URL), which is treated as an address. Most browsers support a variety of formats in addition to HTML such as the JPEG image formats. Another type of media and presentation software is Hybrid Editor Player. A Hybrid Editor Player is a computer software application used to display information, normally in the form of a slide show. There are many different types of presentations like professional, educational and general communication. Presentation programs are excellent alternative for paper documentation such as pamphlets, handouts, chalkboards and flip charts. Many presentation programs such as Adobe Photoshop or Adobe Illustrator have pre- designed graphic images. Programs like Adobe Photoshop also include presentation functions for displaying them in a slide show format. For example, Apple's iPhoto allows groups of digital photos to be displayed in a slide show.

3.3.5 Educational Software

Educational software is a computer application whose purpose is teaching or self- learning. There are various types of software aimed at the home education of younger children. The design of educational software programs for home use has been influenced strongly by computer gaming concepts -in other words, they are designed for fun as well as education. However, there is a large difference between proper learning modules and software games. An example of educational software is the software designed for use in school classrooms. Such software may be projected onto a large whiteboard at the front of the class or run simultaneously on a network of desktop computers in a classroom. This type of software is often called classroom management software. Electronic-learning (E- learning) module is very popular educational software. E-learning is a general term used to refer to computer-enhanced learning. E-learning is naturally suited to distance learning and flexible learning, but sometimes it can also be used for face-to-face teaching. There are many universities, which offer academic degree and certificate programmes via the Internet. Some programmes require the students to attend some campus classes or orientations, which are delivered completely online. In addition, several universities offer online student support services such as online advising and registration, e-counselling, online textbook purchase and student newspapers. E-learning is also used extensively in the business sector to provide cost-effective online training. Advantages of E- learning are flexibility, convenience and the ability to work at any place where an Internet connection is available. E-classes allow learners to participate and complete coursework in accordance with their daily commitments. This makes e- learning education an effective option for those who cannot participate easily.

3.4 SYSTEM SOFTWARE

System software is an essential part of the computer software, which controls and manages the hardware and its functioning,, so that the application software can perform a particular operation. System software is known as firmware if it is stored in a non-volatile storage such as integrated circuits. Thus, system software can be said to be a set of instructions that arrange, utilize and control the hardware of a computer system. Some of the common types of system software are:

- Operating Systems
- Device Drivers
- Other system software such as utility programs and language translators

3.4.1 Operating Systems

An operating system is a type of software that acts as an interface between the user and the computer. It is the first program that gets loaded into the computer memory through the process called booting. Operating system manages all the operations of the computer and performs fundamental tasks. An operating system acts as a platform on which various application programs can run.

An operating system is a set of instructions stored on a storage device such as hard disk, Compact Disk Read Only Memory (CD ROM) or floppy disk. When you switch on a computer, the power-on routine activates and a set of power-on routine activities is performed. These power-on routine activities verify the

devices attached to the CPU such as keyboard, hard disk, floppy disk, CD ROM and printers for their proper functioning. The instructions for these power-on routine activities are stored in the Read Only Memory (ROM). ROM is permanent in nature and stores the data even when the power is switched off. However, ROM stores only a few kilobytes of instructions due to its finite size. As a result, the power-on routine activities are stored permanently in the hard disk as operating system and are transformed from the hard disk into the Random Access Memory (RAM) on booting the computer.

RAM is also called main memory, which is volatile in nature and as a result, the programs and instructions are temporarily stored on it and are lost on power failure. Secondary memory such as hard disk is non-volatile and thus, retains information even in case of power failure. For example, you are working in MS Word and saving your content in the main memory. The content will be erased from the main memory if the computer is switched off.

Some of the important functions of an operating system are mentioned below:

- Process management
- Resource management
- File management .I/O management
- Storage management

3.4.1.1 Process management

A process goes through various states for performing several tasks. The transition of a process from one state to another occurs depending on the flow of the execution of the process. It is not necessary for a process to undergo all the states. There are the following process states related to a process:

- **New:** It indicates that the process has just been created.
- **Ready:** It indicates that the process is waiting for a chance to be allocated the CPU time for execution.
- **Running:** It indicates that the process has been allocated the CPU time and is executing the tasks.
- **Waiting:** It indicates that the process is waiting for the completion of either another process or an I/O task such as reading a file.
- **Terminated:** It indicates that the process has finished its execution. All the tasks in the process are complete.

3.4.1.2 Resource management

In resource management, the resources of distributed system are divided into two broad categories- I/O devices and files. Files are the central element in a distributed system, because files provide input to an application for execution and the output of the execution is recorded in the files.

For every I/O operation, you need to access the files that are stored on disks or on specialized servers, which are assigned with the function of managing a file system only. In order to achieve the high data transfer rate and increase performance, CPU enhances the rate of processing I/O operations of files. As the client has to access the remote files, so it becomes critical to access the files in case of a distributed system.

3.4.1.3 File management

Files are stored permanently on secondary storage devices such as the hard disk. File system is a part of operating system that is responsible for controlling secondary storage space. It hides device-specific complexities and provides a uniform logical view to the users. The following are the various functions of file management system:

- It enables users to give user-defined names, to create, modify and delete files.
- It maps user-defined names with low-level identifiers, which are the names in machine understandable format through which a machine identifies a file uniquely.
- It provides a uniform logical view of data to users rather than physical view, i.e., internal structure by giving user-friendly interface.
- It controls transferring of data blocks between secondary storage and main memory and also between different files.
- It provides semantics or the rules for file sharing among multiple processes and users.
- It also allocates and manages space for files on secondary storage devices such as disks or magnetic tapes. Space management is an important function of file management system.
- It protects the files from system failures and applies measures for recovery and backup.
- It provides security measures for confidential data such as electronic funds or criminal records.

It also provides encryption and decryption facilities to users. Encryption is a mechanism of converting data into some code form that is unreadable to everyone except the recipient.

3.4.1.4 I/O management

Controlling all the input/output devices is one of the most important functions of an operating system. Issuing commands to the devices, catching interrupts, handling errors and providing interfaces between the various devices of the system are some of the functions of the operating system.

3.4.1.5 Store management

Storage or memory management is a very important function of operating system. A program is a set of sequential instructions, which are given to a computer. The programs are usually stored in a secondary storage device as an executable file. When you run a program, the computer reads the instructions and loads them as process in the ready queue. The ready queue is a collection of processes to be executed by a computer. The operating system selects a process sequentially from the ready queue and executes it.

3.4.2 Device Drivers

Device drivers are the device specific codes that control the I/O device attached to a computer. These codes are written by the device's manufacturer and delivered along with the device. Device manufacturers supply device drivers for commonly used operating systems, since each operating system has its own specific drivers.

Each device driver usually handles only one type of device or a class of closely related devices. For example a SCSI disk driver can handle disks having different sizes and speeds and sometimes even CD ROM but, a single device driver cannot be used for a mouse as well as a joystick as these two devices are very much different. However, a single device driver controlling multiple devices that are different is technically not restricted.

The device drivers need to be a part of the operating system, especially a part of the current architecture for accessing the device's hardware, i.e., controller's registers. Constructing device drivers that run in user space, with system calls for reading and writing the device registers can isolate the kernels from the drivers and the drivers from each other so as to reduce a major source of system crashes. Most of the operating systems define a standard interface, which must be supported by all the block drivers and a second standard interface that must be supported by all the character drivers. The remaining operating system can call these interfaces that contain a number of procedures such as reading a block or writing a character string to perform some function.

The most important function of a device driver is to accept abstract read and write from the device-independent software above it. Some other functions of device drivers are to initialize the device when needed, and manage its power requirements and log events. Most of the device drivers have a similar structure. First, a device driver checks the validity of the input parameters. If it is not valid an error is returned; otherwise, the parameters are translated from abstract to concrete terms. Next, the drivers check the availability of the

device. The request is queued for later processing if the device is in use. If the device is idle the hardware condition is examined so that the request can be handled at the instant. The actual device control begins once the device is switched on and becomes ready.

Issuing a sequence of commands to the device is called controlling. The command sequence is determined at the driver place. The drivers start writing the command into the controller's device registers only after it has the full knowledge of the commands to be issued. After writing each command to the controller, it is checked if the controller accepted the commands and is ready to accept the next command. In this way, all the commands are issued. After all the commands are issued, there arise two cases. One case can be that the device driver blocks itself until the interrupt comes to unblock it. The second case can be that the operation finishes without any delay and the driver remains unblocked.

3.4.3 Other System Software

There are various other types of system software that are commonly used. Some of these are as follows:

- **Language translators:** It is a computer program which accepts the text in a particular language such as French or German and converts it into another language. While converting the language of the text, the format of the document is maintained. Various sites such as yahoo and gmail that offer the language translation facility enable you to convert text in one language into another.

- **Utility programs:** These are a type of system software, designed to manage the computer hardware and operating system. Various examples of utility programs are given below:

- **Disk defragmenters:** It helps detect computer files whose content is stored in disjoint fragments on the hard disk. It also moves the fragments together to increase the efficiency of the hard disk. It also helps the user to decide what to delete when his hard disk is full.

- **System profilers:** It provides detailed information about the software installed and the hardware attached to the computer. Back-up software can make a copy of all information stored on a computer and restore either the entire system or selected files.

- **Virus scanners:** It scans the computer system to find computer viruses among files and folders.

- **Binary/Text Editor:** It helps modify the text or data of a file without the What You See Is What You Get (WYSIWYG) view in editor suites.

- **Compression:** It executes the output in a shorter stream or a smaller file when provided with a stream or file.

- **Encryption:** It uses a specific algorithm to produce an encrypted stream or encrypted file when provided with a key and a plain text.

- **Communication software:** This is an application program that helps exchange text, audio and video messages between users situated at different computer systems. This type of communication is used in:

- **Instant messaging:** This is a real time conversation, which helps users exchange instant messages using a special online program,

- known as instant messengers. These instant messengers use a single protocol program that support file transfer, gaming, audio-video chat and SMS messaging.

- **Chatting:** This is also real time conversation that takes place at one website to allow multiple users to chat and exchange messages in the form of text, audio and video.

3.4.4 Functions of System Software

System software performs some very important functions in a computer system. The following are the functions of system software:

- System software provides the facility for process management. Process management deals with

monitoring the program currently in execution. It maintains the order of process execution such that it can provide necessary resources for execution. The various resources that are required to execute a process are CPU time, memory, I/O devices and files. The following are the tasks performed during process management task of a system software:

- System software provides various mechanisms to handle deadlock situation among different processes. Consider a deadlock situation, process A is waiting for a resource that is already held by process B, process B is waiting for a resources that is held by process C and Process C is also waiting for a resource that is held by process A. This situation is known as deadlock situation.

- System software implements various mechanisms for synchronization process.

- It creates, deletes and suspends system processes to manage various processes, so that each process can optimize the utilization of CPU.

- System software supports memory management. Memory management manages memory space such that you can increase CPU utilization and decrease CPU response time. The following are the tasks performed by system software during memory management:

- System software allows you to manage memory space that is used by different users.

- It allows you to load new processes into memory respective to their order of priority.

- It allows you to allocate and deallocate memory space provided to different processes.

- System software supports I/O system management, which is used to manage various I/O devices such as keyboard, mouse and printer. System software performs the following tasks with respect to I/O system:

- It handles various input and output devices by issuing the input and output request.

- It captures interrupts such as hardware failure.

- It handles errors that appear in the reading and writing process of devices.

- System software provides the facility for file management. File management manages various files such as data file, source file and object file on the basis of information stored in them. Data files represent the information in numeric, alphabetic or alphanumeric mode. Source files store the code for programs and object files are created when you compile the programs. Files are stored in storage devices such as hard disk, floppy and CD. Files are grouped together into directories for easy access. The various file management tasks performed by system software are as follows:

- It creates and deletes files and directories.

- It maps files onto disk storage and takes the back-up of the files.

- Security provided by system software is used to protect various resources such as memory segment, files and CPU against unauthorized users. The operating system also uses timers that prevent unauthorized processes to access CPU.

- Networking provided by the system software is used for exchanging information among different computers that are distributed across various locations. Distributed systems consist of multiple processors and each processor has its own memory and clock. The processors communicate using various communication links such as telephone lines or buses. Bus is a collection of wires that runs parallel across the width of the motherboard. These wires transfer the data from one device to another. Distributed systems include general-purpose computers, minicomputers, microcomputers and workstations. Their processors are connected through a communication network that maintains security among networks.

- System software contains command interpretation system, which provides an interface between a computer and a user. A user interacts with computer using control statements that give commands to the operating system. These control statements also control the execution of other statements. A program that interprets control statements is executed automatically in an operating system. The command interpreter system is also known as control card interpreter, command line interpreter or shell. The function of command interpreter is to acquire command statements and execute them. The command statement itself deals with process management, main memory management, secondary storage management, I/O system, file system,

protection and networking.

3.4.5 Firmware

Firmware is a software that you can embed in a hardware device to improve the performance and reliability of the hardware device. This software is a computer program, which can be a ROM integrated circuit, EPROM chip or EEPROM chip. Recording devices such as DVD and CD are embedded with a firmware that constantly updates the software configuration of DVD and CD devices. Some examples of firmware are:

- BIOS found in IBM compatible computers.
- Run-Time Abstraction Services (RTAS), used in IBM computers.
- Open firmware used in systems from Sun Microsystems and Apple computer.

3.5 PROGRAMMING SOFTWARE

Programming software is a collection of programming tools that a software programmer uses while developing the software programs and applications. These tools help a developer to create, edit, maintain and debug the software applications.

The different programming tools such as linkers, loaders and other control programs came into existence during 1950. However, these tools got popularity with the invention of UNIX operating system during 1970. The UNIX operating system came with strong programming tools such as grep, awk and make.

The programming tools are generally included into Integrated Development Environments (IDEs), which help a developer to create, run and debug software applications easily. The most commonly used programming tools included in an IDE can be:

- Text editors
- Compilers
- Interpreters
- Linkers
- Debuggers
- Visual Studio. NET IDE

3.5.1 Text Editors

A text editor is a software program that is used to edit plain text files. Plain text files are simply the straight text files that do not contain any types of formatted data. Some text editors come with operating system such as notepad or can be provided as third-party tool such as MS Word. However, some IDEs also come with their own text editors that help programmers to edit the source code easily. For example, the programming software such as Visual Studio provided by Microsoft comes with its own editor, which helps a programmer to edit the source code easily. Some features of the text editors are as follows:

- **Search and replace:** This feature allows a user to find a string in the document and replace it with some other string.
- **Copy, cut and paste:** This feature allows a user to move the text within a file or between different files.
- **Text formatting:** Some text editors provide formatting features such as word wrap, bullet list and comment formatting.
- **Undo and redo:** Text editors also provide the feature of undo and redo. Undo is a command that is used to revert back the last change made by the user. Undo is very powerful feature provided by the text editors. The redo command is used to reverse the effect of undo command.
- **Importing:** This feature is used to read and merge the contents of another text file into the original file.

- **Filtering:** This feature allows you to send some contents of a file to (another utility and read the result back into the file.

3.5.2 Compilers

Compilers are the computer programs that can be used to convert the source program into machine understandable code, which is also called the object code. The compiler actually converts the program written in some high-level programming language into machine language. The various types of operations performed by the compiler are:

- **Lexical analysis:** It is the process of converting the sequence of characters of the source code into sequence of tokens. This process is generally performed by the lexical analysers or lexers.

- **Preprocessing:** Preprocessing is the process of processing the source code before it is parsed by the parser. For example, in C language, preprocessors can be used to implement macros.

- **Parsing:** This process is also called as the syntactic analysis and is carried out by the parser. Parser is generally the component of the compiler. This process is used to analyse the sequence of tokens against the grammatical structure. The output generated by this process is called the parse tree.

- **Semantic analysis:** It is the process of adding semantic information to the parse tree.

- **Code generation:** It is the process of converting the internal representation of the code into machine understandable code.

- **Code optimization:** It is the process of executing the computer programs more speedily.

3.5.3 Interpreters

An interpreter is a program that executes instructions written in high-level language. An interpreter translates a high-level language into an intermediate form. This intermediate form is then used for executing a program. An interpreter is designed to execute high-level languages such as BASIC and LISP.

3.5.4 Linkers

A linker is a software program that is used to assemble the different objects generated by the compilers into a single executable program. The objects for the linkers can also come from the library. Some linkers only include specific symbols from the library instead of linking the whole library.

3.5.5 Debuggers

Debugger is a computer program which is used to find out the bugs in the code. A bug is an error, mistake or a fault in a computer program that prevents it from doing the intended function.

3.5.6 Visual Studio.NET IDE .

Visual Studio.NET IDE is programming software that provides the common interface for building projects for the .NET framework. IDE is a common environment for creating the user interface for the application, writing code, compiling and debugging code.

Applications in Visual Studio.NET are created as files and folders and use the components provided by the IDE. The projects and solutions are the containers to organize files and folders. A project consists of interrelated files and folder. A project enables you to manage, build and debug files and folders to create an application. A solution contains one or more projects. A solution enables you to operate multiple projects at the same time on the Visual Studio .NET IDE.

Figure 3.2 shows the projects and the solutions of Visual Studio .NET.

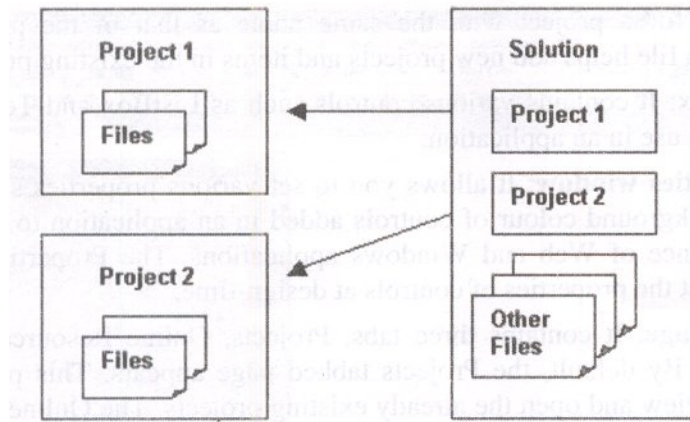


Figure 3.2: Projects and Solutions

To open the Visual Studio .NET IDE, you need to select Start → Programs → Microsoft Visual Studio .NET 2003 Microsoft Visual Studio .NET 2003 → to display the Visual Studio .NET IDE. Figure 3.3 shows the Visual Studio .NET IDE.

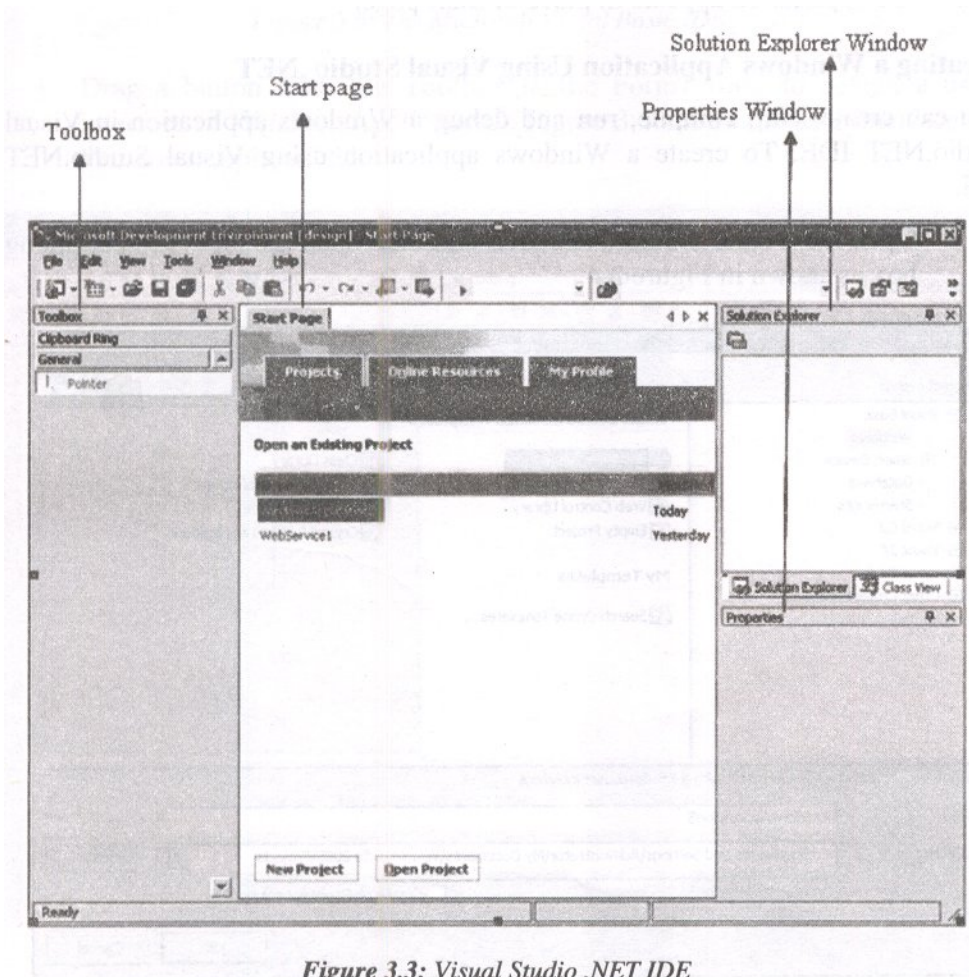


Figure 3.3: Visual Studio .NET IDE

The Visual Studio .NET IDE contains the following components:

- **Solution Explorer** window: It represents the projects and items such as Class and Class File included in the projects hierarchy. The Solution Explorer window also contains a solution file that Visual Studio 2003 creates for a project with the same name as that of the project. The solution file helps add new projects and items in the existing project.
- **Toolbox**: It contains various controls such as ListBox and TextBox that you can use in an application.

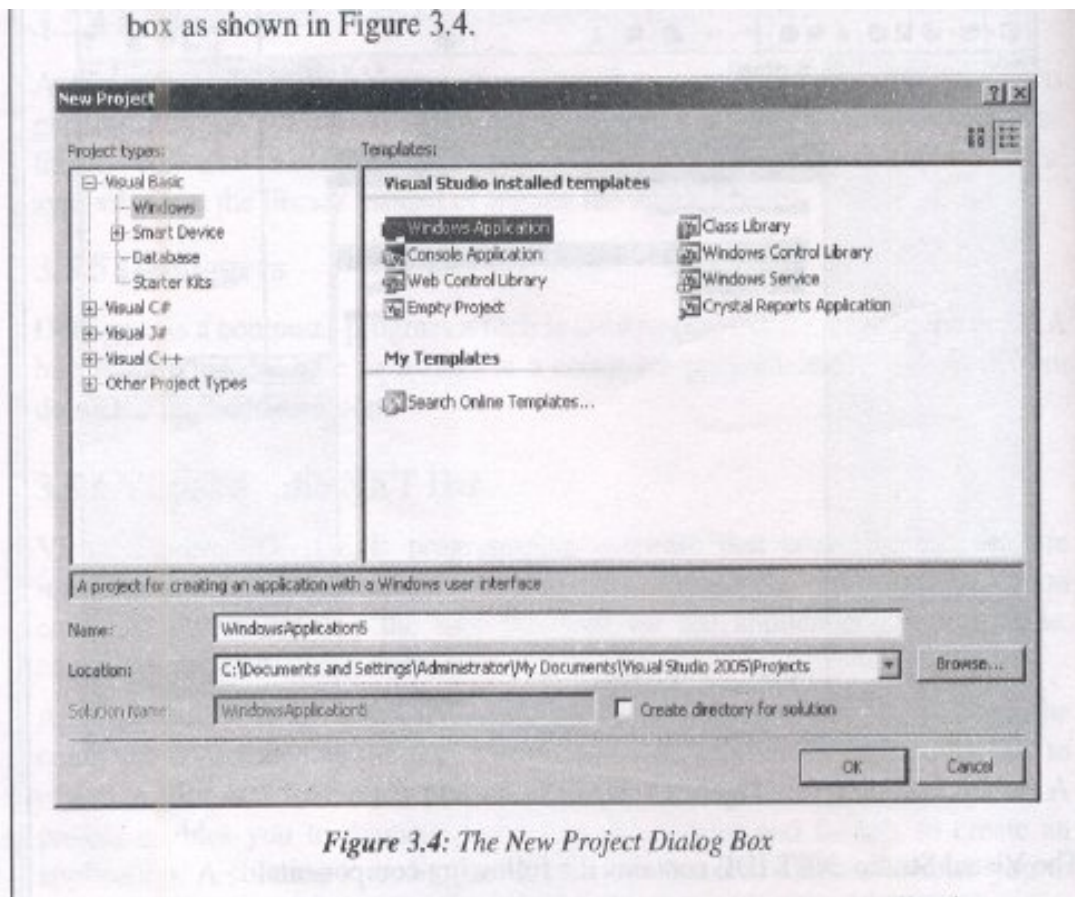
- **Properties window:** It allows you to set various properties such as size and background colour of controls added in an application to change the appearance of Web and Windows applications. The Properties window helps set the properties of controls at design-time.
- **Start page:** It contains three tabs, Projects, Online Resources and My Profile. By default, the Projects tabbed page appears. This page allows you to view and open the already existing projects. The Online Resources tabbed page helps connect to the Internet, open the hyperlinks related to Visual Studio .Net and search the information about the uses and features of Visual Studio .Net. The My Profile tabbed page allows you to customize the environment of Visual Studio .Net.

Note: When you create Windows-based application, the user interface and the code of the application appears in place of Start page.

Creating a Windows Application Using Visual Studio .NET

You can create, edit, compile, run and debug a Windows application in Visual Studio.NET IDE. To create a Windows application using Visual Studio.NET IDE:

1. Open the Visual Studio .NET IDE and then open the New Project dialog box as shown in Figure 3.4.



2. Click the OK button to open a new Windows Application, say WindowsApplication5. The WindowsApplication5 window appears containing the Form! Windows form as shown in Figure 3.5.

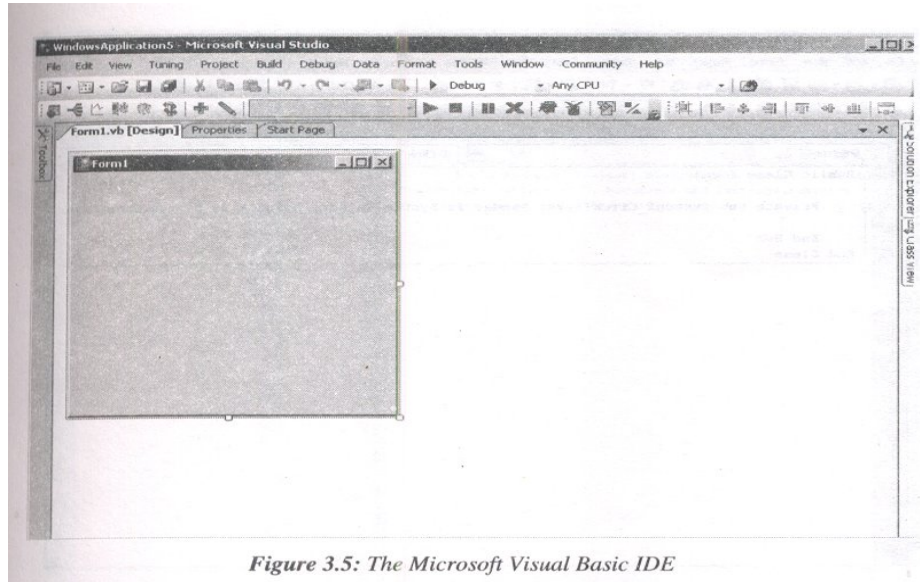


Figure 3.5: The Microsoft Visual Basic IDE

3. Drag a button from the Toolbox to the Form form to design a user interface of Windows Application5. Figure3.6 shows the user interface of WindowsApplicationS .

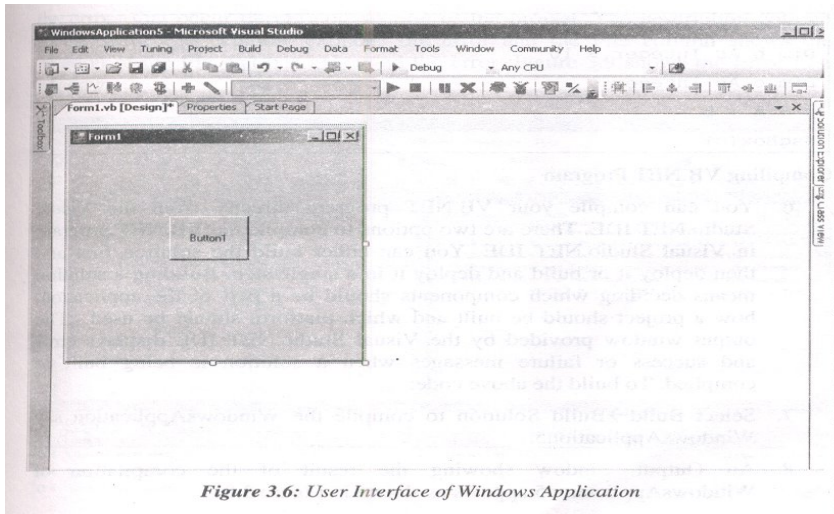


Figure 3.6: User Interface of Windows Application

4. Double-Click the Form 1 to open the From. vb page as shown in Figure 3.7. This is the text editor of the Visual Studio.NET IDE, where you can edit your source code.

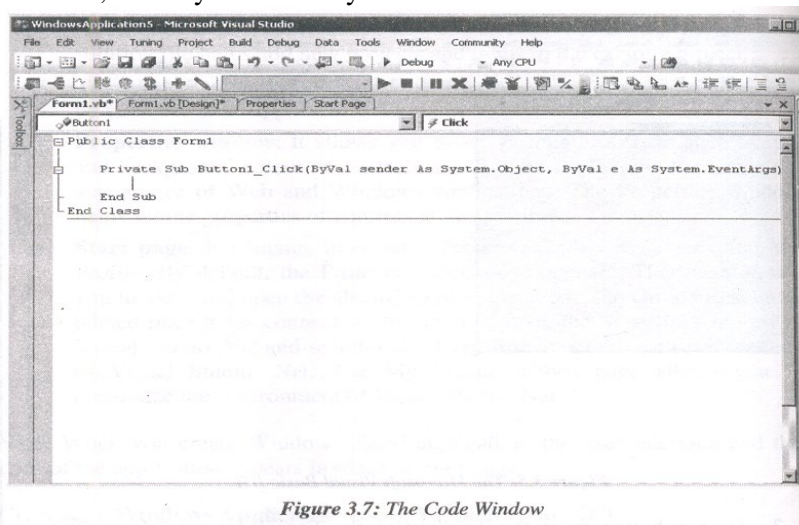


Figure 3.7: The Code Window

5. Add the following code to the Form1.vb page under the Click event of the Button1 control:

```
Dim a As Integer = 20
Dim b As Integer = 10
Dim c As Integer
c = a + b
MsgBox(c)
```

Compiling VB.NET Program

6. You can compile your VB.NET program directly from the Visual Studio .NET IDE. There are two options to compile the VB.NET program in Visual Studio.NET IDE. You can either build the solution first and then deploy it or build and deploy it in a single step. Building a solution means deciding which components should be a part of the application, how a project should be built and which platform should be used. The output window provided by the Visual Studio.NET IDE displays error and success or failure messages when a solution is being built or compiled. To build the above code:

7. Select Build~Build Solution to compile the WindowsApplication say WindowsApplication5.

8. An Output window showing the result of the compilation of WindowsApplication5 appears as shown in Figure 3.8.

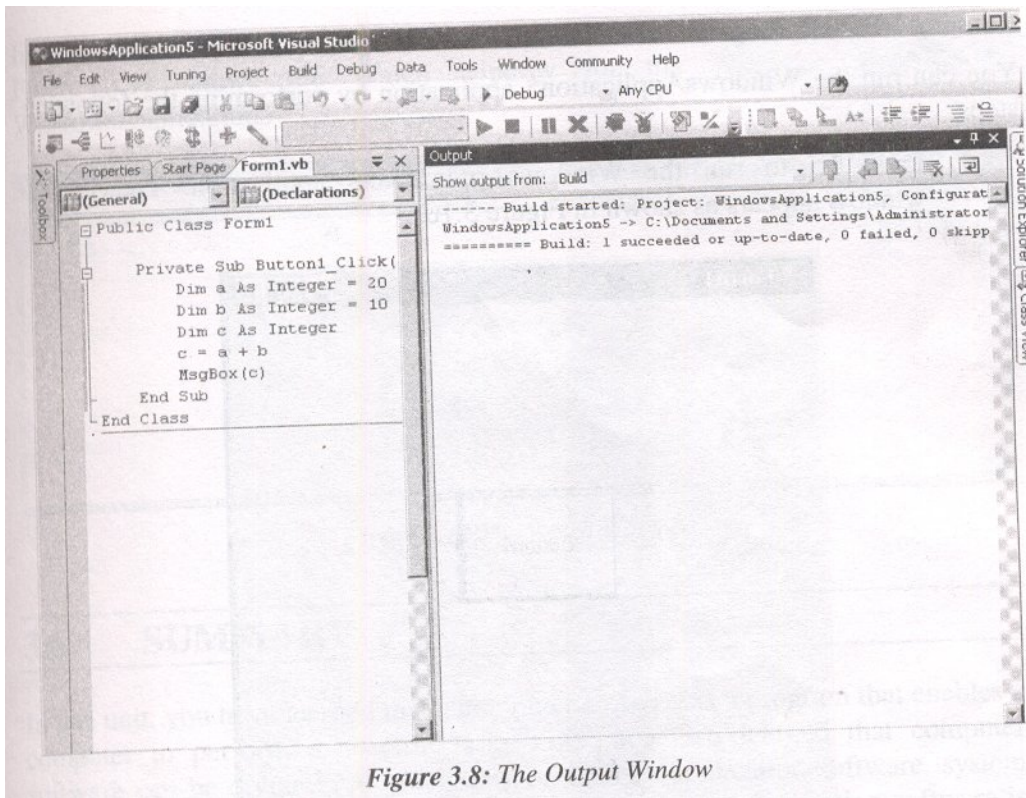


Figure 3.8: The Output Window

The Visual Studio.NET IDE also provides the Error List window to display errors that occur during compilation of the project. The description column the Error List window explains the error and the File column shows the location of the file that has generated the error. Figure 3.9 shows the Error List window.

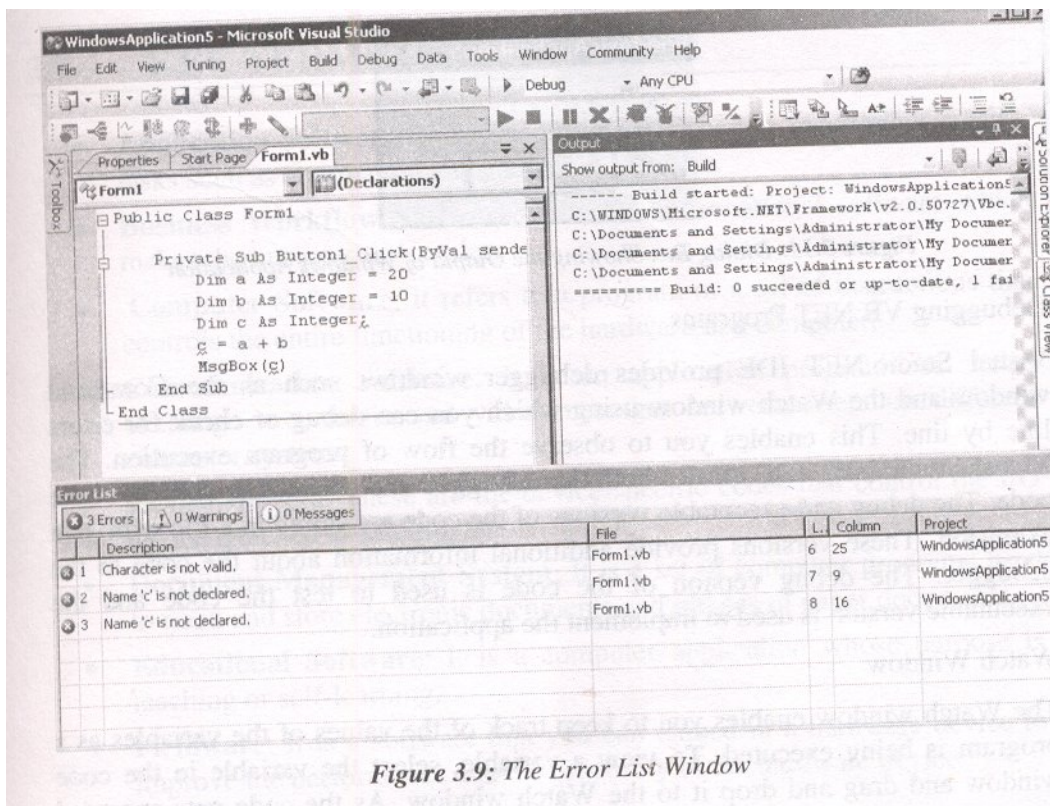


Figure 3.9: The Error List Window

Running VB.NET Program

You can run the WindowsApplication5 application by performing the following steps.

1. Press F5 to run the WindowsApplication5 application. The Form 1 window appears as shown in Figure 3.10.

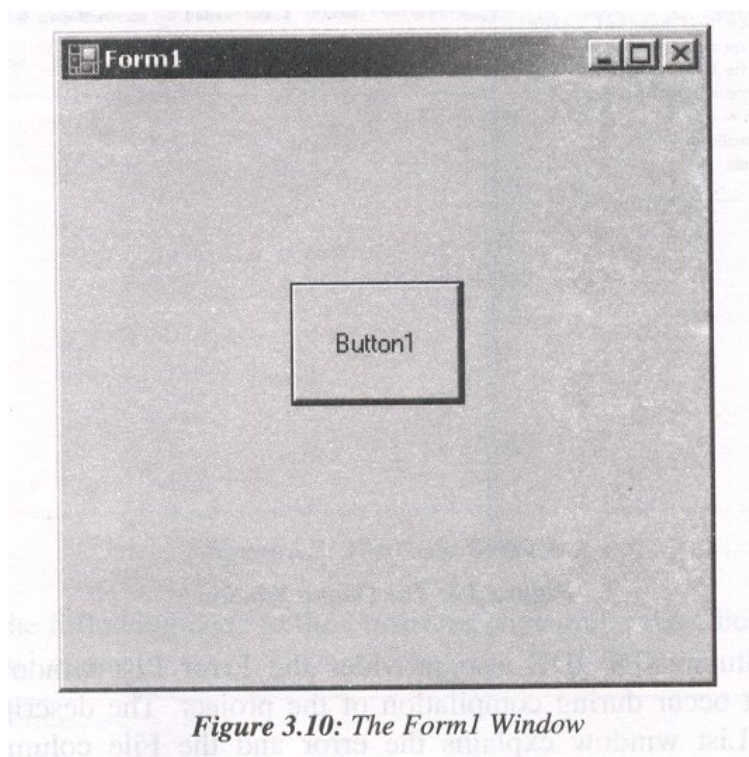


Figure 3.10: The Form1 Window

2. Click the Button! button to display the sum of two numbers as shown in Figure 3.11.

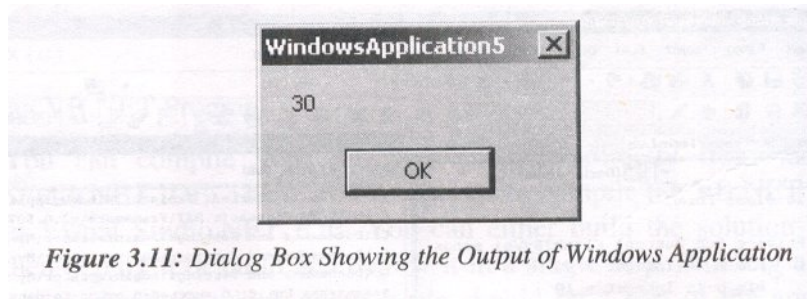


Figure 3.11: Dialog Box Showing the Output of Windows Application

Debugging VB.NET Programs

Visual Studio.NET IDE provides debugger windows such as the Command window and the Watch window using which you can debug or check for errors line by line. This enables you to observe the flow of program execution. The Visual Studio.NET IDE creates both the debugged and executable version of the code. The debug and executable versions of the code are stored in a file with .pdb extension. These versions provide additional information about the code to the debugger. The debug version of the code is used to test the code and the executable version is used to implement the application.

Watch Window

The Watch window enables you to keep track of the values of the variables as a program is being executed. To view a variable, select the variable in the code window and drag and drop it to the Watch window. As the code gets executed line by line, the **IDE** refreshes the value of the variable in the Watch window. Figure 3.12 shows the Watch window for the Windows Application, WindowsApplication5.

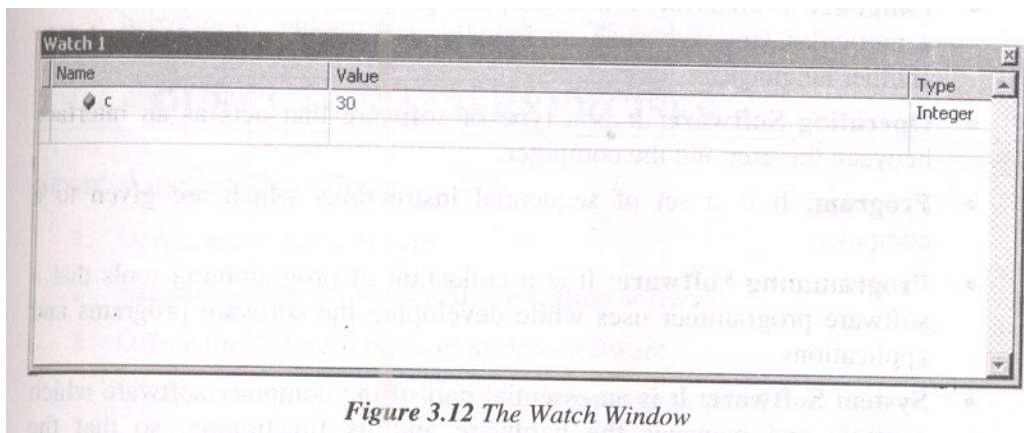


Figure 3.12 The Watch Window

3.6 SUMMARY

In this unit, you have learned that a computer software is a program that enables a to perform a specific task. You have also learned that computer be divided into three classes, namely application software, system I programming software. You now know that application software is designed to accomplish specific tasks such as automation and education You also know that system software controls and manages the hardware its functioning and programming software is a collection of programming that a programmer uses while developing the software programs and applications.

3.7 KEY TERMS

- **Application Software:** It is the software designed to accomplish specific taskssuas automation and education software.
- **Business Workflow Software:** It is the informational software which makes the business task easier.
- **Computer Software:** It refers to a program or a set of instructions that controls the entire functioning of the hardware in a computer.

- **Communication Software:** It is an application program that helps exchange text, audio and video messages between users on different computer systems.
- **Device Drivers:** These are the device-specific codes that control the I/O device attached to a computer.
- **Document Management System:** It is a set of computer programs used to track and store electronic documents and images of paper documents.
- **Educational Software:** It is a computer application whose purpose is teaching or self-learning.
- **Firmware:** It is a software that you can embed in a hardware device to improve the performance and the reliability of the hardware device.
- **Hybrid Editor Player:** It is a computer software application used to display information, normally in the form of a slide show.
 - **Language Translator:** It is a computer program which accepts the text in a particular language such as French or German and converts it into another language.
 - **Operating Software:** It is a type of software that acts as an interface between the user and the computer.
 - **Program:** It is a set of sequential instructions which are given to a computer.
 - **Programming Software:** It is a collection of programming tools that a software programmer uses while developing the software programs and applications.
 - **System Software:** It is an essential part of the computer software which controls and manages the hardware and its functioning, so that the application software can perform a particular operation.
 - **Web browser:** It is a software application that enables a user to display and interact with text, images and other information located on a Web page at a website on the world wide web (www)

3.8 ANSWERS TO ‘CHECK YOUR PROGRESS’

1. The three classes into which computer software can be divided are:
 - A. Application software
 - B. System software
 - C. Programming software
2. Some of the important types of application software are:
 - A. Enterprise Software
 - B. Business Workflow Software
 - C. Document Management System
 - D. Media and Entertainment Software
 - E. Educational Software
3. Some of the important functions of operating systems are:
 - A. Process management
 - B. Resource management
 - C. File management
 - D. Storage management
 - E. Input output management
4. The following are the examples of utility software:
 - A. Disk defragmenters
 - B. System profilers
 - C. Virus scanners !

5. A linker is a software program that is used to assemble the different objects generated by the compilers into a single executable program.

6. The properties window allows you to set various properties such as size and background colour of controls added in an application to change the appearance of Web and Windows applications. The Properties window helps set the properties of controls at design-time.

3.9 QUESTIONS AND EXERCISES

Short-Answer Questions

1. Define computer software.
2. Explain system software and application software.
3. Define the different types of system software.
4. What are the major functions of an operating system?
5. Name some of the most commonly used programming tools that are included in IDE.

Long-Answer Questions

1. Explain the various functions of system software.
2. Explain briefly the commonly used application software.
3. Explain the functions of an operating system in detail.
4. Define programming software. Briefly explain the most commonly used programming tools that are included in IDE.

3.10 FURTHER READING

Shepherd, Robert D., *Introduction to Computers and Technology*. New Delhi: Pentagon Press, First edition.

UNIT- I

THE INTERNET, INTRANET AND EXTRANET

Structure

4.0 Introduction

4.1 Unit Objectives

4.2 The Internet

- 4.2.1 Brief History of the Internet;
- 4.2.2 Characteristics of the Internet;
- 4.2.3 Elements of the Internet;
- 4.2.4 Key Uses of the Internet

4.3 Internet Connectivity Concepts

- 4.3.1 Direct Connection;
- 4.3.2 Internet Service Provider (ISP)

4.4 Internet Protocols

- 4.4.1 Transmission Control Protocol/Internet Protocol (TCP/IP);
- 4.4.2 User Datagram Protocol (UDP);
- 4.4.3 Hyper Text Transfer Protocol (HTTP);
- 4.4.4 File Transfer Protocol (FTP);
- 4.4.5 Telnet

4.5 Basic Services of the Internet

- 4.5.1 Electronic Mail;
- 4.5.2 Usenet;
- 4.5.3 The World Wide Web (WWW);
- 4.5.4 Internet Relay Chat (IRC);
- 4.5.5 Videoconferencing

4.6 Intranet

- 4.6.1 Comparing Intranet and Internet;
- 4.6.2 Advantages of the Intranet;
- 4.6.3 Disadvantages of the Intranet;
- 4.6.4 Hardware and Software Requirements for the Intranet

4.7 Extranet

- 4.7.1 Virtual Private Network (VPN);
- 4.7.2 Disadvantages of VPN

4.8 Summary

4.9 Key Terms

4.10 Answers to 'Check Your Progress'

4.11 Questions and Exercises

4.12 Further Reading

4.0 INTRODUCTION

In this unit, you will learn about the Internet, intranet and the extranet. You will learn about the internet connectivity concepts, Internet protocols and the basic services of the Internet. You will also learn about intranet, which is a network of computers used in an organization. In addition, this unit will also explain the concept of extranet. An extranet is a network that allows two or more organizations to share information.

4.1 UNIT OBJECTIVES

After going through this unit, you will be able to:

- Describe the characteristics of the Internet
- Evaluate the various uses and applications of the Internet
- Understand the concept of Internet connectivity
- Describe the various protocols used in Internet
- Describe the working of an intranet and extranet

4.2 THE INTERNET

The Internet is a global network connecting millions of computers to exchange data such as files, applications and messages. It is a network of networks, which uses a common set of protocols for communication between two computers on the network. Each computer in the network, referred as host, is independent and its operators can choose which Internet service to use and what local services to make available to the global Internet community.

4.2.1 Brief History of the Internet

In 1973, the US Defence Advanced Research Projects Agency (DARPA) initiated a research program to investigate techniques and technologies for interlinking packet network. The purpose was to develop communication protocols, which would allow networked computers to communicate transparently across multiple, linked packet networks (the networks capable of transmitting data in form of packets). This was called the Internetting project. The system of networks, which emerged from the research, was known as the Internet.

From this research, two types of protocols were developed: Transmission Control Protocol (TCP) and Internet Protocol (IP). In 1986, the US National Science Foundation (NSF) initiated the development of the NSFNET, which today, provides a major backbone communication service for the Internet. NSFNET has 45 megabit per second facilities to carry 12 billion packets per month between the networks it links. The National Aeronautics and Space Administration (NASA) and the US Department of Energy contributed additional backbone facilities in the form of the NSINET and ESNET, respectively.

During the late 1980s, however, the population of Internet users and network constituents expanded internationally and began to include commercial facilities such as shares marketing. Since then, the Internet has rapidly grown to become the world's largest communication network. Indeed, the bulk of the system today is made up of private networking facilities in educational and research institutions, businesses and in government organizations across the globe. After 1989, the Internet system began to integrate support for other protocols that fits into the basic networking fabric. The present emphasis in the network system is on multiprotocol internetworking and on Open Systems Interconnection (OSI) protocols.

4.2.2 Characteristics of the Internet

The Internet is one of the fastest growing technologies in the field of computers. The different characteristics of the Internet are as follows:

- It is the network of networks comprising over 150 million computers.
 - The architecture of the Internet is disorganized so that it contains no central indexing scheme or database. This disorganized architecture of the Internet can create confusions even for the experienced users.
 - It is generally considered as the decentralized system. The decentralized system is the self-regulating system that functions without the organized centre or authority.
- It is composed of billions of files having different formats.
- It is a widely-used technology. Almost 40 million people use the Internet daily.
- It is accessed by users in approximately 140 countries.

- It is a dynamic technology. In every 30 minutes, a new network is connected to the Internet.

4.2.3 Elements of the Internet

The hierarchical model of the Internet consists of three elements. These elements are described as follows:

- **Clients:** These are the computers- that communicate with the server for receiving the required information. These computers generally maintain the part-time connections to the Internet. If your computer is connected to the Internet then your computer is categorized as the client computer.

- **Servers:** These are powerful computers that have the full-time Internet connection. These computers satisfy the requests sent from the multiple client computers simultaneously.

- **Networks:** The network is generally the collection of one or more server computers and multiple client computers.

4.2.4 Key Uses of the Internet

The Internet has many uses, some of which are described as follows:

- **Direct Communication:** You can send messages to family and friends, business associates and acquaintances using the electronic mail facility. Mail messages can be sent and received from anywhere in the world within a few seconds.

- **Internet Relay Chat (IRC):** Using the Internet relay chat, you can converse with people over the net. You can log into a chat room and converse with others by typing messages that are instantaneously relayed. Today, with the improvement in connectivity speed and proliferation of broadband you can not only type, but also use medium such as voice and graphics to converse with people.

- **Online Shopping:** The Internet has helped remove all barriers of distance and nationality. You can shop for products and services across the world by logging onto a web portal. What more -you can also pay online! Using your credit and debit cards you can transfer money between different accounts without having to move from your computer table.

- **Distance Education:** The Internet is a perfect medium for knowledge sharing and information dissemination because of the intrinsic flexibility. Courses are available on the Internet-you can register, pay and complete a course on different interest areas. You can now pursue specialized higher studies in the comfort of your own office or home.

- **Knowledge Base:** The Internet is like a huge warehouse of data that can be accessed by people around the globe. Using special programs called search engines you can search for detailed information on virtually any topic under the sun.

- **Banking:** The banking industry was one of the first to use information technology to automate operations and save costs. The use of ATMs marked a major breakthrough in shifting the mundane back-office work to the customer himself. Instead of hiring an army of bank clerks, ATMs are operated directly by the customers. This has helped to considerably reduce time and operational costs for the banks.

- **Travel:** The Internet boom has resulted in the travel boom. Airlines, railways, taxi or car rental companies have all gained tremendously by the Internet. They can now publish their services on the Web along with the latest discounts, packages and availability details. The customers on the other hand, have benefited because they can now compare rates, make online booking and avail the discounts without having to run around multiple offices.

- **Bill Payments:** The government sector has also realized the benefits of IT. It is now possible to make online payments for public utilities such as water, electricity, phone, etc., using credit cards as the payment medium.

4.3 INTERNET CONNECTIVITY CONCEPTS

Internet access is one of the most important concepts that emerge in the field of networking. The most common option available for the customers is to purchase the Internet services from the different service providers. The customers that buy the Internet from the service provider do not need to care about issues

such as security, routing, additional management and monitoring. Therefore, it is the best option for the customers to buy the Internet services from the service providers.

There are generally two options available that can be used for connecting to the Internet. These options are:

- Direct connection
- Internet Service Provider (ISP)

4.3.1 Direct Connection

A direct connection consists of a dedicated machine that acts as a gate, connected to the Internet backbone. While this method provides full access to all services, it is very expensive to implement and maintain. This is the reason why such an option is suitable only for very large organizations or companies.

4.3.2 Internet Service Provider (ISP)

ISP provides the gateway that the customers can use to connect to the internet, The range of services available through different ISPs varies, so you must choose the one that is best suited for your requirement. You could connect to your ISP by using either of the two methods:

- **Remote dial-up connection:** A dial-up connection provides connecting a device to the network using a modem over the public telephone network (the modem converts the computer bits or digital signals to modulated or analog signals that the phone lines can transmit. These signals are received on the ISP's end and demodulated into bits and bytes for the user). Dial-up access is either by way of SLIP (Serial Line Internet Protocol) or PPP (Point to Point Protocol). Since the dial-up uses the regular telephone lines, the quality of connection is not always good. In the past the maximum data transfer rates supported by a dial-up connection was limited to 56 kbps (56,000 bits per second).

- **Permanent dedicated connection:** You can also have a direct connection to ISP which typically translates into having a dedicated phone line to ISP. A dedicated Internet connection is a permanent telephone connection between two points. Computer networks that are physically separated are often connected using leased or dedicated lines. These lines are preferable because these are always open for communication traffic unlike the regular telephone lines that require a dialing sequence to be activated. Often, this line is an ISDN (Integrated Services Digital Network) line. As the name suggests, it is a digital communication line for the transmission of data, voice, video and graphics at very high speeds. ISDN applications have revolutionized the way businesses communicate. ISDN lines support upward scalability which means that you can transparently add more lines to get faster speeds -going up to 1.28Mbps (million bits per second). T1 and T3 are the other two types of only used dedicated line types for network connections. Dedicated lines are becoming popular because of their faster data transfer rates. It is a cost-effective method for businesses that use Internet connectivity extensively.

4.4 INTERNET PROTOCOLS

The different computers, peripherals and devices connected in a network with each other for the purpose of transferring data and information. Therefore, it is necessary to define a set of rules for transmitting and a in order to avoid collision. A network protocol defines a rules and conventions for communication between different devices over the network. It includes, for example, rules that specify how to package data into, message acknowledgement, data compression, etc., to support reliable and high performance network communication.

