Bachelor of Arts

(B.A.-Sem-I&II)

{CALI L-1-101 and 102 (i&ii)}

COMPUTER AWARENESS

(Basic Computer Education plus Practical)

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INTRODUCTION TO COMPUTER

Structure

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1.0 LEARNING OBJECTIVES

The main objective of this lesson is to introduce 'computer' to the students. After successful completion of the lesson the students will be able to:

- ✓ Understand the definition of computer
- ✓ Understand the characteristics computers
- ✓ Understand the capabilities as well as the limitations of computers.
- ✓ Understand about generations and classifications of computers

1.1 INTRODUCTION

Today, almost all of us in the world make use of computers in one way or the other. It finds applications in various fields of engineering, medicine, commercial, research and others. Not only in these sophisticated areas, but also in our daily lives, computers have become indispensable. They are present everywhere, in all the devices that we use daily like cars, games, washing machines, microwaves etc. and in day to day computations like banking, reservations, electronic m ails, internet and many more.

The word computer is derived from the word compute. Compute means to calculate. The computer was originally defined as a super-fast calculator. It had the capacity to solve complex arithmetic and scientific problems at very high speed. But nowadays in addition to handling complex arithmetic computations, computers perform many other tasks like accepting, sorting, selecting, moving, comparing various types of information. They also perform arithmetic and logical operations on alphabetic, numeric and other types of information. This information provided by the user to the computer is data. The information in one form which is presented to the computer is the input information or input data.

Information in another form is presented by the computer after performing a process on it. This information is the output information or output data.

The terms hardware and software are almost always used in connection with the computer.

- **The Hardware:**

The hardware is the machinery itself. It is made up of the physical parts or devices of the computer system like the electronic Integrated Circuits (ICs), magnetic storage media and other mechanical devices like input devices, output devices etc. All this various hardware is linked together to form an effective functional unit. The various types of hardware used in the computers, has evolved from vacuum tubes of the first generation to Ultra Large Scale Integrated Circuits of the present generation.

- **The Software**:

The computer hardware itself is not capable of doing anything on its own. It has to be given explicit instructions to perform the specific task. The computer program is the one which controls the processing activities of the computer. The computer thus functions according to the instructions written in the program. Software mainly consists of these computer programs, procedures and other documentation used in the operation of a computer system. Software is a collection of programs which utilize and enhance the capability of the hardware.

1.2 WHAT IS A COMPUTER?

The word "computer" comes from the word ‘compute’, which means to calculate. So a computer is normally considered to be a calculating device. In fact, the original objective for inventing the computer was to create a fast calculating machine. But more than 90% of the work done by computers today is of non-mathematical or non-numerical nature. Hence, to define a computer merely as calculating device is to ignore over 90% of its work.

More accurately, a computer may be defined as a device that operates upon information or data. Data can be anything like bio-data of various applicants when the computer is used for recruiting personnel, or the marks obtained by various students in various subjects when the computer is used to prepare results, or the details (name, age, sex etc.) of various passengers when the computer is employed for making airline or railway reservations, or numbers of different types in case of application of computers

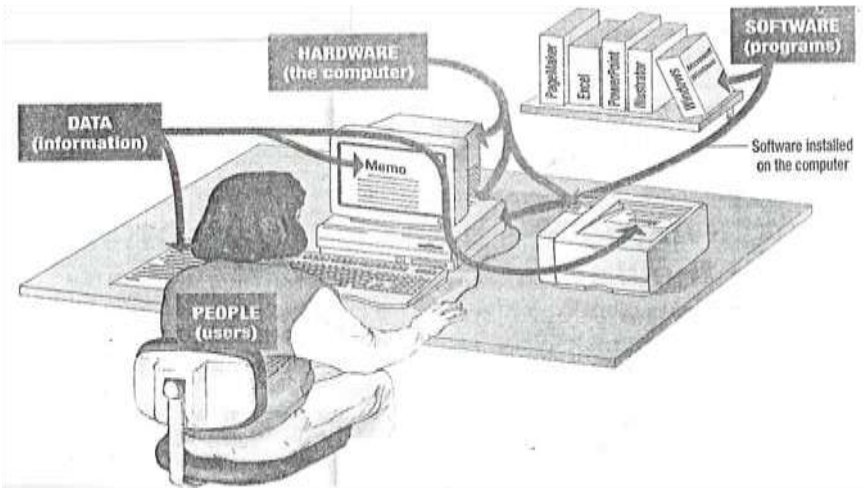
for scientific research problems, etc. Thus Computer can be defined as an electronic device for processing data that takes data input from its user, stores, processes data and generates the required output as per the processing instructions given to it by the user.

The fact that computers process data is so fundamental that many people have started calling it a data processor. The name data processor is more inclusive because modern computers not only compute in the usual sense but also perform other functions with the data that flow to and from them. For example, data processor may

- gather data from various sources;
- merge (process of mixing or putting together) them all;
- sort (process of arranging in some sequence-ascending or descending) them; and
- Print them in desired format.

Thus computers not only can add, subtract, multiply and divide numbers but can also do certain logical operations; can remember (i.e. store and recall information); can communicate with operators; can direct themselves in a predetermined manner; can process a large volume of data effortlessly; can interpret massages from remote locations. Computers undertake repetitive and boring tasks, relieving us for more critical, creative activities. Computers offer unmatched speed, performance, and accuracy in data processing. Computers work at constant efficiency and perform tasks repeatedly without errors, avoiding the fatigue, that affect human beings. Computers can be used in almost every field and for almost every purpose. Computers allow society to undertake new activities in various fields and to function more efficiently. Computers are impartial.

They offer a mean of data processing unaffected by social, religious or cultural bias and prejudice. Computers offer effective and efficient data storage and retrieval, highest degree of integrity and reliability.



Computers come in many varieties, including the personal computer, tiny computers built into appliances and automobiles, and mainframe machines used by many people simultaneously to run a business. Despite their differences in size and use, all these computers are part of a system. A complete computer system consists of four parts: hardware, software, people, and data as shown in above figure.

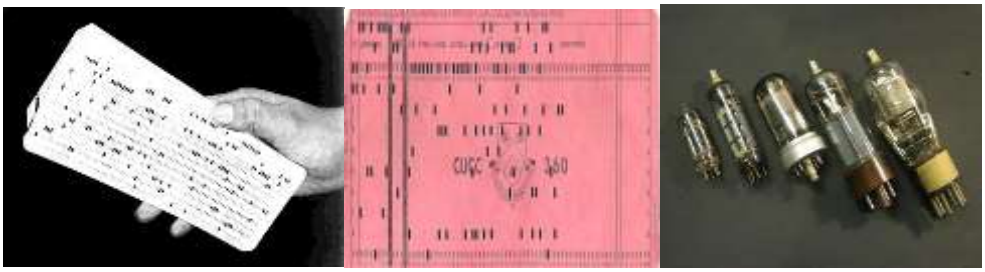
1.2.1 EVOLUTION OF COMPUTERS

The computers of today are vastly different in appearance and performance as compared to the computers of earlier days. But where did this technology come from and Where is it heading? To fully understand the impact of computers on today's world and the promises they hold for the future, it is important to understand the evolution of computers.

1.2.1.1 The First Generation

The first generation computers made use of:

- Vacuum tube technology,
- Punched cards for data input,
- Punched cards and paper tape for output,
- Machine Language for writing programs,
- Magnetic tapes and drums for external storage.

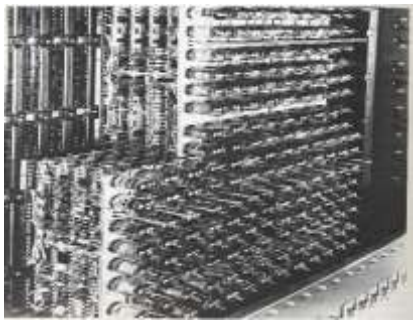


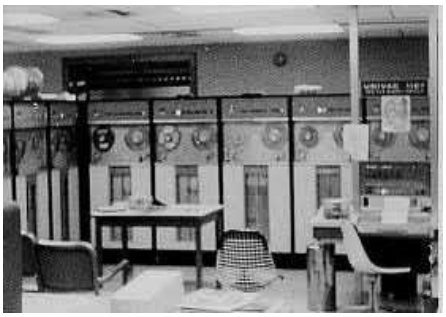
Punched cards *Paper tape* *Vacuum tube*

The first Generation Computer technology

The computers of the first generation were very bulky and emitted large amount of heat which required air conditioning. They were large in size and cumbersome to handle. They had to be manually assembled and had limited commercial use. The concept of operating systems was not known at that time. Each computer had a different binary coded program called a machine language that told it how to operate.

The Abacus, which emerged about 5000 years ago in Asia Minor and is still in use today, allows users to make computations using a system of sliding beads arranged on a rack. Early merchants used Abacus to keep trading transactions.





Abacus ***Pascaline***

The first Generation Computers

Blaise Pascal, a French mathematician invented the first mechanical machine, a rectangular brass box, called Pascaline which could perform addition and subtraction on whole numbers. This was in the seventeenth century. Colmar, a Frenchman invented a machine that could perform the four basic arithmetic functions of addition, subtraction, multiplication and division. Colmar's mechanical

calculator, "Arithmometer", presented a more practical approach to computing. With its enhanced versatility, the "Arithmometer" was widely used until the First World War, although later inventors refined Colmar's calculator, together with fellow inventors, Pascal and Leibniz, he helped define the age of mechanical computation.

Charles Babbage a British mathematician at Cambridge University invented the first analytical engine or difference engine. This machine could be programmed by instructions coded on punch cards and had mechanical memory to store the results. For his contributions in this field Charles Babbage is known as 'the father of modern digital computer.

Some of the early computers included:

Mark I –

This was the first fully automatic calculating machine. It was designed by Howard Aiken of Harvard University in collaboration with IBM. This machine was an electronic relay computer. Electromagnetic signals were used for the movement of mechanical parts. Mark I could perform the basic arithmetic and complex equations. Although this machine was extremely reliable, it was very slow (it took about 3-5 seconds per calculation) and was complex in design and large in size.

Fig.3 Mark-I Computer

Atanasoff-Berry Computer (ABC)

This computer dev eloped by John Atanasoff and Clifford Berry was the world's first general purpose electronic digital computer. It made use of vacuum tubes for internal logic and capacitors for storage.

The machine was, however, the first to implement three critical ideas that are still part of every modern computer:

- Using binary digits to represent all numbers and data
- Performing all calculations using electronics rather than wheels, ratchets, or mechanical switches
- Organizing a system in which computation and memory are separated.

ABC Computer

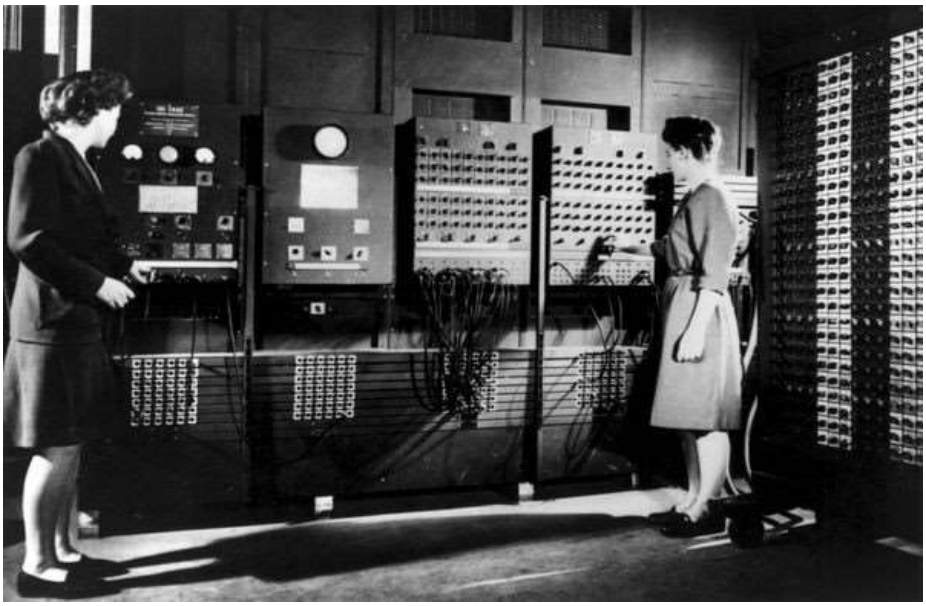
The memory of the Atanasoff–Berry Computer was a system called regenerative capacitor memory, which consisted of a pair of drums, each containing 1600 capacitors that rotated on a common shaft once per second. The capacitors on each drum were organized into 32 "bands" of 50 (30 active bands and two spares in case a capacitor failed), giving the machine a speed of 30 additions/subtractions per

second. Data was represented as 50-bit binary fixed-point numbers. The electronics of the memory and arithmetic units could store and operate on 60 such numbers at a time (3000 bits).

ENIAC (Electronic Numeric Integrator and Calculator)

The first all-electronic computer was produced by a partnership between the US Government and the University of Pennsylvania. It was built using 18,000 vacuum tubes, 70,000 resistors and 1,500 relays and consumed 160 kilowatts of electrical power. The ENIAC computed at speed about thousand times faster than Mark I. However, it could store and manipulate only a limited amount of data. Program modifications and detecting errors were also difficult.

ENIAC was a modular computer, composed of individual panels to perform different functions. Twenty of these modules were accumulators that could not only add and subtract, but hold a ten-digit decimal number in memory. Numbers were passed between these units across several general-purpose buses (or trays, as they were called). In order to achieve its high speed, the panels had to send and receive numbers, compute, save the answer and trigger the next operation, all without any moving parts. Key to its versatility was the ability to branch; it could trigger different operations, depending on the sign of a computed result.

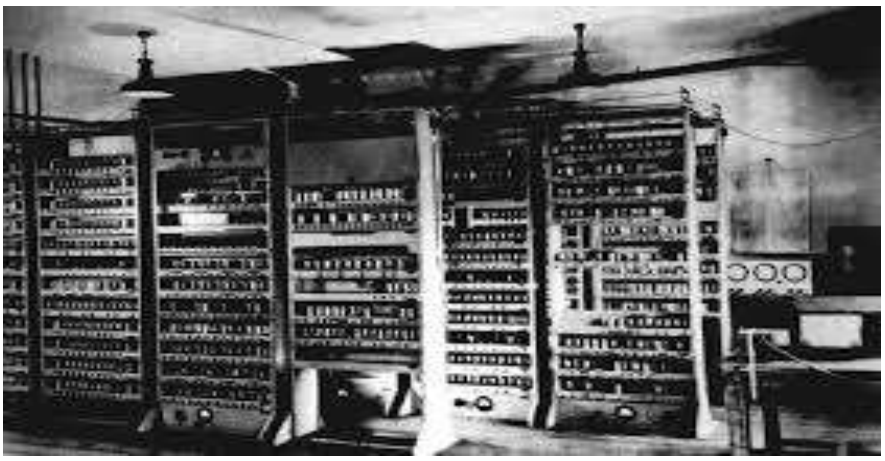


ENIAC Computer

EDVAC

In the mid 1940's Dr. John v on Neumann designed the Electronic Discrete Variable Automatic Computer with a memory to store both program and data. This was the first machine which used the stored program concept. It had five distinct units - arithmetic, central control, memory, input and output. The key element was the central control. All the functions of the computer were co-ordinate through this single source, the central control. The programming of the computers was done in machine language.

Functionally, EDVAC was a binary serial computer with automatic addition, subtraction, multiplication, programmed division and automatic checking with an ultrasonic serial memory capacity of 1,000 34-bit words. EDVAC's average addition time was 864 microseconds and its average multiplication time was 2,900 microseconds.



EDVAC Computer

UNIVAC

Remington Rand designed this computer specifically for business data processing applications. On June 14, 1951, the U.S. Census Bureau dedicates UNIVAC, the world's first commercially produced electronic digital computer. UNIVAC, which stood for Universal Automatic Computer, was developed by J. Presper Eckert and John Mauchly, makers of ENIAC, the first general-purpose electronic digital computer. These giant computers, which used thousands of vacuum tubes for computation, were the forerunners of today's digital computers. UNIVAC and other first-generation computers were replaced

by transistor computers of the late 1950s, which were smaller, used less power, and could perform nearly a thousand times more operations per second.

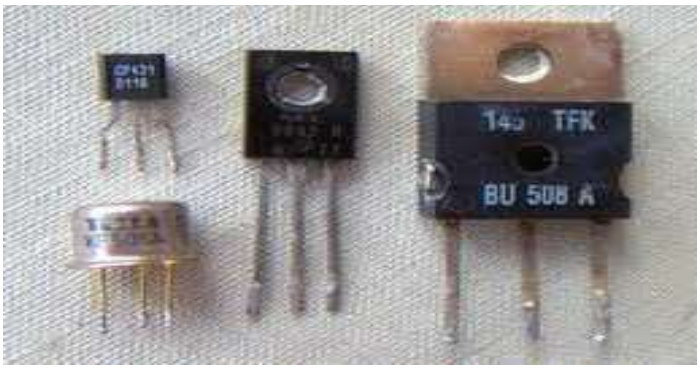
UNIVAC Computer

1.2.1.2 The Second Generation

In the second generation computers:

- Vacuum tube technology was replaced by transistorized technology,
- Size of the computers started reducing,
- Assembly language started being used in place of machine language,
- Concept of stored program emerged,
- High level languages were invented.

This was the generation of Transistorized Computers. Vacuum tubes were replaced by transistors. As a result, the size of the machines started shrinking. These computers were smaller, faster, more reliable and more energy efficient. The first transistorized computer was TX-0. The first large scale machines that took advantage of the transistor technology were the early supercomputers, Stretch by IBM and LARC by Sperry Rand. These machines were mainly developed for atomic energy laboratories. Typical computers of the second generation were the IBM 1400 and 7000 series, Honeywell 200 and General Electric.



Transistors

IBM 1401 was universally accepted throughout the industry and most large businesses routinely processed financial information using second generation computers. The machine language was replaced by assembly language. Thus the long and difficult binary code was replaced with abbreviated programming code which was relatively easy to understand.

The stored program concept and programming languages gave the computers flexibility to finally be cost effective and productive for business use. The stored program concept implied that the instructions to run a computer f or a specific task were held inside the computer's memory and could quickly be modified or replaced by a different set of instructions for a different function. High lev el languages like COBOL, FORTRAN and AL- GOL were dev eloped. Computers started finding vast and varied applications. The entire software industry began with the second generation computers.

1.2.1.3. The Third Generation

The third generation computers were characterized by:

- Use of Integrated circuits,
- Phenomenal increase in computation speed,
- Substantial reduction in size and power consumption of the machines,
- Use of magnetic tapes and drums for external storage,
- Design-of Operating systems and new higher level languages,
- Commercial production of computers.

This generation was characterized by the invention of Integrated Circuits (ICs). The IC combined electronic components onto a small chip which was made from quartz.

Later, even more components were fitted onto a single chip, called a semiconductor. This reduced the size even further. The weight and power consumption of computers decreased and

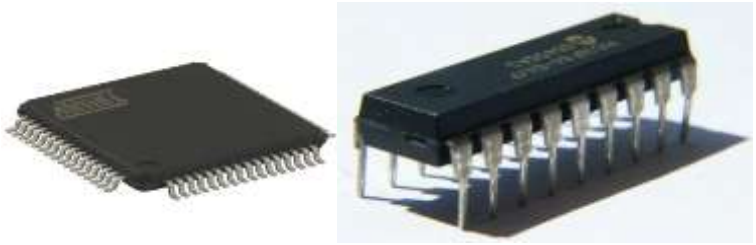


Fig. 1.9 Integrated Circuit

the speed increased tremendously. Heavy emphasis was given to the development of software. Operating systems were designed which allowed the machine to run many different programs at once. A central program monitored and co-ordinate the computer's memory. Multiprogramming was made possible, whereby the machine could perform several jobs at the same time. Computers achieved speeds of executing millions of instructions per second. Commercial production became easier and cheaper. Higher lev el languages like Pascal and Report Program Generator (RPG) were introduced and applications oriented languages like FORTRAN, COBOL, and PL/1 were developed.

1.2.1.4. The Fourth Generation

The general features of the fourth generation computers were:

- Use of Very Large Scale Integration,
- Invention of microcomputers,
- Introduction of Personal Computers,
- Networking,
- Fourth Generation Languages.

The third generation computers made use of 'Integrated Circuits that had 10- 20 components on each chip, this was Small Scale Integration (SSI).

The Fourth Generation realized Large Scale Integration (LSI) which could fit hundreds of components on one chip and Very Large Scale integration (VLSI) which squeezed thousands of components on one chip. The Intel 4004 chip, located all the components of a computer (central processing unit, memory,

input and output controls) on a single chip and microcomputers were introduced. Higher capacity storage media like magnetic disks were dev eloped. Fourth generation languages emerged and applications software's started becoming popular.

Fig. 1.10 VLSI

Computer production became inexpensive and the era of Personal Computers (PCs) commenced. In 1981, IBM introduced its personal computer for use in office, home and schools. In direct competition, the Macintosh was introduced by Apple in 1984. Shared interactive systems and user friendly environments were the features of these computers.

As the computers started becoming more and more powerful, they could be linked together or networked to share not only data but also memory space and software. The networks could reach enormous proportions with local area networks. A global web of computer circuitry, the Internet, links the computers worldwide into a single network of information.

1.2.1.5 The Fifth Generation

Defining the fifth generation computers is somewhat difficult because the field is still in its infancy. The computers of tomorrow would be characterized by Artificial Intelligence (At). An example of Al is

Expert Systems. Computers could be developed which could think and reason in much the same way as humans. Computers would be able to accept spoken words as input (voice recognition).

Many advances in the science of computer design and technology are coming together to enable the creation of fifth generation computers. Two such advances are parallel processing where many CPUs work as one and advance in superconductor technology which allows the flow of electricity with little or no resistance, greatly improving the speed of information flow.

1.2.2 CHARACTERISTICS OF A COMPUTER SYSTEM

Computers are not just adding machines; they are capable of doing complex activities and operations. They can be programmed to do complex, tedious and monotonous tasks. All computers have certain common characteristics irrespective of their type and size. The following are the important characteristics which took together, enable a computer to surpass its performance in some tasks in which the human beings cannot perform efficiently:

1. Speed: A computer is a very fast device capable of data processing at unbelievable speed. It can perform in a few seconds the amount of work that a human being may not be able to do in an entire year even if he works day and night and does nothing else. Computers can process millions of instructions per second thus carrying out even the complex tasks in fractions of seconds without any mistake.

While talking about the speed of a computer, we do not talk in terms of seconds or even milliseconds (10-3). Our units of speed are the microseconds (10-6), the nanoseconds (10-9), and even the picoseconds (10-12). A powerful computer is capable of performing about 3 to 4 million simple arithmetic operations per second.

2. Accuracy: In addition to speed, the computer has high accuracy in computing. The accuracy of a computer is consistently high and the degree of accuracy of a particular computer depends upon its design. But for a particular computer, each and every calculation is performed with the same accuracy. Errors can occur in a computer, but these are mainly due to human rather than technological weakness. The errors in computer are due to errors in programming and operation by human and due to inaccurate data.

3. Versatility: A computer is a very versatile machine. Versatility is one of the most wonderful features of the computer in the sense that they are not only capable of handling complex arithmetical problems, but can do equally well other number of jobs. They can perform activities ranging from simple calculations to performing complex CAD modeling and simulations to navigating missiles and satellites. In other words, computers can be programmed to perform any task that can be reduced to a series of logical steps. Computers can communicate with other computers and can receive and send data in various forms like text, sound, video, graphics, etc. We, now, live in a connected world and all this is because of computers and other related technologies.

4. Diligency: Unlike human beings, a computer is free from monotony, tiredness, lack of concentration etc. and hence can work for hours together without creating any error and without grumbling. Due to this property computer obviously score over human beings in doing routine type of jobs, which require greater accuracy. They will perform the tasks that are given to them - irrespective of whether it is interesting, creative, monotonous or boring; irrespective of whether it is the first time or the millionth time - with exactly the same accuracy and speed.

5. Storage Capability: Computers have their main memory and auxiliary memory systems. A computer can store a large amount of data. With more and more auxiliary storage devices, which are capable of storing huge amounts of data, the storage capacity of a computer is virtually unlimited. The factor that makes computer storage unique is not that it can store vast amount of data, but the fact that it can retrieve the information that the user wants in a few seconds. Every piece of information can be retained as long as desired by the user and can be recalled as and when required. Even after several years, the information recalled is as accurate as on the day when it was fed to computer. A computer forgets or loses certain information only when it is asked to do so. So it is entirely up to the user to make a computer retain or forget particular information.

6. Reliability: Reliability of the computers is indeed very high. Modern electronic components have long failure free lives. A microprocessor chip is said to have a life of 40 years even under adverse conditions and much before it fails, it will become obsolete. Computers are also designed in modular form so as to make maintenance easy; when a component fails, it can be replaced or repaired at a minimal cost.

7. Automation: The level of automation achieved in a computer is phenomenal. It is not a simple calculator where you have to punch in the numbers and press the equal to sign to get the result. Once a task is initiated, computers can proceed on its own till its completion. Computers can be programmed to perform a series of complex tasks involving multiple programs. Computers will perform these things flawlessly. They will execute the programs in the correct sequence, they will switch on/off the machines at the appropriate time, they will monitor the operational parameters, and they will send warning signals or take corrective actions if the parameters exceed the control level, and so on. Computers are capable of these levels of automation, provided they are programmed correctly.

1.2.3 CAPABILITIES OF COMPUTERS

Stepping down from the domains of technical people such as scientists and engineers; computer, today, is a very familiar household word. In 1950's computers were special purpose machines, which only huge institutions such as governments and universities could afford. In the 1960's modern computer began to revolutionize the business world and today it has become popular with all kinds of people from business to employees, from doctors to lawyers and from players to school going children. Today, computers are directly or indirectly influencing every aspect of our lives. Wherever human intellect and technology meet, we will find computers. Computers of all sizes and shapes are used for every purpose imaginable - from selling railway tickets to running washing machines; from stock market analysis to playing games; from publishing a new letter to designing a building… They can perform activities ranging from simple calculations to performing complex CAD modeling and simulations to navigating missiles and satellites. Computers can communicate with other computers and can receive and send data in various forms like text, sound, video, graphics, etc. This ability of computer to communicate to one another has led to the development of computer networks, Internet, WWW and so on. Today, we can send e-mail to people all around the world. We, now, live in a connected world and all this is because of computers and other related technologies.

Uses of Computers

Application Area	Use of Computers
Scientific Research	Used to resolve complex scientific problems accurately in a short time
Business	Used in banks, airports, share markets, hotels, export houses, Government offices and others for rising business applications like MIS, Payroll, Inventory, Financial Accounting *etc.*
Defense	Used to computerize warplanes, ships, radars and many advanced weapons
Space	Used to design computerized space satellites, rockets and related technology
Data Communication	Used to computerize geo-graphically separated offices through networking
Telecommunication	Used in ISDN, E-mail, Internet, Intranet, VSAT, Videoconferencing, Paging, Cellular phones *etc.*
Medicine	Used in hospitals and nursing homes/clinics for maintaining medical records, prescription writing, diagnostic applications and computerized scanning(CAT Scanning)
Education	Used in development of CBT (Computer Based Teaching)/ CAT (Computer Aided Teaching) programs for education
Law & Order	Used to records data of vehicles
Libraries	Used to develop Library Management Systems
Publishers	Used for Desk Top Publishing (DTP) for designing & printing of books
Engineering	Used CAD (Computer Aided Designing)/CAM (Computer Aided Manufacturing) by engineering companies
Emerging Technologies	Used in Artificial Intelligence (Expert Systems, Robotics *etc.*) and Virtual Reality

During the last four decades, computers have revolutionized almost all disciplines of our life. Computers have made possible many scientific, industrial and commercial advances that would have been impossible otherwise. Computers are being used in many areas of application viz. business, industry, scientific research, defense, space, communications, medicine, education and so on. The utilization of computers in different fields is summarized in above Table.

1.2.3.1 COMPUTERS IN BUSINESS

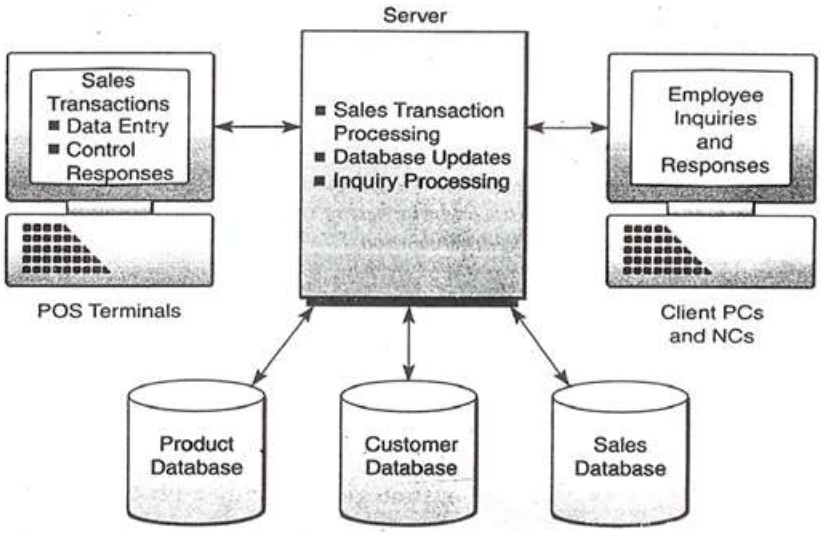
Computers have completely altered the structure of business. They are reshaping the basics of business. Customer service, operations, product and marketing strategies, and distribution are heavily, or sometimes even entirely, dependent on computer-enabled applications. The computers that support these functions can be found on the desk, on the shop floor, in the store, even in briefcases. Computers have become an everyday part of business life.

Figure below, illustrates the fundamental roles of computers in business. Computer systems perform three vital roles in any type of organization:

- Support of Business Operations
- Support of Managerial Decision-Making
- Support of Strategic Competitive Advantage

Three Major Roles of Computer-based Information Systems

Let's take a retail store as an example to illustrate these important roles. As a consumer, we have to deal regularly with the computer-based information systems that support business operations at many retail stores where we shop. For example, most retail stores now use computer-based information systems to help them record customer purchases, keep track of inventory, pay employees, buy new merchandise, and evaluate sales trends. Store operations would grind to a halt without the support of such information systems. See Figure below,



A Computer-based Sales Processing System that supports Sales Transaction Processing, Employee Inquiries and Responses, and the Access and Updating of Business Databases

Computer-based information systems also help store managers make better decisions and attempt to gain a strategic competitive advantage. For example, decisions on what lines of merchandise need to be added or discontinued, or on what kind of investment they require, are typically made after an analysis provided by computer-based information systems. This not only supports the decision making of store managers but also helps them look for ways to gain an advantage over other retailers in the competition for customers. Gaining a strategic advantage over competitors requires innovative use of computers and information technology. For example, store managers might make a decision to install computerized touch-screen catalog ordering systems in all of their stores, tied in with computer-based telephone ordering systems and an Internet-based computer shopping network. This might attract new customers and lure customers away from competing stores because of the ease of ordering provided by such innovative information systems. Thus, computer-based strategic information systems can help provide strategic products and services that give a business organization competitive advantage over its competitors.

1.2.4 LIMITATIONS OF COMPUTERS

There is no doubt that computers surpass human being in many aspects and can perform certain tasks better, faster and cheaper. But it cannot substitute man. The words of John F Kennedy are also 100% true ***"Man is still the most extraordinary Computers of all".*** The Computer, being an electronic device, has certain limitations, which can be summarized as follow:

1. **No IQ:** A computer is not a magical device. It can only perform tasks that a human being can. The difference is that it performs these tasks with unthinkable speed and accuracy. It possesses no intelligence of its own. Its IQ is zero, at least till today. Hence, only the user can determine what tasks a computer will perform. A computer cannot take its own decision in this regard. Unlike the human brain, a computer cannot think on its own, but has to be given very explicit, step-by-step instructions to make it perform a task.

2. **No Feelings:** Computers are devoid of emotions. They have no feelings and no instincts because they are machine. Although men have succeeded in building a memory for the computer, but no computer possesses the equivalent of human heart and soul. Based on our feelings, taste, knowledge, and experience, we often make certain judgments in our day-to-day life. But computers cannot make such judgments on their own. Their judgments are based on the instructions given to them in the form of programs that are written by us. They are only as good as man makes and uses them. They do not learn from experiences.

It is said for computers, "Garbage In Garbage Out (GIGO)". Many of the problems with computers occur because the computer can't tell the difference between doing something sensible versus something ridiculous. Erasing all its stored data is no different to a computer from adding two numbers. Computers operate logically, but they are incapable of acting prudently and rationally.

> ***Thus a computer is not intelligent: it is a fast, rule-following idiot. Fast because it works at electronic speeds; rule-following because it needs to be given very detailed and complete instructions before it can do even the simplest task; and an idiot because it will unhesitatingly follow instructions even when to us it would be obvious that they were nonsense.***

1.2.5 CLASSIFICATION OF COMPUTERS

We can categorize computer by two ways:

- Data handling capabilities and
- Size

On the basis of data handling capabilities, the computer is of three types:

- Analogue Computer
- Digital Computer
- Hybrid Computer

1) Analogue Computer

Analogue computers are designed to process the analogue data. Analogue data is continuous data that changes continuously and cannot have discrete values such as speed, temperature, pressure and current. The analogue computers measure the continuous changes in physical quantity and generally render output as a reading on a dial or scale. Analogue computers directly accept the data from the measuring device without first converting it into numbers and codes.

Speedometer and mercury thermometer are examples of analogue computers.

2) Digital Computer

Digital computer is designed to perform calculations and logical operations at high speed. It accepts the raw data as digits or numbers and processes it with programs stored in its memory to produce output. All modern computers like laptops and desktops that we use at home or office are digital computers.

3) Hybrid Computer

Hybrid computer has features of both analogue and digital computers. It is fast like analogue computer and has memory and accuracy like digital computers. It can process both continuous and discrete data. So it is widely used in specialized applications where both analogue and digital data is processed. For example, a processor is used in petrol pumps that converts the measurements of fuel flow into quantity and price.

On the basis of size, the computer can be of five types:

- Supercomputer
- Mainframe Computer
- Miniframe Computer
- Workstation
- Microcomputer

1) Supercomputer

Supercomputers are the biggest and fastest computers. They are designed to process huge amount of data. A supercomputer can process trillions of instructions in a second. It has thousands of interconnected processors. Supercomputers are particularly used in scientific and engineering applications such as weather forecasting, scientific simulations and nuclear energy research. First supercomputer was developed by Roger Cray in 1976.

2) Mainframe computer

Mainframe computers are designed to support hundreds or thousands of users simultaneously. They can support multiple programs at the same time. It means they can execute different processes simultaneously. These features of mainframe computers make them ideal for big organizations like banking and telecom sectors, which need to manage and process high volume of data.

3) Miniframe computer

It is a midsize multiprocessing computer. It consists of two or more processors and can support 4 to 200 users at one time. Miniframe computers are used in institutes and departments for the tasks such as billing, accounting and inventory management.

4) Workstation

Workstation is a single user computer that is designed for technical or scientific applications. It has faster microprocessor, large amount of RAM and high speed graphic adapters. It generally performs a specific job with great expertise; accordingly, they are of different types such as graphics workstation, music workstation and engineering design workstation.

5) Microcomputer

Microcomputer is also known as personal computer. It is a general purpose computer that is designed for individual use. It has a microprocessor as a central processing unit, memory, storage area, input unit and output unit. Laptops and desktop computers are examples of microcomputers.

1.3 CARRIERS IN COMPUTER

Computers are growing in popularity very rapidly. Computers are running almost everything we can of think: from organizing records to directing traffic. The Information Technology (IT) industry is growing at an incredible rate. The impact of computers on our everyday lives is monumental, though taken for granted. Every time we make a bank deposit, purchase items on a credit card, pay an insurance premium or rent a video movie, innumerable computer operations are involved. Making all these operations happen, behind the scenes, is the work of a vast array of professionals: computer programmers, programmer analysts, systems analysts, hardware and software engineers, database managers, *etc*. As our society becomes more computerized and technologically sophisticated, the need for highly skilled computer professionals increases accordingly.

1.3.1 Career Options

The computer technology industry on the whole encompasses many fields of professional involvement and advancement. In broad terms, here are some of the career options that one can consider

1. Computer Science Jobs

Computer scientists are involved in designing computer systems and in researching ways to enhance the practical applications of such designs. Computer scientists address highly theoretical and complex problems associated with making new technology beneficial to all segments of society: academia, the military, civilian businesses, end-user consumers, *etc*. Included in this group of computer scientists are computer engineers, database administrators, computer support analysts, and other technically specialized professionals.

2. **Systems Development Jobs**

People working in this field analyze the informational needs within an organization and the ways by which various computer systems should properly relate to each other to enhance the overall operation of

the organization. Systems analysts ensure that the functional areas of the organization - accounting, marketing, sales *etc*.- communicate properly with each other. To accomplish this task, systems analysts study and modify the capabilities of the computer hardware and software to meet the changing demands of an evolving organization.

3. EDP Auditor Jobs

This is a challenging career option for professionals who have keen interests and skills in computers as well as in accounting and finance. The fundamental goal of EDP (Electronic Data Processing) auditing is to ensure the accuracy, efficiency, and integrity of a company's computer system, which is at the heart of all its business operations. EDP auditors are concerned, in part, with the accuracy of computer input and output as this accuracy relates to the possibility of financial impropriety, security leaks, or fraud. Along with knowledge of computer systems, programming languages, and various applications, EDP auditors need a good understanding of business and financial management. In fact, many EDP auditors hold MBA degrees and/or CA certification.

4. Consulting Jobs

One who aspires to become computer consultant can follow a number of career paths. Some computer consultants are motivated by strong entrepreneurial instincts. With several years of industry experience, they choose the route of freelance consulting, often as stepping-stones for starting their own companies to carve their niches in the computer market. Talented young professionals may also consider a career with combined-practice companies, such as the prestigious consulting firms, or with major hardware/ software suppliers, or with international consulting firms that offer computer consulting as part of turnkey business services. Other rewarding computer careers include sales/marketing support, technical writing and instruction, quality assurance, network engineering, management information systems, and so forth.

5. Teaching Jobs

One can make career in computer teaching at both under graduate and post graduate levels.

1.3.2 Computers in Non-IT Professions

Even if we are not interested in becoming a computer professional, it is a must that we have basic

knowledge of computers and the commonly used applications. It is imperative that we become a computer savvy professional-a person who can use computers with ease to perform routine tasks like composing a letter or memo, send and receive e-mail, surf the Internet, make computer presentations, *etc*. Because in today's information age- where computers hold the center stage - computer proficiency is a must for our survival and success.

The workers and professionals of the world will soon be divided into two distinct groups: those who will control computers and those who will be controlled by computers. It would be best for you to be in the former group.