The most commonly used Internet protocols can be:

- Transmission Control Protocol /Internet Protocol (TCP/IP)
- User Datagram Protocols (UDP)
- HyperText Transfer protocol (HTTP)
- File Transfer Protocol (FTP)
- Telnet

4.4.1. Transmission Control Protocol/Internet Protocol (TCP/IP)

TCP/IP is a two-layer program that is used to connect hosts on the Internet. TCP-or Transmission Control Protocol, works at the transport layer and manages the assembling of a message or file into smaller packets that are transmitted over the Internet to be received by a TCP layer on the other side, which then reassembles the data packets into the original message.

IP -or Internet Protocol, works at the network layer and handles the of each packet so that it reaches the right destination. Usually, each gateway computer on the network checks this address to see where to forward the message. This implies that even though some packets of the same message may be routed differently from the others, they will be reassembled at the destination.

The working of TCP/IP can be compared to shifting your residence location. This activity would involve packing your belongings in smaller boxes for ease of transporting, with the new address and a number written the boxes. You would then load these on multiple vehicles. These vehicles may take different routes to reach the same destination guided by the amount of traffic and the length of the route. Once these boxes reach the destination check these to make sure all have arrived in good shape, then unpack the boxes and 'reassemble' your house.

4.4.2 User Datagram Protocol (UDP)

UDP is a connectionless protocol, which transports the information that does not require a reliable delivery. Connectionless protocol means that the data is transferred from the source to the destination without setting up any v in between them. UDP does not sequence the segments it receives from the upper layer protocol and it does not care in which order these segments destination. UDP does not provide any acknowledgement for the data it has sent to the destination. Figure 4.1 shows the format of UDP segment.

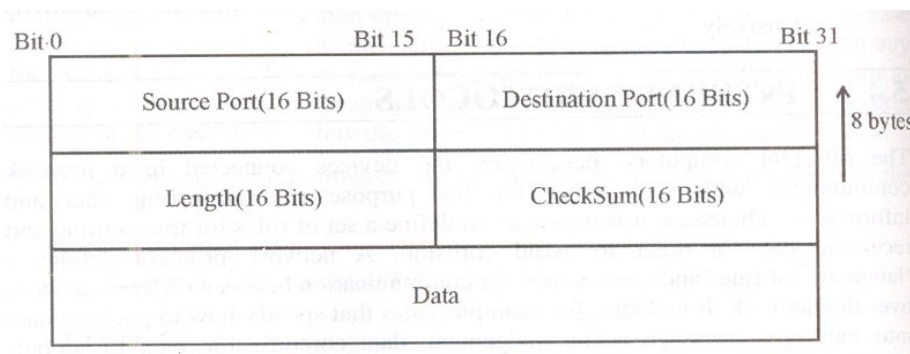


Figure 4.1: The UDP segment format

The UDP segment contains the following fields:

- **Source port:** It specifies the port number of the application the source host, which is responsible for sending the data to the destination host.
- **Destination port:** It is the port number of the application residing on the destination host, which receives the data sent to it by the application present at the source host.
- **Length:** This field specifies the length of the UDP header and the data.
- **Checksum:** This field contains the checksum of both urn UDP data fields. Checksum provides a method for ensuring of the data sent by the source to the destination and it is placed at the end of the data. Checksum is a number calculated from a series of values taken through a sequence of mathematical functions. When the data reaches the destination, checksum is again calculated at the receiving end by using the same mathematical functions which are used at the source host.
- **Data:** This field specifies the data UDP has received from the upper layer protocol. It is an optional field which depends on whether there is any data to be sent or not.

4.4.3 HyperText Transfer Protocol (HTTP)

HTTP is a set of rules for transferring files (text, image, sound, video, and other multimedia files) on the World Wide Web. It is an application protocol that runs on top of the TCP/IP suite of protocols (which is the foundation protocol of the Internet). It defines how such messages are formatted and transmitted, and what actions the Web servers and browsers should take in response to the commands issued.

HTTP is based on a Client/Server principle, where your Web browser acts as a HTTP client making requests to the Web server machines. These server machines contain, in addition to the Web pages, the files which can serve as HTTP daemon. This is a program that is designed to, wait for HTTP requests and handle them when they arrive. Typically, when a user (client) makes a request by either typing a URL (Uniform Resource Locator) or clicking on a hypertext link, the browser builds an HTTP request and sends it to the IP address as indicated in the URL. The HTTP daemon on the destination server then receives this request, and responds by sending back the requested Web page. Figure 4.2 shows how a HTTP request is processed.

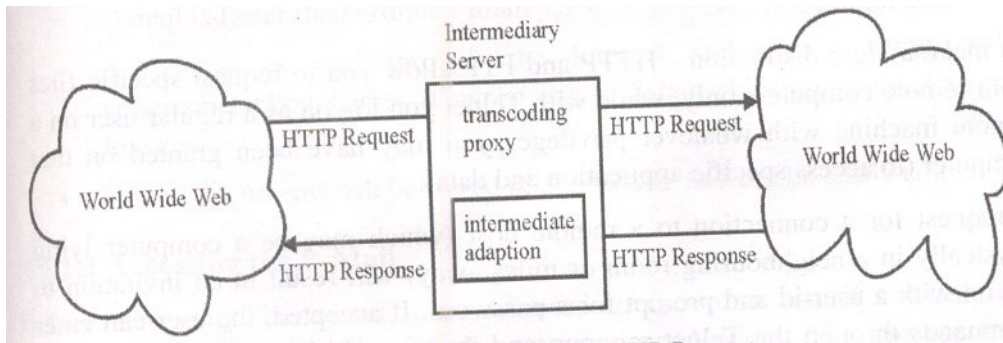
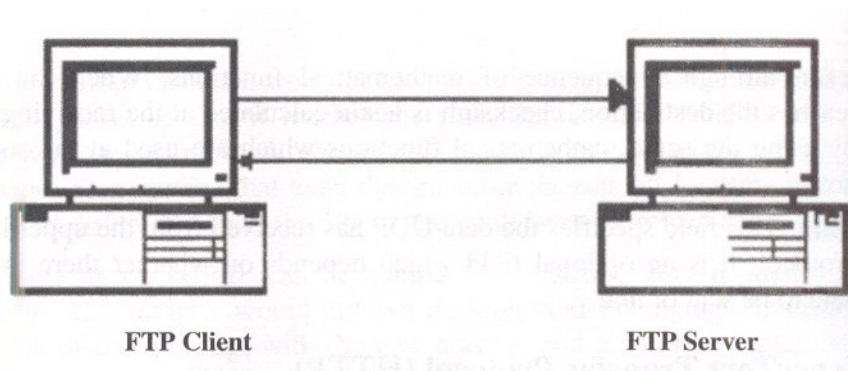


Figure 4.2: processing of a HTTP Request

HTTP is a stateless protocol, which means that each request or command is executed independently, without any knowledge of the commands that came before it. This is the reason why newer technologies like ActiveX, Java, etc., have gained popularity.

4.4.4 File Transfer Protocol (FTP)

FTP is an application protocol for exchanging files between computers over the Internet. It is the simplest and most commonly used method to download/upload a file from a computer to a server (e.g., downloading a document or an article from a website). Like other technologies, the FTP also uses the Internet's TCP/IP to enable data transfer. Figure 4.3 shows the interaction between the FTP client and the FTP server.



FTP also works on a client/server principle, where an FTP client program is used to make a request to an FTP server. (Files can be stored on computers referred to as FTP servers). Basic FTP support is usually provided as part of the TCP/IP suite of programs. You can use FTP using a simple command line interface (for e.g., from the Windows MS-DOS prompt window) or use a commercial program that provides a graphical user interface. Using FTP you can update files on a server. Your Web browser can also make FTP requests to download programs you request from your Web page. Typically, you would need a login to an FTP server. However, publicly available files can be easily accessed using anonymous FTP.

4.4.5 Telnet

Telnet is a protocol that allows you to access someone else's computer (host) provided you have been given the permission to do so. It is typically referred to as 'remote login'.

To make a clear distinction -HTTP and FTP allow you to request specific files from remote computers only, while with Telnet you log on as a regular user on a remote machine with whatever privileges you may have been granted on that computer (to access specific application and data).

A request for a connection to a remote host (which may be a computer lying physically in a neighbouring room or miles away) will result in an invitation to log on with a user-id and prompt for a password. If accepted, the user can enter commands through the Telnet program and these would be executed as if they were being entered directly from the host machine. The user's monitor would also display what is taking place on the remote computer during the connected Telnet session. In other words, once connected, the user's computer emulates the remote computer.

Program developers who need to access data and/or applications located at a particular host computer typically use Telnet.

4.5 BASIC SERVICES OF THE INTERNET

The Internet today is a large-scale network of millions of computers that allow fast and easy communication between the Internet users across the globe. Telnet is one of the important services provided by the Internet. Apart from Telnet, the other basic services or applications that make use of the Internet are as follows:

- Electronic mail
- Usenet
- The World Wide Web (WWW)
- Internet Relay Chat (IRC)
- Videoconferencing

4.5.1 Electronic Mail

Electronic mail (E-Mail) is one of the most popular features of the Internet. It permits the Internet user to send and receive messages and files to one another via modems almost instantly. The term 'e-mail' applies both to the Internet e-mail system based on the Simple Mail Transfer Protocol (SMTP) and to the Intranet systems allowing users within one organization to e-mail each other. SMTP is a simple, text-based protocol, where one or more recipients of a message are specified and then the message text is transferred. The messages in e-mail service can contain not only text documents, but also images, audio and video data. The audio and video data is converted into a format that a computer accepts such as GIF and JPEG file format, before it is attached to the e-mail message. With the e-mail service, the Internet has proved to be a productive communication tool for millions of users. The following are the advantages of an electronic mail:

- E-mail is faster than ordinary mail.
- An e-mail is sent through the Internet and thus, it transcends geographical boundaries. It can be sent to distant places instantly at a very low cost.
- E-mail documents can be stored in a computer and can be easily edited.

4.5.1.1 Accessing the E-Mail

Before, accessing the e-mail, you just need to create an e-mail account for , yourself using a website that offers such services. Various sites provide this facility-some charge for it, while others provide it for free. Yahoo.com, Rediffcom, hotmail.com and gmail.com are some of the sites that provide free e- mail services. Once you register yourself on a website, you become a member and can simply log into your mail account to start sending and receiving e-mails. For all future access you would require to remember your user id and password because that is the key to your log in.

The steps for accessing the e-mail are described as follows:

1. Select Start → Programs → Internet Explorer to open the Microsoft Internet Explorer window, as shown in Figure 4.4.

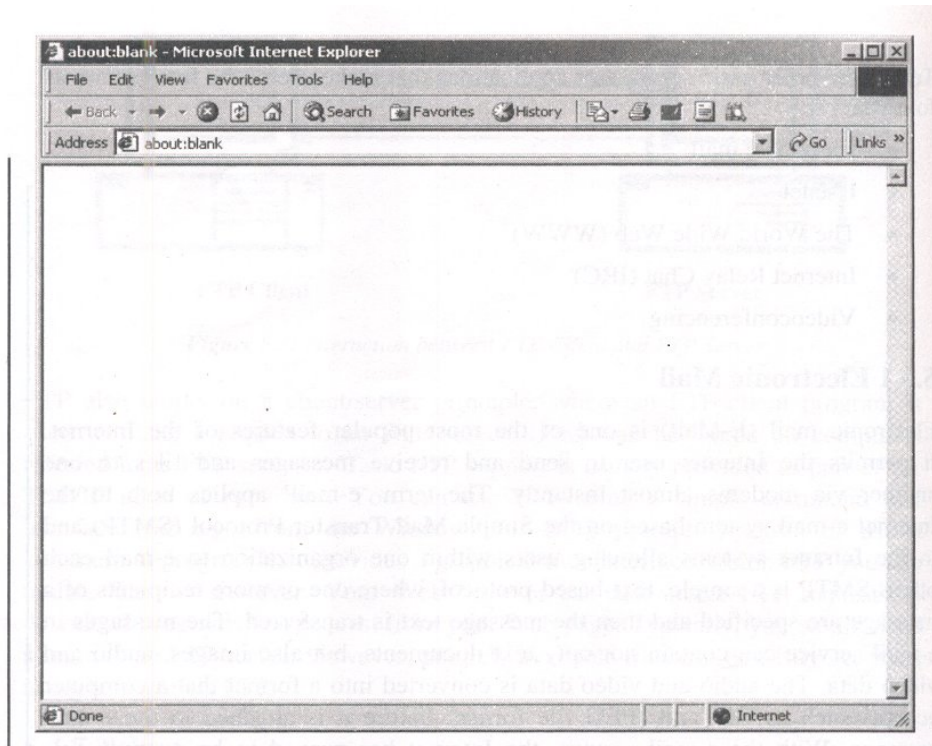


Figure 4.4: The microsoft Internet Explorer Window

2. Enter the URL such as, <http://www.yahoo.com>, in the address bar, which appear in the Microsoft Internet Explorer window to display the sign in page of the yahoo mail website, as shown in Figure 4.5.

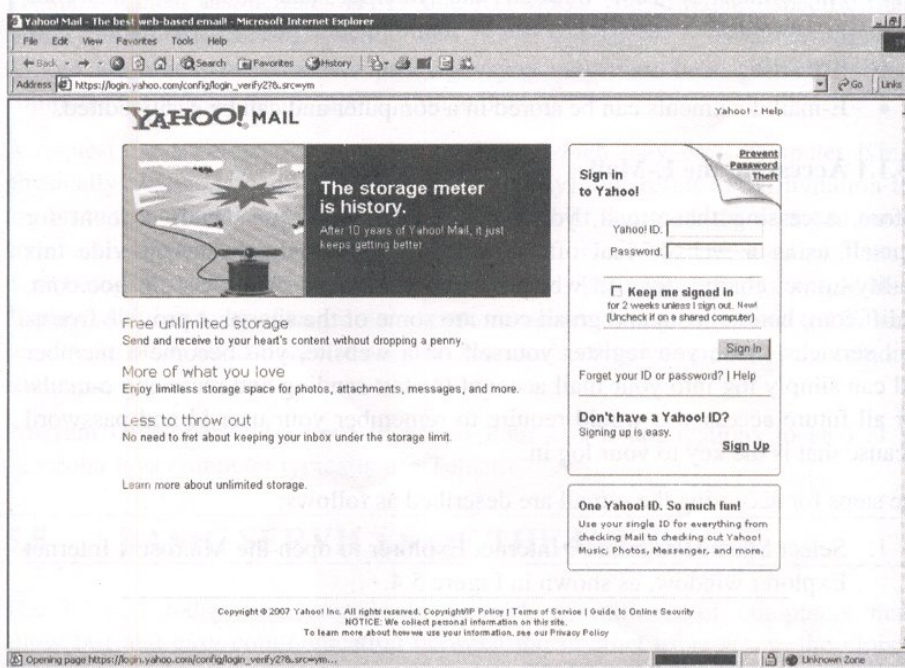


Figure 4.5: The Sign in Page of the Yahoo Mail Website

3. Enter an id such as yogesh52 and a password in the Yahoo ID and Password text boxes to specify the e-mail id and the password to sign in the Yahoo mail website for accessing E-mail.

4. Click the Sign In button to display the Welcome page containing hyperlinks such as Inbox and Sent as shown in Figure 4.6.

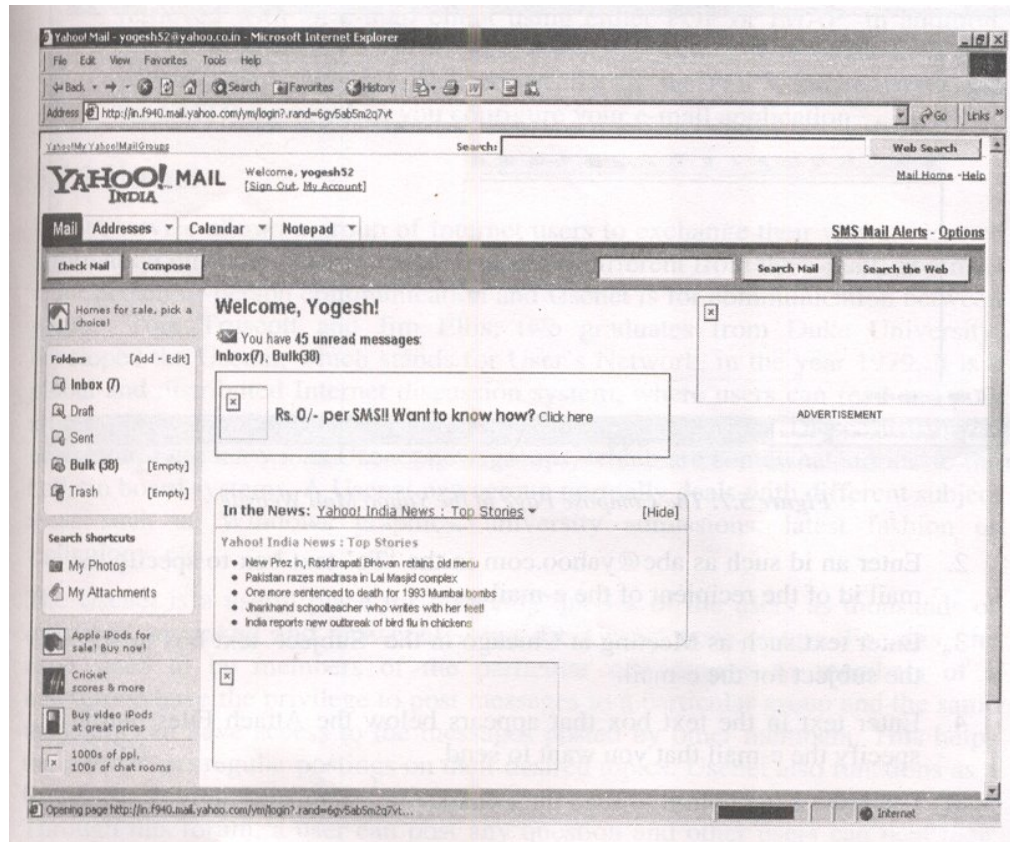


Figure 4.6: The Welcome Page of the Yahoo Mail Website

5. Click the Inbox hyperlink that appears on the left pane in the Microsoft Internet Explorer window to access the e-mail messages contained in the Inbox.

4.5.1.2 Sending an E-Mail

You have to first compose an e-mail message before sending it to your contacts for communicating specific information to them. To compose and send an e-mail message:

1. Click the Compose button that appears in the Welcome page of the Yahoo mail website to display the Compose page as shown in Figure 4.7.

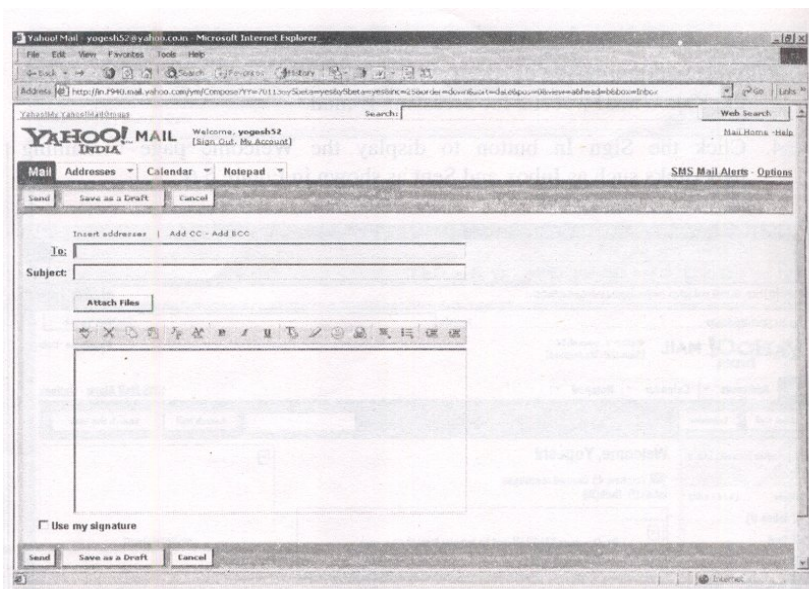


Figure 4.7: The Compose Page of the Yahoo Mail Website

2. Enter an id such as abc@yahoo.com in the 'To' text box to specify the e-mail id of the recipient of the e-mail.
3. Enter text such as Meeting at Chicago in the 'Subject' text box to specify the subject for the e-mail.
4. Enter text in the text box that appears below the Attach Files button to specify the e-mail that you want to send.
5. Click the Send button to send the e-mail.

4.5.1.3 E-Mail Protocols

E-mails are sent to a mail server that stores the received messages in the recipient's e-mail mailbox. The recipient uses the e-mail retrieval protocols to receive the messages in the mailbox. While some clients and servers preferentially use vendor specific, typically proprietary protocols, most clients and servers support the Internet standard protocols SMTP for sending e-mail and Internet Message Access Protocol (IMAP) for retrieving e-mail, allowing interoperability with other servers and clients. E-mail clients can generally be configured to use IMAP4 to retrieve e-mails and SMTP for sending the e-mail. The various e-mail protocols are described as follows:

- **IMAP:** It is an application layer Internet protocol that allows the local client to access the e-mail on a remote server. IMAP is often used in large networks such as a college-campus mail system to retrieve e-mail from the e-mail server. IMAP allows users to access new messages instantly on their computers, since the mail is stored on the local college-campus e-mail server.
- **IMAP4:** Unlike many older Internet protocols, IMAP4 natively supports encrypted login mechanisms. Plain-text transmission of passwords in IMAP4 is also possible. Plain-text passwords are used in some combinations of clients and servers, because the encryption mechanism to be used must be agreed between the server and client. IMAP4 works over a TCP/IP connection using network port 143.
- **Simple Mail Transfer Protocol (SMTP):** It is the most widely used protocol for sending e-mails between servers. The messages can then be retrieved with an e-mail client using either POP or IMAP. In addition, SMTP is generally used to send messages from a mail client to a mail server. This is why you need to specify all, the POP3, IMAP server and the SMTP server when you configure your e-mail application.

4.5.2 Usenet

Usenet service allows a group of Internet users to exchange their views, ideas or information on some common topic. Usenet is different from the e-mail, as e-mail is for person-to-person communication and Usenet is for communication between groups. Tom Truscott and Jim Ellis, two graduates from Duke University, developed the Usenet, which stands for User's Network, in the year 1979. It is a global and distributed Internet discussion system, where users can read and post articles to a number of distributed news group categories. These distributed newsgroups are known as Usenet newsgroups, which are somewhat similar to the bulletin board systems. A Usenet newsgroup normally deals with different subject areas such as Windows graphics, university admissions, latest fashion or technology, etc.

The Usenet is a useful place for resolving queries of the users as thousands of questions are asked and answered using the Usenet news groups. For this, the users need to be members of the particular newsgroups, as members of a newsgroup have the privilege to post messages to a particular group and the same members can have access to the messages posted by other members. This helps the users to get regular postings on their desired topics. Usenet also functions as a forum for getting help or information from the fellow users on various topics. Through this forum, a user can post any question and other users can post their answers on the message board.

Newsgroups are of two types- moderated and non-moderated. In a moderated newsgroup, only selected members have the right to post a message. The message first goes to the authorized members, who have the right to post a message on the virtual message board. The authorized member checks the message for its content first and if the message is appropriate, only then it is posted. If the message requires any editing, the authorized member edits it. This member then posts the message on the message board. The main idea of

the moderated news group is to ensure the quality of the content that is being exchanged. In a non-moderated news group, any member can directly post a message to the virtual message board or newsgroup.

The Usenet groups available are categorized by the Usenet on the basis of a classification system, which divides the newsgroups into different sections according to their subject matter. The Usenet also provides a designator code to a particular section that distinguishes the section from other news group sections. Table 4.1 shows some of the news group sections along with their designator codes.

Table 4.1: NewsGroup Sections and their Designator Codes.

Newsgroup Section	Designator Code	Subject Matter
Alternative	Alt	General interest
Business	Biz	Business
Computer	Com;	Computer hardware, software, programming, etc.
News	News	Internet, Usenet issues
Social	Soc	Discussions on politics, religion, society, etc.

A Usenet newsgroup needs to specify its designator code to its name. Some of the available Usenet newsgroups are:

- alt.fashion
- alt.education.research
- biz.job.offered
- comp.os.ms.windows.programmer.graphics
- comp.os.ms.windows.announcements
- comp.sys.mac.portable
- soc.college.admissions
- soc.college.financial-aid

4.5.3 The World Wide Web

WWW or W3 is a collection of online documents stored on servers around the world that are connected to the Internet. The online documents are written in HTML (Hyper Text Mark-Up Language) language, which provides links to other documents stored on a web server. These hypertext online documents on the Internet are known as Web pages.

WWW uses an Internet Protocol called the Hyper-Text Transport Protocol (HTTP) for interaction between the computers on the Internet. Any computer on the Internet, which uses the HTTP protocol, is called the Web server and any computer, which can access that server, is called a Web Client. In a client-server model, a link can be shown on the screen in multiple ways like highlighted text or different coloured text. Link is a special type of item in a hypertext document, which connects the document to another document that provides more information about the hypertext document. These documents can be accessed over the Internet using a Web browser such as the Internet Explorer or the Netscape Navigator.

4.5.4 Internet Relay Chat

IRC is a popular and interactive communication service available via the Internet, where people from all

around the world can involve in real time conversations. The conversations in IRC are known as channels and each channel is organized by a topic. The channels involve transfer of speeches and video images over the Internet with the help of voice modems, digital cameras and microphones. You can use various types of IRC software to perform IRC for real time conversations. Some of the popular windows-based IRC software includes:

- mIRC
- PIRCH
- Visual IRC

4.5.5 Videoconferencing

This feature of the Internet allows a group of users located in different parts of the world to talk and interact with each other. Individuals interacting can see each other talking on their computer screens and can hear each other's voice through a special audio-device fixed in their computer. The 'CU-SeeMe' system developed at the Cornell University is an example of an Internet-based videoconferencing system.

Videoconferencing involves transmission of audio and video. For example, a point-to-point (two-person) videoconferencing system works much like a video telephone. Here, each participant has a video camera, microphone and speakers mounted on his or her computer. As the two participant~ speak to one another, their voices are carried over the network and delivered to the other's speakers and whatever images appear in front of the video camera appear in a window on the other participant's monitor. This reproduces the effect of an actual meeting.

Multipoint videoconferencing allows three or more participants to sit in a virtual conference room and communicate as if they were sitting right next to each other. These systems are based on PCs featuring a digital camera and run on visual communication software.

The communication links are still quite expensive making the desktop videoconferencing useful only for selected applications. The most common applications of computer-based teleconferencing include management communications and training, budget meetings, technical consultations, project reviews and contract negotiations.

4.6 INTRANET

The Intranet is a private network connecting all the computers of an organization to share the organization's information and resources. It may be a network of more than one LANs and uses protocols of the Internet for communication between two computers. However, it is different from the Internet. It can be called a 'private version of the Internet'. The users use the graphical Web browsers to navigate the Intranet sites. However, the choice of a Web browser depends on the requirements of the users and the organization.

4.6.1 Comparing Intranet and Internet

The Intranet and the Internet, both are used to exchange information between the server and the client. Both of them use the same protocols and services for sharing information, yet there are a number of differences between these two, which are listed below:

- The speed of the Intranet is faster than the speed of the Internet.
- The Intranet contains more complex applications than the Internet.
- The Intranet provides websites related to a particular organization. The users of that Intranet are very limited as compared to the Internet, because the Internet is spread all over the world.
 - The amount of information available on the Intranet is less than that on the Internet, because that information is related to a fixed number of files of the organization. So, the information space of the Intranet is smaller than that of the Internet.
- The user interface design for the Internet and the Intranet are different.
- The Internet has more variety of information than the Intranet.

- The searching process for a specific content or a word over the Internet is more complex than the Intranet.

4.6.2 Advantages of Intranet

Maintenance of applications and databases on computers over a network in any organization is a tedious task. The Intranet makes it easy by providing a common Web server. Apart from this, the Intranet has many other advantages, which are as follows:

- It provides easy access to information without any time bounds.
- It saves time by providing fast and smooth communication between the management and the employees of an organization.
- It provides virtual conferencing place for discussing matters related to the organization.
- It provides file sharing system to the members of an organization.
- It provides a common platform for developing and deploying new applications in an organization.

4.6.3 Disadvantages of Intranet

The Intranet provides various facilities such as easy communication and easy access of information, but every coin has two sides. Likewise, the Intranet also has some disadvantages. These disadvantages are as follows:

- There may be a need to train the employees to access the Intranet.
- A critical change of information is not reflected to the common database resulting in inconsistent state of information.
- The Intranet needs extra care and budget for security and maintenance purpose.

4.6.4 Hardware and Software Requirements for Intranet

An Intranet requires three basic tools- a Web server software, an authoring tool and a Web browser (the client software). If the Intranet grows in size and some special applications are to be used, then search engines and programming tools such as Java and VB.Net are also needed. The behaviour and functionality of the Intranet depends on the software selection for the server or the type of the browser.

4.6.4.1 Web Server Software

A Web server is a specialized computer inside a network that sends out Web content in the form of pages, graphics, files, etc., when a request is made by a Web browser client. A Web server can run other programs such as database- related applications or search engines. Before selecting a Web server-software, the type of services and performance level required in the network should be analysed. Some of the most popular server software packages are as follows:

- **Microsoft Internet Information Server (IIS):** It was released in early 1996. It is a powerful Web server that is closely integrated with NT Server's operating system security controls. IIS also includes a Gopher server and an FTP server. It supports SSL 2 security and Virtual servers, Perl and CGI scripts, server-side Java and Microsoft's Internet Server API (ISAPI) for developing complex Web-based applications.
- **Netscape FastTrack Server:** It is a popular Web server that speeds up the Intranet. It has SSL 3 support, Navigator Gold page-authoring tool, extensive server-level access control and excellent performance.
- **Netscape Enterprise Server:** It builds on the foundation of FastTrack server. It includes MKS Integrity Engine for HTML such as document, check-in, check-out and revision control. Once a document is checked out no one can modify the document until it is checked in again. The MKS system maintains copies of all the previous versions of a document on the server.

To select the right server-software packages, the requirements and functionality of the Intranet should be clear. The following factors should be considered before selecting the package:

- Type of hardware environment available.
- Type of software environment and facilities provided by the underlying operating system.
- Level of performance required.
- Connection with the Internet.
- Technical support required within the available budget.

4.6.4.2 Hardware Requirements

The hardware requirements depend on the number of users and the complexity of the Intranet design. More sophisticated hardware is required if the number of people using the network increases. The hardware platform that will integrate the current network infrastructure with the available software in the best possible way should be selected. For example, a simple Window-based Intranet for a small company could function properly using Web server software on a PC with at least 16 MB of memory, a 486 or Pentium CPU, a 500 MB to 2 GB hard disk and at least VGA graphics.

Network hardware devices are also required to connect the systems in the network. Networking hardware facilitates the use of computer networks. The basic network devices used in the Intranet are as follows:

- **Gateway:** A gateway is a network point that acts as an entrance to another network. In an organization, the gateway is the computer that routes the traffic from a workstation to the outside network.
- **Router:** It is a network device that connects two similar networks having the same network protocol and determines the next network point to which a packet should be forwarded towards its destination. A packet is the unit of data that is routed between an origin and a destination on the network. It also chooses the best path between two networks when there are multiple paths.
- **Bridge:** It is a device that connects multiple networks along the data link layer. A bridge copies the data frame from one network to the next network along the communication path. A frame is the data that is transmitted between network points as a unit with addressing and necessary protocol control information.
- **Switch:** It is a device that controls the flow of traffic between multiple network nodes. Unlike a hub, a switch splits the network traffic and sends it to different destinations rather than to all systems on the network.
- **Hub:** It is a device into which one or more computers are connected.
- **Repeater:** It is a device to amplify or regenerate digital signals received while setting them from one part of a network into another.
- **Multiplexer:** It is a device that combines several electrical signals into a single signal.
- **Network Interface Card:** It is a computer circuit board or card that is installed in a computer so that it can be connected to a network. The NIC provides connectivity between the computer and the physical medium of the network such as a copper or a fibre-optic cable.
- **Modem:** It is a device that converts digital signals from your computer into analog signals to send over the phone lines (MODulation) and converts the phone's analog signals into digital for the computer (DEModulation).

4.7 EXTRANET

The Extranet is another type of network similar to the Intranet. Like the Intranet, it is also privately owned by an organization. It is used by the organization to share its private information with its business partners, customers and vendors for different business transactions. An extranet can be viewed as part of an organization's Intranet that can also be used by the users outside the company. Thus, it can also be said as an 'Intranet mapped onto an Internet'. Such privately owned networks connected to the Internet are also called Virtual Private Networks (VPNs). The Extranets are also used to designate the restricted parts of a company's website, which requires the registered users to login and prove their authentication through login ID and password.

The extranet uses the Internet protocols and the public telecommunication system for securely sharing the information. These networks are more secure than other networks because they implement a well-defined security policy and provide privacy, passwords and security to information and resources accessible over the Extranet. Implementation of a proper security system is essential to restrict the access of users to the confidential information and resources of the organization. Some of the security mechanisms implemented are firewalls, encryption of messages, and user authentication. Any organization can use an Extranet for the following purposes:

- Exchange large volumes of data using EDI.
- Share product catalogues exclusively with wholesalers.
- Work with other companies on joint development efforts.
- Jointly develop and use training programmes with other companies.
- Share news of common interest exclusively with partner companies.
- Offer customer discussion forums for reporting problems related to the products and relevant suggestions to the problems.
- Establish a network to discuss and coordinate financial and research related queries about the product development projects with outside partners.

4.7.1 Virtual Private Network (VPN)

An organization member communicates with the members of the other organization using WAN. Virtual Private Network (VPN) performs the same function using the Internet among the companies to transfer information. It basically acts like a tunnel, separating a community's data over an Internet. The information is sent as data packets. It uses the ISP to assign a unique name and password to every user on the network to access the network.

A VPN is of two types: remote access and site to site. The remote access VPN provides the connection between a user and a LAN connection, i.e., a user is privately connected to the LAN of the organization. The site-to-site VPN allows a company to connect its network over the Internet, called 'the Intranet based VPN' or it can connect its network to the network of another organization.

VPN provides the following advantages:

- It increases the geographic connectivity.
- It extends the security between the networks.
- It increases the productivity.
- It provides network opportunities to the organization.
- It simplifies the design of the network.
- It provides features such as security, reliability, scalability, network management and policy management.

4.7.1.1 Understanding VPN

An employee in a company communicates with the employee in another company using a private network called WAN. For example, Consider a company has various offices in different parts of the country. The offices exchange information with each other using leased lines. In addition, a company connects to the Internet using an Internet service provider. This adds extra cost to the whole network. Figure 4.8 shows the network diagram of a particular company.

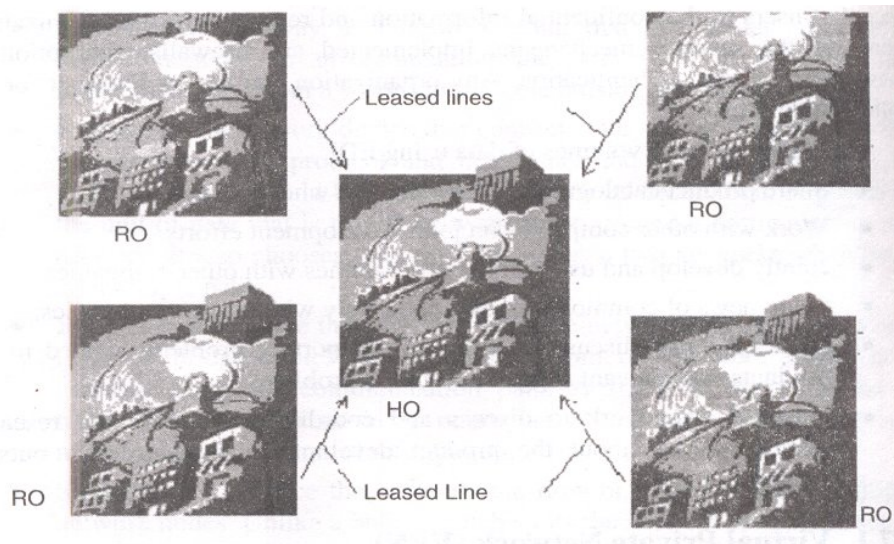


Figure 4.8: Network Diagram of a Company

In the network diagram of a company, HO and RO denote the head office and the regional office of the company. The regional offices are connected to the head office using leased lines.

An alternative to this is to connect the head office to the regional office using the Internet. Figure 4.9 shows the network connection between a regional office and a head office using the Internet.

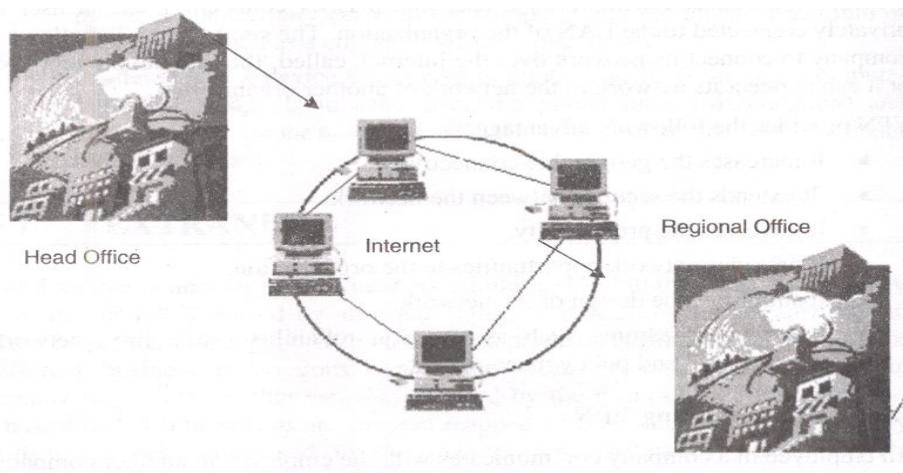


Figure 4.9: Networking Using Internet

Using the Internet between the head office and the regional office reduces the cost of transferring data. While sending the data from one office to another, it can be corrupted on the way to the Internet. VPN enables you to connect offices and other organizations using the Internet. Figure 4.10 shows a virtual private network.

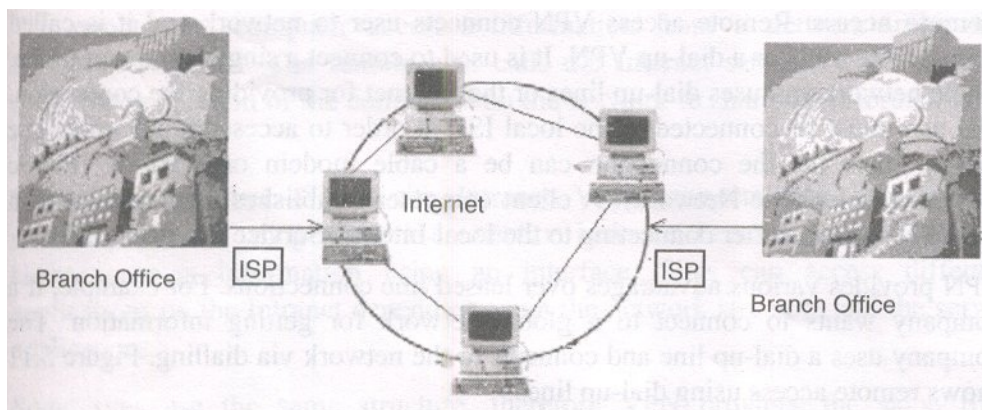


Figure 4.10: Virtual Private Network

VPN uses ISP to send and receive data packets through the network between two offices. An unidentified user can also access the Internet services because VPN provides user name and password to the user who wants to access the network outside the office. The advantages of VPN over LAN and WAN are as follows:

- Any user can access the network with its name and password because it involves low cost.
- ISP reduces the number of leased lines.
- Less bandwidth reduces the total cost.
- User authentication and code encryption provides good security.
- Interconnected network helps to share data and information.
- A user can access the network from anywhere.
- Resource sharing is possible with VPN.

Tunnelling process, used in VPN, provides security of data packets over the Internet. The tunnelling process encapsulates data and encrypts it into standard TCP/IP packets, which can then safely travel across the Internet. Tunnelling, thus, hides the private network computers during transmission of data packets. The three types of protocols used in tunnelling are described as follows:

- **Point-to-point tunneling:** It uses the Internet to connect the private network computer across different offices by creating a network between the client and remote computer.
- **Layer two tunneling:** It enables the users to access the data from remote networks.
- **IPSec:** It provides encryption of the data that prevents the hacking of information over the Internet.

4.7.1.2 Types of VPN

The following are the three types of VPN that provides connection across the network:

- **Remote access:** It allows a private network user to connect to remote computers.
- **Site-to-site Intranet:** It connects the sites of the same organization using the Intranet.
- **Site-to-site Extranet:** It provides connectivity between two organizations that access network service of each other.

Remote access: Remote access VPN connects user to network and it is called point-to-site VPN or a dial-up VPN. It is used to connect a single computer to the whole network and uses dial-up lines or the Internet for providing the connection. The user must be connected to the local ISP in order to access the network. The dial-up lines for the connection can be a cable modem or a PSTN (Public Switched Telephone Network). A client computer establishes a connection with the VPN software after connecting to the local Internet Service Provider (ISP).

VPN provides various advantages over leased line connections. For example, if a company wants to connect to a global network for getting information. The company uses a dial-up line and connects to the network via dialling. Figure 4.11 shows remote access using dial-up lines.

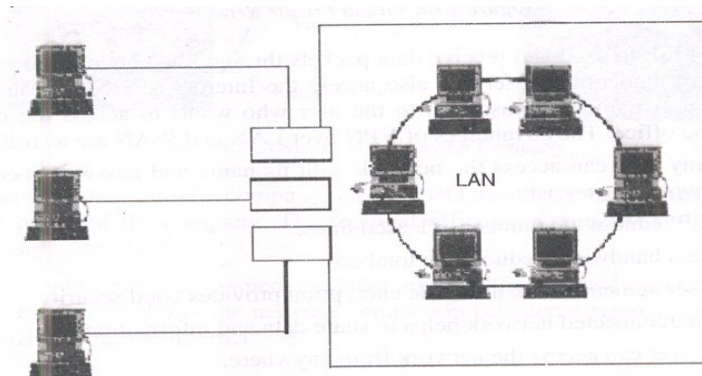


Figure 4.11: Remote Access Set-up

The private computers of the organization are connected to the LAN service provider. The costs of using these dial-up connections are very high. Figure 4.12 shows a virtual private network connection.

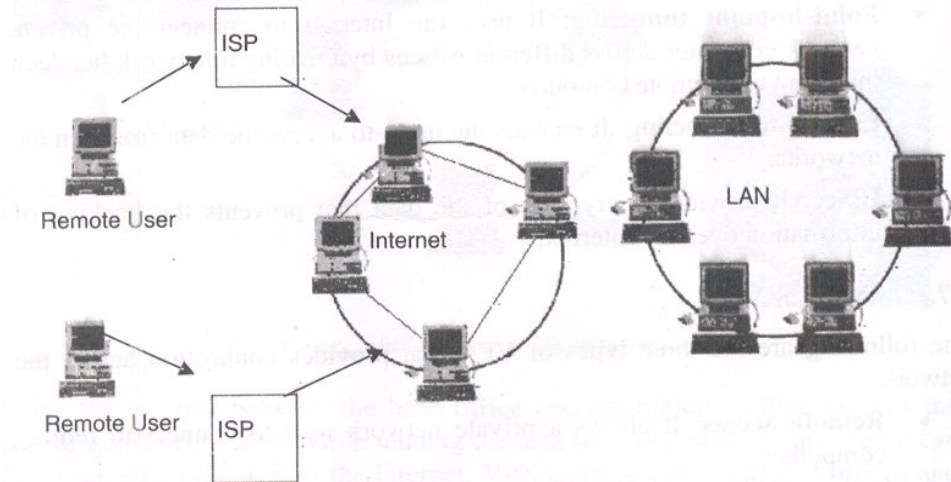


Figure 4.12: Remote Access VPN

The remote-user computer accesses information from a network using the ISP or the Internet. The remote user calls the Internet service, which in turn seeks the permission of the computers on the network to share the information of LAN.

Site-to-site Intranet: Site-to-site Intranet VPN connects two sites of the same organization using network connection between them. A site on a remote client accesses information using an interface. Sites can access different applications on the Intranet depending upon the network structure and the server applications.

Some sites use the same structure, therefore VPN provides the same file-sharing services to both the sites and if they have different network structure, then VPN provides protocols for only messaging and browsing the applications.

For example, if two branch offices situated apart are connected by a leased line, then the cost of connecting the two offices includes router and cable cost, plus the cost of using and maintaining WAN across them. Figure 4.13 shows the WAN connection between two offices.

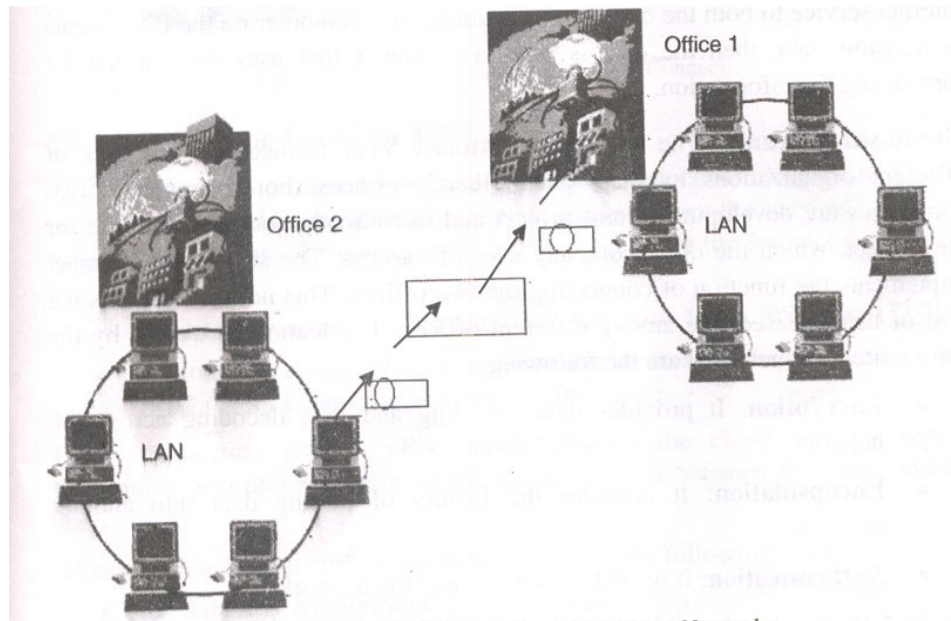


Figure 4.13: WAN Connection between two Networks

Office 1 and office 2 share information across the network using WAN. LAN systems transfer information

to the router, which then passes information to the router that connects the different offices. The advantages of site-to-site VPN over leased line connections are the following:

- **Reduces cost:** It creates a connection using the Internet service provider that has less cost than the point-to-point leased line connection.

- **Point-to-point connection:** It uses components that require high maintenance.

Figure 4.14 shows a site-to-site VPN connection.

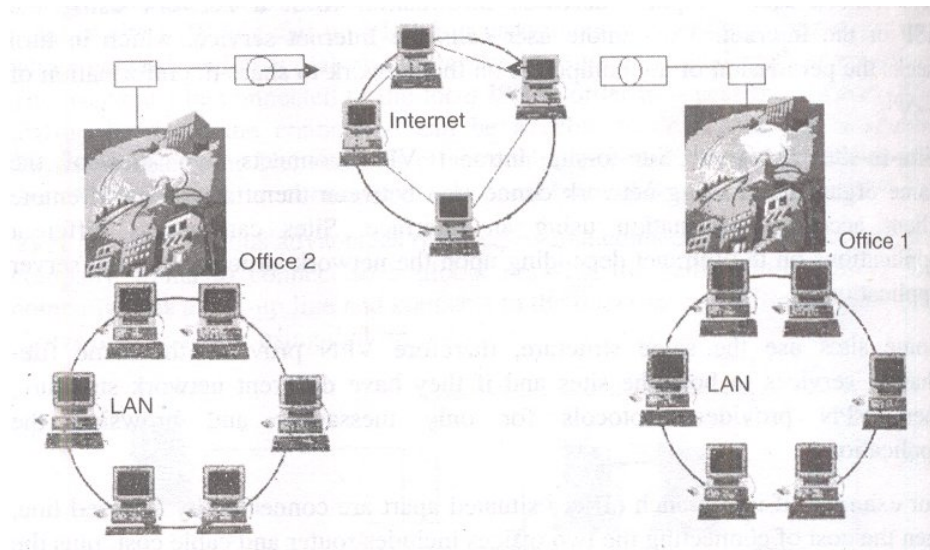


Figure 4.14: Site-to-Site VPN Connections

The Internet is connected between the two routers of the offices that provide the Internet service to both the offices. For example, if a computer on the LAN wants to transmit data, then the data is sent to its router that uses the Internet for forwarding the information.

Site-to-site extranet: The site-to-site Extranet VPN connects two offices of different organizations to share each others' services. For example, if two companies are developing a joint project and one already contains database for the project, which the other company needs to access. The site-to-site Extranet implements the function of connecting the two offices. This network reduces the cost of using leased line among different offices. The features provided by the site-to-site Extranet VPN are the following:

- **Encryption:** It provides data encoding and data decoding across the network.
- **Encapsulation:** It provides the facility of putting data into another function.
- **Authentication:** It provides security over the network.

Figure 4.15: Site-to-Site Extranet VPN Connection

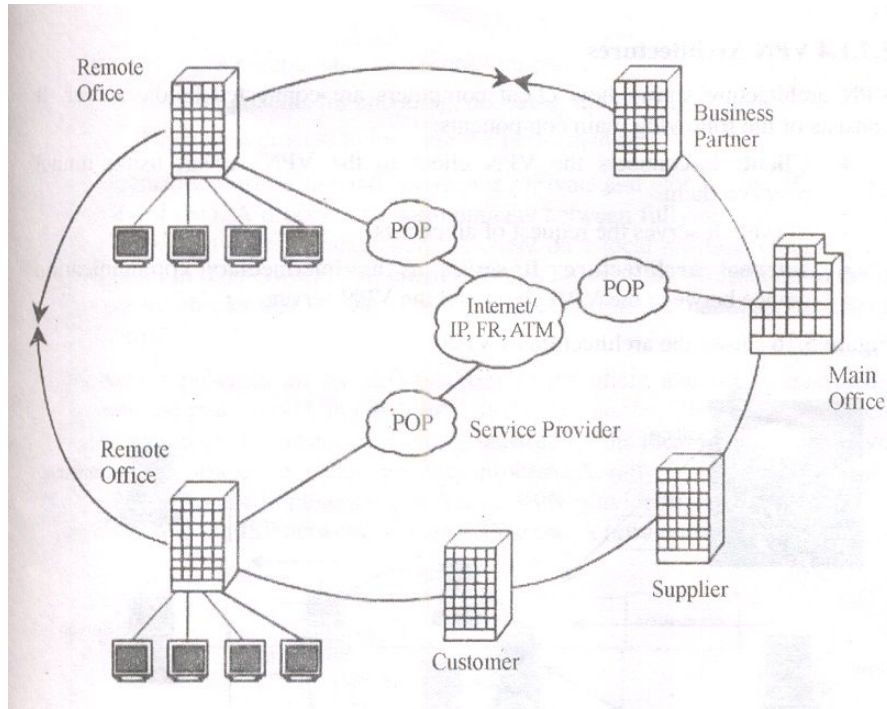


Figure 4.15: Site-to-Site Extranet VPN Connection

4.7.1.3 Connection Issues for VPN

A VPN should be designed in such a way that it reduces time and cost for the organization. In addition, it should provide security over the network. The two types of connections for connecting client computers to the Internet using VPN are:

- **Direct:** It connects the user to the Internet using ISDN, PSTN and DSL.
- **Connection using network components:** It uses routers, proxy servers or firewalls for connecting the client to the server.

Direct connection uses a VPN device between the client and the server. Communication protocols remove the inconsistencies between the client and the server.

Connection using network components considers the following issues:

- **IP Address Assignment:** It assigns an address to each computer on the network.
- **User Authentication:** It provides security services to each user of the network.
- **Connectivity Types:** It provides different types of connection such as leased line or ISP.
- **Routing Capabilities:** It provides routing services to each client.
- **Hardware and software requirements:** It determines the hardware and software required for connection.
- **Data Encryption:** It decodes or encodes the information across the network.

4.7.1.4 VPN Architectures

VPN architecture shows how client computers are connected to the server. It consists of the following main components:

- **Client:** It connects the VPN client to the VPN server, using tunnel between them.
- **Server:** It serves the request of all clients.

● **Internet architecture:** It serves as an intermediary communication device between the VPN client and the VPN server.

Figure 4.16 shows the architecture of VPN.

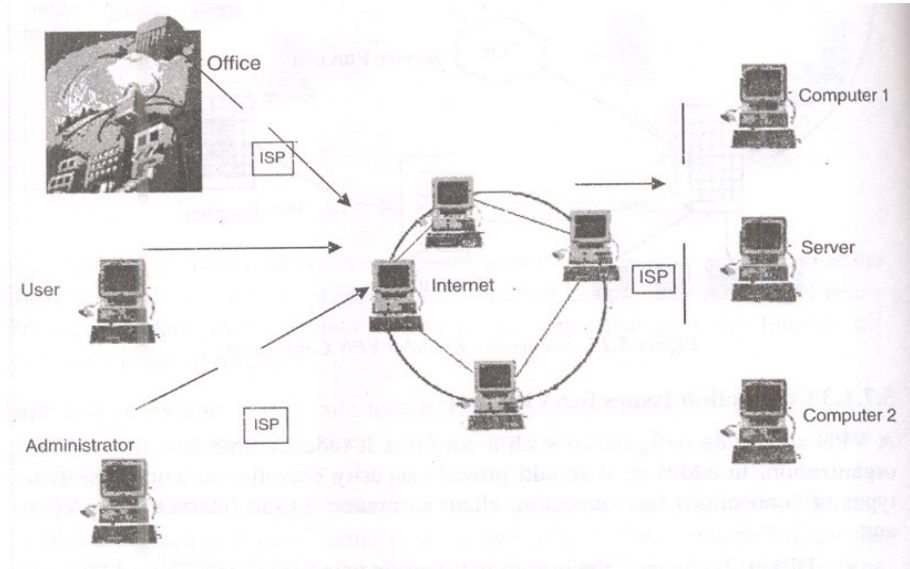


Figure 4.16: VPN Architecture

Users of VPN are PCs, administrators and office computers that are connected to the Internet using the ISP. The Internet supplies information to the clients by accessing information from the server through the Internet service provider. The three types of VPN architecture are:

- **Fully outsourced:** It provides complete solution of VPN to the company using ISP.
- **In-house VPN:** It provides and controls the solution of VPN through the organization.
- **Hybrid VPN:** It combines the feature of 'in-house VPN' and 'fully outsourced VPN'.

Fully Outsourced VPN:

Fully outsourced VPN is used in an organization where cost is the primary factor. For example, if an organization has a network across all its branches and clients on one branch need to connect to clients on other branches. An organization has to invest a lot of money for long distance telephone lines. Instead, it can use fully outsourced VPN. The components that are needed to set up a fully outsourced VPN are:

- Network components for security purpose.
- The components for encoding, decoding and routing of data.
- The tunnel process to increase the performance.