1.4 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. A computer is made up of two components- one is _____ and other is _____.
2. _____computers incorporate the technology of both analog and digital computers.
3. All physical components of computer are part of the_____.
4. The smallest unit of data in computer is _____.
5. The fastest and most expensive computers are_____

B. State whether the following statements are True or False:

1. A hybrid computer is the one having combined properties of analog and digital computer.
2. Charles Babbage is the father of computer.
3. Minicomputer works faster than micro-computers.
4. UNIVAC is universal array computer.
5. Fourth generation computers are based on VLSI.

1.5 SUMMARY

A computer is an electronic device that can perform a variety of operations according to the instructions given by the programmer/user and provides the desired information as an output. Computers are fast, accurate, diligent, having high memory, but no intelligence.

Computer are classified as general purpose or special purpose computers according to the purpose of their requirement. According to the technology used, computers are classified as analog which are used for scientific and engineering application, digital which are considered as general purpose computers or hybrid computers. Which incorporate the technology of both analog and digital computers. According to their size, computer can be classified as super computer, mainframe computer, minicomputer and microcomputer.

1.6 KEYWORDS

Computer: an electronic device for storing and processing data, typically in binary form, according to instructions given to it in a variable program.

Supercomputer: is a computer with a high level of performance as compared to a general-purpose computer. The performance of a supercomputer is commonly measured in floating-point operations per second (FLOPS) instead of million instructions per second (MIPS).

Minicomputer: Mini-Computer that is smaller, less expensive, and less powerful than a mainframe or supercomputer.

Mainframe computers or mainframes: are computers used primarily by large organizations for critical applications; bulk data processing, such as census, industry and consumer statistics, enterprise resource planning; and transaction processing.

PDA: Personal digital assistant, also known as a handheld PC, is a variety mobile device which functions as a personal information manager.

1.7 SELF-ASSESSMENT TEST

1 What are the motivating factors behind the development of computers?

2 Explain some of the important characteristics of computers.

3 Write a short note on "Capabilities of Computers". How the field of business is affected by the capabilities of computers?

4 Explain the limitations of computers.

5 What is a computer? Why is it known as data processor?

6 Explain the generations of computer.

7 Discuss the classification of computers.

1.8 ANSWERS TO CHECK YOUR PROGRESS

Check your Progress A

1. Software, Hardware
2. Hybrid
3. Hardware
4. Bit
5. Supercomputers

Check your Progress B

1. True
2. True
3. True
4. False
5. True

1.9 REFERENCES/SUGGESTED READINGS

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Course: BC 104	Author: Mr. Sawtantar Singh
Lesson: 2	Updated By: Mr. Balwant

Computer Components and Peripheral Devices

Structure

2.0 Learning Objectives

2.1 Introduction

2.1.1 Components of a computer system

2.1.2 Input/output devices

2.1.3 What is port?

2.1.3.1 Parallel port

2.1.3.2 Serial port

2.1.3.3 Universal serial bus (USB)

2.1.3.4 Small computer system interface (SCSI)

2.2 Input Devices

2.3 Output devices

2.4 Check Your Progress

2.5 Summary

2.6 Keywords

2.7 Self-Assessment Questions

2.8 Answers to Check Your Progress

2.9 References/Suggested Readings

2.0 LEARNING OBJECTIVES

After studying this lesson, you should be able to understand:

- ✓ Components of a Computer System
- ✓ The basic concepts of input/output devices
- ✓ Functions of input/output devices
- ✓ Types of input/output devices
- ✓ Types of Ports

2.1 INTRODUCTION

In this lesson we shall discuss about components of a computer system and discuss something about input/output devices and their functions. Input/output devices constitute a major part of a computer system. These are also called peripheral devices. Without I/O devices, a user cannot communicate with the computer. They are required to enter data and instructions in a computer so that the computer can process that data and provide the result to the user through output devices. In computer, inputs are the signals and data received by the system and outputs are the signals and data which are generated from the system.

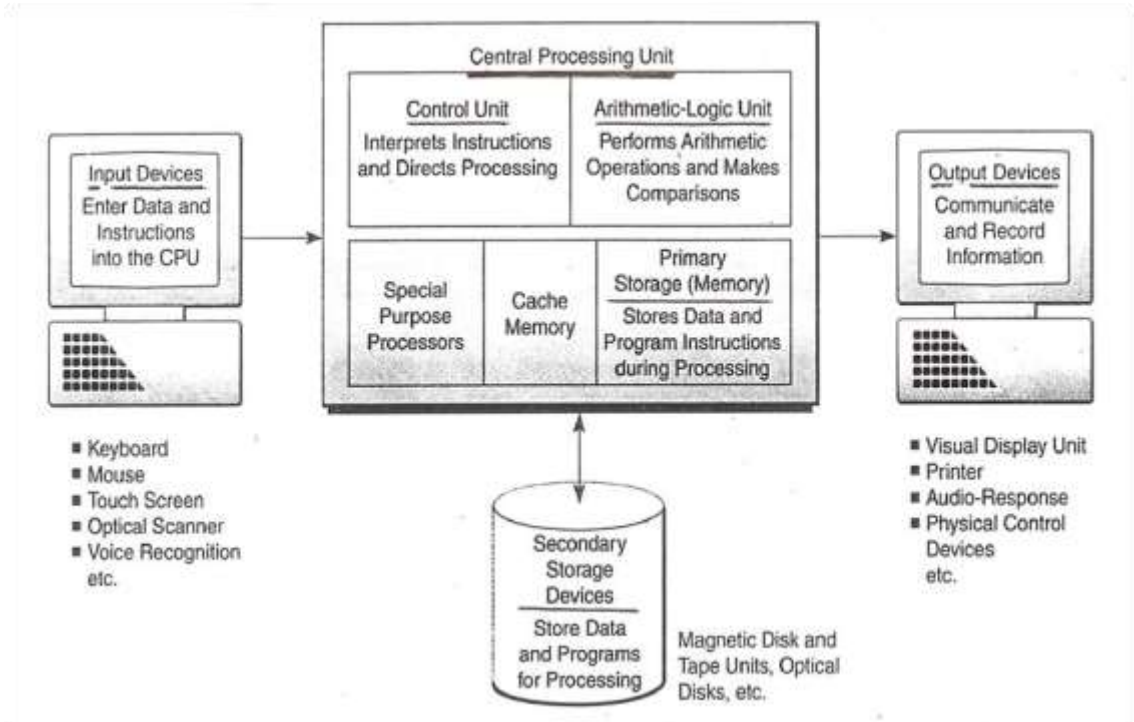
First we will discuss about components of a computer system in detail. Then input/output devices and then move on to the function and structure of input and output devices. And finally, we will discuss about recent trends in input devices such as digital camera, barcode reader, magnetic ink character recognition and magnetic stripe reader such as ATM machines and Electronic Point of Sale (EPOS).

2.1.1 COMPONENTS OF A COMPUTER SYSTEM

The capacity, size, cost and internal architectural design of computers differ from one model to another. However, the basic organization remains the same for all computer systems. A block diagram is shown in fig. below, which displays the basic building blocks or functional units, of a digital computer system. These units correspond to the basic operations performed by all computer systems. The function of each of these units is described below.

2.1.1.1 Input Unit

Data and instructions must enter the computer system before any computation can be performed on the supplied data. The input unit that links the external environment with the computer system performs this task. Data and instructions enter input units in forms that depend upon the particular device used. For example, data is entered from a keyboard in a manner similar to typing, and this differs from the way in which data is entered through a card reader which is another type of input device. However, regardless of the form in which they receive their inputs, all input devices must provide a computer with data that are transformed into the binary codes that the primary memory of a computer is designed to accept. This transformation is accomplished by units called input interfaces. Input interfaces are designed to match the unique physical or electrical characteristics of input devices to the requirements of the computer system.



Components of a Computer System

In short, an input unit performs the following functions:

- It accepts (or reads) the list of instructions and data from the outside world.
- It converts these instructions and data in the computer acceptable form.

- It supplies the converted instructions and data to the complete system for further processing.

2.1.1.2 Output Unit

The job of an output unit is just the reverse of that of an input unit. It supplies information and results of computation to the outside world. Thus, it links the computer with the external environment. As computers work with binary code, the results produced are also in the binary form. Hence, before supplying the results to the outside world, it must be converted to human acceptable (readable) form. This task is accomplished by units call output interfaces. Output interfaces are designed to match the unique physical or electrical characteristics of output devices (terminals, printers, etc.) to the requirements of the external environmental.

In short, an output unit performs the following functions:

- It accepts the results produced by the computer, which are in coded form and hence cannot be easily understood by us.
- It converts these coded results to human acceptable (readable) form.
- It supplies the converted results to the outside world.

2.1.1.3 Storage Unit

The data and instructions that are entered into the computer system through input units have to be stored inside the computer before the actual processing starts. Similarly, the results produced by the computer after processing must also be kept somewhere inside the computer system before being passed on to the output units. Moreover, the intermediate results produced by the computer must also be preserved for ongoing processing.

The storage unit at the primary/main storage of a computer system is designed to cater to all these needs. It provides space for storing data and instructions; space for intermediate results; and also space for the final results.

In short the specific functions of the storage unit are to hold (store):

- All the data to be processed and the instructions required for processing (received from input devices).
- Intermediate results of processing.

- Final results of processing before these results are released to an output device.

Two Kinds of Memory

The main memory, housed inside the computer unit, is built from two different kinds of memory chip: the first kind, called ROM (read only memory), has permanently built into information and instructions the computer needs to know in order to operate properly; the second kind of memory, called RAM (random access memory), holds the program and other information typed in at the keyboard.

The RAM is a 'read and write' memory. This means we can store, or 'write', information into this memory and later recall it, or 'read' it out again. The ROM, on the other hand, can only be read; we cannot write information into it. This ensures that we do not destroy

the vital information held in ROM by over-writing it.

An important difference between the two types of memory is that RAM is 'volatile', i.e. it loses all the information stored when the power is switched off. ROM, on the other hand, is 'non-volatile'; its information is not lost when the power is switched off.

The secondary storage medium stores data, instructions and output for archival purpose so that whenever any data or instructions is required in the future it can be retrieved for reference or for further processing.

2.1.1.4 Central Processing Unit

The Arithmetic Logic Unit and the Control Unit of a computer system are jointly known as the Central Processing Unit (CPU). The CPU is the brain of any computer system. In a human body, the brain takes all major decisions and the other parts of the body function as directed by the brain. Similarly, in a computer system, all major calculations and comparisons are made inside the CPU and the CPU is also responsible for activating and controlling the operations of other units of a computer system.

2.1.1.5 Arithmetic Logic Unit

The Arithmetic Logic Unit (ALU) of a computer system is the place where the actual execution of the instructions takes place during the processing operation. To be more precise all calculations are performed and all comparisons (decisions) are made in the ALU. The data and instructions stored in the primary storage prior to processing, are transferred as and when needed to the ALU where processing

takes place. No processing is done in the primary storage unit. Intermediate results generated in the ALU are temporarily transferred back to the primary storage until needed at a later time. Data may, thus, move from primary storage to ALU and back again to storage many times before the processing is over. After the completion of processing the final results, which are stored in the storage unit, are released to an output device.

The type and number of arithmetic and logic operations that a computer can perform is determined by the engineering design of the ALU. However almost all ALU's are designed to perform the four basic arithmetic operations (add, subtract, multiply, divide) and logic operations or comparisons such as less than, equal to, or greater than.

2.1.1.6 Control Unit

How does the input device know that it is time for it to feed data into the storage unit? How does the ALU know what should be done with the data once they are received? And how is it that only the final results are sent to the output device and not the intermediate result? All this is possible because of the Control Unit of the computer system. By selecting, interpreting, and seeing to the execution of the program instructions, the Control Unit is able to maintain order and direct the operation of the entire system. Although, it does not perform any actual processing on the data, the Control Unit acts as a central nervous system for the other components of the computer. It manages and coordinates the entire computer system. It obtains instructions from the program stored in main memory, interprets the instructions, and issues signals that cause other units of the system to execute them.

2.1.2 INPUT/OUTPUT DEVICES

The computer will be of no use if it is not communicating with the external world. Thus, a computer must have a system to receive information from the outside world and must be able to communicate results to the external world. Thus, a computer consists of input/output devices. Input and output devices can also be written as I/O devices.

Input and output devices of a computer system are the devices that connect you to computer. Input devices let you to transfer data and user command into the computer system. I/O devices are used to interact with the computer system. For example, you can type in data by using a keyboard, or you can input data in picture form by using a scanner in computer system.

On the other hand, output devices display the result of input data or signals after processing it. Examples of these could be your computer's monitor, which displays all the programs which are running on the computer, as well as the printer, which will print out a hard copy of the information which is saved in your computer.

Input and output devices allow the computer system to interact with the outside world by moving data into and out of the computer system.

Examples of some input devices are:

- Keyboard
- Mouse
- Joystick
- Bar code reader
- Graphics tablet
- Pen drive
- CD/DVD
- Digital Camera

An output device is used to send data out of the system. The user sees the result after processing of data by the computer through output devices. Examples of some output devices are:

- Monitor
- Printer
- Plotter
- Speaker

Input and output devices are also called I/O devices. They are directly connected to an electronic module called I/O module or device controller. For example, the speakers of a multimedia computer system are directly connected to a device controller called an audio card, which in turn is connected to the rest of the system. Input and output devices are similar in operation but perform opposite functions. It is through the use of these devices that the computer is able to communicate with the outside world.

Input data for the computer system could be in any of the following forms:

- Manual inputs from a keyboard or console.
- Analog inputs from instruments or sensors.
- Inputs from a storage device, such as pen-drive, CD's and Floppy Drives.

The speed of a processor is far more than the input devices, such as the keyboard of computer system. Computer systems can process hundreds or thousands of computer words or characters per second. Thus, a study of the first method, i.e. manual input reflects the inability of human-operated keyboards or keypunches to supply data at a speed that matches the speed of digital computers.

2.1.3 WHAT IS PORT?

Port is a connecting socket, outside the system into which different types of cables are plugged. It is a specific place from which other devices can be physically connected. I/O ports are the interfaces through which computers communicate with external devices such as printers, modems, joysticks and terminals. There are many types of ports used in computer system. Some of them are given as follows.

2.1.3.1 Parallel Port

Various peripherals can be connected through parallel port, which is a parallel communication physical interface. A parallel port transmits 8 bits of a byte of data in parallel. It is used for transmitting fast data over short distances. It is used to connect a printer to a computer. Since a parallel port transmits an entire byte at a time, it operates I/O devices at a relatively high speed. A Parallel port is primarily used to connect printers to a computer and hence it is often called a printer port.

Parallel Port

2.1.3.2 Serial Port

Serial port transmits one bit of a byte, one at a time as a single stream of bits. It is meant for transmitting slow data over long distances. Communication over a phone is an example of serial communication. It is a serial communication physical interface which transmits one bit at a time. Dial-

up modems and serial mice use serial ports.

Serial Port

2.1.3.3 Universal Serial Bus (USB)

A USB Port can connect up to 127 peripheral devices such as a digital camera, digital speakers, scanners, speakers etc. It permits Plug and Play – configuring of expansion cards and peripheral devices as and when they are installed.

USB

2.1.3.4 Small Computer System Interface (SCSI) Port

SCSI-Small Computer System Interface Port allows data to be transmitted in a daisy chain to up to 7 devices at a speed higher (32 bits at a time) than those possible with serial and parallel ports. It is a fast data transmitting device and is used to connect HDD,

CD ROM drives and scanners with the computer system.

2.2 INPUT DEVICES

In this section we will discuss various types of input devices used for entering data into the computer system. These are:

2.2.1 Keyboard

It is the most common input device used for entering data and information into the computer system. This is the standard input device attached to all computers. The keyboard is a primary device for inputting text by pressing a set of keys. All the keys are neatly mounted in a keyboard connected to the computer system. Keyboard devices can be classified into two types general purpose keyboards and special purpose keyboards. General purpose keyboard are standard keyboards used with most computer system. They are called general purpose because that have enough keys to make them useful for any type of application. The layout of keyboard is just like the traditional typewriter of the type QWERTY. It also contains some extra command keys and function keys. It contains a total of 101 to 104 keys. You have to press a correct combination of keys to input data. The computer can recognize the electrical signals corresponding to the correct key combination and processing is done accordingly.

The User can enter data into the computer by pressing a set of keys on the keyboard. In a keyboard letters are printed on the keys. The first keyboard was developed in the 18th century and was named as a QWERTY keyboard. A Computer keyboard includes control circuitry which converts the key pressed by the user into key codes so that the computer can understand it. Now-a-days wireless keyboards are also being used which increase user freedom. The wireless feature is achieved by infrared signals or by radio frequency.

In general, a computer keyboard has following keys:

1. Alphanumeric Keys: It includes letters and numbers.
2. Punctuation Keys: These include comma, period, semicolon etc. and
3. Special Keys: These can be function keys, control keys, arrow keys and Caps lock keys etc.

All the modern keyboards of computer are classified as:

(a) Original PC keyboard having 84 keys;

(b) Advance Technology (AT) Keyboard having 101-104 keys; and

(c) Multimedia Keyboard having 120 – 140 keys.

2.2.2 Mouse

A Mouse is a handy device which can be moved on a smooth surface to cause the movement of a cursor on the screen. It is a pointing device which is used to input data and information into the computer system by pointing on it. Physically, a mouse contains a small case, held under one of the user's hands with one or more buttons. For GUI-based systems a mouse is an essential pointing-device. The cursor of the mouse moves in the same direction in which the mouse ball rolls.

Its name is derived from its shape, which looks a bit like a mouse, with its connecting wire that one can imagine to be the mouse's tail. A Mouse rolls on a small ball and has two or three buttons on the top. When you roll the mouse across a flat surface on the screen, sensors sense the mouse in the direction of mouse movement. The cursor moves very fast with a mouse giving you more freedom to work in any direction. It is easier and faster to move through a mouse compared to movement using keys.

Types of Mouse

Mouse could be mechanical, optical or cordless types. Further information regarding these types are as follows:

Mechanical Mouse: Mechanical Mouse uses ball for the movement of cursor on the computer screen. When the ball is rolled in any direction, a sensor of the mouse detects it and also moves the mouse pointer in the same direction.

Optical Mouse: Optical Mouse uses Laser rays for the movement of cursor on the computer screen. It is an advanced pointing device. Movement is detected by sensing changes in the reflected light rather than the motion of a rolling sphere.

Cord-Less Mouse: Cord-Less Mouse is battery driven and does not need any wire for the physical connection with the motherboard. It transmits data through infrared or radio signal.

Computer mice are very useful in designing pictures and graphs and computer and video games by multimedia designers. A Mouse pad is required to move the mouse because it provides a smooth surface. However, an optical or laser mouse doesn't require a mouse pad.

2.2.3 Digitizing (Graphic) Tablet

Digitizing or Graphics' tablet is a computer input device that allows one to hand-draw images and graphics, similar to the way one draws images with a pencil and paper. These tablets may also be used to capture data of handwritten signatures. Some tablets are intended as a general replacement for a mouse as the primary pointing and navigation device for desktop computers. These are used by architects, engineers and designers in Computer Aided Design (CAD) for designing purposes, such as buildings, cars, mechanical parts, robots etc. These are also used in Geographical Information System (GPS) for digitizing of maps.

Graphics Tablet

Graphics tablet is most suited for artists and those who want the natural feel of a pen-like object to manipulate the cursor on their screen. Wacom is the most well-known manufacturer of graphics tablets, and is incredibly well respected.

2.2.4 Trackball

Trackball is a moveable ball mounted on a stationary device, which can be rotated manually by using fingers. It is also a pointing device. In a trackball, the ball is placed on the top along with buttons which can be rolled with the fingers. These are used in playing video games. Mouse and mobile phones are equipped with trackballs to navigate addresses as well as play games.

2.2.5 Joystick

Joystick is a remote control device for a computer which is used for playing video games to indicate the position. It has a stick that pivots on a base and is used for controlling the action in video games. The User moves a spherical ball with the help of a stick in the joystick as opposed to the trackball where fingers are used for moving the ball. Joysticks are also used for controlling machines such as cranes, trucks, underwater unmanned vehicles, flight simulators, industrial robots etc. The Joystick shown in figure has a base and a handle for controlling the movement of the cursor on the screen.

2.2.6 Pick Devices

Pick devices are used to select an object on the screen. The selected object can be text or graphics. Examples of pick devices are light pens and touch screens.

2.2.6.1 Light Pens

A Light pen is a pen like light-sensitive device. It is connected by a wire to the computer terminal to detect the CRT beam when pointed towards the screen and generate a narrow electrical pulse that can be fed to the computer as an input signal.

It is used to draw on the screen or to point to the displayed objects. It operates by detecting the light emitted by the screen phosphors. A light pen can work with any CRT monitor but not with LCD monitors. It is used by architects and engineers for CAD applications and editing.

Light Pen

2.2.6.2 Touch Screens

Touch screens are monitors / electronic visual display screens which detect where they are being touched. The user makes selections by directly touching the screen, rather than moving a cursor to the point on the screen with a mouse or joystick

Now days touch screens are being used in ATM machines for making it user friendly and

Kiosk machines are used for guiding the travelers about their travel plans. Touch screens are also used in many of the modern cell phones.

Touch Screen

2.2.7 Source Data Entry Devices

Entry of data into a computer system directly from the source, without transcription is called source data entry. Source data entry devices have a lower probability of error in input data than standard keyboard entry.

Some of the common source data entry devices are discussed below:

2.2.7.1 Digital Camera

A Digital camera is an electronic device which takes video or still photographs or both, digitally by recording images via an electronic image sensor. Digital cameras can do things which film cameras can't, for example displaying images on screen immediately after they are recorded. Images recorded on a digital camera can be cropped for editing, deleted and various types of special effects can be created by using Photoshop software.

Digital cameras look like ordinary cameras but have sufficient memory in the form of chips to store thousands of images, rather than using photographic films.

Digital camera

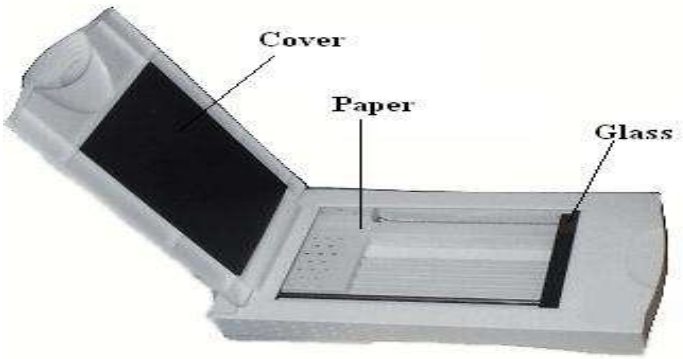
Most digital cameras allow users to choose the resolution needed for a picture. Most of those can connect directly to a computer to transfer data. A USB port is generally used for this purpose. A Wireless connection can also be used for connecting to a computer via Bluetooth.

These cameras use memory cards with flash memory to store images. The joint photographing expert's group standard (JPEG) is the most common file format used for storing data in a camera. Other formats include raw image format, DNG format etc.

2.2.7.2 Scanners

A Scanner is an input device and is used to input data into the computer system in the form of pictures. It optically scans images, printed text, handwriting, or an object, and converts it to a digital image. Examples of scanners are a desktop or flatbed scanner.

In scanners the document is placed on a glass window for scanning. Mechanically driven scanners that move the document are typically used for large-formatted volume of documents. Another type of scanner is a planetary scanner. This scanner takes photographs of books and documents. Three dimensional scanners are used for producing three-dimensional models of objects.



Optical Scanner

2.2.7.3 Optical Mark Recognition (OMR)

OMR is the scanning of paper to detect the presence or absence of a mark in a predetermined position. Now days, it is used as an input device for source data entry purposes. Universities and colleges often use OMR for the evaluation of OMR sheets for competitive exams. OMR sheets consist of multiple

choice question papers and students are required to make a mark to indicate their answers. OMR is used in the evaluation of questionnaires, surveys and university exam OMR sheets.

Optical Mark Recognition

2.2.7.4 Magnetic Ink Character Recognition (MICR)

Magnetic Ink Character Recognition is a character recognition system that uses special ink and characters. When a document that contains this ink needs to be read, it passes through a machine, which magnetizes the ink and then translates the magnetic information into characters.

MICR technology is used by banks for faster processing of large volumes of cheques. Numbers and characters found on the bottom of checks (usually containing the check number, sort number, and account number) are printed using Magnetic Ink. To print Magnetic Ink codes, we need a laser printer that accepts MICR toner.

MICR provides a secure, high-speed method of scanning and processing information. This technology is used for processing large volume of data. It speeds up data input for the bank because cheques can be directly fed into the input device as it also ensures accuracy of data entry. The most commonly used character set by MICR devices are known as E13B font which consists of the numerals 0 to 9, and four special characters.

2.2.7.5 Bar Code Reader

A barcode reader is an electronic device which is used to read printed barcodes. Barcodes represent alphanumeric data which is a combination of vertical lines (bars) that vary in width and length. It is a fast and effective way to input data. A Barcode reader uses a laser beam to read the series of thick and thin lines which represent the bar code number.

Bar Codes **Bar Code Reader**

The bar code is 13 digits long and it has four main divisions. The First two digits of a bar code represent the country, the second part represents the manufacturer's code (five digits) the third part represents the product code (five digits) and the last digit is a check digit.

2.2.7.6 Magnetic Stripe Reader

A magnetic reader is a hardware device which is used to read the information encoded in the magnetic stripe located at the back of a credit/debit card. A bank card holds data about the owner of the card, bank account number and code of the bank branch, where the account is held.

Magnetic Stripe Reader **ATM Machine with Card**

Magnetic stripe readers are often used at supermarkets and in many different types of shops. In these machines data is read electronically and the point of sale is called Electronic Point of Sale (EPOS).

There are several other pick devices such as microphones and speakers. These have been discussed in length under the section Out Put Devices section of this unit.

2.3 OUTPUT DEVICES

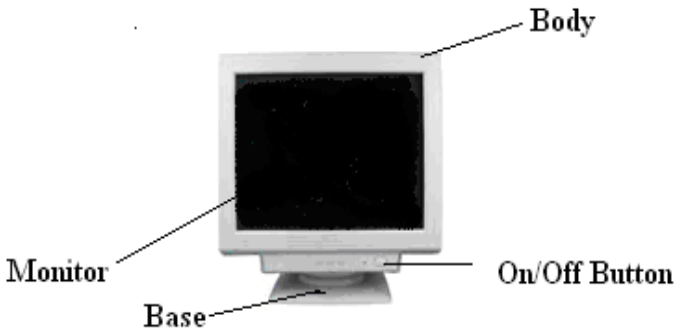
One of the most important output devices in computer system is its screen commonly called monitor. It is an output device and displays all the programs and applications which are running on the computer

system. A Monitor is the visual display unit of the computer system. It displays images generated from the video output. It displays images without keeping a permanent record.

A Graphic display is made up of a series of dots called 'pixels' (picture elements) whose pattern produces images in computer system. Each dot on the screen is defined as a separate unit which can be addressed separately. Since each dot on the screen can be controlled separately it gives greater flexibility in drawing pictures. The Number of dots per inch (dpi) is called the resolution of the screen and represents the quality of the computer system.

2.3.1 Cathode Ray Tube Monitors (CRT)

Monitors display what is going on in your computer. They can run at various resolutions. It is the part of computer which looks like a TV set. After typing the characters from the keyboard, we can see them on the monitor. The main components of a CRT monitors are the electron gun, the electron beam controlled by an electromagnetic field and phosphor coated display screen. These older monitors are bulky and require a lot of space for installation.



In CRT monitors, the image is projected on the screen by directing the electron beam onto the computer screen. To precisely direct the electron beams, copper steering coils are used to create a magnetic field inside the tube. By applying varying voltages to the copper coils a beam can be positioned at any point on the screen.

2.3.2 Liquid Crystal Displays (LCD)

First introduced in watches and clocks in the1970's, LCDs are now used to display images in monitors. A newer technology in computer screens is TFT LCD monitors. These are light weight monitors and are used in laptop computers. Active matrix structure is used by most of the modern LCD monitors and

television sets. In this technology, a matrix of thin-film transistors (TFT) is added to the polarizing and color filters. It enhances the display to make it look brighter and sharper. It can also produce much better images and have quicker response times.

These monitors are portable, reliable and consume less electricity. Images produced by these monitors are of better quality than that of old CRT monitors. The LCD monitors have very high resolution and emit less radiation than CRT monitors. The screen is also flicker free.

2.3.3 Thin Film Transistor Liquid Crystal Display (TFT LCD)

It is type of monitor which used thin film transistor technology to enhance the image quality of LCD Monitors. These are used as monitor in television set, desktop computer, laptop computer and mobile phones etc.

2.3.4 Light Emitting Diodes Monitors (LED)

Light Emitting Diodes (LED) is the latest technology which is being used now a day for making high definition TV screens and monitors. It is a semi-conductor light source. In this technology diodes are used to light up the screen instead of liquid crystal Diodes.

LED is known as light emitting diode. It is an electronic device that lights up when electricity is passed through it. LEDs are usually red. They are good for displaying images because they can be relatively small, and they do not burn out. However, they require more power than LCD monitors. LED is light weight monitors and is used in laptop computers and in TV.

The Life of LED monitors is three times than that of LCD monitors and they have less warm up time than that of CRT or LCD monitors. These monitors require less space on the desk, less power consumption and have flicker free screen.

2.3.5 Projection Displays

These are normally used for large group presentations. These systems can be connected to a computer and whatever appears on the computer terminal gets enlarged and projected on a large screen. Video projector receives video signals and projects the corresponding image on a projection screen. It uses a lens system for this projection.

LCD Overhead Projector

These are popularly used for seminars, class room lectures, marketing presentations and conference room presentations etc.

2.3.6 Printers

Printers are used for producing output on paper. There are a large variety of printers and printing devices which can be classified according to the print quality and printing speed.

These varieties of printers are:

Printing Technology – impact printers vs. non-impact printers

Impact printers use variations of the standard typewriter printing mechanism where a hammer strikes paper through an inked ribbon.

A non-Impact printer uses chemical, heat or electrical signals to produce symbols on paper. Some of these require special coated or treated paper to print characters on them.

2.3.7 Plotters

A Plotter is a device that draws pictures on a page as output, after receiving a print command from the computer. It is also called a graph plotter. In plotters pens are used to draw lines on the paper, which is placed in the plotter.

Plotter

Plotters produce high quality diagrams on the paper and their output quality is good. Engineers, architects and planners use plotters to generate high quality, high-precision graphic output of different sizes. For several design applications such as design of layout of an aircraft, car, and architectural design of a building and in other computer-aided design applications plotter are very useful.

Plotter is of two types:

- Drum Plotter
- Flat-Bed Plotter

The drum plotters are generally smaller than flatbed plotters and they have lower resolutions than flatbed plotters. HP, Canon and Epson are the popular companies which manufacture good quality of platters.

2.3.8 Speaker

Computer speakers, or multimedia speakers, are external speakers, commonly equipped with a low-power internal amplifier which produces sound as output. External speakers are connected with a computer by using a plug and socket.

Computer speakers range widely in quality and in price. Laptop computers have inbuilt speakers.

2.4 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. The _____ pen is a small input device used to select and display objects on a screen.
2. _____ keys are present on the top row of the keyboard.
3. The OCR recognises the _____ of the characters with the help of light source.
4. The most common method of entering text and numerical data into a computer system is through the use of a ____.
5. Information that comes from an external source and is fed into computer software is called ____.

B. State whether the following statements are True or False:

1. Scanner is used to print documents.
2. Printer is used to display pictures.
3. Pick devices are used to pick objects on the monitor.
4. Graphic tablets are used for designing purposes.
5. Speaker is an output device.

2.5 SUMMARY

Input/output devices are the devices that connect you to your computer. Input devices let you input data and other information into your computer and they also let you give your computer special instructions so that it will know what to do. For example, you can type in data by using a keyboard, or you can input data in picture form by using a scanner.

On the other hand, output devices display the results of your computer's computations. Examples of these would be your computer's monitor, which displays all of the programs you're running, as well as the printer, which will print out a hard copy of the information. Source data entry devices are those devices which automatically capture data and images at its source, record it in small chips and produces images immediately.

2.6 KEYWORDS

Input Unit: This unit contains devices with the help of which we enter data into the computer. This unit creates a link between the user and the computer.

CPU: Central Processing Unit is considered as the brain of the computer. CPU performs all types of data processing operations.

Output Unit: The output unit consists of devices with the help of which we get the information from the computer. This unit is a link between the computer and the users.

Input Devices: In computing, an input device is a piece of computer hardware equipment used to provide data and control signals to an information processing system such as a computer.

Output Devices: An output device is any piece of computer hardware equipment which converts information into human-readable form. It can be text, graphics, tactile, audio, and video.

2.7 SELF-ASSESSMENT TEST

1. Explain the various components of a computer system.
2. What do you mean by a port? Discuss various types of port associated with computer.
3. What do you mean by peak devices? Discuss various types of pick devices.
4. Write a short note on:
    a. CPU
    b. ALU
5. Define input devices. Describe various types of input devices.
6. Define output devices. Describe various types of output devices.

2.8 ANSWERS TO CHECK YOUR PROGRESS

Check your Progress A

1. Light
2. Function
3. Shape
4. Keyboard

5. Input

Check Your Progress B

1. False
2. False
3. True
4. True
5. True

2.9 REFERENCES/SUGGESTED READINGS

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Lesson: 3	Updated By: Mr. Balwant

Computer Memory

Structure

3.0 Learning Objectives

3.1 Introduction

3.2 Computer Memory

- 3.2.1 Register Memory
- 3.2.2 Cache memory
- 3.2.3 Primary memory
- 3.2.4 Secondary memory
  - 3.2.4.1 Hard disk
  - 3.2.4.2 Solid state drive
  - 3.2.4.3 Pen drive
  - 3.2.4.4 SD card
  - 3.2.4.5 Compact disk (CD)
  - 3.2.4.6 DVD

3.3 Memory units

3.4 Introduction to modern processor

3.5 Check Your Progress

3.6 Summary

3.7 Keywords

3.8 Self-Assessment Test

3.9 Answers to Check Your Progress

3.10 References/Suggested Readings

3.0 LEARNING OBJECTIVES

After studying this lesson, you should be able to understand:

- ✓ The basics of computer memory and its types
- ✓ What is RAM and its types
- ✓ ROM and its types
- ✓ Mass storage devices and its types
- ✓ Brief idea of modern processor

3.1 INTRODUCTION

Charles Babbage, the famous 19th century English mathematician and polymath, once said that for a machine to perform the functions of a human computer it must possess three things: a unit capable of performing the operations of arithmetic, a built-in power of judgement and a store.

The latter - a store - would retain the numbers and instructions required to define the successive stages in computation. Of course, in the 21st century we'd recognize this as 'computer memory', but in the 19th century this really was a groundbreaking idea.

Let's first define, in modern terms, what we mean by a store, or the memory of a computational machine:

> "The memory of a computer is where the program and data are stored before the calculations begin. During a computer run, the control section may store partial answers in the memory, similar to the way we use paper to record our work. The memory is therefore one of the most active parts of a computer, storing not only the program and data but processed data as well. The memory is equivalent to thousands of registers, each storing a binary word."

In this lesson we discuss register memory, cache memory, primary memory and secondary memory.

3.2 COMPUTER MEMORY

The computer memory holds the data and instructions needed to process raw data and produce output. The computer memory is divided into large number of small parts known as cells. Each cell has a unique address which varies from 0 to memory size minus one.

Computer memory is of two types: Volatile (RAM) and Non-volatile (ROM). The secondary memory (hard disk) is referred as storage not memory.

But, if we categorize memory on behalf of space or location, it is of four types:

1. Register memory
2. Cache memory
3. Primary memory
4. Secondary memory

3.2.1 REGISTER MEMORY

Register memory is the smallest and fastest memory in a computer. It is not a part of the main memory and is located in the CPU in the form of registers, which are the smallest data holding elements. A register temporarily holds frequently used data, instructions, and memory address that are to be used by CPU. They hold instructions that are currently processed by the CPU. All data is required to pass through registers before it can be processed. So, they are used by CPU to process the data entered by the users.

Registers hold a small amount of data around 32 bits to 64 bits. The speed of a CPU depends on the number and size (no. of bits) of registers that are built into the CPU. Registers can be of different types based on their uses. Some of the widely used Registers include Accumulator or AC, Data Register or DR, the Address Register or AR, Program Counter (PC), I/O Address Register, and more.

3.2.1.1 Types and Functions of Computer Registers

Data Register: It is a 16-bit register, which is used to store operands (variables) to be operated by the processor. It temporarily stores data, which is being transmitted to or received from a peripheral device.

Program Counter (PC): It holds the address of the memory location of the next instruction, which is to be fetched after the current instruction is completed. So, it is used to maintain the path of execution of the different programs and thus executes the programs one by one, when the previous instruction gets completed.

Instructor Register: It is a 16-bit register. It stores the instruction which is fetched from the main memory. So, it is used to hold instruction codes, which are to be executed. The Control Unit takes instruction from Instructor Register, then decodes and executes it.

Accumulator Register: It is a 16-bit register, which is used to store the results produced by the system. For example, the results generated by CPU after the processing are stored in the AC register.

Address Register: It is a 12-bit register that stores the address of a memory location where instructions or data is stored in the memory.

I/O Address Register: Its job is to specify the address of a particular I/O device.

I/O Buffer Register: Its job is to exchange the data between an I/O module and the CPU.

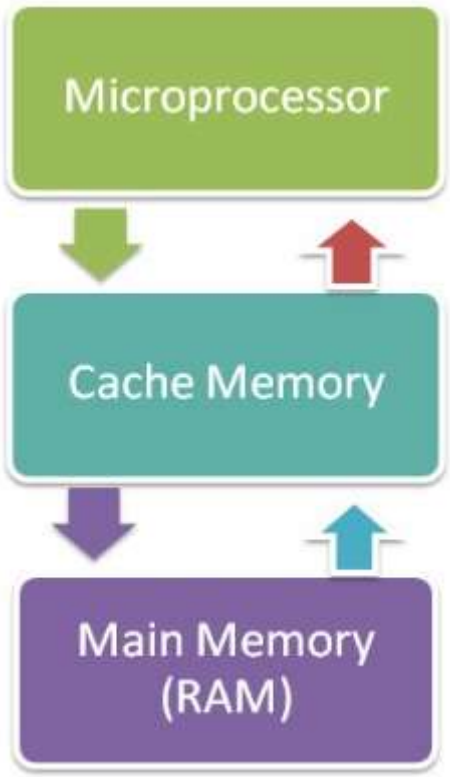
3.2.2 CACHE MEMORY

Cache memory is a high-speed memory, which is small in size but faster than the main memory (RAM). The CPU can access it more quickly than the primary memory. So, it is used to synchronize with high-speed CPU and to improve its performance. Cache memory can only be accessed by CPU. It can be a reserved part of the main memory or a storage device outside the CPU. It holds the data and programs which are frequently used by the CPU. So, it makes sure that the data is instantly available for CPU whenever the CPU needs this data. In other words, if the CPU finds the required data or instructions in the cache memory, it doesn't need to access the primary memory (RAM). Thus, by acting as a buffer between RAM and CPU, it speeds up the system performance.

3.2.2.1 Types of Cache Memory

L1: It is the first level of cache memory, which is called Level 1 cache or L1 cache. In this type of cache memory, a small amount of memory is present inside the CPU itself. If a CPU has four cores (quad core CPU), then each core will have its own level 1 cache. As this memory is present in the CPU, it can work at the same speed as of the CPU. The size of this memory ranges from 2KB to 64 KB. The

L1 cache further has two types of caches: Instruction cache, which stores instructions required by the CPU, and the data cache that stores the data required by the CPU.



L2: This cache is known as Level 2 cache or L2 cache. This level 2 cache may be inside the CPU or outside the CPU. All the cores of a CPU can have their own separate level 2 cache, or they can share one L2 cache among themselves. In case it is outside the CPU, it is connected with the CPU with a very high-speed bus. The memory size of this cache is in the range of 256 KB to the 512 KB. In terms of speed, they are slower than the L1 cache.

L3: It is known as Level 3 cache or L3 cache. This cache is not present in all the processors; some high-end processors may have this type of cache. This cache is used to enhance the performance of Level 1 and Level 2 cache. It is located outside the CPU and is shared by all the cores of a CPU. Its memory size ranges from 1 MB to 8 MB. Although it is slower than L1 and L2 cache, it is faster than Random Access Memory (RAM).

3.2.2.2 How does cache memory work with CPU?

When CPU needs the data, first of all, it looks inside the L1 cache. If it does not find anything in L1, it looks inside the L2 cache. If again, it does not find the data in L2 cache, it looks into the L3 cache. If data is found in the cache memory, then it is known as a cache hit. On the contrary, if data is not found inside the cache, it is called a cache miss.

If data is not available in any of the cache memories, it looks inside the Random Access Memory (RAM). If RAM also does not have the data, then it will get that data from the Hard Disk Drive.

So, when a computer is started for the first time, or an application is opened for the first time, data is not available in cache memory or in RAM. In this case, the CPU gets the data directly from the hard disk drive. Thereafter, when you start your computer or open an application, CPU can get that data from cache memory or RAM.

3.2.3 PRIMARY MEMORY

Primary Memory is of two types: RAM and ROM.

RAM (Volatile Memory)

It is a volatile memory. It means it does not store data or instructions permanently. When you switch on the computer the data and instructions from the hard disk are stored in RAM. CPU utilizes this data to perform the required tasks. As soon as you shut down the computer the RAM loses all the data.

ROM (Non-volatile Memory)

It is a non-volatile memory. It means it does not lose its data or programs that are written on it at the time of manufacture. So it is a permanent memory that contains all important data and instructions needed to perform important tasks like the boot process.

3.2.3.1 What is RAM?

RAM, which stands for Random Access Memory, is a hardware device generally located on the motherboard of a computer and acts as an internal memory of the CPU. It allows CPU store data, program, and program results when you switch on the computer. It is the read and write memory of a computer, which means the information can be written to it as well as read from it.

RAM is a volatile memory, which means it does not store data or instructions permanently. When you switch on the computer the data and instructions from the hard disk are stored in the RAM, e.g., when the computer is rebooted, and when you open a program, the operating system (OS), and the program are loaded into RAM, generally from an HDD or SSD. CPU utilizes this data to perform the required tasks. As soon as you shut down the computer, the RAM loses the data. So, the data remains in the RAM as long as the computer is on and lost when the computer is turned off. The benefit of loading data into RAM is that reading data from the RAM is much faster than reading from the hard drive.

In simple words, we can say that RAM is like a person's short term memory, and hard drive storage is like a person's long term memory. Short term memory remembers the things for a short duration, whereas long term memory remembers for a long duration. Short term memory can be refreshed with information stored in the brains long term memory. A computer also works like this; when the RAM fills up, the processor goes to the hard disk to overlay the old data in Ram with new data. It is like a reusable scratch paper on which you can write notes, numbers, etc., with a pencil. If you run out of space on the paper, you may erase what you no longer need; RAM also behaves like this, the unnecessary data on the RAM is deleted when it fills up, and it is replaced with new data from the hard disk which is required for the current operations.

RAM comes in the form of a chip that is individually mounted on the motherboard or in the form of several chips on a small board connected to the motherboard. It is the main memory of a computer. It is

faster to write to and read from as compared to other memories such as a hard disk drive (HDD), solid-state drive (SSD), optical drive, etc.

A computer's performance mainly depends on the size or storage capacity of the RAM. If it does not have sufficient RAM (random access memory) to run the OS and software programs, it will result in slower performance. So, the more RAM a computer has, the faster it will work. Information stored in RAM is accessed randomly, not in a sequence as on a CD or hard drive. So, its access time is much faster.

3.2.3.1.1 History of RAM:

- The first type of RAM was introduced in 1947 with the Williams tube. It was used in CRT (cathode ray tube), and the data was stored as electrically charged spots on the face.
- The second type of RAM was a magnetic-core memory, invented in 1947. It was made of tiny metal rings and wires connecting to each ring. A ring stored one bit of data, and it can be accessed at any time.
- The RAM which we know today, as solid-state memory, was invented by Robert Dennard in 1968 at IBM Thomas J Watson Research Centre. It is specifically known as dynamic random access memory (DRAM) and has transistors to store bits of data. A constant supply of power was required to maintain the state of each transistor.
- In October 1969, Intel introduced its first DRAM, the Intel 1103. It was its first commercially available DRAM.
- In 1993, Samsung introduced the KM48SL2000 synchronous DRAM (SDRAM).
- In 1996, DDR SDRAM was commercially available.
- In 1999, RDRAM was available for computers.
- In 2003, DDR2 SDRAM began being sold.
- In June 2007, DDR3 SDRAM started being sold.
- In September 2014, DDR4 became available in the market.

3.2.3.1.2 Types of RAM:

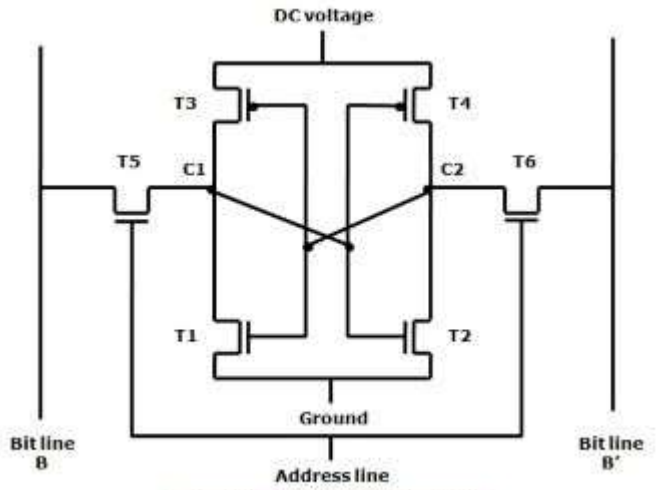
Integrated RAM chips can be of two types:

- Static RAM (SRAM):

- Dynamic RAM (DRAM):

Both types of RAM are volatile, as both lose their content when the power is turned off.

1) Static RAM:



Static RAM (SRAM) Cell

Static RAM (SRAM) is a type of random access memory that retains its state for data bits or holds data as long as it receives the power. It is made up of memory cells and is called a static RAM as it does not need to be refreshed on a regular basis because it does not need the power to prevent leakage, unlike dynamic RAM. So, it is faster than DRAM.

It has a special arrangement of transistors that makes a flip-flop, a type of memory cell. One memory cell stores one bit of data. Most of the modern SRAM memory cells are made of six CMOS transistors, but lack capacitors. The access time in SRAM chips can be as low as 10 nanoseconds. Whereas, the access time in DRAM usually remains above 50 nanoseconds.

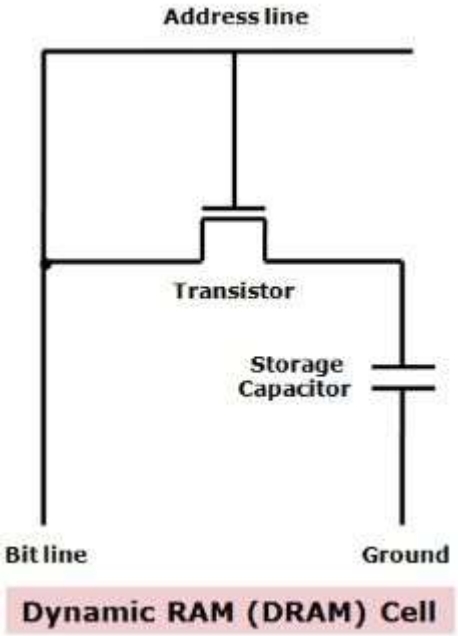
Furthermore, its cycle time is much shorter than that of DRAM as it does not pause between accesses. Due to these advantages associated with the use of SRAM, It is primarily used for system cache memory, and high-speed registers, and small memory banks such as a frame buffer on graphics cards.

The Static RAM is fast because the six-transistor configuration of its circuit maintains the flow of current in one direction or the other (0 or 1). The 0 or 1 state can be written and read instantly without waiting for the capacitor to fill up or drain. The early asynchronous static RAM chips performed read

and write operations sequentially, but the modern synchronous static RAM chips overlap read and write operations.

The drawback with Static RAM is that its memory cells occupy more space on a chip than the DRAM memory cells for the same amount of storage space (memory) as it has more parts than a DRAM. So, it offers less memory per chip.

2) Dynamic RAM:



Dynamic RAM (DRAM) Cell

Dynamic Ram (DRAM) is also made up of memory cells. It is an integrated circuit (IC) made of millions of transistors and capacitors which are extremely small in size and each transistor is lined up with a capacitor to create a very compact memory cell so that millions of them can fit on a single memory chip. So, a memory cell of a DRAM has one transistor and one capacitor and each cell represents or stores a single bit of data in its capacitor within an integrated circuit.

The capacitor holds this bit of information or data, either as 0 or as 1. The transistor, which is also present in the cell, acts as a switch that allows the electric circuit on the memory chip to read the capacitor and change its state.

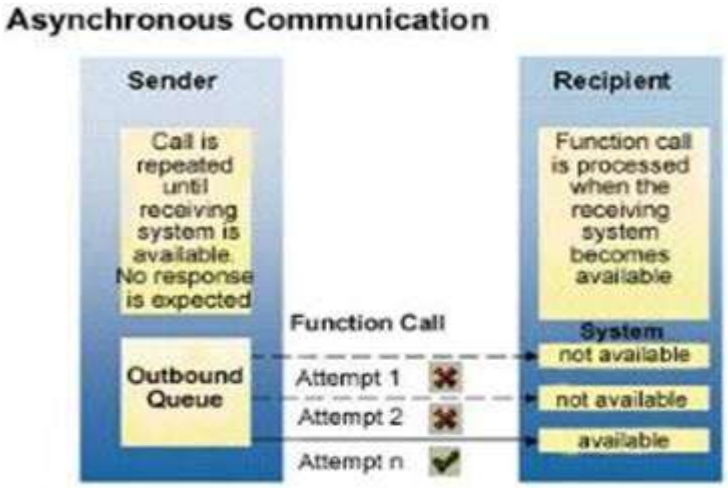
The capacitor needs to be refreshed after regular intervals to maintain the charge in the capacitor. This is the reason it is called dynamic RAM as it needs to be refreshed continuously to maintain its data or it

would forget what it is holding. This is achieved by placing the memory on a refresh circuit that rewrites the data several hundred times per second. The access time in DRAM is around 60 nanoseconds.

We can say that a capacitor is like a box that stores electrons. To store a ?1? in the memory cell, the box is filled with electrons. Whereas, to store a ?0?, it is emptied. The drawback is that the box has a leak. In just a few milliseconds the full box becomes empty. So, to make dynamic memory work, the CPU or Memory controller has to recharge all the capacitors before they discharge. To achieve this, the memory controller reads the memory and then writes it right back. This is called refreshing the memory and this process continues automatically thousands of times per second. So, this type of RAM needs to be dynamically refreshed all the time.

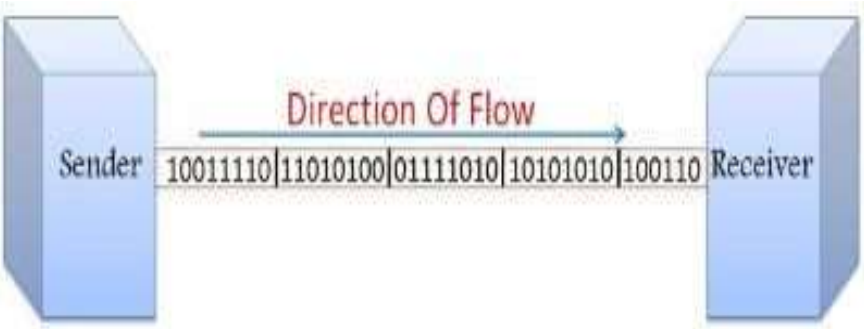
Types of DRAM:

i) Asynchronous DRAM:



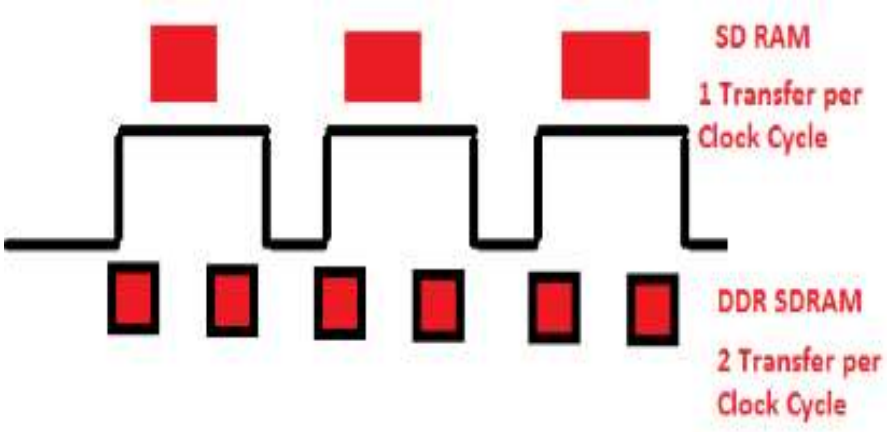
This type of DRAM is not synchronized with the CPU clock. So, the drawback with this RAM is that CPU could not know the exact timing at which the data would be available from the RAM on the input-output bus. This limitation was overcome by the next generation of RAM, which is known as the synchronous DRAM.

ii) Synchronous DRAM:



SDRAM (Synchronous DRAM) began to appear in late 1996. In SDRAM, the RAM was synchronized with the CPU clock. It allowed the CPU or to be precise the memory controller to know the exact clock cycle or timing or the number of cycles after which the data will be available on the bus. So, the CPU does not need for the memory accesses and thus the memory read and write speed can be increased. The SDRAM is also known as the single data rate SDRAM (SDR SDRAM) as data is transferred only at each rising edge of the clock cycle. See the image in the following description.

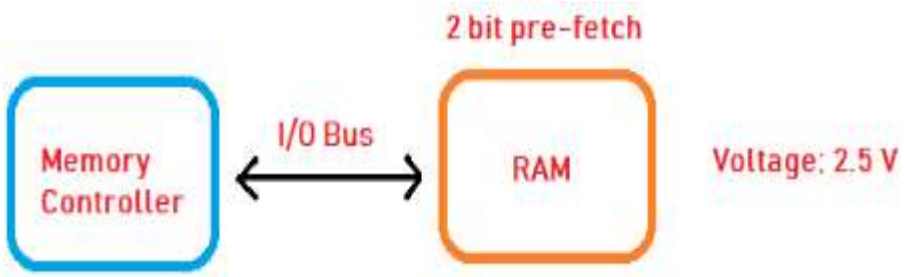
iii) DDR SDRAM:



The next generation of the synchronous DRAM is known as the DDR RAM. It was developed to overcome the limitations of SDRAM and was used in PC memory at the beginning of the year 2000. In DDR SDRAM (DDR RAM), the data is transferred twice during each clock cycle; during the positive edge (rising edge) and the negative edge (falling edge) of the cycle. So, it is known as the double data rate SDRAM.

There are different generations of DDR SDRAM which include DDR1, DDR2, DDR3, and DDR4. Today, the memory that we use inside the desktop, laptop, mobile, etc., is mostly either DDR3 or DDR4 RAM. Types of DDR SDRAM:

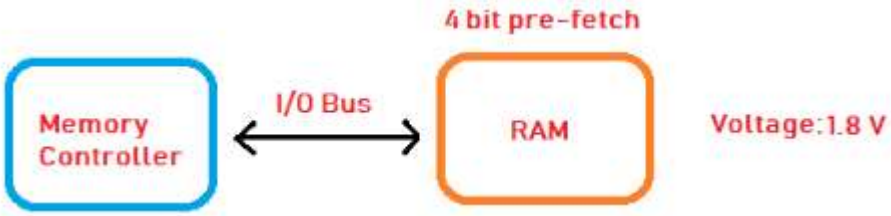
a) DDR1 SDRAM:



DDR1 SDRAM is the first advanced version of SDRAM. In this RAM, the voltage was reduced from 3.3 V to 2.5 V. The data is transferred during both the rising as well as the falling edge of the clock cycle. So, in each clock cycle, instead of 1 bit, 2 bits are being pre-fetched which is commonly known as the 2-bit pre-fetch. It is mostly operated in the range of 133 MHz to the 200 MHz.

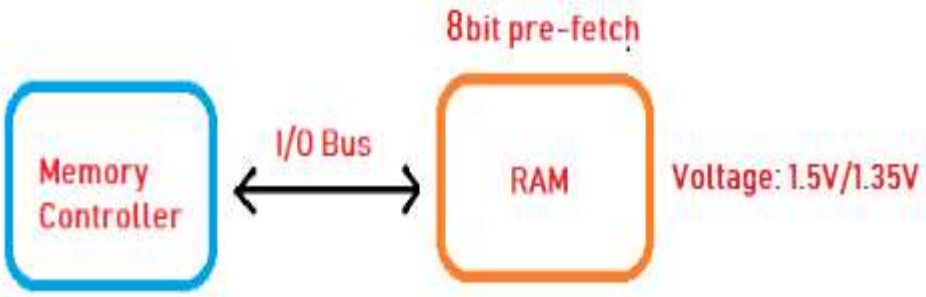
Furthermore, the data rate at the input-output bus is double the clock frequency because the data is transferred during both the rising as well as falling edge. So, if a DDR1 RAM is operating at 133 MHz, the data rate would be double, 266 Mega transfer per second.

b) DDR2 SDRAM:



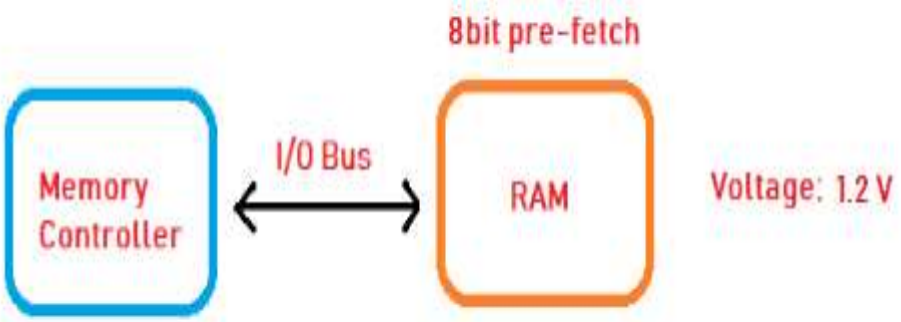
It is an advanced version of DDR1. It operates at 1.8 V instead of 2.5V. Its data rate is double the data rate of the previous generation due to the increase in the number of bits that are pre-fetched during each cycle; 4 bits are pre-fetched instead of 2 bits. The internal bus width of this RAM has been doubled. For example, if the input-output bus is 64 bits wide, the internal bus width of it will be equal to 128 bits. So, a single cycle can handle double the amount of data.

c) DDR3 SDRAM:



In this version, the voltage is further reduced from 1.8 V to the 1.5 V. The data rate has been doubled than the previous generation RAM as the number of bits that are pre-fetched has been increased from 4 bits to the 8 bits. We can say that the internal data bus width of RAM has been increased 2 times than that of the last generation.

d) DDR4 SDRAM:



In this version, the operating voltage is further reduced from 1.5 V to 1.2 V, but the number of bits that can be pre-fetched is same as the previous generation; 8 bits per cycle. The Internal clock frequency of the RAM is double of the previous version. If you are operating at 400 MHz the clock frequency of the input-output bus would be four times, 1600 MHz and the transfer rate would be equal to 3200 Mega transfer per second.

Difference between Static RAM and Dynamic RAM:

SRAM	DRAM
It is a static memory as it does not need to be refreshed repeatedly.	It is a dynamic memory as it needs to be refreshed continuously or it will lose the data.
Its memory cell is made of 6 transistors. So its cells occupy more space on a chip and offer less storage capacity (memory) than a DRAM of the same physical size.	Its memory cell is made of one transistor and one capacitor. So, its cells occupy less space on a chip and provide more memory than a SRM of the same physical size.
It is more expensive than DRAM and is located on processors or between a processor and main memory.	It is less expensive than SRAM and is mostly located on the motherboard.
It has a lower access time, e.g. 10 nanoseconds. So, it is faster than DRAM.	It has a higher access time, e.g. more than 50 nanoseconds. So, it is slower than SRAM.
It stores information in a bistable latching circuitry. It requires regular power supply so it consumes more power.	The information or each bit of data is stored in a separate capacitor within an integrated circuit so it consumes less power.
It is faster than DRAM as its memory cells don't need to be refreshed and are always available. So, it is mostly used in registers in the CPU and cache memory of various devices.	It is not as fast as SRAM, as its memory cells are refreshed continuously. But still, it is used in the motherboard because it is cheaper to manufacture and requires less space.
Its cycle time is shorter as it does not need to be paused between accesses and refreshes.	Its cycle time is more than the SRAM's cycle time.
Examples: L2 and LE cache in a CPU.	Example: DDR3, DDR4 in mobile phones, computers, etc.
Size ranges from 1 MB to 16MB.	Size ranges from 1 GB to 3 GB in smartphones and 4GB to 16GB in laptops.

3.2.3.2 What is ROM?

ROM, which stands for read only memory, is a memory device or storage medium that stores information permanently. It is also the primary memory unit of a computer along with the random access memory (RAM). It is called read only memory as we can only read the programs and data stored on it but cannot write on it. It is restricted to reading words that are permanently stored within the unit.

The manufacturer of ROM fills the programs into the ROM at the time of manufacturing the ROM. After this, the content of the ROM can't be altered, which means you can't reprogram, rewrite, or erase its content later. However, there are some types of ROM where you can modify the data.

ROM contains special internal electronic fuses that can be programmed for a specific interconnection pattern (information). The binary information stored in the chip is specified by the designer and then embedded in the unit at the time of manufacturing to form the required interconnection pattern (information). Once the pattern (information) is established, it stays within the unit even when the power is turned off. So, it is a non-volatile memory as it holds the information even when the power is turned off, or you shut down your computer.

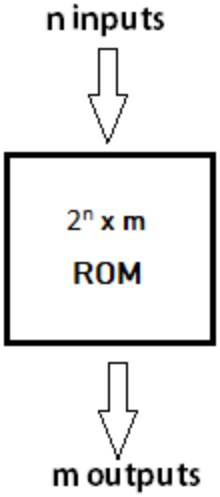
The information is added to a RAM in the form of bits by a process known as programming the ROM as bits are stored in the hardware configuration of the device. So, ROM is a Programmable Logic Device (PLD).

A simple example of ROM is the cartridge used in video game consoles that allows the system to run many games. The data which is stored permanently on personal computers and other electronic devices like smartphones, tablets, TV, AC, etc. is also an example of ROM.

For example, when you start your computer, the screen does not appear instantly. It takes time to appear as there are startup instructions stored in ROM which are required to start the computer during the booting process. The work of the booting process is to start the computer. It loads the operating system into the main memory (RAM) installed on your computer. The BIOS program, which is also present in the computer memory (ROM) is used by the microprocessor of the computer to start the computer during the booting process. It allows you to open the computer and connects the computer with the operating system.

ROM is also used to store Firmware, which is a software program which remains attached to the hardware or programmed on a hardware device like a keyboard, hard drive, video cards, etc. It is stored in the flash ROM of a hardware device. It provides instructions to the device to communicate and interact with other devices.

Block Diagram of ROM:

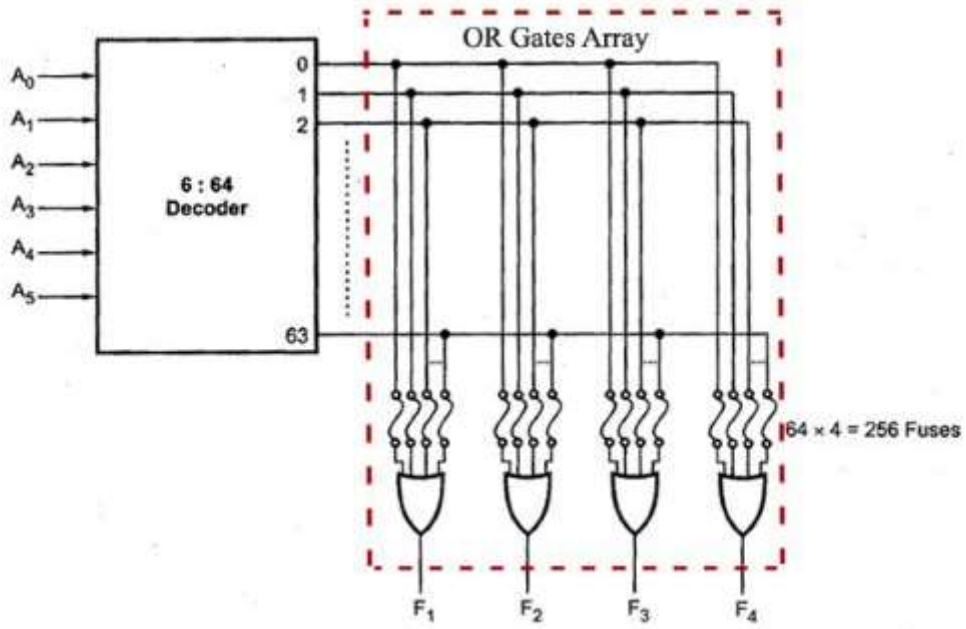


The block of ROM has 'n' input lines and 'm' output lines. Each bit combination of the input variables is known as an address. Each bit combination that comes out through output lines is called a word. The number of bits per word is equal to the number of output lines, m.

The address of a binary number refers to one of the addresses of n variables. So, the number of possible addresses with 'n' input variables is 2n. An output word has a unique address, and as there are 2n distinct addresses in a ROM, there are 2n separate words in the ROM. The words on the output lines at a given time depends on the address value applied to the input lines.

3.2.3.2.1 Internal Structure of ROM:

The internal structure comprises two basic components: decoder and OR gates. A decoder is a circuit that decodes an encoded form (such as binary coded decimal, BCD) to a decimal form. So, the input is in binary form, and the output is its decimal equivalent. All the OR gates present in the ROM will have outputs of the decoder as their output. Let us take an example of 64 x 4 ROM. The structure is shown in the following image.



Internal construction of 64x4 ROM

This Read Only Memory consists of 64 words of 4 bits each. So, there would be four output lines, and one of the 64 words available on the output lines is determined from the six input lines as we have only six inputs because in this ROM we have 26 = 64, so we can specify 64 addresses or minterms. For each address input, there is a unique selected word. For example, if the input address is 000000, word number 0 will be selected and applied to the output lines. If the input address is 111111, word number 63 is selected and applied to the output lines.

3.2.3.2.2 Types of ROM:

1) Masked Read Only Memory (MROM):

It is the oldest type of read only memory (ROM). It has become obsolete so it is not used anywhere in today's world. It is a hardware memory device in which programs and instructions are stored at the time of manufacturing by the manufacturer. So it is programmed during the manufacturing process and can't be modified, reprogrammed, or erased later.

The MROM chips are made of integrated circuits. Chips send a current through a particular input-output pathway determined by the location of fuses among the rows and columns on the chip. The current has

to pass along a fuse-enabled path, so it can return only via the output the manufacturer chooses. This is the reason the rewriting and any other modification is not impossible in this memory.

2) Programmable Read Only Memory (PROM):

PROM is a blank version of ROM. It is manufactured as blank memory and programmed after manufacturing. We can say that it is kept blank at the time of manufacturing. You can purchase and then program it once using a special tool called a programmer.

In the chip, the current travels through all possible pathways. The programmer can choose one particular path for the current by burning unwanted fuses by sending a high voltage through them. The user has the opportunity to program it or to add data and instructions as per his requirement. Due to this reason, it is also known as the user-programmed ROM as a user can program it.

To write data onto a PROM chip; a device called PROM programmer or PROM burner is used. The process or programming a PROM is known as burning the PROM. Once it is programmed, the data cannot be modified later, so it is also called as one-time programmable device.

Uses: It is used in cell phones, video game consoles, medical devices, RFID tags, and more.

3) Erasable and Programmable Read Only Memory (EPROM):

EPROM is a type of ROM that can be reprogramed and erased many times. The method to erase the data is very different; it comes with a quartz window through which a specific frequency of ultraviolet light is passed for around 40 minutes to erase the data. So, it retains its content until it is exposed to the ultraviolet light. You need a special device called a PROM programmer or PROM burner to reprogram the EPROM.

Uses: It is used in some micro-controllers to store program, e.g., some versions of Intel 8048 and the Freescale 68HC11.

4) Electrically Erasable and Programmable Read Only Memory (EEPROM):

ROM is a type of read only memory that can be erased and reprogrammed repeatedly, up to 10000 times. It is also known as Flash EEPROM as it is similar to flash memory. It is erased and reprogrammed electrically without using ultraviolet light. Access time is between 45 and 200 nanoseconds.

The data in this memory is written or erased one byte at a time; byte per byte, whereas, in flash memory data is written and erased in blocks. So, it is faster than EEPROM. It is used for storing a small amount of data in computer and electronic systems and devices such as circuit boards.

Uses: The BIOS of a computer is stored in this memory.

5) FLASH ROM:

It is an advanced version of EEPROM. It stores information in an arrangement or array of memory cells made from floating-gate transistors. The advantage of using this memory is that you can delete or write blocks of data around 512 bytes at a particular time. Whereas, in EEPROM, you can delete or write only 1 byte of data at a time. So, this memory is faster than EEPROM.

It can be reprogrammed without removing it from the computer. Its access time is very high, around 45 to 90 nanoseconds. It is also highly durable as it can bear high temperature and intense pressure.

Uses: It is used for storage and transferring data between a personal computer and digital devices. It is used in USB flash drives, MP3 players, digital cameras, modems and solid-state drives (SSDs). The BIOS of many modern computers are stored on a flash memory chip, called flash BIOS.

3.2.4 SECONDARY MEMORY

The secondary storage devices which are built into the computer or connected to the computer are known as a secondary memory of the computer. It is also known as external memory or auxiliary storage.

The secondary memory is accessed indirectly via input/output operations. It is non-volatile, so permanently stores the data even when the computer is turned off or until this data is overwritten or deleted. The CPU can't directly access the secondary memory. First, the secondary memory data is transferred to primary memory then the CPU can access it.

Some of the secondary memory or storage devices are described below:

3.2.4.1 Hard Disk:

It is a rigid magnetic disc that is used to store data. It permanently stores data and is located within a drive unit.

The hard disk is also known as a hard drive. It is a rigid magnetic disc that stores data permanently, as it is a non-volatile storage device. The hard disk is located within a drive unit on the computer's motherboard and comprises one or more platters packed in an air-sealed casing. The data is written on the platters by moving a magnetic head over the platters as they spin. The data stored on a computer's hard drive generally includes the operating system, installed software, and the user's files and programs, including pictures, music, videos, text documents, etc.

Components of Hard Drive:

The main components of a hard drive include a head actuator, read/write actuator arm, read/write head, platter, and spindle. A circuit board, which is called the disk controller or interface board, is present on the back of a hard drive. It allows the hard drive to communicate with the computer.

3.2.4.2 Solid-state Drive:

SSD (Solid State Drive) is also a non-volatile storage medium that is used to hold and access data. Unlike a hard drive, it does not have moving components, so it offers many advantages over SSD, such as faster access time, noiseless operation, less power consumption, and more.

As the cost of SSD has come down, it has become an ideal replacement for a standard hard drive in desktop and laptop computers. It is also suitable for notebooks, and tablets that don't require lots of storage.

3.2.4.3 Pen drive:

Pen drive is a compact secondary storage device. It is also known as a USB flash drive, thumb drive or a jump drive. It connects to a computer via a USB port. It is commonly used to store and transfer data between computers. For example, you can write a report using a computer and then copy or transfer it in the pen drive. Later, you can connect this pen drive to a computer to see or edit your report. You can also store your important documents and pictures, music, videos in the pen drive and keep it at a safe place.

Pen drive does not have movable parts; it comprises an integrated circuit memory chip that stores the data. This chip is housed inside a plastic or aluminum casing. The data storage capacity of the pen drive generally ranges from 2 GB to 128 GB. Furthermore, it is a plug and play device as you don't need additional drives, software, or hardware to use it.

3.2.4.4 SD Card:

SD Card stands for Secure Digital Card. It is most often used in portable and mobile devices such as smartphones and digital cameras. You can remove it from your device and see the things stored in it using a computer with a card reader.

There are many memory chips inside the SD card that store the data; it does not have moving parts. SD cards are not created equal, so they may differ from each other in terms of speed, physical sizes, and capacity. For example, standard SD cards, mini SD cards, and micro SD cards.

3.2.4.5 Compact Disk (CD):

Compact Disk is a portable secondary storage device in the shape of a round medium disk. It is made of polycarbonate plastic. The concept of CD was co-developed by Philips and Sony in 1982. The first CD was created on 17 August 1982 at the workshop of Philips in Germany.

In the beginning, it was used for storing and playing sound recordings, later it was used for various purposes such as for storing documents, audio files, videos, and other data like software programs in a CD.

Physical characteristics of a CD/ Structure of CD:

A standard CD is around 5 inches in diameter and 0.05 inches in thickness. It is made of a clear polycarbonate plastic substrate, a reflective metallic layer, and a clear coating of acrylic plastic. These thin circular layers are attached one on top of another as described below:

- A polycarbonate disc layer at the bottom has the data encoded by creating lands and pits.
- The polycarbonate disc layer is coated with a thin aluminum layer that reflects the laser.
- The reflective aluminum layer is coated with a lacquer layer to prevent oxidation in order to protect the below layers. It is generally spin coated directly on the top of the reflective layer.

- The label print is applied on the lacquer layer, or artwork is screen printed on the top of the disc on the lacquer layer by offset printing or screen printing.

How Does a CD Work?

The data or information is stored or recorded or encoded in CD digitally using a laser beam that etches tiny indentations or bumps on its surface. The bump is called a pit, which represents the number 0. Space, where the bump is not created, is called land, and it represents the number 1. Thus, the data is encoded into a compact disc by creating pits (0) and lands (1). The CD players use laser technology to read the optically recorded data.

3.2.4.6 DVD:

DVD is short for digital versatile disc or digital video disc. It is a type of optical media used for storing optical data. Although it has the same size as a CD, its storage capacity is much more than a CD. So, it is widely used for storing and viewing movies and to distribute software programs as they are too large to fit on a CD. DVD was co-developed by Sony, Panasonic, Philips, and Toshiba in 1995.

Types of DVDs:

DVDs can be divided into three main categories which are as follows:

DVD-ROM (Read-Only): These types of DVDs come with media already recorded on them, such as movie dvds. As the name suggests, data on these discs cannot be erased or added, so these discs are known as a read-only or non-writable DVD.

DVD-R (Writable): It allows you to record or write information to the DVD. However, you can write information only once as it becomes a read-only DVD once it is full.

DVD-RW (Rewritable or Erasable): This type of discs can be erased, written, or recorded multiple times.

3.3 MEMORY UNITS

Memory units are used to measure and represent data. Some of the commonly used memory units are:

1) **Bit**: The computer memory units start from bit. A bit is the smallest memory unit to measure data stored in main memory and storage devices. A bit can have only one binary value out of 0 and 1.

2) **Byte**: It is the fundamental unit to measure data. It contains 8 bits or is equal to 8 bits. Thus a byte can represent 2*8 or 256 values.

3) **Kilobyte**: A kilobyte contains 1024 bytes.

4) **Megabyte:** A megabyte contains 1024 kilobytes.

5) **Gigabyte:** A gigabyte contains 1024 megabyte.

6) **Terabyte**: A terabyte contains 1024 gigabytes.

3.4 INTRODUCTION TO MODERN PROCESSOR

A processor, or "microprocessor," is a small chip that resides in computers and other electronic devices. Its basic job is to receive input and provide the appropriate output. While this may seem like a simple task, modern processors can handle trillions of calculations per second.

The central processor of a computer is also known as the CPU, or "central processing unit." This processor handles all the basic system instructions, such as processing mouse and keyboard input and running applications. Most desktop computers contain a CPU developed by either Intel or AMD, both of which use the x86 processor architecture. Mobile devices, such as laptops and tablets may use Intel and AMD CPUs, but can also use specific mobile processors developed by companies like ARM or Apple.

Modern CPUs often include multiple processing cores, which work together to process instructions. While these "cores" are contained in one physical unit, they are actually individual processors. In fact, if you view your computer's performance with a system monitoring utility like Windows Task Manager (Windows) or Activity Monitor (Mac OS X), you will see separate graphs for each processor. Processors that include two cores are called dual-core processors, while those with four cores are called quad-core processors. Some high-end workstations contain multiple CPUs with multiple cores, allowing a single machine to have eight, twelve, or even more processing cores.

Besides the central processing unit, most desktop and laptop computers also include a GPU. This processor is specifically designed for rendering graphics that are output on a monitor. Desktop computers often have a video card that contains the GPU, while mobile devices usually contain a graphics chip that is integrated into the motherboard. By using separate processors for system and graphics processing, computers are able to handle graphic-intensive applications more efficiently.

3.5 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. Storage which stores or retains data after power off is called _____.
2. _____ memories must be refreshed many times per second.
3. Magnetic tape is not practical for applications where data must be quickly recalled because tape is _____.
4. Main memory works in conjunction with _____.
5. SRAM stands for _____.

B. State whether the following statements are True or False:

1. Magnetic Tape used random access method.
2. Cache memory is placed in between the CPU and ROM.
3. Primary memory is usually referred to as RAM.
4. A group of 8 bits is called a byte.
5. ROM is a volatile memory

3.6 SUMMARY

The basic computer model works on stored program concept. The computer architecture has been developed to be able to store data, instructions and storage space for temporary variables. This storage space is supplemented by internal (primary storage devices) and external (secondary storage devices). Variety of storage devices have been developed depending upon the need and suitability of the application. This lesson discussed the different types of primary and secondary storage devices.

3.7 KEYWORDS

Computer memory: is any physical device capable of storing information.

Register memory is the smallest and fastest memory in a computer. It is not a part of the main memory and is located in the CPU in the form of registers.