An organization uses a firewall between the private and global networks to ensure security of data. A process can communicate between fully outsourced VPN and the external network. For example, the client on a local machine connects to the In local point in the network. The client provides his account information to the ISP. The server checks this information for authentication and connects the client to the Internet.

The server provides all the ISP facilities to the client and act as intermediary between the main server and the client as a proxy server. The information across the client and the ISP is decoded on the network by the local point in the network. This whole process is called gateway process. A fully outsourced VPN needs extra resources for implementation. These VPN provide higher security between the client and the ISP network. Figure 4.17 shows a fully outsourced VPN.

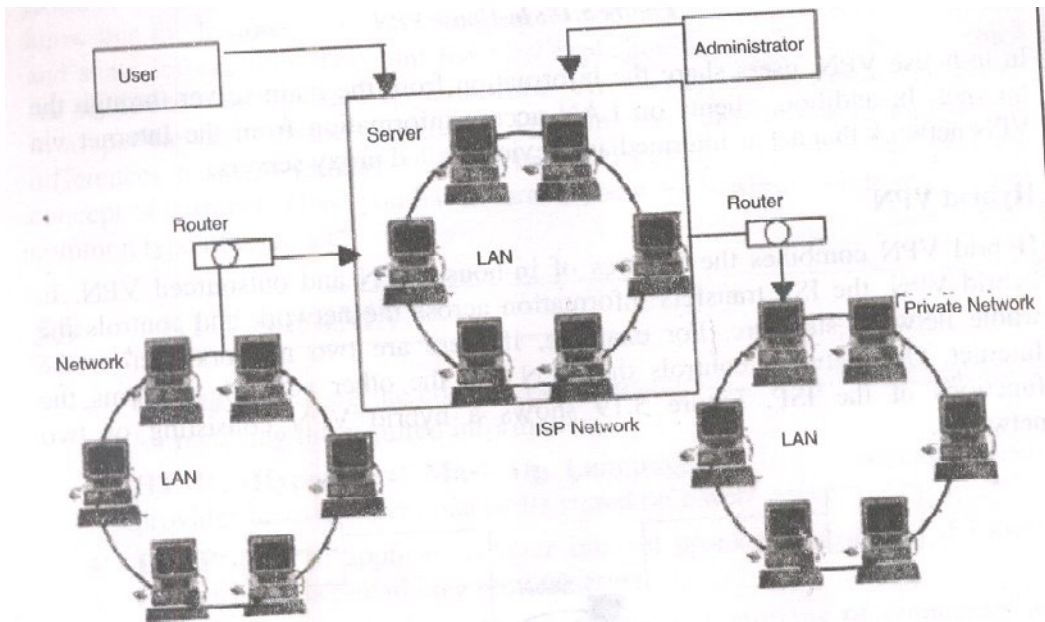


Figure 4.17: Fully Outsourced VPN

Fully outsourced VPN connects user, administrator and private network clients to the main server. The user and the administrator directly access the information from the server. In addition, the private network takes the help of outer network to access the information through main server. Clients on private network access information from server using router that is provided by another network across the circuit.

In-House VPN:

In-house VPN is controlled by the organization. ISP provides the service of transmitting data and act as a carrier between the private network and the main server. The Internet obtains information from the network by accessing data through the local point. The information is tunnelled, encoded and encapsulated in the remote server. Figure 4.18 shows the network structure of the in-house VPN.

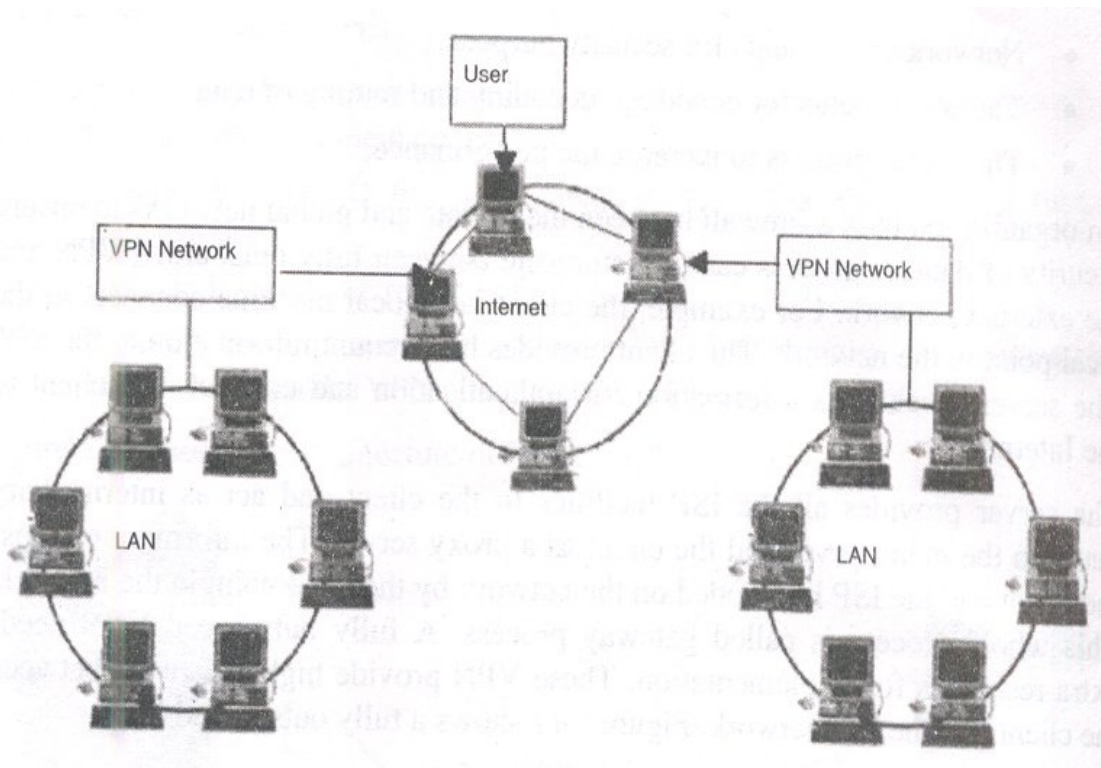


Figure 4.18: In-House VPN

In in-house VPN, users share the information from the main server through the Internet. In addition, clients on LAN access information from the Internet via VPN network that act as intermediary devices called proxy servers.

Hybrid VPN

Hybrid VPN combines the features of in-house VPN and outsourced VPN. In hybrid VPN, the ISP transfers information across the network and controls the whole network structure. For example, if there are two networks across the Internet. One network controls the VPN and the other network performs the functions of the ISP. Figure 4.19 shows a hybrid VPN consisting of two networks.

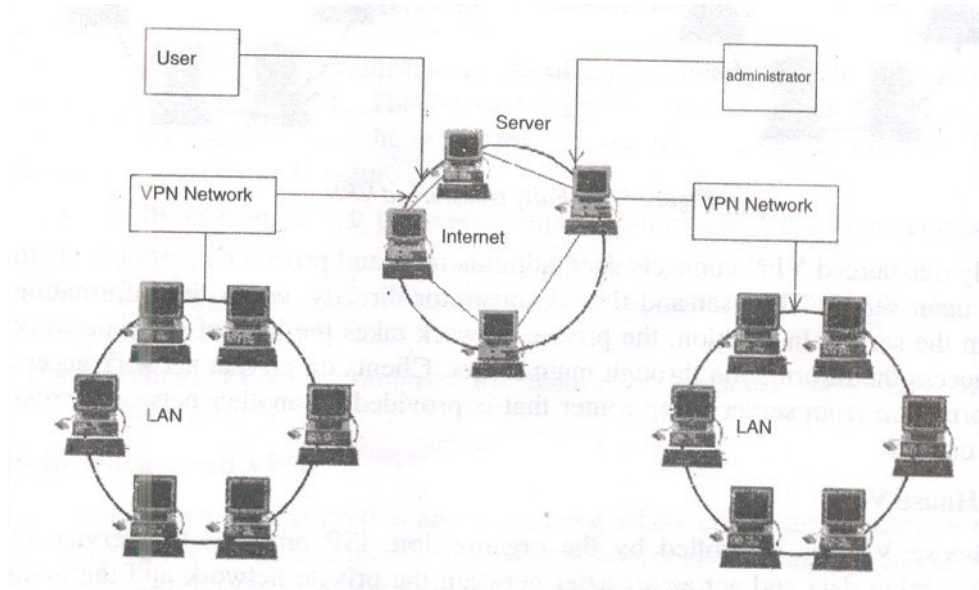


Figure 4.19: A Hybrid VPN

Hybrid VPN, both user and administrator access the information from the network. Clients on the LAN access the information from network by using VPN that provides all the ISP services.

4.7.2 Disadvantages of VPN

The various disadvantages of VPN are as follows:

- It is costly to implement and maintain (the set-up costs of hardware, software and employee training costs).
- Security is a main concern. The security methods and system access should be implemented with great care to avoid valuable information passing into wrong hands.

4.8 SUMMARY

In this unit, you have learned about the basics of the Internet, an intranet and an extranet. You have learned about the Internet connectivity concepts. Thus, you know that the Internet allows you to connect your computer with other computers and share information. This unit has also explained the various protocols which are needed to transfer data over a network. Another type of network that is used via in a specific organization is intranet. The unit has enabled you to analyse the differences between intranet and the internet. Finally, this unit explained the concept of extranet. Thus, you have learned about VPN which is one of the most common type of extranet.

4.9 KEY TERMS

- **Clients:** These are the computers that communicate with other machines for receiving the required information.
- **HTML (Hyper Text Mark-Up Language):** It is the language which provides links to other documents stored on a web server.
- **IMAP:** It is an application layer Internet protocol that allows the local client to access e-mail on a remote server.
- **Internet:** It is a global network connecting millions of computers to exchange data such as files, applications and messages.
 - **ISDN (Integrated Services Digital Network):** It is a digital communications line that allows transmission of data, voice, video and graphics at very high speeds.
- **ISP:** It provides the gateway that the customers can use to connect to the Internet.
- **Modem:** A modem converts the computer bits or digital signals into modulated or analog signals which are transmitted through the telephone lines. These signals are received on the ISP's end and demodulated into bits and bytes for the computer.
- **Network:** The network is generally a collection of one or more server computers and multiple client computers.
- **Protocol:** A network protocol defines a 'language' of rules and conventions for communication between different devices over the network.
- **Servers:** These computers satisfy the requests sent from multiple client computers simultaneously.
- **WWW:** WWW or W3 is a collection of online documents stored on servers around the world that are connected to the Internet.

4.10 ANSWERS TO 'CHECK YOUR PROGRESS'

1. The Internet is a global network connecting millions of computers to exchange data such as files, applications and messages.
2. The basic elements of the Internet are clients, servers and networks.
3. The key uses of the Internet are direct communication, banking, travel, knowledge base, etc.
4. The two advantages of e-mail are:
 - A. E-mail is faster than ordinary mail.
 - B. An e-mail is sent through the Internet and thus, it transcends geographical boundaries. It can be sent to distant places instantly at a very low cost.
5. Videoconferencing allows a group of users located in different parts of the world to talk and interact with each other.
6. An intranet is a private network connecting all the computers of an organization to share the organization's information and resources.
7. The advantages of intranet are the following:
 - A. It provides easy access to information without any time limits.
 - B. It saves time by providing fast and smooth communication between the management and the employees of an organization.
8. The three types of protocols used for tunnelling are point-to-point, layer two, and IPSec.
9. The three types of VPN are remote access, site-to-site intranet and site-to-site extranet.
10. The three architectures of VPN are fully outsourced, in-house and hybrid.

4.11 QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are the steps used to access an email?
2. How do we send an email?
3. Briefly explain the Usenet.
4. Distinguish between an intranet and the internet.
5. Write a short note on extranet.

Long-Answer Questions

1. Describe the various protocols used for e-mail.
2. Explain VPN architecture in detail and add a note on its advantages.
3. Explain the different types of VPN.
4. Write an essay on the services provided by the Internet.

4.12 FURTHER READING

Rajaraman, V., *Fundamentals of Computers*. New Delhi: Prentice-Hall of India, Fourth edition.

Unit - II

Microsoft Office and Word Processing

2.0 Objectives:

This lesson provides an introduction to the Microsoft Office. It covers Microsoft Office Products, introduction to Word-Processing and features of Word-Processing.

Structure of the Lesson:

- 2.1 Introduction to Microsoft Office
- 2.2 Word-processing
- 2.3. Features of word-processing
- 2.4. Summary
- 2.5. Technical Terms
- 2.6. Model Questions
- 2.7. References

2.1. Introduction to MS-OFFICE:

Microsoft Office for windows is a suite of applications that are also available as independent programs. Microsoft Office is a major facility in computer applications field. Microsoft Office comes in two ways. One is called **Standard** and other one is called **Professional**. Both the versions have the following primary applications.

1. Microsoft Word
2. Microsoft Excel
3. Microsoft PowerPoint
4. Microsoft Access
5. Microsoft Mail
6. Microsoft Graph
7. Microsoft Clip Art Gallery
8. Microsoft Word Art
9. Microsoft Organization Chart
10. Microsoft Equation Editor
11. Microsoft Publisher

1. Microsoft Word

This is a full-featured word processor that can create letters, menus, reports, newsletters, manuals and any kind of documents. You can use it for daily correspondence and desktop publishing also. It is having more menus, keyboard shortcuts and toolbars. Toolbars containing buttons that you can click to perform, common tasks like centering text, saving and printing documents. After developing our own working style we can make custom toolbars. Word provides macro capability to do repetitive tasks. It provides some model reports called templates, rather than typing all the matters it gives skeleton reports. Wizards are more powerful than templates. Word having spell checker that checks the document and more features like Auto formatting, Printing envelopes and labels, Mail Merge.

2. Microsoft Excel

This is a spreadsheet program that allows you to organize, analyze information. It is designed to work with numbers. You can enter data in cells arranged horizontal rows and vertical columns on work sheets. Excel organizes the worksheets with workbook. Every workbook having 3 (default) worksheets and you can add up to 255 worksheets and you can remove 1 or 2 worksheets from the three. Worksheets contains 65,536 rows and 256 columns (numbered A to IV)..The address of the cell is combination of row and column labels. Excel provides tool bars, menu choices and functions. Other than these features excel provides Screen wizard, autocalc, auto complete, templates, templates wizard etc

3. Microsoft PowerPoint

It is a presentation tool. We can create slides, handouts and speaker notes. The slides can be arranged sequentially in presentations.

4. Microsoft Access

This is a powerful database program but you can store, retrieve, and organize data. Access comes with wizards and variety of predefined database elements.

2. Microsoft Mail

Microsoft Mail is a product that comes with a license to use mail on the workstation where office is installed. If your workgroup is using Microsoft Mail, this license allows to copy the necessary software to your machine.

6. Microsoft Graph

Microsoft Graph is used to convert the tabular as well as text data into the graphs and charts. A number of graphs and chart options are provided by this component of Office.

7. Microsoft Clip Art Gallery

Clip Art Gallery is a collection of ready-made graphics that the user can import into any of the primary applications to make them more effective.

2. Microsoft Word Art

Word Art enables a user to convert the text into various shapes for logos, banners, and headlines.

2. Microsoft Organization Chart

Microsoft Organization Chart provides the tools for creating figures such as organization charts by selecting the different styles and organizations for charts.

10. Microsoft Equation Editor

Microsoft Equation Editor enables a user to format complex equations correctly.

Microsoft Publisher

It helps to organize the material of textbooks in the form of chapters and volumes.

2.2. Word Processing:

Using a computer to create, edit, and print documents is called word processing. Of all computer applications, word processing is the most common. To perform word processing, you need a computer, a special program called a word processor and a printer. A word processor enables you to create a document, store it electronically on a disk, display it on a screen, modify it by entering commands and characters from the keyboard and print it on a printer.

The great advantage of word processing over using a typewriter is that you can make changes without retyping the entire document. If you make a typing mistake, you simply back up the cursor and correct your mistake. If you want to delete a paragraph, you simply remove it, without leaving a trace. It is equally easy to insert a word, sentence, or paragraph in the middle of a document. Word processors also make it easy to move sections of text from one place to another within a document, or between documents. When you have made all the changes you want, you can send the file to a printer to get a hardcopy.

2.3. Features of word processing:

Insert text: Allows you to insert text anywhere in the document.

Delete text: Allows you to erase characters, words, lines, or pages as easily as you can erase them on a black board.

Cut and paste: Allows you to remove (cut) a section of text from one place in a document and insert (paste) it somewhere else.

Copy: Allows you to duplicate a section of text.

Page size and margins: Allows you to define various page sizes and margins, and the word processor will automatically readjust the text so that it fits.

Search and replace: Allows you to direct the word processor to search for a particular word or phrase. You can also direct the word processor to replace one group of characters with another everywhere that the first group appears.

Word wrap: The word processor automatically moves to the next line when you have filled one line with text, and it will readjust text if you change the margins.

Print: Allows you to send a document to a printer to get hardcopy.

File management: Many word processors contain file management capabilities that allow you to create, delete, move, and search for files.

Font specifications: Allows you to change fonts within a document. For example, you can specify bold, italics, and underlining. Most word processors also let you change the font size and even the typeface.

Footnotes and cross-references: Automates the numbering and placement of footnotes and enables you to easily cross-reference other sections of the document.

Graphics: Allows you to embed illustrations and graphs into a document. Some word processors let you create the illustrations within the word processor; others let you insert an illustration produced by a different program.

Headers, footers, and page numbering: Allows you to specify customized headers and footers that the word processor will put at the top and bottom of every page. The word processor automatically keeps track of page numbers so that the correct number appears on each page.

Layout: Allows you to specify different margins within a single document and to specify various methods for indenting paragraphs.

Macros: A macro is a character or word that represents a series of keystrokes. The keystrokes can represent text or commands. The ability to define macros allows you to save yourself a lot of time by replacing common combinations of keystrokes.

Merges: Allows you to merge text from one file into another file. This is particularly useful for generating many files that have the same format but different data. Generating mailing labels is the classic example of using merges.

Spell checker: A utility that allows you to check the spelling of words. It will highlight words that it does not recognize.

Table of contents and index: Allows you to automatically create a table of contents and index based on special codes that you insert in the document.

Thesaurus: A built-in thesaurus that allows you to search for synonyms without leaving the word processor.

Windows: Allows you to edit two or more documents at the same time. Each document appears in a separate window. This is particularly valuable when working on a large project that consists of several different files.

WYSIWYG (What You See Is What You Get): With WYSIWYG, a document appears on the display screen exactly as it will look when printed.

2.4. Summary:

At the end of this lesson you have learnt the importance of Microsoft Office products and important features of Word Processing. In all the MS-Office products, the familiar products are MS Word, MS Excel, MS PowerPoint and MS Access. Word processor enables you to create a document, store it electronically on a disk, display it on a screen, modify it by entering commands and characters from the keyboard and print it on a printer.

2.5. Technical Terms:

Cut and paste: Allows you to remove (cut) a section of text from one place in a document and insert (paste) it somewhere else.

Copy: Allows you to duplicate a section of text.

WYSIWYG: What You See Is What You Get.

Spell checker: A utility that allows you to check the spelling of words.

Word wrap: The word processor automatically moves to the next line when you have filled one line with text, and it will readjust text if you change the margins.

2.6. Self Assessment Questions:

1. Explain in detail about Ms-Office
2. Define Word-Processing? Explain the features of Word Processing?

2.7. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' **BPB Publications, New Delhi**

MS OFFICE 2000 Complete, BPB Publications, New Delhi

Y. SURESH BABU, M.Com., M.C.A.,
Lecturer, Dept.Of Computer Science,
JKC College, GUNTUR.

UNIT- II**Microsoft Word****2.1.2 Objectives:**

This lesson provides an introduction to the fundamentals of Microsoft Word. It covers starting Word, the Word interface, creating a Word document, editing a Word document, selection techniques, text formatting, page setup and print documents.

Structure of the Lesson:

- 2.1 Starting word and components of word window
- 2.2 Creating and saving a document
- 2.3 Adding & modifying text
- 2.4 Selecting Text
- 2.5 Cut, Copy and Paste Text
- 2.6 Paste Special
- 2.7 Find and Replace
- 2.8 Redo and Undo
- 2.9 Formatting Text & Paragraphs
- 2.10 Header and Footer
- 2.11 Bullets and Numbering
- 2.12. Zooming
- 2.13. Page Break
- 2.14. Auto Correct and Auto Text
- 2.15. Page Setup
- 2.16. Print Preview and Printing
- 2.17. Summary
- 2.12. Technical Terms
- 2.12. Model Questions
- 2.20. References

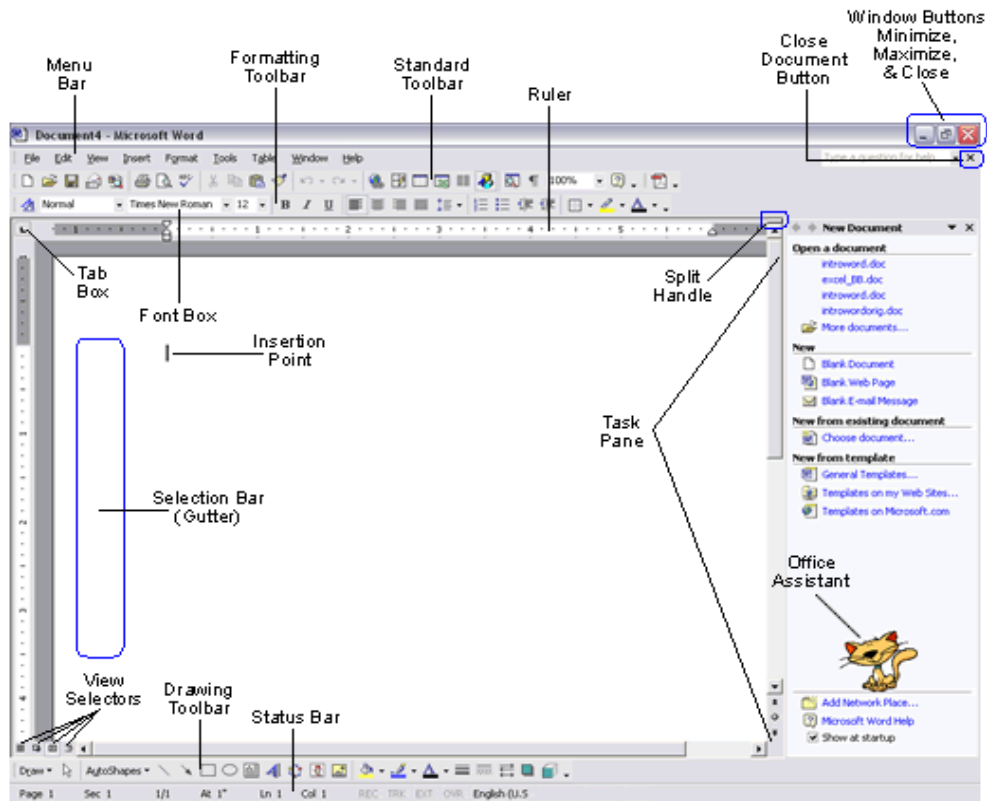
2.1. Getting Started with Microsoft Word:**Starting Word**

On the PC, select Start followed by Programs, and Microsoft Word from the Start list.

Components of the Word Window

Besides the usual PC window components (close box, title bar, scroll bars, etc.), a Word window has other elements, as shown in the following figure.

Figure 6.1



Component	Functionality or Purpose of the Component
Menu Bar	Contains File, Edit, View, Insert, Format, Tools, Table, Window and Help menus.
Standard Toolbar	Contains icons for shortcuts to menu commands.
Formatting Tool Bar	Contains pop-up menus for style, font, and font size; icons for boldface, italic, and underline; alignment icons; number and bullet list icons; indentation icons, the border icon, highlight, and font color icons.
Ruler	Ruler on which you can set tabs, paragraph alignment, and other formats.
Insertion Point	Blinking vertical bar that indicates where text you type will be inserted. Don't confuse the insertion point with the mouse I-beam. To move the insertion point, just click the mouse where you want the point moved.
End-of-File Marker	Non-printing symbol that marks the end of the file. You cannot insert text after this mark.
Selection Bar (Gutter)	Invisible narrow strip along the left edge of the window. Your mouse pointer changes to a right-pointing arrow when it is in this area. It is used to select a line, a paragraph, or the entire

	document.
Split Handle	Double-click to split the window in two (to view different portions of the same file). Double-click to return to one window
Status Bar	Displays page number, section number, and total number of pages, pointer position on page and time of day.
Task Pane	Displays and groups commonly used features for convenience.
Office Assistant	An animated character that can provide help and suggestions. There are multiple characters to choose from, and it is possible to turn the Office Assistant off.

2.2. Creating and Saving a Document:

Opening and Closing A Document

To open a file, select Open... from the File menu. In the dialog box, click on the filename and then on the Open button. If your file is not in the opened folder, click on the down arrow (next to folder name) to see a directory listing. The Up One Level button icon on the right enables you to move up one level. You can then switch to the floppy disk, hard drive or Desktop where the appropriate file or folder is located.

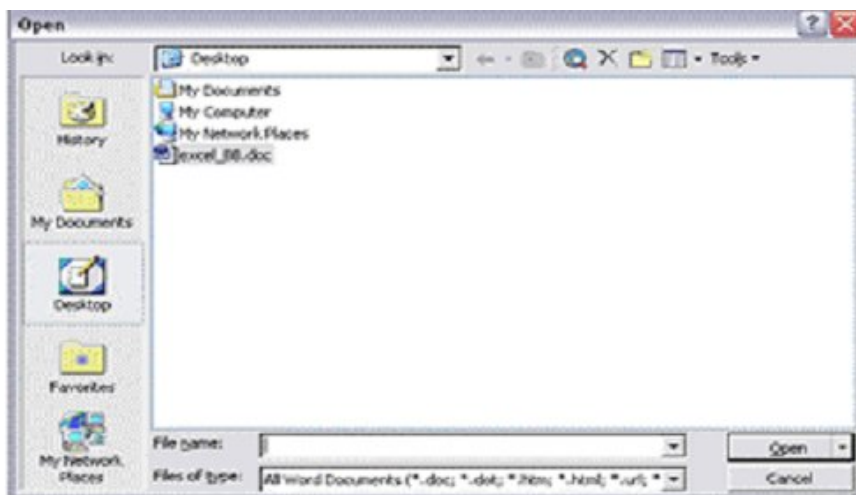


Figure 6.2

For example, to open a file from a floppy disk, select Open... from the File menu. If the disk's name does not appear on the left side of the dialog box, click on the down arrow. Select its name in the box at the left or if it is not displayed, click the Up One Level button to see a different display of files and folders. When you locate the desired diskette or file, click Open. (Double-clicking on the name will also open it).

To close a document, click its close box in the upper right of the title bar (box with the large X on it) or select Close from the File menu. The keyboard shortcut is <Ctrl + W>.

Saving a Document

Saving means preserve the content in a Secondary Storage device. It is a good idea to save your document right away and they continue saving every 5 or 10 minutes so if your computer crashes you will not be losing much. Your document and changes you make to a document are not saved to disk until you issue a save command. Saving is quick and easy. You should save often to minimize the loss of your work. Word has two save commands - Save and Save As. - that work similarly. Both are under the File menu.

Save	Save As
When you save a new document for the first time, Word displays a dialog box where you can choose a document name and where you want to save your document and disk. Use the Save As command whenever you give it a name. When you save an existing document that you have been editing, the newly saved version is written over the older version.	This command always displays a dialog box where you can choose a document name and where you want to save your document and disk. Use the Save As command whenever you give it a name. When you save an existing document that you have been editing, the newly saved copy becomes the active document.

2.3. Adding and Modifying Text

Entering Text

To enter text, just start typing. Word inserts the text you type at the insertion point. If you press a wrong key, use the **Delete** key to erase the mistake. Word automatically starts a new line when you reach the end of the current line. This is called "word wrap". Do not press Enter at the end of a line. Press Enter only at the end of paragraphs.

For typing a paragraph follow the procedure given below:

Remember, don't press Enter at the end of the line.

To move the insertion point with the mouse, click the mouse in the desired location. If the location you want is not visible, use the scroll bars to move up or down in the document. To move the insertion point to the top of the document, press **<Ctrl + Home>**. To move to the end of the document, press **<Ctrl + End >**.

To insert new text, just click the mouse at the point where you want to insert the additional text and start typing. Existing text moves to accommodate your additions.

Type **<Ctrl + Home>** to move to the very beginning of your document.

Deleting Text

The **Backspace** key deletes one character to the left of the insertion point. The **Delete** key deletes one character to the right of the insertion point. You can use these keys any time. To delete more than just a few characters, select the text and press the **Delete** key.

Undoing Mistakes

If you have accidentally deleted an important paragraph, use the **Undo** command under the **Edit menu** immediately (The keyboard shortcut is **<Ctrl + Z >**). The deleted portion of the text is brought back. This command can bring back the deleted contents only if you have not pressed any other key in between.

2.4. Selecting Text:

You select a portion of text in order to perform some operation on it. You can then delete, replace, copy, move, or format it. The Selection Bar is located to the left of the document window. When you put your mouse pointer, which is a left pointing arrow in that area, the arrow swings to the right. The following table gives the process of selection of text contents.

To Select...	Do this...
Word	Double click anywhere on the word.
Line	Click right-pointing arrow in the selection bar to left of line.
Sentence	<Ctrl + click> anywhere in sentence.
Paragraph	Double-click the right-pointing arrow in the selection bar to the left of the paragraph, or triple-click in paragraph.
A block of text of any size	Click at one end of the block and shift-click at the other end of the block. Or click at one end of block and drag to the other end of the block.
Entire document	Press < Ctrl + A> or hold down the Ctrl key and click in the selection bar.
Deselect text	Click anywhere outside the selection.
Extend a selection	Shift-click an additional block. For example, if you have selected a paragraph and you shift-click on another paragraph, it will be added to the selection.

2.5. Cut, Copy and Paste Text:

You can copy selected text from one place to another with the Copy and Paste commands.

Cut - The Cut command extracts the selected text and puts it on the Clipboard (a temporary storage area). The contents of the Clipboard are overwritten with each copy or cut. This can be done either by selecting Edit from the menu bar and opting the cut option in it. Alternative usage of the short cut key is CTRL +X.

Copy - The Copy command puts a copy of the selected text on the Clipboard. By selecting the Edit from the menu bar and opting the Copy option in it. Alternative is usage of the short cut key is CTRL + C.

Paste - The Paste command inserts the Clipboard's contents at the insertion point. The text that has been selected using Cut/ Copy command will be pasted at the insertion point. Existing text moves to accommodate pasted text. By selecting the Edit from the menu bar and opting the Paste option in it. Alternative usage of the short cut key is CTRL + V.

2.6. Paste Special:

Paste Special is a way to paste information from one application/document to another. The Paste Special dialog box allows you to paste information in different ways. Choose Paste Special from the Edit Menu.

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You can paste in the information in several ways:

Formatted Text, Unformatted Text, Picture Object.

When we paste Formatted Text, it will paste all formatting (such as Bold, etc.) along with the text. When we use Paste Special option the formatted text can be pasted as unformatted text or an object.

2.7. Find and Replace:

Word allows us or helps us to search for a word in a document

Find: Find is used for searching a word in your document.

1. On the Edit menu, click Find.

2. In the **Find what** box, enter the text that you want to search for.

Replace: Replace is used to replace the searched word by another text.

Click On the Edit menu, click Replace.

In the **Find what** box, enter the text that you want to search for.

In the **Replace with** box, enter the replacement text.

The other options you have are Replace, Replace All, Find Next and Cancel.

Replace button replaces a word selected, at the first occurrence of the word in your document after the insertion point.

Replace All button replaces all the searched words in your document.

Find Next button searches for the next occurrence of the word being searched.

Cancel button cancels the search process.

2.2. Undo and Redo:

Undo

When working in Microsoft Word you will often commit mistakes. Instead of manually trying to undo these actions you are able to rectify the mistake just by clicking the Undo button on the Standard toolbar.

To practice the Undo Feature:

1) Press CTRL +End to move to the end of the document

2) Highlight the last paragraph in the document

3) Press the Delete key on the keyboard

To Undo the Previous Action:

Click the Undo button on the Standard Toolbar

Redo

You may accidentally click Undo too many times and thus, need to redo it. This command works exactly in the reverse of Undo command.

To Redo the Previous Action:

Click the Redo button on the Standard Toolbar

Save and close the file.

2.2. Formatting Text and Paragraph

Microsoft Word allows you to format a document very easily. Without formatting, a document looks very plain and may not get the attention that is desired.

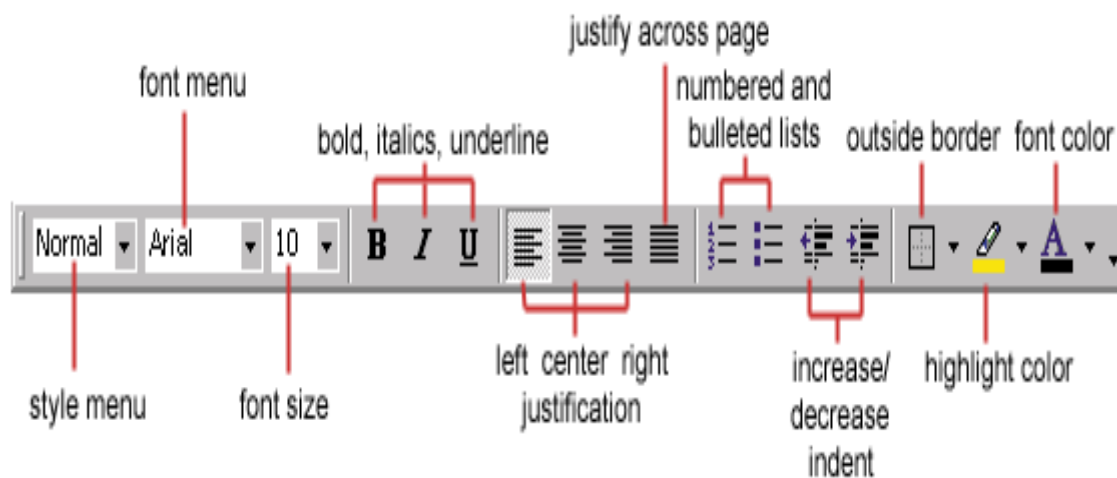


Figure 2.9a

Making Font Changes

In Microsoft Word you are able to change the font size, color, type and attributes. Below we demonstrate various ways to change the font.

Select a document of unformatted text for formatting.

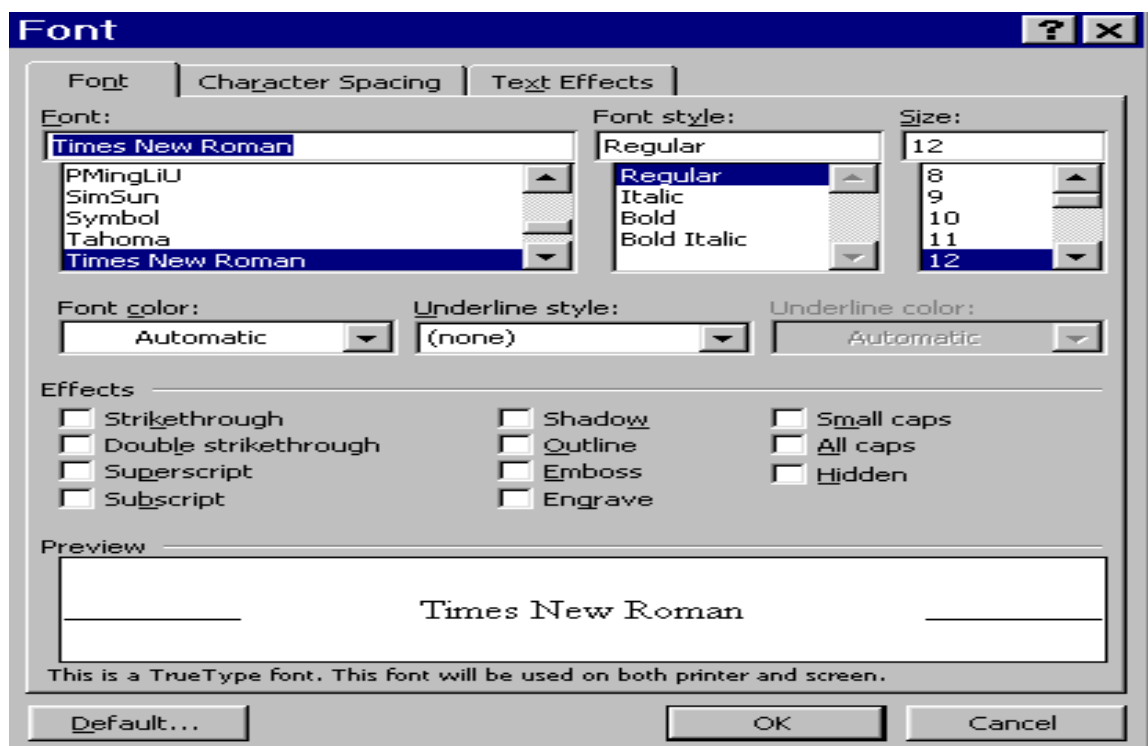


Figure 2.9b

UNIT-I**To edit the font style**

- 1) Highlight the paragraph
- 2) Select Format menu
- 3) Select a Font type.
- 4) Notice the Preview window at the bottom of the dialog box, which displays the style of the font, selected.
- 5) Click OK

Font Size

Opting the one of the numbers in size box does changing the font size for a selected portion of the text.

Using Bold, Italics and Underline

Another way to make text stand out in a document is by using bold, italics and underline (or a combination of these) formatting.

To Bold Text in a Document

- 1) Select any word(s) in the document
- 2) Click the Bold icon on the Formatting Toolbar

To Italicize Text in a Document

- 1) Select any word(s) in the document
- 2) Click the Italic icon on the Formatting Toolbar

To Underline Text in a Document

- 1) Select any word(s) in the document
- 2) Click the Underline icon on the Formatting Toolbar

Formatting Paragraphs

In Microsoft Word, a paragraph is any amount of text followed by a paragraph symbol (¶). A one-word heading is a paragraph. A 100-word job description is a paragraph. Even a blank line terminated by a ¶ is a paragraph.

You can perform paragraph formatting from the Format menu.
Highlight the paragraph you want to format.
Click on Format from the Command menu.
Choose Paragraph.

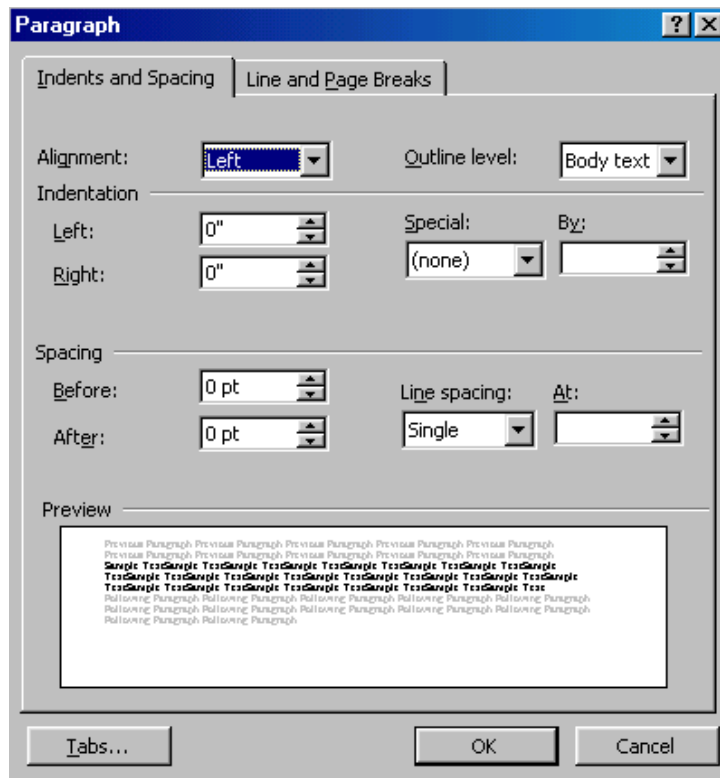


Figure 2.9c

Make the changes from the options that are displayed in the window. For example, to change line spacing from single to double, click on the Line spacing drop down arrow, and choose double. You can also choose options from the Formatting Tool Bar to format paragraphs.

2.10. Header and Footer

A header or footer is text or other information such as graphics that is stored at the top or bottom of the page throughout your document. You can use the same header and footer throughout a document or change for part of the document. For example, you can use your corporate logo in the first-page header, and then include the document's file name in the header for subsequent pages.

To view Headers and Footers in Normal View, click View > Header and Footer. If you are in Page Layout View (Word 97) or Print Layout View (Word 2000), simply double click the visible header or footer that appears as gray text.

In either case, the Header/Footer toolbar appears.

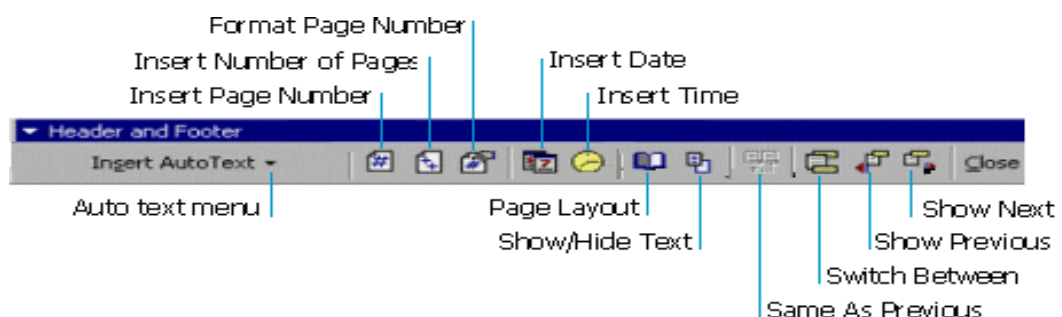


Figure 2.10

2.11. Bullets and Numbering:

Word has a feature of giving automatic numbers and bullets for paragraphs or for points. For bullets first select the paragraph or points to be bulleted and then select bullets icon from the standard toolbar or select Format from menu bar and opt for Bullets and numbering. Select different types of symbols as bullets.

2.12. Zooming:

The level of magnification of the text can be controlled by this zooming control. Choose percentage value from the zoom popup menu and size of magnification of text.

2.13. Page Break:

After allowing certain number of lines MS Word automatically inserts a dotted line in the document called page break. We can insert a page break at any line in the document. Select Insert Menu from menu bar and click break. Now the page break dialog box appears. Here select page break button and click on it. Then page break will be inserted at the current cursor position.

2.14. Auto Correct and Auto Text:

Auto Correct

Auto Correct is used to correct the repeated typing mistakes. Select Tools menu from the menu bar and click Auto Correct option, then activate Auto correct tab. Here type frequently misspelled words in 'Replace box' and the correct one's in 'with box'. Click the Add button to add this to the dictionary. Afterwards if we misspell a word, which was added to the dictionary, word will automatically correct the mistake.

Auto Text

Frequently typed text can be placed into an Auto Text entry. First type the text what we want to put into an Auto Text entry and then select it. Select Tools menu and Click Auto Correct and then activate Auto Text Tab. Now, enter the abbreviation for the selected text and click OK. Afterwards, if we want to type the text that is there in the Auto Text, simply type the abbreviation and click OK. Then automatically the text will be typed without actually typing.

2.15. Page Setup:

Page Margins

The page margins of the document can be changed using the rulers on the page and the Page Setup window. The ruler method is discussed,



Figure 2.15a

first move the mouse over the area where the white ruler changes to gray.

When the cursor becomes a double-ended arrow, click with the mouse and drag the margin indicator to the desired location. Release the mouse when the margin is set.

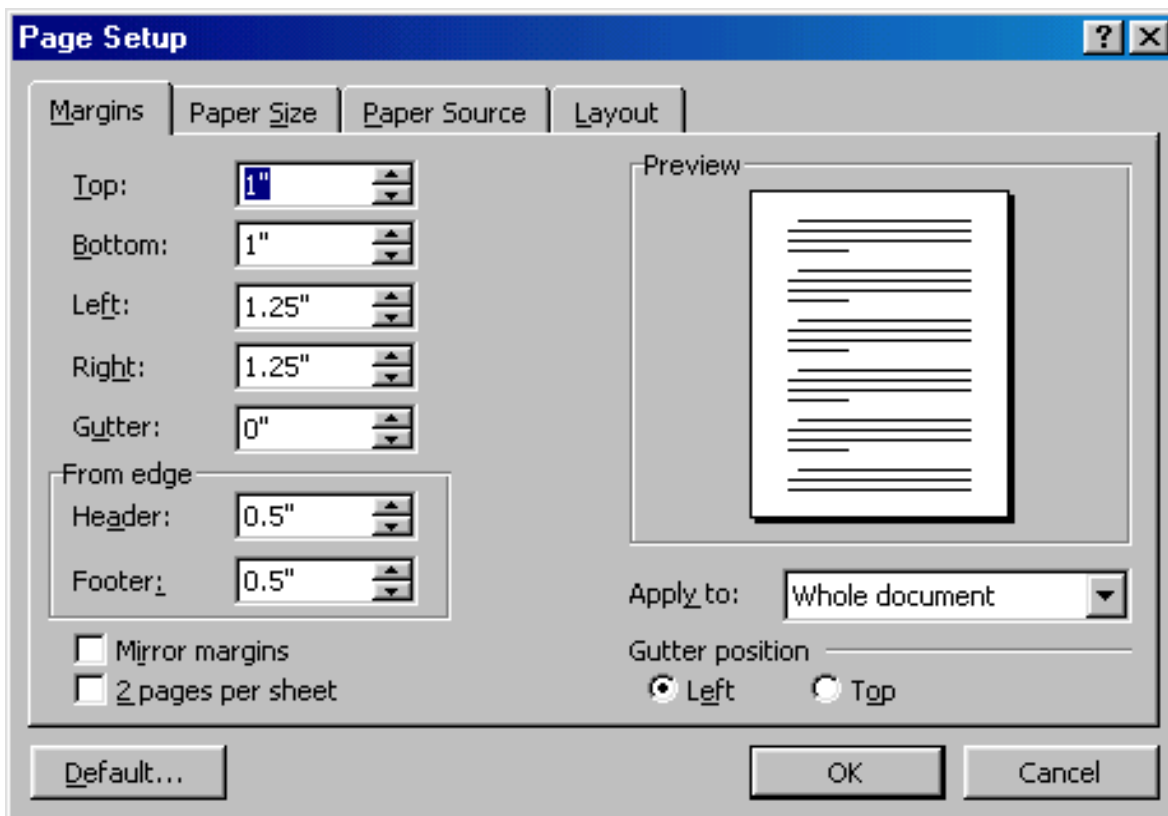


Figure 2.15b

The margins can also be changed using the Page Setup dialog box: Select File/Page Setup and choose the Margins tab in the dialog box.

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Enter margin values in the Top, Bottom, Left, and Right boxes. The Preview window will reflect the changes. If the document has Headers and/or Footers, the distance this text appears from the edge of the page can be changed. Click OK when finished.

Page Size and Orientation

Change the orientation page within the Page Setup dialog box. Select File/Page Setup and choose the Paper Size tab.

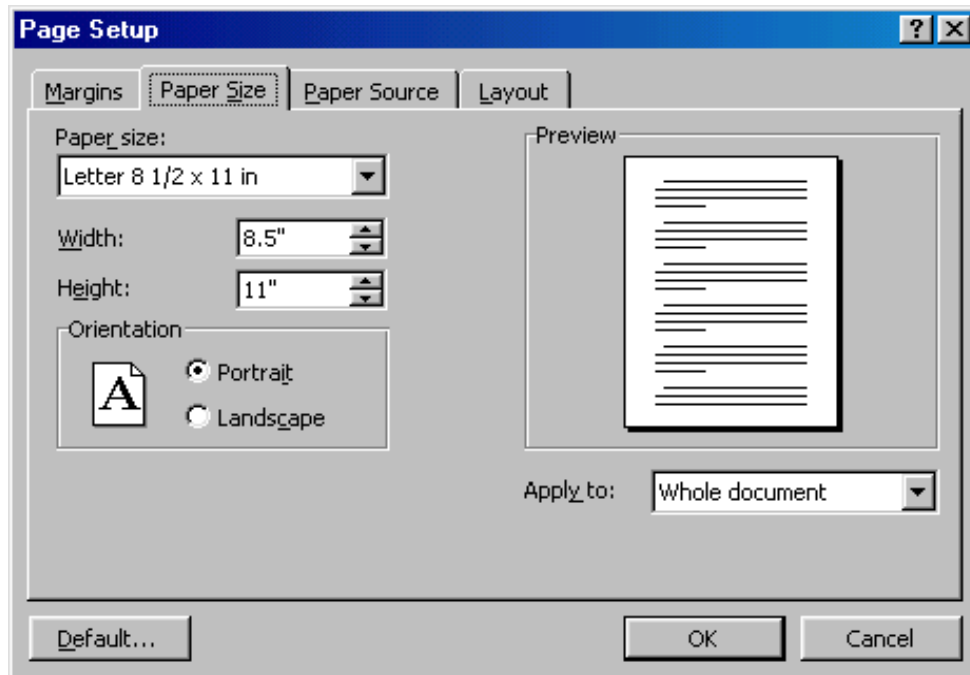


Figure 2.15c

Select the proper paper size from the drop-down menu. Change the orientation from Portrait or Landscape by checking the corresponding radio button.

Page Numbers

Follow these instructions to add page numbers to a document. Select Insert/Page numbers from the menu bar and the following dialog box will appear.

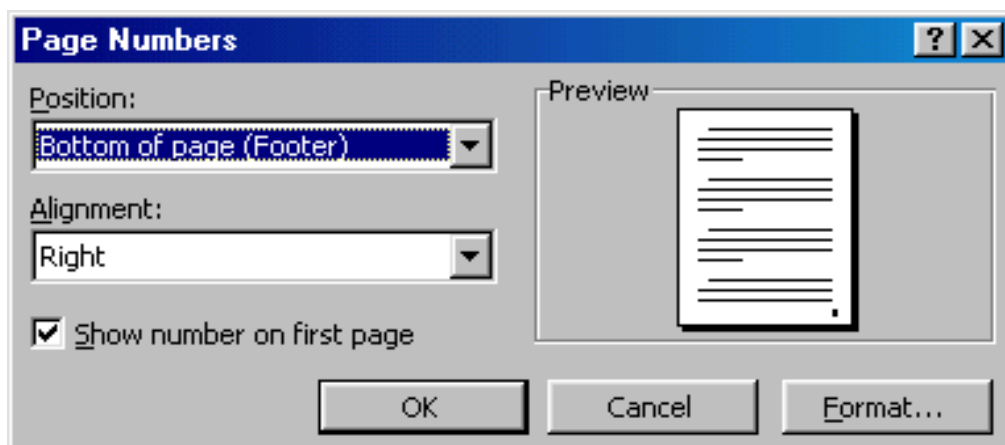


Figure 6.15d

Select the position of the page numbers by choosing "Top of page" or "Bottom of page" from the Position drop-down menu. Select the alignment of the page numbers in the Alignment drop-down menu. If you do not want the page number to show on the first page (if it is a title page, for example), uncheck the Show number of first page box. Click OK when finished.

2.16. Print Preview and Printing:

Preview your document by clicking the Print Preview button on the standard toolbar or by selecting File/Print Preview. When the document is ready to print, click the Print button from the Print Preview screen or select File|Print.

2.17. Summary:

At the end of this lesson you have learnt the important features of Ms-Word. We started with procedure to invoke Ms-Word. We have identified toolbars available in the word. You learnt the procedure of creating a new document and opening an existing document. Now you are in a position to create a new document and can make corrections like deleting a character, word, line or paragraph and replace with required text by using replace option. You can also move the selected part of the text to another place by the "cut" and "paste" commands. At the end of the lesson we discussed the procedure of saving a document and exit from word.

You have gained the knowledge of formatting a document using different formatting options like setting margins, changing the font size, and alignment to the text. The headers, footers, tabs, indents make the document in presentable format.

2.12. Technical Terms:**Font**

Font refers to the combination of a **typeface** (eg. Times Roman, Arial, Century Schoolbook) and its **attributes** (bold, italics, size (12pts)).

Bullets

Bullets are special characters or symbols that are used to set off a paragraph. Typically, each bulleted paragraph is an item in a list, and it consists of the bullet symbol and indenting to set the bullet apart from the text.

Document

A document is any data file that is created by a specific application.

Current Document

The current, or active document is the document you see on the Word screen.

Drag-and-drop

Drag-and-drop is a feature that allows you to move or copy information without using the Windows Clipboard. To use it, you simply drag a selected item from one location to another. It is best used for moving or copying small items short distances.

Footer

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A Footer is the contents of an area located within the bottom margin of a page.

Header

A header is the contents of an area located within the top margin of a page.

Justification

Justification determines how lines and characters within those lines are printed. With full justification, all lines start at the left margin and end at the right margin.

Margin

The margin is the amount of blank space, usually measured in inches or characters, above and below and to the right and left of the main body of a document.

Menu Bar

The menu bar contains the names of Word's menus and is used to navigate through their commands.

Paragraph

A paragraph in Word begins where you start typing, and it ends where you press [ENTER].

2.12. Model Questions:

1. Explain about different components of MS-Word window.
2. Explain Find, Replace & Go To?
3. Explain Header and Footer?
4. What is the difference between Auto Correct and Auto Text
5. Explain the text formatting features in MS-Word

2.20. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' BPB Publications, New Delhi

MS OFFICE 2000 Complete, BPB Publications, New Delhi

Y. SURESH BABU, M.Com., M.C.A.,
Lecturer, Dept.Of Computer Science,
JKC College, GUNTUR.

UNIT – II

Microsoft Word

2.0.2 Objectives:

This lesson provides an introduction to the Views, Spell Checking, Tables, Macros and Mail merge.

Structure of the Lesson:

- 2.1. Views
- 2.2. Spell Checker
- 2.3. Word Count
- 2.4. Macro
- 2.5. Graphics
- 2.6. Lines and Shapes
- 2.7. Word art
- 2.2. Tables
- 2.2. Borders and Shading
- 2.10. Footnote and Endnote
- 2.11. Tabs
- 2.12. Mail merge
- 2.13. Format Painter
- 2.14. Summary
- 2.15. Technical Terms
- 2.16. Model Questions
- 2.17. References

2.1. Views:

Any document can be viewed in different fashions. These views can be selected from the view menu of the menu bar.

Normal view is a default view for all new documents. However saved document will be opened last saved view. For example a document is opened in normal view and saved in page layout view, when saved document is reopened, the document will be opened in page layout view.

Normal View

You can create and edit text or graphics normally. To work with header and footers you invoked select item/Header and Footer. Footer details will not be displayed on screen.

This view will not show side-by-side column positioning, footers and headers. Automatic page breaks are shown as dotted lines. Manual page breaks containing the words “ Page Break”.

Page layout View

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In this view headers & footers can be seen and edited. You can modify the Header/Footer by the selecting the matter itself. It will display the left side scale also.

Outline View

This view is used to see entire contents of the document, chapter headlines and sections headings if your document is properly formatted. It is useful if the document is large.

Print Preview

Print preview is another way to view a document. Choose file → print preview or Ctrl +F2. You can see one page to six pages at a time in print preview.

Split Screen View

You can see two parts of your document at once. This feature is useful to make copying, cutting and pasting quickly in both the documents simultaneously.

2.2. Spelling Checker:

To start the spelling checker, select Spelling and Grammar from the Tools menu. MS Word will begin to check for misspellings. If a word is found that is not in its dictionary, it pauses, displays the word, and if possible, suggests alternatives (see figure below).

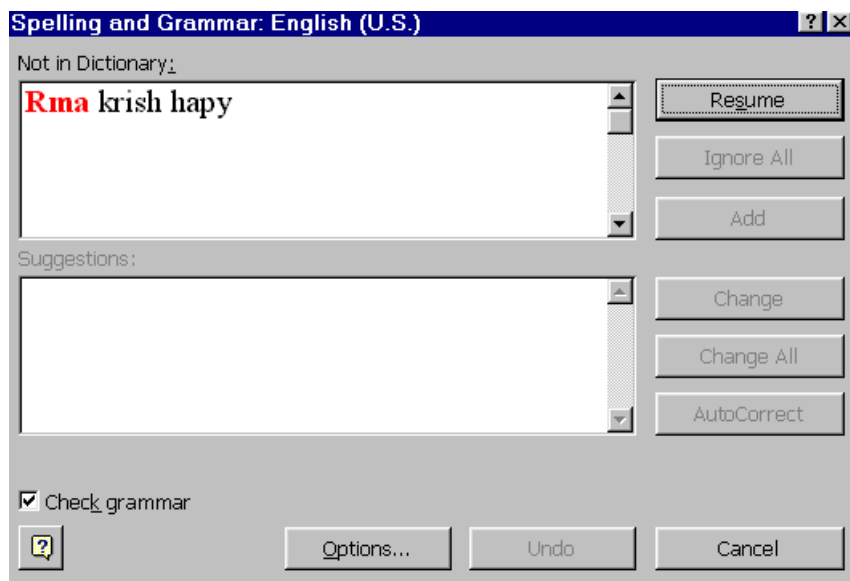


Figure 2.2

You have several choices at this point described in the table below. If the word is spelled correctly, you can Ignore it or add it to a custom dictionary by selecting the options. If the word is incorrect, you can use Replace it with one of its suggestions or with a spelling you type in the Change To: box.

If the word is spelled correctly...

To ignore only this occurrence of the word, click	Ignore
To ignore all occurrences of the word, click	Ignore All
To add the word to a custom dictionary, click	Add
If the word is misspelled...	
First, click correct spelling in Suggestions list or type the correction in the Change To: box. Then...	
To change only this occurrence of the word, click	Change
To change all occurrence of the word, click	Change All

2.3. Word Count:

Word count displays the number of words, paragraphs, lines, characters, pages in the document. Select Tools menu from the menu bar and click on the word count.

2.4. Macro:

Macros are advanced features that can speed up editing or formatting you may perform often in a Word document. They record sequences of menu selections that you choose so that a series of actions can be completed in one step.

Recording A Macro

To record a macro, follow these steps:

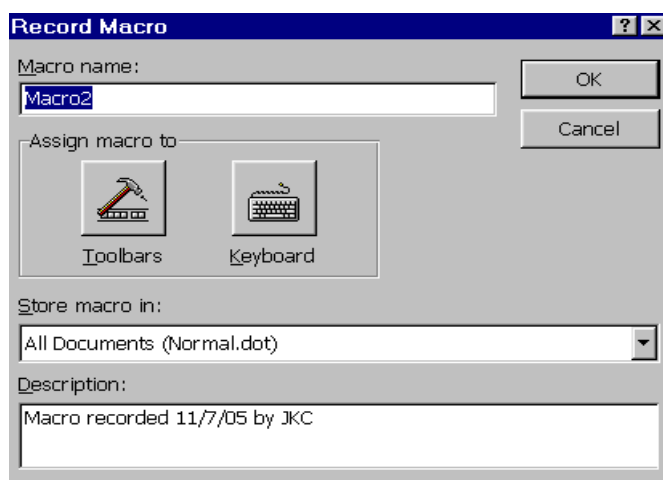


Figure 2.4a

Click Tools/Macro/Record New Macro on the menu bar.

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Name the macro in the Macro name field. This name cannot contain spaces and or begin with a number.

From the Store macro in drop-down box, select the document you would like the macro to be associated with or choose "All Documents" enabling to use the macro in any document. Enter a description of the macro in the Description field. This is for your reference only so you remember what the macro does. Click OK to begin recording.

Select options from the drop-down menus and Word will record the options you choose from the dialog boxes, such as changing the margins on the Page Setup window. Select only options that modify the document. Word will not record toggle actions such as View/Toolbars that have no effect on the document itself.

The recording toolbar will allow you to stop, pause, and resume recording. Click the Stop button in the recording toolbar. The macro is now saved.



Figure 2.4b

Running A Macro

To run an existing macro, follow these steps:

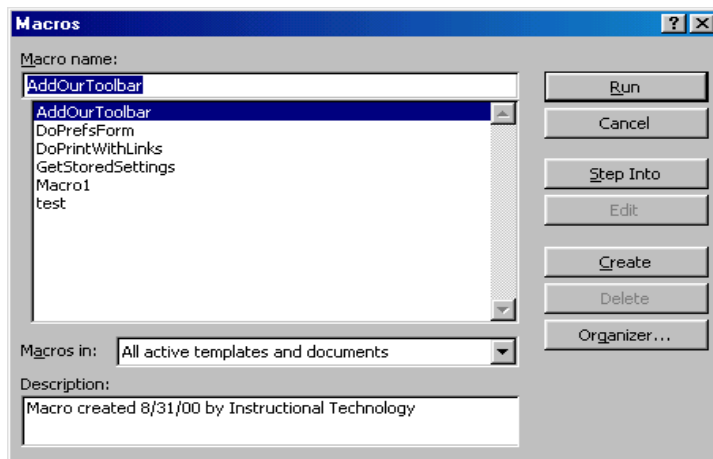


Figure 2.4c

Select Tools/Macro/Macros from the menu bar.

From the Macros window, highlight the Macro name in the list and click Run. If the macro is long and you want to stop it while it is running, press BREAK (hold CTRL and press PAUSE).

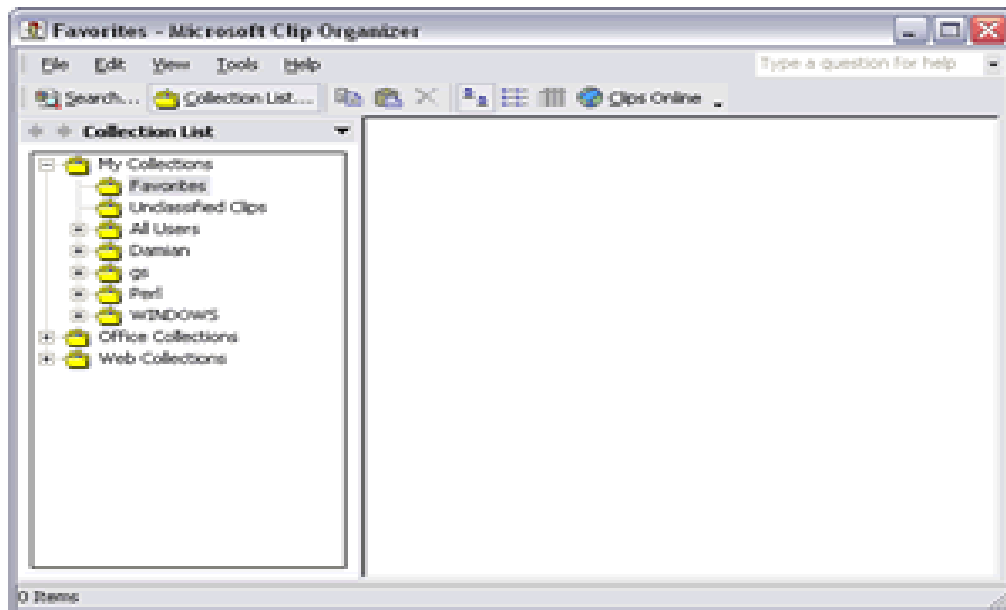


Figure 2.5.

2.5.Graphics:

Microsoft Word contains a full set of graphic tools. You can:

Create graphics from scratch.

Import graphics from other programs.

Place graphics within text.

Manipulate graphics on a page.

Word comes with some pre-designed graphics that are normally installed in the MS OFFICE\CLIP ART folder. These graphics can be resized and placed within text.

Inserting a Graphic in your Document

To insert a graphic in a document position the insert point where you want to place the graphic in the text. Select Picture from the insert menu. Click on Clip art, and double-click the graphic you want to insert.

Choose Insert, Picture, Clip Art or click the Insert Clip Art button on the Drawing toolbar.

Word opens the Clip Art Task Pane.

Search for a specific clip image by entering what you are looking for within the Search field in the Task Pane.

Alternately, click on the Clip Organizer button toward the bottom of the Task Pane to open up the Clip Art Organizer.

Select a clip and when Word shows a control palette, select the first option, Insert Clip. The clip is inserted where your insertion point is positioned.

You can also drag the clip art into your document.

Wrapping Text around a Graphic

By default text does not wrap around a graphic. To get text to wrap around a graphic, do the following:

Right click on the graphic to get the short cut menu.

Choose Format Picture from the list displayed.

Select the Layout tab.

Choose the style of wrap that you like and click OK.

Resizing a Picture

Select the inserted picture by clicking once on it.

Click the Cropping tool on the Picture toolbar.

Notice that the mouse cursor has changed.

Drag one of the corners with the pointer to reduce its size and eliminate it.

2.6. Lines and Shapes

Use the Drawing toolbar to create lines, shapes, text boxes, AutoShapes, WordArt, or Clip Art.

Drawing a Line or Arrow

Open a new Word document. Click the Drawing tool in the Standard toolbar or right click in any toolbar on your screen to display a list of available toolbars. Select the Drawing toolbar. Click a line or arrow on the Drawing toolbar. When the cross hair (+) appears, point to a spot in your document where you want the line or shape and draw a shape.

Drawing an AutoShape

Click AutoShapes on the Drawing toolbar. Select Stars and Banners from the drop down list of categories. Select the shape you want. Click in your document and drag the cross hair that appears to draw the shape.

Adding a Text Box:

Click the Text Box icon on the Drawing toolbar. When the cross hair appears, point to a spot in your document where you want the text box and drag. The box appears with an insertion point in it. Type "Microsoft Word Graphics" within the box.

2.7. WordArt :

To display the Word Art Gallery, choose Insert, Picture, WordArt or click the WordArt icon on the Drawing toolbar. Double-Click a WordArt style. Word opens the Edit WordArt dialog box. Type the text you want and it will replace the sample text. Choose a font, font size, and style. Click OK to close the WordArt Gallery and see your text.



Figure 2.7

2.2. Tables:

Creating Tables Using the Menu

A table is a grid of rows and columns on the page, like a spreadsheet. The area where a row and column intersect is called a cell. The number and width of columns can vary from row to row. Cells are separated by gridlines, which are non-printing separators. To display the table gridlines, select Gridlines from the Table menu.

Each cell can contain a paragraph, multiple paragraphs of text, or graphics. Microsoft Word wraps text within a cell in the same way that text is wrapped at the end of a line of normal text. Text within cells can be formatted, copied, cut, and pasted. You can add text, edit text, change its size, add borders, or add and delete columns and rows.

To create a table, select the Insert Table command from the Table menu. The Table Dialog box appears: enter the number of columns and rows you want to include in the table and click on the OK button. A table with the number of columns and rows that you specified is inserted in your document and the cursor is positioned in the first cell of the table. You can move from cell to cell using the <Tab> key, to move forward to the next cell and the <Shift Tab> keys to move back to the previous cell.

Creating a Table Using the Table Button in the Standard Toolbar

The Table button on the Toolbar provides another way to create a table. To use the Table button, place the mouse on the Table button and press the mouse button. The Table button selection box pops down. Drag the mouse down to select the number of rows you want and to the right to select the number of columns. When you have selected the correct number of rows and columns, release the mouse button. A table with the number of cells you have specified is inserted in your document.

Selecting Tables

Cells in a table can be selected using the click-and-drag method or one of the following techniques:

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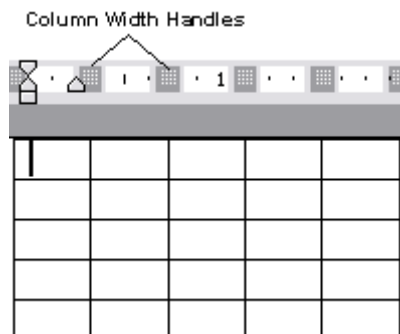
To select a cell:	Click in the lower left corner of the cell. (The mouse pointer shape becomes a right pointing arrow.)
To select a row:	Single Click in the selection bar to the left of the row.
To select a column:	Place the mouse on the top border of the column and click. (The mouse pointer becomes a black down pointing arrow.)
To select the entire table:	On a Macintosh hold down the Option button and double-click in the table. On a Windows machine Press the <Alt> key and the number 5 key on the numeric keypad . (The NumLock must be turned off.)
To select more than one cell:	Drag the mouse across the desired cell selection.

Inserting Columns and Rows

To insert a row or column within a table, select Insert Row or Column options from the Table menu and position the insertion point in the row/column you want to insert.

Changing Column Width

You can adjust the width of a column, or you can adjust the width of all the cells in a column. To change the column width, click on the column width button. Drag the button to the left or right according to your needs. To change the width of all the columns select the entire table and drag the column width button you wish to change.



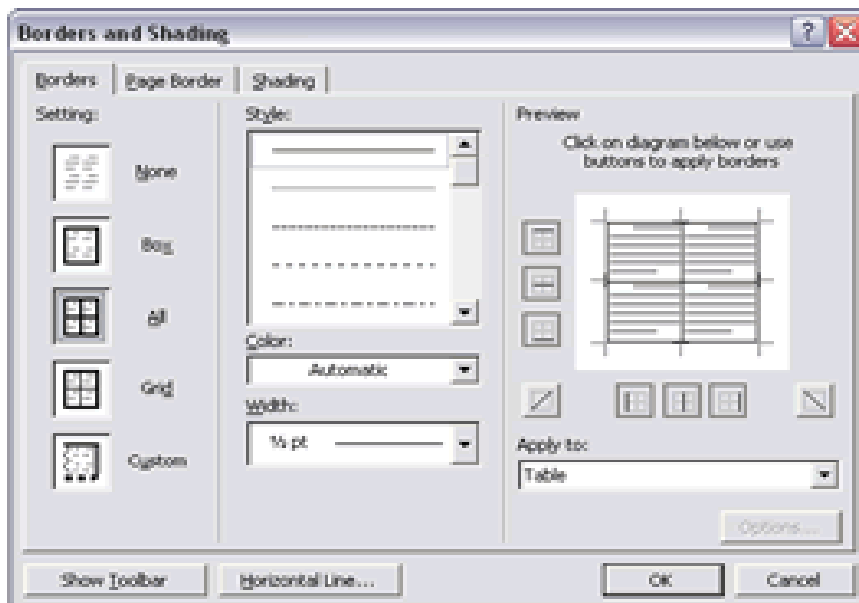
Click and drag the first column width button to the 1.5-inch mark. Click on the Next Column width button to the 3-inch mark. The mouse can also be used to change column widths. To select the column that you want to change, place the mouse pointer on the right border of the column. As you move the mouse pointer on top of the column border the pointer becomes a two-headed arrow (see example). When the mouse pointer is displayed as the two-headed arrow, press the mouse button and drag to reposition the column width. As you drag the mouse, an outline of the new border shows the border position. When you have resized the column to a satisfactory width, release the mouse button. The entire column is resized accordingly.

Deleting Columns and Rows

To delete a column or row, select the column or row you want to delete then select Delete column or row from the Table menu. Notice that if you select a column, the command is Delete Columns. If you select a row, the command is Delete Rows.

2.2. Borders and Shading:

You can add a border to any or all sides of each page in a document, to pages in a section, to the first page only, or to all pages except the first. You can add page borders in many line styles and colors, as well as a variety of graphical borders.



2.10. Footnote and Endnote:

Footnotes and Endnotes are used in printed documents to explain, comment on, or provide references for text in a document. You can include both Footnotes and Endnotes in the same document — for example, you might use Footnotes for detailed comments and Endnotes for citation of sources. Footnotes appear at the end of each page in a document. Endnotes typically appear at the end of a document.

1. In print layout view, click where you want to insert the note reference mark.
2. On the **Insert** menu, click **Footnote**.
3. Click **Footnote** or **Endnote**.
4. Under **Numbering**, click the option you want.
5. Click **OK**.

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Word inserts the note number and places the insertion point next to the note number.

6. Type the note text.
7. Scroll to your place in the document.

2.11. Tabs:

By using tab key on the keyboard we can move the cursor by a fixed distance in the document. By default, every tab press, the cursor moves half-inch. But we can create our own tab positions. For creating customized tab positions first we have to select the tab alignment button at the left hand side corner of the ruler line. Tabs can also be created, by using the tab dialog box. Select Format menu from the menu bar and click tabs option. Then we get Tabs dialog box. Here we select the type of the tab and distance and click OK. button. Then the tabs will be set accordingly. Here by using tab dialog box we can also create one more tab i.e., bar tab. By this we can create a vertical line in the text at the specified bar tab position.

2.12. Mail Merge:

Mail Merge is used to quickly create form letters, mailing labels, envelopes and catalogs by merging the information from two different files. Those two files are generally the Main Document and Data Source File. After creating those two files, they are merged to get the desired result. Generally mail merge is used to print multiple copies of a particular letter addressed to many members. For example Circulars, Greetings & Invitations will come under mail merging.

Main Document

The main document contains the subject matter of the letter to be printed. It can contain text, graphics objects and fields (data), which are to be inserted in to the letter. When merging, data will be merged with the main document.

Data Source

Data Source file contains the information in the form of records, which is to be inserted to the main document. In one record, one member's information is stored – for example one person's address. The individual information in the records is called a field. Actually the data written in these fields will be inserted in the main document during merge.

Merge requires 3 steps

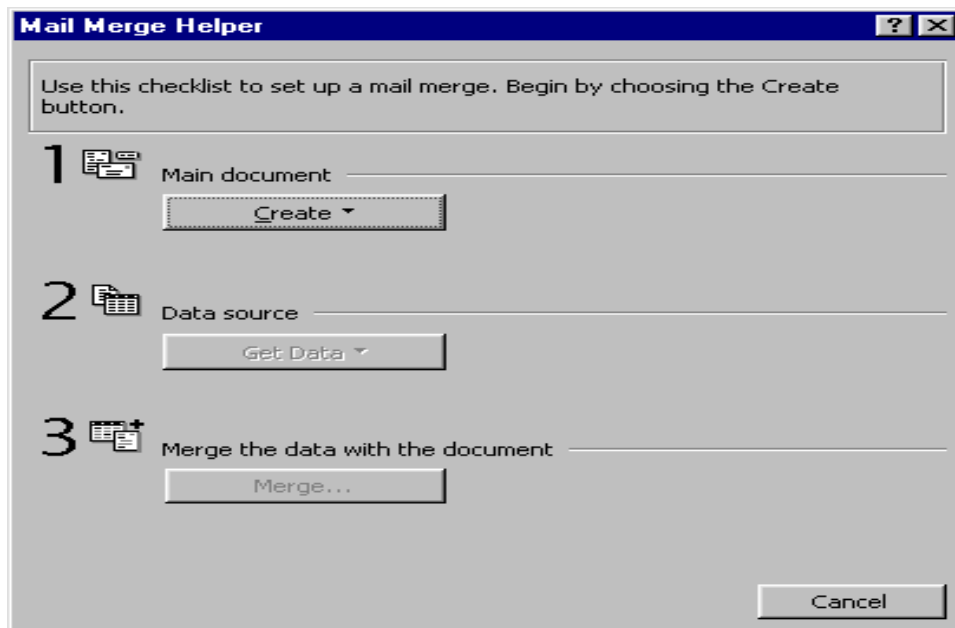
Creating Main Document

Creating Data Source

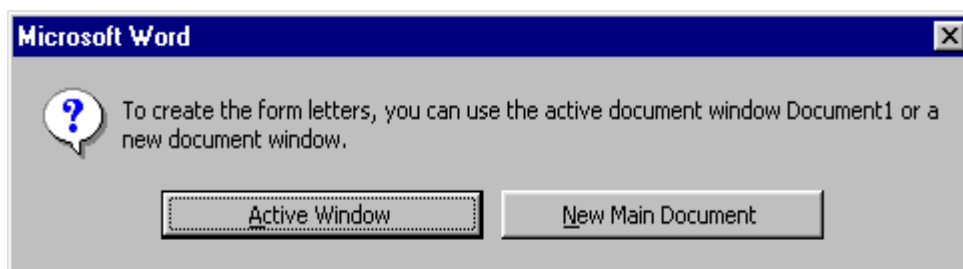
Merging two files.

Creating Main Document

First, Open a new document to create a main document by selecting File→New. Then select Tools→Mail Merge. The following dialog box will be displayed on screen:



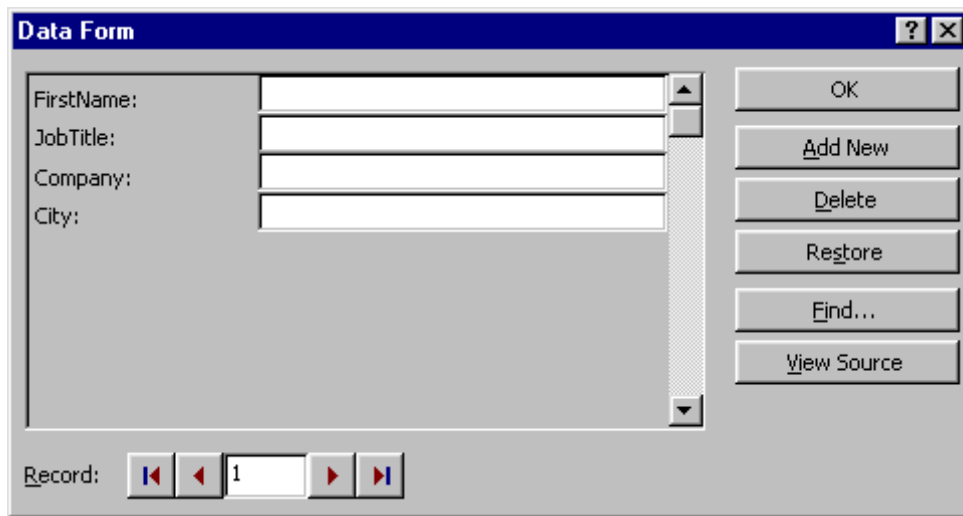
Click on the "Create" button to display the available formats (form letter, mailing labels, envelopes or catalog) of the main document. Then a dialog will be displayed prompting where to create the main document (whether the active window or a new document). Click on "active window" to create the main document in the active window.



Creating Data Source

To create a data source file click on Get Data in Data Source. The following will be displayed. Click on Create Data Source to specify the fields to be included in the address, like name, place etc.,

The existing field names will be displayed on the screen to the right. Unwanted fields can be removed by clicking on the field name and by clicking on the field name and by clicking on the button "remove field name". If any new fields are to be added, type the field name on the left side. After specifying the field names, to type the contents, click on ok. A dialog box will be displayed to specify a name for the data source. Type the name and click on "Save". A dialog box is displayed asking to edit the data source or edit the master document. The following diagram specifies the same:



Type the details by pressing enter after typing the first name, job title etc., for this, click on “Add new”. After typing all the details click on OK. Add contents to the document. Insert the merge fields in the window document. Finally select tools→mail merge. Merge dialog box will again get displayed, click on “Merge”.

2.13. Format Painter:

The **Format Painter** is a button on the Standard toolbar. It makes it easy to copy all the formatting features of one paragraph to one or more paragraphs.

To copy the paragraph formatting using the Format Painter you will:

1. Highlight the paragraph whose format you want to copy.
2. Now click the Format Painter button on the Standard toolbar.
 - If you press the button once, you will be allowed to copy the format to only one paragraph.
 - If you double-click the button, the button will stay depressed and allow you to copy the format to as many paragraphs as you want. When you are finished you must then click the Format Button once in order to turn off the feature.
3. Notice that your insertion point now has a Paint Brush attached to it. This indicates that the format of the selected paragraph may be painted or copied onto another paragraph.
4. Place your insertion point anywhere within the paragraph that is to receive the format and click the left mouse button. At this point the format of this paragraph will change.

2.14. Summary:

In this lesson we discussed the procedure of inserting a table in the document. You can insert a table of required number of rows and columns. In this lesson you have learnt the concept of mail merge and its usefulness. The mail merge feature supports many word processors that

enable you to generate form letters. The mail merge feature of Ms-Word requires mainly two components: the main document and the data file. The main document is the body of the letter that has to be sent. The data file contains the list of names and addresses in the form of rows. You have learnt the procedures of creating the main document and the data file, and combining them.

You have observed how to use spell checker, the macro capability, and working with the graphics like ClipArt, WordArt, Format Painter, Footnote and Endnote features.

2.15. Technical Terms:

ClipArt

ClipArt consists of pre-designed images that can be placed within a document.

Data Form

A data form is a dialog box that allows you to view and edit individual records in a database.

Data Source

A data source contains the information from which a merged document is created. The data source is merged with a main document, which specifies the kind of output required.

Database

A database is a collection of organized information.

Dictionary

Word uses two kinds of dictionaries, a main dictionary and a custom dictionary. The main dictionary cannot be altered; we can add words to the custom dictionary.

Mail Merge

Mail Merge refers to the process of combining a data source, and a main document to produce a unique output.

Wizard

A wizard is a feature of Microsoft applications that lets you work through a series of dialog boxes to help you complete a task.

2.16. Model Questions:

1. What is a macro? Explain the procedure for creating a macro?
2. How do you perform mail merge?
3. Explain the difference between Footnote and Endnote?
4. Explain the procedure to create a table?
5. Explain different views in Ms Word ?

6. Explain the graphic facilities in MS-Word ?

2.17.Refereneces:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' **BPB Publications, New Delhi**

MS OFFICE 2000 Complete, BPB Publications, New Delhi

UNIT- II**Microsoft PowerPoint****2.0 Objective:**

This lesson introduces the basic features of Microsoft PowerPoint, Creating Presentations, View options, Inserting new slides and setting background color scheme to the presentation.

Structure of the Lesson:

- 2.1 PowerPoint basics**
- 2.2 Starting a presentation**
- 2.3 PowerPoint window properties**
- 2.4 Save a PowerPoint presentation**
- 2.5. Copy and Move data in a PowerPoint presentation**
- 2.6. View options**
- 2.7 Add a slide**
- 2.2 Add/Modify text**
- 2.9 Bullet styles**
- 2.10 Speaker notes**
- 2.11 Background/Color scheme**
- 2.12 Slide master**
- 2.13 Headers/Footers**
- 2.14 Summary**
- 2.14 Technical Terms**
- 2.15 Model Questions**
- 2.16 References**

2.1. PowerPoint Basics:

PowerPoint is an application that lets you build, print, and deliver presentations. You have several options for the delivery of a presentation, but you only have to develop it once. You can print slides, print handouts, print notes pages, prepare for 35mm slides, or deliver an on-screen presentation. Only the on-screen presentation allows you to use the full range of PowerPoint's features.

As you develop a PowerPoint presentation, it is important to remember that you should not try to include every piece of information you wish to deliver. PowerPoint slides should contain brief, concise, descriptive phrases that will help you remember what you want to present and to serve as a reminder for your audience.

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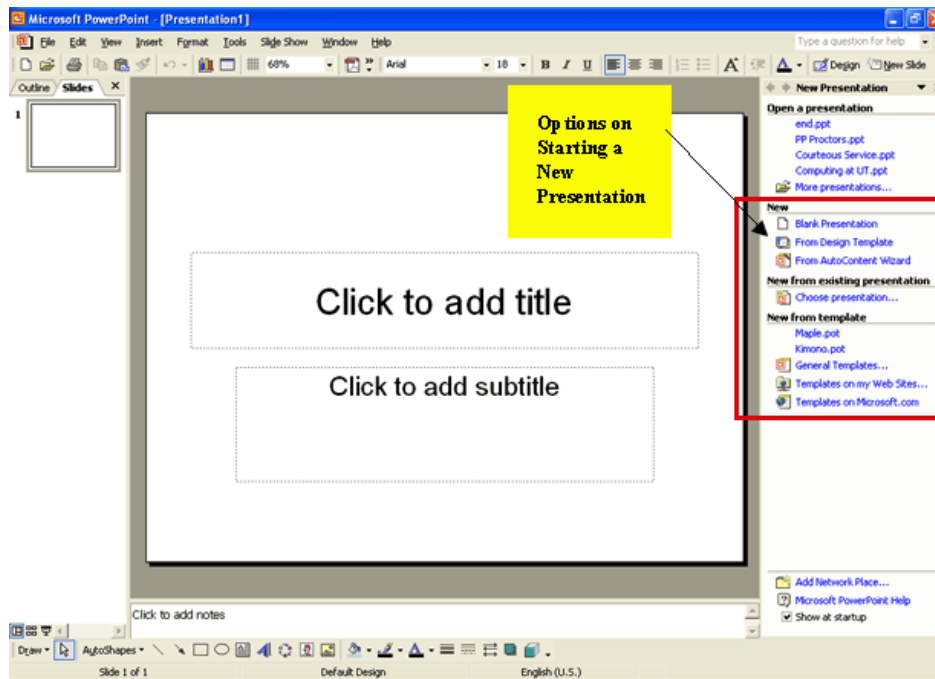
2.2. Starting A Presentation:

Start PowerPoint by either of two methods:

1. Go to the Start menu. Choose Programs and then click on Microsoft PowerPoint.
2. Double-click the icon of any PowerPoint document. When you double-click a PowerPoint document, PowerPoint opens with the document already loaded.

A PowerPoint presentation consists of slides that can contain text, graphics, charts, and other data types. When you start PowerPoint, you can start with a blank presentation, or you can begin from a template or use the AutoContent Wizard.

The AutoContent Wizard is series of step-by-step instructions designed to assist you. The Template button to help accesses slide templates create a consistent, professional look for your slide presentation.



New Presentation Dialog Box

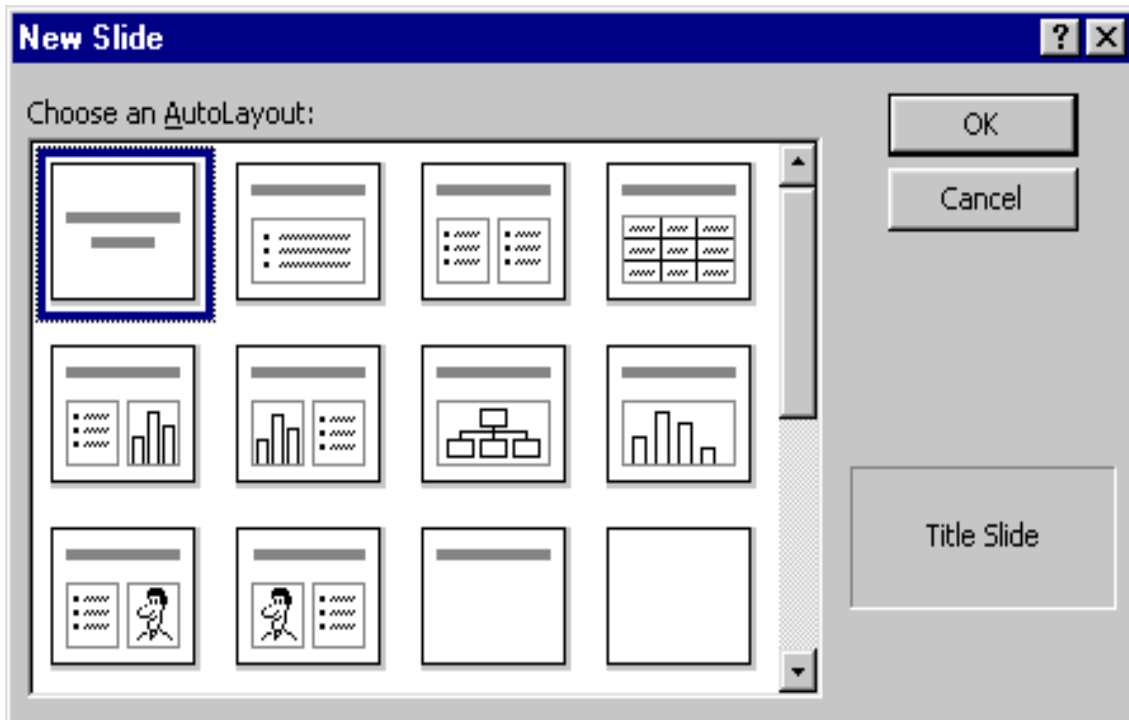
AutoContent Wizard walks you through a series of questions designed to elicit information about you and the type of presentation you are making. The Wizard then builds a dummy presentation that will guide you in developing the content of the presentation.

Design Template allows you to establish the background and color scheme from the available templates prior to beginning work in the new presentation. Template choices are generally easier to make after you have opened the new presentation because you can better see the characteristics of each template before making a selection.

Blank presentation opens a new presentation with no template. Open an existing presentation displays a list of recently opened PowerPoint presentations from which you can choose. Or, you may choose More Files to move to the location of a previously saved presentation file and open it.

AutoLayout

After you have opened a new presentation, PowerPoint displays the New Slide dialog box containing several Auto Layouts. Auto Layouts provide a pre-determined layout for each specific type of slide. They provide consistency throughout the presentation. Each layout depicted is described in the lower right corner when you click the layout. This sample New Slide dialog box shows the Title Slide selected (denoted with the thick border).



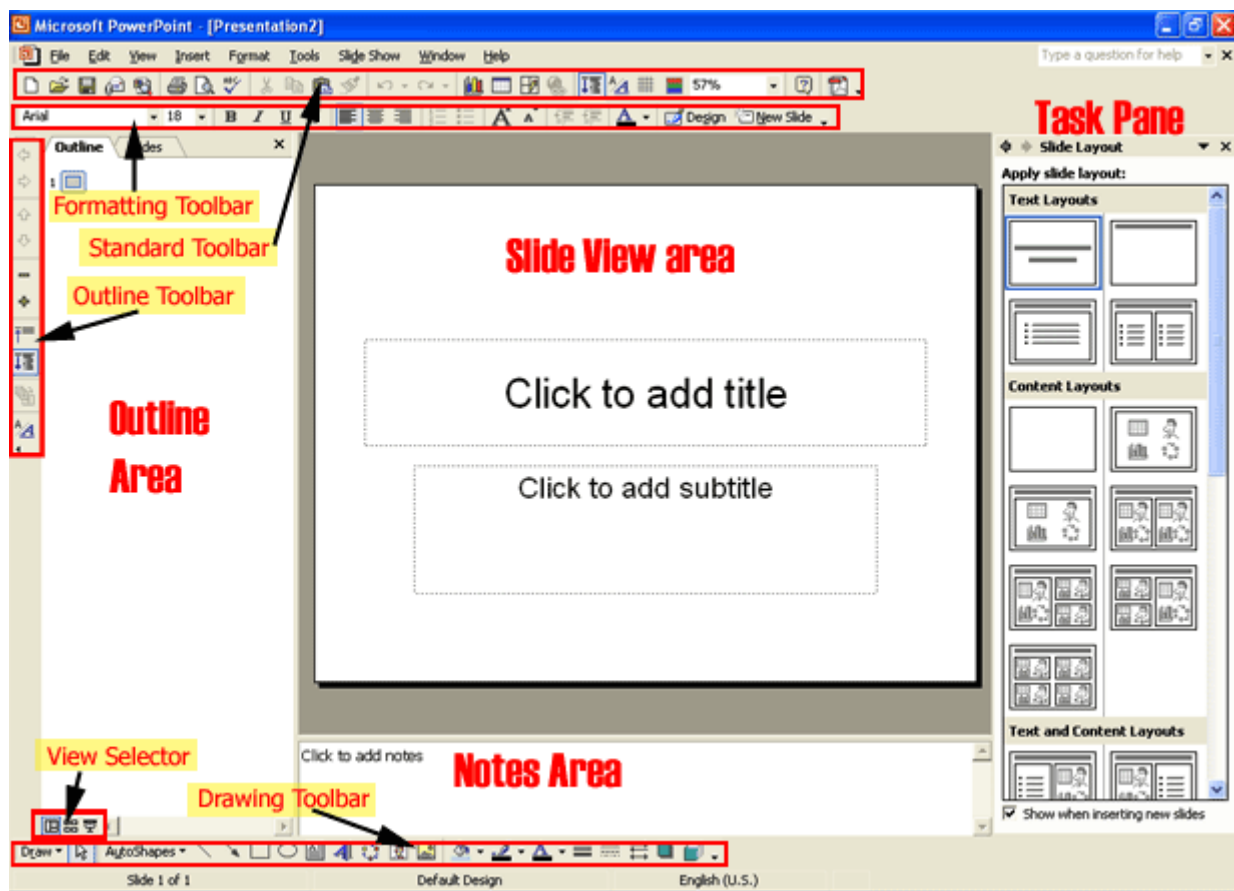
New Slide Layout Dialog Box

2.3. PowerPoint Window Properties:

The Microsoft PowerPoint window has many of the same attributes as other windows in the Microsoft Office Suite. The table below lists the different features and provides a brief description of each one.

Besides the usual window components, the PowerPoint window has several unique elements, identified in the figure below.

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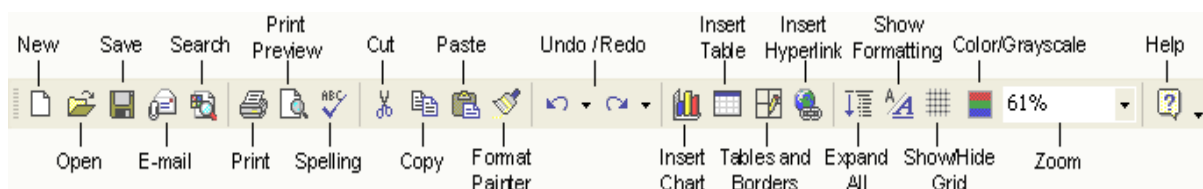


Menu Bar

The words listed at the top of the application window, immediately underneath the Title bar. You can access all application commands from the Menu bar

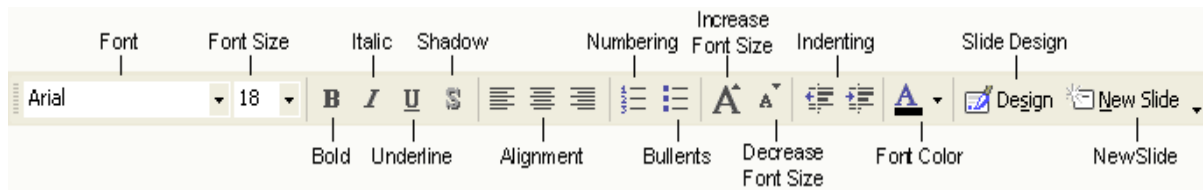
Standard Toolbar

The Standard toolbar, located beneath the menu bar, has buttons for commonly performed tasks like printing, saving, inserting clip art, and other operations. You can customize the toolbar or even display multiple toolbars at the same time.



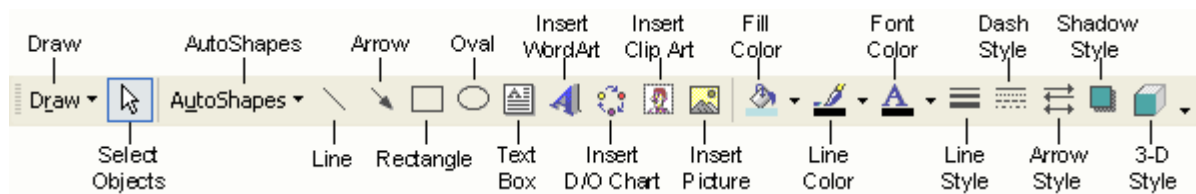
Formatting toolbar

The Formatting toolbar, located beneath the Standard toolbar bar, or possible to the side of it, has buttons for various formatting operations like changing text size or style, changing alignment, formatting bullets, and animation



Drawing Toolbar

The Drawing toolbar on the bottom of the PowerPoint window contains drawing and text tools for creating graphics.



Slide Layout Task Pane

The area on the left side of the window that allow you to easily switch between the **Outline** and the **Slides** views.

Slide Area

The area in the middle, in which you actually work on your presentation slides

Task Pane

The area on the right side of the window that allows you to easily access various commands. You can display different Task Pane options by clicking on the dropdown arrow in the upper right-hand corner of the pane.

2.4. Save a PowerPoint Presentation:

Changes you make to a document are not saved to disk until you issue a Save command. Saving is quick and easy, and you should save often to minimize the loss of your work. PowerPoint has two save commands, Save and Save As, that work similarly. Both commands are on the File menu.

Save

When you save a new presentation for the first time, PowerPoint displays a dialog box similar to the Open dialog box. Select the disk in which to save the presentation and specify a name for the file. When you save an existing document that you have been editing, the newly saved version replaces the older version.

Save As

This command displays a dialog box where you can choose a document name and destination folder or disk. Use the Save As command whenever you want to save a copy of the current document with a different name or in a different folder or disk. The newly saved copy becomes the active document

A presentation is normally saved as name.ppt file type. However, PowerPoint Show with the extension of name.ppt is also a useful file type so that your file is able to run regardless of operating system.

2.5. Copy and Move data in a PowerPoint Presentation:

Use the Copy and Paste commands to copy selected text and graphics from one slide to another. If you want to move data instead, use the Cut and Paste commands. To do this:

- Select the text you want to cut or copy by highlighting it.
- Go to the Standard Toolbar to choose the Cut or Copy short cut icon.
- Move and click your mouse to the place where you want the text to go. Note the cursor is blinking.
- Go to the Standard Toolbar to choose the Paste short cut icon.

2.6. View Options:

Power point offers different views for entering, editing and previewing your information. They are:

- Slide view
- Outline view
- Slide Sorter view
- Notes Pages view
- Slide show view

Slide View

Slide view shows how our listed slides will work. We can move from one slide to another with **pg up** and **pg dn** keys. We can edit text and other slide elements in slide view.

Outline view

It will display all the text in the presentation. Here we can easily rearrange line item. We collapse items in this view so that we can see important headings or names of each slide.

Enter and Edit Text in Outline View:

PowerPoint's Outline Area lets you focus on the content of your presentation, by typing up the outline prior to laying the presentation out. After you type an outline, you can concentrate on how your presentation looks

The boundary of the Outline Area can be resized by dragging the vertical separation to the right. This will make it easier to enter your outline.

Entering Slide Titles and Bullets:

Typing in PowerPoint's Outline view is similar to using a word processor. Type your slide title or bullet point and press Return to start a new slide or bullet. To force a line break within a slide title or bullet, press Shift-Enter. This starts a new line for the same title or bullet.

Move Slides in the Outline Area:

It's easy to change the order of your slides and bullets in the Outline Area. Press the mouse button on the item you want to move and drag it to the desired location. You can also select the item you want to move and click on the Move Up or Move Down buttons.

Delete Slides or Bullets:

While working in the Outline Area, you can delete a slide by clicking on the slide icon next to the title and pressing the Delete key. Delete bullets and sub bullets similarly.

Slide Sorter view

It will show the slides in reduced size. We drop the sliders to move the slides so that we can change the order of slides. We can make the slides appear and disappear using the effects.

Notes Page View

It is to create and see notes to the presenter. It shows miniature slide image and provides a text area for presenters notes.

To enter notes

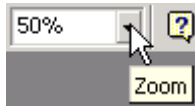
1. Click on the text area shown below this line. The box outline will change appearance.
2. Type and edit in the note box.

Slide show view

It will show the slides in reduced size. We drop the slides to move the slides so that we can change the order of slides. We can make the slides appear and disappear using the effects.

When you right click on the slide it will show some options. In that we can opt 'Pen' to draw the temporary lines. These lines will not be saved on the slides. To leave from the slide show press Esc.



Zoom



The **Zoom** adjuster lets you alter how large your slides appear on the screen relative to full-screen presentation mode. Click on the **Zoom** drop-down list (in the toolbar near the top of the screen), or click on the **View** menu, and select **Zoom...** Select "fit", a default percentage, or type in your own number, according to your needs.

2.7. Add a Slide:

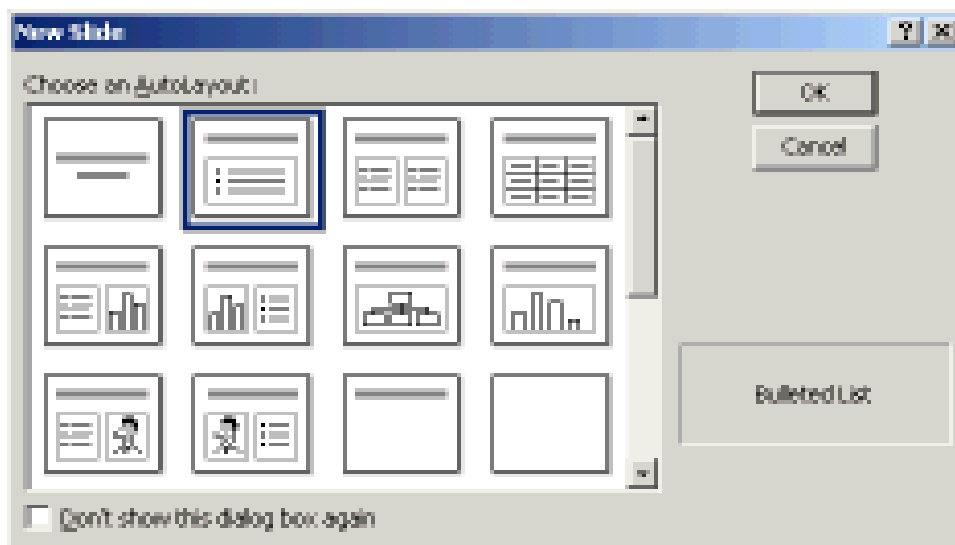
In the **Text Outline** area, you can add a slide *before* or *after* an existing slide.

- To add *before* a slide position the cursor at the beginning of text of the slide in front of which you would like a new slide, and press the **Enter** key.
- To add *after* a slide, position the cursor at the end of the text of the slide after which you would like a new slide, and press the **Enter** key (if you had indented levels of text on the previous slide, use the **Promote** (left arrow) button in the toolbar at the top of the screen to move the text back to the left to force a new slide.  

In **Normal**, **Outline**, **Slide**, or **Slide Sorter** view, select the slide *after* which you wish to insert a new slide.


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- Then click on the **Insert** menu, and select **New Slide**.
- When you add a new slide this way, the **New Slide** window appears, asking you to select a slide layout.
- Select whichever layout is appropriate for the content you will place on the new slide. The one selected in the example on the right is "Bulleted List". If the provided layouts don't meet your needs, select the bottom-right layout, "Blank", which will provide you with a new empty slide. However, no matter which layout you choose, you will be able to modify it later.



2.8. Add/Modify Text:

Here are a few ways to insert or modify text in PowerPoint:

- In **Normal** or **Slide** view, select the slide on which you wish to insert text. If there is already a text box on the slide you may click your mouse on it and start typing. Familiar word processing tools for modifying text (color, style, font, alignment, etc.) are provided.
 - In **Normal** or **Slide** view, to add a new text box to a slide, click on the **Insert** menu, and select **Text Box**. Put your mouse over the slide layout - the cursor will change to a narrow down-arrow (as shown on the left below). Click, hold, drag, and release the mouse to form a rectangle on the slide. Then you can type into the text box created for you (as shown below).
- 

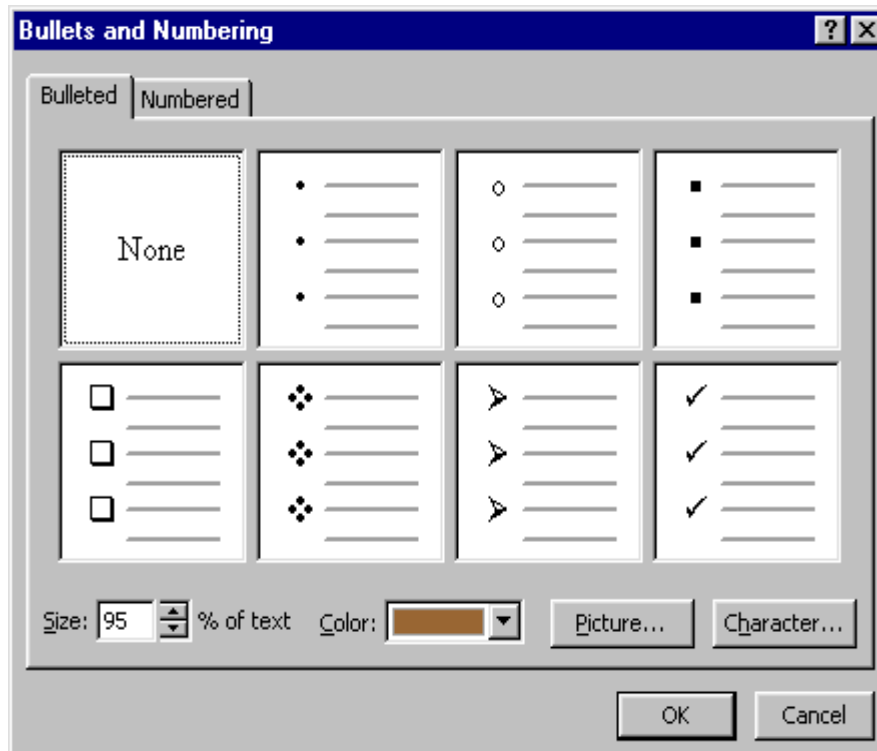
(as shown below).
- To work directly in the **Text Outline** area, position the cursor at the point where you would like the new text to appear and just type it in. Use the **Promote / Demote** buttons in the toolbar at the top of the screen to create different levels of indentation. 

2.2. Bullet Styles:

Although you can set Bullet Styles in the Master, you also can change the bullet style on any slide or on any bulleted point. When you change the bullet style, every subsequent bullet on that slide, whether promoted or demoted, will have that style until you change back to the default or change to a different slide.

To change the bullet style, make sure the cursor is in the line of text in which you wish to change the bullet, then choose FORMAT: Bullet.

NOTE: Sometimes it is difficult to remember exactly what the default bullet style was, so pay close attention to the selected bullet before proceeding with any changes.




Format Bullet Dialog Box

You can choose from the selections provided by PowerPoint, choosing both the size (in percentage of text size) and the color.

Click Character to include any symbol font installed on your system. Keep in mind, however, that if you choose a font that is not installed on the computer from which you are giving your presentation, the presentation computer will choose the "closest" font to the one you chose and the result may not be one you like. Both Symbol and Wingdings font are standard on most computers and should display as you intended.

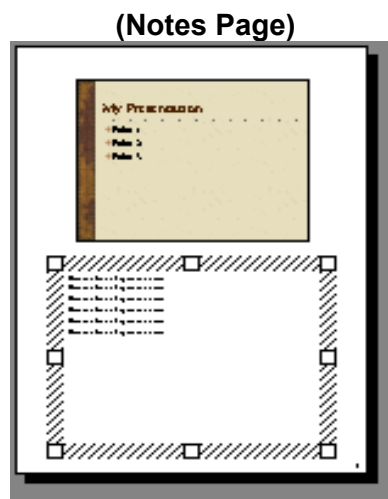
Adding / Removing Bullets

 The Bullet Tool is a toggle. Click it once to place a bullet at the beginning of the current line of text (the one in which the cursor is flashing). Click it again to remove the bullet. This way you can add bullets to text you have typed without using the Bullet AutoLayout.

2.10. Speaker Notes:

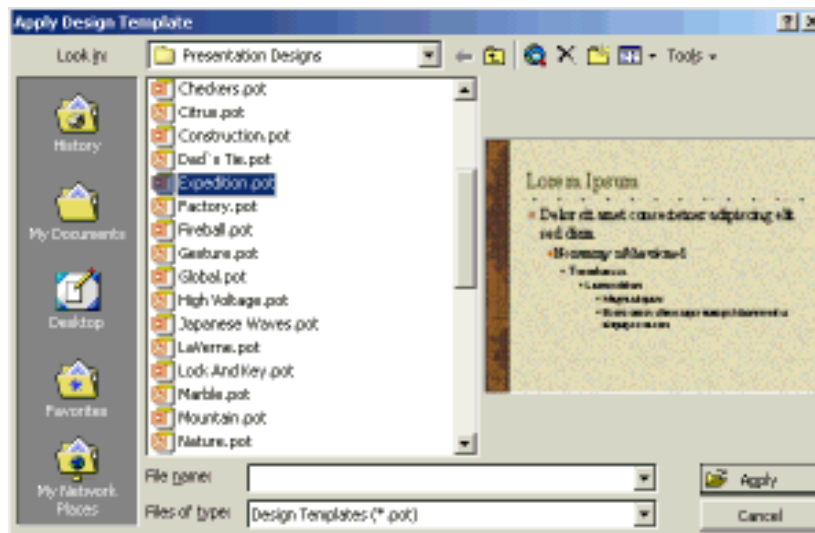
PowerPoint has a facility for adding speaker notes to a presentation. These can be notes that you create for yourself — for example, to help you remember key points during a presentation — or you can create them as additional information for your audience. After you have completed a presentation, you can print the notes for each slide, along with a smaller version of the slide. To add notes to a slide:

- Click on the **View** menu, and select **Notes Page** (you may want to adjust the **Zoom** percentage to get a larger view).

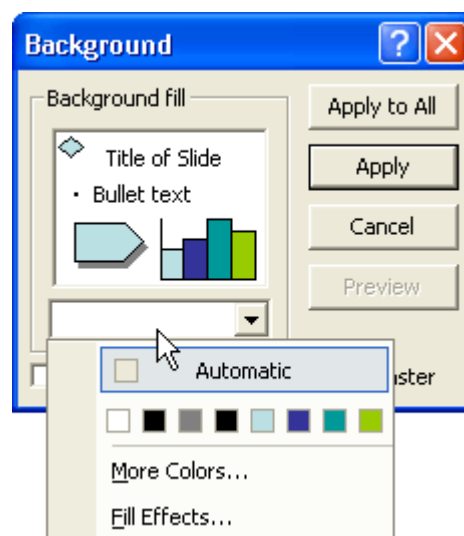


2.11. Background / Color Scheme:

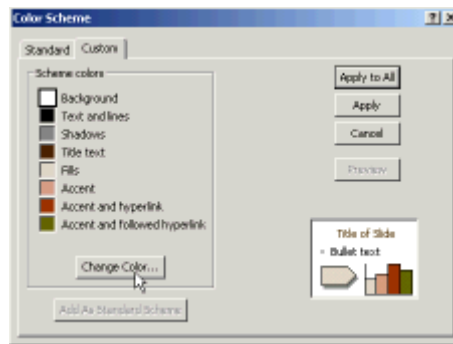
Design templates contain color schemes, slide and title masters with custom formatting, and styled fonts, all designed to create a particular look. Not only can you specify a design template when you begin a new presentation, you can choose a design template (for the whole presentation, not individual slides) any time while editing a presentation. To do this, click on the **Format** menu, and select **Apply Design Template**. A window will open asking you to choose a design. Select one and click **Apply**. The name of the template chosen will be displayed in the center of the status bar at the bottom of the PowerPoint screen. If the status bar is not visible, click on the **Tools** menu, select **Options**, click on the **View** tab, and ensure that **Status bar** is checked.