Cache memory is an extremely fast memory type that acts as a buffer between RAM and the CPU.

Primary memory is computer memory that is accessed directly by the CPU.

Secondary memory is where programs and data are kept on a long-term basis. Common secondary storage devices are the hard disk and optical disks.

3.8 SELF-ASSESSMENT TEST

1. Define computer memory? Why we need memory?
2. Describe the register memory. Discuss various types of registers.
3. What do you mean by cache memory? How cache memory works with CPU?
4. Discuss different types of Cache memory.
5. What do you mean by primary memory? Explain different types of primary memory.
6. What do you mean by secondary memory? Explain different types of secondary memory.
7. Differentiate between SRAM and DRAM.
8. Discuss the various types of ROM in detail.
9. Discuss the different types of RAM in detail.

3.9 ANSWERS TO CHECK YOUR PROGRESS

Check your Progress A

1. Non-volatile memory
2. Dynamic RAM
3. A sequential-access medium
4. CPU
5. Static Random-Access Memory

Check Your Progress B

1. False
2. False
3. True
4. True
5. False

3.10 REFERENCES/SUGGESTED READINGS

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Course: BC 104	Author: Mr. Sawtantar Singh
Lesson: 4	Updated By: Mr. Balwant

INTRODUCTION TO COMPUTER SOFTWARE AND PROGRAMMING LANGUAGE

Structure

4.0 Learning Objectives

4.1 Introduction

4.1.1 Types of software

4.1.1.1 System Software

4.1.1.2 Application Software

4.1.2 Software Acquisition

4.1.3 Introduction of Programming Language

4.1.3.1 Types of Programming Language

4.1.3.1.1 Machine Language

4.1.3.1.2 Assembly Language

4.1.3.1.3 High Level Language

4.2 Converting to Machine Language

4.3 Different generations of Programming Languages

4.4 Choosing a Programming Language

4.5 Check your progress

4.6 Summary

4.7 Keywords

4.8 Self-Assessment Test

4.9 Answers to Check Your Progress

4.10 References/suggested readings

4.0 LEARNING OBJECTIVES

The computer, as a machine, can do nothing for you without the software. Software is required for the functioning of computer. Software programs instruct computer about the actions to be performed, so as to get the desired output. The purpose of this chapter is to introduce you to the different categories of software.

In this lesson you will learn about

- ✓ Computer software and its types
- ✓ System software
  - o For management and functionality of computer—Operating system, device drivers, and system utilities
  - o For development of application software—Programming languages, translator
- ✓ software, loader, and linker
- ✓ Operating system
- ✓ Device drivers
- ✓ System utility software—Anti-virus, data compression, cryptographic, disk compression,
- ✓ disk partitioning, disk cleaner, backup, system profiling, and network manager
- ✓ Programming language—Machine language, assembly language, high-level language, and different generations of programming languages
- ✓ Translator software—Assembler, compiler, and interpreter
- ✓ Linker, and loader software
- ✓ Application software—Word processing software, image processing software, accounting
- ✓ software, spreadsheet software, presentation software, CAD/CAM software, and web browser software

4.1 INTRODUCTION

Computer software, or simply software, is a collection of data or computer instructions that tell the computer how to work. This is in contrast to physical hardware, from which the system is built and actually performs the work. Computer software includes computer programs, libraries and related non-executable data, such as online documentation or digital media. Computer hardware and software require each other and neither can be realistically used on its own.

At the lowest programming level, executable code consists of machine language instructions supported by an individual processor—typically a central processing unit (CPU) or a graphics processing unit (GPU). A machine language consists of groups of binary values signifying processor instructions that change the state of the computer from its preceding state. For example, an instruction may change the value stored in a particular storage location in the computer—an effect that is not directly observable to the user. An instruction may also invoke one of many input or output operations, for example displaying some text on a computer screen; causing state changes which should be visible to the user. The processor executes the instructions in the order they are provided, unless it is instructed to "jump" to a different instruction, or is interrupted by the operating system. As of 2015, most personal computers, smartphone devices and servers have processors with multiple execution units or multiple processors performing computation together, and computing has become a much more concurrent activity than in the past.

The majority of software is written in high-level programming languages. They are easier and more efficient for programmers because they are closer to natural languages than machine languages. High-level languages are translated into machine language using a compiler or an interpreter or a combination of the two. Software may also be written in a low-level assembly language, which has strong correspondence to the computer's machine language instructions and is translated into machine language using an assembler. In this lesson, we will discuss the different categories of computer software.

4.1.1 TYPES OF SOFTWARE

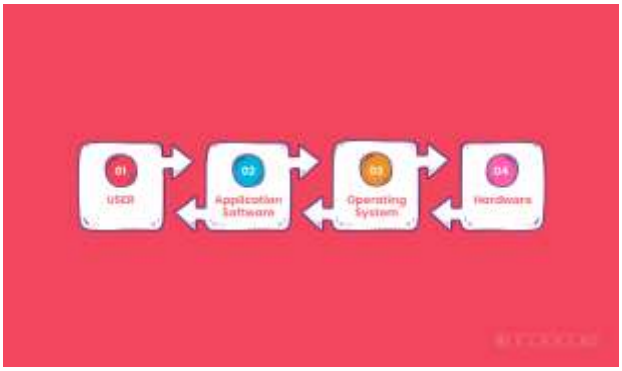
On virtually all computer platforms, software can be grouped into a few broad categories.

Based on the goal, computer software can be divided into:

4.1.1.1 System Software

Which is software for managing computer hardware behaviour, as to provide basic functionalities that are required by users, or for other software to run properly, if at all. System software provides basic functionality to the computer. System software is required for the working of computer itself. The user of computer does not need to be aware about the functioning of system software, while using the computer. For example, when you buy a computer, the system software would also include different device drivers. When you request for using any of the devices, the corresponding device driver software interacts with the hardware device to perform the specified request. If the appropriate device driver for any device, say a particular model of a printer, is installed on the computer, the user does not need to know about the device driver, while printing on this printer.

It only runs in the background of your device, at the most basic level while you use other application software. This is why system software is also called **"low-level software"**.



Example of System Software

The purposes of the system software are:

- To provide basic functionality to computer,
- To control computer hardware, and
- To act as an interface between user, application software and computer hardware.

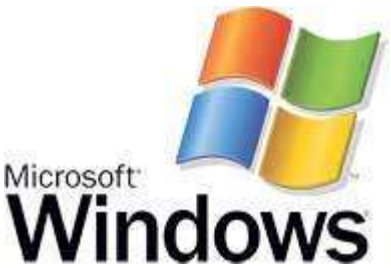
On the basis of their functionality, system software may be broadly divided into two categories:

➢ System software for the management and functionality of computer relates to the functioning of different components of the computer, like, processor, input and output devices etc. System software is required for managing the operations performed by the components of computer and the devices attached to the computer. It provides support for various services, as requested by the application software. Operating system, device drivers, and system utilities constitute the system software for management of computer and its resources.

➢ System software for the development of application software provides services required for the development and execution of application software. System software provides the software tools required for the development of application software. The programming language software, translator software, loader, and linker are also categorized as system software, and are required for the application software development.

Features of a system software

- Close to the system
- Fast in speed
- Difficult to design
- Difficult to understand
- Less interactive
- Smaller in size
- Difficult to manipulate
- Generally written in low-level language



System software is also designed for providing a platform for running application software, and it includes the following:

Operating system

Which are essential collections of software that manage resources and provide common services for other software that runs "on top" of them. Supervisory programs, boot loaders, shells and window systems are core parts of operating systems.

All of your computer-like devices run on an operating system, including your desktop, laptop, smartphone, and tablet, etc. Here is a list of examples of an operating system. Let's take a look and you might spot some familiar names of system software:

For desktop computers, laptops and tablets:

- Microsoft Windows
- Mac (for Apple devices)
- Linux

For smartphones:

- Apple's iOS
- Google's Android
- Windows Phone OS

In practice, an operating system comes bundled with additional software (including application software) so that a user can potentially do some work with a computer that only has one operating system.

- It controls the execution of different programs to prevent occurrence of error.
- It provides a convenient interface to the user in the form of commands and graphical interface, which facilitates the use of computer.
- Some available operating systems are Microsoft Disk Operating System (MS-DOS), Windows 7, Windows XP, Linux, UNIX, and Mac OS X Snow Leopard

Device drivers

Which operate or control a particular type of device that is attached to a computer. Each device needs at least one corresponding device driver; because a computer typically has at minimum at least one input device and at least one output device, a computer typically needs more than one device driver.

➢ Driver software is often classified as one of the types of system software.

➢ They operate and control devices and peripherals plugged into a computer.

➢ Drivers are important because they enable the devices to perform their designated tasks. They do this by translating commands of an Operating System for the Hardware or devices, assigning duties.

➢ Therefore, each device connected with your computer requires at least one device driver to function.

Driver Software

➢ Since there are thousands of types of devices, drivers make the job of your system software easier by allowing it to communicate through a standardized language.

➢ Some examples of driver software that you may be familiar with are:

- Printer Driver

- Mouse Driver
- Network Card

Usually, the operating system comes built-in with drivers for mouse, keyboard, and printers by default. They often do not require third-party installations. But for some advanced devices, you may need to install the driver externally. Moreover, if you use multiple operating systems like Linux, Windows, and Mac, then each of these supports different variants of drivers. For them, separate drivers need to be maintained for each.

Utilities

Which are computer programs designed to assist users in the maintenance and care of their computers. Some features of utility software include:

- Antivirus and security software
- File compressor
- Disk cleaner
- Disk defragmentation software
- Data backup software

➢ Backup Utility to make a copy of all information stored on the disk. It also restores the backed up contents in case of disk failure.

➢ System Profiling Utility provides detailed information about the software installed on the computer and the hardware attached to it.

➢ Network Managers to check the computer network and to log events.

The system utilities on a computer working on Windows XP OS can be viewed by clicking **<Start><All Programs><Accessories><System Tools>**

Malicious Software

which is software that is developed to harm and disrupt computers. As such, malware is undesirable. Malware is closely associated with computer-related crimes.

Programming tools

Programming tools are also software in the form of programs or applications that software developers (also known as *programmers, coders, hackers* or *software engineers*) use to create, debug, maintain (i.e. improve or fix), or otherwise support software.

4.1.1.2 APPLICATION SOFTWARE

Which is software that uses the computer system to perform special functions or provide entertainment functions beyond the basic operation of the computer itself. There are many different types of application software, because the range of tasks that can be performed with a modern computer is so large.

As a user of technology, Application Software or 'Apps' are what you engage with the most. These types of computer software are productive end-user programs that help you perform tasks. Following are some examples of application software that allow you to do specific work:

- **Word Processing Software:** For writing letter, reports, documents etc. (e.g. MS-WORD).
- **Image Processing Software:** For assisting in drawing and manipulating graphics (e.g. Adobe Photoshop).
- **Accounting Software:** For assisting in accounting information, salary, tax returns (Tally software).
- **MS Excel:** It is spreadsheet software that you can use for presenting and analyzing data.
- **Photoshop:** It is a photo editing application software by Adobe. You can use it to visually enhance, catalog and share your pictures.
- **Skype:** It is an online communication app that you can use for video chat, voice calling and instant messaging.
- **Spreadsheet Software:** Used for creating budget, tables etc. (e.g. MS-Excel).
- **Presentation Software:** To make presentations, slide shows (e.g. MS-PowerPoint)
- **Suite of Software having Word Processor, Spreadsheet and Presentation Software:** Some examples are MS-Office, Google Docs, Sun Openoffice, Apple iWork.
- **CAD/CAM Software:** To assist in architectural design. (e.g. AutoCAD, Autodesk)

- **Geographic Information Systems:** It captures, stores, analyzes, manages, and presents data, images and maps that are linked to different locations. (e.g. ArcGIS)
- **Web Browser Software:** To access the World Wide Web to search documents, sounds, images etc. (e.g. Internet Explorer, Netscape Communicator, Chrome)

Application Software

Examples of Application software are the following −

- Payroll Software
- Student Record Software
- Inventory Management Software
- Income Tax Software
- Railways Reservation Software
- Microsoft Office Suite Software
- Microsoft Word
- Microsoft Excel
- Microsoft PowerPoint

Features of application software are as follows −

- Close to the user
- Easy to design
- More interactive
- Slow in speed
- Generally written in high-level language
- Easy to understand

Software applications are also referred to as non-essential software. They are installed and operated on a computer-based on the user's requirement. There are plenty of application software that you can use to perform different tasks. The number of such apps keeps increasing with technological advances and the evolving needs of the users. You can categorize these software types into different groups, as shown in the following table:

Application Software Type	Examples
Word processing software: Tools that are used to create word sheets and type documents etc.	Microsoft Word, WordPad, AppleWorks and Notepad

Application Software Type	Examples
Spreadsheet software: Software used to compute quantitative data.	Apple Numbers, Microsoft Excel and Quattro Pro
Database software: Used to store data and sort information.	Oracle, MS Access and FileMaker Pro
Application Suites: A collection of related programs sold as a package.	OpenOffice, Microsoft Office
Multimedia software: Tools used for a mixture of audio, video, image and text content.	Real Player, Media Player
Communication Software: Tools that connect systems and allow text, audio, and video-based communication.	MS NetMeeting, IRC, ICQ
Internet Browsers: Used to access and view websites.	Netscape Navigator, MS Internet Explorer, and Google Chrome
Email Programs: Software used for emailing.	Microsoft Outlook, Gmail, Apple Mail

4.1.2 SOFTWARE ACQUISITION

Different kinds of software are made available for use to users in different ways. The user may have to purchase the software, can download for free from the Internet, or can get it bundled along with the hardware. Nowadays with the advent of Cloud computing, many application software are also available

on the cloud for use through the Internet, e.g. Google Docs. The different ways in which the software are made available to users are:

Retail Software is off-the-shelf software sold in retail stores. It comes with printed manuals and installation instructions. For example, Microsoft Windows operating system.

OEM Software stands for "Original Equipment Manufacturer" software. It refers to software which is sold, and bundled with hardware. Microsoft sells its operating system as OEM software to hardware dealers. OEM software is sold at reduced price, without the manuals, packaging and installation instructions. For example, Dell computers are sold with the "Windows 7" OS pre-loaded on them.

Demo Software is designed to demonstrate what a purchased version of the software is capable of doing and provides a restricted set of features. To use the software, the user must buy a fully- functional version.

Shareware on the other hand, are software applications that are paid programs, but are made available for free for a limited period of time known as 'trial period'. You can use the software without any charges for the trial period but you will be asked to purchase it for use after the trial ends. Shareware allows you to test drive the software before you actually invest in purchasing it. Some examples of Shareware that you must be familiar with are:

- Adobe PhotoShop
- Adobe Illustrator
- Netflix App
- Matlab
- McAfee Antivirus

Freeware is software that is free for personal use. It is downloadable from the Internet. The commercial use of this software may require a paid license. The author of the freeware software is the owner of the software, though others may use it for free. The users abide by the license terms, where the user cannot make changes to it, or sell it to someone else.

Some well-known examples of freeware are:

- Google Chrome
- Skype
- Instagram
- Snapchat
- Adobe reader

Although they all fall under the category of Application or end-user software, they can further be categorized as freeware because they are free for you to use.

Public Domain Software is free software. Unlike freeware, public domain software does not have a copyright owner or license restrictions. The source code is publicly available for anyone to use. Public domain software can be modified by the user.

Open-Source Software

is software whose source code is available and can be customized and altered within the specified guidelines laid down by the creator. Unlike public domain software, open-source software has restrictions on their use and modification, redistribution limitations, and copyrights are some examples of open-source software.

Common examples of open source software used by programmers are:

- LibreOffice
- PHP
- GNU Image Manipulation Program (GIMP)
- Linux
- Apache
- Firefox
- OpenOffice

Closed Source Software

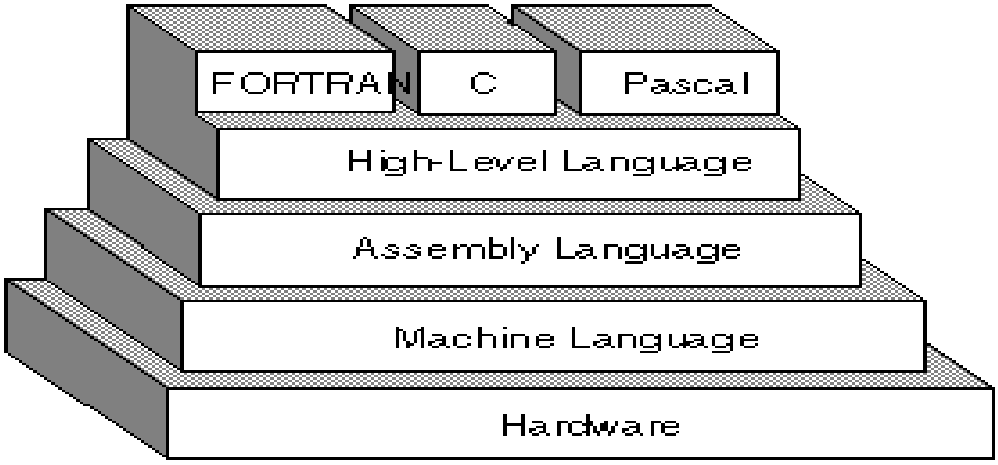
These are the types of software that are non-free for the programmers. For this software, the source code is the intellectual property of software publishers It is also called **'proprietary software'** since only the original authors can copy, modify and share the software. Following are some of the most common examples of closed-source software:

- .Net
- Java
- Android
- Microsoft Office
- Adobe Photoshop

4.1.3 INTRODUCTION OF PROGRAMMING LANGUAGES

Software is written in one or more programming languages; there are many programming languages in existence, and each has at least one implementation, each of which consists of its own set of programming tools. These tools may be relatively self-contained programs such as compilers, debuggers, interpreters, linkers, and text editors, that can be combined together to accomplish a task; or they may form an integrated development environment (IDE), which combines much or all of the functionality of such self-contained tools.

A programming language is a vocabulary and set of grammatical rules for instructing a computer or computing device to perform specific tasks. The term *programming language* usually refers to high-level languages, such as BASIC, C, C++, COBOL, JAVA, FORTRAN, Ada, and Pascal. Each programming language has a unique set of keywords (words that it understands) and a special syntax for organizing program instructions.



Computer Program

- **A program is a set of instructions following the rules of the chosen language.**
- **Without programs, computers are useless.**
- **A program is like a recipe. It contains a list of ingredients (called variables) and a list of directions (called statements) that tell the computer what to do with the variables.**

4.1.3.1 TYPES OF PROGRAMMING LANGUAGE

There are three types of programming language: –

- Machine language (Low-level language)
- Assembly language (Low-level language)
- High-level language

Low-level languages are closer to the language used by a computer, while high-level languages are closer to human languages.

4.1.3.1.1 Machine Language

- Machine language is a collection of binary digits or bits that the computer reads and interprets. Machine languages are the only languages understood by computers.
- While easily understood by computers, machine languages are almost impossible for humans to use because they consist entirely of numbers.

Machine Language

169 1 160 0 153 0 128 153 0 129 153 130 153 0 131 200 208 241 96

High level language

FOR I=1 TO 1000: PRINT "A"; NEXT I

- Machine Language Example:
  - Let us say that an electric toothbrush has a processor and main memory.
  - The processor can rotate the bristles left and right, and can check the on/off switch.

4.1.3.1.2 Assembly Language

A program written in assembly language consists of a series of instructions mnemonics that correspond to a stream of executable instructions, when translated by an assembler, that can be loaded into memory and executed.

- Assembly languages use keywords and symbols, much like English, to form a programming language but at the same time introduce a new problem.
- The problem is that the computer doesn't understand the assembly code, so we need a way to convert it to machine code, which the computer does understand.
- Assembly language programs are translated into machine language by a program called an assembler.
- Example: – Machine language: 10110000 01100001

  Assembly language: mov a1, #061h

  Meaning: Move the hexadecimal value 61 (97 decimal) into the processor register named "a1".

4.1.3.1.3 High Level Language

High-level languages allow us to write computer code using instructions resembling everyday spoken language (for example: print, if, while) which are then translated into machine language to be executed.

- Programs written in a high-level language need to be translated into machine language before they can be executed.

- Some programming languages use a compiler to perform this translation and others use an interpreter
- Examples of High-level Language:
    1. ADA
    2. C
    3. C++
    4. JAVA
    5. BASIC
    6. COBOL
    7. PASCAL
    8. PHYTON

4.2 CONVERTING TO MACHINE LANGUAGE

Regardless of what language you use, you eventually need to convert your program into machine language so that the computer can understand it. There are two ways to do this:

1) Compile the program.
2) *Interpret* the program.

Compile is to transform a program written in a high-level programming language from source code into object code.

- This can be done by using a tool called compiler.
- A compiler reads the whole source code and translates it into a complete machine code program to perform the required tasks which is output as a new file.

Interpreter is a program that executes instructions written in a high-level language.

- An interpreter reads the source code one instruction or line at a time, converts this line into machine code and executes it.

Computer programming is the process of writing, testing, debugging/troubleshooting, and maintaining the source code of computer programs.

The question of which language is best is one that consumes a lot of time and energy among computer professionals. Every language has its strengths and weaknesses. For example, FORTRAN is a particularly good language for processing numerical data, but it does not lend itself very well to organizing large programs. Pascal is very good for writing well-structured and readable programs, but it is not as flexible as the C programming language. C++ embodies powerful object-oriented features, but it is complex and difficult to learn.

Programs are easier to write, read or understand in high-level languages than in machine language or assembly language. For example, a program written in C++ is easier to understand than a machine language program.

- Programs written in high-level languages is the source code which is converted into the object code (machine code) using translator software like interpreter or compiler.
- A line of code in high-level program may correspond to more than one line of machine code.
- Programs written in high-level languages are easily portable from one computer to another.

4.3 DIFFERENT GENERATIONS OF PROGRAMMING LANGUAGES

In addition to the categorization of programming languages into machine language, assembly language, and high-level language, programming languages are also classified in terms of generations in which they have evolved.

- **First Generation Languages**, or 1GL, are low-level languages that are machine language.
- **Second Generation Languages**, or 2GL, are also low-level languages that generally consist of assembly languages.
- **Third Generation Languages**, or 3GL, are high-level languages such as C.
- **Fourth Generation Languages**, or 4GL, are languages that consist of statements similar to statements in a human language. Fourth generation languages are commonly used in database programming and scripts.
- **Fifth Generation Languages**, or 5GL, are programming languages that contain visual tools to help develop a program. A good example of a fifth generation language is Visual Basic.

4.4 CHOOSING A PROGRAMMING LANGUAGE

Before you decide on what language to use, you should consider the following:

- your server platform
- the server software you run
- your budget
- previous experience in programming
- the database you have chosen for your backend

4.5 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. ----------is a program that translate mnemonic statements into executable instructions.
2. A set of instructions is called ----------.
3. The instructions that tell a computer how to carry out the processing tasks are referred to as computer.....
4. The only language which the computer understands is _____.
5. The software designed to perform a specific task is _____.

B. State whether the following statements are True or False:

1. Word processing software is a type of application software.
2. Binary code comprises of digits from 0 to 9.
3. Word processor is an example of system software?
4. Software Package is a group of programs that solve a multiple problem.
5. Interpreter is a program that reads each of the instructions in mnemonic form and translates it into the machine-language equivalent.

4.6 SUMMARY

In conclusion, there can be multiple ways to classify different types of computer software. The software can be categorized based on the function they perform such as Application software, System software, Programming Software, and Driver software. They can also be classified based on different features such as the nature of source code, accessibility, and cost of usage.

After reading this chapter, I am hopeful you will now be able to clearly identify the types of software around you. A clear understanding of them will help you choose and use the software efficiently.

4.7 KEYWORDS

Freeware: Freeware is software, most often proprietary, that is distributed at no monetary cost to the end user.

Program: A computer program is a collection of instructions that can be executed by a computer to perform a specific task.

Anti-virus utility: Antivirus software is a type of utility used for scanning and removing viruses from your computer.

Application software: Application software is a program or group of programs designed for end users.

Programming languages: A programming language is a formal language comprising a set of instructions that produce various kinds of output.

Assembler: program for converting instructions written in low-level symbolic code into machine code.

High-level language: high-level language is any programming language that enables development of a program in a much more user-friendly programming

Assembly language: programming language that consists of instructions that are mnemonic codes for corresponding machine language

Shareware: software that is available free of charge and often distributed informally for evaluation, after which a fee may be requested for continued use.

Software: Computer software, or simply software, is a collection of data or computer instructions that tell the computer how to work

Interpreter: an interpreter is a computer program that directly executes instructions written in a programming or scripting language, without requiring them previously to have been compiled into a machine language program.

CAD/CAM software: CAD/CAM software is used to design and manufacture prototypes, finished products and production runs.

Linker: a program used with a compiler or assembler to provide links to the libraries needed for an executable program.

Source code: *source code* is any collection of *code*, possibly with comments, written using a human-readable programming language, usually as plain text.

Compiler: A compiler is a computer program that translates computer code written in one programming language into another language

Low-level language: A *low-level language* is a type of *programming language* that contains basic instructions recognized by a computer.

System software: System software is software designed to provide a platform for other software

System utility: *Utility* software is software designed to help to analyze, configure, optimize or maintain a computer

Object code: object code is a sequence of statements or instructions in a computer language, usually a machine code language or an intermediate language

4.8 SELF-ASSESSMENT TEST

1. What is the purpose of a device driver? What are the uses of system utilities?
2. Why are programming languages used?
3. What is the need for programming languages?
4. Name the three categories of programming languages.
5. What are low-level languages?
6. Define source code?
7. Define object code?
8. Machine language is hardware dependent—True or False.
9. List the key features of machine language.
10. List the key features of assembly language.
11. List the key features of high-level languages
12. Why is it difficult to write a program in machine language?
13. State three features of the program written in machine language?

4.9 ANSWERS TO CHECK YOUR PROGRESS

Check your Progress A

1. Assembler

2. Program
3. Program
4. Binary
5. Application software

Check Your Progress B

1. True
2. False
3. False
4. False
5. False

4.10 REFERENCES/SUGGESTED READINGS

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Course: BC 104	Author: Mr. Sawtantar Singh
Lesson: 5	Updated By: Mr. Balwant

Operating System and Open Source Software

Structure

5.0 Learning Objectives

5.1 Introduction

5.1.1 Functions of Operating System

5.1.2 Evolution of Processing Trends

5.2 Types of Operating Systems

5.2.1 Batch operating system

5.2.2 Multiprogramming Operating system

5.2.3 Multitasking Operating system

5.2.4 Multi-user Operating system

5.2.5 Multithreading

5.2.6 Time-sharing System

5.2.7 Real-time systems

5.2.8 Combination of Operating systems

5.2.9 Distributed Operating system

5.2.10 Mobile Operating system

5.3 Open Source Software

5.4 Check Your Progress

5.5 Summary

5.6 Keywords

5.7 Self-Assessment Test

5.8 Answers to Check Your Progress

5.9 References/Suggested Readings

5.0 LEARNING OBJECTIVES

The objective of this lesson is to make the students familiar with the basics of operating system and basics of open source software. After studying this lesson, they will be familiar with:

- ✓ What is an operating system?
- ✓ Important functions performed by an operating system.
- ✓ Different types of operating systems.
- ✓ What is mobile OS and its types
- ✓ Get an idea of open source software

5. 1 INTRODUCTION

Operating System (OS) is system software, which acts as an interface between a user of the computer and the computer hardware. The main purpose of an Operating System is to provide an environment in which we can execute programs. The main goals of the Operating System are:

(i) To make the computer system convenient to use,

(ii) To make the use of computer hardware in efficient way.

Operating System may be viewed as collection of software consisting of procedures for operating the computer and providing an environment for execution of programs. It is an interface between user and computer. So an Operating System makes everything in the computer to work together smoothly and efficiently.

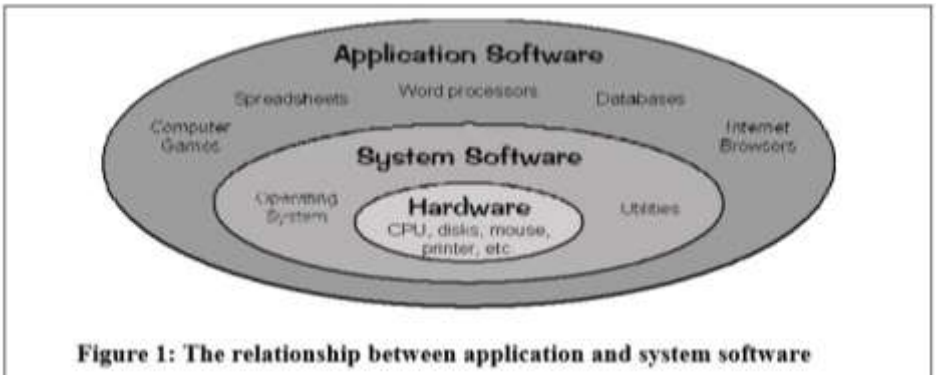


Figure 1: The relationship between application and system software

Basically, an Operating System has three main responsibilities:

(a) Perform basic tasks such as recognizing input from the keyboard, sending output to the display screen, keeping track of files and directories on the disk, and controlling peripheral devices such as disk drives and printers.

(b) Ensure that different programs and users running at the same time do not interfere with each other.

(c) Provide a software platform on top of which other programs can run.

The Operating System is also responsible for security and ensuring that unauthorized users do not access the system. Figure 1 illustrates the relationship between application software and system software.

The first two responsibilities address the need for managing the computer hardware and the application programs that use the hardware. The third responsibility focuses on providing an interface between application software and hardware so that application software can be efficiently developed. Since the Operating System is already responsible for managing the hardware, it should provide a programming interface for application developers. As a user, we normally interact with the Operating System through a set of commands. The commands are accepted and executed by a part of the Operating System called the command processor or command line interpreter.

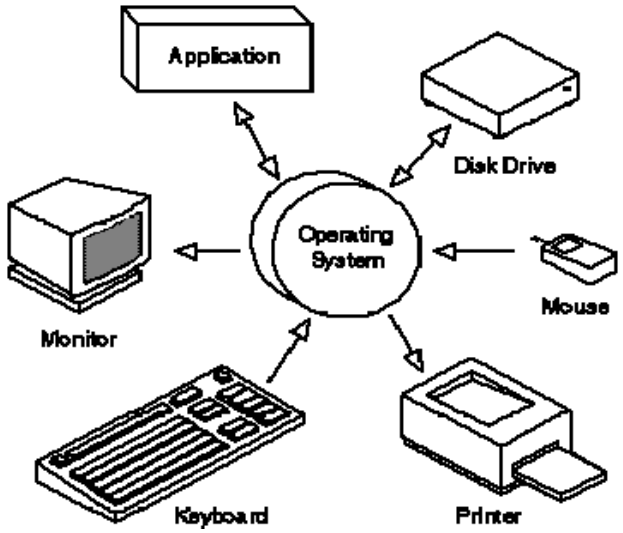


Figure 2: The interface of various devices to an operating system

In order to understand operating systems, we must understand the computer hardware and the development of Operating System from beginning. Hardware means the physical machine and its electronic components including memory chips, input/output devices, storage devices and the central processing unit. Software are the programs written for these computer systems. Main memory is where the data and instructions are stored to be processed. Input/output devices are the peripherals attached to the system, such as keyboard, printers, disk drives, CD drives, magnetic tape drives, modem, monitor, etc. The central processing unit is the brain of the computer system; it has circuitry to control the interpretation and execution of instructions. It controls the operation of entire computer system. All of the storage references, data manipulations and I/O operations are performed by the CPU. The entire computer systems can be divided into four parts or components (1) The hardware (2) The Operating System (3) The application programs and system programs (4) The users.

The hardware provides the basic computing power. The system programs the way in which these resources are used to solve the computing problems of the users. There may be many different users trying to solve different problems. The Operating System controls and coordinates the use of the hardware among the various users and the application programs.

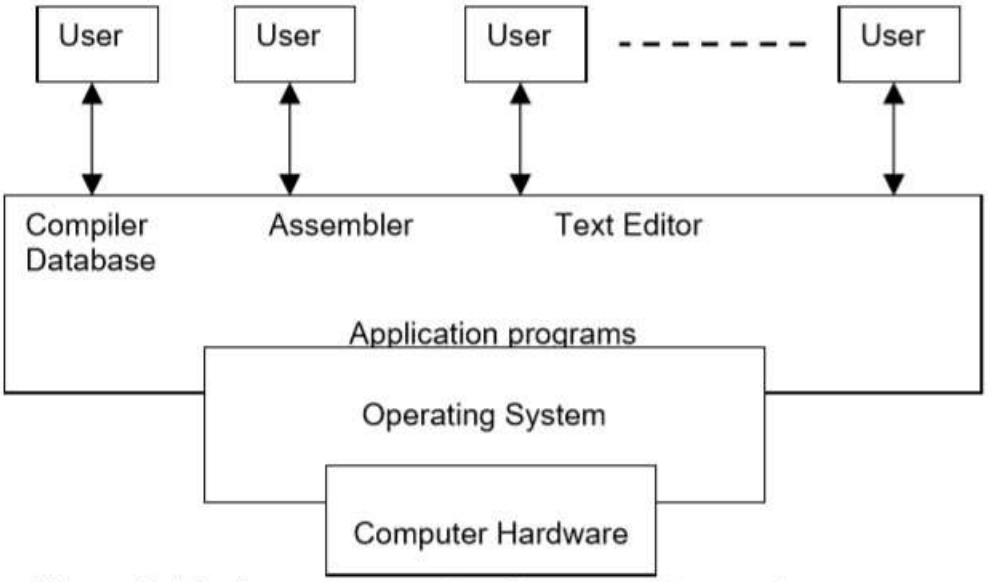


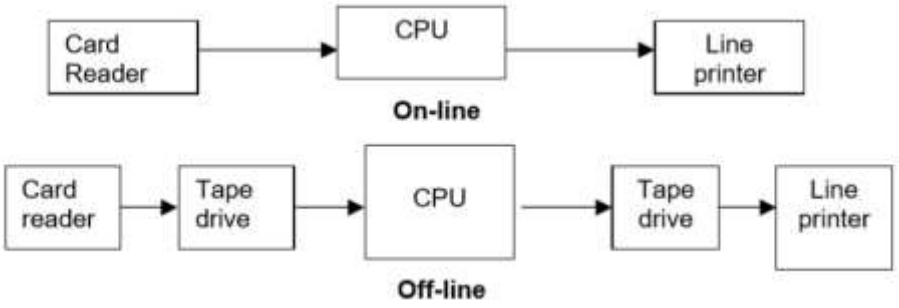
Figure 3. Basic components of a computer system

We can view an Operating System as a resource allocator. A computer system has many resources, which are to be required to solve a computing problem. These resources are the CPU time, memory space, files storage space, input/output devices and so on. The Operating System acts as a manager of all of these resources and allocates them to the specific programs and users as needed by their tasks. Since there can be many conflicting requests for the resources, the Operating System must decide which requests are to be allocated resources to operate the computer system fairly and efficiently.

An Operating System can also be viewed as a control program, used to control the various I/O devices and the users programs. A control program controls the execution of the user programs to prevent errors and improper use of the computer resources. It is especially concerned with the operation and control of I/O devices. As stated above the fundamental goal of computer system is to execute user programs and solve user problems. For this goal computer hardware is constructed. But the bare hardware is not easy to use and for this purpose application/system programs are developed. These various programs require some common operations, such as controlling/use of some input/output devices and the use of CPU time for execution. The common functions of controlling and allocation of resources between different users and application programs is brought together into one piece of software called operating system. It is easy to define operating systems by what they do rather than what they are. The primary goal of the operating systems is convenience for the user to use the computer. Operating systems makes it easier to

compute. A secondary goal is efficient operation of the computer system. The large computer systems are very expensive, and so it is desirable to make them as efficient as possible. Operating systems thus makes the optimal use of computer resources. In order to understand what operating systems are and what they do, we have to study how they are developed. Operating systems and the computer architecture have a great influence on each other. To facilitate the use of the hardware operating systems were developed.

First, professional computer operators were used to operate the computer. The programmers no longer operated the machine. As soon as one job was finished, an operator could start the next one and if some errors came in the program, the operator takes a dump of memory and registers, and from this the programmer have to debug their programs. The second major solution to reduce the setup time was to batch together jobs of similar needs and run through the computer as a group. But there were still problems. For example, when a job stopped, the operator would have to notice it by observing the console, determining why the program stopped, takes a dump if necessary and start with the next job. To overcome this idle time, automatic job sequencing was introduced. But even with batching technique, the faster computers allowed expensive time lags between the CPU and the I/O devices. Eventually several factors helped improve the performance of CPU. First, the speed of I/O devices became faster. Second, to use more of the available storage area in these devices, records were blocked before they were retrieved. Third, to reduce the gap in speed between the I/O devices and the CPU, an interface called the control unit was placed between them to perform the function of buffering. A buffer is an interim storage area that works like this: as the slow input device reads a record, the control unit places each character of the record into the buffer. When the buffer is full, the entire record is transmitted to the CPU. The process is just opposite to the output devices.



Fourth, in addition to buffering, an early form of spooling was developed by moving off-line the

operations of card reading, printing etc. SPOOL is an acronym that stands for the simultaneous peripherals operations on-line. For example, incoming jobs would be transferred from the card decks to tape/disks off-line. Then they would be read into the CPU from the tape/disks at a speed much faster than the card reader.

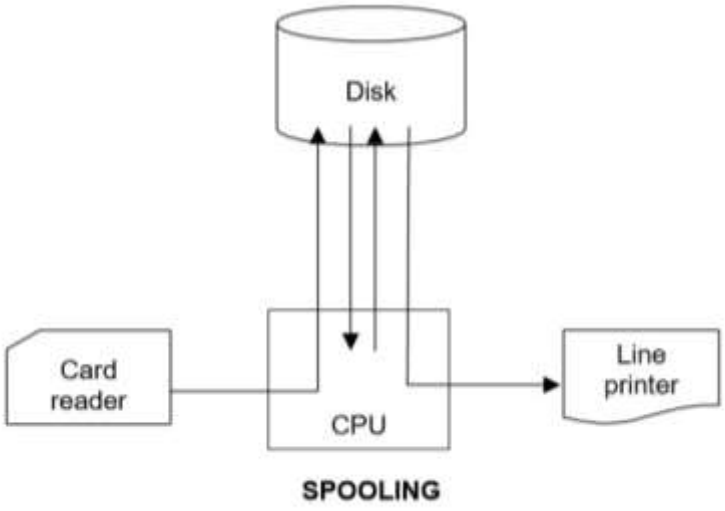


Figure 4: the on-line, off-line and spooling processes

Moreover, the range and extent of services provided by an Operating System depends on a number of factors. Among other things, the needs and characteristics of the target environmental that the Operating System is intended to support largely determine user- visible functions of an operating system. For example, an Operating System intended for program development in an interactive environment may have a quite different set of system calls and commands than the Operating System designed for run-time support of a car engine.

5.1.1 FUNCTIONS OF OPERATING SYSTEM

The Operating System is a manager of system resources. A computer system has many resources as stated above. Since there can be many conflicting requests for the resources, the Operating System must decide which requests are to be allocated resources to operate the computer system fairly and efficiently. *Here we present a framework of the study of Operating System based on the view that the Operating System is manager of resources. The Operating System as a resources manager can be classified in to the following three popular views: primary view, hierarchical view, and extended machine view.*

The primary view is that the Operating System is a collection of programs designed to manage the system's resources, namely, memory, processors, peripheral devices, and information. It is the function of Operating System to see that they are used efficiently and to resolve conflicts arising from competition among the various users. The Operating System must keep track of status of each resource; decide which process is to get the resource, allocate it, and eventually reclaim it.

The major functions of each category of Operating System are.

5.1.1.1 Memory Management Functions

To execute a program, it must be mapped to absolute addresses and loaded into memory. As the program executes, it accesses instructions and data from memory by generating these absolute addresses. In multiprogramming environment, multiple programs are maintained in the memory simultaneously. The Operating System is responsible for the following memory management functions:

- Keep track of which segment of memory is in use and by whom.
- Deciding which processes are to be loaded into memory when space becomes available. In multiprogramming environment, it decides which process gets the available memory, when it gets it, where does it get it, and how much.
- Allocation or de-allocation the contents of memory when the process request for it otherwise reclaim the memory when the process does not require it or has been terminated.

5.1.1.2 Processor/Process Management Functions

A process is an instance of a program in execution. While a program is just a passive entity, process is an active entity performing the intended functions of its related program. To accomplish its task, a process needs certain resources like CPU, memory, files and I/O devices. In multiprogramming environment, there will a number of simultaneous processes existing in the system. The Operating System is responsible for the following processor/ process management functions:

- Provides mechanisms for process synchronization for sharing of resources amongst concurrent processes.
- Keeps track of processor and status of processes. The program that does this has been called the

traffic controller.

- Decide which process will have a chance to use the processor; the job scheduler chooses from all the submitted jobs and decides which one will be allowed into the system. If multiprogramming, decide which process gets the processor, when, for how much of time. The module that does this is called a process scheduler.
- Allocate the processor to a process by setting up the necessary hardware registers. This module is widely known as the dispatcher.
- Providing mechanisms for deadlock handling.
- Reclaim processor when process ceases to use a processor, or exceeds the allowed amount of usage.

5.1.1.3 I/O Device Management Functions

An Operating System will have device drivers to facilitate I/O functions involving I/O devices. These device drivers are software routines that control respective I/O devices through their controllers. The Operating System is responsible for the following I/O Device Management Functions:

- Keep track of the I/O devices, I/O channels, etc. This module is typically called I/O traffic controller.
- Decide what is an efficient way to allocate the I/O resource. If it is to be shared, then decide who gets it, how much of it is to be allocated, and for how long. This is called I/O scheduling.
- Allocate the I/O device and initiate the I/O operation.
- Reclaim device as and when its use is through. In most cases I/O terminates automatically.

5.1.1.4 Information/File Management Functions

- Keeps track of the information, its location, its usage, status, etc. The module called a file system provides these facilities.
- Decides who gets hold of information, enforce protection mechanism, and provides for information access mechanism, etc.
- Allocate the information to a requesting process, e.g., open a file.

- De-allocate the resource, e.g., close a file.

5.1.1.5 Network Management Functions

An Operating System is responsible for the computer system networking via a distributed environment. A distributed system is a collection of processors, which do not share memory, clock pulse or any peripheral devices. Instead, each processor is having its own clock pulse, and RAM and they communicate through network. Access to shared resource permits increased speed, increased functionality and enhanced reliability. Various networking protocols are TCP/IP (Transmission Control Protocol/ Internet Protocol), UDP (User Datagram Protocol), FTP (File Transfer Protocol), HTTP (Hyper Text Transfer protocol), NFS (Network File System) etc.

5.1.1.6 Other Important Functions

Following are some of the important functions that an Operating System performs:

- **Security** − By means of password and similar other techniques, it prevents unauthorized access to programs and data.
- **Control over system performance** − Recording delays between request for a service and response from the system.
- **Job accounting** − Keeping track of time and resources used by various jobs and users.
- **Error detecting aids** − Production of dumps, traces, error messages, and other debugging and error detecting aids.
- **Coordination between other software and users** − Coordination and assignment of compilers, interpreters, assemblers and other software to the various users of the computer systems.

5.1.2 EVOLUTION OF PROCESSING TRENDS

Starting from the bare machine approach to its present forms, the Operating System has evolved through a number of stages of its development like serial processing, batch processing multiprocessing etc. as mentioned below:

5.1.2.1 Serial Processing

In theory, every computer system may be programmed in its machine language, with no systems

software support. Programming of the bare machine was customary for early computer systems. A slightly more advanced version of this mode of operation is common for the simple evaluation boards that are sometimes used in introductory microprocessor design and interfacing courses. Programs for the bare machine can be developed by manually translating sequences of instructions into binary or some other code whose base is usually an integer power of 2. Instructions and data are then entered into the computer by means of console switches, or perhaps through a hexadecimal keyboard. Loading the program counter with the address of the first instruction starts programs. Results of execution are obtained by examining the contents of the relevant registers and memory locations. The executing program, if any, must control Input/output devices, directly, say, by reading and writing the related I/O ports. Evidently, programming of the bare machine results in low productivity of both users and hardware. The long and tedious process of program and data entry practically precludes execution of all but very short programs in such an environment.

The next significant evolutionary step in computer-system usage came about with the advent of input/output devices, such as punched cards and paper tape, and of language translators. Programs, now coded in a programming language, are translated into executable form by a computer program, such as a compiler or an interpreter. Another program, called the loader, automates the process of loading executable programs into memory. The user places a program and its input data on an input device, and the loader transfers information from that input device into memory. After transferring control to the loader program by manual or automatic means, execution of the program commences. The executing program reads its input from the designated input device and may produce some output on an output device. Once in memory, the program may be rerun with a different set of input data.

The mechanics of development and preparation of programs in such environments are quite slow and cumbersome due to serial execution of programs and to numerous manual operations involved in the process. In a typical sequence, the editor program is loaded to prepare the source code of the user program. The next step is to load and execute the language translator and to provide it with the source code of the user program. When serial input devices, such as card reader, are used, multiple-pass language translators may require the source code to be repositioned for reading during each pass. If syntax errors are detected, the whole process must be repeated from the beginning. Eventually, the object code produced from the syntactically correct source code is loaded and executed. If run-time

errors are detected, the state of the machine can be examined and modified by means of console switches, or with the assistance of a program called a debugger.

5.1.2.2 Batch Processing

With the invention of hard disk drive, the things were much better. The batch processing was relied on punched cards or tape for the input when assembling the cards into a deck and running the entire deck of cards through a card reader as a batch. Present batch systems are not limited to cards or tapes, but the jobs are still processed serially, without the interaction of the user. The efficiency of these systems was measured in the number of jobs completed in a given amount of time called as throughput. Today's operating systems are not limited to batch programs. This was the next logical step in the evolution of operating systems to automate the sequencing of operations involved in program execution and in the mechanical aspects of program development. The intent was to increase system resource utilization and programmer productivity by reducing or eliminating component idle times caused by comparatively lengthy manual operations. Furthermore, even when automated, housekeeping operations such as mounting of tapes and filling out log forms take a long time relative to processors and memory speeds. Since there is not much that can be done to reduce these operations, system performance may be increased by dividing this overhead among a number of programs. More specifically, if several programs are batched together on a single input tape for which housekeeping operations are performed only once, the overhead per program is reduced accordingly. A related concept, sometimes called phasing, is to prearrange submitted jobs so that similar ones are placed in the same batch. For example, by batching several Fortran compilation jobs together, the Fortran compiler can be loaded only once to process all of them in a row. To realize the resource-utilization potential of batch processing, a mounted batch of jobs must be executed automatically, without slow human intervention. Generally, Operating System commands are statements written in Job Control Language (JCL). These commands are embedded in the job stream, together with user programs and data. A memory- resident portion of the batch operating system- sometimes called the batch monitor- reads, interprets, and executes these commands.

Moreover, the sequencing of program execution mostly automated by batch operating systems, the speed discrepancy between fast processors and comparatively slow I/O devices, such as card readers and printers, emerged as a major performance bottleneck. Further improvements in batch processing

were mostly along the lines of increasing the throughput and resource utilization by overlapping input and output operations. These developments have coincided with the introduction of direct memory access (DMA) channels, peripheral controllers, and later dedicated input/output processors. As a result, computers for offline processing were often replaced by sophisticated input/output programs executed on the same computer with the batch monitor.

Many single-user operating systems for personal computers basically provide for serial processing. User programs are commonly loaded into memory and executed in response to user commands typed on the console. A file management system is often provided for program and data storage. A form of batch processing is made possible by means of files consisting of commands to the Operating System that are executed in sequence. Command files are primarily used to automate complicated customization and operational sequences of frequent operations.

5.1.2.3 Multiprogramming

In multiprogramming, many processes are simultaneously resident in memory, and execution switches between processes. The advantages of multiprogramming are the same as the commonsense reasons that in life you do not always wait until one thing has finished before starting the next thing. Specifically:

- More efficient use of computer time. If the computer is running a single process, and the process does a lot of I/O, then the CPU is idle most of the time. This is a gain as long as some of the jobs are I/O bound -- spend most of their time waiting for I/O.
- Faster turnaround if there are jobs of different lengths. Consideration (1) applies only if some jobs are I/O bound. Consideration (2) applies even if all jobs are CPU bound. For instance, suppose that first job A, which takes an hour, starts to run, and then immediately afterward job B, which takes 1 minute, is submitted. If the computer has to wait until it finishes A before it starts B, then user A must wait an hour; user B must wait 61 minutes; so the average waiting time is 60-1/2 minutes. If the computer can switch back and forth between A and B until B is complete, then B will complete after 2 minutes; A will complete after 61 minutes; so the average waiting time will be 31-1/2 minutes. If all jobs are CPU bound and the same length, then there is no advantage in multiprogramming; you do better to run a batch system. The multiprogramming

environment is supposed to be invisible to the user processes; that is, the actions carried out by each process should proceed in the same was as if the process had the entire machine to itself.

This raises the following issues:

- Process Model: The state of an inactive process has to be encoded and saved in a process table so that the process can be resumed when made active.
- Context switching: How does one carry out the change from one process to another?
- Memory translation: Each process treats the computer's memory as its own private playground. How can we give each process the illusion that it can reference addresses in memory as it wants, but not have them step on each other's toes? The trick is by distinguishing between virtual addresses -- the addresses used in the process code -- and physical addresses -- the actual addresses in memory. Each process is actually given a fraction of physical memory. The memory management unit translates the virtual address in the code to a physical address within the user's space. This translation is invisible to the process.
- Memory management: How does the Operating System assign sections of physical memory to each process?
- Scheduling: How does the Operating System choose which process to run when?

Let us briefly review some aspects of program behavior in order to motivate the basic idea of multiprogramming. This is illustrated in Figure 6, indicated by dashed boxes. Idealized serial execution of two programs, with no inter-program idle times, is depicted in Figure 6(a). For comparison purposes, both programs are assumed to have identical behavior with regard to processor and I/O times and their relative distributions. As Figure 6(a) suggests, serial execution of programs causes either the processor or the I/O devices to be idle at some time even if the input job stream is never empty. One way to attack this problem is to assign some other work to the processor and I/O devices when they would otherwise be idling.

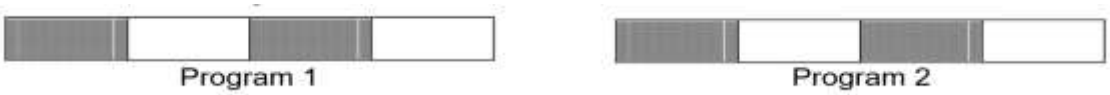


Figure 6(a)

Figure 6(b) illustrates a possible scenario of concurrent execution of the two programs introduced in Figure 6(a). It starts with the processor executing the first computational sequence of Program 1. Instead of idling during the subsequent I/O sequence of Program 1, the processor is assigned to the first computational sequence of the Program 2, which is assumed to be in memory and awaiting execution. When this work is done, the processor is assigned to Program 1 again, then to Program 2, and so forth.

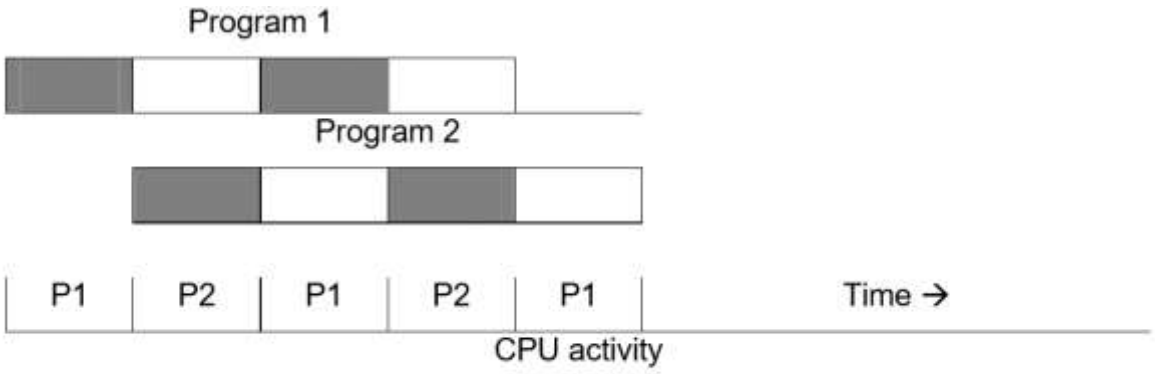


Figure 6 (b) Multiprogrammed executions

As Figure 6 suggests, significant performance gains may be achieved by interleaved executing of programs, or multiprogramming, as this mode of operation is usually called. With a single processor, parallel execution of programs is not possible, and at most one program can be in control of the processor at any time. The example presented in Figure 6(b) achieves 100% processor utilization with only two active programs. The number of programs actively competing for resources of a multi-programmed computer system is called the degree of multiprogramming. In principle, higher degrees of multiprogramming should result in higher resource utilization. Time-sharing systems found in many university computer centers provide a typical example of a multiprogramming system.

5.2 TYPES OF OPERATING SYSTEMS

Operating System can be classified into various categories on the basis of several criteria, viz. number of simultaneously active programs, number of users working simultaneously, number of processors in the computer system, etc. In the following discussion several types of operating systems are discussed.

5.2.1 Batch Operating System

Batch processing is the most primitive type of operating system. Batch processing generally requires the program, data, and appropriate system commands to be submitted together in the form of a job. Batch operating systems usually allow little or no interaction between users and executing programs. Batch processing has a greater potential for resource utilization than simple serial processing in computer systems serving multiple users. Due to turnaround delays and offline debugging, batch is not very convenient for program development. Programs that do not require interaction and programs with long execution times may be served well by a batch operating system. Examples of such programs include payroll, forecasting, statistical analysis, and large scientific number-crunching programs. Serial processing combined with batch like command files is also found on many personal computers. Scheduling in batch is very simple. Jobs are typically processed in order of their submission, that is, first-come first-served fashion.

Memory management in batch systems is also very simple. Memory is usually divided into two areas. The resident portion of the Operating System permanently occupies one of them, and the other is used to load transient programs for execution. When a transient program terminates, a new program is loaded into the same area of memory. Since at most one program is in execution at any time, batch systems do not require any time-critical device management. For this reason, many serial and I/O and ordinary batch operating systems use simple, program controlled method of I/O. The lack of contention for I/O devices makes their allocation and deallocation trivial.

Batch systems often provide simple forms of file management. Since access to files is also serial, little protection and no concurrency control of file access in required.

5.2.2 Multiprogramming Operating System

A multiprogramming system permits multiple programs to be loaded into memory and execute the programs concurrently. Concurrent execution of programs has a significant potential for improving system throughput and resource utilization relative to batch and serial processing. This potential is realized by a class of operating systems that multiplex resources of a computer system among a multitude of active programs. Such operating systems usually have the prefix multi in their names, such as multitasking or multiprogramming.

5.2.3 Multitasking Operating System

It allows more than one program to run concurrently. The ability to execute more than one task at the same time is called as multitasking. An instance of a program in execution is called a process or a task. A multitasking Operating System is distinguished by its ability to support concurrent execution of two or more active processes. Multitasking is usually implemented by maintaining code and data of several processes in memory simultaneously, and by multiplexing processor and I/O devices among them. Multitasking is often coupled with hardware and software support for memory protection in order to prevent erroneous processes from corrupting address spaces and behavior of other resident processes. The terms multitasking and multiprocessing are often used interchangeably, although multiprocessing sometimes implies that more than one CPU is involved. In multitasking, only one CPU is involved, but it switches from one program to another so quickly that it gives the appearance of executing all of the programs at the same time. There are two basic types of multitasking: preemptive and cooperative. In preemptive multitasking, the Operating System parcels out CPU time slices to each program. In cooperative multitasking, each program can control the CPU for as long as it needs it. If a program is not using the CPU, however, it can allow another program to use it temporarily. OS/2, Windows 95, Windows NT, and UNIX use preemptive multitasking, whereas Microsoft Windows 3.x and the MultiFinder use cooperative multitasking.

5.2.4 Multi-user Operating System

Multiprogramming operating systems usually support multiple users, in which case they are also called multi-user systems. Multi-user operating systems provide facilities for maintenance of individual user environments and therefore require user accounting. In general, multiprogramming implies multitasking, but multitasking does not imply multi-programming. In effect, multitasking operation is one of the mechanisms that a multiprogramming Operating System employs in managing the totality of computer-system resources, including processor, memory, and I/O devices. Multitasking operation without multi-user support can be found in operating systems of some advanced personal computers and in real-time systems. Multi-access operating systems allow simultaneous access to a computer system through two or more terminals. In general, multi-access operation does not necessarily imply multiprogramming. An example is provided by some dedicated transaction-processing systems, such as airline ticket reservation systems, that support hundreds of active terminals under control of a single

program.

In general, the multiprocessing or multiprocessor operating systems manage the operation of computer systems that incorporate multiple processors. Multiprocessor operating systems are multitasking operating systems by definition because they support simultaneous execution of multiple tasks (processes) on different processors. Depending on implementation, multitasking may or may not be allowed on individual processors. Except for management and scheduling of multiple processors, multiprocessor operating systems provide the usual complement of other system services that may qualify them as time- sharing, real-time, or a combination operating system.

5.2.5 Multithreading

Multithreading allows different parts of a single program to run concurrently. The programmer must carefully design the program in such a way that all the threads can run at the same time without interfering with each other.

5.2.6 Time-sharing system

Time-sharing is a popular representative of multi-programmed, multi-user systems. In addition to general program-development environments, many large computer-aided design and text-processing systems belong to this category. One of the primary objectives of multi-user systems in general, and time-sharing in particular, is good terminal response time. Giving the illusion to each user of having a machine to oneself, time-sharing systems often attempt to provide equitable sharing of common resources. For example, when the system isloaded, users with more demanding processing requirements are made to wait longer.

This philosophy is reflected in the choice of scheduling algorithm. Most time- sharing systems use time-slicing scheduling. In this approach, programs are executed with rotating priority that increases during waiting and drops after the service is granted. In order to prevent programs from monopolizing the processor, a program executing longer than the system-defined time slice is interrupted by the Operating System and placed at the end of the queue of waiting programs. This mode of operation generally provides quick response time to interactive programs. Memory management in time-sharing systems provides for isolation and protection of co-resident programs. Some forms of controlled sharing are sometimes provided to conserve memory and possibly to exchange data between programs. Being

executed on behalf of different users, programs in time-sharing systems generally do not have much need to communicate with each other. As in most multi-user environments, allocation and de-allocation of devices must be done in a manner that preserves system integrity and provides for good performance.

5.2.7 Real-time systems

Real time systems are used in time critical environments where data must be processed extremely quickly because the output influences immediate decisions. Real time systems are used for space flights, airport traffic control, industrial processes, sophisticated medical equipment's, telephone switching etc. A real time system must be 100 percent responsive in time. Response time is measured in fractions of seconds. In real time systems the correctness of the computations not only depends upon the logical correctness of the computation but also upon the time at which the results is produced. If the timing constraints of the system are not met, system failure is said to have occurred. Real-time operating systems are used in environments where a large number of events, mostly external to the computer system, must be accepted and processed in a short time or within certain deadlines.

A primary objective of real-time systems is to provide quick event-response times, and thus meet the scheduling deadlines. User convenience and resource utilization are of secondary concern to real-time system designers. It is not uncommon for a real-time system to be expected to process bursts of thousands of interrupts per second without missing a single event. Such requirements usually cannot be met by multi-programming alone, and real-time operating systems usually rely on some specific policies and techniques for doing their job. The Multitasking operation is accomplished by scheduling processes for execution independently of each other. Each process is assigned a certain level of priority that corresponds to the relative importance of the event that it services. The processor is normally allocated to the highest-priority process among those that are ready to execute. Higher-priority processes usually preempt execution of the lower-priority processes. This form of scheduling, called priority-based preemptive scheduling, is used by a majority of real-time systems. Unlike, say, time-sharing, the process population in real-time systems is fairly static, and there is comparatively little moving of programs between primary and secondary storage. On the other hand, processes in real-time systems tend to cooperate closely, thus necessitating support for both separation and sharing of memory. Moreover, as already suggested, time-critical device management is one of the main characteristics of real-time systems. In addition to providing sophisticated forms of interrupt

management and I/O buffering, real-time operating systems often provide system calls to allow user processes to connect themselves to interrupt vectors and to service events directly. File management is usually found only in larger installations of real-time systems. In fact, some embedded real-time systems, such as an onboard automotive controller, may not even have any secondary storage. The primary objective of file management in real-time systems is usually speed of access, rather than efficient utilization of secondary storage.

5.2.8 Combination of operating systems

Different types of Operating System are optimized or geared up to serve the needs of specific environments. In practice, however, a given environment may not exactly fit any of the described molds. For instance, both interactive program development and lengthy simulations are often encountered in university computing centers. For this reason, some commercial operating systems provide a combination of described services. For example, a time-sharing system may support interactive users and also incorporate a full-fledged batch monitor. This allows computationally intensive non-interactive programs to be run concurrently with interactive programs. The common practice is to assign low priority to batch jobs and thus execute batched programs only when the processor would otherwise be idle. In other words, batch may be used as a filler to improve processor utilization while accomplishing a useful service of its own. Similarly, some time-critical events, such as receipt and transmission of network data packets, may be handled in real-time fashion on systems that otherwise provide time-sharing services to their terminal users.

5.2.9 Distributed Operating Systems

A distributed computer system is a collection of autonomous computer systems capable of communication and cooperation via their hardware and software interconnections. Historically, distributed computer systems evolved from computer networks in which a number of largely independent hosts are connected by communication links and protocols. A distributed Operating System governs the operation of a distributed computer system and provides a virtual machine abstraction to its users. The key objective of a distributed Operating System is transparency. Ideally, component and resource distribution should be hidden from users and application programs unless they explicitly demand otherwise. Distributed operating systems usually provide the means for system- wide sharing of

resources, such as computational capacity, files, and I/O devices. In addition to typical operating-system services provided at each node for the benefit of local clients, a distributed Operating System may facilitate access to remote resources, communication with remote processes, and distribution of computations. The added services necessary for pooling of shared system resources include global naming, distributed file system, and facilities for distribution.

5.2.10Mobile Operating System

Much like the Linux or Windows operating system controls your desktop or laptop computer, a mobile operating system is the software platform on top of which other programs can run on mobile devices. The operating system is responsible for determining the functions and features available on your device, such as thumb wheel, keyboards, WAP, synchronization with applications, email, text messaging and more. The mobile OS will also determine which third-party applications (mobile apps) can be used on your device.

5.2.10.1 Types of Mobile Operating System

Symbian

Symbian OS is officially the property of Nokia. It means that any other company will have to take permission from Nokia before using this operating system. Nokia has remained a giant in the low-end mobile market, so after Java Symbian was the most used in the mobile phones till a couple of years ago. Still Symbian is widely used in low-end phones but the demand rate has ben continuously decreasing. By upgrading Symbian mobile OS, Nokia has made it capable to run smartphones efficiently. Symbian ANNA and BELLE are the two latest updates that are currently used in Nokia's smartphones. Overall, the Symbian OS is excellently designed and is very user-friendly.

Unfortunately, Symbian OS graph is going downwards nowadays due to the immense popularity of Android and iOS.

Some of the phones currently running on Symbian OS are Nokia C6-01, Nokia 603, Nokia 700, Nokia 808 Pure View, Nokia E6 (ANNA) and Nokia 701 (BELLE). Symbian is a popular choice among Nokia dual sim mobile phones as well.

Android

September 20th, 2008 was the date when Google released the first Android OS by the name of 'Astro'. After sometime next upgraded versions 'Bender' and 'Cupcake' were also released. Google then adopted the trend of naming Android versions after any dessert or a sweet in alphabetical order. The other releases are Donut, Éclair, Froyo, Gingerbread, Honeycomb, Ice Cream Sandwich and Jelly Bean.Marshmallow (Android 6.0) is so far the latest Android version from Google. Since the platform is not closed like iOS, there are too many great Android apps built by developers.

Just after stepping into the smartphone and tablets market Android gained immense popularity due to its beautiful appearance and efficient working. Many new features were introduced which played a significant role in Android's success. Google Play is an official app market that contains millions of different apps for Android devices. Samsung, HTC, Motorola and many other top manufacturers are using Android in their devices. Currently, Android is one of the top operating systems and is considered serious threat for iPhone. Some of the smartphones operating on Android are HTC Desire, Samsung Galaxy Gio, Motorola Droid Razr, Samsung Galaxy S3 and HTC Wildfire.

iOS

iOS was introduced in 29th June 2007 when the first iPhone was developed. Since then iOS has been under gone many upgrades and currently the latest one is the iOS 9.

Apple has still not allowed any other manufacturer to lay hands on its operating system. Unlike Android, Apple has more concentrated on the performance along with appearance. This is the reason that the basic appearance of iOS is almost the same as it was in 2007. Overall it is very user-friendly and is one of the mobile best operating systems in the world. So far iOS has been used in all iPhones, iPod & iPad.

Blackberry OS

Blackberry OS is the property of RIM (Research In Motion) and was first released in 1999. RIM has developed this operating system for its Blackberry line of smartphones. Blackberry is much different from other operating systems. The interface style, as well as the Smartphone design, is also different having a trackball for moving on the menu and a qwerty keyboard.

Like Apple, Blackberry OS is a close source OS and is not available for any other manufacturer. Currently, the latest release of this operating system is Blackberry OS 7.1 which was introduced in May 2011 and is used in Blackberry Bold 9930. It is a very reliable OS and is immune to almost all the viruses.

Some of the smartphones operating on Blackberry OS are Blackberry Bold, Blackberry Curve, Blackberry Torch and Blackberry 8520.

Windows OS

All of you will be familiar with Windows OS because it is used in computers all over the world. Windows OS has also been used in mobile phones, but normal mobile phone users find it a bit difficult to operate it but at the same time it was very popular among people who were used to it. This was the case until Nokia and Microsoft joined hands to work together. The latest Windows release by Microsoft is known as Windows 7 which has gained immense popularity among all kind of users. With its colorful and user-friendly interface, it has given Windows OS a new life and is currently in demand all over the world. Another reason behind its success is that this latest OS is used in very powerful devices made by Nokia. The computer like look has totally vanished from the windows phones with the release of Windows 7. Samsung and HTC also released some Windows-based phones, but they could not many places in the market.

Nokia Lumia series is completely windows based. Some of the latest Windows Phones are Nokia Lumia 800, Nokia Lumia 900, Samsung Focus and HTC Titan 2.

BADA OS

Like others, Samsung also owns an operating system that is known as BADA. It is designed for mid-range and high-end smartphones. Bada is a quiet user-friendly and efficient operating system, much like Android, but unfortunately Samsung did not use Bada on a large scale for unknown reasons.

The latest version Bada 2.0.5 was released on March 15th, 2012. There are only three phones that are operating on Bada. These three smartphones are Samsung Wave, Samsung Wave 2 and Samsung Wave 3. I believe that Bada would have achieved much greater success if Samsung had promoted it properly.

Palm OS

Palm OS was developed by Palm Inc in 1996 especially for PDAs (Personal Digital Assistance). Palm OS was designed to work on touchscreen GUI. Some Years later it was upgraded and was able to support smartphones. Unfortunately, it could not make a mark on the market and currently is not being used in any of the latest top devices.

It has been 5 and half years since we saw the latest update of Palm OS in 2007. Palm OS was used by many companies including Lenovo, Legend Group, Janam, Kyocera and IBM.

Open Web OS

Open WebOS also known as Hp WebOS or just WebOS which was developed by Palm Inc but after some years it became the property of Hewlett-Packard. WebOS was launched in 2009 and was used in a number of smartphones and tablets.

Hp promoted WebOS at a very high level by using it in high-end smartphones and tablets. The latest device working on WebOS was the Hp Touch Pad. With the introduction of Android in the market sales of Hp WebOS, based tablets got very less. At last Hp announced to discontinue WebOS-based devices, but the existing users were assured that they will get regular updates of the operating system.

5.3 OPEN SOURCE SOFTWARE

Some of the most popular types of software are an open source, which means that the product's source code is openly available to the public. Anyone can view, copy, or change the software without having to pay licensing fees or royalties. Because of this openness, the development of open source code is usually collaborative, with multiple parties and interests producing the code and improving it for mutual benefit. This type of centralized and collaborative development can best be understood in contrast to proprietary commercial software development, in which code is developed within a corporation or by a single person. Once developed, the source code remains proprietary. It is not visible to the public and therefore is not available for copying, changing, and redistribution.

Examples of popular open source software include the following:

Open Office – A software suite of office applications, including word-processing, spreadsheet, presentation, database, and graphics software. It can be downloaded for free at http://openoffice.org.

Apache HTTP server – A popular Web server application that is freely available to anyone who wants to establish a Web server.

Linux – A prominent example of an open source operating system. Linux is primarily used for servers, although some people use Linux as their primary operating system.

Mozilla Firefox – A popular open source Web browser that is freely available to download from the internet. Firefox is probably most downloadable open source application.

MySQL – A popular open source database used for managing large amounts of data.

As the list indicates, open source initiatives span all types of software, including operating systems, programming languages, and applications. Many examples of open source software are available for free but others must be purchased. A user with a laptop/PC could download the Linux operating system, the Firefox Web browser, and the Open Office suite.

5.3.1 Advantages

- Open source software allows you to make choices, rather than being locked into the design and development of a commercial application.
- Open source software is under constant development which addresses vulnerabilities, bug fixes, enhancements, and more.
- You can modify the software as necessary for your own purposes.
- Some open source programs give the user the option of automatic updates, which keep the software current. i.e. WordPress.
- A number of open source programs have a core application which can be enhanced by the use of plug-ins and themes. i.e. WordPress and Joomla.
- Open source software offers a tremendous amount of flexibility.
- Open source software is potentially more secure than commercial programs because the code is constantly being scrutinized by many programmers, not just a select few.
- Many open source programs can be installed on your computer, unlike a proprietary system which you can use, but where you have no control. If the software owner doesn't like what you are doing, they can wipe out your hard work overnight.

5.3.2 Disadvantages

- If you don´t know how to write code, you´re at the mercy of those who do unless you have the budget to pay for modifications or learn how to code yourself.
- If the author of a product no longer supports the software, you might be out of luck unless the development is picked up by other programmers. That said, you're not at the mercy of a software company which goes out of business (and refuses to allow licensing to a 3rd party). You can take over development yourself if you wish.
- Open source is sometimes referred to as 'open wallet' in the sense that it may cost you more to have open source code modified than it would cost you to buy a commercial program.
- Unless there's a structure in place to ensure the quality of the code it might wind up with many changes, bug fixes, and patches, all of which can make the code more complex and/or degrade the quality, which in turn leads to more maintenance.
- The software might not be well-documented, which could make it difficult to learn.

5.4 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. Program which acts as a interface between a user and the hardware is called -------
2. ---------- is a primary memory.
3. The most common type of spooling is _____.
4. Buffering is _____ management technique.
5. Symbian is the operating system developed and sold by _____.

B. State whether the following statements are True or False:

1. Restarting a computer is called Soft booting.
2. A system that can process two or more programs is called Multiprogramming.
3. The overall functions of the O.S are to manage I/O, files and memory.
4. DOS is an example of GUI.
5. UNIX is an operating system.

5.5 SUMMARY

Operating System is also known as resource manager because its prime responsibility is to manage the resources of the computer system i.e. memory, processor, devices and files. In addition to these, Operating System provides an interface between the user and the bare machine. Following the course of the conceptual evolution of operating systems, we have identified the main characteristics of the program-execution and development environments provided by the bare machine, serial processing, including batch and multiprogramming.

On the basis of their attributes and design objectives, different types of operating systems were defined and characterized with respect to scheduling and management of memory, devices, and files. The primary concerns of a time- sharing system are equitable sharing of resources and responsiveness to interactive requests. Real-time operating systems are mostly concerned with responsive handling of external events generated by the controlled system. Distributed operating systems provide facilities for global naming and accessing of resources, for resource migration, and for distribution of computation.

5.6 KEYWORDS

Operating system: is a software which performs all the basic tasks like file management, memory management, process management, handling input and output, and controlling peripheral devices such as disk drives and printers.

Multiprogramming system: in multiprogramming system CPU will never be idle and keeps on processing.

CPU Scheduling: if several jobs are ready to run at the same time, then the CPU scheduling chooses which one to run.

Time Sharing Systems are very similar to Multiprogramming batch systems. In fact, time sharing systems are an extension of multiprogramming systems.

A Multiprocessor system consists of several processors that share a common physical memory.

Hard Real-Time Operating Systems: The Real-Time Operating system which guarantees the maximum time for critical operations and complete them on time.

Soft Real-Time Operating Systems: The real-time operating systems that can only guarantee a maximum of the time, i.e. the critical task will get priority over other tasks, but no assurity of completing it in a defined time.

5.7 SELF-ASSESSMENT TEST

1. What are the objectives of an operating system? Discuss.
2. Differentiate between multiprogramming, multitasking and multiprocessing.
3. Discuss whether there are any advantages of using a multitasking operating system, as opposed to a serial processing one.
4. What are the major functions performed by an operating system? Explain.
5. Why operating system is referred to as a resource manager? Explain.
6. What is real time system? How is it different from other types of operating system? Explain.
7. Define operating system. Discuss different types of operating systems.
8. What is a mobile operating system? Discuss various types of mobile operating systems.
9. Write a short note on evolution of processing trends.
10. What do you mean by open source software? Discuss its advantages and disadvantages.

5.8 ANSWERS TO CHECK YOUR PROGRESS

Check your Progress A

1. Operating System
2. RAM
3. Print Spooling
4. Device
5. Symbian Ltd.

Check your Progress B

1. False
2. True
3. True
4. False

5. True

5.9 REFERENCES/SUGGESTED READINGS

- Operating System Concepts, 5th Edition, Silberschatz A., Galvin P.B., John Wiley and Sons.
- Systems Programming and Operating Systems, 2nd Revised Edition, Dhamdhere D.M., Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Operating Systems, Madnick S.E., Donovan J.T., Tata McGraw Hill Publishing Company Ltd., New Delhi.
- Operating Systems-A Modern Perspective, Gary Nutt, Pearson Education Asia, 2000.
- Operating Systems, Harris J.A., Tata McGraw Hill Publishing Company Ltd., New Delhi, 2002.
- https://www.tutorialspoint.com/operating_system/os_overview.htm on 13/05/2020.
- https://www.guru99.com/operating-system-tutorial.html 13/05/2020.
- https://www.javatpoint.com/os-tutorial 13/05/2020.
- https://www.studytonight.com/operating-system/ 13/05/2020.

Course: BC 104	Author: Mr. Sawtantar Singh
Lesson: 6	Updated By: Mr. Balwant

APPLICATION SOFTWARES

Structure

6.0 Learning Objectives

6.1 Introduction

6.2 Microsoft Excel 2003

6.3 Microsoft Word 2003

6.4 Microsoft Access 2003

6.5 Check Your Progress

6.6 Summary

6.7 Keywords

6.8 Self-Assessment Tests

6.9 Answers to Check Your Progress

6.10 References/Suggested Readings

6.0 LEARNING OBJECTIVES

After going through this lesson you will be familiar with

- ✓ What is an application software?
- ✓ How to use spreadsheet
- ✓ How to use word processor for creating, editing text?
- ✓ What is DBMS?

6.1 INTRODUCTION

Application software is a software that performs specific tasks for the end user. Effectively, if the user is interacting directly with a piece of software it is application software. For example, Microsoft Word or Excel are application software, as are common web browsers such as Firefox or Google Chrome.

It also includes the category of mobile apps, including communication apps such as WhatsApp or games such as Candy Crush Saga. There are also app versions of common services such as those providing weather or transport information or apps for customers to interact with companies.

Application software is distinct from system software, which refers to the software that actually keeps the systems running such as the operating system, computational science software, game engines, industrial automation, and software as a service application. Instead of interacting with the user, the system software interacts with other software or hardware. In this lesson we will discuss the following application software

- ✓ Microsoft Excel 2003
- ✓ Microsoft word 2003
- ✓ Microsoft Access 2003

6.2 MICROSOFT EXCEL 2003

A spreadsheet is essentially a matrix of rows and columns. Consider a sheet of paper on which horizontal and vertical lines are drawn to yield a rectangular grid. The grid namely a cell, is the result of the intersection of a row with a column. Such a structure is called a **Spreadsheet**.

A spreadsheet package contains electronic equivalent of a pen, an eraser and large sheet of paper with vertical and horizontal lines to give rows and columns. The cursor position uniquely shown in dark mode indicates where the pen is currently pointing. We can enter text or numbers at any position on the worksheet. We can enter a formula in a cell where we want to perform a calculation and results are to be displayed. A powerful recalculation facility jumps into action each time we update the cell contents with new data.

MS-Excel is the most powerful spreadsheet package brought by Microsoft. The three main components of this package are

- Electronic spreadsheet
- Database management
- Generation of Charts.

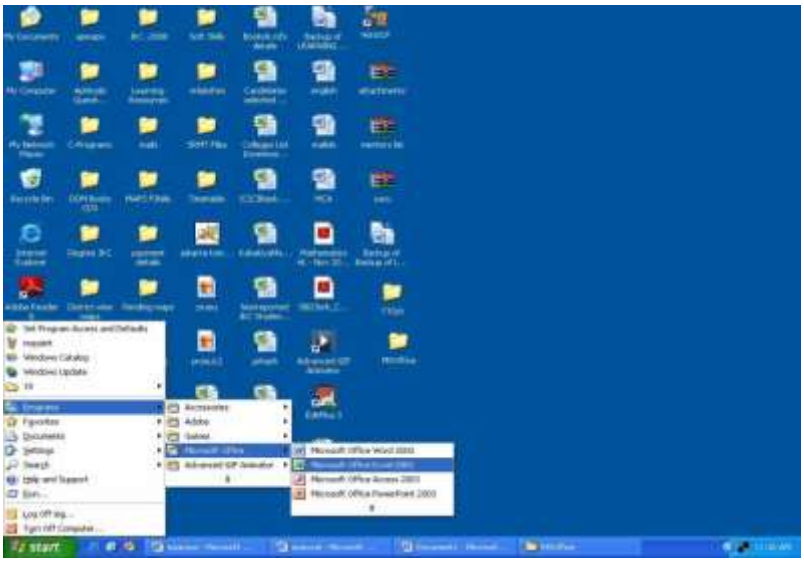
Each workbook provides 3 worksheets with facility to increase the number of sheets. Each sheet provides 256 columns and 65536 rows to work with. Though the spreadsheet packages were originally designed for accountants, they have become popular with almost everyone working with figures. Sales executives, book-keepers, officers, students, research scholars, investors bankers etc, almost any one find some form of application for it.