The *background color of slides* can be customized by clicking on the **Format** menu / **Background**. Click on the drop-down list to select either another color from the subset provided or click on **More Colors** and **Fill Effects** to see other choices. One of the **Fill Effects** available is **Picture** (import an external image file to use as a slide background). When you are done, click on **Apply** (if you wish to alter just the current slide) or **Apply to All** (to alter all slides at once).



The *color scheme for slides* can be customized by clicking on **Format / Slide Color Scheme**. Either chooses a preset scheme from the **Standard** tab or click the **Custom** tab, click on the desired component (e.g. Background), and click **Change Color** (a color selection window will appear). When you are done making color choices, click on **Apply** (if you wish to alter just the current slide) or **Apply to All** (to alter all slides at once).



2.12. Slide Master

The Slide Master in a template is a slide that controls the formatting, text, and objects that appear on every slide in your presentation. For example, if you want a small picture of the world to appear on every slide, place that picture on the Slide Master. To display the Slide Master, choose Master/Slide Master from the View menu. You can then edit this slide. Changes you make to the Slide Master also appear on each slide in your presentation.

It is easy to edit the text of a slide in the Outline Area. However, to modify a slide's appearance, switch to Slide View. If you want your changes to apply to every slide in the presentation, choose Master/Slide Master from the View menu.

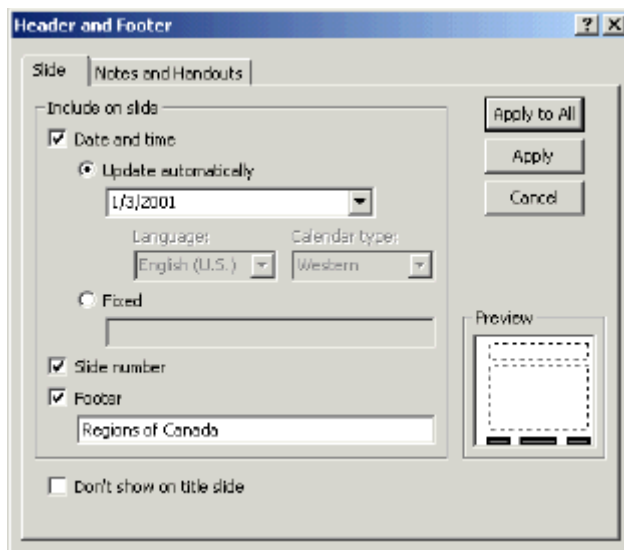
In Slide View just click on an object to select it. Then use the Format menu to apply the change you want. For example, to change the font or color of the slide title, select the slide title and choose Font from the Format menu. The Format menu also has commands for centering or left aligning text (Alignment), and changing colors (Colors and Lines). You can even change the format of slide bullets using the Bullets command on the Format menu. PowerPoint also has a Formatting toolbar to simplify basic formatting tasks.



Sample Slide Master

2.13. Headers / Footers:

- On the **View** menu, click **Header and Footer**.
- On the **Slide** tab, you set options, the effect of the options selected will appear at the bottom of slides:
 - **Date and time** can be set to **Update automatically** (to reflect the last date the slides were modified) or **Fixed** (type a certain date such as when the presentation will be given).
 - Selecting the **Slide number** option will automatically insert a sequence number.
 - Selecting **Footer** (and typing text in the box below it) inserts fixed footer text.
 - Selecting **Don't show on title slide** will omit the footer from the title slide (but it will appear on the other slides).
 - Normally you click on the **Apply to All** button to make these changes throughout the presentation, but of course you can click **Apply** to affect just the current slide.
- Similar options are available on the **Notes and Handouts** tab, plus the option of adding a page header to your printouts.



2.14. Summary:

At the end of this lesson you have learnt the important features of Ms-PowerPoint including creating a presentation, opening an existing presentation and working with different kinds of slide layouts. We identified different toolbars available in PowerPoint.

You are in a position to format the text, applying background color to the presentation, working with master slide, applying speaker notes to slide, applying header and footer to the document.

2.14. Technical Terms:

Slide: Brief, concise, descriptive phrases that will help you remember what you want to present and to serve as a reminder for your audience.

PowerPoint Presentation: PowerPoint presentation consists of slides that can contain text, graphics, charts, and other data types.

Slide Master: The Slide Master in a template is a slide that controls the formatting, text, and objects that appear on every slide in your presentation.

Speaker Notes: Speaker notes can be notes that you create for yourself, key points during a presentation, additional information for your audience.

2.15. Model Questions:

1. What are the features of PowerPoint?
2. What is a Slide? Explain the procedure to create a Slide?
3. What is Slide Master? Write the procedure to create Slide Master?
4. Explain the procedure to create Header and Footer in PowerPoint?
5. Explain the views available in PowerPoint?

2.16. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, 'The ABC'S Of Microsoft Office.' BPB Publications, New Delhi

MS OFFICE 2000 Complete, BPB Publications, New Delhi

UNIT - II**Microsoft PowerPoint****2.0 Objective:**

This lesson introduces the Drawing Objects, Images and ClipArt, Audio and Video, Slide Transition, Rehearse Timings and Charts.

Structure of the Lesson:

- 2.1 Working with Text**
- 2.2. Drawing Objects**
- 2.3 Images and Clip Art**
- 2.4 Audio and Video**
- 2.5 Creating Hyperlinks**
- 2.6 Animating the presentations**
- 2.7 Slide Miniature**
- 2.8 Slide Transition**
- 2.9 Slide Show Animation**
- 2.10 Rehearse Timings**
- 2.11 Slide Setup and Printing**
- 2.12 Charts**

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2.1. Working with Text:

Any time you wish to make formatting changes to text, you must highlight the text to be changed. Making a selection from the Text Toolbar affects the highlighted text only. In addition to the standard text formatting tools of font choice and size, bold, italics, and underline, you also can align text left, center, or right. Other special tools are described below.

Shadowed Text


The Shadow Text Tool places a slight shadow behind the text. Although the effect is not prominent, this is an excellent tool to use to give more definition to title text. You should NOT shadow all body text since this makes it very "muddy" to read.

Hollingsworth
shadowed

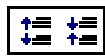
Hollingsworth
not shadowed

Sample Shadowed Text

To shadow text,

1. Type the text to be shadowed.
2. Highlight the text.
3.  Click the Shadow Tool.

Increase / Decrease Paragraph Spacing



The Increase and Decrease Paragraph Spacing Tools expand and contract paragraph spacing, respectively.

Format Painter



The Format Painter Tool picks up any formatting applied to existing text and applies that same formatting to any text it is "painted" over. The two pieces of text need not be on the same slide.

To use the Format Painter,

1. Highlight the text containing the formatting you desire to "pick up".

2. Click the Format Painter Tool.

3. Press and drag over the text as you would to highlight it. The formatting will be applied.

After the formatting is applied the Format Painter will de-select.

To apply formatting to multiple selections of text without needing to click the Format Painter between each application, double click the Format Painter. The Painter will remain the selected tool until you click it to de-select, allowing you to press and drag over multiple sections of text, applying the same format to each.

Increase/Decrease Font Size



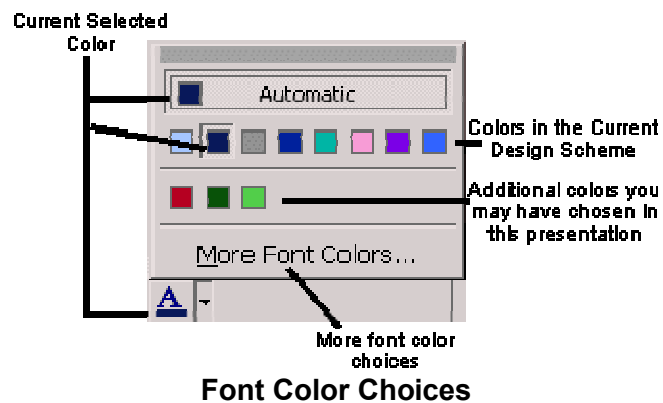
You can increase or decrease the font size of highlighted text by clicking on the Increase Font Size or Decrease Font Size Tool, respectively. Size increments and decrements by the standard font sizes.

Text Colors



You choose text colors with the Font Color Tool located in the Drawing Toolbar. Highlighted text will change to the color displayed in the band beneath the A.

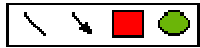
To make additional color choices or to see additional non-scheme colors you have used in this presentation, click the drop-down arrow beside the A.



Word Wrap

Whether text is in a Placeholder or a textbox, you can narrow or widen the width of the box by dragging the box border. This affects where the text wraps. Make sure the cursor looks like a two-headed arrow to affect the Placeholder width; a four-headed arrow will move the placeholder.

2.2. Drawing Objects:

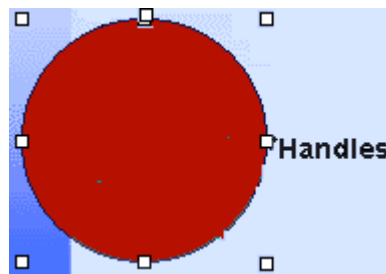
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To draw a line, an arrow, a square, or a circle, select the appropriate tool from the Drawing Toolbar. When you move the cursor over the slide, it will be a crosshair. Press and drag the cursor to insert the object. The larger an area you drag, the larger the object will become.

TIP: To draw a straight line or arrow, or a perfect square or circle, hold SHIFT as you press and drag.

Selecting

To alter any PowerPoint object, you first must select the object. When you click the object, you will see Handles around the perimeter of the object. This lets you know exactly which object you will be affecting.



Sample Handles

Deleting

To delete an object, click to select it, then press DELETE.

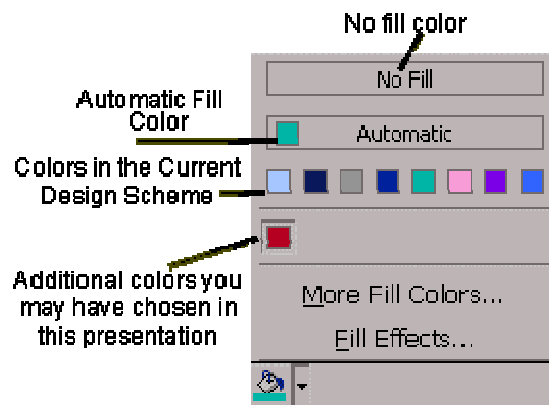
Fill Colors

When you draw solid objects (squares and circles), they fill with the automatic color. The underline under the Paintbucket is the current fill color.



To fill an object with the current fill color, select the object, then click the Paintbucket Tool.

To change the current fill color, drop down the arrow beside the Paintbucket and make a new selection. There are also additional options under Fill Effects, including choosing no fill color at all.

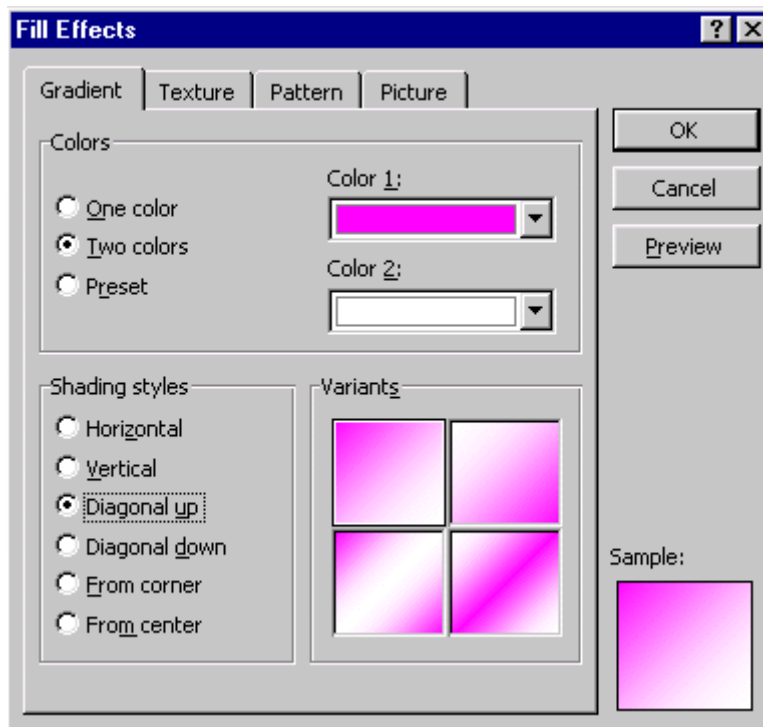


Alternate Choices for Fill Colors

Fill Effects

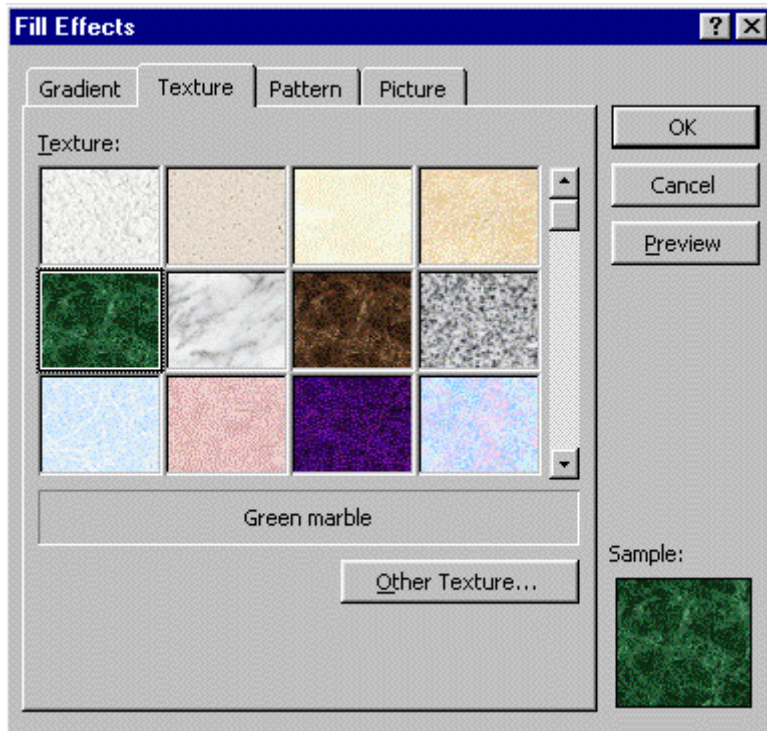
Fill effects include Gradients where you can select one or two colors of your choice, as well as the direction and variants of the gradient. Textures are image files similar to web page wallpapers; you can use PowerPoint's selections or choose an image file from your workstation. Patterns allow you to choose two colors and the pattern design with which you want to fill the object. Picture allows you to choose an image file from your workstation; the photograph will center itself within the selected object, hiding any parts of the image, which do not automatically show within the object's shape.

Gradients

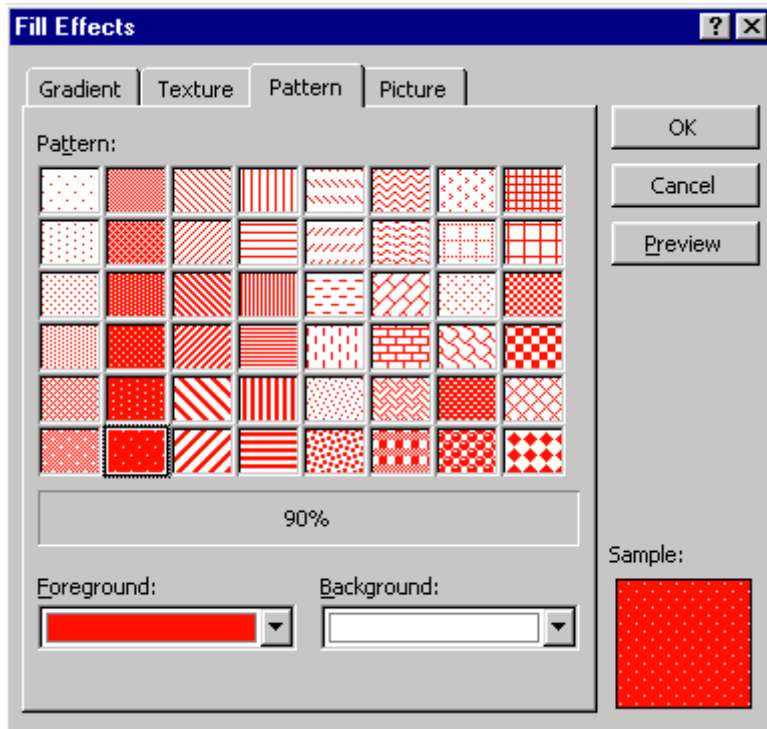


Textures

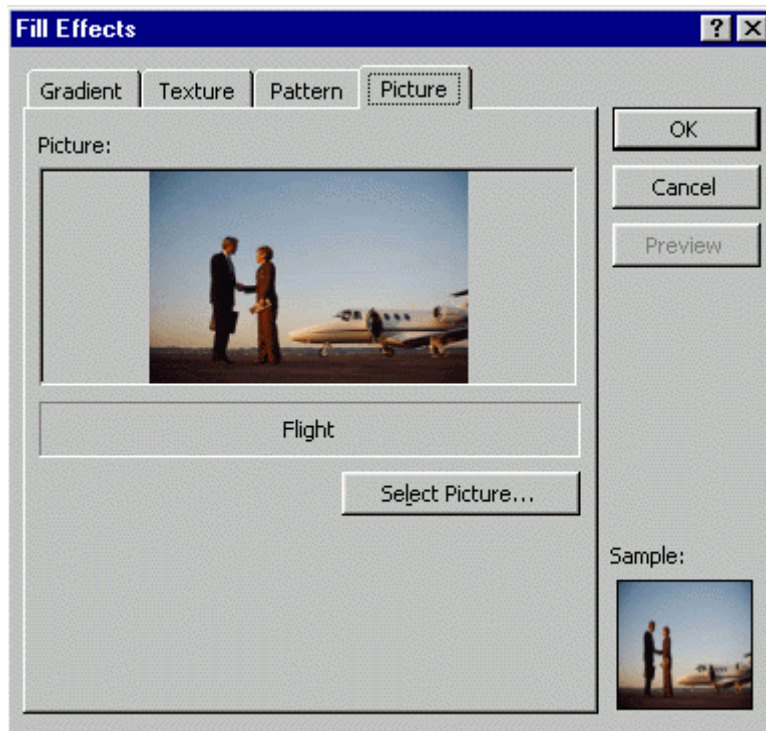
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Patterns



Photos

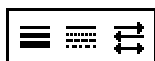


Line Effects



Each drawing object has an outline the color of the automatic color. The underline under the Line Color Tool is the current line color. To outline an object with the current line color, select the object, then click the Line Color Tool.

To change the line color, drop down the arrow and make a new selection. Other options with the Line Color Tool include color and patterns similar to the Fill Tool.



To change line style, dash style, and arrow style, click on these tools, respectively, after drawing the object and while it is still selected.

Object Effects



To place a shadow or 3D effect on an object, select the object, then click the tool selection.

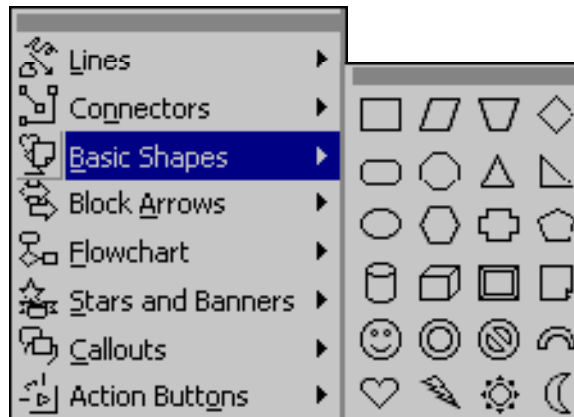
AutoShapes and WordArt

If you're not particularly artistic, AutoShapes and WordArt can come to the rescue. To use AutoShapes,

1. From the Drawing Toolbar, click the drop-down arrow beside AutoShapes, and then select the shape type.

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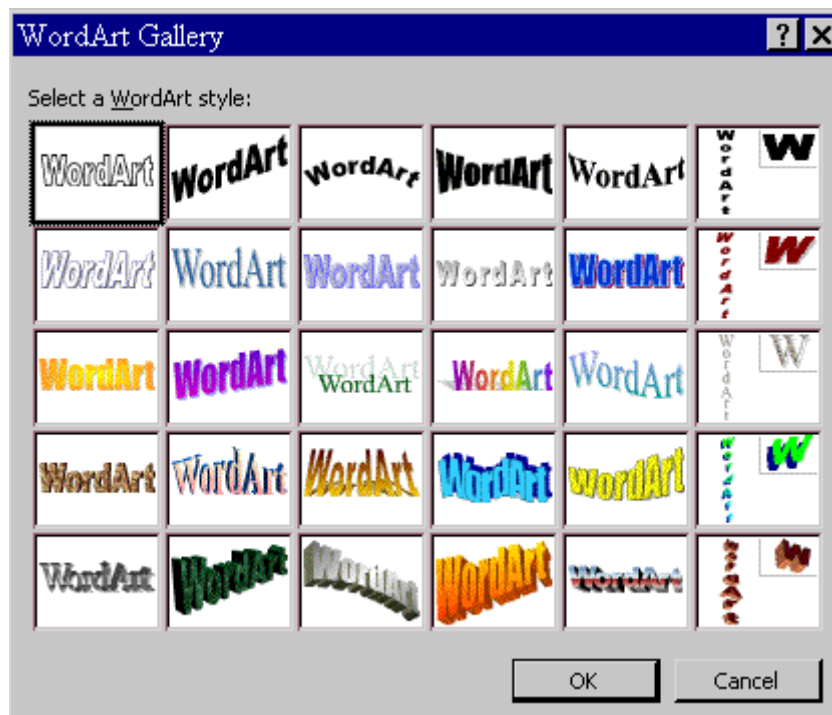
2. Click the shape you want. The cursor will change to a cross-hair as you move the mouse across the slide.
3. Click on the slide where you want to place the shape.
4. Move the object, change its size or color, as desired.



Autoshapes Tool

 To use WordArt,

1. Click the WordArt Tool.
2. From the WordArt Gallery, click the design you want, then click OK.

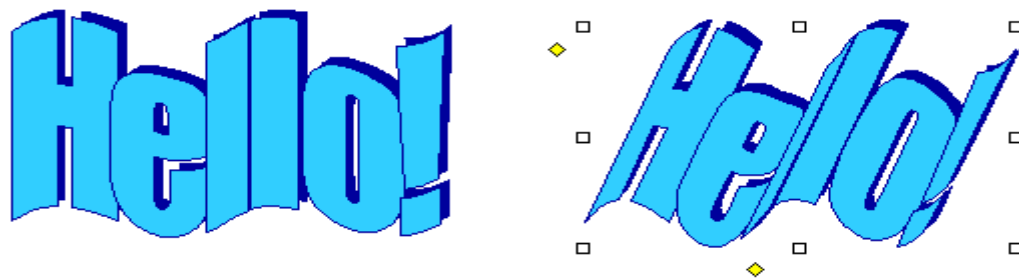


WordArt Gallery

3. In the Edit WordArt Text box, type your text. You can also change the font face and type size, or add bold or italics. Then click OK.

The art will be placed in the center of the slide and is always smaller than you would like—press and drag the handles to enlarge the object to the desired size.

Many of the WordArts also have one or more small yellow diamond-shaped handles. You can press and drag any of these to distort the shape of the object:



Samples of Word Art

To change the colors in WordArt, make sure the object is selected, then choose **FORMAT: WordArt** and make your selections.

Text Tool



To insert text on the slide other than in a Placeholder

1. Click the Text Tool.
2. Press and drag the cursor over the slide to create a Text Box.
3. Type in the box.

NOTE: Any text you type in a placeholder will show in Outline View; text inserted via the Text Tool is treated as an object and will not display in the outline.

Moving

To move an object on the slide, select it, then move the cursor over the object until you see the four-headed arrow along with the cursor. Press and drag the object to the location you need it.

NOTE: Be sure it is a four-headed arrow rather than a two-headed arrow. Two-headed arrows re-size objects.

To move a text box, select it, then move the cursor over the frame until you see the four-headed arrow along with the cursor. Press and drag the text box to the location you need it. If you move the cursor within the box, it will change to an insertion point so that you can type or edit text.

Rotating

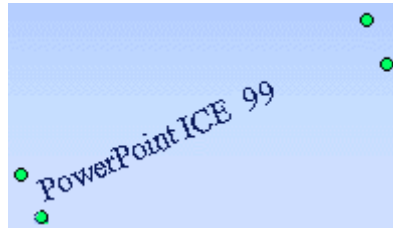


To rotate any object, including a text box,

1. Click the Rotate Tool.

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2. Click the object to be rotated.
3. You will see small green disks in place of the normal handles on the object.



Sample Rotated Text

4. As you move the cursor over the disk, it will change to a looped circle. Position the loop over one of the green disks and press and drag to the desired rotation.
5. Click the Rotate Tool to deselect it.

Grouping and Ungrouping

Often after you have created multiple objects and layered them in the sequence you need, you want them to "stay put". By grouping multiple objects, you can move or resize them as a single entity rather than manipulating their individual components.

To group multiple objects:

1. Size each individual object as necessary.
2. Layer objects as necessary.
3. Each object must be selected prior to grouping. To select multiple objects, hold SHIFT then click each object. Each object clicked becomes selected and the handles of each are displayed. Release SHIFT after you have selected each of the objects to be grouped.
4. From the Drawing Toolbar, choose DRAW : Group. You will see that the objects' individual handle-sets will be combined, leaving a single handle-set for the grouped object.

Sometimes, if your object is very complex, you will find it beneficial to group your object components incrementally. When you finish a subset of your final object, group the components you have finished. Then you can continue building additional components, knowing you won't accidentally move or re-size the portion you have completed.

Text that you include in a grouped object will not change point size if you re-size the grouped object, however, word-wrapping may adjust to conform to the re-sizing.

To manipulate individual components of grouped objects, you must ungroup them. To ungroup an object, select it, then from the Drawing Toolbar, choose DRAW : Ungroup. After editing, you can choose Re-group.

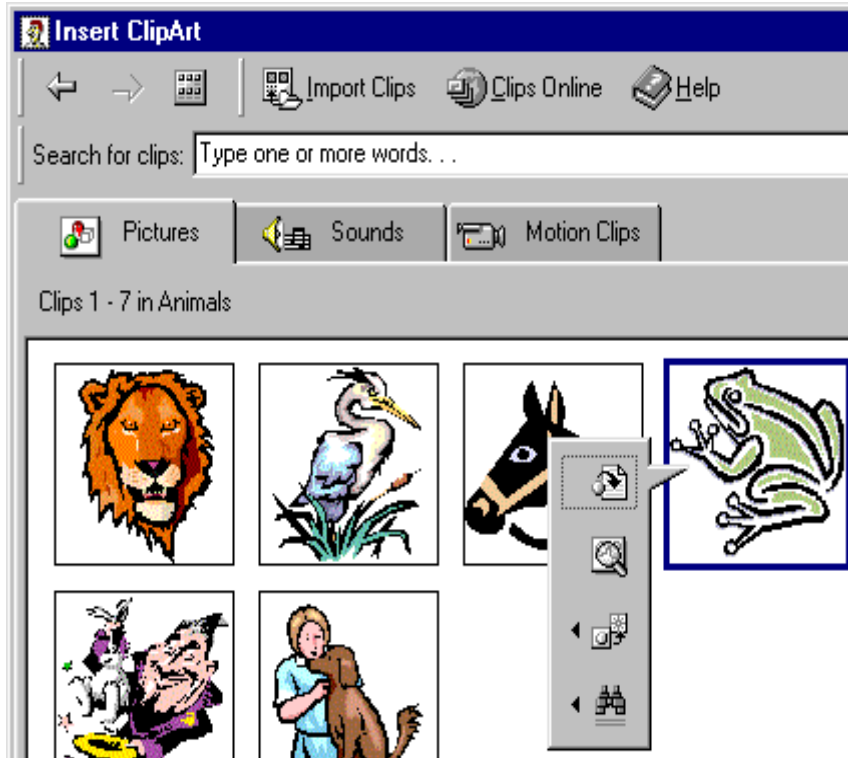
2.3. Images and Clip Art:

PowerPoint comes with a library of "clip art" that includes traditional clip art, as well as videos, photographs, and sounds. You can also insert graphics from other sources into a presentation.



To access PowerPoint's ClipArt Gallery, click the ClipArt Gallery Tool (located on the Drawing Toolbar).

To use a Gallery ClipArt image, in the Insert ClipArt dialog box, select the category pertaining to the type of image you are looking for, then select the image you want. A pop-up box will allow you to: insert the image, preview the clip, add the clip to a different category, and/or find similar clips.



Insert ClipArt Dialog Box

The greatest benefit of the ClipArt Gallery is that you can add multiple selections to your presentation without leaving the Gallery.

ClipArt images will be inserted in the center of the slide. You can move, enlarge, or reduce them.


To select multiple objects using the mouse,

1. Position your mouse cursor beyond the corner of the object to be re-grouped. Make sure you start far enough beyond the objects to catch all of the components.
2. Press and drag diagonally across the objects to select all the components. Make sure that you do not accidentally include an object in the selection that you do not want to be selected. (You may have to try this step several times, it is a bit tricky to master.)

3. After all the components are selected, from the Drawing Toolbar, choose DRAW : Group (or Regroup).

2.4. Audio and Video:

Your presentation can link to external audio and video files.

- Select the slide on which you wish to add a link to an audio or video file.
- On the **Insert** menu, point to **Movies and Sounds**.
- To insert a sound from a file, click **Sound from File**. To insert a video from a file, click **Movie from File**.
- A standard file directory window appears.
- Locate the folder that contains the audio/video file you want, and then double-click the filename.
Note: In PowerPoint, by default your movie or sound will play manually. If you want it to play automatically you will have to set **Custom Animation** options for the slide.
- For audio files, a sound icon  appears on the slide.
- For movies, an image consisting of the first frame is displayed as a placeholder.
- To preview the audio/video in Normal view, double-click its icon.

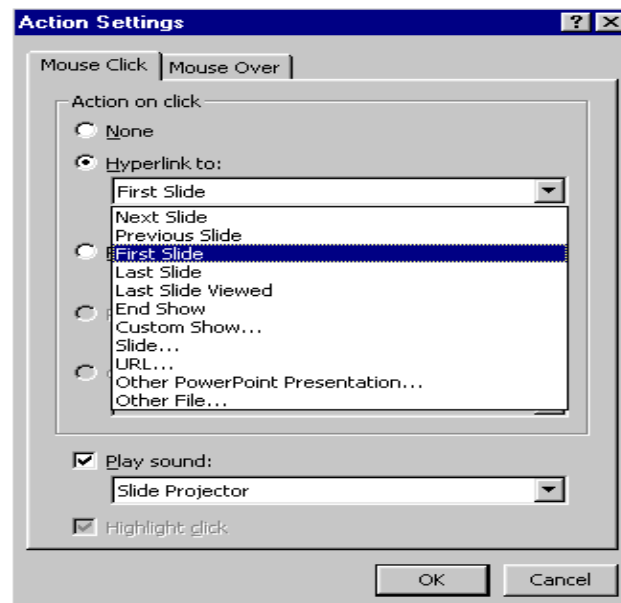
Note: Alternatively, you may have to use the **Insert / Object** command since PowerPoint is not able to play all audio/video formats inline. **Insert / Object** will open the media element in a new window rather than making it appear embedded on the slide, and it will be played by an external program.

2.5. Creating Hyperlinks:

Hyperlinks cause the selection of an object to result in a move to a new location or the performance of an action. You can create your own object or choose an AutoShape Action button.

To link an object with an action, select the object, then choose SLIDE SHOW: Action Settings.

In the Action Settings dialog box, choose either Mouse Click or Mouse Over. Then select the button "Hyperlink to" then select the destination or action. You can also choose to play a built-in PowerPoint sound during this action and/or to highlight the object as you click it.

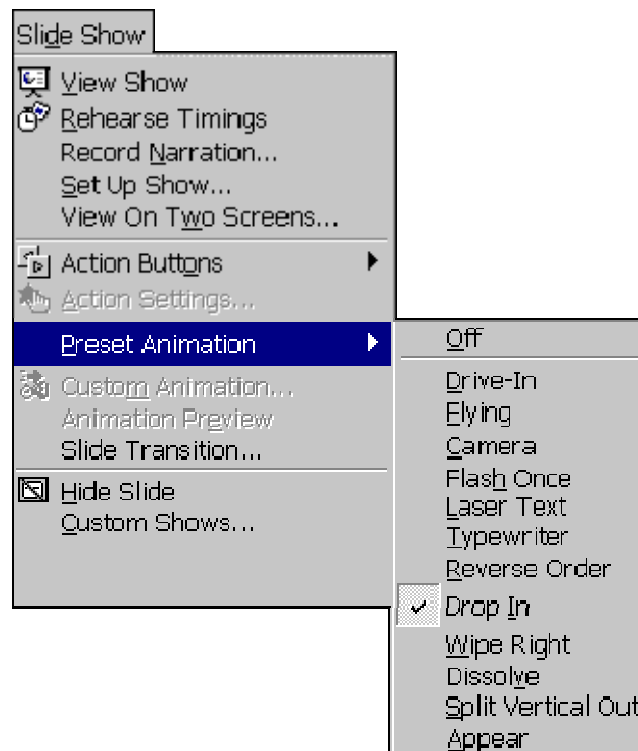


Hyperlink Action Dialog Box

2.6. Animating the Presentation:

To animate a single object on a PowerPoint slide

1. Select the object.
2. Choose SLIDE SHOW: Preset Animation.
3. Select the animation effect you desire for the selected object.



Preset Animation Dialog Box

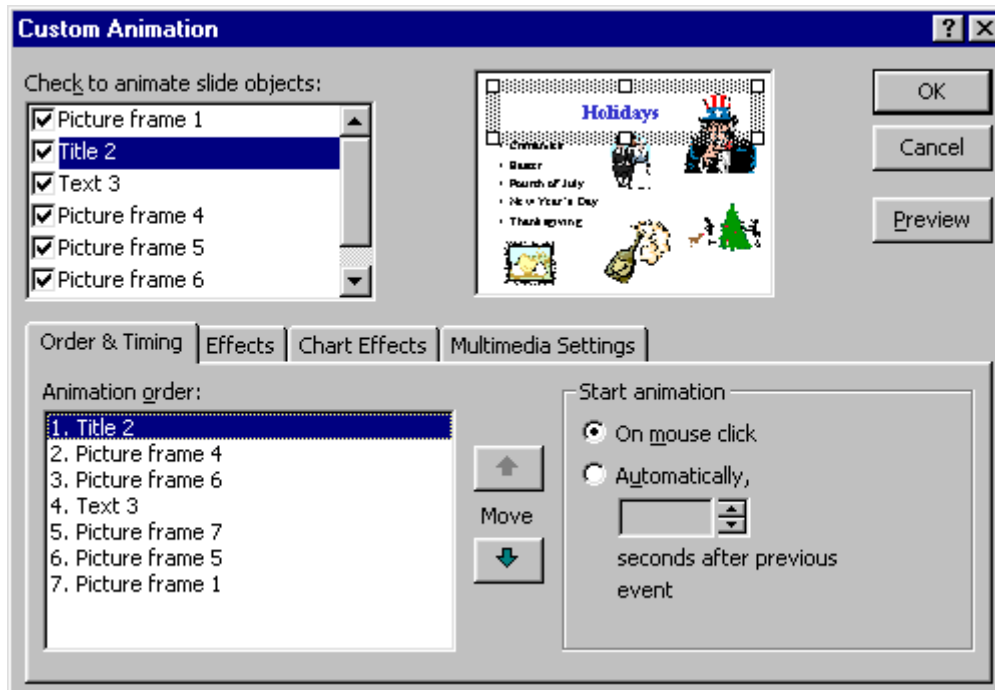
Animated Layers or Slides

You may find it useful to bring a layered object into a presentation one layer at a time, building it on-screen. To animate a layered object or to animate each object on a slide

1. Choose SLIDE SHOW: Custom Animation. (You must be in Normal, Outline, or Slide View.)
2. In the Custom Animation dialog box, each object is identified in the Check to animate slide objects list.

If you don't remember what a particular object is, click the object's name in the list; that object appears selected in the preview window.

3. Click in the object's checkbox to animate that object. It will be added to the Animation order list.
4. To change the order that the animated objects appear, select the object in the Animation order list, then click the up or down arrow to move the object through the list.
5. Choose whether the object appears only on a mouse click or after a specified number of seconds.



Layer Animation Dialog Box

To choose other effects such as sound effects and how the object appears on the slide during the on-screen presentation, click on the Effects tab.

To animate text,

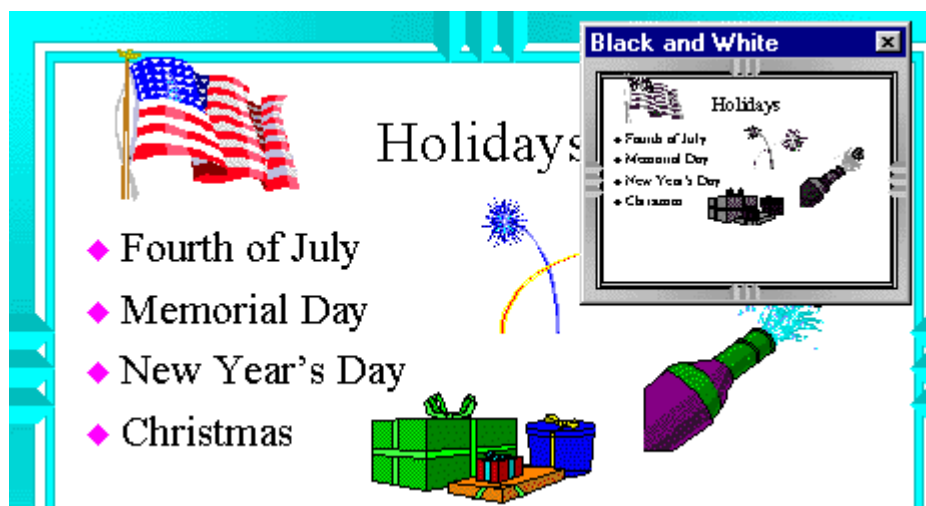
1. Click on the Effects tab.
2. In the Introduce Text section, from the drop-down box, choose whether the text is introduced all at once, by word, or by letter.

To animate charts click the Chart Effects tab. You can choose to introduce the data by series, categories, or elements.

NOTE: Be careful of using too many effects in any single presentation because they soon become a distraction rather than an enhancement of the presentation.

2.7. Slide Miniature:

When you have zoomed the view of your slide so that all of the slide cannot be seen on the screen at one time, PowerPoint will create a black and white Slide Miniature in the corner. This allows you to see the overall effects of the changes you are making to the slide.



Sample Slide Miniature

You may also choose to work in black and white mode by choosing VIEW: Black and White. To see a small color view of the current slide when you are working in black and white, choose VIEW: Slide Miniature.

2.8. Slide Transitions:

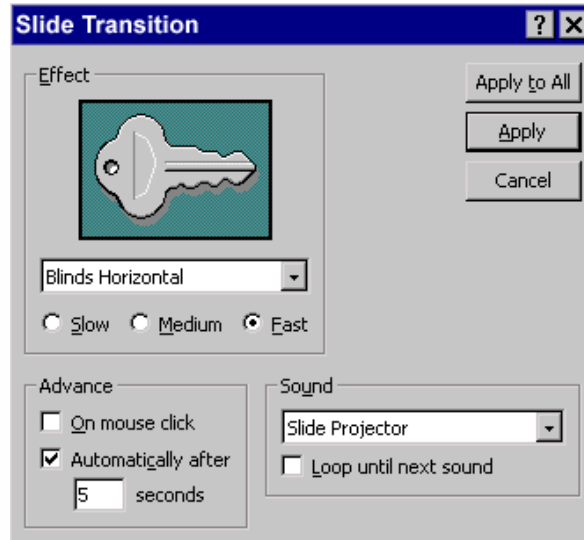
Transitions determine the effects applied when you move from one slide to another during an on-screen presentation. You must be in Slide Sorter View to access the Transition Toolbar.

To choose only a transition effect, click the dropdown box beside the words "No Transition" and select a transition. To have other transition choices available to you, click the Slide Transition Tool.



Sample Transition Tool and Drop-down Box

When you click the Slide Transition Tool, the Slide Transition dialog box allows you to choose not only a transition effect from a drop-down box, but also offers other choices that affect your on-screen presentation.



Sample Transition Dialog Box

TIP: Do not use a different transition on each slide because your audience attention should remain focused on you and the content, not the effects. If you want to use multiple transitions, a good rule of thumb is to apply a unique transition to each slide in a specific module of the presentation.

Generally, you should leave the Effect Speed set to Fast. This brings in the next content slide quickly and keeps your audience's attention focused on the presentation content.

PowerPoint contains a few built-in sounds. To play a sound as the slide is transitioning, make a sound selection from the Sound drop-down box. Unless you have a well thought out reason for doing so, do not choose to have the sound loop until the next sound; it can become annoying very fast while you are giving a presentation, as well as making it difficult for you to speak over. Also, many presentation locations do not have adequate speakers attached to the computer to allow all of your audience to hear the sound.

- In **Slide** or **Slide Sorter** view, select the slide or slides on which you want to add a transition.
- On the **Slide Show** menu, click **Slide Transition**.
- From the **Effect** drop-down list, click the transition you want.

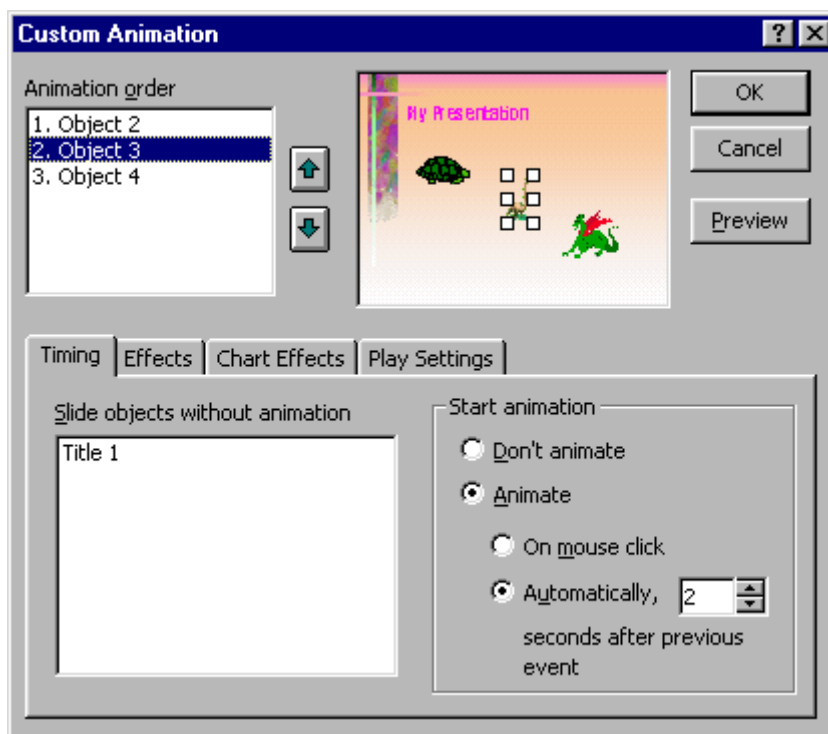


- Select any other options you want (speed Slow/Medium/Fast, Advance on mouse Click or Automatically, Sound or No Sound)
- To apply the transition to the selected slide, click **Apply**. To apply the transition to all the slides, click **Apply to All**.
- Repeat the process for each slide you want to add a transition to.
- To view the transitions, on the **Slide Show** menu, click **Animation Preview**.

2.9. Slide Show Animation:

You can control how and when text, graphics, and other objects appear on your PowerPoint slides. For example, you can make graphics or text items appear one at a time and add visual or sound effects. Animation can aid in focusing attention during a presentation and make your slide show more interesting. To set slide show animation options, display the slide that has the objects you want to animate, then on the **Slide Show** menu, click **Custom Animation**.

Timing Tab

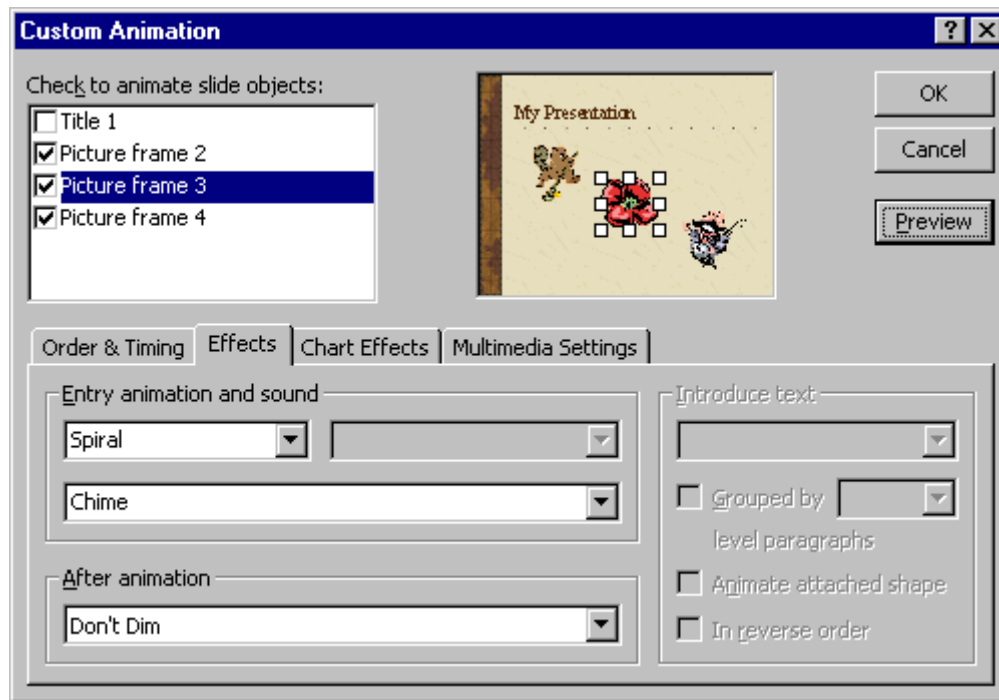


- In PowerPoint, ensure that you are on the **Timing** tab.
- Under **Slide objects without animation**, double-click the objects you want to animate. (they should be moved up to the **Animation Order** box).
- Use the up and down arrows to the right of **Animation Order** to change the sequence in which objects will appear (move objects up or down in the list).
- Under **Start Animation** set the timing (when objects will appear). Select each object and then do one of the following:

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- To start the animation by clicking the object, select the **On mouse click** option.
- To start the animation automatically, select the **Automatically** option, and then enter the number of seconds you want to have elapse since the previous animation.

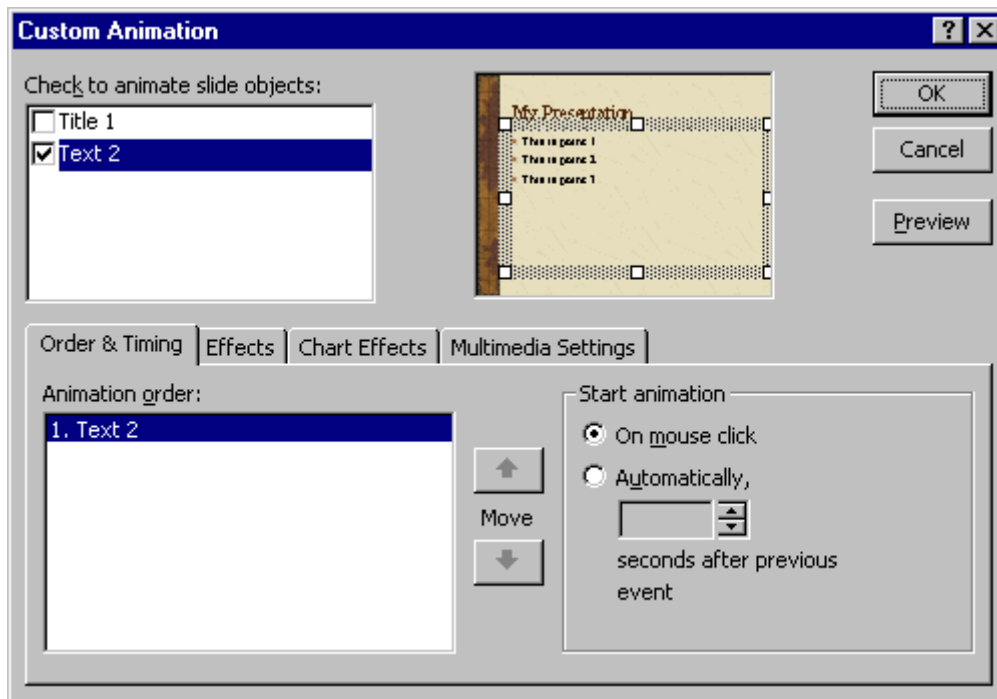
Effects Tab



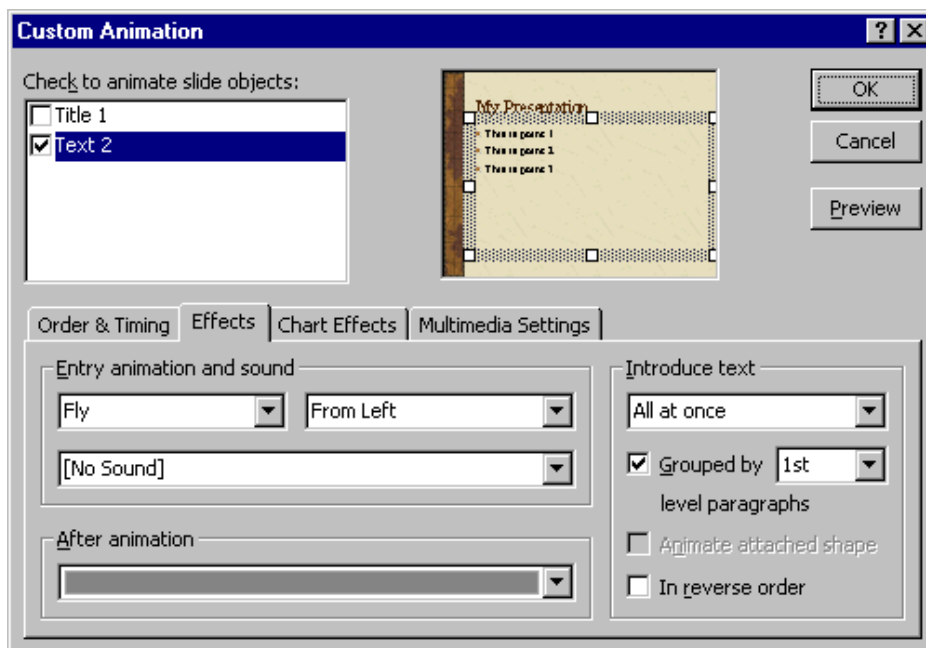
- Click the **Effects** tab to set options for visual or sound effects.
- Under **Entry animation and sound** select the options you want.
- To preview the animation effects, click the **Preview** button.
- In the example above, the object will enter the screen with a **Spiral animation** and the **Chime sound** will play.

Animating a text box containing bulleted text

- On the **Order & Timing** tab, the text box is selected with a check mark, and the **On mouse click** option is chosen (to let the presenter control the slide show with mouse clicks).



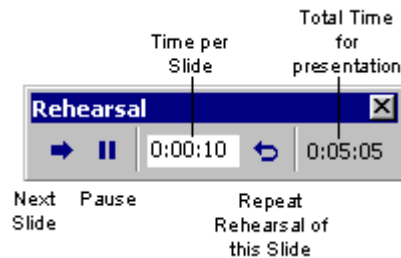
- On the **Effects** tab, the options set below will make each line of text enter the screen with a **Fly From Left** animation, **No sound** will play, and when the next line of text appears the previous line will change to a lighter color (a **dimming** effect). To preview the animation effects, click the **Preview** button.



The series of images below show what the screen looks like after each mouse click when the slide with the bulleted text (set with options as above) is displayed during a **Slide Show**. Notes that the previous text points are dimmed as each subsequent line appears.

2.10. Rehearse Timings:

The Rehearse Timing Tool allows you to practice giving an on-screen presentation, regardless of any slide advance timings you may have set previously. The tool sets time not only for the entire presentation, but also each individual slide, as you rehearse. Each time you advance the slide, the time is recorded. You must be in Slide Sorter View to access the Rehearse Timing Tool.

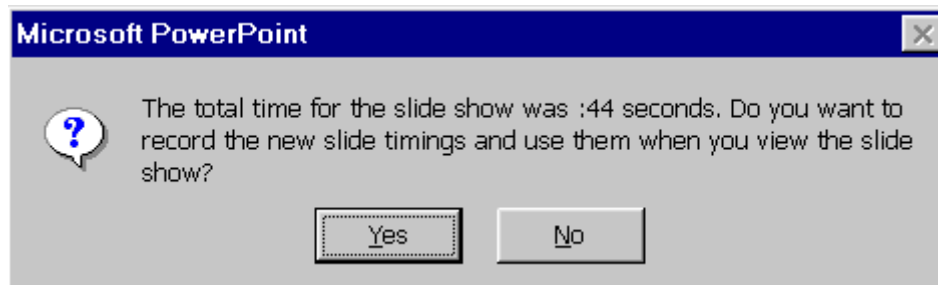


Sample Recorded Rehearsal Timings



To use the Rehearse Timing Tool, click the Rehearse Timing Tool.

When you have completed rehearsing, PowerPoint displays the total time for the rehearsed presentation and asks if you want to record the new timings. If you click "Yes", these new timings will replace any slide advance timings you may have previously set for the presentation.



Sample New Timings Dialog Box

Before you print your slide presentation, make sure the slide size and orientation is correct. Also, decide whether you want to print in color or black and white.

Change these settings using the Page Setup and Print commands on the File menu.

Slide Setup

The Slide Setup dialog box has controls for slide size and orientation. Choose the appropriate slide size and orientation before you do significant formatting in your presentation. Changing slide orientation from portrait to landscape or vice versa may require editing and reformatting slides.