You will learn the following features at the end of this section.

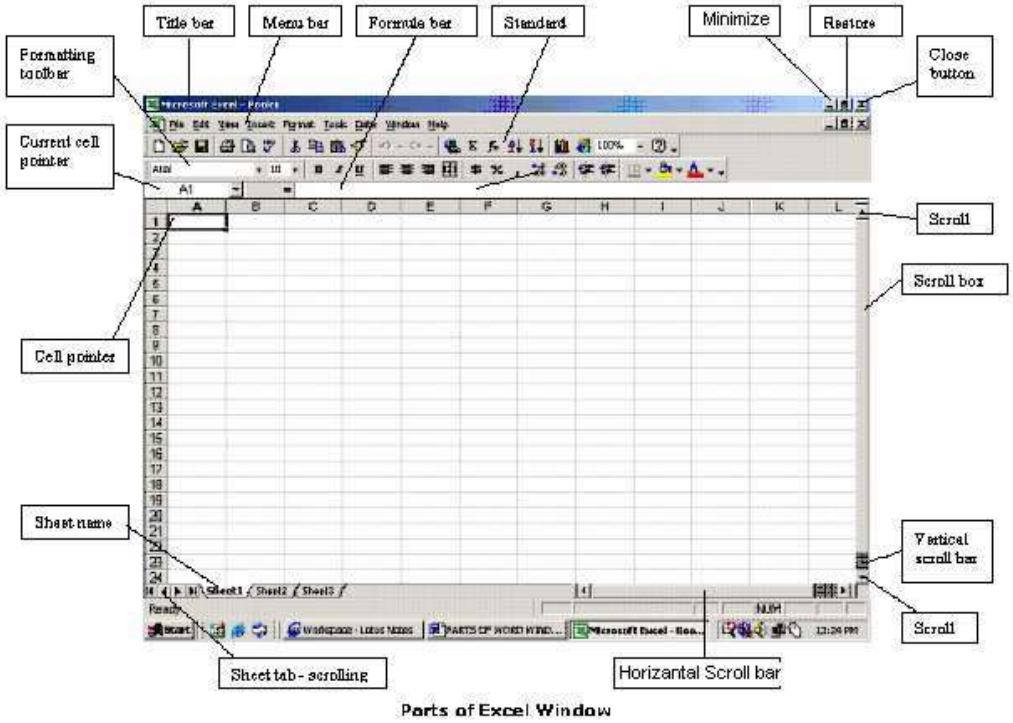
- Starting Excel 2003
- Using Help
- Workbook Management
- Cursor Management
- Manipulating Data
- Using Formulae and Functions
- Formatting Spreadsheet
- Printing and Layout
- Creating Charts and Graphs

Starting Excel 2003

- Switch on your computer and click on the **Start** button at the bottom left of the screen.
- Move the mouse pointer to Programs, then across to Microsoft Excel, then click on **Excel** as shown in this screen.



When you open Excel a screen similar to this will appear



Parts of Excel Window

The options shown below is called as **Menu Bar**

File Edit View Insert Format Tools Data Window Help

TOOLBARS AND THE ICONS

Standard Toolbar

New
Creates a new blank file.
Alternative: File → New
Shortcut → Ctrl + N

Open
Opens or finds a file.
Alternative: File → Open
Shortcut → Ctrl + O

Save
Saves the active file.
Alternative: File → Save
Shortcut → Ctrl + S

E-Mail
Sends contents of the current worksheet as body of the e-mail message

Print
Prints the active file using current defaults.
Alternative: File → Print
Shortcut → Ctrl + P

Print Preview
Displays full pages as they are printed.
Alternative: File → Print Preview
Shortcut → Ctrl + F2

Spelling
Checks the spelling in the active file.
Alternative: Tools → Spelling and Grammer
Shortcut → F7

Cut
Cuts the selection and puts it on the Clipboard.
Alternative: Edit → Cut
Shortcut → Ctrl + X

Past
Inserts the Clipboard contents at the insertion point.
Alternative: Edit → Past
Shortcut → Ctrl + V

Copy
Copies the selection and puts it on the clipboard.
Alternative: Edit → Copy
Shortcut → Ctrl + C

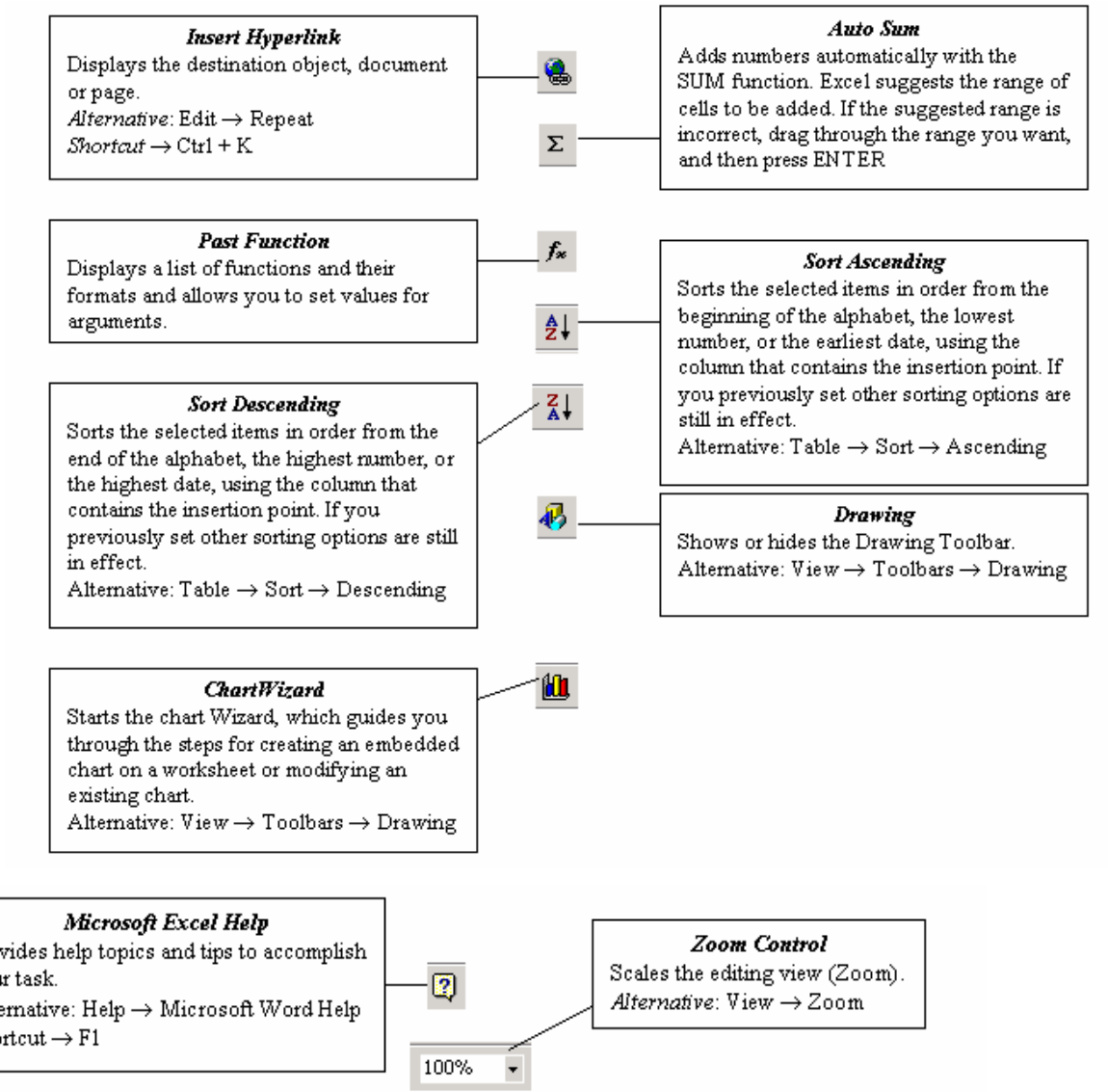
Format Painter
Copies the formatting of the selection to a specified location.
Shortcut → Ctrl + Shift + C

Undo
Reverses certain commands.
Alternative: Edit → Undo
Shortcut → Ctrl + Z

Redo
Reverses the action of the Undo command.
Alternative: Edit → Repeat
Shortcut → Ctrl + Y

Insert Hyperlink
Displays the destination object, document or page.
Alternative: Edit → Repeat
Shortcut → Ctrl + K

Auto Sum
Adds numbers automatically with the SUM function. Excel suggests the range of cells to be added. If the suggested range is incorrect, drag through the range you want, and then press ENTER



The **formula bar** is the place in which you enter the formula(=A3*B5)

❖ The alphabets **A,B**… are known as **columns**

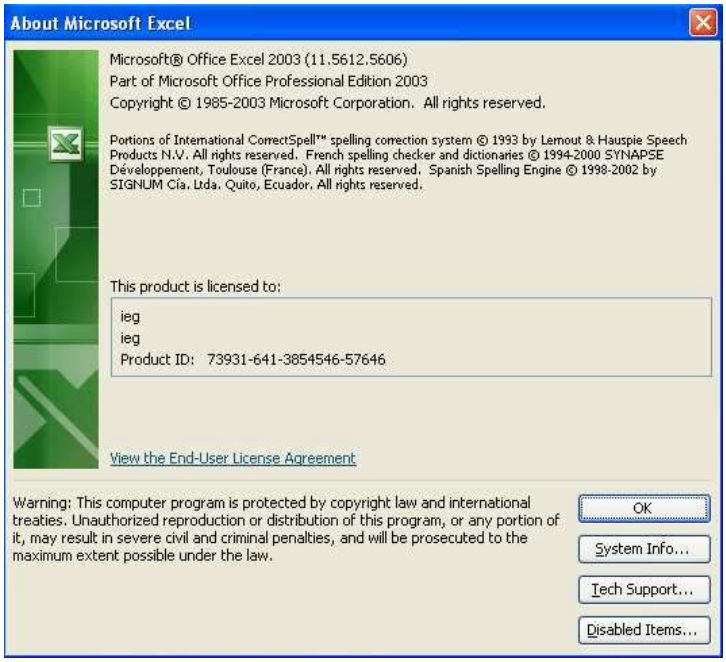
This is the name of the workbook. (**Book1**)

❖ The rows are numbered as **1,2,3**…

- **Sheet1,Sheet2, Sheet3** are known as **worksheet tabs**

How to use Help Menu

- Click on **Help, Contents** and **Index**, then click on the **Index** tab. The following screen will appear

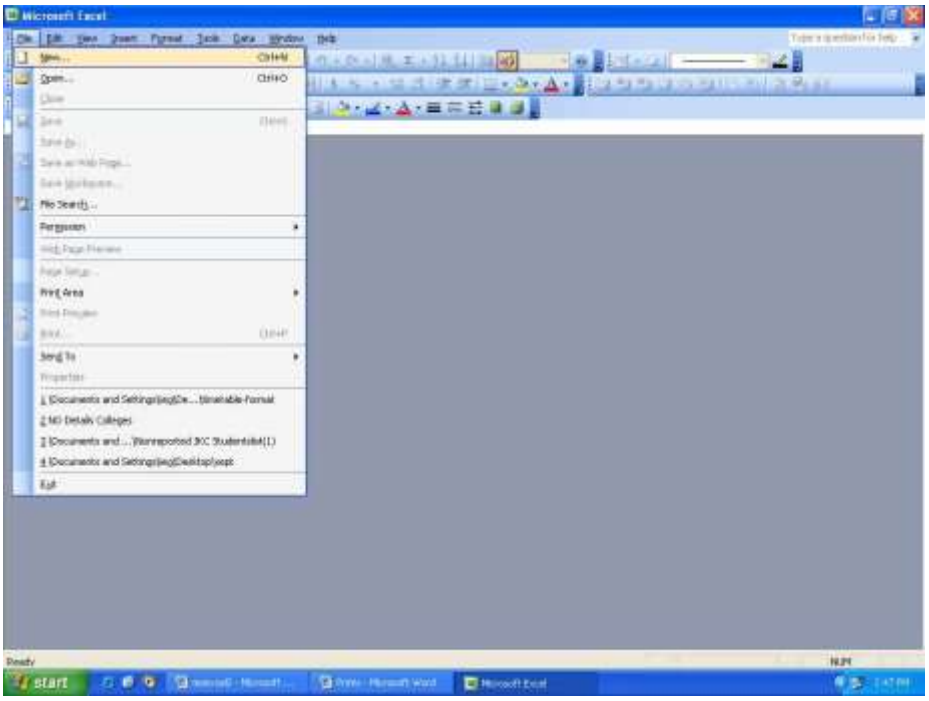


- Type the first few letters to see the help entries for those letters.
- You can get the printout of any help topic by selecting it, right clicking and then clicking **Print Topic**.

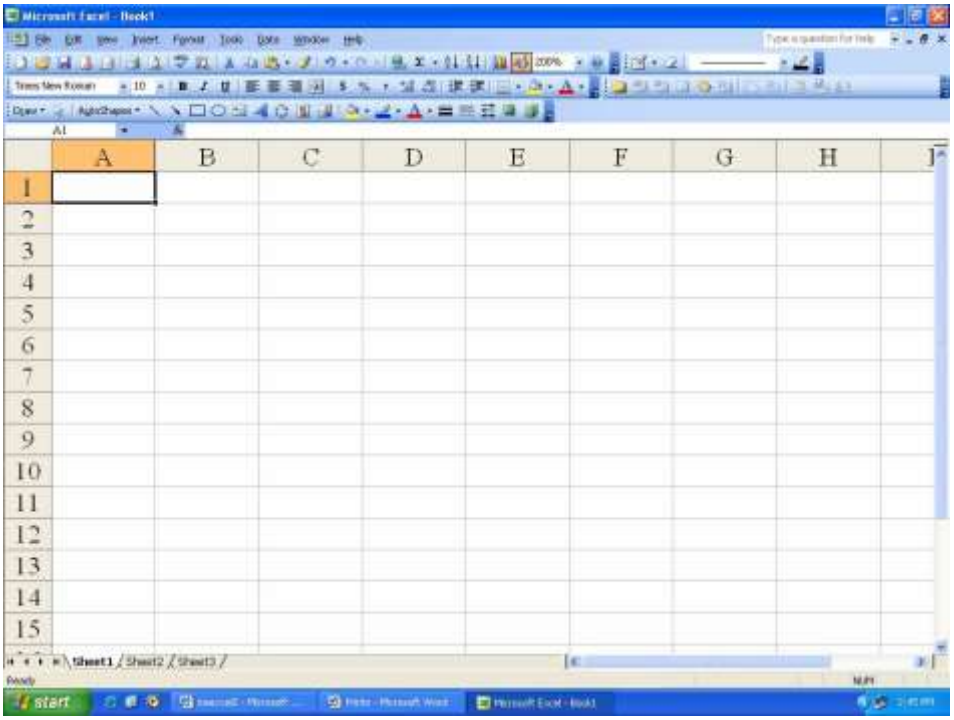
Workbook Management

Task 1: Creating a new workbook

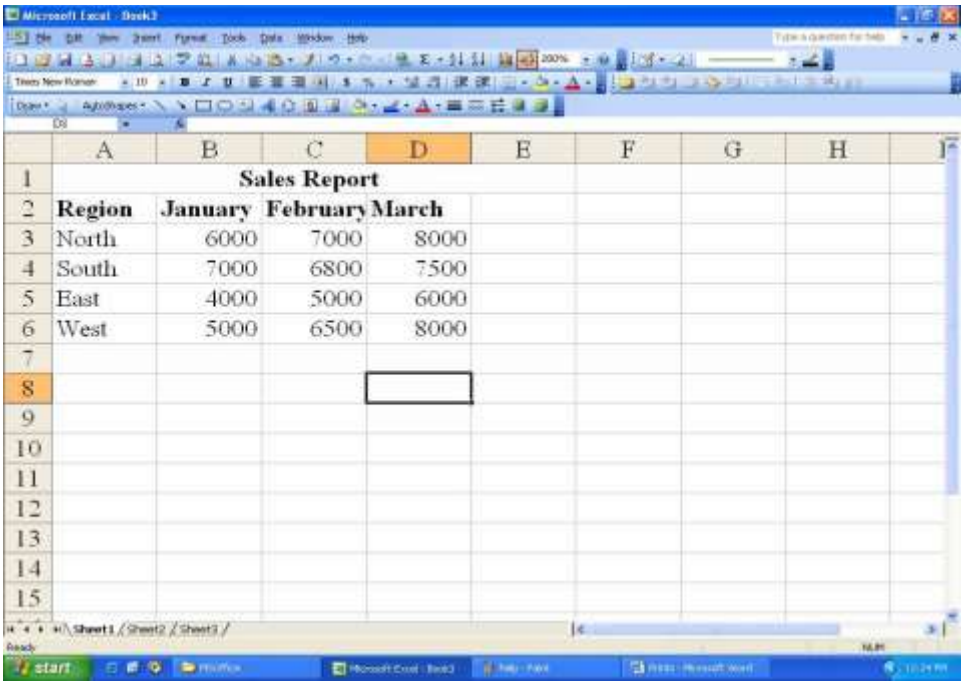
- Click on **File** menu and then click on **New**.



❖ Click **Workbook** and then click **OK** button. You will get the screen as shown below.



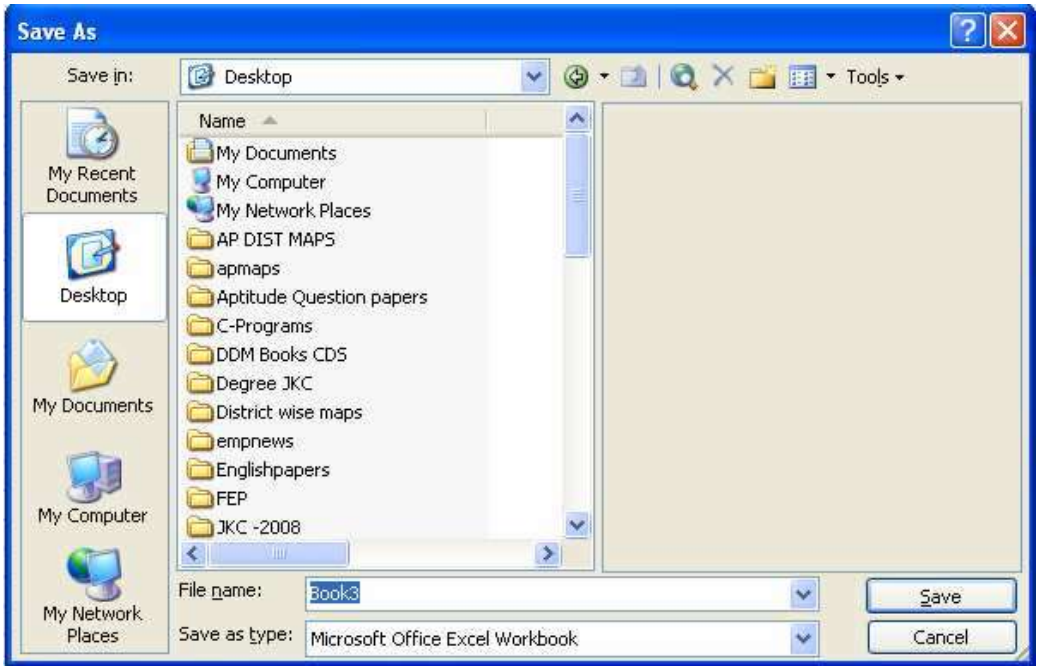
Enter data as shown in the figure below :



	A	B	C	D	E	F	G	H
1			Sales Report					
2	Region	January	February	March				
3	North	6000	7000	8000				
4	South	7000	6800	7500				
5	East	4000	5000	6000				
6	West	5000	6500	8000				
7								
8								
9								
10								
11								
12								
13								
14								
15								

Task 2: Saving Workbook

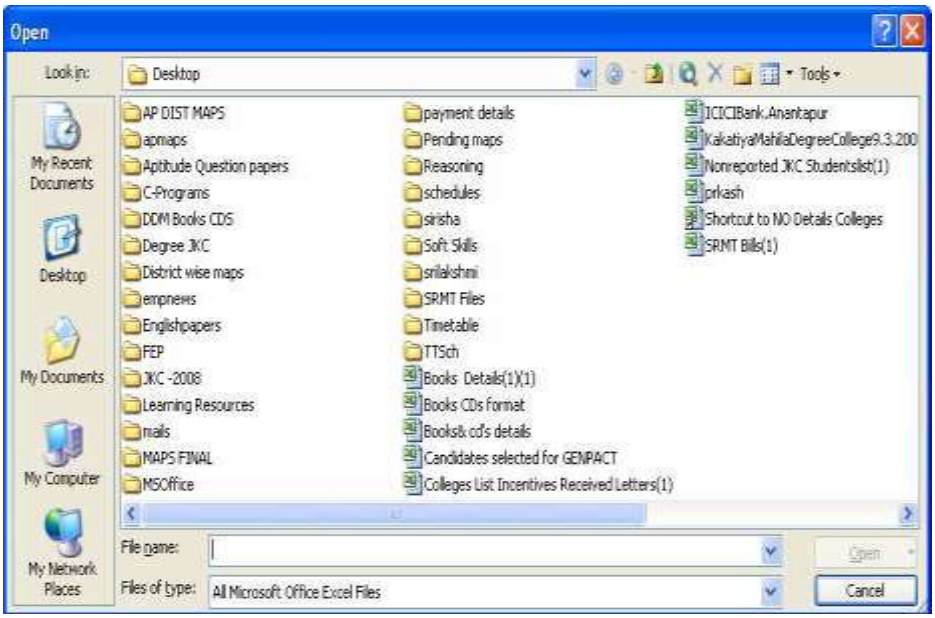
- Click on **File** menu and then click **save**. You will get the below screen



- In the **File name** text box, type **sample** and then click **Save** button

Task 3: Opening an existing workbook

- Click on the **File** menu and click on **Open**. The open dialog box will appear



- Click on some file (Example: **sample.xls**), then click on **Open**.

Task 4: Closing your workbook

- Click on **File** menu, then click **Close** to close your workbook

Cursor Management

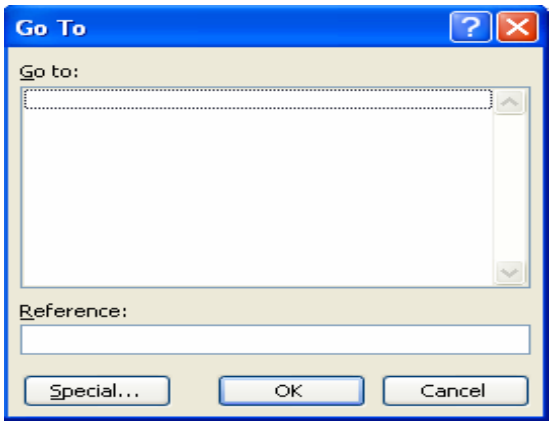
Task 1: Moving around the worksheet

- Open **sample.xls** workbook.
- Move the cursor in your worksheet by using the **arrow keys** on the right hand side of the keyboard.
- When you have got lots of rows of data you can move the cursor more quickly by using the **PgUp** and **PgDn** keys to move up and down a screen at a time.
- To move one screen to the right, press the **Alt** key and **PgDn** keys together.
- To move one screen to the left, press the **Alt** and **PgUp** keys together.
- To move further to the right, just keep pressing the **right arrow** key

- To move back to cell **A1**, press the **Ctrl** and **Home** keys together.
- Pressing the **Home** key on its own takes you back to **column A**
- To move to the last column(**IV**) press the **Ctrl** and **right arrow** keys together.
- To move to last cell containing data, press **Ctrl** and **End** keys together.
- To move to the last row(65,536), press **Ctrl** and the **down arrow** keys together.
- You can also move the cursor with the mouse. Move the mouse pointer to the location you want. Press and release the left mouse button once when the cursor is where you want it.

Task 2: Moving to a Specified cell

- Click on the **Edit** menu, choose **Go To**. You will get the below screen

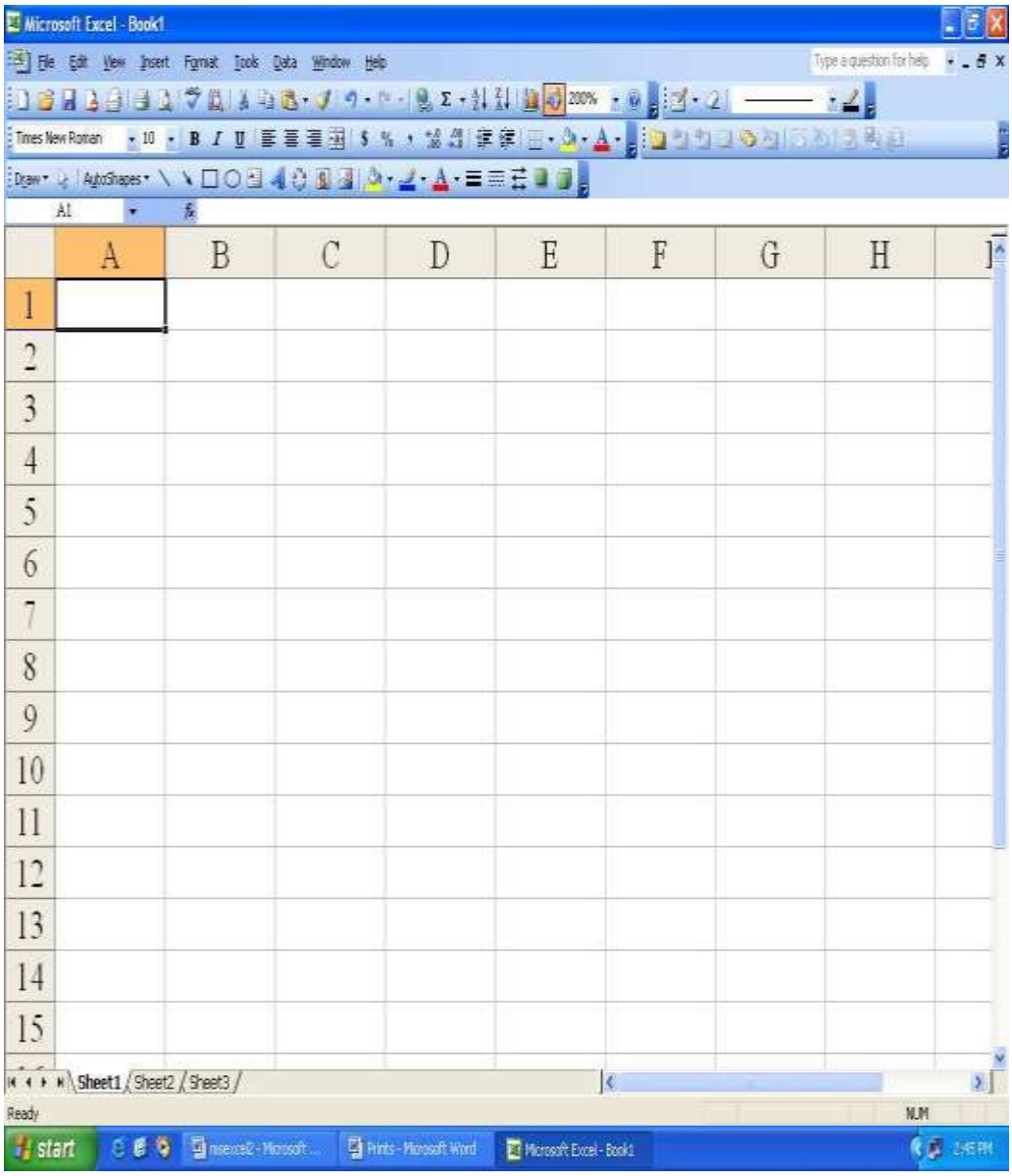


- Enter the destination cell reference in the **Reference** text box.
- Click **OK** to move directly to the specified cell.

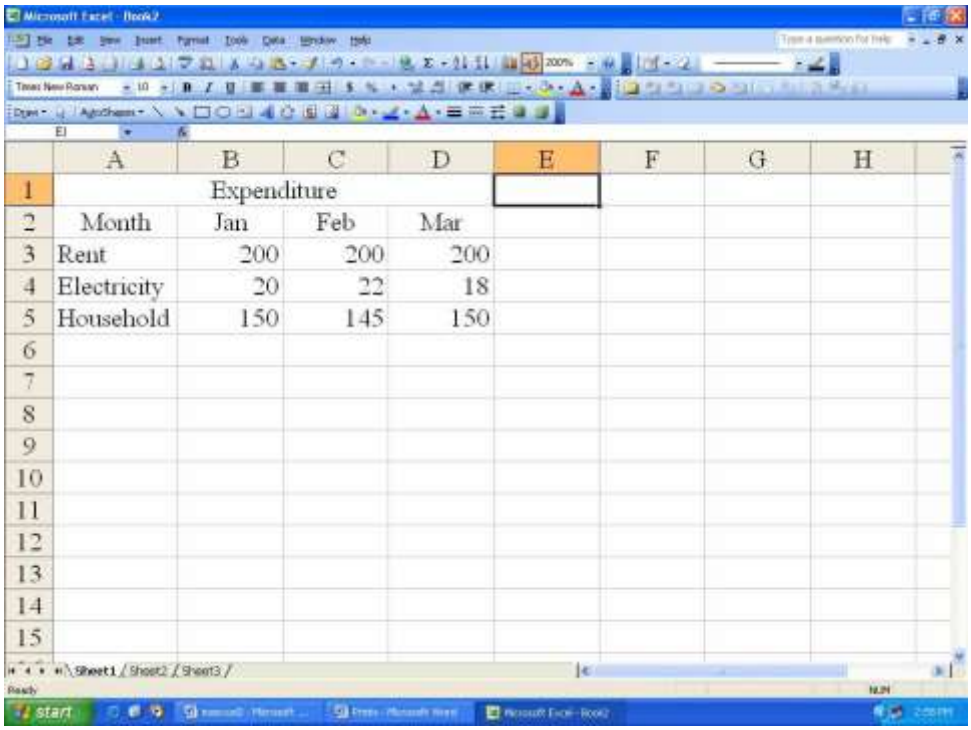
Data Manipulation

Task 1: Entering data

- Start **Excel**. Click **File** and then **New**. An empty worksheet appears as shown below

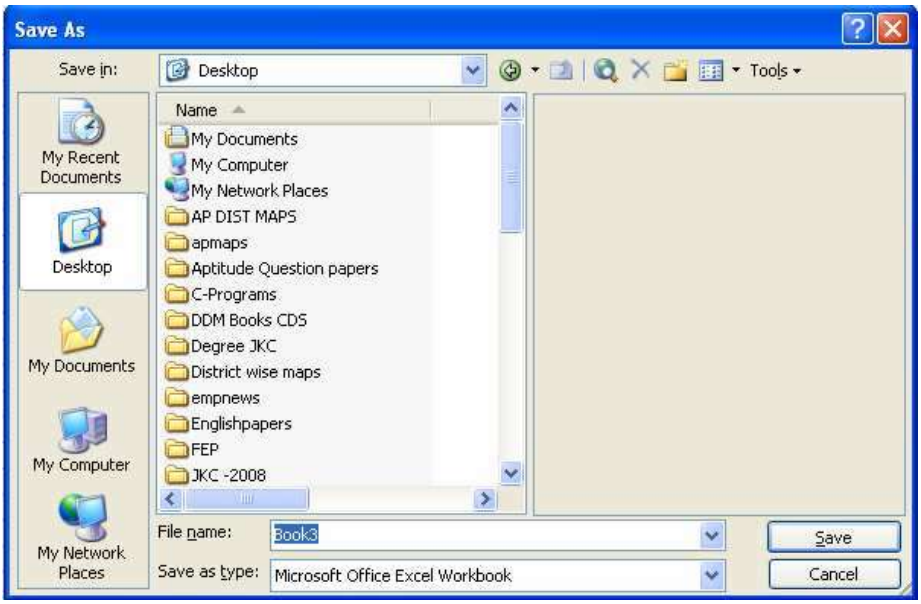


- Type Expenditure in cell **A1** then press **down arrow** key to move to cell **A2**.
- Type **Month** then press the **down arrow** key to move to cell **A3**
- Continue to type the data. The resulting worksheet should appear like the following screen.



	A	B	C	D	E	F	G	H
1		Expenditure						
2	Month	Jan	Feb	Mar				
3	Rent	200	200	200				
4	Electricity	20	22	18				
5	Household	150	145	150				
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

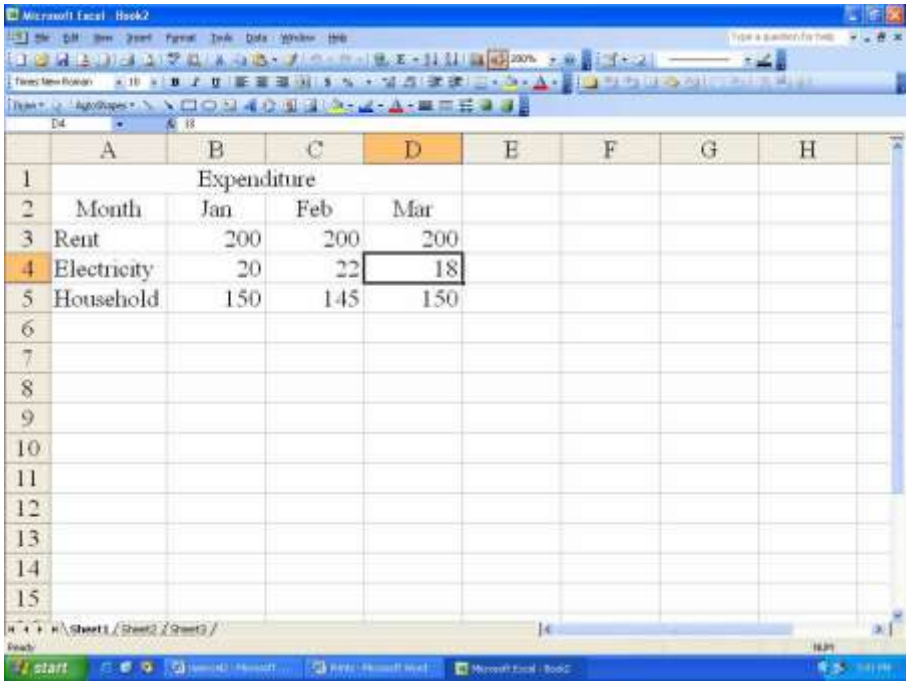
- Save your work by clicking **File** and then **Save As**. This dialog box appears.



- Type **cash** in the **File Name** text box and then click **Save** button.
- Excel automatically adds the extension **.xls** to your file name.

Task 2: Editing data

- Click **File** and then click **Open**.
- Click **cash.xls** and then click **Open**.
- Move the mouse pointer to cell **D4**, click and release. The cell is highlighted and 18 appears in the formula bar.
- Move the mouse pointer to the formula bar and click once to the right of 18.



	A	B	C	D	E	F	G	H
1		Expenditure						
2	Month	Jan	Feb	Mar				
3	Rent	200	200	200				
4	Electricity	20	22	18				
5	Household	150	145	150				
6								
7								
8								
9								
10								
11								
12								
13								
14								
15								

- Use the **Backspace** key to delete 8,then type 4 and press **Enter**. Cell D4 now contains the value 14.

Task 3: Replacing cell data

- Make the cell B5 active by clicking on it.
- Type 200 and press **Enter**. The cell B5 will now contain the value 200 replacing old value (150).

Task 4: Deleting cell contents

- Move to cell **C5** and click to **select**.
- Press the **Delete** key.

- The cell becomes blank.
- Drop down the **Edit** menu and click **Undo** to reinstate the 145.
- Excel 97 allows 16 levels of undo. You can use **Undo** and **Redo** buttons also.

Task 5: Copying data

- Open the **cash** spreadsheet.
- Select the cells **D3** to **D5**
- Click **Edit** menu and then click **Copy**.
- Select the cells **F3** to **F5**.
- Click **Edit** menu and then click **Paste**.
- Now the cells D3 to D5 are copied into F3 to F5.

Task 6: Moving data

- Open **cash.xls** spreadsheet.
- Select the cells from **B3** to **B5**.
- Click **Edit** menu and then click **Cut**.
- Select the cells **G3** to **G5**.
- Click **Edit** menu and then click **Paste**.

Task 7: Data Auto Fill

There is an easy method to fill the data in columns and rows. The data may be *Numeric* or *dates* and *text*.

To fill *Slno* by using auto fill

- Type *Slno* for 2 cells i.e 1,2 in the cells A1 and A2 respectively.
- Select two cells and drag the Fill Handle

	A	B	C	D	E	F
1	1	2	3	4	5	6
2	2					
3	3					
4	4					
5	5					
6	6					
7	7					
8	8					
9	9					

To fill dates in the cells

- Type date in the cell
- Select the cell and drag the **Fill Handle**

	A	B	C	D
1	01/01/2008	02/01/2008	03/01/2008	04/01/2008
2	02/01/2008			
3	03/01/2008			
4	04/01/2008			
5	05/01/2008			
6	06/01/2008			
7	07/01/2008			
8	08/01/2008			
9	09/01/2008			
10	10/01/2008			
11	11/01/2008			

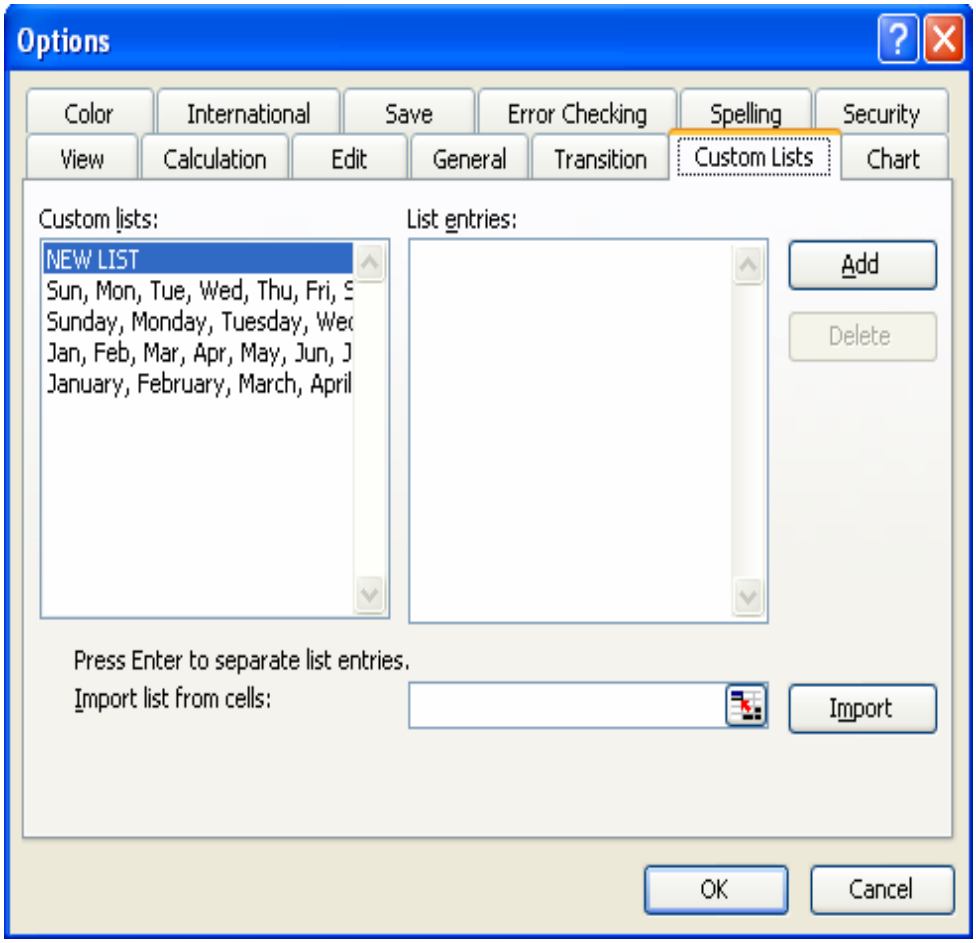
We can customize the lists with different text data to minimize the redundancy of work.

Some of the lists are listed below:

1. Jan, Feb, Mar, Apr, May, June, July…. like months
2. Sunday, Monday, Tuesday, Wednesday, Thursday…Like week days
3. Adilabad, Anatapur, Chittor, Cuddapah… like District names
4. Ravi, Kiran, Praveen, Rama…. like employees list

To create a customized list follow the steps given below:

- Click **Tools** Menu ,Click **Options** then click **Custom Lists** tab, Then you will find the figure given below:



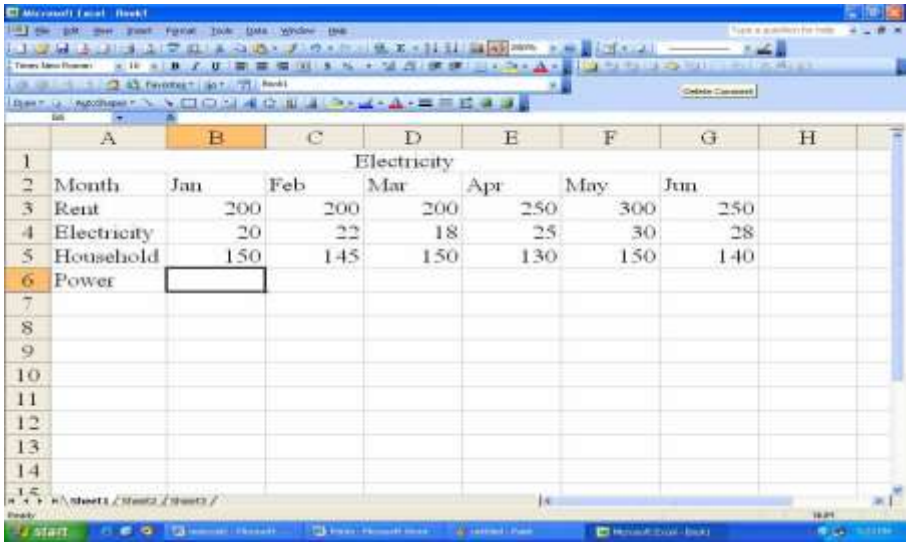
- Click **NEW LIST** and enter the list in the List entries window Click **Add** button then click **OK** button then your list will be added to the **Custom Lists**. That list you can use as and when required to type.
- Now you can Drag the **fill handle** (+) to get the list automatically.

Using Formulae and Functions

Task 1: Entering a formulae

- Click **File** and then click **New**.

- Enter the data in the new worksheet as shown below



	A	B	C	D	E	F	G	H
1				Electricity				
2	Month	Jan	Feb	Mar	Apr	May	Jun	
3	Rent	200	200	200	250	300	250	
4	Electricity	20	22	18	25	30	28	
5	Household	150	145	150	130	150	140	
6	Power							
7								
8								
9								
10								
11								
12								
13								
14								

- Cell B6 should contain formula. Move the cell pointer to cell B6.
- Type =B3+B5(formulae and functions should always begin with = sign)
- Cell B6 will now contain the value 350
- Look at cell B6; you will see the result of the formula in the cell B6 rather than formula.
- Now repeat the appropriate formula for cell C6, D6.
- Save your worksheet as cash3.xls.

Task 2: Editing Formulae

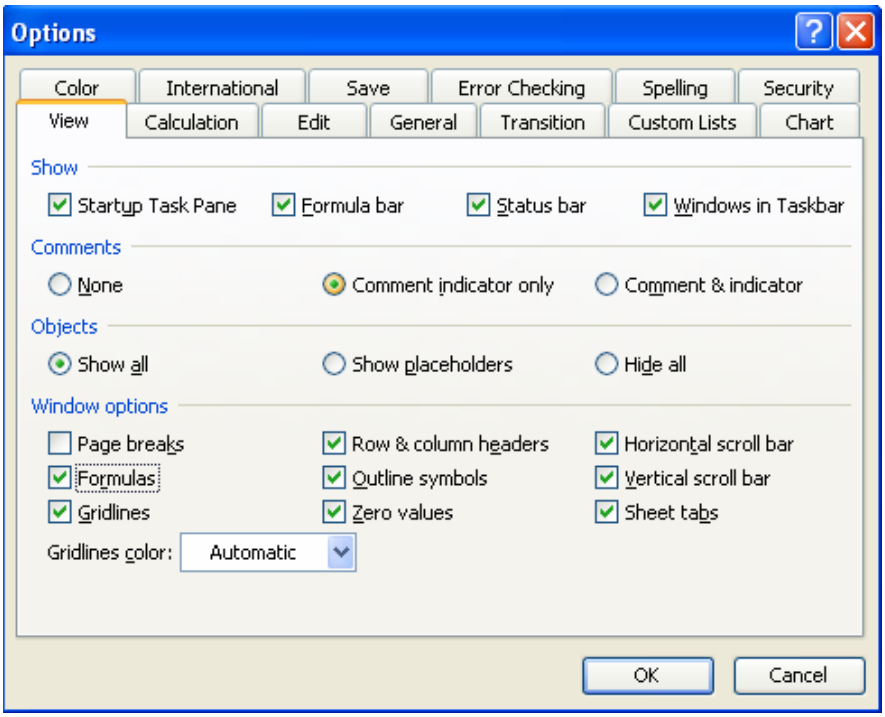
- Move the cursor to the formula bar with the mouse, clicking once.
- Make the desired changes.
- When you have finished editing the formulae, press the Enter key for the changes to take effect.

(OR)

- Edit the contents by pressing F2 key on the keyboard

Task 3: Displaying and Printing formulae

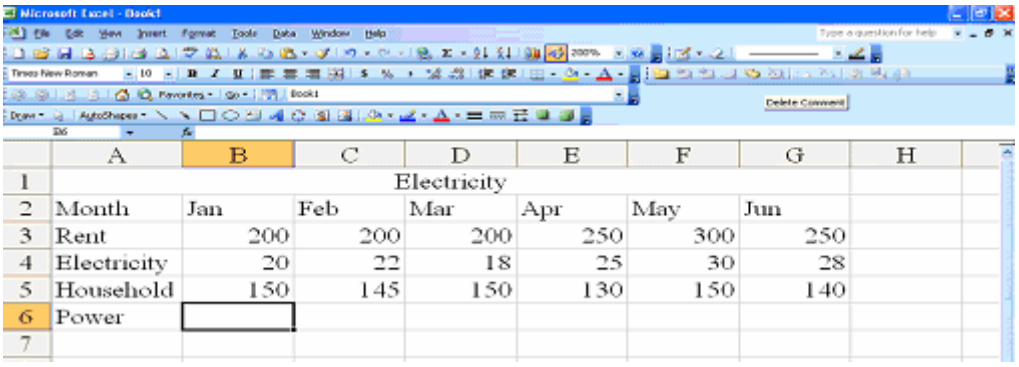
- Click **Tools** menu and then click **Options**.
- Click **View** tab.
- In Window options check Formulas check box. The below screen appears.



- Click **OK** button.
- To print the worksheet with formulae displayed, click **File** menu and click on **Print Preview**. If the layout is satisfactory, click on the **Print** button.

Task 4: Using the SUM function

- Open **cash3.xls** spreadsheet.



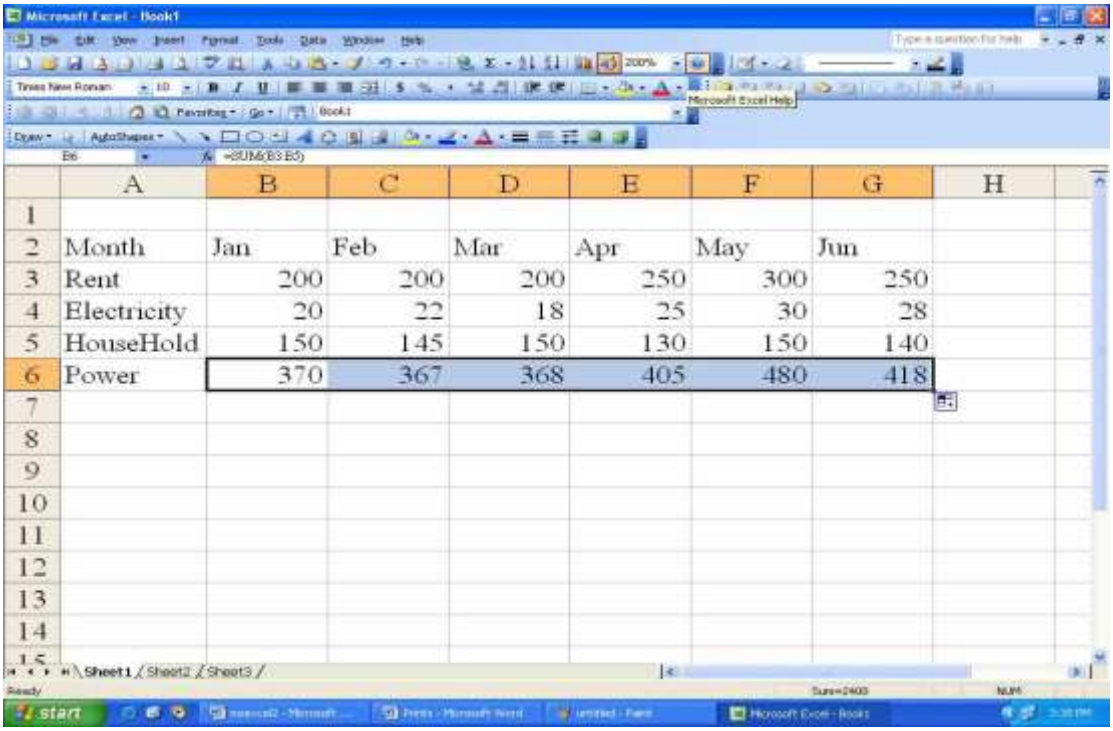
	A	B	C	D	E	F	G	H
1				Electricity				
2	Month	Jan	Feb	Mar	Apr	May	Jun	
3	Rent	200	200	200	250	300	250	
4	Electricity	20	22	18	25	30	28	
5	Household	150	145	150	130	150	140	
6	Power							
7								

- Suppose if you want the summation of the cells B3 to B5 should appear in the cell B6, then first select the cells from B3 to B6.

- Click the **Auto Sum** icon Σ on the toolbar.
- The result of (**B3+B4+B5**) will appear in the cell **B6**.

Task 4: Copying Formulae

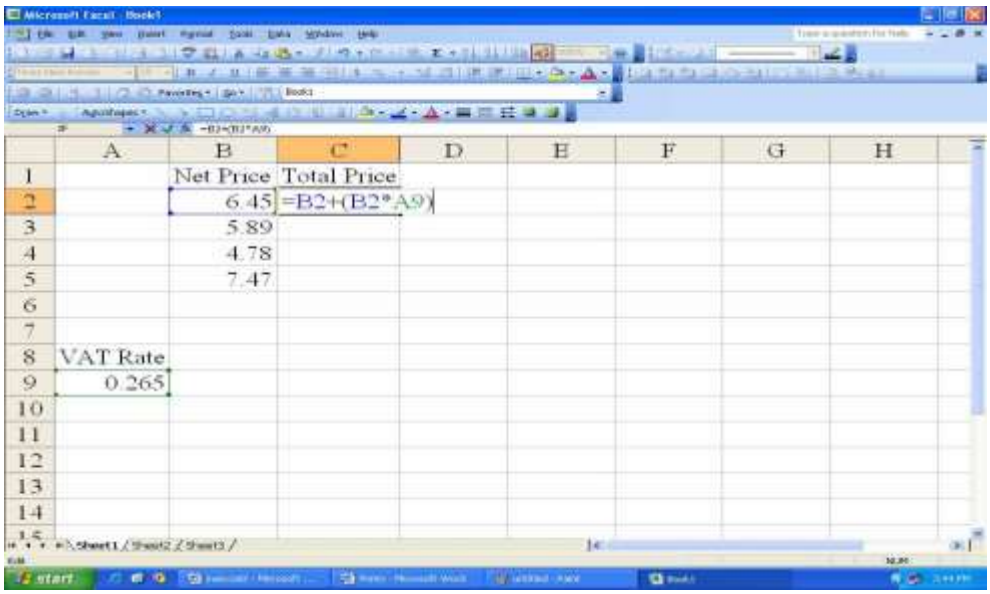
- Open **cash3.xls** spreadsheet.
- If you want to copy the formula in the cell B6 to C6,D6,E6 then first select the cell B6.
- Move the cursor to the lower right corner of the cell B6. The cursor will change to + icon.
- Drag the cursor from **B6 to E6** and release **left mouse** button.
- You will notice that the cells C6, D6 and E6 are updated immediately as shown below.



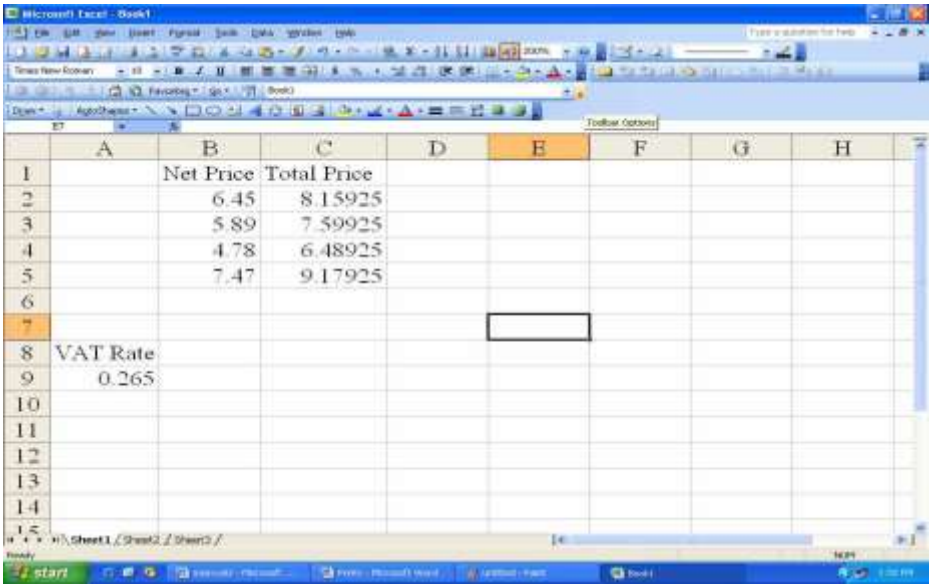
	A	B	C	D	E	F	G	H
1								
2	Month	Jan	Feb	Mar	Apr	May	Jun	
3	Rent	200	200	200	250	300	250	
4	Electricity	20	22	18	25	30	28	
5	HouseHold	150	145	150	130	150	140	
6	Power	370	367	368	405	480	418	
7								
8								
9								
10								
11								
12								
13								
14								

Task 5: Copying formulae using absolute addressing

- Create the worksheet shown below and save ABS
- If you copy the formula in the cell c2 to c3, c4, c5 you will get the incorrect



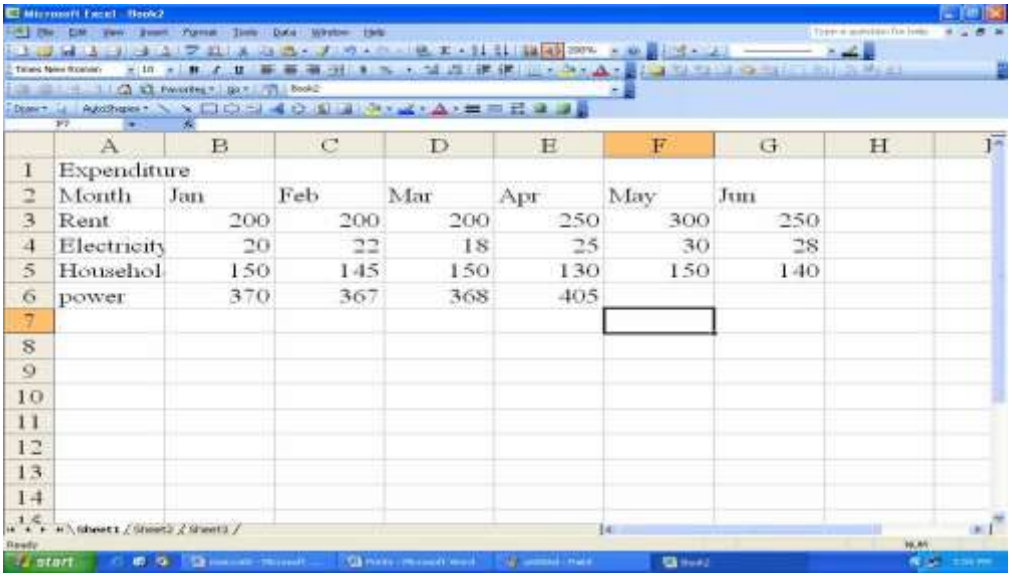
- result because the formula will change in the cell (C3)to B3*A10 but the value in the A10 is not defined. The reason is that we are copying relative address but not absolute address. To use absolute address move to **c2** cell.
- Edit the formula to =**B2+(B2*A9)** and press **Enter** key.
- Copy the formula to cells **C3** to **C5**.



Formatting Spreadsheet

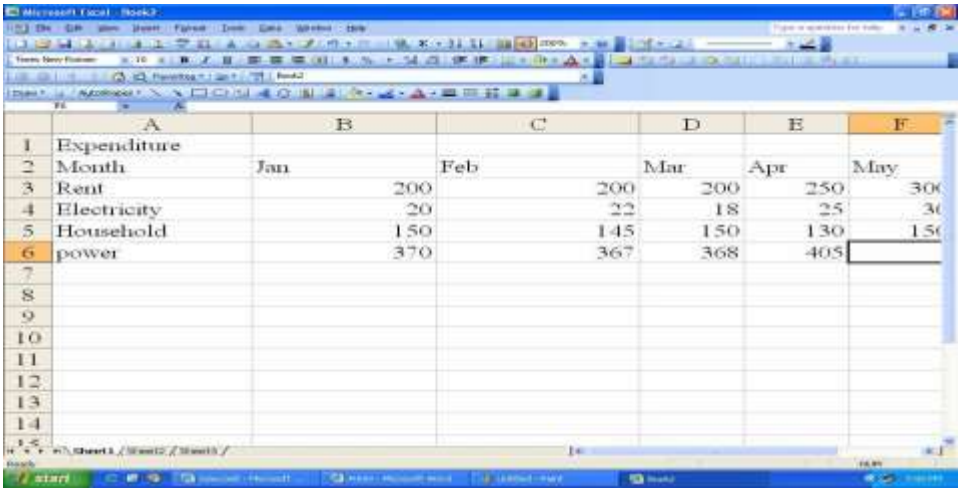
Task1: Increasing column width

- Open an existing worksheet(For example cash3.xls)



	A	B	C	D	E	F	G	H
1	Expenditure							
2	Month	Jan	Feb	Mar	Apr	May	Jun	
3	Rent	200	200	200	250	300	250	
4	Electricity	20	22	18	25	30	28	
5	Household	150	145	150	130	150	140	
6	power	370	367	368	405			
7								
8								
9								
10								
11								
12								
13								
14								

- Move the mouse pointer to the position(column B)shown below in the column header. When the black cross appears, hold down the left button and drag the mouse to the right to increase the column width by the required amount.



	A	B	C	D	E	F
1	Expenditure					
2	Month	Jan	Feb	Mar	Apr	May
3	Rent	200	200	200	250	30
4	Electricity	20	22	18	25	3
5	Household	150	145	150	130	15
6	power	370	367	368	405	
7						
8						
9						
10						
11						
12						
13						
14						

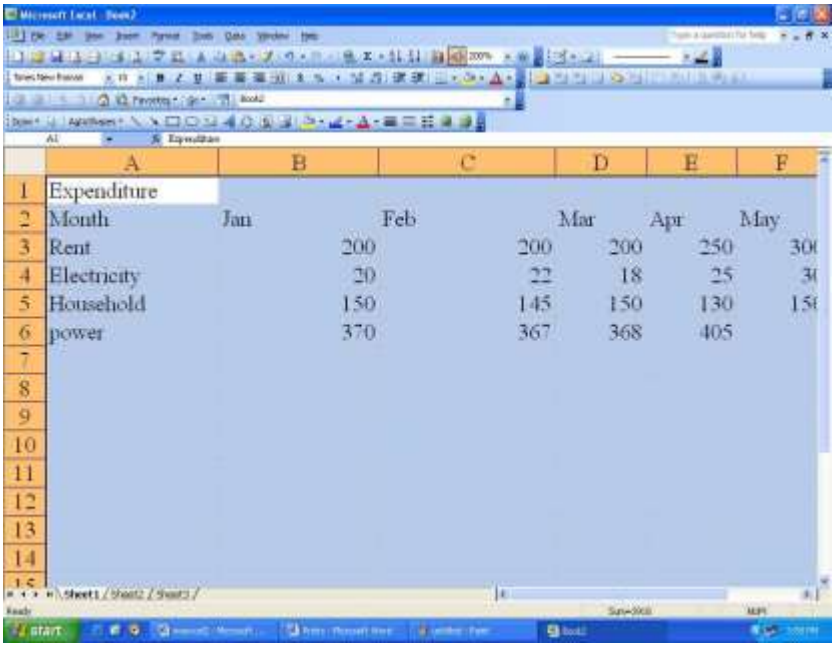
Task 2: Decreasing column width

- Open **cash3.xls** spreadsheet.
- Move the mouse pointer to the column **B**. When the black cross appears, hold down the **left**

button and drag the mouse to the left to reduce the cell width.

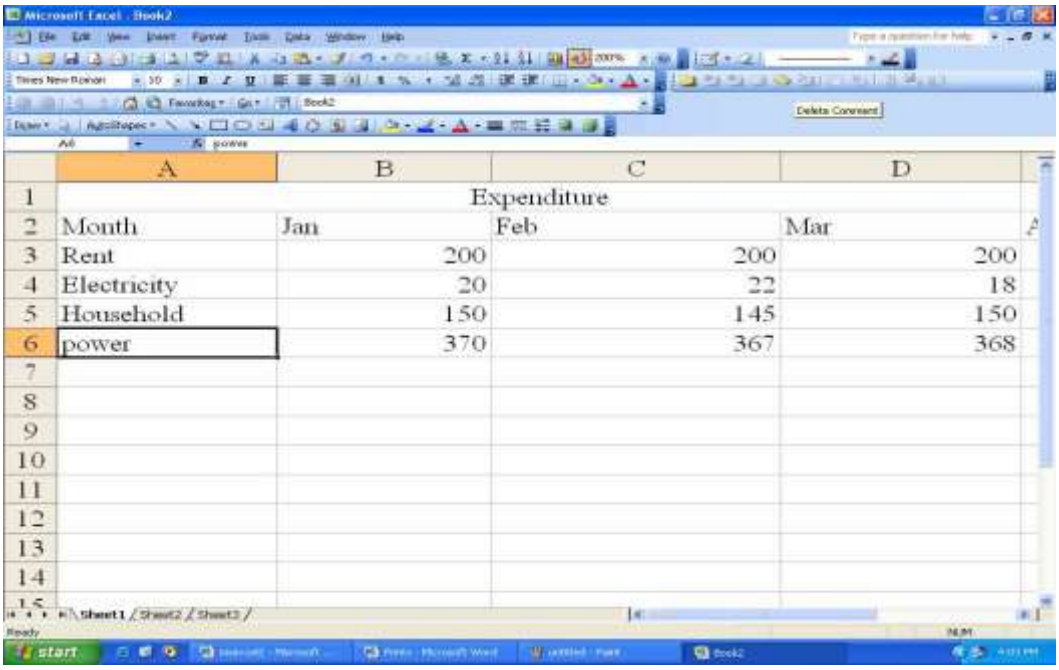
Task 3: Changing width of all cells in a spreadsheet

- Open **cash3.xls** spreadsheet
- Select the entire worksheet by clicking the **Select All** button (to the left of A1 cell) at the top left corner of the worksheet. The worksheet changes from white to black.



- Click **Format** menu, click **Column**, then click **Width**
- In the column width text box type **20**, then click **OK** button. Your worksheet cells should all increase in width.

- You will get the below screen. You will notice that widths of all columns are now changes to 20

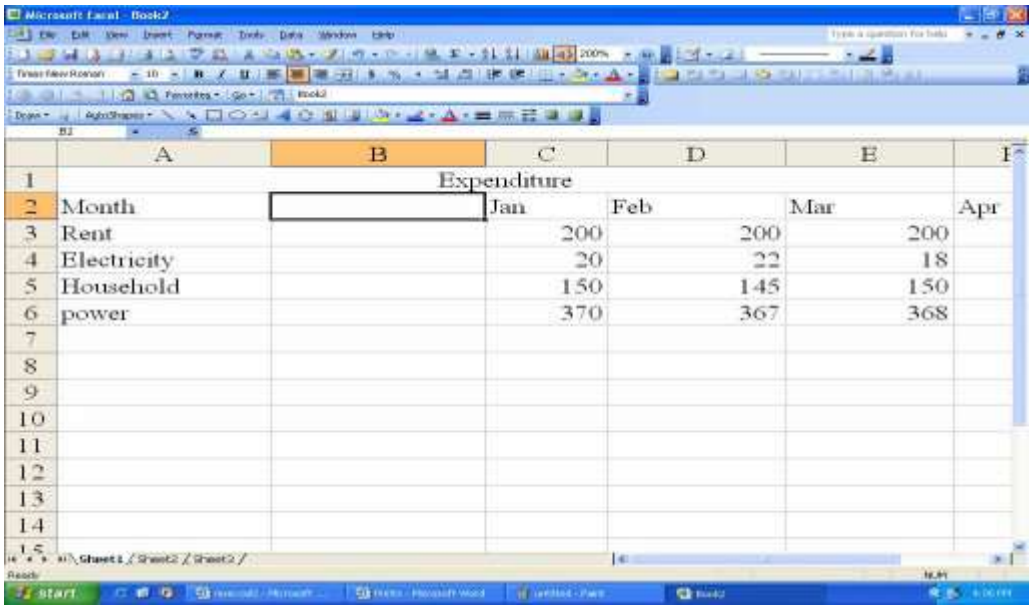


	A	B	C	D
1		Expenditure		
2	Month	Jan	Feb	Mar
3	Rent	200	200	200
4	Electricity	20	22	18
5	Household	150	145	150
6	power	370	367	368

- Click the **Undo** button to revert to the previous cell width.

Task 3: Inserting Columns

- Open **cash.xls** spreadsheet.
- Move to cell **B2** and **click**.
- Click **Insert** menu, click **Columns**. You will get the below screen.



	A	B	C	D	E
1		Expenditure			
2	Month		Jan	Feb	Mar
3	Rent		200	200	200
4	Electricity		20	22	18
5	Household		150	145	150
6	power		370	367	368

- A blank column will be inserted before(to the left of column B)

Task 4: Deleting Column contents

- Open **cash.xls** spreadsheet.
- Move the mouse pointer to column **E** header and click to select **column E**

	C	D	E	F
1	enditure			
2	Jan	Feb	Mar	Apr
3	200	200	200	250
4	20	22	18	25
5	150	145	150	130
6	370	367	368	405
7				
8				

- Press **Delete** button. The column contents will be deleted.
- Click **Undo** button to revert to the previous screen.

Task 5: Removing columns, rows, and cells completely

- Select individual columns or rows or cells.
- Click **Edit** menu and click **Delete**

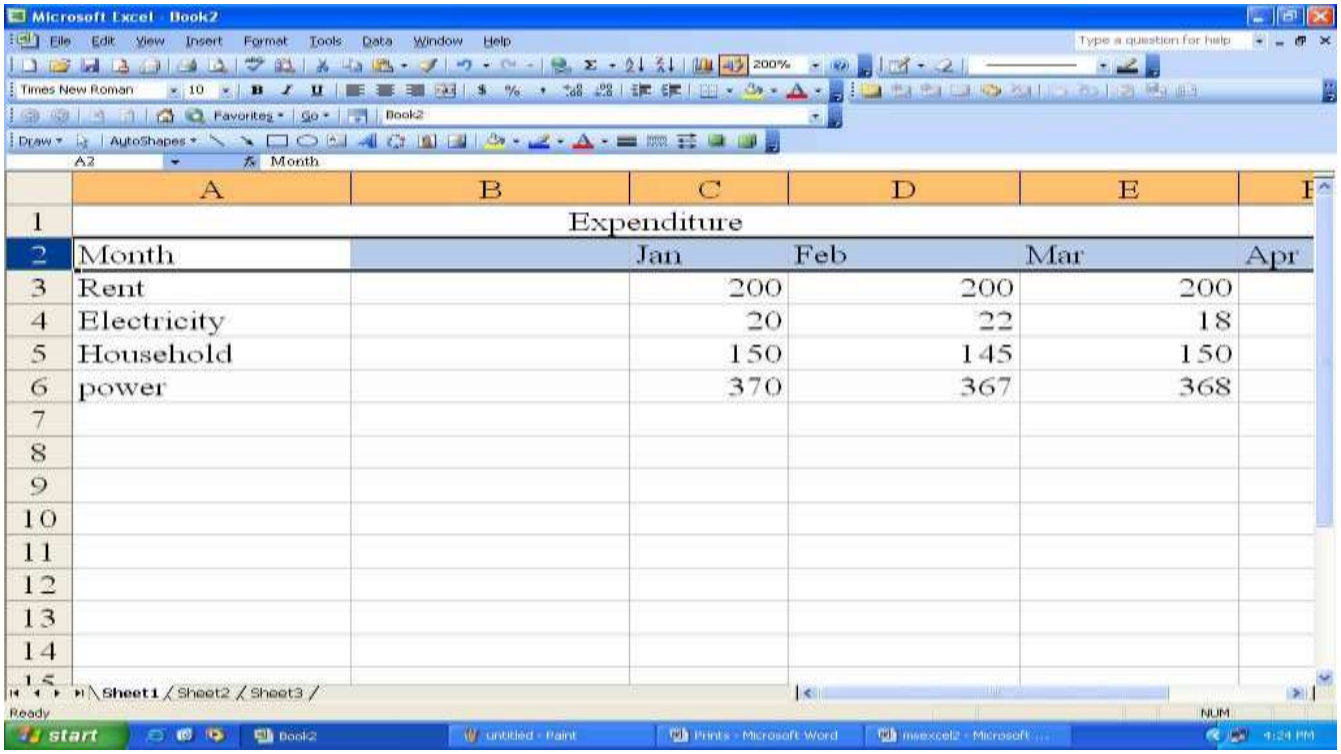
Task 6: Inserting a row

- When you insert a row, it is inserted above the current row, so if you want to insert a new row above row 6(between rows 5 and 6), place the cursor on a cell in row 6 and Click on the **Insert** menu.
- Click Entire Rows insert a blank row between rows 5 and 6.

Task 7: Deleting row contents

- Open **cash.xls** spreadsheet.

❖ Move the mouse pointer to row 2 header and click to select the row as shown below



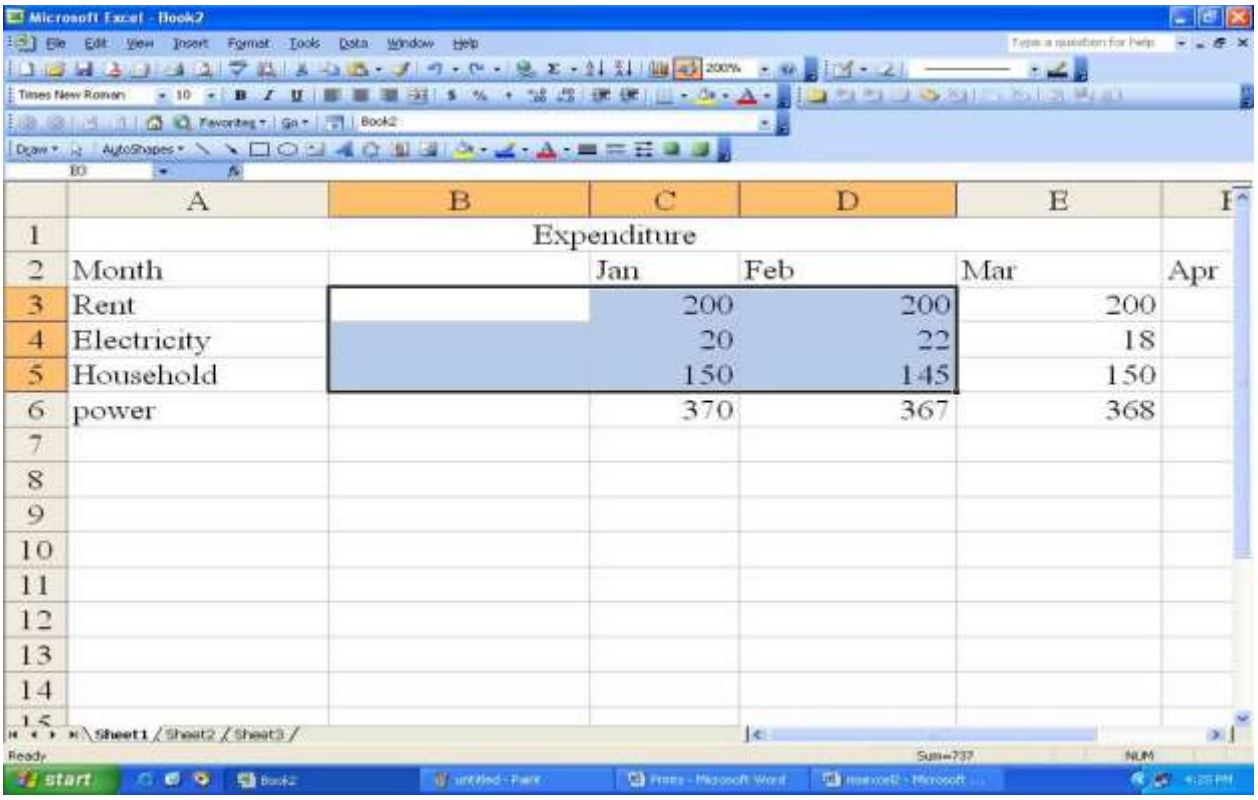
❖ Press **Delete** to remove the contents of row.

❖ Click the **Undo** button to cancel the delete operation.

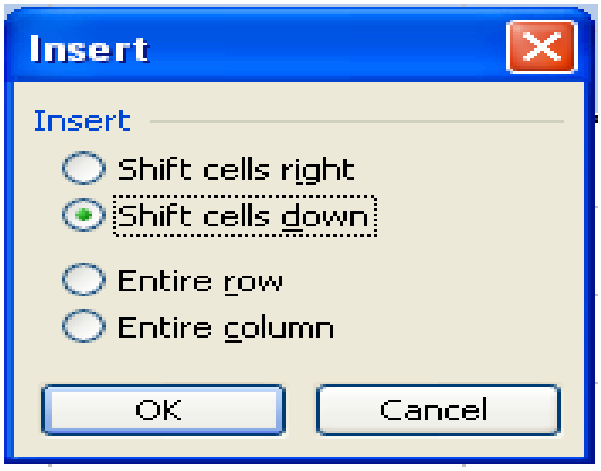
Task 8: Inserting cells

❖ Open **cash.xls** spreadsheet.

❖ Select cells **B2** to **D4** by moving the mouse pointer to cell **B2**, holding down the **left mouse** button and dragging the mouse pointer to cell **D4**, then releasing the left button. The cells should be highlighted.



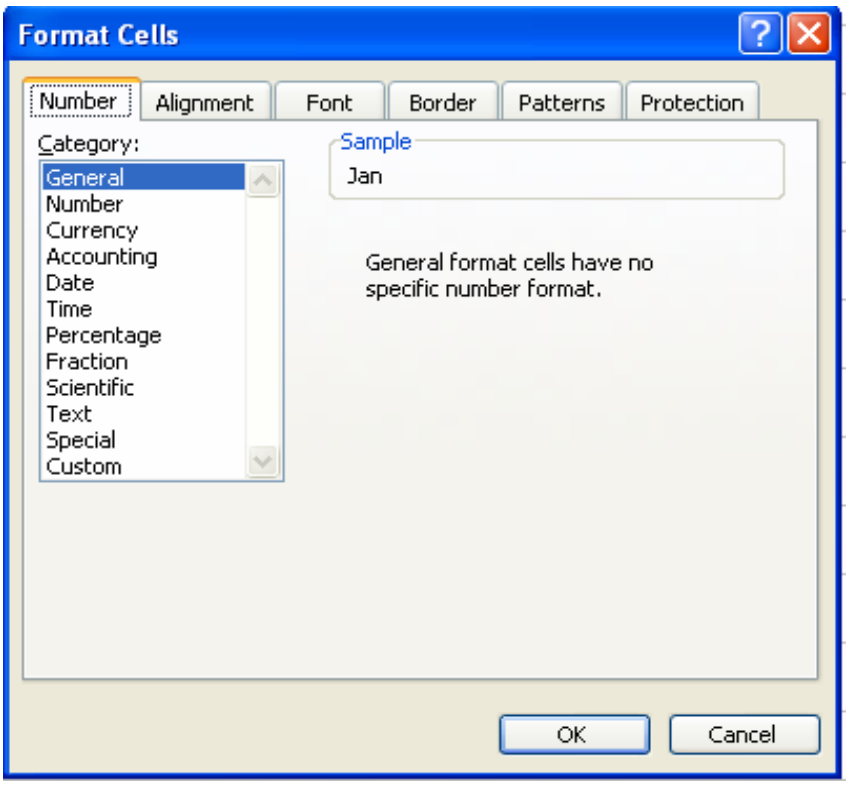
- Click **Insert** menu and click **Cells**. This dialog box appears.
- Click **OK** to shift the cell down.