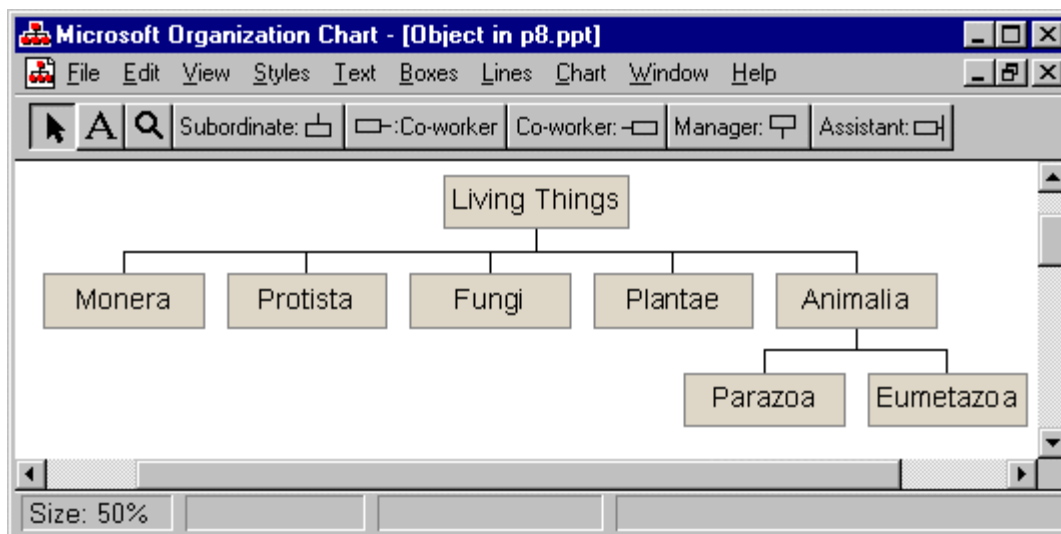
Printing

To print your slide presentation, choose Print from the File menu, or click the Print button on the toolbar. In the Print dialog box you can choose how many copies you want to print. Use the Print What: drop-down list to select whether you want to print just the slides, notes, or handouts with multiple slides per page.


2.12. Charts:

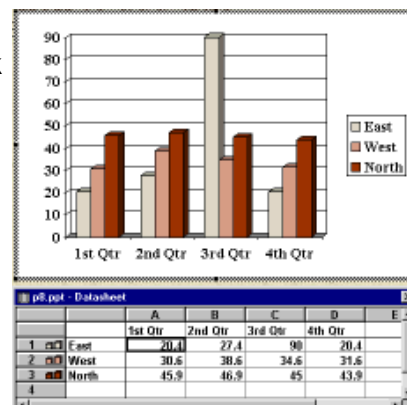
To insert an *organization chart* (depicts hierarchical relationships):

- First display the slide on which you want the chart to appear.
- On the **Insert** menu, point to **Picture**, and then click **Organization Chart**.
- A separate **Microsoft Organization Chart** window appears.
- Use the buttons at the top of the Organization Chart window to add text boxes to your chart (above, below, or beside existing boxes).
- Click your mouse inside a box to edit the text inside of it.
- As shown in the example below, you can use this type of chart for almost any type of information you want, not just managers, workers, and other positions within a company.



To create a *bar or pie chart* (or similar chart based on numbers in a datasheet):

- First display the slide on which you want the chart to appear.
- On the **Insert** menu, click **Chart** - or click the **Insert Chart** button on the PowerPoint toolbar. 
- A sample chart and datasheet (spreadsheet) appear on the screen as shown below.
- To replace the sample data, click a cell on the datasheet, and then type the information you want.
- To change the chart type, on the **Chart** menu, click **Chart Type**. In the **Chart Type** window, which appears, click on the desired Chart type and subtype and then click the **OK** button.
- To return to PowerPoint, where you can move and size the chart, click outside the chart on the PowerPoint slide.



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- If you wish to re-edit the chart, double-click the chart on the PowerPoint slide.

2.13. Summary:

At the end of this lesson you have learnt how to insert and format text, working with the pictures and inserting images into a slide. The concept of Slide transition, Slide animation, Rehearse timings allows you to automatically move to next slide without manual interaction. A layman can also know more about the data results with the help of charts.

2.14. Technical Terms:

Hyperlink: Hyperlinks cause the selection of an object to result in a move to a new location or the performance of an action.

Slide Transition: Slide Transition determine the effects applied when you move from one slide to another during an on-screen presentation.

Slide Show Animation: Slide Show Animation can aid in focusing attention during a presentation and make your slide show more interesting.

Rehearse Timings: The Rehearse Timing Tool allows you to practice giving an on-screen presentation, regardless of any slide advance timings you may have set previously.

Slide Setup: The Slide Setup controls for slide size and orientation.

2.15. Model Questions:

1. Explain the procedure to draw the objects in PowerPoint?
2. Define Hyperlink? Explain the procedure to create Hyperlinks in PowerPoint?
3. What is a Slide Miniature?
4. Define Rehearse Timing? Explain the procedure to set the rehearse timings to slides?

2.16. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' **BPB Publications, New Delhi**

MS OFFICE 2000 Complete, BPB Publications, New Delhi

UNIT - III

Microsoft Access

3.0 Objective:

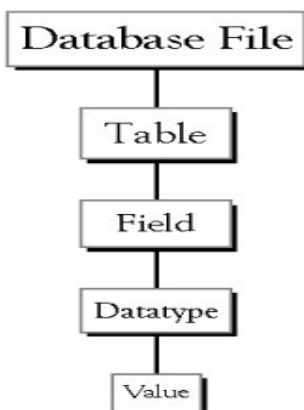
This lesson provides an introduction to the fundamentals of Microsoft Access. It covers starting MS-Access, creating Data bases, Tables, Queries, Forms, Reports, and Relational Data Bases.

Structure of the Lesson:

- 3.1 Microsoft Access Introduction
- 3.2 Starting Microsoft Access
 - 3.3 Creating and opening Data bases
 - 3.4 Tables
 - 3.5 Query
 - 3.6 Relational Data Bases
 - 3.7 Forms
 - 3.8 Reports
 - 3.9 Summary
- 3.3. Technical Terms
- 3.3. Model Questions
- 3.3. References

3.1. Microsoft Access:

Microsoft Access is a powerful program to create and manage your databases. It has many built in features to assist you in constructing and viewing your information. Access is much more involved and is a more genuine database application than other programs such as Microsoft Works.



Database File: This is your main file that encompasses the entire database and that is saved to your hard-drive or floppy disk.

Example studentDatabase.mdb

Table: A table is a collection of data about a specific topic. There can be multiple tables in a database.

Example #1) Students

Example #2) Teachers

Field: Fields are the different categories within a Table. Tables usually contain multiple fields.

Example #1) Student LastName

Example #2) Student FirstName

Data types: Data types are the properties of each field. A field only has 1 data type.

3.2. Starting Microsoft Access:

Starting Microsoft access in two ways.

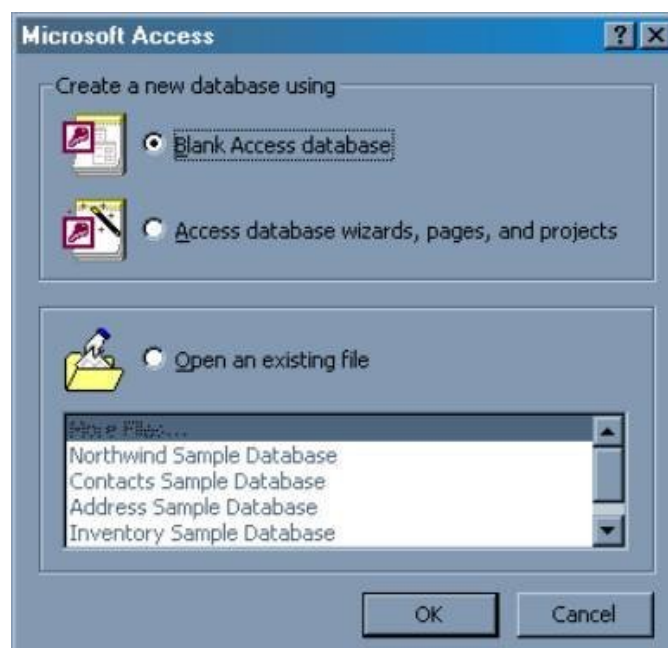
1. Double click on the Microsoft Access icon on the desktop.



2. Click on Start --> Programs --> Microsoft Access

3.3. Creating New and Opening Existing Databases:

If you start MS Access a window will appear as below.



The above Window gives you the option to:

- Create a New Database from scratch
- Use the wizard to create a New Database
- Open an existing database
- The white box gives you the most recent databases you have used. If you do not see the one you had created, choose the More Files option and hit OK. Otherwise choose the database you had previously used and click OK.

Create a database using the Database Wizard

1. When Microsoft Access first starts up, a dialog box is automatically displayed with options to create a new database or open an existing one. If this dialog box is displayed, click **Access Database Wizards, pages, and projects** and then click **OK**.

If you have already opened a database or closed the dialog box that displays when Microsoft Access starts up, click **New Database** on the toolbar.

2. On the **Databases** tab, double-click the icon for the kind of database you want to create.
3. Specify a name and location for the database.
4. Click **Create** to start defining your new database

Create a database without using the Database Wizard

1. When Microsoft Access first starts up, a dialog box is automatically displayed with options to create a new database or open an existing one. If this dialog box is displayed, click **Blank Access Database**, and then click **OK**.

If you have already opened a database or closed the dialog box that displays when Microsoft Access starts up, click **New Database** on the toolbar, and then double-click the **Blank Database** icon on the **General** tab.

2. Specify a name and location for the database and click **Create**. (Below is the screen that shows up following this step).



3.4. Tables:

A table is a collection of data about a specific topic, such as students or contacts. Using a separate table for each topic means that you store that data only once, which makes your database more efficient, and reduces data-entry errors.

Tables organize data into columns (called **fields**) and rows (called **records**).

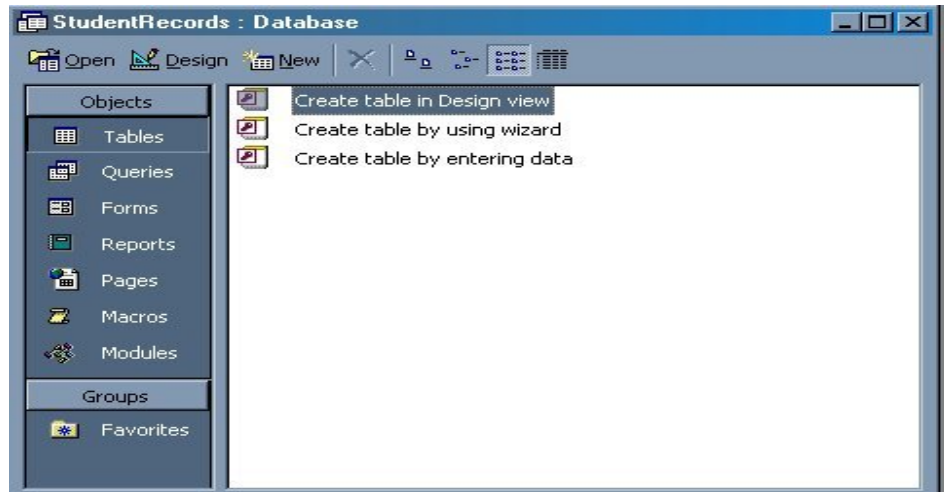
Each field in the Student Records table contains the same type of information for every student, such as student's student identification number. This is an example of a COLUMN

Student Records Table					
SID#	First Name	Last Name	BirthDate	Address	City
123456789	Todd	Jones	1/1/78	312 Wenona Rd	Bay City
315465866	Alan	Craig	2/8/80	123 N Union	Bay City
968585471	Stacy	Evans	3/8/81	RR 5 Box 880	Auburn
848131523	John	Anderson	4/5/80	83 Washington Dr.	Midland

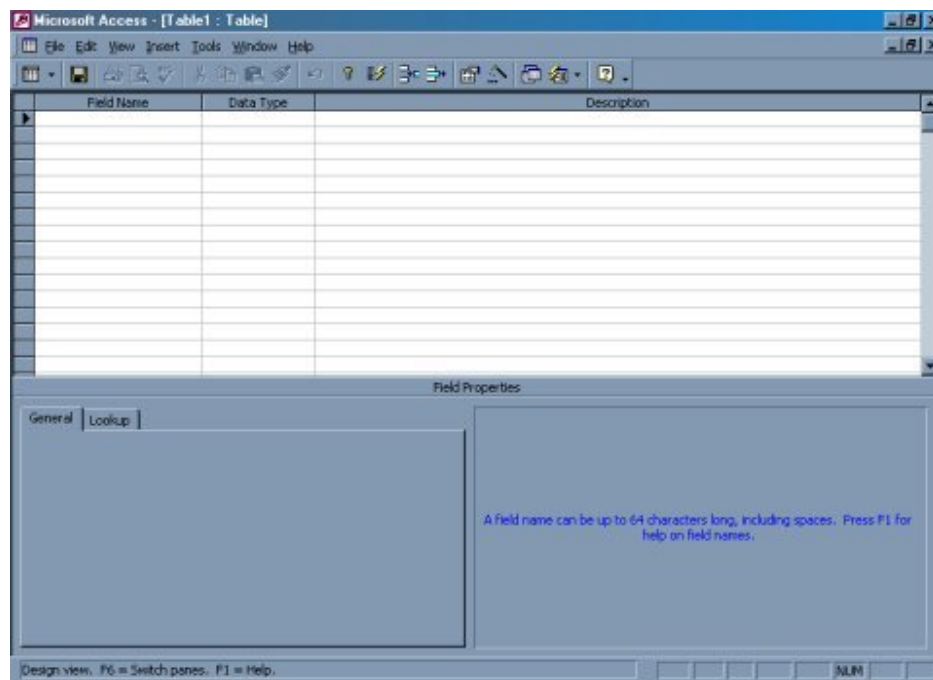
Each record in a Student Records table contains all of the information about one student, such as their First Name, Last Name, Birthday, Address, and City, etc... This is an example of a ROW.

Create a Table from scratch in Design view

1. If you haven't already done so, switch to the Database Window You can press F11 to switch to the Database window from any other window.



2. Double-Click on "**Create table in Design view**".
(*DESIGN VIEW*)



3. Define each of the fields in your table.

- Under the Field Name column, enter the categories of your table.
- Under Data Type column, enter the type you want for your categories.
 - The attribute of a variable or field determines the kind of data it can hold. For example, in a Microsoft Access database, the **Text** and **Memo** field data types allow the field to store either text or numbers, but the **Number** data type will allow the field to store numbers only. Number data type fields store numerical data that will be used in mathematical calculations. Use the **Currency** data type to display or calculate currency values. Other data types are **Date/Time**, **Yes/No**, **Auto Number**, and **OLE object** (Picture).
- Under the Description column, enter the text that describes what your field is. (This field is optional).
- For example

Field Name	Data Type	Description
stdid	Text	stdid Uniquely identifies a student
First Name	Text	Student's First Name
Last Name	Text	Student's Last Name
BirthDate	Date/Time	Student's Birthdate
Address	Text	Students Address
City	Text	City student resides in
State	Text	State student resides in
Zip	Text	Zip Code student resides in
Phone	Text	Student's home phone number

Primary Key



- One or more fields (columns) whose value or values uniquely identify each record in a table. A primary key does not allow Null values and must always have a unique value. A primary key is used to relate a table to foreign keys in other tables.
- In the above example, the **Stdid #** field the primary key, meaning that every student has a student identification number.
 - To do this, simply select the **Stdid #** field and select the primary key button.



- After you do this, Save the table

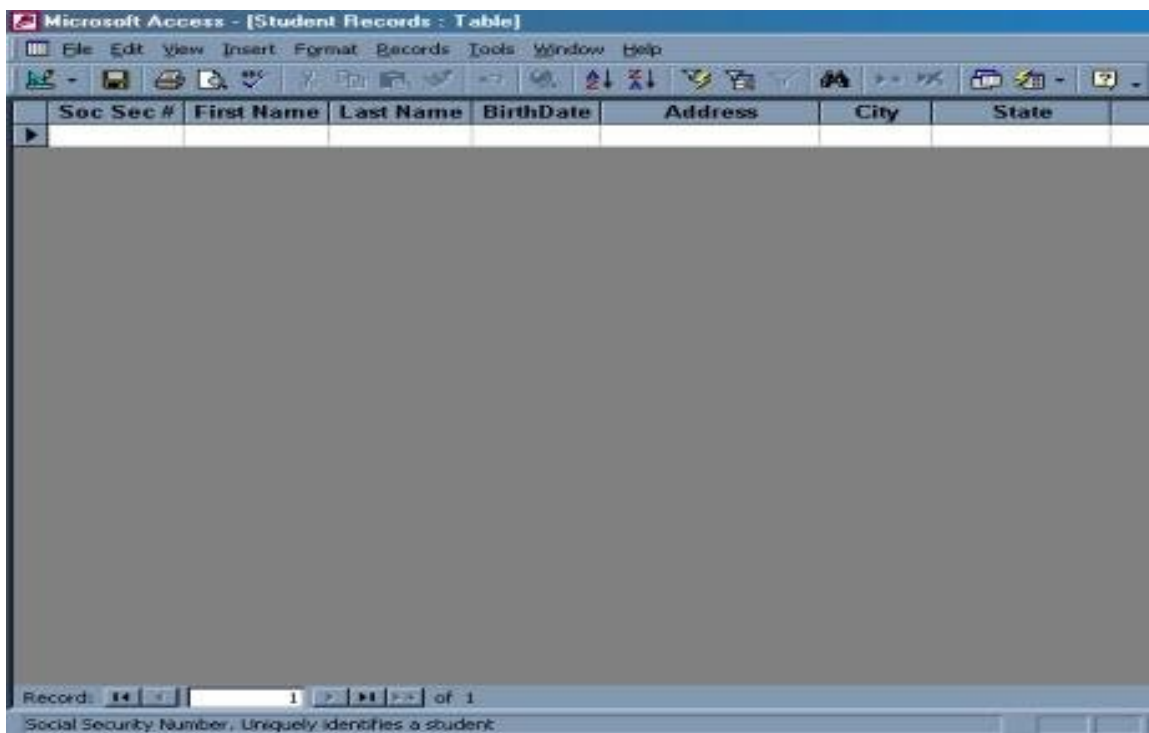
Switching Views

- Views are two types. They are Design view and Datasheet view. You can select the views from view menu from menu bar.

Datasheet View	Design View
 <p>Displays the view, which allows you to enter raw data into your database table.</p>	 <p>Displays the view, which allows you to enter fields, data-types, and descriptions into your database table.</p>

Entering Data

- Click on the Datasheet View and simply start "chugging" away by entering the data into each field.



Manipulating Data

- **Adding a new row**
 - Simply drop down to a new line and enter the information.
- **Updating a record**
 - Simply select the record and field you want to update, and change its data with new contents
- **Deleting a record**
 - Simply select the entire row and hit the Delete Key on the keyboard

3.5. Query:

Queries are questions about your database. You can design a query manually, specifying all of the tables and fields you wish to display on your screen, or you can use a Query Wizard to create simple displays in predefined formats.

QUERY WIZARD

Access provides several query formats

- *simple* - looks like the Table datasheet view
- *crosstab* – is similar to a spreadsheet with summary information inserted into the intersection of each row and column
- *find duplicates* – lists the records which have duplicate values in any specified field
- *find unmatched* – compares two tables and identifies records, which do not have a match in a related table.

Using Query Wizard

From Database window:

- Click Query Tab
- Click New
- Select Query type from list (OK)
- Follow prompts:

- select Tables / Queries (Next)
- select Fields (Next)
- create a Title
- click Finish.

In general, there are two types of query: Select and Action. A select query gathers, collates and presents information in usable forms. An action query makes changes in specified records of an existing table, or creates a new table. In this course, we will concentrate on select queries only.

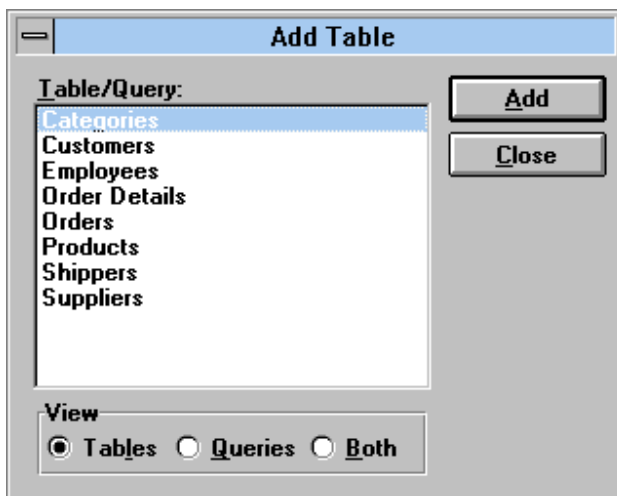
Sometimes, information is scattered in many tables. For example, customers' information is stored in **Customers** table while their ordering information is stored in **Orders** table. In order to retrieve information from more than one table, queries are used. Moreover, queries are capable of performing the functions of filters, namely adding selection criteria and sorting instructions. In addition, queries allow calculation of new fields.

In contrast to a filter, a query is **reusable**. When a table is closed, the selection criteria and/or sorting instructions will be lost. Therefore, in order to retrieve the same records again, the filter has to be recreated. However, a query allows the selection criteria and/or sorting instructions to be saved and reused.

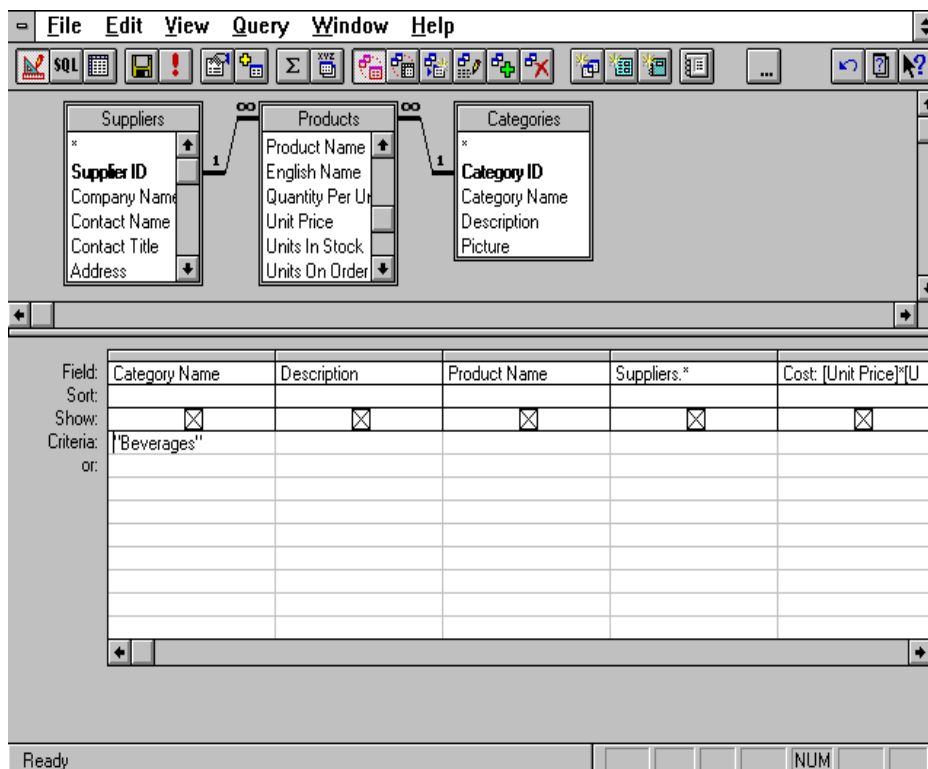
Create a Query

Find all the products under the category Beverages and the total costs for each of these products. In addition, you have to find the suppliers' information of these products.

1. Click the **Query** button and then the **New** button in the Database window.
2. Click **New Query** in the resulting dialog box to open the design window for a new query.
3. From the **Add Table** dialog box, select **Categories**, **Products** and **Suppliers** tables. Click **Close** to close the **Add Table** dialog box.



4. Drag the **Category Name** and **Description** fields from the **Categories** field list to the first and second column in the grid. Then drag the **Product Name** fields from the **Products** field list to the third column. Finally, drag the * field from the **Suppliers** field list to the fourth column.
5. In the fifth column of the grid, type **Cost: [Unit Price]*[Units in Stock]*0.7**.
6. Select the **Criteria** row in the **Category Name** column and enter **Beverages**.
7. Run the query by clicking the **Run** button (!) in the tool bar.



8. To print the result, choose **Print** command from the **File** menu.
9. To save the query, choose **Save** command from the **File** menu.

3.6. Relationships:

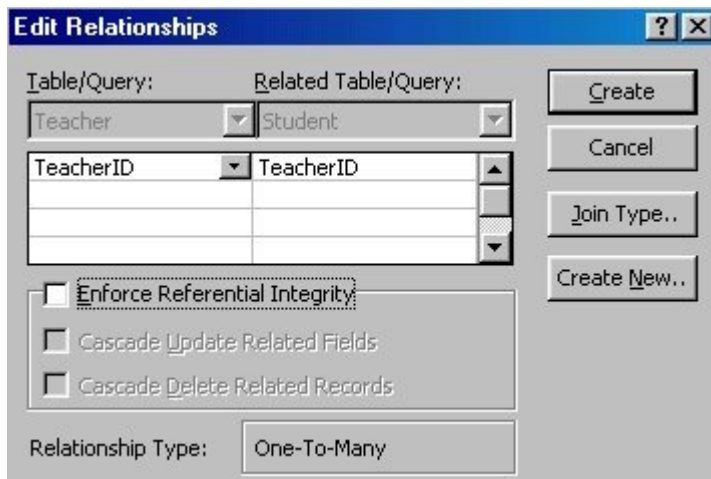
After you have set up multiple tables in your Microsoft Access database, you need a way of telling Access how to bring that information back together again. The first step in this process is to define relationships between your tables. After you have done that, you can create queries, forms, and reports to display information from several tables at once.

A relationship works by matching data in key fields - usually a field with the same name in both tables. In most cases, these matching fields are the primary key from one table, which provides a unique identifier for each record, and a foreign key in the other table. For example, teachers can be associated with the students they're responsible for by creating a relationship between the teacher's table and the student's table using the TeacherID fields. Having met the criteria above, follow these steps for creating relationships between tables.

1. In the database window view, at the top, click on Tools ---> Relationships
2. Select the Tables you want to link together, by clicking on them and selecting the Add Button
3. Drag the primary key of the Parent table (Teacher in this case), and drop it into the same field in the Child table (Student in this case.)



4. Select **Enforce Referential Integrity**



- When the Cascade Update Related Fields check box is set, changing a primary key value in the primary table automatically updates the matching value in all related records.
- When the Cascade Delete Related Records check box is set, deleting a record in the primary table deletes any related records in the related table

5. Click Create and Save the Relationship

2.7. Forms:

A form is nothing more than a graphical representation of a table. You can add, update, and delete records in your table by using a form.

A form is very good to use when you have numerous fields in a table. This way you can see all the fields in one screen, whereas if you were in the table view (datasheet) you would have to keep scrolling to get the field you desire.

Create a Form using the Wizard

It is a very good idea to create a form using the wizard, unless you are an advanced user and know what you are doing. Microsoft Access does a very good job of creating a form using the wizard. The following steps are needed to create a basic form:

1. Switch to the Database Window. You can do this by pressing F11 on the keyboard.
 2. Click on the **Forms** button under **Objects** on the left side of screen.
 3. Double click on **Create Form Using Wizard**
 4. On the next screen select the fields you want to view on your form. Most of the time you would select all of them.
 5. Click Next.
 6. Select the layout you wish.
 7. Click Next.
 8. Select the style you desire.
 9. Click Next.
3. Give your form a name, and select **Open the Form and enter information**.
3. Select **Finish**.
3. You should see your form. To adjust the design of your form, simply hit the design button (same as with the tables), and adjust your form accordingly.

3.8. Reports:

A report is an effective way to present your data in a printed format. Because you have control over the size and appearance of everything on a report, you can display the information the way you want to see it.

Create a Report using the Wizard

As with the Form, it is a very good idea to create a report using the wizard, unless you are an advanced user. Microsoft Access does a very good job using the wizard to create reports.

1. Switch to the Database Window. You can do this by pressing F11 on the keyboard.
2. Click on the **Reports** button under **Objects** on the left side of screen.
3. Double click on **Create Report Using Wizard**.
4. On the next screen select the fields you want to view on your form. Most of the time you would select all of them.
5. Click Next.
6. Select if you would like to group your files. Keep repeating this step for as many groupings as you would like.
7. Click Next.
8. Select the layout and the paper orientation you desire.
9. Click Next.
3. Select the style you desire.
3. Click Next.
3. Give your report a name, and select **Preview the Report**.
3. Select **Finish**.
14. You should see your report. To adjust the design of your report, simply hit the design button, and adjust your report accordingly.

3.9. Summary:

At the end of this lesson you have learnt what is a database, which contains Tables, Queries, Forms and Reports. Table is a collection of data to a specific content which contains some rows and columns. You have learnt the procedure how to create tables and Queries. Queries are questionnaires to a database. A form is nothing more than a graphical representation of a table. You can add, update, and delete records in your table by using a form. Reports are used to present your data in a printed format.

3.3. Technical Terms:

Database: A database is a collection of information stored in a computer in a systematic way, such that a computer program can consult it to answer questions.

Table: A table is a collection of data about a specific topic, such as students or contacts.

Primary Key: Primary Key is a field or whose value or values uniquely identify each record in a table.

Query: Queries are questionnaires to a database.

Form: A form is nothing more than a graphical representation of a table.

Relationship: Relationship is used to bring the information back together again.

Report: Reports are used to present your data in a printed format.

3.3. Model Questions:

1. Explain about the creation of databases in MS-Access.
2. Explain the procedure to create a Table with an example?
3. Define a Query? Explain the procedure to create query-using relationships?
4. Explain different data types in MS-Access.
5. What is a Primary Key?
6. What is a Form? Write the procedure to create a form in different ways?

3.3. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' **BPB Publications, New Delhi**

MS OFFICE 2000 Complete, BPB Publications, New Delhi

UNIT-III

Microsoft Excel

Objectives:

This lesson introduces the basic features of Microsoft Excel, a spreadsheet program, entering and editing data, formatting, formulas, page setup, and printing spreadsheets.

Structure

- 3.1 Excel Features
- 3.2 Starting Microsoft Excel
- 3.3. Formula Bar
- 3.3 Working with Excel
- 3.4 Entering and Editing Data
- 3.5 Row and Column Headings
- 3.6 Auto Fill
- 3.7 Custom Fill Lists
- 3.8 Row or Column Size
- 3.10. Inserting Rows and Columns
- 3.3. References
- 3.3. Charts
- 3.3. Summary
- 3.14. Technical Terms
- 3.15. Model Questions
- 3.16. References

3.1. Features of Excel:

Answer Wizard: Like word, excel has a new feature called answer wizard. It uses “IntelliSense” to determine what kind of work you need, based upon your questions.

Autocalc: When we selected a group of numbers, the sum automatically appears on the status area. We can see average, count the numbers by right clicking on the status area.

Auto Complete: Auto complete will try to figure out what you intend to type, based upon the entries you have already made.

Auto Correct: Excel can automatically correct the mistakes. It will not allow two consecutive initial caps, capitalizing names of days and so on. You can create your own auto correct entries.

Drag And Drop: Like other office features we can drag and drop the group of cells using mouse. We can drag the specified portion of from one worksheet to other.

Cell tips and Scroll Tips: When you touch the scroll bar it will display the row and column number that you are heading for. This is great for large worksheets. You can use Cell tips to read notes you've made for yourself in cells.

Data Map: It is having a data map feature. We can make maps of different regions in different countries. This can be quite impressive in presentations. This can be helping you in our business matters.

Easier retrieval of Documents: It has greatly streamlined file management. It can quickly find worksheets and you can easily delete or rename files from the open dialog box.

Number Formatting: It is easy to format the numbers with Excel's new number-formatting feature. There are many types of formats here like telephone numbers, dollar amounts, and dates.

Templates and Wizards: A variety of templates (predefined) formats available with excel for use in business organizations. We can have a template wizard to link database with worksheets. If we made changes in the worksheet, automatically database updated.

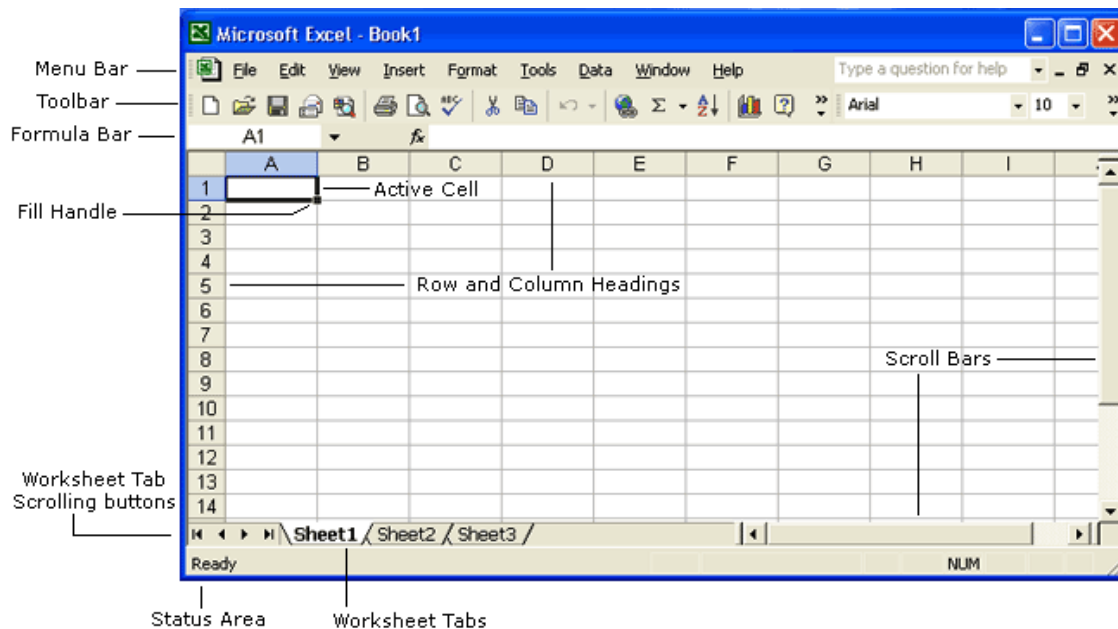
3.2. Starting Excel:

On the PC, select Start, Programs, and Microsoft Excel from the Start list.

Components of the Excel Window

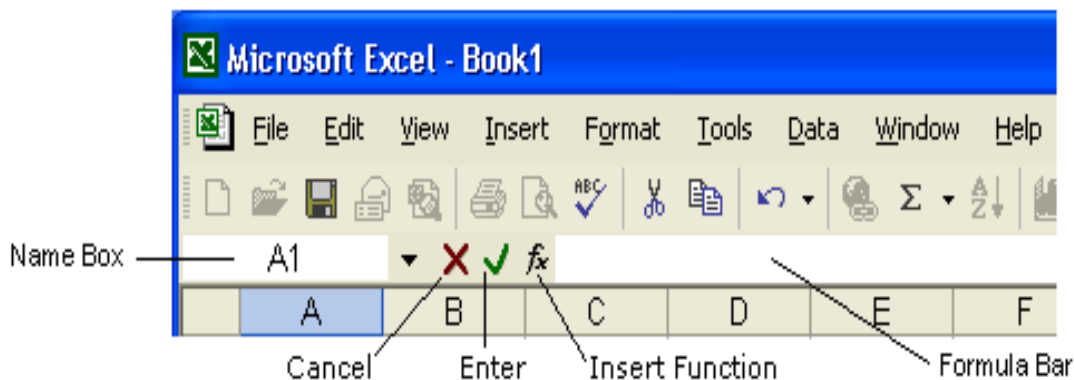
Besides the usual window components (close box, title bar, scroll bars, etc.), an Excel window has several unique elements identified in the figure below:

3.3. Formula Bar:



3.4. Formula Bar:

In addition to the other toolbars the formula bar is located under the formatting toolbar at the top of the Excel worksheet. Use the formula bar to enter and edit worksheet data.



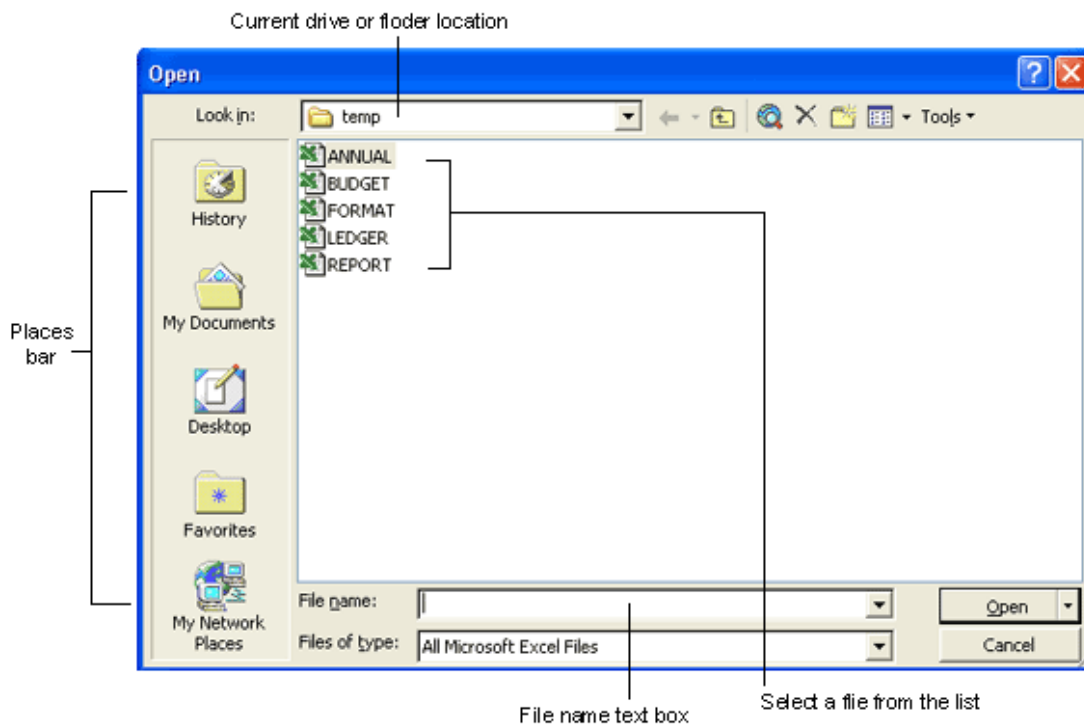
The contents of the active cell always appear in the formula bar. When you click the mouse in the formula bar, an X and a check mark appear. You can click the check icon to confirm and complete editing, or the X to abandon editing.

3.5. Working with Excel:

Opening and Closing worksheet

To open an existing Excel workbook, choose **Open** from the **File menu** or click the **Open tool** on the **toolbar**. Excel will display the **Open dialog box**, which is similar in appearance and function to the **Save As** dialog box. It contains a File Name: box for you to type a file name.

To open a file, select the appropriate location by clicking on the down pointing arrow next to the **Look In:** selection box. Excel will display all Excel files found there. Select the file you wish to open and click Open to open the file.



Saving a worksheet

To save an untitled Excel workbook, from the File menu choose **Save As** or click the **Save** button on the toolbar. The **Save As** dialog box contains a text box for you to type a specific filename, a "Save File as Type:" box to save your workbook in a different format that other programs can read, a selection box to designate the folder and drive in which to save the file, and a "Places Bar" that offers other locations to save your file.

Creating a New Workbook

If you are already in Excel and you want to create a new workbook, choose **New** from the File menu or click the New tool on the toolbar.

Managing Multiple Workbooks

Excel enables you to have more than one workbook open simultaneously. Each open workbook appears on the **Window menu**. The document with the check next to it is the active document. To switch to another document, simply choose that document from the **Window menu**. To navigate between worksheets within a workbook, click the worksheet tab you want to activate. Double-click a worksheet tab to change its name.

3.6. Entering and Editing Data:

Entering Data

You can enter text, numbers and dates in an Excel worksheet. In Excel's terminology, numbers and dates are called **values** and text is referred to as a **label**. To enter data of any type, click on the cell you want to contain that data, and then type the information you want in the cell. When you begin typing, your data also appears in the formula bar. When you have finished typing the data for the active cell, press the Return or Enter key.

Editing Data

The easiest way to edit the contents of a cell is to select the cell and then retype the entry. The new entry replaces the old contents. For example, to change the number in cell C8 to 123, select cell C8, type 123 and press Return. This method works well with numbers, but is more difficult when editing long text labels or formulas.

The formula bar gives you more flexibility while editing. When the mouse pointer moves into the formula bar, it changes shape to an I-beam, signifying that you can enter or edit text. Text in the active cell appears in the formula bar and you can edit it there. Use the mouse to select the text you want to change in the formula bar and then type the new text. Excel automatically replaces what is selected. Don't forget to press the Return key when you finish editing a cell.

You can also edit labels and values directly in cells. Double-click on the cell you want to edit. This puts an insertion point in the cell. Edit the contents of that cell.

Moving the Active Cell

Cell selection and movement around the worksheet are similar operations in Excel. To select a given cell or make it active, simply click on that cell. Use the mouse or the arrow keys to move around the worksheet. For example, if you press the right arrow key twice you move two cells to the right.

Name box

The Name box displays the reference of the selected cells.

3.6. Row and Column Headings:

Letters and numbers identify the rows and columns on an Excel worksheet. The intersection of a row and a column is called a cell. Use row and column headings to specify a cell's reference. For example, the cell located where column C and row 8 intersect is called C8.

Active cell

The active cell has a dark border around it to indicate your position in the worksheet. All text and numbers that you type are inserted into the active cell. Click the mouse on a cell to make it active.

Fill handle

The lower right corner of the active cell has a small box called a Fill Handle. Your mouse changes to a cross hair when you are on the Fill Handle. The Fill Handle helps you copy data and create series of information. For example, if you type Monday in the active cell and then drag the Fill Handle over four cells, Excel automatically inserts Tuesday, Wednesday, Thursday, Friday and Saturday.

Worksheet tabs

An Excel workbook consists of 3 worksheets by default. Use the worksheet tabs at the bottom of the screen to navigate between worksheets within a workbook.

Go To Command

A quick way to move a large distance on a worksheet is with the Go To command on the Edit menu. When you select the Go To command, a dialog box prompts you to identify the cell. Enter the cell reference and click OK or press Return.

Clearing Cell Contents

To clear the contents of a cell choose **Clear** from the **Edit** menu. Then, select what you want to clear from the cell: All, Formats, Contents, or Notes. Most frequently you will want to clear the Contents of a cell. Pressing the **Delete** key also clears the contents of cells.

Undoing Mistakes

If you make a terrible mistake and you accidentally delete important data. Use the **Undo** command on the **Edit** menu or the Undo tool to correct the mistake.

Copying and Moving Data

Copy selected data from one cell to another with the **Copy** and **Paste** commands, or with the Drag and Drop procedure. If you want to move data use the **Cut** and **Paste** commands, or the Drag and Drop procedure.

Drag and Drop

This procedure does not involve the Clipboard and works best when moving data a short distance. To move cells, position the mouse on the cell borders. Wait until the mouse pointer changes to a left-pointing arrow then press and drag the data to the new location.

3.7. Auto Fill:

A series of numbers, month's names or week names can be filled automatically in Excel. For doing this simply type the first word in a cell then place the mouse pointer on the fill handle and then drag it either horizontally or vertically so that Excel fills the data automatically.

3.8. Custom Fill Lists:

Excel providing a facility to create our own fill lists we can create our college courses, names, a series of your colleague's name. These are the steps to create custom lists.

- Select Tools/Options.
- Click on custom lists.
- Click on New list on custom area.
- Type your list of entries in list entries area.
- Select add button.
- Your new list will be created.

3.9. Row or Column Size:

The height of a row or the width of a column can be changed to any desired value.

Row height

Select the row, which you want to increase the height, select Row from format menu. Specify the value. Then automatically the height of the Row increases.

Or

Select the row, then place the mouse pointer on the bottom borders of the row then the mouse pointer changes. Press left mouse button and drag the mouse downwards until the desired row height reaches.

Column Height

Select the Column, which you want to increase the width. Select Column from format menu. Specify the value. Then automatically the width of the column increases.

Or

Select the column, then place the mouse pointer on the top borders of the column then the mouse pointer changes. Press left mouse button and drag the mouse downwards until the desired column width reaches.

3.10. Inserting Rows and Columns:

Select Insert menu from menu bar and select row option. Then automatically the row will be inserted. Similarly select Insert menu from menu bar and select column option. Then automatically a column will be inserted.

3.11. References:

About cell and range references

A reference identifies a cell or a range of cells on a worksheet and tells Microsoft Excel where to look for the values or data you want to use in a formula. With references, you can use data contained in different parts of a worksheet in one formula or use the value from one cell in several formulas. You can also refer to cells on other sheets in the same workbook.

Relative reference

Relative cell references are references to cells relative to the position of the formula. When you create a formula, references to cells or ranges are usually based on their position relative to the cell that contains the formula. In the following example

The total amount is calculated by the formula $\text{rat} * \text{qty} + \text{vat}$. The fixed vat price has to be applied to all the transactions. Here we are applying absolute reference for the cell f2. i.e., $\$F\2 .

Named reference

You can assign names to cells or ranges of cells. When you do that, you can use the names in your formulas. For example, if you had a column named QTY and a column named Price, you could create a formula like $= \text{QTY} * \text{Price}$.

3.3. Charts:

Excel has features for preparing charts for the selected data in a worksheet. A chart can be drawn in the same worksheet in which data is available or can be drawn as a separate chart sheet. Chart sheets have again tabs in the tab area, which operates as worksheets tabs. All charts in Excel are available in chart wizard so that a chart can be prepared very easily by using this special chart wizard.

The Best Chart Types

There are a lot of different chart types out there, and it can be confusing to work out just which chart type you need for a particular set of data. Some of the most common types of chart and their uses are explained below. The definitions of the charts remain the same no matter what operating system you use, or what spreadsheet program.

Pie Chart Type

Pie charts should only be used if you want to show proportions. This chart type emphasizes the relationship between the whole and each part of that whole. A good example of this would be to display data on what spreadsheet program is preferred by 100 of the top spreadsheet experts.

Column/Bar Chart Type

The bar chart is undoubtedly the king of all chart types. Its simplicity makes it so useful for a range of data types. It is the best chart type to use if you need to compare values.

Scatter Chart Type

Scatter charts (also known as XY-Scatter charts) can be used when you need to display two related sets of data on a chart, particularly if you want to make predictions based on the data.

Line Chart Type

Line charts should generally only be used where there is a period of time involved. These charts are perfect for displaying trends. For example, if you want to chart the increase in use of open

source spreadsheets during a 5-year period, the line chart would be an excellent choice for your chart type.

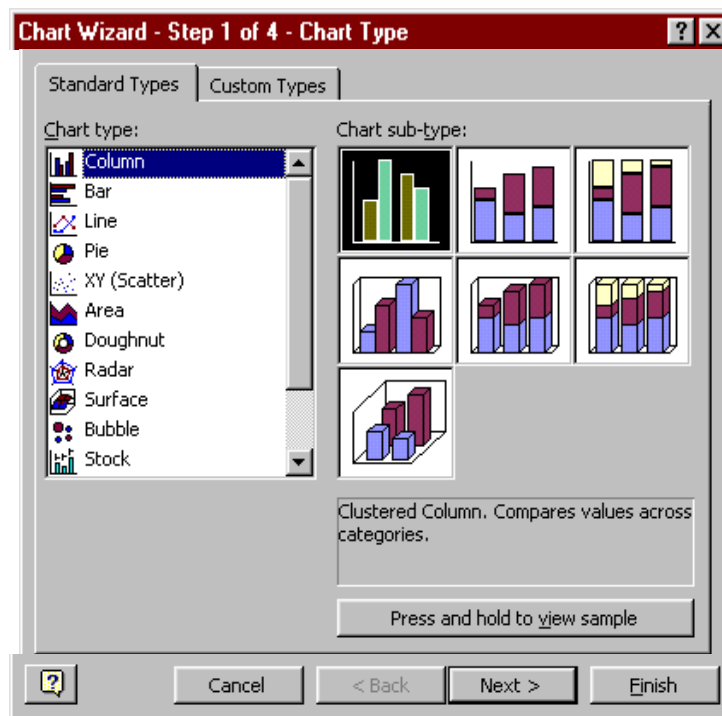
The first step to making our chart is to select the range of data to be charted.

	A	B	C	D	E	F	G
1							
2			Apples	Oranges	Grapes	Bananas	
3		January	13	8	8	13	
4		February	8	11	3	7	
5		March	4	7	7	15	
6		April	8	8	8	8	
7		May	7	11	11	4	
8		June	12	3	12	15	
9		July	9	7	11	11	
10		August	4	14	15	9	
11		September	7	7	8	13	
12		October	10	9	5	15	
13		November	8	15	15	6	
14		December	5	13	6	3	
15							
16							
17							

The **Chart Wizard** can be started by using the **Chart Wizard** button on the Standard command bar (left) or from the **Chart...** button on the **Insert** menu. The data can be selected prior to running the chart wizard, filled in while running the chart wizard, or added to the chart later. The Chart Wizard runs through a series of steps that help you set up your chart.

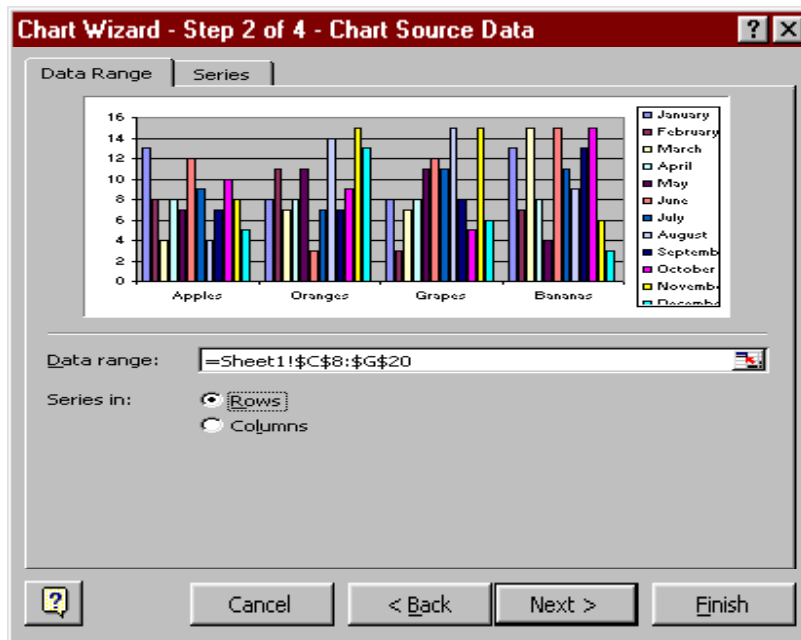
Step 1 - Select a Chart Type


The Standard Types tab of Step 1 of the Chart Wizard shows a list of chart types on the left side, and several chart sub-types on the right. The Custom Types tab has a number of built-in custom types of charts, including several combination charts. You can add your favorite custom chart types to the User-Defined list.



Step 2 - Source Data

The Data Range tab gives you a preview of the chart style you selected in Step 1, indicating where the chart's source data range is, and allowing you to plot by row or by column. The first dialog box below shows a column chart, plotted by rows. The second shows an area chart plotted by columns.



If you click in the Data range box, or click on the Range selection button , the dialog box shrinks to the size of just the data range box, obscuring less of the worksheet, so you are able to adjust this range with your mouse.



When the Source Data dialog box is activated, a “marching ants” border, shown in unanimated form below, highlights the source data range.

	Apples	Oranges	Grapes	Bananas
January	13	8	8	13
February	8	11	3	7
March	4	7	7	15
April	8	8	8	8
May	7	11	11	4
June	12	3	12	15
July	9	7	11	11
August	4	14	15	9
September	7	7	8	13
October	10	9	5	15
November	8	15	15	6
December	5	13	6	3


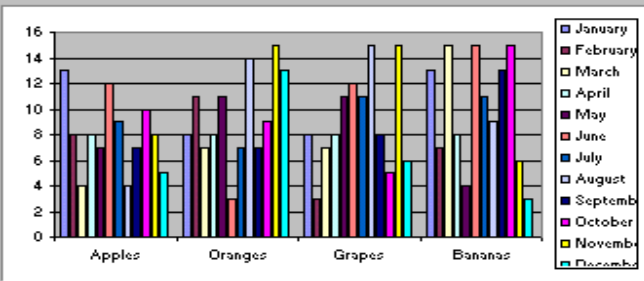
Clicking on the Series tab gives you the option to add or remove some of the data series in the selected source data range. You can change the Name, Values (Y axis), and Category labels (X axis) of each series, by editing the contents of the respective box, or by clicking on the Range selection button , then dragging with the mouse.

Chart Wizard - Step 2 of 4 - Chart Source Data

Data Range **Series**



Series

January
February
March
April
May

Name: =Sheet1!\$C\$9

Values: =Sheet1!\$D\$9:\$G\$9

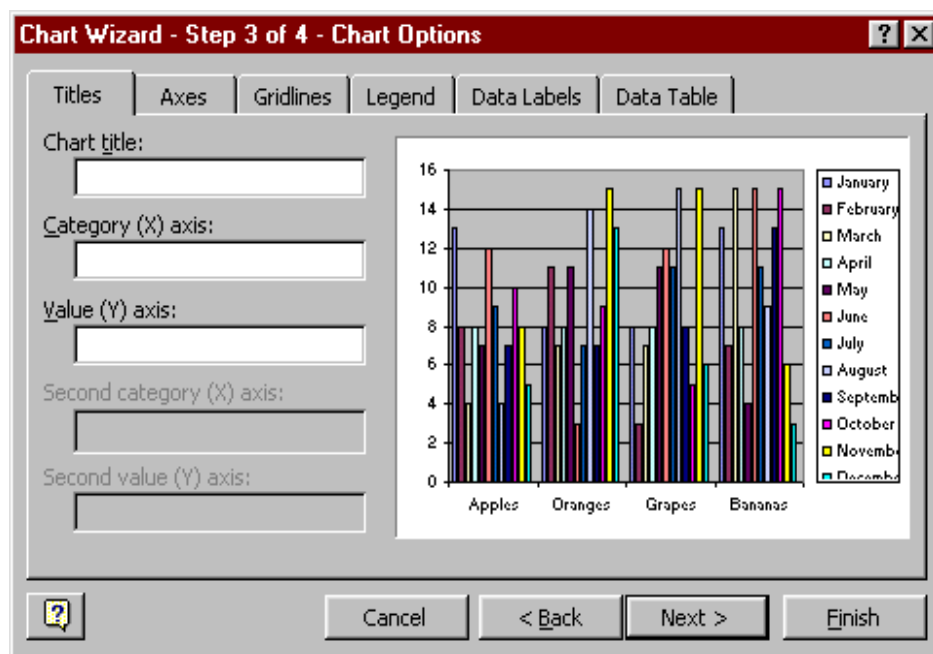
Add Remove

Category (X) axis labels: =Sheet1!\$D\$8:\$G\$8

Cancel < Back Next > Finish

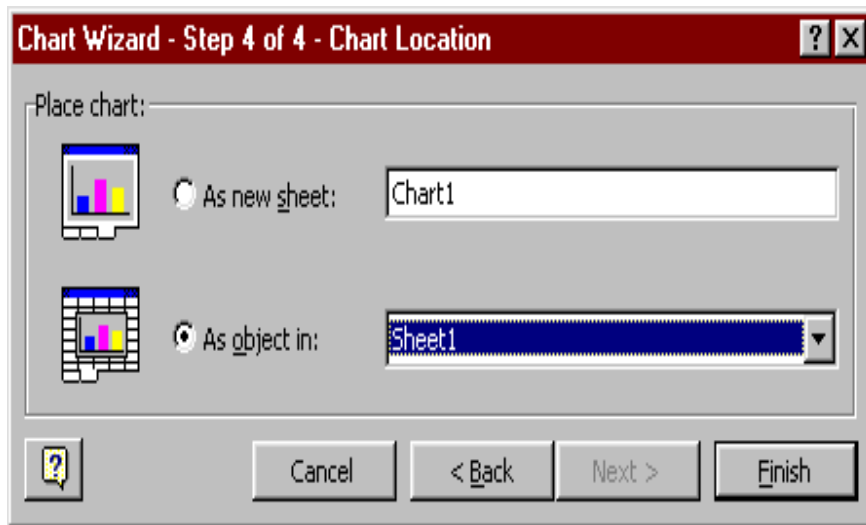
Step 3 - Chart Options

This step allows you to provide a title for the chart and for the chart axes, to select which and what kind of axes to put in your chart, and whether to show other options, such as gridlines, a legend, and data labels.



Step 4 - Chart Location

Here you tell Excel where to place the chart. You can put the chart onto its own sheet with a name that you enter in the box (where it says "Chart1") or you can embed the chart as a chart object in one of the existing worksheets (or chart sheets), which you select from the drop down list.



3.3. Summary:

In this lesson you learnt the basic features of Spread Sheet. Excel is used for performing accounting problems. In this chapter we introduced the concept of inserting, modifying and deleting rows/columns. We have learnt the procedure of changing the size of rows/columns and changing the data in a cell. Excel is having different types of references like Relative, Absolute and Named references. The data can be represented in many ways; using the different types of charts we can represent the data in effective manner.

3.14. Technical Terms:

Active Cell: The active cell has a dark border around it to indicate your position in the worksheet.

Relative Reference: Relative cell references are references to cells relative to the position of the formula.

Absolute Reference: Absolute references, which are cell references that always refer to cells in a specific location.

Formula Bar: Use the formula bar to enter and edit worksheet data.

3.15. Model Questions:

1. Explain the features o MS-Excel
2. Explain different references in MS-Excel
3. Explain the Chart feature in MS-Excel.
4. What is Auto Fill ? Explain Custom Fill List feature MS-Excel.

3.16. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' **BPB Publications, New Delhi**

MS OFFICE 2000 Complete, BPB Publications, New Delhi

Lesson –12

Microsoft Excel

3.0 Objectives:

This lesson introduces the basic features of Microsoft Excel, Pictures and Auto shapes, Worksheet Formatting, Worksheet Printing, Worksheet as Database and Macro in Excel.

Structure

- 3.1. Pictures and Auto shapes
- 3.2. Worksheet Formatting
- 3.3. Functions
- 3.4. Worksheet as Data base
- 3.5. Worksheet Printing
- 3.6. Macro
- 3.7. Summary
- 3.8. Technical Terms
- 3.9. Model Questions
- 3.10. References

3.1. Pictures and Auto shapes:

Pictures

Excel has a feature of inserting pre-defined pictures or clipart into the worksheets. All these features are available under Insert Menu of the menu bar.

Inserting Clipart

Select the worksheet area in which you want to insert clipart. Select insert menu from the menu bar, click picture, and clipart. Now we see lot of pictures in a dialog box. Select Clipart tab, category, select an image and click insert. Then automatically the selected image will be displayed in the worksheet and then figure will have small squares around the surface. These are called handles and are used to increase or decrease the size of the image.

Inserting picture form file

We can also insert pictures form a file. For this select insert menu from the menu bar and click picture from file. Then we see a dialog box in that select the required folder in which the file is

available and the name of the file and click on the Insert button. Then the pictures from the file will be inserted into the worksheet.

Inserting Auto shapes

An auto shape can be inserted into a worksheet. For this select Insert menu from the menu bar and click picture and in it Auto shape. Then different shapes will appear in the dialog box. From that select the required auto shape. Now place the mouse pointer in the sheet where you want to draw the auto shape. The mouse pointer looks like a + sign. Then press the left mouse button and drag the mouse diagonally or towards right so that the selected auto shape will appear in the worksheet. After reaching the required auto shape then release the left mouse button. The size of the auto shape can be increased or decreased and also you can rotate the auto shape by an angle using the auto shape tool bar.

3.2. Worksheet Formatting:

Alignment of cells

Generally in Excel by default all the text will be aligned left and numbers to the right. But we can align text or number in the desired fashion. Select Format menu from the menu bar, Cells, then activate the Alignment Tab. There are two types of cell alignments they are Horizontal and Vertical alignments.

In the case of Horizontal alignment we have default option left (contents are aligned left), right (contents are aligned right), center (contents are aligned center), fill (contents are duplicated so that they fill the cells), justify (aligned left and right) options available.

In the case of vertical alignment we have Top (contents are aligned top), center (contents are aligned center), bottom (contents are aligned bottom), justify (contents are aligned top and bottom) options are available.

Excel allows Text Wrap option. When we type text, if the text overflows then adjacent cells will be used. But in the text wrap option there will not be any overflow instead the cell width will be increased to accommodate the text.

Number Formatting

Entering and formatting numbers

Numbers are referred as constant values or values. In addition to the numbers 0 to 9, you can enter the following symbols. That are

+ - () , . \$ %

It treats commas and other dolor signs correctly, and it accepts numbers entered in scientific notation (2.5E+2)

Different Number Formats

General

Number

Currency

Accounting

Date
Time
Percentage
Fraction
Scientific
Text
Special
Custom

When we enter any number it will take the number in general format. We can change the type of cell after entering the numbers in a cell.

For example If you activate a cell in the General format, then type a number with a dollar sign (\$), the cell's format will change from general to currency format.

When a number is too big to be properly displayed in its cell, excel after displays a series of pound signs (#####) instead of the number. Some times excel switch to scientific notation to accommodate a large number.

Entering Dates and Times

You can enter dates and times by typing item in most commonly accepted American formats.

11/7/97

11-Nov-97

Nov 7, 1997

The excel stores dates and times as serial numbers using January 1, 1900 at the starting date that in one (1). The serial number 2 stand January 2, 1990. You can change the date format to number, and number to date. If we enter 8/93, the system automatically displays accepts as Aug-93.

If we enter numbers starting with ' (single quote), the entered data will be treated as text.

Fonts for Cells

To change the, font size, font style, Bold, Italic and Underline, select the cells in which we want to change the font. Select Format menu from the menu bar, Cells, then activate the Font Tab. Now apply font style, size, bold, italic etc., and click OK. Now the selected cells will be formatted accordingly.

Auto Format

Excel has some pre-defined formatting schemes, and those can be utilized directly instead of formatting worksheet.

Select the cells, which are to be auto formatted and then select Format from the menu bar and click Auto Format. Then we get auto format dialog box on the screen. Here click the required format style, and click O.K. Then the selected cells will be formatted according to the selected pre-defined auto format.

3.3. Functions:

The various MS-Excel functions are classified as:

1. Statistical function:

Function	Purpose
SUM()	It computes the sum of a particular defined range or range names. Ex: sum(a1:a4)
Average()	It computes the average of a particular defined range or range numbers. Ex:- Average(a1:a4)
Count()	It counts the number of non blank cells in a particular defined range or range names. Ex:- count(a1:a4)
Max()	It will display the maximum value from a particular defined range or range names. Ex:- max(a1:a4)
Min()	It will display the minimum value from a particular defined range or range names. Ex:- min(a1:a4)

2. Mathematical function:

Function	Purpose
ABS()	It will calculate the absolute value of a number. Ex:- abs(-9) will display as 9.
Int()	It will round off the number down to its nearest integer. Ex:- int(19.34) will display as 19
Mod()	It will calculate the remainder after integer division. Ex:-mod(5,2) will display 1
Round()	It will round off the number down to a specified number of decimal places. Ex:- round(a1,2) will display 19.34 if cell a1 contains 19.345678
Sqrt()	It will calculate the square root of a positive number. Ex:- sqrt(9) will display 3.

3. Trigonometric functions:

These functions are used for trigonometric calculations on a list of values. Some commonly functions like SIN, COS, TAN, ACOS, ATAN, ACOSH, ATANH and DEGREES etc.

Syntax:- function (cell address/value)

4. Financial functions:

These functions are used to compute loans, depreciation, cash flow etc., Some commonly used financial functions are RATE, FV, PMT etc.,

Rate(): It calculates the rate of interest per period. The syntax is RATE(nper, pmt, pv, fv, type, guess). Here nper is the total payment period, pmt is payment made per period, pv is present value of the total amount, fv is the future value, type is the number 0 or 1 depending upon whether the payment is to be made at the end of the period or at the beginning respectively. Guess is the guess value for the rate of interest.

For example, amount of loan = Rs.50,000 to be paid in 24 monthly installments of 3,000 each. Here nper = 24, pmt=-3,000, pv=50,000 fv=0. The default guess is 10%. Now RATE(24,-3000,50000,0,0,10) will display 1% as rate of interest.

PMT(): The purpose of PMT() function is to compute the equal periodic payments required to pay off a loan. The general syntax of PMT() function is PMT(rate, nper, pv, fv, type)

Here fv and type are optional. Suppose if you want to take a loan of Rs.2,00,000/-. The annual interest rate is 14% and has to be paid in 15 years in equal monthly installments. Here rate is 14%/12, nper is 180 (15 * 12) and pv is 2,00,000. Here fv is zero by putting all these in the formula

Pmt(14/12,180,200000).

3.4. Worksheets as Data Bases:

Excel is a spreadsheet application but can also be used as a database. There are two limits for using Excel as a database. The first one is that only one person at a time can enter data into the database.

The second limit is a matter of quantity of data. Each sheet in an Excel workbook comprises 65,000 rows and 256 columns. An Excel workbook can comprise up to 256 sheets. We are talking about 4,292,608,000 cells.

Excel needs to recognize your set of data as a database or you will not have access to any of the database functionalities from the "Data" menu item (Sort, Filter, Form, Subtotal).

The DATABASE is a set of columns and rows in your spreadsheets without empty rows and empty columns. Many cells can be empty but never an entire row or an entire column.

The database must have a single title row. Use "Text Wrap" in Format/Cells/Alignment to write more than one line of text in one cell.

The DATABASE must be surrounded by empty rows and columns (row "1" and column "A" of the worksheet are considered preceded by an empty row or column).

So anybody can develop a database in Excel. You don't need to develop complex forms to enter data, you don't need to develop queries you just use SUMPRODUCT, INDEX/MATCH and SUBTOTAL formulas to develop reports by yourself when you need them and that have the layout that you need.

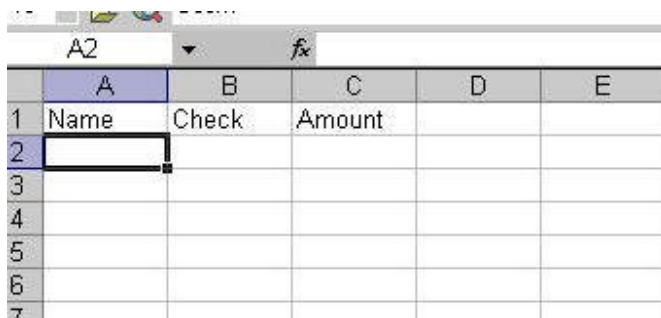
Excel is the most user friendly analyzing and reporting application so they don't need to train a few analysts on other reporting applications creating a bottleneck at the report development level. Adopting Excel also allows all the analyst and decision makers to develop significant analysis and reports improving the bottom line of the whole corporation.

Using Data Forms

A *data form* is used to allow easy manipulation of information in an Excel data list. While a list is small--for instance, when it fits on one screen--it is easier to enter or change information directly. When you start getting a larger number of records, then you may find using a data form to be easier. A data form is a dialog box that displays one complete record from your list at a time. Excel considers a record to be a single row in your data list, so a data form basically extracts the information from a row, uses the field labels from the first row of the list, and displays the information so you can understand it easier. To utilize a data form, follow these two simple steps:

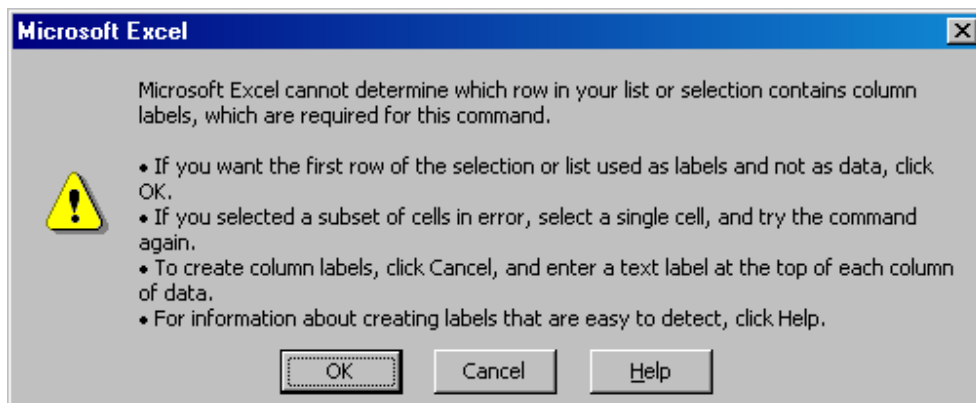
Creating Data Forms in Excel

When you have to input a data into a worksheet, using an Excel generated data form may make the job easier. Your worksheet should contain column titles as in the example below:



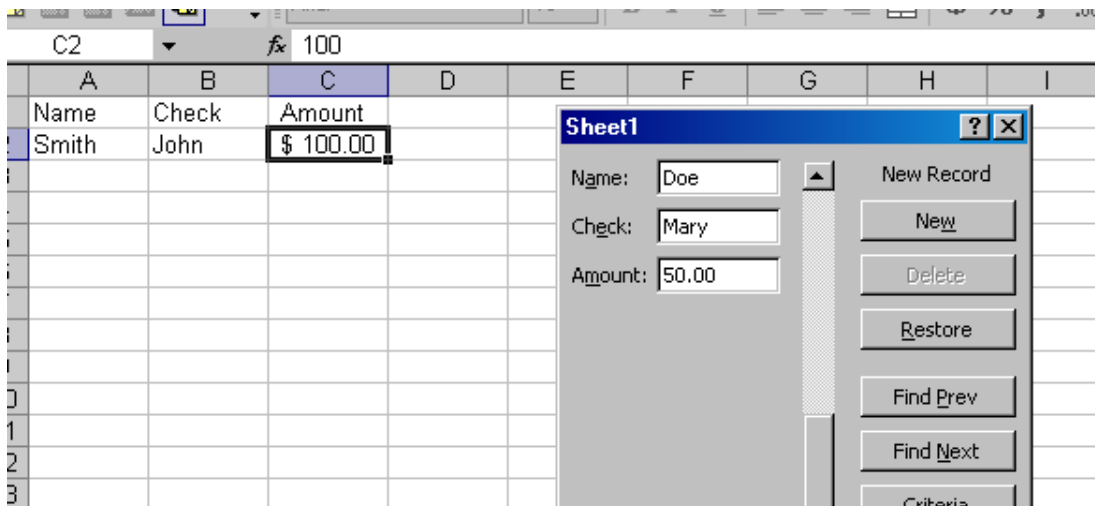
	A	B	C	D	E
1	Name	Check	Amount		
2					
3					
4					
5					
6					
7					

Click in the first cell in the row directly below your titles, then select Data, Form. If you receive the message below, click OK.



Your data form is created and ready for data entry.

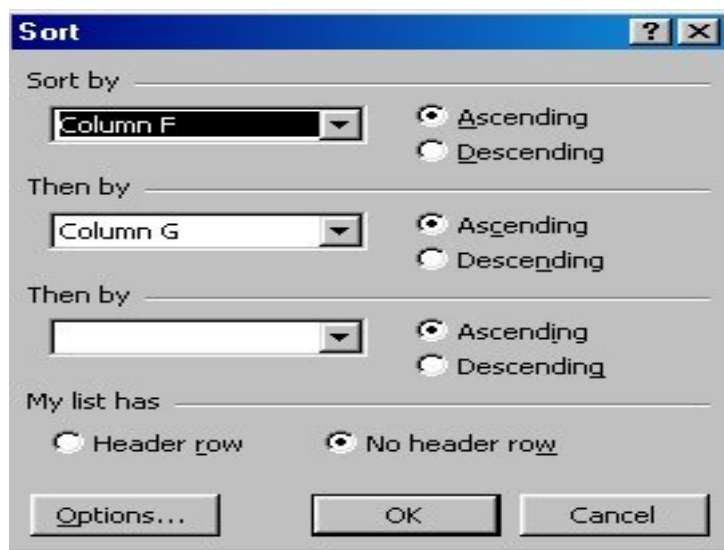
Type your data, tabbing between fields and press Enter or click New after each record to add it to the worksheet.



When you are done entering records, click Close.

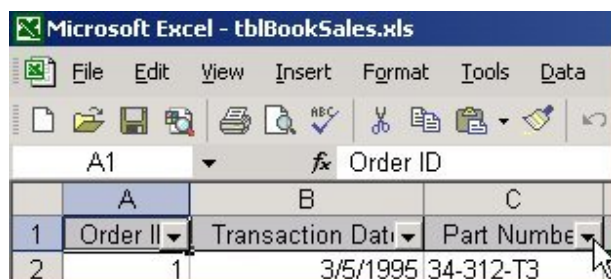
Sorting Data:

1. Select the columns that you want to sort.
2. Click Data>Sort.
3. In the sort window choose the column or columns you want to sort by.
4. If you have a heading row make sure the Heading row option is selected.
5. Click OK.
6. The data will now be sorted.



Filter Data:

1. Click **Data>Filter>AutoFilter**.
2. The first row of the spreadsheet becomes the filtering row.
3. To filter for specific data, click on the down arrow next to the head of the column you want to filter by.
4. Then select the criteria you want to filter for.
5. You may filter by multiple columns at once by repeating steps 3-4 for each column you want to filter by.



3.5. Worksheet Printing:

Page Breaks

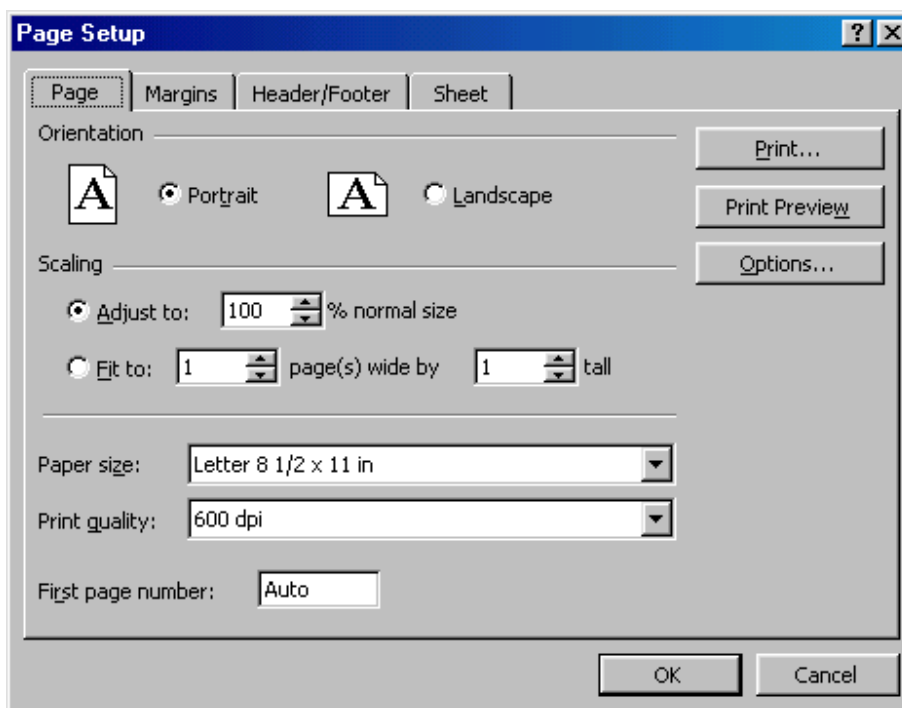
To set page breaks within the worksheet, select the row you want to appear just below the page break by clicking the row's label. Then choose **Insert|Page Break** from the menu bar. You may need to click the double down arrow at the bottom of the menu list to view this option.

Page Setup

Select **File|Page Setup** from the menu bar to format the page, set margins, and add headers and footers.

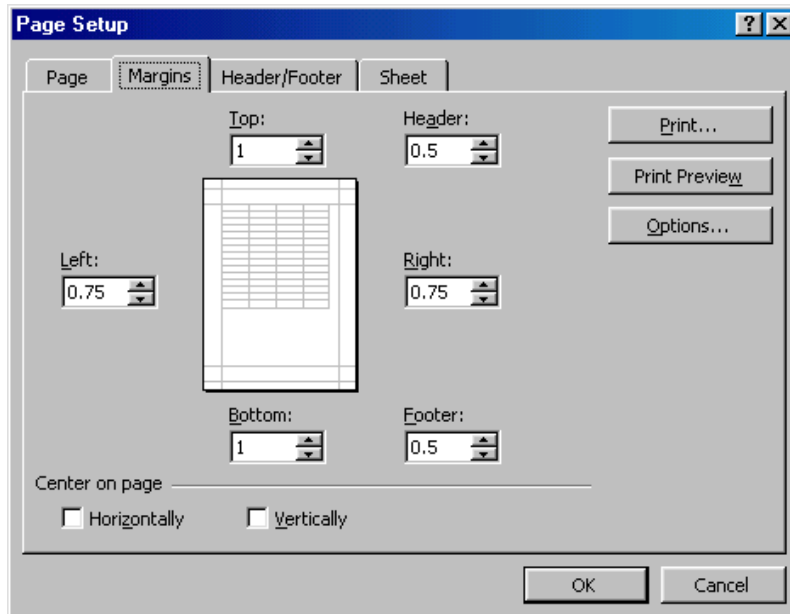
Page

Select the **Orientation** under the **Page** tab in the Page Setup window to make the page Landscape or Portrait. The size of the worksheet on the page can also be formatting under **Scaling**. To force a worksheet to print only one page wide so all the columns appear on the same page, select **Fit to 1 page(s) wide**.



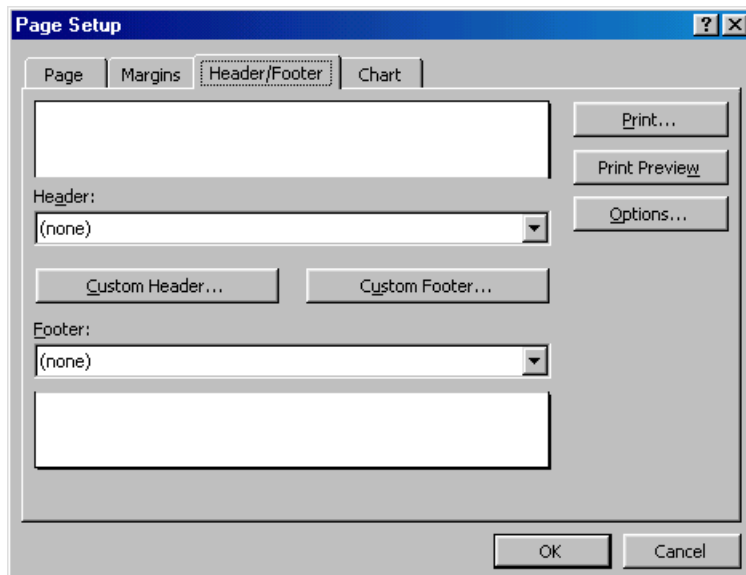
- **Margins**

Change the top, bottom, left, and right margins under the **Margins** tab. Enter values in the header and footer fields to indicate how far from the edge of the page this text should appear. Check the boxes for centering horizontally or vertically on the page.

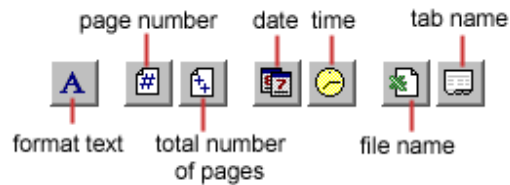


- **Header/Footer**

Add preset headers and footers to the page by clicking the drop-down menus under the Header/Footer tab.



To modify a preset header or footer, or to make your own, click the **Custom Header** and **Custom Footer** buttons. A new window will open allowing you to enter text in the left, center, or right on the page.



Format Text - Click this button after highlighting the text to change the font, size, and style.

Page Number - Insert the page number of each page.

Total Number of Pages - Use this feature along with the page number to create strings such as "page 1 of 15".

Date - Add the current date.

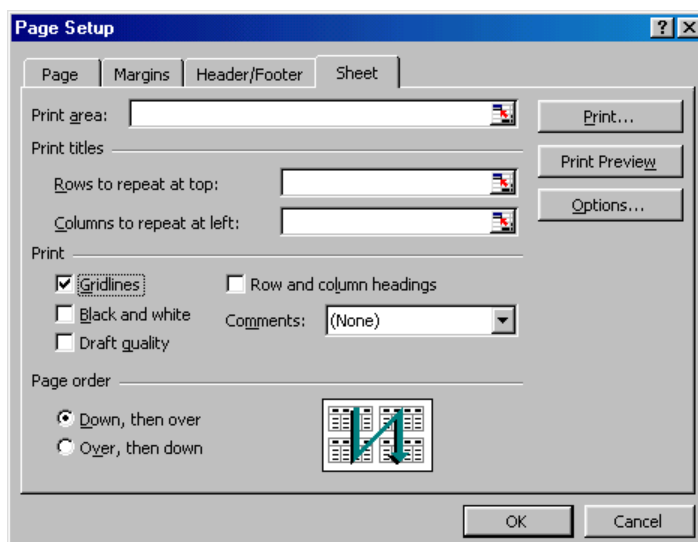
Time - Add the current time.

File Name - Add the name of the workbook file.

Tab Name - Add the name of the worksheet's tab.

- *Sheet*

Check **Gridlines** if you want the gridlines dividing the cells to be printed on the page. If the worksheet is several pages long and only the first page includes titles for the columns, select **Rows to repeat at top** to choose a title row that will be printed at the top of each page.

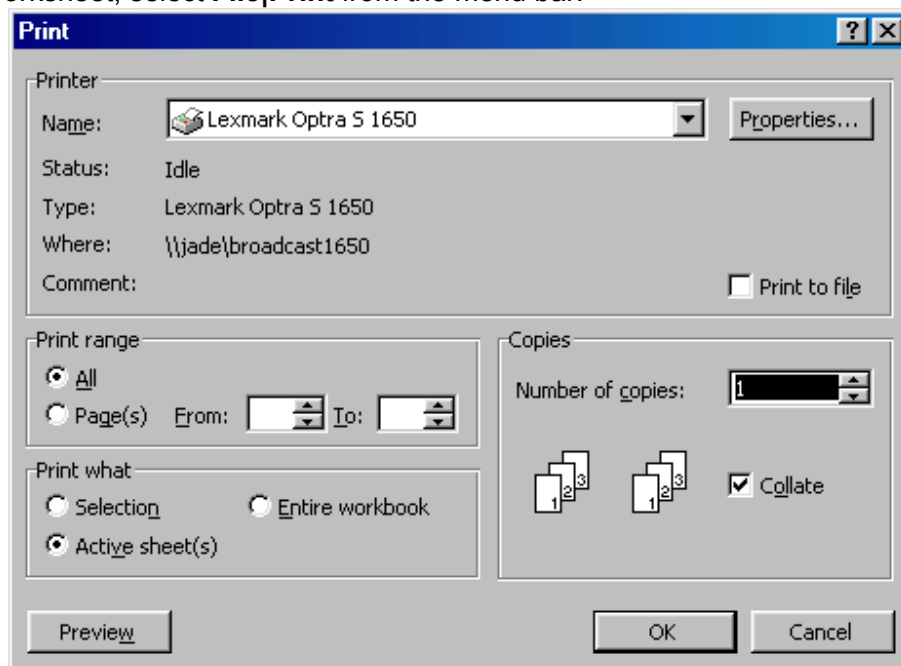


Print Preview

Select **File|Print Preview** from the menu bar to view how the worksheet will print. Click the **Next** and **Previous** buttons at the top of the window to display the pages and click the **Zoom** button to view the pages closer. Make page layout modifications needed by clicking the **Page Setup** button. Click **Close** to return to the worksheet or **Print** to continue printing.

Print

To print the worksheet, select **File|Print** from the menu bar.



- **Print Range** - Select either all pages or a range of pages to print.
- **Print What** - Select selection of cells highlighted on the worksheet, the active worksheet, or all the worksheets in the entire workbook.
- **Copies** - Choose the number of copies that should be printed. Check the **Collate** box if the pages should remain in order.

Click **OK** to print.

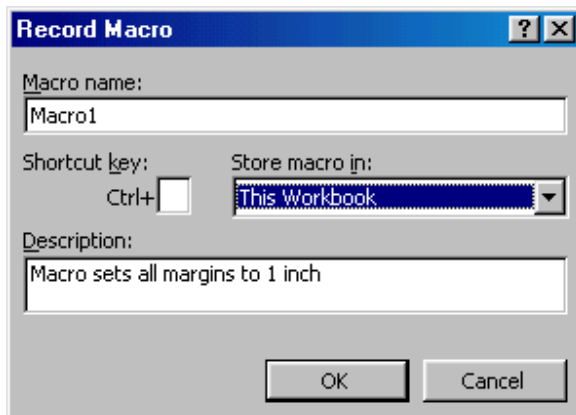
3.6. Macro:

Macros can speed up any common editing sequence you may execute in an Excel spreadsheet. In Macro two options are there. They are Recording a Macro and Running a Macro.

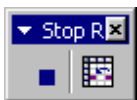
Recording A Macro

In this example we will make a simple macro that will set all the margins on the page to one inch.

- Click **Tools|Macro|Record New Macro** from the menu bar.



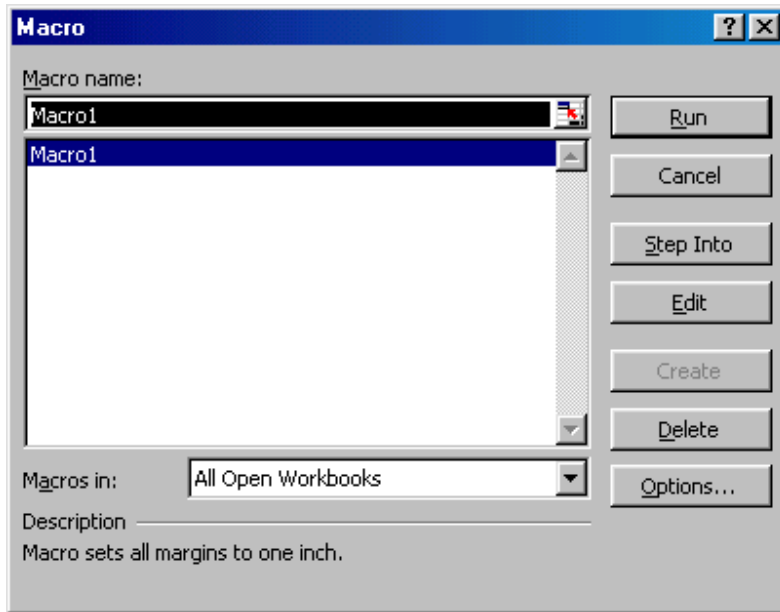
- Name the macro in the **Macro name** field. The name cannot contain spaces and must not begin with a number.
- If you would like to assign a shortcut key to the macro for easy use, enter the letter under **Shortcut key**. Enter a lower case letter to make a CTRL+number shortcut and enter an upper case letter to assign a CTRL+SHIFT+number shortcut key. If you select a shortcut key that Excel already uses, your macro will overwrite that function.
- Select an option from the **Store macro in** drop-down menu.
- Enter a description of the macro in the **Description** field. This is for your reference only so you remember what the macro does.
- Click **OK** when you are ready to start recording.
- Select options from the drop down menus and Excel will record the options you choose from the dialog boxes, such as changing the margins on the Page Setup window. Select **File|Page Setup** and change all the margins to 1". Press **OK**. Replace this step with whatever commands you want your macro to execute. Select only options that modify the worksheet. Toggle actions such as **View|Toolbars** that have no effect on the worksheet will not be recorded.



- Click the **Stop** button the recording toolbar. The macro is now saved.

Running A Macro

- To run a macro you have created, select **Tools|Macro|Macros** from the menu bar.
- From the **Macros** window, highlight the **Macro name** in the list and click **Run**.



- If the macro is long and you want to stop it while it is running, press **BREAK** (hold **CTRL** and press **PAUSE**).

3.7. Summary:

In this lesson we have learnt how to insert graphics in Excel. You have learnt the usage of functions. Functions are differentiated into different types. We can use the functions with respect to our application. It is the best way to see the output in print preview fashion before we are going for final print. Worksheet can also be used as a Database. You have learnt the concept of using Data Forms. By using the Data Form we can enter the data and treat it as a record. We can sort the data and can filter the data with respect to our criteria.

3.8. Technical Terms:

Data Form: A *data form* is used to allow easy manipulation of information in an Excel data list.

Page Orientation: Page Orientation is used to set the page Landscape or Portrait.

3.9. Model Questions:

1. Explain the usage of functions of Excel?
2. Explain the procedure to use the Data Forms in Excel?
3. Explain the concept of formatting data in excel?
4. How you can use the worksheet as a Database? Explain.

3.10. References:

RON MANSFIELD, 'Working with MS OFFICE', Tata Mc Graw Hill – 2000 Edition

GUY HART DAVIS, ' The ABC'S Of Microsoft Office. ' **BPB Publications, New Delhi**

MS OFFICE 2000 Complete, BPB Publications, New Delhi

Lesson 13

–

Introduction to 'C'

Objectives:

The main objectives of this lesson are:

- To familiarize the students with the history and development of C language.
- To clarify certain basic concepts in C language.
- To know the different elements of C like character set, keywords etc.,
- To classify different C program entities like identifiers, constants, statements and expressions.
- To know different types of data types available in C language.
- To understand the working and usage of input/output statements in C language.

Structure of the Lesson:

- 13.1. Introduction
- 13.2. History and Development of C
- 13.3. Features of C
- 13.4. Types of C compilers
- 13.5. Structure of a C program
- 13.6. C character set
- 13.7. Escape sequences
- 13.8. C reserved words
- 13.9. Identifiers
- 13.10. Data types
- 13.11. Constant
- 13.12. Variables
- 13.13. Expression
- 13.14. Statements
- 13.15. Symbolic constants
- 13.16. Operators
- 13.17. scanf()
- 13.18. printf()
- 13.19. Summary
- 13.20. Technical terms
- 13.21. Model questions
- 13.22. References

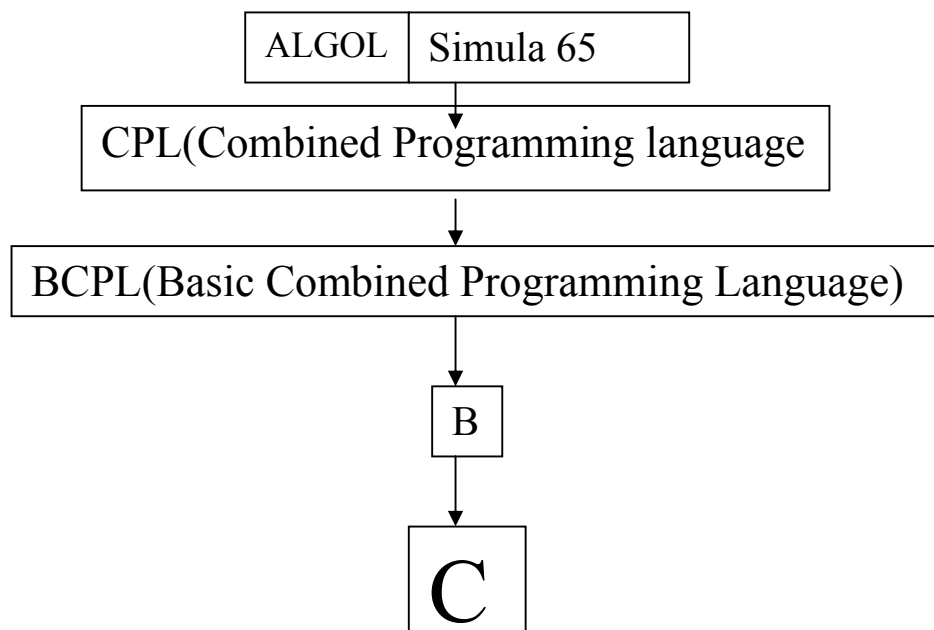
13.1.Introduction:

The step-by-step process of solving a given problem is called an algorithm. Using the algorithm select a programming language of your choice, based on the type of problem. Convert the algorithm into a program following the syntax of that language. One of such programming languages is our C.

13.2.History and Development of C Language:

C is an offspring of the Basic Combined Programming Language (BCPL) and B developed in 1960 at Cambridge University. The language B was modified by Dennis Ritchie and implemented at Bell Laboratories in 1972. This modification was named as C.

'C' was then used to implement the UNIX operating system. C is a general-purpose language, which has been closely associated with the UNIX operating system.



13.3.Features of C language:

C is a beautiful language and provides many built-in functions that help in problem solving. We list out certain common features of C that have been quite useful.

- C is a powerful, flexible language that provides fast program execution and imposes few constraints on the programmer.
- C's power and fast program execution come from its ability to access low level commands, similar to assembly language, but with high level syntax.
- Another strong point of C is its use of modularity. Sections of code can be stored in libraries for re-use in future programs. This concept of modularity also helps with C's portability and execution speed.
- C is a block-structured language with fundamental flow-control construction.
- C includes certain low-level features that are normally available in assembly or machine languages.
- Programs written in C compile into small object programs that execute efficiently.
- C is a largely machine independent language and programs written in C can be easily ported from one computer to another.
- C compilers are widely available in most personal computers minicomputers and mainframes.

13.4.Types of C compilers:

The following are the some of the compilers for C language:

- Turbo C
- Quick C
- Microsoft C

13.5. Structure of a C program:

Every C program consists of one or more functions, one of which must be called main. The program will always begin by executing the main function. Additional function definitions may precede or follow main(). Hence we say that C is a function dependent language.

Structure of a C program:

```
Documentation section
Include libraries - Linkage section - Preprocessor Directives
Declare global variables
Declare constants
Define macros
Function Prototype Declaration Section
main()
{
Local variable declarations
-----//
Main body of the program
-----//
}
function-1()
{
-----
}
function-2()
{
-----
}

.....

Function-n()
{
-----
-----
}
```

Here

1. Comments are non-executable statements meant for remarks regarding program. Comment lines begin with a `/*` and end with a `*/`.
2. 'C' is very case sensitive. All 'C' statements should be in lower case except user-defined expressions.
3. Every statement in 'C' must be terminated by a semicolon except the conditional statements like `if`, `if-else`, `switch`, `for`, `while` and compile directive statements like `#include`, `#define`.
4. Every statement must be included in `{` and `}` of `main()`.
5. Every program must include at least one function called `main()`

13.6.C Character Set:

Character set means the characters and symbols that can be used in a C program. They are grouped to form the commands, expressions and other tokens for C language. Character set is the combination of characters, digits, special characters and blank spaces. C language uses

Alphabets:	upper case letters A to Z Lower case letters a to z
Digits:	0 to 9
Special Characters:	{,}, #, :, ;, &, ? Etc.,

13.7.Escape Sequences:

A special kind of a character that allows the user to customize the output of a program is referred as escape sequence.

<code>\b</code>	back space
<code>\n</code>	new line
<code>\t</code>	horizontal tab
<code>\a</code>	bell
<code>\\</code>	backslash
<code>%%</code>	percentage
<code>\v</code>	vertical tab
<code>\0</code>	NULL character
<code>\f</code>	form feed

13.9. Identifiers:

Identifiers are names given to various program elements, such as variables, functions and arrays. Identifiers consist of letters and digits, in any order, except that the first character must be a letter. Both uppercase and lowercase are permitted. Upper and lowercase letters are not interchangeable, i.e., uppercase letter is not equivalent to the corresponding lowercase letter and vice versa. The under score character (_) can also be included. An underscore is often used in the middle of an identifier.

Valid Identifiers

A, B, Stno, tax_rate etc.,

Invalid Identifiers

4th "x"

13.10. Data Types:

C supports several different types of data, each of which may be represented differently within the computer's memory. A data type is a C token that tells about the type of data being assigned to an identifier.

C supports a rich set of data types. The category follows:

- Primary data types or Primitive data types
- Secondary data types

While using the above data types, one should intimate the compiler by providing corresponding format specifier or control string.

Primary data types:

Short int
int
long int
float
double
long double

Secondary data types:

Arrays
Functions
Pointers
Structures
Unions
Enumeration

The % format specifiers:

The % specifies that you can use in ANSI C are:

Format	Data Type
%d (%i)	Int
%e (%E)	float or double
%f	float or double
%o	Octal
%p	Pointer
%s	String
%u	Unsigned data representation
%x (%X)	Hexa-decimal data representation
%c	Character (single)
%ld	Long int
%lf	Long double

The data size of each data type follows:

Data type	Data size in bytes	Range
Short int	1(8 Bits)	-128 to 127
Unsigned short Int	1(8 bits)	0 to 255
Int	2(16 bits)	-32768 to 32767
Unsigned int	2(16 bits)	0 to 65535
Long int	4(32 bits)	-2,147,483,648 to 2,147,483,647
Double	8(48 bits)	1.7E-308 to 1.7E+308
Long double	10(80 bits)	3.4E-4932to 1.1E+4932
Char	1(8 bits)	-128 to 127

13.11. Constants:

A constant is an identifier whose value can never be changed during the program execution. C has four basic types of constants. They are

1. Integer constant
2. Floating-point constants
3. Character constant
4. String constant

Integer constant:

0 1 743 5280

Floating constants:-

0. 1. 0.2 825.602 2E-8 0.06E-3

3×10^5 can be represented as follows:

300000. 3E5 3E+5 3.0E+5 .3E+6 30E4

5.026×10^{-17} can be represented as follows:

5.026E-17

.5026E-16

Character constants:-

'A', 'X', '3', '\$'

String Constants:

A string consists of any number of consecutive characters enclosed in double quotations.

Ex: "green", "jkc college"

13.12. Variable:

A variable is an identifier that is used to represent some specified type of information. Or a variable is an identifier whose value may or may not be changed during the program execution.

```
int a, b, c;
```

```
char d; a=3; b=4; d = 'a';
```

All variables must be declared before they can appear in executable statements.

```
int a, b, c; float root1, root2;  
char flag;
```

13.13.Expression:

An expression represents a single data item, such as a number or a character. It may also consist of a combination of entities interconnected by one or more operators.

Ex: c=a+b
 x=y;
 x<=y
 x==y
 ++i;

13.14.Statements:

A statement causes the computer to carry out some action. There are three different classes of statements in C.

- Expression Statement
- Compound Statement
- Control Statement

An expression statement consists of an expression followed by a semicolon.

```
a=3;  
c=a+b;  
a++;  
printf("jkc college");
```

A compound statement consists of several individual statements enclosed within a pair of braces {}.

```
{  
pi=3.1415;  
area=pi*radius*radius;  
}
```

Control statements are used to create special program features, such as logical tests, loops and branches.

Ex: Program to add two numbers 10 and 20.

```
#include <stdio.h>
#include <conio.h>
main()
{
    int a, b, sum;
    clrscr();
    a = 10;
    b = 20;
    sum = a + b;
    printf("\n\t Sum of %d and %d is %d", a, b, sum);
}
```

13.15. Symbolic constants:

A symbolic constant is a name that substitutes for a sequence of characters. The characters may represent a numeric constant, a character constant or a string constant.

```
# define name text
```

Where name represents a symbolic name, typically written in uppercase letters, and text represents the sequence of characters associated with the symbolic name. Note that text does not end with a semicolon.

```
# define TAXRATE 0.25
# define PI 3.1415
# define TRUE 1
# define FALSE 0
```

Notice that the symbolic names are written in uppercase, to distinguish them from ordinary C identifiers.

13.16. Operators:

An operator performs an operation over one or more operands. C supports a rich set of operators. The following are the some of the examples.

Unary Operator:

An unary operator performs operation on one operand. The unary operators are: ++, --

Ex:

→ ++a or a++ is equivalent to a=a+1
→ --a or a-- is equivalent to a=a-1.
Here ++a - Pre-incrementation
 a++ - Post-incrementation
 --a - Pre-decrementation
 a-- - Post-decrementation

- In Pre-incrementation the value is incremented first, then assigned.
- In Post-incrementation, the value is assigned first, then incremented.
- In Pre-decrementation, the value is decremented first, then assigned.
- In Post-decrementation, the value is assigned first, then decremented.

For example:

```
int i = 5;
printf ("%d\n",i);    →    5
printf ("%d\n",i++); →    5
printf ("%d\n",i);    →    6
printf ("%d\n",++i);  →    7
printf ("%d\n",i);    →    7
printf ("%d\n",i--);  →    7
printf ("%d\n",i);    →    6
printf ("%d\n",--i);  →    5
printf ("%d\n",i);    →    5
```

Binary Operators:

A binary operator is an operator that performs operations on two operands or values. There are many binary operators in C. Some of them are: +, -, *, /, %, +=, -=, *=, /= etc.,

Arithmetic operators are the regular operators that can be used to perform basic arithmetic operations like addition subtraction, multiplication and division in a program in order to solve a problem.

Operators	Purpose
+	Addition
-	Subtraction
*	Multiplication
/	Division
%	Reminder

Suppose a and b are integer variables such as a=10 b=3

Expression	Value
a+b	13
a-b	7
a*b	30
a/b	3
a%b	1

v1 v2 are floating points variables whose values are 12.5 and 2.0

Expression	Value
v1+v2	14.5
v1-v2	10.5
v1*v2	25.0
v1/v2	6.25

The value of an expression can be converted to a different data type if desired. To do so the expression must be preceded by the name of the desired data type, enclosed in parentheses.

```
(Data type) expression
int a=10;
int b=3;
a/b becomes 3
(float)a/(float)b becomes 3.33
int 10+15.5 becomes 25
```

Relational Operators:

Operators	Meaning
<	less than
<=	less than or equal to
>	greater than
>=	greater than or equal to
==	equal to
!=	not equal to

Logical Operators:

Operator	Meaning
&&	and
	or
!	not

Assignment Operators:

In C there are different assignment operators available. They are: =, +=, -=, *=, /=, %=.

Syntax: identifier = expression;

Example: a=3;
x=y;
sum=a+b;
a += 4; // a = a+4;
a -= 4; // a = a- 4;
a *= 4; // a = a4;
a /= 4; // a = a/4;
a %= 4; // a = a%4;

13.17. Scanf function:

In order to provide input to any program one has to use a standard input statement in C. Another way to input data into the computer is through a standard input device using C library function `scanf()`. This function can be used to enter any combination of numerical values, single characters and strings.

```
scanf(control-string, arg1,arg2,... argn);
```

Where control string refers to a string containing certain required formatting information and `arg1, arg2...argn` are arguments that represent the individual input data items.

```
%c  single character
%d  decimal integer
%e  floating point value
%f  floating point value
%s  string
%x  hexa decimal
%o  octal
```

Each variable name must be preceded by an ampersand (&). The arguments are actually pointers that indicate where the data items are stored in the computers memory.

Example:

```
int a;
float b;
char c;
scanf("%d%f%c",&a,&b,&c);
char name[20];
scanf("%s", name);
```

13.18.printf Function:

A standard output statement with which the user is able to display or view the result or output of a program is nothing but a printf() statement. printf() is a C library function. This function can be used to output any combination of numerical values, single characters, and strings.

```
printf( control-string,arg1,arg2,...);
```

Where control string refers to a string that contains formatting information, and arg1, arg2 are arguments that represent individual output data items.

```
%c  single character
%d  decimal integer
%e  floating point value
%f  floating point value
%s  string
%x  Hexa decimal
%o  Octal
```

However, both printf() and scanf() are the standard input and output statements, they can be referred as formatted I/O statements or standard I/O.

Ex:Program to accept integer, float and character values and display them back.

```
main()
{
    int a;
    float f;
    char ch;
    clrscr();
    printf("\n Enter an integer          : ");
    scanf("%d", &i);
    printf("\n Enter a floating number   : ");
    scanf("%f", &f);
    printf("\n Enter a character            : ");
    scanf("%c", &ch);
    printf("\n Integer value           : %d", i);
    printf("\n Floating value          : %f", f);
    printf("\n Character value         : %c", ch);
}
```

Program to add, subtract, multiply and divide two numbers

```
#include <stdio.h>
#include <conio.h>
main()
{
    int num1, num2, sum, diff, prod;
    float division;
    printf("Enter any two numbes");
    scanf("%d%d",&num1,&num2);
    sum = num1 + num2;
    diff  = num1 - num2;
    prod = num1 * num2;
    division = num1 / num2;
    printf("\n Sum is %d",sum);
    printf("\n Difference is %d. ",diff);
    printf("\n\n\t Product is %d. ",prod);
    printf("\n\n\t Division is %d. ",division);
}
```

Program to find area and perimeter of a rectangle given its length as 5 units and breadth as 10 units.

```
#include <stdio.h>
#include <conio.h>

main()
{
    int length, breadth;
    int area, perimeter;
    area = length * breadth;
    perimeter = 2 * (length + breadth);
    clrscr();
    printf("\n\n\t Length of Rectangle      :%d ",length);
    printf("\n\n\t Breadth of Rectangle      :%d
",breadth);
    printf("\n\n\t Area of Rectangle      :%d ",area);
    printf("\n\n\t Perimeter of Rectangle  :%d
",perimeter);
}
```

13.19. Summary:

In this lesson you learned history and development of C language and basics required to write a C program: character set, keywords, data types, operators and input/output functions. You learnt that there are three basic data types in C: integer, float and character. You have learnt how to declare a variable, how to define a constant and how to use the arithmetic statements.

Input/output statements you have learnt in this lesson are scanf() and printf(). You have also learnt how to use these functions for input and output of different types of variable like integer, float, character, string etc.

13.20. Technical Terms:

Algorithm: A step- by- step procedure for solving a problem or accomplishing a task.

Structured programming: Is a design approach where complex systems are broken down into smaller, more manageable pieces.

ANSI[American National Standards Institute]: This organization produces many standards, among them the standard for the C programming language.

Escape Sequences: A special sequence of characters used for describing nonprinting characters, such as '\n' for new line.

Keyword: A keyword is a word that has special meaning. Keywords are reserved for specific purpose and not to be used as variable names.

Built-in Function: The language provides built-in functions that perform various numerical and string computations.

Variable: A name used to represent data that can be changed while the program or procedure is running.

Constant: A specific quantity that does not or cannot change or vary; the opposite of a variable.

Token: it is a smallest individual program element of a C program.

Preprocessor: It is a program, which processes the source code before it passes through the compiler.

13.21. Model questions:

1. What is C? Explain the history of C language?
2. Explain the features of C language?
3. Write about the structure of a C language program?
4. Explain various data types in C?
5. Explain different types of operators available in C?
6. Write about printf() and scanf() statements?

13.22. References:

Byron C. Gottfried **"Programming with C"**

Kelly & Pohl **"A book on C"**

Yeshavanth kanethkar **"Let us C"**

Ravi Chandran **"Programming in C"**

Yeshavanth kanethkar **"Working with C"**

Blaguruswamy **"ANSI C"**

AUTHOR:

G.RAMANJIAH.,M.Sc(Computers)
Lecturer,
Dept.Of Computer Science,
JKC College,
GUNTUR.

Lesson 14 - Control Structures

Objectives:

The main objectives of this lesson are:

- To use control structures to write effective programs
- To understand various types of control structures

To develop C programs using decision making constructs **Objectives:**

-
- To develop C programs using iterative constructs
- To understand break, continue, goto and label statements

Structure of the Lesson:

- 14.1. Introduction
- 14.2. What are Control structures?
- 14.3. Conditional branching
 - 14.3.1. Simple **if** statement
 - 14.3.2. **if else** statement
 - 14.3.3. nested **if** statement
 - 14.3.4. **switch** statement
- 14.4. Looping structures
 - 14.4.1. **while** statement
 - 14.4.2. **do while** statement
 - 14.4.3. **for** statement
- 14.5. **break** and **continue**
- 14.6. **goto** and **exit** statements
- 14.7. Summary
- 14.8. Technical terms
- 14.9. Model questions
- 14.10 References

14.1.Introduction:

Every C program is a sequence of instructions, which are executed, in a sequential fashion. There are many situations in which these sequential executions need to be altered with a few instructions being executed only when a condition is satisfied. Sometimes it may be necessary to execute a group of instructions for a fixed number of times or until some condition is satisfied. In such situations programmer may require to include control statements in programs. These control statements allow the programmer to alter the sequential order of execution.

14.2.Control structures:

In high-level programming languages, flow of program execution may be changed using certain control statements called control structures. A control structure is a **control flow statement** that allows you to alter the **sequential flow**.

Control flow statements fall into three categories:

1. Conditional branching (or) Decision Making or Non-iterative
2. Looping or iterative or repetitive
3. Unconditional branching.

14.3.Conditional Branching (or) Decision Making:

Conditional branching is the most basic control feature of any programming language. It enables a program to make decisions, to decide whether or not to execute a statement or a block of statements based on the value of an expression. The expression may result in either true or false value. Since the value of the expression may vary from one execution to another, this feature allows a program to react dynamically to different data.

C supports various types of conditional branching statements. The following categories illustrate several conditional control structures.

- **Simple if**
- **if ..else**
- **else if ladder**
- **Nested if**
- **Switch**

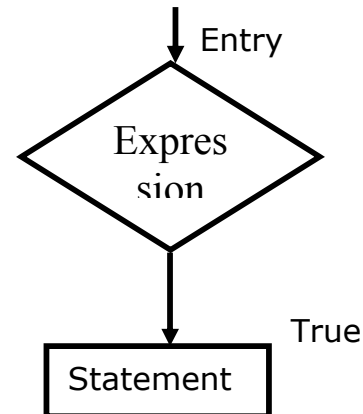
14.3.1. Decision Making with Simple if statement:

The **simple if** statement is wonderful decision making statement and is used to control the flow of execution of a single or multiple instructions.

The general form of "**simple if**" follows:

```
If (condition/expression)
Statement;
```

In this statement the given condition is tested first and responds accordingly. If the result of expression is true then the given statement is executed. If the result is false the statement cannot be executed.



When multiple statements are to be executed using if control structure then it may be referred as compound if.

Syntax:

```
If (expression)
{
    statement-block;
}
statement-x;
```

The statement-block may be a single statement or a group of statements. If the expression is true statement-block will be executed, other wise the statement-block will be skipped and the execution will jump to the statement-x.

Ex: Program to find biggest of two numbers.

```
main()
{
    int a, b;
    printf("\n\t Enter A value          : ");
    scanf("%d", &a);
    printf("\n\t Enter B value          : ");
    scanf("%d", &b);
    if (a>b)
        printf("\n %d is Greater than %d", a, b);
    if (b>a)
        printf("\n %d is Greater than %d", b, a);
}
```

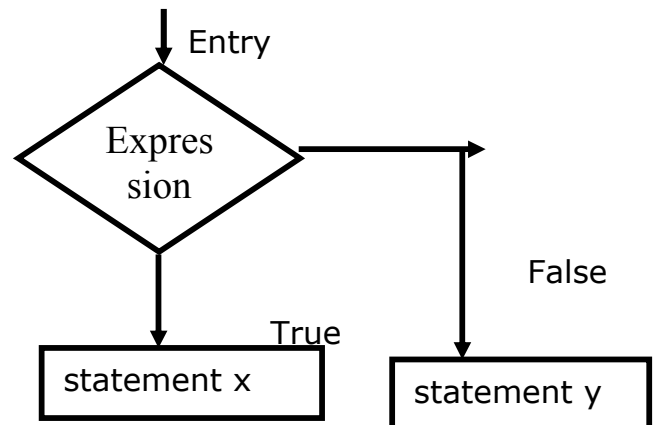
14.3.2. Decision making with if – else statement:

In **if-else** control statement there exists an extension of the simple if statement. It allows the user to perform another block of statements in case the condition result is false.

syntax :

```
if (expression)
    statement-x;
else
    statement-y ;
```

Here the **expression** is evaluated; if the result of the expression is a true then statement-x is executed otherwise statement-y will be executed.



Flow graph

Ex:

Program to check whether given number is even or odd

```
main()
{
    int n;

    printf("\n Enter a number..");
    scanf("%d",&n);
    if (n%2==0)
        printf("\n Given number is even");
    else
        printf("\n Given number is odd");
    getch();
}
```

14.3.3. Decision making with else.. if ladder:

In **else..If ladder** number of conditions are checked depending on the falsity of the previous condition. Literally, too many conditions are evaluated in if..else ladder.

```
Syntax:  If <condition1>
           {
             -----
           }
           else if <condition2>
           {
             ----- True block 1
           }
           else
           {
             ----- False block
           }
```

In this, condition1 is checked and if it is true then its corresponding condition is executed. If the condition is false then next condition is verified. If all the given conditions are false then false block is executed. Only one of all the available blocks gets executed. After the execution of any one of the blocks, control is transferred to next statement after the construct.

Ex:

program to find biggest of three numbers

```
main()
{
    int a,b,c;
    clrscr();
    printf("enter three numbers:");
    scanf("%d%d%d",&a,&b,&c);
    if(a>b)
        if(a>c)
            printf("%d is big",a);
        else
            printf("%d is big",c);
    else if(b>c)
        printf("%d is big",b);
    else
        printf("%d is big ",c);
}
```

Program to award grade to a student

```
main()
{
    int comp,mat,stat,tot;
    float avg;
```

```
char gra;
printf("\n\t Enter Computers marks  : ");
scanf("%d", &comp);
printf("\n\t Enter Maths marks  : ");
scanf("%d", &mat);
printf("\n\t Enter Mathematics marks  : ");
scanf("%d", &stat);
tot = comp+maths+stat;
avg = tot / 6.0;
if(comp>=35 && maths >= 35 && stat>=35)
{
    if (avg >= 80)
        gra = 'A';
    else if (avg >= 70)
        gra = 'B';
    else if (avg >= 60)
        gra = 'C';
    else if (avg >= 50)
        gra = 'D';
    else
        gra = 'E';
}
else
    gra = 'F';
printf("\n|           JKC COLLEGE, GUNTUR   |");
printf("\n-----");
printf("\n\n\tComputers :%d",Comp);
printf("\n\n\tMaths: %d",maths);
printf("\n\n\t Statistics: %d",stat);
printf("\n-----");
printf("\n\n\tTotal Marks      :%d",tot);
printf("\n\n\tAverage      : %8.2f",avg);
printf("\n-----");
printf("\n\n\t\t\t Grade awarded      : %c",gra);
printf("\n\n-----");
}
```

14.3.4.Decision making with Nested if:

A **nested if** control structure consists of multiple if statements in one another. Here each if statement consists of subsequent branching

statement. Literally a nested if consists of one if statement in another if statement. It is used when multiple conditions are to be evaluated.

Syntax:

```
if(expression)
{
    if(expression)
    {
        if(expression)
        {
            ---
            ---
        }
    }
}
```

Here evaluations of expressions or conditions are based on the first condition. If the first condition itself is false, then there is no way of evaluating other conditions. At any level of expression the program control may be altered.

Ex:**Program Biggest of 3 numbers using nested if**

```
main()
{
    int a,b,c,big;
    printf("\n Enter the value of a : ");
    scanf("%d",&a);
    printf("\n Enter the value of b : ");
    scanf("%d",&b);
    printf("\n Enter the value of c : ");
    scanf("%d",&c);
    if (a>b)
        if (a>c)
            big = a;
        else
            big = c;
    else
        if (b>c)
            big = b;
        else
            big = c;
    printf("\nBiggest of three numbers is:%d",big);
}
```

14.3.5.Switch Statement:

C provides a special kind of conditional control structure that acts as an alternative to **if..else ladder**. When there are more conditions or

paths in a program, if-else branching can become more difficult. In such situations switch may act better. The **switch** statement allows the user to specify an unlimited number of execution paths based on the value of a single expression. Each execution path is referred as a case.

However, all the cases should be unique.

Each case must be terminated by a '**break**' statement. The '**default**' case is not mandatory.

In a switch statement, there are four different keywords to be used:

- **switch**
- **case**
- **break**
- **default**

Though the switch control structure enables the user to improve clarity of the program, it causes more errors. So, it requires more attention while implementation.

Syntax:

```
switch(expression)
{
    case value1:
        statement;
        break;
    case value2:
        statement;
        break;
    :
    :
    :
    default :
        statement;
}
```

Among all the cases, only one case can be executed successfully because each case is terminated by a 'break' statement.

Ex:

Program to accept two integer values and perform arithmetic operation by getting the user input.(1) Addition,2) Subtraction ,3) Multiplication,4) Division. 5) Exit).

```
main()
{
    int a, b, c, ch;
    clrscr();
    printf("\n\t\t\t Enter two numbers :   ");
    scanf("%d %d", &a, &b);
    printf("Enter your choice:")
    printf("1)Addition\n2)Subtraction");
    printf("\n3)Multiplication");
    printf("\n4) Division. \n5) Exit").
    scanf("%d",&ch);
    switch (ch)
    {
    case 1:
        c = a + b;
        break;
    case 2:
        c = a - b;
        break;
    case 3:
        c = a * b;
        break;
    case 4:
        c = a / b;
        break;
    default :
        printf("\n Invalid option ");
        exit(0);
    }
    printf("\n\t\t\t Result   :%d",c);
}
```

14.4.Looping structures:

Some times, in a program, a statement or a block of statements need to be executed repeated number of times. In such situations decision control structures may not be useful, as they do not transfer the

control back. Hence the user may require another form of control structures, which perform a group of instructions for a fixed number of times. Such control structures are named as looping control structures. C language provides three different iterative or looping structures.

- **while** loop
- **do...while** loop
- **for** loop

14.4.1.While statement:

The **while** control structure executes a single or multiple statements for repeated number of times based on a given condition. It executes the statements as long as the given condition or expression results in a true value. It terminates execution as and when the condition is false.

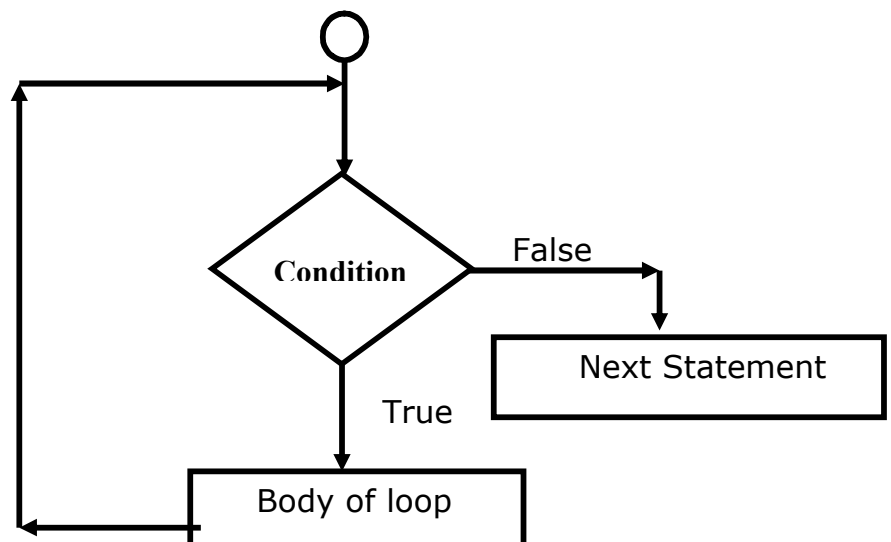
Syntax: initialization statement;
while(condition)
{
 ...
 Condition reachable statement;
}

Flow graph:

Here the condition is tested every time, it executes the block of statements.

The keyword **while** verifies the trueness and falsity of the expression and responds accordingly. If the condition is false for the first time the minimum number of iterations is 0 in

while control structure. It requires three statements in order to perform repetitive tasks.



They are

- Initialization statement
- Conditional statement
- Condition reachable statement

If any of the above statements is ignored then the while may not perform well.

Ex:

Program to print the numbers from 1 to 10

```
main()
{
    int i;
    i=1;
    while (i<=10)
    {
        printf("%d\n", i);
        i++;
    }
}
```

Program to print even numbers from 2 to 100

```
main()
{
    int a=2;
    while (a<=100)
    {
        printf("\n %d",a);
        a = a + 2;
    }
}
```

Program to print odd numbers from 1 to 100

```
main()
{
    int a=1;
    while (a<=100)
    {
        if (a%2 != 0)
            printf("\n %d",a);
        a++;
    }
}
```

14.4.2.Do - While statement:

C provides another form of while control structure i.e., **do-while** control structure. In **do-while** control structure the

statements in the block get executes first, later on the condition is evaluated. Hence the user can assume that the minimum number of iterations for do while control structure as 1, even if the expression or condition results in false for the first time.

Syntax:

Initialization statement;

do

{

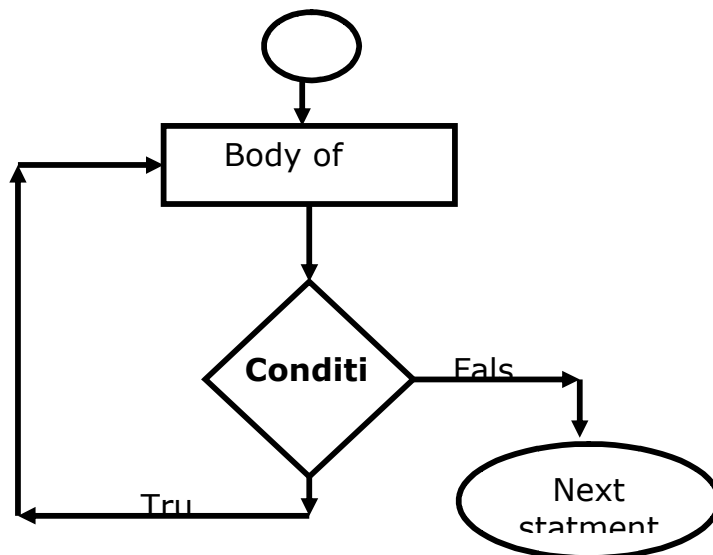
Condition reachable statement;

} **while(condition);**

Flow graph:

Here the statements in the loop will be executed until the given condition becomes false. The while statement should be terminated by a semicolon (;) in do while.

Ex: print the numbers from 1 to 10



main()

{

int i;

i=1;

do

{

printf("%d\n", i++);

} while (i<=10);

}

14.4.3.For Loop:

C provides a more flexible form of looping control structure that improves clarity of the code. It is nothing but for control structure. Usually the for control statement is used

to perform fixed number of iterations. The major difference between **for** and **other looping structures** is the number of iterations. In case of while and do-while the number of iterations are indefinite. The user may not predict the number of iterations. On the other hand for specifies the number of iterations in the statement itself.

Syntax:

```
for(initialization; test condition; increment/decrement part)
{
    Body of the loop;
}
```

The initialization may contain single or multiple assignment statements. A control variable is involved in this part of statements.

The test condition verifies the validity of the control variable for each iteration.

Increment or decrement part increments or decrements the value of the control variable in order to reach the test condition.

Ex:

program to print the numbers from 1 to 10

```
main()
{
    int i;
    for (i=1 ; i<=10; i++)
        printf("%d\n", i);
}
```

14.5.Break and continue Statement:

Break:

This statement takes control out of the switch statement or loop structure. In other words, a break statement takes the control out of the current block in execution. The control is transferred to the statement that follows the block.

Syntax: *break;*

Continue Statement

To skip a part of the body of the loop in execution on certain condition and for the loop to be continued for the next iteration continue statement is used.

Syntax: *continue;*

14.6. goto and label statements:

C supports an unconditional branching statement called 'goto'. This 'goto' is meant for transferring control from one part of the program to another part a label is present. A label is a user-defined word to where the control is supposed to be transferred. The given label must reside in the same function and can appear before only one statement in the same function. Although it may not be preferable to use the goto statement in a highly structured language like C, there may be occasions where the use of goto is desirable.

Syntax:

```
goto label:
-----
-----
label:
statement;
```

```
label: ←
statement;
-----
goto label:
```

the following example demonstrates the **goto** statement:

```
void main()
{
    int x = 1;
    abc:
    printf(" %d",x);
    x++;
    if(x <= 5 )
        goto abc;
}
```

14.7.Summary:

This lesson has focused the major elements of programming - control structures in C language. You have learnt about the conditional, looping and unconditional statements. You have also seen conditional statements: if, if-else, nested If and switch. Also focus on three categories of loops, available in C language: while, do – while and for loop. Usage of break, continue, goto and exit statements, which are very useful in loops have been covered.

14.8. Technical Terms:

Looping: Repeating a block of statements based on condition or a counter.

Compound Statement: A series of statements, enclosed in curly braces. Compound statements may be nested.

Expression: an expression is a statement in which either arithmetic or assignment operations are performed.

Control statement: A statement, which controls the logical flow of a program. Ex: **if, goto, switch.**

while: It is an entry- controlled loop in which the body of the loop is executed only when the condition is true.

do—while: it is a loop construct, which is used to test a condition after the body of the loop is executed once.

for loop: It is an entry-controlled loop, which provides a more concise loop control.

14.9. Model Questions:

1. Describe the control structures of C language and explain each of them with an example.
 2. Discuss various control flow statements available in C language?
 3. Explain the various loop constructs in available in C language?
 4. How can the do-while loop vary from the while-loop?
 5. Explain break and continue statements with example?
 6. Explain goto and label statements with an example?
-

14.10. References:

Byron C. Gottfried "**Programming with C**"
Kelly & Pohl "**A book on C**"
Yeshavanth kanethkar "**Let us C**"
Ravi Chandran "**Programming in C**"
Yeshavanth kanethkar "**Working with C**"
Blaguruswamy "**ANSI C**"

AUTHOR:

G.RAMANJIAH.,M.Sc(Computers)
Lecturer,
Dept.Of Computer Science,
JKC College,
GUNTUR.

Lesson 15 - Functions and Storage classes

Objectives:

The main objectives of this lesson are:

- To understand what a function is
- To know the advantages of functions
- To understand different types of functions
- To understand the function declaration, variable declaration and function calling in a program
- To understand the concept of recursion
- To understand the concept of storage classes

Structure of the Lesson:

- 15.1. Introduction
- 15.2. Functions
- 15.3. Advantages of functions
- 15.4. Types of functions
- 15.5. Types of function calls
- 15.6. Recursion
- 15.7. Storage classes
 - 15.7.1. Auto
 - 15.7.2. Static
 - 15.7.3. Extern
 - 15.7.4. Register
- 15.8. Summary
- 15.9. Technical terms
- 15.10. Model questions
- 15.11. References

15.1. Introduction:

A large program may be split into several sub programs in order to reduce complexity. Bigger applications are not manageable as they contain large code. Modular programming is the concept of splitting a problem or program into several manageable pieces called sub modules or sub programs. C provides such modular programming in an extensive manner.

15.2. Functions:

A **function** is a self-contained block of statements to perform a sub task in a program. It can be referred to as a module or procedure or a subtask. A function itself is not a program; rather it extends the ability of a program.

As C is a function dependent language, it supports a rich set of functions in a sophisticated way. Every C program starts with at least one function called **main()**. There are two different categories of functions, system defined and user defined functions.

System defined functions:

A system-defined function is a subprogram, which is prewritten by the compiler. There is a library in C for system defined functions. For example, `printf()`, `scanf()`, `clrscr()`, `getchar()` etc.,

User Defined Functions:

Some times, the user may require a function, which performs a specific task of his own. In such cases, C permits user-defined functions.

Every function has its own significance and provides a separate scope for variables. A function requires three different types of statements to be specified by the user. They are

- Function prototype declaration
- Function Definition
- Function calling

As C supports top down approach in executing the programs, explicit declaration of the functions must be required in a program.

Every function requires definition without which the system is able to perform nothing. Literally the user has nothing to do without defining any function.

Unless the user makes an explicit call to the function, the function declaration & definition have no significance and they perform nothing.

Hence the above three statements are essential for implementing functions.

15.3. Advantages of Functions:

1. Program debugging is made easy if a C program contains functions.
2. Functions allow a larger task to be subdivided into several smaller tasks, so that they can be managed easily.
3. The length of the source program can be reduced to a maximum extent using functions.
4. The same function can be used for many programs once it is written.
5. Functions may increase program execution speed.
6. Functions improve optimum utilization of memory.
7. Functions are more reliable.

Structure of a Function:

```
return type function - name (data type arg1, data type arg2.....)
{
    local variable declarations ;
    // body of function
    .....
    return(expression);
}
```

return type is nothing but specifying the type of the value being returned by the function to its parent function or caller function. Every function requires a name (function name) so that it can be referred or identified by the user. Function names are unique in a program. While specifying names, make sure that the name doesn't possess any space in between the characters.

A function may accept any number of values as input from the caller function in order to perform the task assigned to it. Each value is referred as an **argument** or **parameter**. Usually parameters are specified in the brackets `(`, `)`'.

The keyword return is not mandatory. It is the last statement of a function. If at all, a function wants to send a value back to the caller, return statement may be kept in use.

15.4.Types of Functions:

In C, functions are divided into the following categories:

- System Defined Functions
- User Defined Functions

Both system defined and user defined functions may fall in the following category:

- Functions with no arguments and no return type.
- Functions with arguments and no return type.
- Functions with arguments and return type.
- Functions with no arguments and return type.

Functions with no arguments and no return type:

In this category of function, the caller function does not send any argument to the function and the called function does not return any value.

Functions with arguments and no return type:

In this category of function, the caller function sends one or more values to called function but in return the called function does not return any value.

Functions with arguments and return type:

In this category of function, the caller and called functions send values to one another.

Functions with no arguments and return type:

This category of function doesn't accept any value from the caller function but returns one value back to the caller.

15.5.Types of Function calls:

There are two types of function calls.

1. Call by value
2. Call by reference.

Call by value:

In call by value, the actual parameters are sent to the called functions from the caller.

Call by reference:

In call by reference, instead of copy, the address of the actual parameter is sent to the called function from caller. Therefore, the called function can alter the value of the actual parameters. In this case, pointers are used.

Ex: **Write a function to clear the screen.**

```
main()
{
    void screenclear();
    screenclear();
    getch();
}
void screenclear()
{
    int i,j;
    for(i=1;i<=24;i++)
    {
        for(j=1;j<=80;j++)
        {
            gotoxy(j,i);
            printf(" ");
        }
    }
    gotoxy(1,1);
}
```

Write a program to find factorial of a given number.

```
main()
{
    void fact();
    clrscr();
    fact();
    getch();
}
void fact()
{
    int x;
    long int f=1;
    printf("\n Enter a number to find factorial : ");
    scanf("%d",&x);
    while(x>0)
    {
        f = f * x;
        x--;
    }
    printf("\n Factorial of given number is : %ld",f);
}
```

15.6.Recursion:

When a called function in turn calls another function, then a process of chaining occurs. Recursion is special case of this process. In other words, **Recursion** is a process by which a function calls itself repeatedly, until some specified condition is true. The number of recursive calls is limited to the size of the stack. A function is called 'recursive' if a statement within the body of a function calls the same function. Sometimes called 'circular definition'.

```
Ex: void ramu()
{
    static count = 1;
    printf ("%d", count);
    count++;
    ramu();
}
main ()
{
    ramu ();
}
```

What will the program do? First it prints the value of count, which is 1 then it increments count; then it calls itself. The second time, count equals 2. This repeats the function infinite times. The output will be 1 2 3 4 5.

At some point, the computer will run out of stack memory, and the program will abort with a runtime error. This illustrates an important point about recursive programming. You must include a stop point or the program will run forever (or until it runs out of memory). So, we can modify the above function so that calls itself only three times.

```
void ramu ( )
{
    static count = 1;
    if ( count > 3)
        return;
    else{
        printf("%d\n", count);
        count++;
        ramu ( );
    }
}
main ( )
{
    ramu ( );
}
```

Each time the function is called, new storage is allocated for the parameters for the **auto** and **register** variables so that their values in previous, unfinished calls are not overwritten. Parameters are directly accessible to the instance of the function in which they are created. Previous parameters are not directly accessible to ensuing instances of the function.

Note that the program would not end if count were automatic rather than fixed because it would dynamically create a new variable called count and reinitialize it to 1 with each call. For each new call, the compiler creates a whole new set of automatic variables. Even though they have the same name, they refer to different memory areas. That variables declared with **static** storage do not require new storage with each recursive call. Their storage exists for the lifetime of the program. Each reference to such a variable accesses the same storage area.

15.7.Storage classes:

Every variable and functions in C is associated with a data type. We have already seen that all variables have an attribute, its type. In addition to the data type, C associated a storage class with variables and functions. Storage class is pertaining to the storage of the variable.

A storage class is associated with its object certain properties such as scope and lifetime in a program. By scope of an object we understand that the portions of the program in which the object can be used. The lifetime of an object is the period of time during which it is allocated storage space in memory.

The scope and lifetime of objects are determined by storage class specifications. There are four types of storage classes.

- Auto
- Register storage class
- Static
- Extern

15.7.1.Auto variables:

Auto is the default storage class to be used within a program or file. For ex:

```
int x; (or) auto int x;
```

Here, The 'auto' keyword declares the storage specifier for the variable x is automatic.

The scope of automatic variable is limited to the block in which it appears. They are created when the function is called and destroyed when the function is exited. Their memory locations get deallocated when the function is existed. They are recreated when function is called again.

Automatic variables are not initialized to any value when they are created. They usually start with garbage values. Automatic variables have two pleasing aspects. First, memory space used economically. Second their local scope protects us from affecting them inadvertently in other function. So, variable in other function need not necessarily be given different names.

Ex: Auto variables

```
void main()
{
    auto a=1;
    {
        auto a=2;
        {
            auto a=3;
            printf("%d \t",a);
        }
        printf("%d\t",a);
    }
    printf("%d\t",a);
}
```

Output: 3 2 1

15.7.2.Static variables:

The static variables are defined within a function. They have the same scope of the rules of the automatic variables, but in the case of static variables the contents of the variables will be retained throughout the program. Static is a keyword used to define the storage class as static. In the absence of any initialization, static variables are initialized to zero.

Like automatic variables, static variables are also local to the function. When they are declared.

Ex:

```
int myblock()
{
    static float a;
    static int b[]={1,2,3,4,5};
    -----
}
```

The variable a and the array b have been declared static. They will start with an internal value and their value is retained when the function is exited.

15.7.3.External variables:

The variables that are declared before the function main() are globally existing for all the functions inside the program. These variables are called global variables. The extern declaration of the variables makes the variables to be available even for the external functions that are called from the program.

The extern storage class does not create a variable. It only informs the compiler of its existence and so the extern declaration cannot include any initialization.

Extern int I;

Here, I is a global variable which may be defined in another file, thus supporting multi-file communication.

External variables are declared outside the block in which it is used. It can be declared either before the block or after the block. If it is declared after the block, we have to declare the variable as extern before using it. If the variable is declared before the block it is not necessary to declare it as extern.

```
Ex: # include <stdio.h>
      int a,b;
      float x;
      void main()
      {
          -----
          -----
      }
```

Here a, b and x are defined outside of all functions, including main. Therefore they are external. However, the word extern should not precede them. They are recognized as external by virtue of their position in the program.

15.7.4. Register variables:

The keyword register is used to specify the storage class of the variables. All the computers have a few memory locations on the microprocessor. These memory locations are known as registers. Storage and retrieval of data from a register can be done by a program much faster than from a location in the main memory of the computer.

The register specification is quite useful when a particular value is frequently required, for example, index variables. Otherwise it is stored in the RAM with the default storage class.

Ex: Register int a;

The scope and life of a register variable is similar to that of the automatic variables. There are some restrictions on register variables. Since a machine register is usually single word, many compilers only allow those variables that fit into the word to be placed in registers.

15.8. Summary:

In this lesson you have learnt what is a function, how to use a functions, how the functions interact with one another, how to send them information using arguments, and how to use them to return values.

In this lesson we have discussed the concepts of storage class and scope for variables in a C program. The language provides four storage classes: automatic, register, external, and static.

15.9. Technical Terms:

Function: In computer science, a subroutine (function, procedure, or subprogram) is a sequence of code, which performs a specific task.

Local variable: A variable that exists only inside a particular function, not affecting anything outside the function.

Global variable: A variable that can be accessed by all parts of a program.

Register: Memory device that is the part of computer memory that has a specific address and that is used to hold information of a specific kind.

Secondary storage: Secondary storage is a category of computer storage. It is used to store data that is not in active use. It is usually slower and has higher capacity than primary storage, and is almost always non-volatile.

Recursion:When a function calls itself, either directly or indirectly. If this isn't clear, refer to the entry for "recursion."

15.10. Model Questions:

1. What is a function? Explain advantages of functions in a program?
2. Write short notes on different types of functions?
3. Explain recursion with an example?
4. Write about storage classes?

15.11. References:

Byron C. Gottfried **"Programming with C"**

Kelly & Pohl **" A book on C "**

Yeshavanth kanethkar **"Let us C"**

Ravi Chandran **"Programming in C"**

Yeshavanth kanethkar **"Working with C"**

Blaguruswamy **"ANSI C"**

AUTHOR:

G.RAMANJIAH.,M.Sc(Computers)
Lecturer,
Dept.Of Computer Science,
JKC College,
GUNTUR.

Lesson 16 - Arrays and strings

Objectives:

The main objectives of this lesson are:

- To understand what an array is.
- To understand different types of arrays.
- To know the declaration and initialization process.
- To understand the concept of strings.
- To understand the declaration and initialization of strings.
- To familiarize with string manipulating functions.

Structure of the Lesson:

- 16.1. Arrays
- 16.2. Single dimensional arrays
- 16.3. Two dimensional arrays
- 16.4. Multi dimensional arrays
- 16.5. Strings
- 16.6. String handling functions
- 16.7. Summary
- 16.8. Technical terms
- 16.9. Model questions
- 16.10. References

16.1.Arrays:

An array is a group of related data items that shares a common name (or) an array is a collection of identically (similarly) typed variables stored contiguously in memory.

Each variable in an array is called an element and can be accessed by giving the array name plus an index expression called a subscript. A subscript value of 0 identifies the initial element; a value of 1 identifies the next element, and so forth.

The most basic purpose of arrays is to store large amounts of related data that share the same data type. Suppose you want to store 100 names of your relatives and friends. This requires 100 memory locations. Obviously, it would be extremely tiresome to declare 100 variables, each with a unique name. Arrays provide a solution to this problem.

16.2.Single dimensional arrays:

Apart from the broad spectrum of data types C supports arrays. This data type is useful when a group of elements are to be represented by a common name.

An array is a group of elements that share a common name, that are differentiated from one another by their positions within the array. An array is a collection of homogeneous data.

Declaring arrays: -

An array must be declared, since it is basically a variable.

Syntax: type variable-name [size];

Every element in the array is manipulated using its index. The starting index of element is 0 and ends with n-1. A list of data items can be given one variable name using one subscript and such a variable is called one-dimensional array.

➤ Declaring an Array

You can declare an array by placing a pair of brackets after the array name. To specify the size of an array, enter the number of elements within the brackets.

Syntax

Type variable_name[size]

```
int a[10];
```

Represents ten integers, this complete set is called an *array*.

Here, **int** specifies the type of the variable, just as it does with ordinary variables and the word **a** specifies the name of the variable. The number **10** tells how many elements of the type **int** will be in our array. This number is often called the "**dimension**" of the array. The bracket [] tells the compiler that we are dealing with an array.

➤ Initializing

We can initialize the elements in array in the same way as the ordinary variables when they are declared. The general form is

Type array_name [size] = {list of values}

For example:

```
int a[3] = { 1, 2, 3 };
```

In this form the size may be omitted. In such cases, the compiler allocates enough space for all initialized elements.

For example:

```
Char name[] = { 'S', 'S', 'I', 'T'};
```

Thus the above statement declares the name array of four characters, initialized with the string, "**SSIT**".

➤ Accessing Elements

You can access the elements inside the array by using array name and index of the element to be accessed. All the array elements are numbered, starting with 0. Thus **a[2]** is not the second element of the array but the third. In our program we are using the variable *i* as a subscript to refer to various elements of the array. This variable can take different values and hence can refer to the different elements in the array in turn. This ability to use variable as subscripts is what makes arrays so useful.

You can access the first element by using `a[0]`, second element `a[1]`, and so on.

**I.e., `a[0] = 11`
`a[1] = 21`
`a[2] = 31`**

Ex: Program to accept 5 elements into an array and display them back.

```
main()
{
    int a[5],i;
    for(i=0;i<5;i++)
    {
        printf("\n Enter the value of a[%d] : ",i);
        scanf("%d",&a[i]);
    }
    printf("\n");
    for(i=0;i<5;i++)
    {
        printf("\t%d",a[i]);
    }
}
```

Program to find sum of elements of an array with n elements.

```
main()
{
    int a[50], i, n, sum = 0;
    do
    {
        clrscr();
        printf("\n Enter number of elements : ");
        scanf("%d",&n);
    } while (n>50 || n<=0);
    for(i=0;i<n;i++)
    {
        printf("\n Enter the value of a[%d] : ",i+1);
        scanf("%d",&a[i]);
        sum += a[i];
    }
    clrscr();
    for(i=0;i<n;i++)
    {
        printf("\t%d",a[i]);
    }
    printf("\n\n Sum of elements : %d",sum);
    getch();
}
```

Program to find biggest of elements of an array.

```
main()
{
    int a[50],i,n,big;
    do
    {
        clrscr();
        printf("\n Enter number of elements   :  ");
        scanf("%d",&n);
    } while (n>50 || n<=0);
    for(i=0;i<n;i++)
    {
        printf("\n Enter the value of a[%d]   :  ",i);
        scanf("%d",&a[i]);
    }
    big = a[0];
    for(i=1;i<n;i++)
    {
        if (big<a[i])big=a[i];
    }
    for(i=0;i<n;i++)
    {
        printf("\t%d",a[i]);
    }
    printf("\n\n Biggest of elements       :   %d",big);
    getch();
}
```

16.3. Two-dimensional arrays:

So far we have discussed the array variables that can store a list of values. There will be situations where a table of values will have to be stored.

C allows us to define such tables of items by using two-dimensional arrays. This type of arrays can be declared as

Type array_name[row-size][column-size];

For example

int a[3][3];

This two dimensional array consists of three rows and e three columns.

➤ ACCESSING THE ELEMENTS

The first row first element can be accessed by `a[0][0]`, the first row second element can be accessed by `a[0][1]`, similarly the third row second by `a[2][1]` and soon.

Multidimensional arrays are stored in row-major order, which means that the last subscript varies fastest.

➤ INITIALIZATION

Like single dimensional arrays the initialization can be done in multidimensional arrays. When initializing a multidimensional array, you may enclose each row in braces. If there are too few initializers, the extra elements in the row are initialized to zero. Consider the following example:

```
Int m_arr [5] [3] = {{1,2,3},  
                    {4},  
                    {5, 6, 7}};
```

This declares an array with five rows and three columns, but only the first three rows are initialized, and only the first element of the second row is initialized.

```
1 2 3  
4 0 0  
5 6 7  
0 0 0  
0 0 0
```

if we do not include the inner brackets, as in

```
int m_arr[5] [3] = {1, 2, 3,  
                  4,  
                  5, 6, 7};
```

the result is

```
1 2 3  
4 5 6  
7 0 0  
0 0 0  
0 0 0
```

Ex Program to accept an m * n matrix and display it.

```
main()
{
    int a[10][10],i,j,m,n;
    printf("\n\n\n\t\tEnter total number of rows    : ");
    scanf("%d",&m);
    printf("\n\n\n\t\tEnter total number of colomns  : ");
    scanf("%d",&n);
    for (i=0;i<m;i++)
    {
        for(j=0;j<n;j++)
        {
            printf("\n Enter the element a[%d][%d] : ",i+1,j+1);
            scanf("%d",&a[i][j]);
        }
    }
    printf("\n\n Given Matrix is....\n");
    for(i=0;i<m;i++)
    {
        for(j=0;j<n;j++)
        {
            printf("\t %d",a[i][j]);
        }
        printf("\n");
    }
}
```

16.4. Multi- dimensional arrays:

C allows arrays of three or more dimensions. The exact limit is determined by the compiler.

A subscript expression can also have multiple subscripts, as follows:

Type array_name[expression1][expression2]....[expression n];

Subscript expressions associate from left to right. The leftmost subscript expression, *expression1*, is evaluated first. The address that results from adding *expression1* and *expression2* forms a pointer expression; then *expression3* is added to this pointer expression to form a new pointer expression, and so on until the last subscript expression has been added. The indirection operator (*) is applied after the last subscripted expression is evaluated, unless the final pointer value addresses an array type (see examples below).

Expressions with multiple subscripts refer to elements of "multidimensional arrays". A multidimensional array is an array whose elements are arrays. For example, the first element of a three-dimensional array is an array with two dimensions.

16.5. Strings:

A string is a group of characters, usually letters of the alphabet. In order to format your printout which has meaningful names and titles, you need the ability to output text data. Actually you have already been using strings, the second program in this tutorial, way back in Chapter 2, output a message that was handled internally as a string. A complete definition of a string is a series of **char** type data terminated by a null character.

When C is going to use a string of data in some way, either to compare it with another string, output it, copy it to another string, or whatever, the functions are set up to do what they are called to do until a null, which is a zero, is detected. Such a string is often called an ASCII-Z string. We will use a few ASCII-Z strings in this chapter.

One of the most common uses of arrays is to store strings of characters. A string is an array of characters terminated by a **null character**.

A null character is a character with a numeric value of zero. It is represented in c by the escape sequence `'\0'`. A **string constant**, some times called a **string literal**, is any series of characters enclosed in double quotes. It has a data type of **array of char**, and each character in the string takes up one byte. In addition, the compiler automatically appends a **null character** to designate the end of the string.

Declaring and initializing strings

To store a string in memory, you need to declare an array of type char, you may initialize an array of chars, with a string constant. For example

```
char str[] = "some text";
```

The array is one element longer than the number of characters in the string to accommodate the trailing null character. str[], therefore, is ten characters in length. If you specify an array size, you must allocate enough characters to hold the string. In the following example, for instance, the first four elements are initialized with the characters 'y', 'e', 's', and null '\0'. The remaining six elements receive the default initial value of zero.

```
char str[10] = "yes";
```

For example: `char code[] = "abc";`

Initializes code as a four-element array of characters. The fourth element is the null character, which terminates all string literals.

The declaration

```
char s[] = "abc", t[4] = "abc"; is identical to  
char s[] = {'a', 'b', 'c', '\0'}, t[4] = {'a', 'b', 'c' };
```

If the string is shorter than the specified array size, the remaining elements of the array are initialized to 0.

➤ Reading and Writing Strings

You can read and write strings with the `printf ()` and `scanf ()` functions by using the `%s` format specifier. For `scanf ()`, the data argument should be a pointer to an array of characters that is long enough to store the input string. The input string is terminated by any space character. After reading in the input characters, `scanf ()` automatically appends a null character to make it a proper string. On the `printf ()` side, the data argument should be a pointer to a null-terminated array of characters. `Printf ()` outputs successive characters until it reaches a null character.

Ex: Program to accept a string and count no.of characters.

```
main()
{
    char s[20];
    int i,charcount=0;
    clrscr();
    printf("\n Enter any string : ");
    gets(s);
    for(i=0;s[i]!='\0';i++)
    {
        charcount++;
    }
    printf("\n No. of characters in the given string : %d",charcount);
    getch();
}
```

A program to check whether a given string is palindrome or not.

```
main()
{
    char a[20],b[20];
    int i,l=0,flag=0;
    printf("\n enter any string : ");
    gets(a);
    l = strlen(a);
    for(i=0;i<l;i++)
    {
        b[i]=a[l-(i+1)];
    }
    for(i=0;i<l;i++)
    {
        if(b[i]!=a[i])
            flag=1;
    }
    if(flag==1)
        printf("\n %s is not a palindrome.",a);
    else
        printf("\n %s is a palindrome.",a);
}
```

Write a program to count number of vowels in a given string.

```
main()
{
    char s[20];
    int i,l=0;
    printf("\n enter any string:");
    gets(s);
    for(i=0;s[i]!='\0';i++)
    {
        if(s[i]=='a' || s[i]=='e' || s[i]=='i' || s[i]=='o' || s[i]=='u'
           || s[i]=='A' || s[i]=='E' || s[i]=='I' || s[i]=='O' ||
           s[i]=='U' )
            l++;
    }
    printf("\n No. of vowels in a given string are : %d",l);
    getch();
}
```

16.6. String handling functions:

A string in C is simply an array of characters. The following are the basic string handling functions. All the string-handling functions are prototyped in: #include <string.h>

strcpy	Copy one string into another.
strcmp	Compare string1 and string2 to determine Alphabetic order.
strcpy	Copy string2 to string1.
strerror	Get error message corresponding to specified error number.
strlen	Determine the length of a string.
strncat	Append n characters from string2 to string1.
strncmp	Compare first n characters of two strings.
strncpy	Copy first n characters of string2 to string1 .

strlen() Function :

This function counts the number of characters present in a string.

Ex:

```
main()
{
    char s[20];
    int i,charcount=0;
    clrscr();
    printf("\n Enter any string : ");
    gets(s);
    charcount = strlen(s);
    printf("\n No. of characters in the given string : %d",charcount);
    getch();
}
```


strcpy() Function :

This function copies the contents of one string into another. The base address of the source and target strings should be supplied to this function.

Ex:

```
main()
{
    char a[20],b[20];
    int i;
    clrscr();
    printf("\n Enter any string : ");
    gets(a);
    strcpy(b,a);
    printf("\n Copied string is : ");
    puts(b);
    getch();
}
```

strrev() Function :

This function reverses the string.

Ex:

```
main()
{
    char a[20],b[20];
    int i,stringlength=0;
    clrscr();
    printf("\n Enter any string : ");
    gets(a);
    strrev(a);
    printf("\n Reversed string is : ");
    puts(a);
}
```

strcat() Function :

This function concatenates the source string into target string. It is necessary to place '\0' into the target string, to make its end.

Ex:

```
main()
{
    char a[20],b[20],c[40];
    int i,j;
    clrscr();
    printf("\n Enter 1st string:");
    gets(a);
    printf("\n Enter 2nd string :");
    gets(b);
    strcpy(c,a);
    strcat(c,b);
    printf("\n concatenated string is  ");
    puts(c);
}
```

16.7. Summary:

In this Chapter, we have introduced one form of compound data type: the **array**. An array is a block of a number of data items all of the same type allocated in contiguous memory cells.

We have seen that, in C, an array may be declared using the syntax: -

```
specifier    identifier>[<size>];
```

specifying the type of the data items, and the number of elements to be allocated in the array.

This lesson has discussed a very common data type in C programs: the string. We have briefly introduced the concept of an *abstract data type* as consisting of a data declaration and a set of operations on data items of that type. We have defined a user-defined type, `STRING`, for string data and used it throughout the chapter.

We have described the functions for string manipulation, `strlen()` and `strcpy()` as well as string operation, `strcmp()` and `strcat()`, have been described. Other functions described include `atoi()`, `strncmp()`, and `strncpy()`. Throughout the chapter we have shown numerous examples of programs for string processing.

16.8. Technical Terms:

Array: Arrays are a data structure that is used to store a group of objects of the same type sequentially in memory. All the elements of an array must be the same data type.

Character Array. A set of elements of type `char`. (Can be used to store a string).

Pointer: pointer is a variable, which contains the address of another variable.

String: a string is a sequence of characters terminated by a null character.

Concatenation: This term is used to describe the combining of strings

16.9.Model Questions:

1. What is an array? Explain different types of arrays?
2. Write a program to read and display a two dimensional array?
3. Explain string-handling functions in C?
4. Write a program to check whether a given string is palindrome or not.

16.10.References:

Byron C. Gottfried **"Programming with C"**

Kelly & Pohl **" A book on C "**

Yeshavanth kanethkar **"Let us C"**

Ravi Chandran **"Programming in C"**

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AUTHOR:

G.RAMANJIAH.,M.Sc(Computers)
Lecturer,
Dept.Of Computer Science,
JKC College,
GUNTUR.

Lesson 17 - Pointers

Objectives:

The main objectives of this lesson are:

- To understand what a pointer is.
- To know the abilities of pointers in C language.
- To understand pointer variable declaration and its usage in a program.
- To know the pointer usage in functions and arrays.

Structure of the Lesson:

- 17.1. Introduction
- 17.2. Pointer
- 17.3. Abilities of pointers
- 17.3. Summary
- 17.4. Pointers in functions
- 17.5. Function pointers
- 17.6. Different kinds of pointers
- 17.7. Summary
- 17.8. Technical terms
- 17.9. Model questions
- 17.10. References.

17.1.Introduction:

'Pointers' is a wonderful concept provided by C in order to access data in a better way. They provide a convenient environment where in data may be managed by its address locations. Every data that the user stores in memory has certain address location. Address is nothing but a unique ID number associated with every data items placed in memory. In some other way, a pointer provides a convenient way of accessing a data item without referring its name or identifier directly.

17.2.Pointer:

One of the most powerful features of C, and one that makes it quite close to assembly language, is its ability to refer to the address of program variables. A "pointer declaration" names a pointer variable and specifies the type of the object to which the variable points. *A variable declared as a pointer holds a memory address.*

As a definition, a pointer is a variable that holds the address of another variable. Suppose there is an integer variable, to hold its address it requires an integer pointer. For any floating point value, it requires a float type pointer. So is the case even with other data types.

Pointers enable the users to effectively represent complex data structures. A pointer provides an indirect means of accessing the value of a particular data item. In order to create a pointer, use two different operators like indirection operator (*), address of operator (&).

Syntax: `int z=5;`
 `int *p;`
 `p = & z; // address of a.`
 `printf("%d",*p);`

Here 'p' means address of 'z' and '*p' means value at address p.

Literally, `p` → address of z;
 `*p` → value at address(p)

17.3. Abilities of Pointers:

1. To have indirect access to the data.
2. To improve capability of applications.
3. To increase the speed of program execution.
4. To develop hardware level applications.
5. To perform dynamic memory allocation & de-allocation.
6. To return more than one value from a subprogram.
7. A pointer to a pointer may be generated.

Ex:

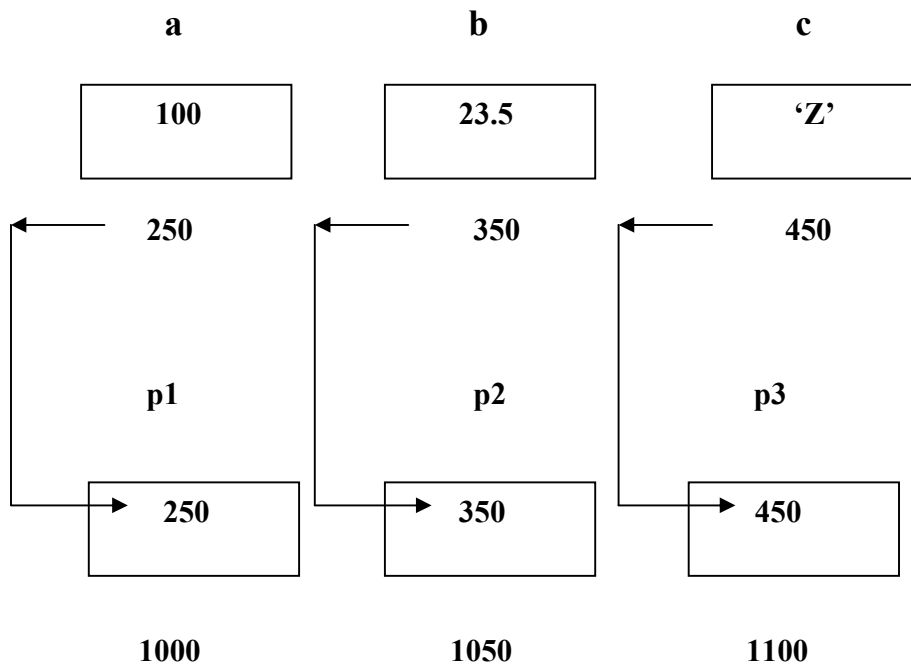
```
int a, *p1;
float b, *p2;
char c, *p3;
a= 100; b = 23.45; c = 'z';
p1 = & a;
p2 = &b;
p3 = &c;
printf("%d %u %u %d %d\n", a, p1, &a, *(&a), *p1);
printf("%d %u %u %d %d\n", b, p2, &b, *(&b), *p2);
printf("%d %u %u %d %d\n", c, p3, &c, *(&c), *p3);
```

Output of above program:

```
100 250 250 100 100
23.5 350 350 23.5 23.5
z 450 450 z z
```

The above program prints the address of a, b and c. Here '%u' is the format specifier, '&' it is meant for displaying unsigned integer values. Every address location is an unsigned integer value. Hence you may use %u or %p for pointers.

Lets see how pointers actually work: When you run the above program variables a, b and c are kept in memory as follows:



Here, a, b, c are the different variables and p1, p2, p3 are the pointers. So the pointers hold always the addresses. Moreover, a pointer may have its own address again i.e., a pointer also gets stored somewhere in memory.

→ 100, 23.5, 'Z' are the data items.

→ 250, 350, and 450 are assumed to be the address of a, b, c in memory respectively.

→ 1000, 1050 and 1100 are the addresses of pointers p1, p2 & p3.

In general pointers may perform arithmetic operations like addition and subtraction. Even relational operators may be applied on pointers. However, multiplication and division cannot be performed. Short-hand operators like ++, -- can also be used.

```
p++; //valid
p--; // valid
p-2; // valid
p+3; //valid
a = *p+2; // valid
p * 2; // invalid
p1/p2 ; // invalid
p/3; // invalid
```


Here pointer instrumentations have special meanings. Suppose p is a pointer and it holds address of a variable k ; then $p+1$ means the value of p is incremented by the length of the data type that it points to, such length is called scale factor.

In case of the following data types; length is:

Data type	Length
Int	2
Char	1
Float	4
Long int	4
Double	8

For example, p has the address 2300 for a variable of double type. $P+2$ means $2300+(2 * 8) = 2317$; p become 2317.

Pointer to Arrays:

A pointer may be applied to arrays. Generally the compiler itself allocates a base address to an array. Moreover, the compiler, in case of arrays, performs implicit addressing. Suppose, we declare an array z as follows:

```
static int z[] = {11,22,33,44,55};
```

Assume that the above is stored in memory as follows:

0	1	2	4	5	index values
11	22	33	44	55	values
100	102	104	106	108	addresses

Consider p is a pointer to array z :

$p = \&z[0]$; or $p = z$; i.e., $p = 100$.

This implies the address or base address of array **z** into **p**.

Hence you can assume the following representation:

11	22	33	44	55
p+0	p+1	p+2	p+3	p+4

The following program illustrates the pointers to arrays:

```
#include <stdio.h>
void main()
{
    static int a[] = {11,22,33,44,55};
    int *p,i;

    p = a; // assigning address of base address of a

    for(i = 0;i<5;i++)
    {
        printf("%d\t",++(*p));
        p++;
    }
}
```

output:

12 23 34 45 56

Here, ++(*p) means the value at address p is incremented by 1. Hence values 11, 22, 33, 44 and will become 12, 23, 34, 45, 56 respectively.

In some other way, the array elements are represented as follows:

a[0]	a[1]	a[2]	a[3]	a[4]
↓	↓	↓	↓	↓
*(a+0)	*(a+1)	*(a+2)	*(a+3)	*(a+4)

In case of two dimensional arrays, suppose, `int a[2][2] = {11,22,33,44};`

`a[0][0] → (*(a+0)+0)`
`a[0][1] → (*(a+0)+1)`
`a[1][0] → (*(a+1)+0)`
`a[1][1] → (*(a+1)+1)`

Ex:

```
#include<stdio.h>
void main()
{
    int I,j;
    int z[3][3] = {{1,2,3},{4,5,6},{7,8,9}};
    for(I=0;I<2;I++)
    {
        for(j=0;j<3;j++)
            printf ( "%4d",*(*(a+i)+j) );
        printf("\n");
    }
}
```

Output:

1	2	3
4	5	6
7	8	9

In case of strings or character arrays:

Like one-dimensional array, strings can be manipulated using pointers. A string is always terminated by a NULL character, it becomes easy to manage.

Ex:

```
#include<stdio.h>
void main()
{
    char *str = "JKC college";
    char *p;

    while(*p!=NULL)
    {
        printf("%c",*p);
        p++;
    }
}
```

Output: JKC college.

17.4. Pointers in Functions:

As 'pointers' is a general concept, it may be used in functions. In case of passing arguments, pointers may be used. In fact, functions: caller and called functions use, pointer in quite a different way.

Functions that call by value may not be useful in certain cases where the reflections of called functions should be done on caller. The following example illustrates the usage of pointers.

```
#include<stdio.h>
void swap(int, int); // prototype declaration

void main()
{
    int a, b;
    a = 5;
    b = 9;

    printf("\n Before swapping....\n");
    printf("%5d%5d",a,b);

    swap(a,b); // called function & is a call by value

    printf("\n After swapping....\n");
    printf("%5d%5d",a,b);
}

void swap(int x, int y)
{
    int temp;

    temp = x;
    x = y;
    y = temp;
    return;
}
```

o/p:

```
Before swapping....
5      9
After swapping....
5      9
```

Here, a, b in main() are the actual parameters and x, y in swap() are the formal or dummy parameters. Though x, y hold values of a, b, the changes made to x, y may not reflect a, b because only the copy of a, b is placed in x, y. Updates are restricted to the called function only.

If at all, every trivial change is to be reflected in the caller function, then user has to consider 'pointers' concept. The following example illustrates the same.

```
#include<stdio.h>
void swap(int &, int &);

void main()
{

    int a,b;
    a = 5;
    b = 9;

    printf("\n Before swapping....\n");
    printf("%5d%5d",a,b);

    swap (&a, &b); // called function & is a call by value

    printf("\n After swapping....\n");
    printf("%5d%5d",a,b);
}

void swap(int *x , int *y)
{
    int temp;

    temp = *x;
    *x   = *y;
    *y   = temp;
    return;
}
o/p:
```

```
    Before swapping....
    5      9
    After swapping....
    9      5
```

17.5. Function Pointer :

Like integer pointer, float pointers and other pointer types, may have function pointers. A function pointer is a pointer that holds the address of a function in memory. It improves program execution speed.

Syntax:

Data type (function_ptr)();

Example:

double (*p)();

The following example illustrates function pointer:

```
#include<stdio.h>
```

```
void test(); // proto type declaration.
```

```
void main()
```

```
{
```

```
    void (*p)();
```

```
    p = test; //assigning address of function to p.
```

```
    (*p)(); // calling test() using function pointer.
```

```
}
```

```
void test()
```

```
{
```

```
    printf(" c ");
```

```
    printf("c++");
```

```
    printf("\vc++");
```

```
}
```

17.6. Different kinds of Pointers:

There is a special kind of category in pointers.

- Near Pointers
- Far Pointers
- Huge Pointers

Based on the memory organization, data may be accessed in different ways. Different microprocessors follow different data models. Based on the data models, the above category of pointers will do the work.

Near Pointer:

It takes 2 bytes so it holds the addresses (offset) from 0 to 65535.

Far Pointer:

It takes 4 bytes of memory, it will hold both the segment address (higher order two bytes) and offset (lower order two bytes).

In order to access CGA video memory, we normally use, far pointers.

Huge Pointer:

In this we have another type is called "**Huge Pointer** " which is just like far pointer except that " the address stored in huge pointer will be normalized".

TSR programming or low level programming is performed using Near, far and huge pointers.

17.7. Summary:

In this lesson we have introduced a new data type, a **pointer**. We have seen how we can declare variables of this type using the * and indicating the type of object this variable can point to, for example:

```
int * iptr;  
float * fptr;  
char * cptr;
```

Declare three pointer variables, iptr which can point to an integer cell, fptr which can point to a cell holding a floating point variable, and cptr which can point to a character cell.

We have also shown how pointer variables may be used to *indirectly* access the value in a cell using the **dereference** operator, *: `y = *iptr;`

As we have seen,, pointers are very useful in developing complex programs. The concept of pointers may be confusing at first, however, a useful tool for understanding the behavior of a program using pointers is to draw the memory picture showing which to cells each pointer is pointing.

17.8. Technical Terms:

Call by reference - passing a pointer to an argument to a function. The function can then change the argument value. See call by value.

Call by value - passing a copy of an argument to a function. The function cannot then change the argument value. C and C++ use call by value argument passing. But also see pointer and reference, also call by reference.

Pointer to data member - a pointer that points at a data member of a class.

Pointer to function - an address of a function or a member function.

17.9. Model Questions:

1. What is a pointer? How it is declared and initialized?
2. What is function pointer? Explain with an example?
3. What are advantages of functions?

17.10. References:

Byron C. Gottfried, **"Programming with C"**

Kelly & Pohl, **" A book on C "**

Yeshavanth kanethkar, **"Let us C"**

Ravi Chandran, **"Programming in C"**

Yeshavanth kanethkar, **"Working with C"**

Blaguruswamy, **"ANSI C"**

AUTHOR:

G.RAMABJAIAH.,M.Sc(Computers)
Lecturer,
Dept.Of Computer Science,
JKC College,
GUNTUR.