Task 9: Formatting cells

	A	B	C	D
1				
2		**Marks**		
3		200	66.66666667	
4		440	22.22222222	
5		640	213.3333333	
6				
7				

- Create a new spreadsheet as shown above and save it as "**marks.xls**"
- Now you can format the cells in column C by selecting column C by clicking on the column heading

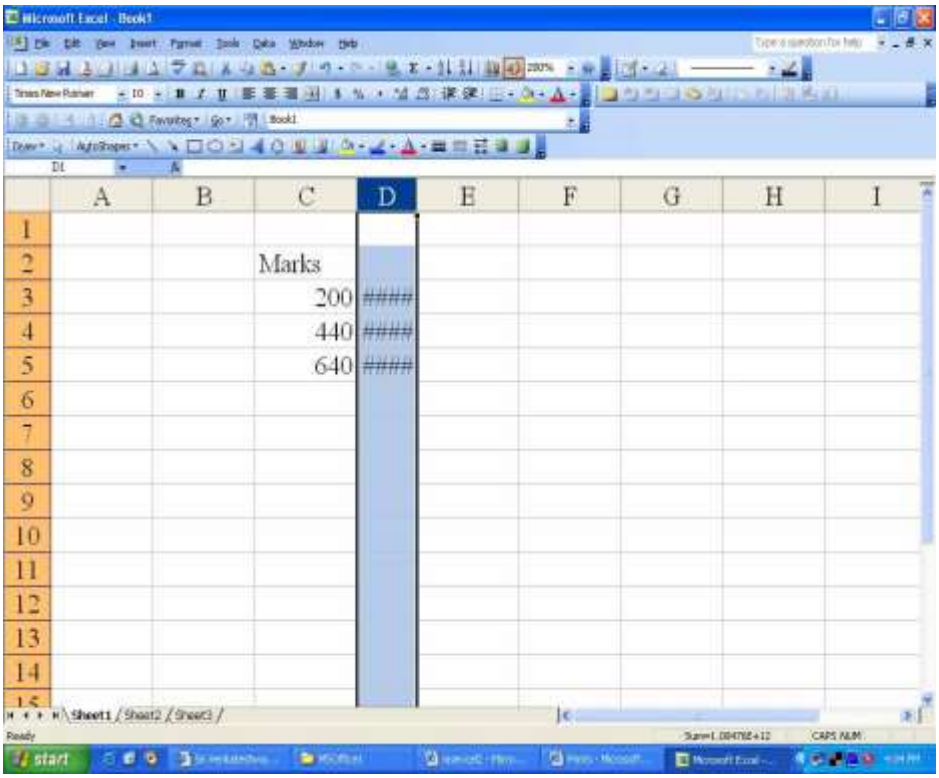


- Click **Format** menu and click on **Cells.** Click on **Number**.
- Use the Down arrow in the Decimal Places to set to 0. Click **OK**.
- Now repeat the formatting but this time format the cells to two decimal places.

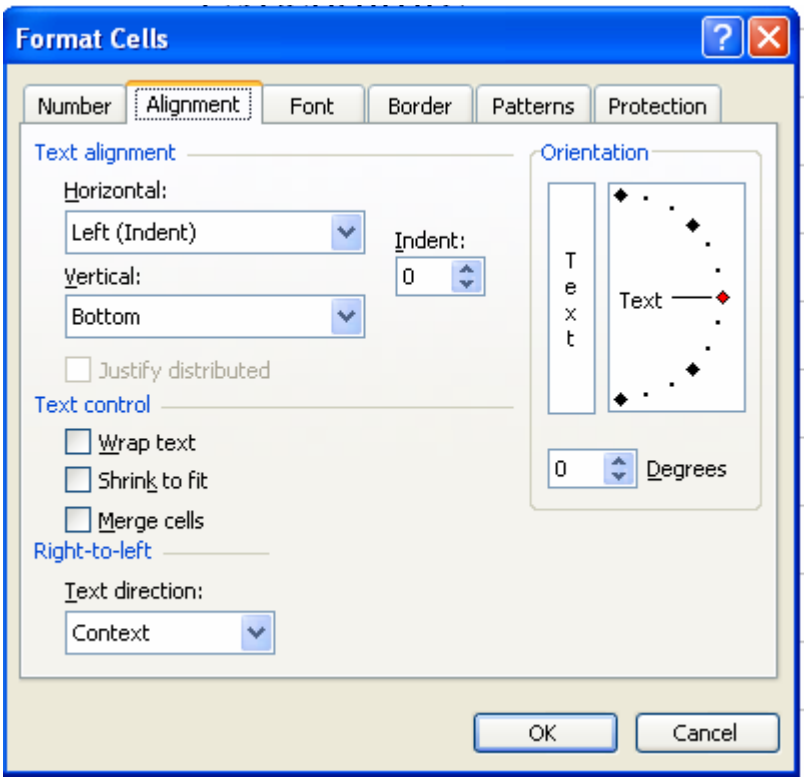
- Again, repeating the formatting operation, but this time to four decimal places.
- Finally, format the cells to eight decimal places. This screen will appear.
- The #### symbols indicate that the cell is too narrow to display the data in the chosen format. However, if you increase the cell width sufficiently, the data will be displayed to eight decimal places.
- Increase the width column C until the data is displayed.
- Now change the formatting back to two decimal places, and reduce the column width to a suitable width.

Changing the data Orientation (Vertical, Horizontal etc.)

Excel offers three options that let you control the orientation of the text within a cell. These are *Text alignment*, *Text orientation*, and *Text control*.



Vertical text alignment can be any one of the following



To display text vertically in a cell:

- Choose Cells from the Format menu. Click the Alignment Tab.
- Specify the desired text orientation by selecting one of the orientation boxes.
- Select the Wrap text check box, if you want Excel to wrap the text
- Click OK

Here are some examples of the different alignment options

	A	B	C	D	E	F
1	Horizontal Text	Wrapped Horizontal Text	Vertical Text	Vertical Text	Slant text	Wrapped slant text

- Select vertical list box and select top to align the data at the top of the cell (Eg: cell A1)

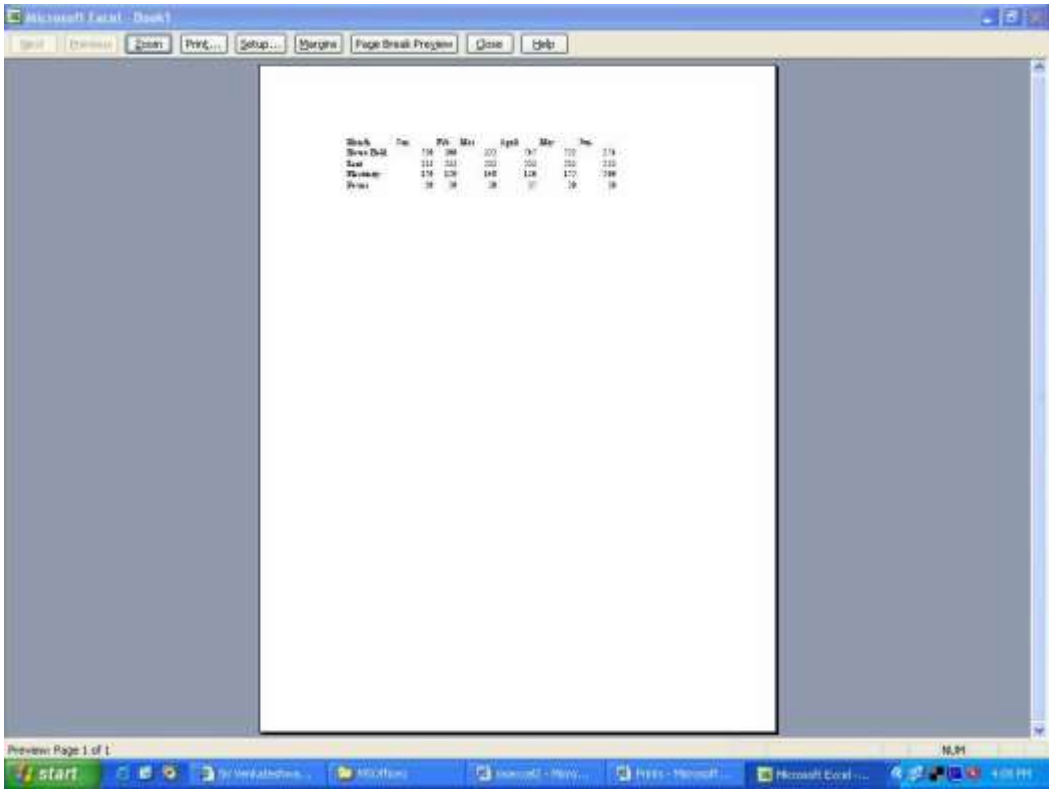
The below figure shows you different Text control options.

	A	B	C	D	E
1	Text control with Wrap text	Text control with Shrink to fit	Text control with merge cells		

Printing and layout

Task 1: Previewing a printout

- Open **cash.xls** spreadsheet.
- Click on the **File** menu and click on **Print Preview**. A screen similar to this should appear.



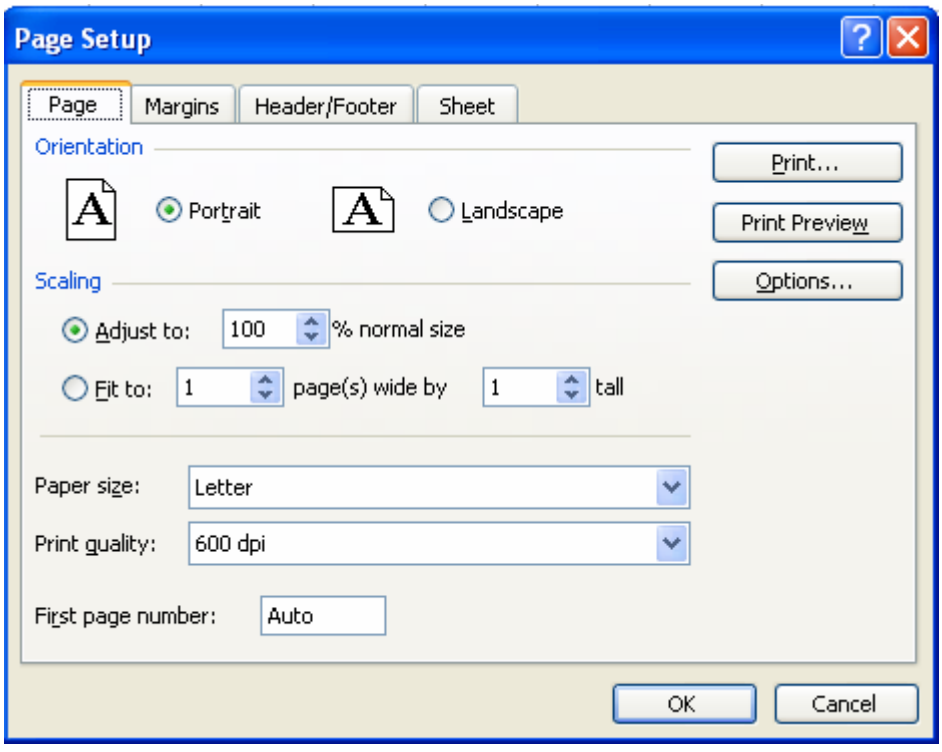
- Since the size of the text is very small, you can click on **Zoom** button, it magnifies the worksheet. Clicking on **Zoom** second time returns you to the original preview format.
- Press **PgDn** to move through your worksheet if it is more than one page long.

- Before printing make sure that your printer is switched on, is loaded with the appropriate paper, and is on-line.

- If you are happy with the layout of your document, click on the **Print** button to obtain a printout. You should see a message on screen telling you that your file is being printer, and on which paper.

Task 2: Printing landscape

- To select landscape mode, click on the **File** menu, **Page Setup**this screen will appear.
- Click on the **Landscape** button.



Task 3: Fitting your worksheet to one page

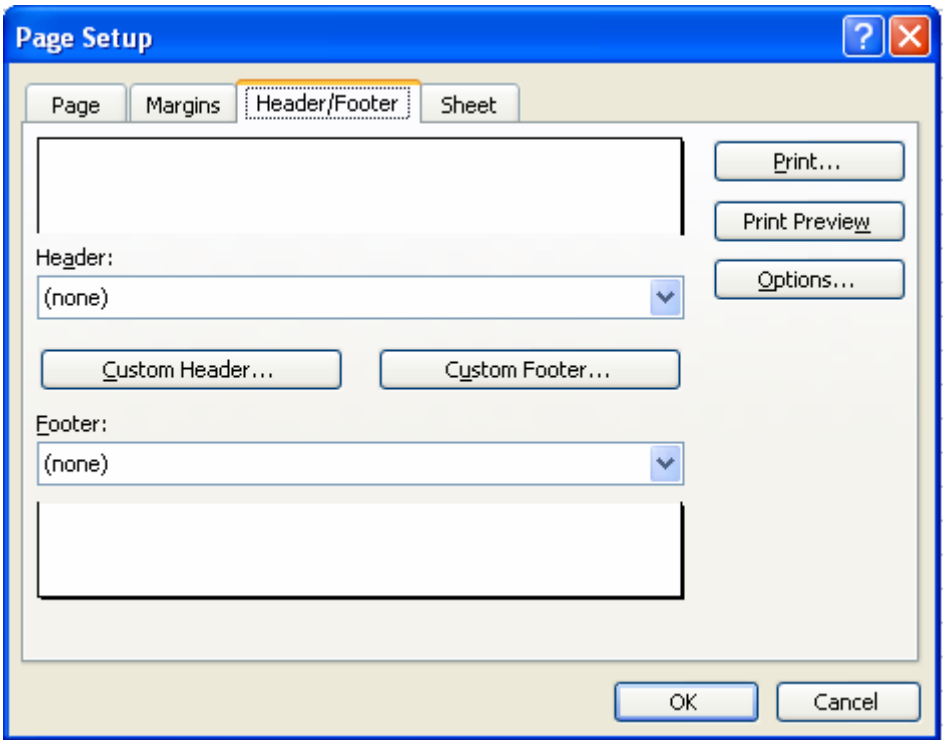
- In the above screen click on the **Fit To**: box and type: 1 page wide by 1 page tall.
- If you need to make changes to your worksheet before printing, click on the **Close** button to return to your workbook.

Task 4: Adjusting margins

- In the **Page Setup** dialog box, click the **Margins** tab and enter the appropriate sizes(in inches or centimeters)

Task 5: Setting Header/Footer to your worksheet

- From the **Page Setup** dialog box, click on the **Header/Footer** tab to display the below screen.



- In the **Header box** either you select a title from the **drop down** menu or enter your own title. Similarly for **Footer box** also you can set your own title.
- Click on **OK**.

Task 6: Printing selected cells

- Open **cash.xls** spreadsheet.
- Click on the row 2 button (or any other row containing data) to highlight the entire row.
- Click on **File**, **Print Area**, **Set Print Area**. The preview screen should only display the selected cells. (Row 2).

- If the preview is satisfactory, click the **Print** button to print out only row 2.
- Click on **File**, **Print Area**, **Clear PrintArea** to reset the PrintArea.

Creating charts and graphs

Task 1: Creating a Pie Chart

- Open **cash.xls** spreadsheet.
- Select the cells **A1** to **G5** as shown below

	A	B	C	D	E	F	G
1	Expenditure						
2	Month	Jan	Feb	Mar	Apr	May	Jun
3	Rent	200	200	200	250	300	250
4	Electricity	20	22	18	25	30	28
5	Household	150	145	150	130	150	140

Click on **Insert** menu and click **Chart** option. This will start the Office Assistant, to guide you through creating chart.

- Follow the instructions in each step of the Wizard. The Assistant explains each step.
- At step 3, you can specify the **Chart title**, **X-axis title** and **Y- axis title** separately.
- At step 4, click **As object** in sheet 1, then click **Finish**.
- Your chart is now finished. Save as **cash4**. Your chart is saved with the spreadsheet. This type of chart is known as an **embedded chart** and is saved with its worksheet.

Task 2: Creating charts when the data range is not continuous

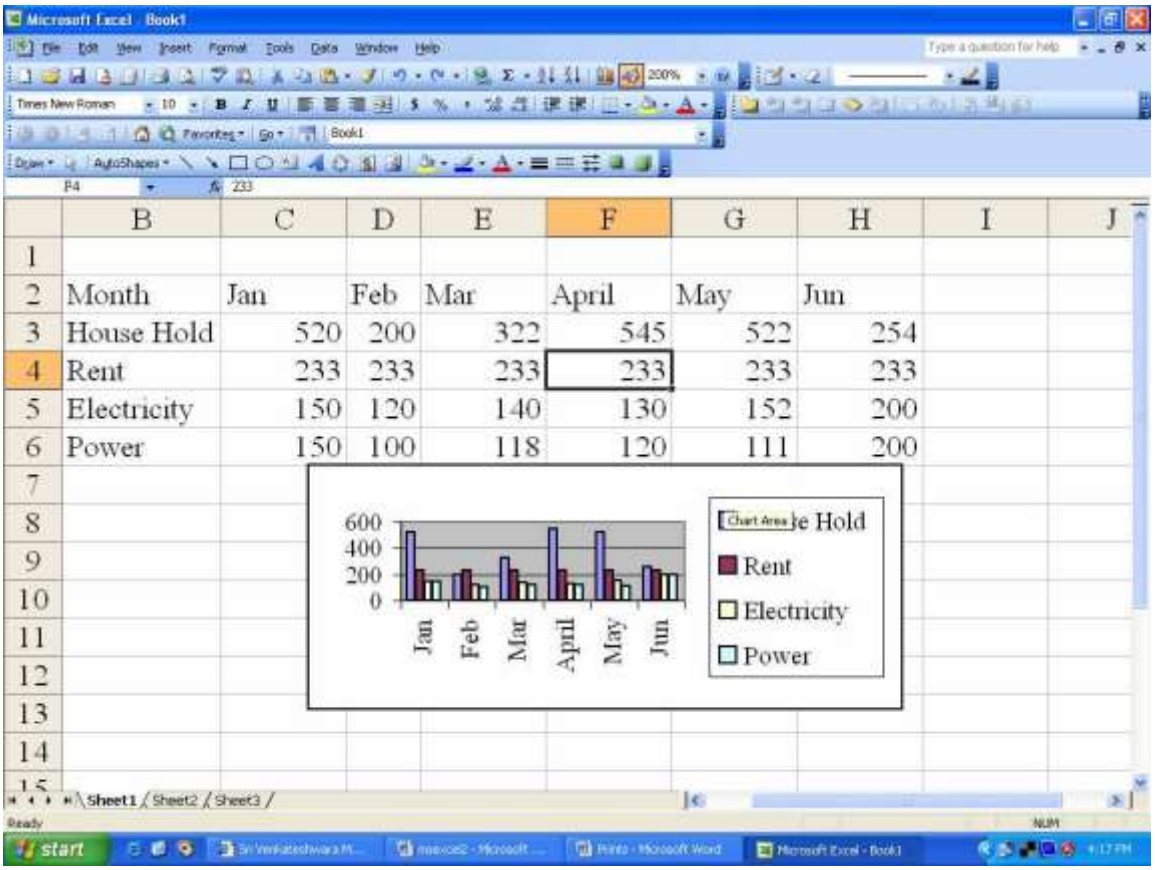
- Open **cash4.xls**
- If your requirement is create a chart to show expenditure for February, then first select cells **A2** to **A5**.
- Hold down the **Ctrl** key and, while holding it down, select cells

  C2 to **C5**. Your screen should be similar to this one.
- Click on the **Chart** Wizard and create a **column chart**. Your screen should look similar to this.

- If your chart doesn't appear to show any data, you probably included some other cells, probably **A1** and/or **C1**. If so, delete your chart and re-select the correct range.

Task 3: Sizing a chart

- Open the **cash3.xls** created earlier. A screen similar to this one should appear.



	B	C	D	E	F	G	H
2	Month	Jan	Feb	Mar	April	May	Jun
3	House Hold	520	200	322	545	522	254
4	Rent	233	233	233	233	233	233
5	Electricity	150	120	140	130	152	200
6	Power	150	100	118	120	111	200

- The small black markers at each corner and mid-way along each side of the chart. These indicate that the chart is selected, and are called its selection squares.
- Click on the mid-point marker on the right-hand side, hold down the left mouse button and drag the mouse to the right about one inch(3cm), then release the mouse. The width of the chart will have increased.
- Now practice the same operation on the mid-point marker of each of the other sides of the chart.
- Now try the above, but this time on one of the four corner markers. Note that when you use

these techniques, the whole chart changes in size, but it retains its original proportions.

- Now use the same technique to reduce the size of the chart.

Task 4: Deleting Charts

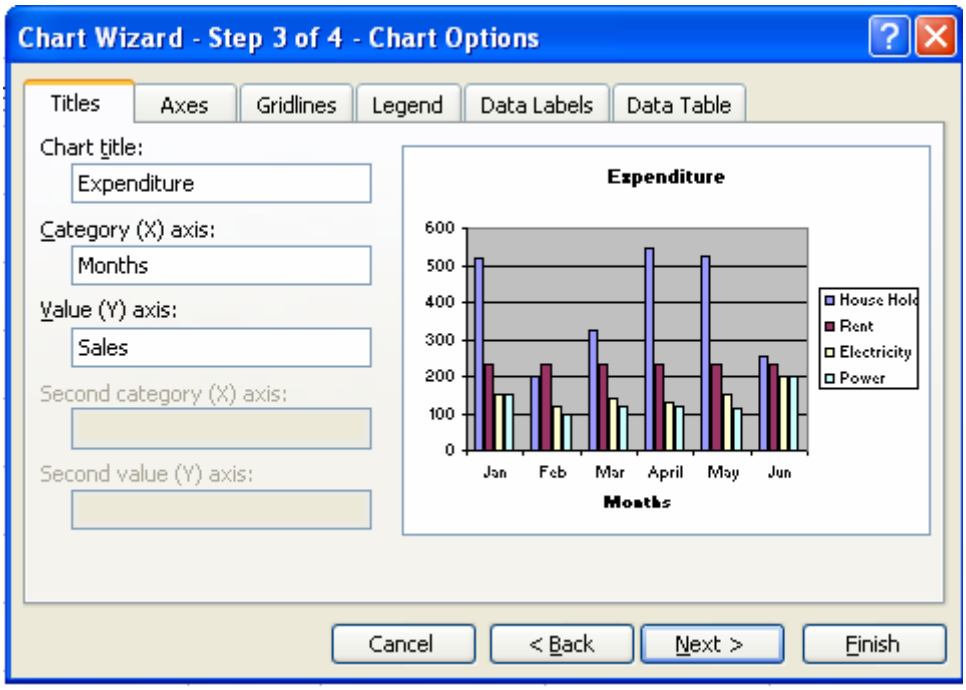
- Make sure the chart is selected(the small black markers are visible). If not, move the mouse pointer into the chart area and click and release the **left mouse button** once.
- Press **Delete** to delete the chart.

Task 5: Moving charts and graphs

- Make the chart active.
- Move the mouse pointer into the chart area.
- Hold down the left mouse button and drag the chart to the desired position.

Task 6: Chart headings and labels

- While creating charts the step3 asks for Chart heading, labels for X-axis and Y-axis. You can define your own labels or click **Next** button so that the default values can be accepted.

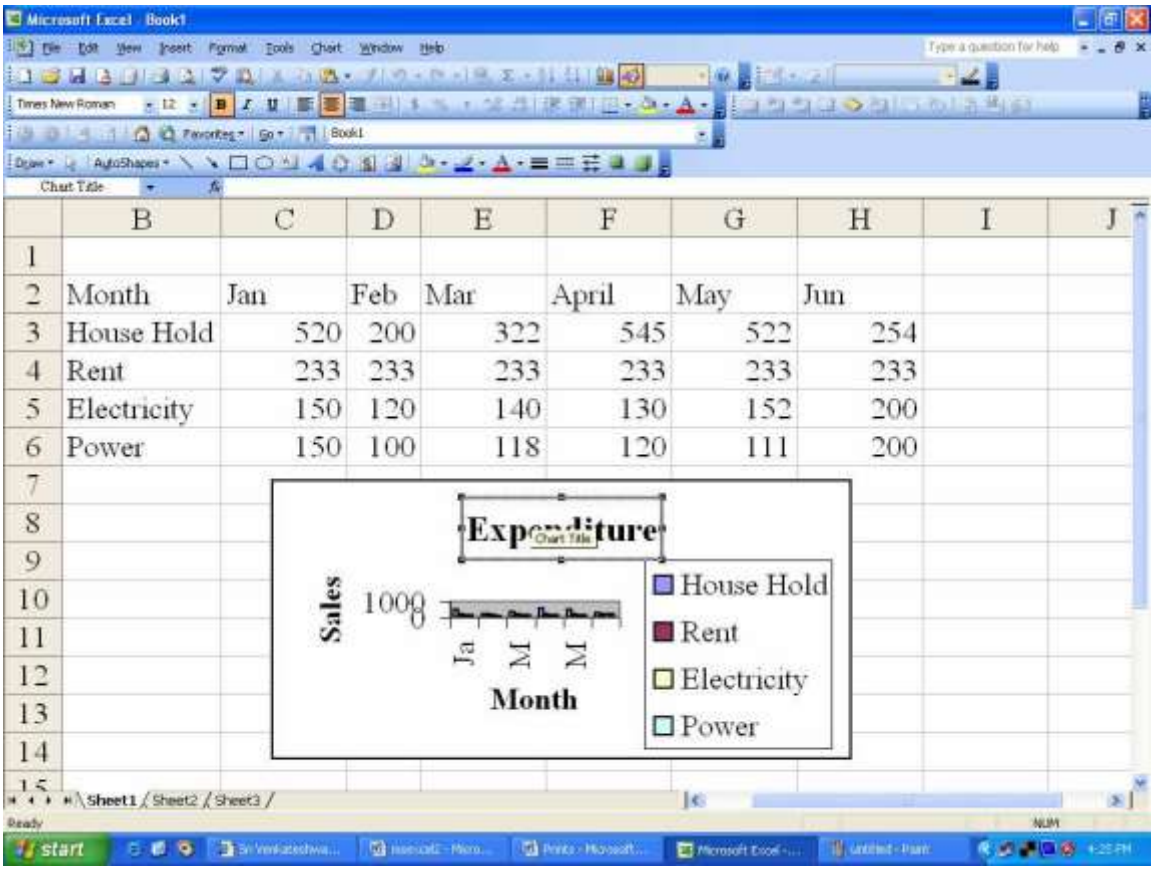


- For example Chart title is Expenditure, X-axis label is months and Y-axis label is

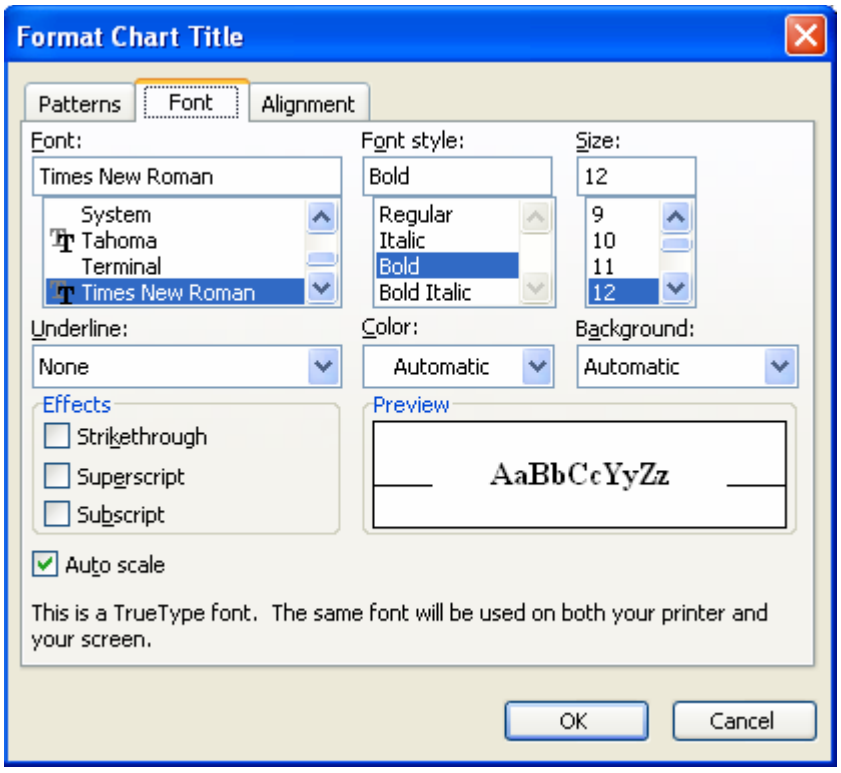
Sales.

Task 7: Editing chart items

- Create the chart as shown below and save it as **cash4.xls**.



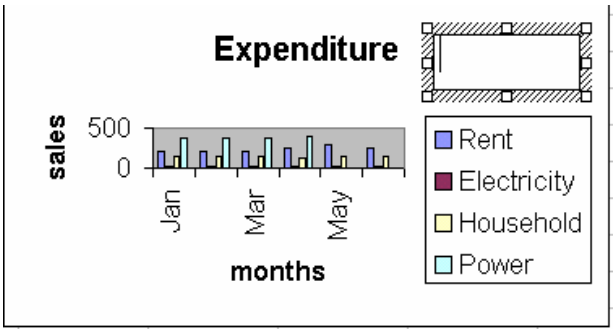
- Click the chart title(Expenditure). Selection markers(small black squares) will appear around the selected item.
- You can move or size the title in the same way that you can move or size a chart. Click the title box and drag it up by about one inch (3 cm), then release the mouse.
- You can format the title by selecting it, then right clicking and then selecting "**Format Chart Title**" from the drop down menu. You will get the below screen.



- You can select **font type**, **font style** and **font size** as shown above
- Click OK.

Task 8: Adding text to a chart

- Open **cash3.xls** worksheet.
- Click **View** menu, click **Toolbars, Drawing**.
- Click the **Text box** icon on the Drawing toolbar.
- Draw a text box inside the chart area as shown below



❖ Click inside the text box. A flashing text cursor will appear. Now type Household Expenditure

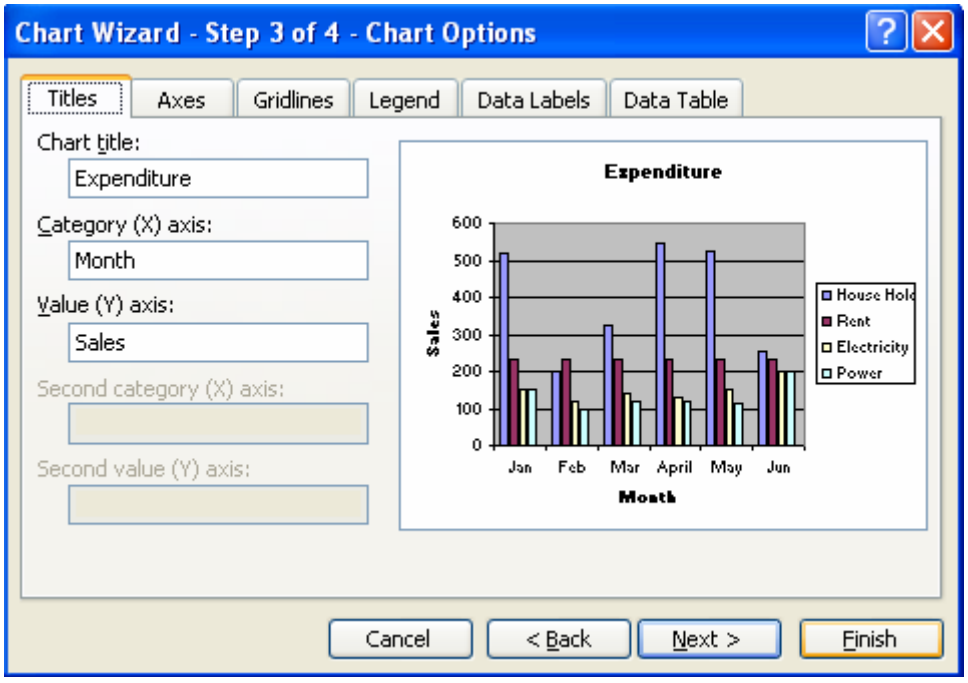
❖ You can use the same procedure for any other text that you want to appear in charts.

Task 10: Adding gridlines to a chart

❖ Open **cash3.xls** worksheet and change chart type to Column chart.

❖ Click **Chart**, Chart options to display this box.

❖ Click the **Gridlines** tab and tick the gridlines boxes required.



6.3 MICROSOFT WORD 2003

Word Processing is perhaps the most common and comparatively easier application to work on any

computer. A word processor lets you to change words or phrases, to move whole sections of text from one place to another, store blocks of text, align margins all in few seconds. Use of word processors has changed the look of official correspondence, reports, and proposals etc. to a great extent. MS Word is an advanced word processing product by Microsoft company. The powerful features of Word will allow you to create even graphic based multicolumn publications such as Fliers, Newsletters and Internet web pages.

This section provides an overview of MS - Word and deals with the following features:

- Starting MS-WORD-2003
- File management
- Editing documents
- Formatting documents
- Printing documents
- Inserting pictures into document
- Tables
- Password protect of document
- Inserting objects of other types (MS-Excel, Photo Editor etc.)
- Other features
- Mail merge

START WORD 2003

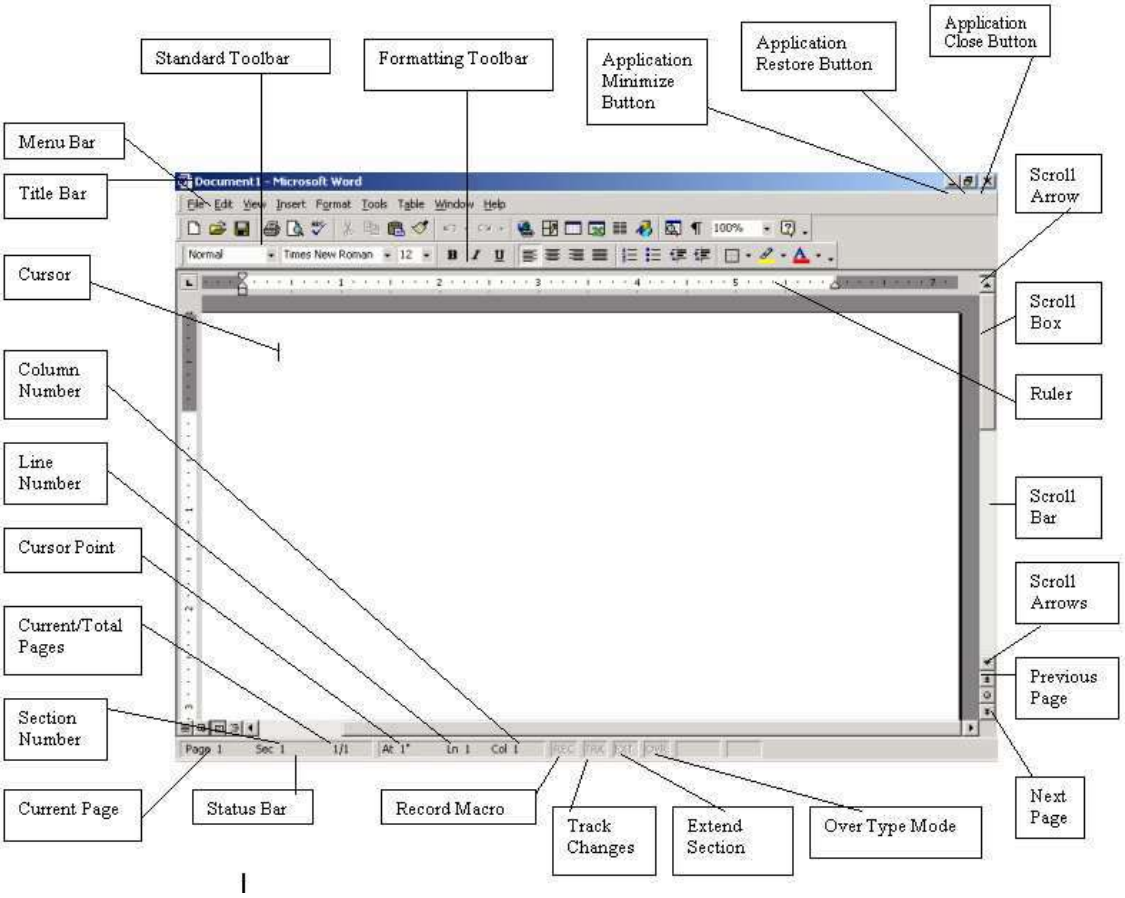
Switch on your computer. Click Start button then point to Programs and then click on MSWord. You will get a screen as shown below:

PARTS OF WORD WINDOW

Please see the picture below for a visual image of parts of an active window has:

Menu bar This is the traditional windows style drop-down menu. When you point to any menu title and

click once with the mouse, the menu will open displaying all the commands available under this menu. Clicking on the desired command would tell Word to execute that command. Some commands have ellipses (…) in front of them. These commands have further sub commands. Commands appearing in dim mode cannot be executed unless the prerequisite functions required by that command have been performed, e.g. you cannot use the Copy or Cut command from the Edit menu unless you have selected a piece of text first. Many commands also have a keyboard shortcuts specified against their names.



T t e bar Th s te s you wh ch app cat on package s current y runn ng and wh ch document s current y open

Standard toolbar Toolbars contain buttons, drop-down menus and other controls that help you to quickly alter the appearance and arrangement of documents by executing a variety of word commands. Toolbars are very helpful and convenient in quickly executing commands without having to go through menus. The standard toolbar contains icons for basic functions like opening files, saving files, printing files, cut, copy, paste etc.

Formatting toolbar This contains icons for changing the look of your text (called "formatting" in computer jargon); for example, there are icons for changing fonts, styles, font sizes, text alignment etc.

Ruler The Ruler lets you make changes to margins and indents, and helps you create document as per dimensions required.

Scroll tools These helps you travel within your document. You can go anywhere, up and down, right and left in your document mainly by two ways: Using the horizontal and vertical scroll bars with the help of the mouse; Or using the keyboard to press PgUp, PgDn, Home, End and arrow keys.

Status bar Also called the Status Area, this is the normally the last line on your screen. This gives the following information about your work—

Current Page

Section Number

Current/Total pages in the document

Current Cursor Position (where the cursor is presently located) Current Line Number

Current Column Number

Record Macro-whether macro recording is On or not

Track Revision-whether revisions have been made or not

Extend Selection

Over type mode-whether you are in Insert mode or overwrite mode

Cursor Also called the Insertion Pointer, this denotes the place where text, graphics or any other item would be placed when you type, overwrite or insert them. This looks like a tall, skinny toothpick and keeps blinking so that you can locate it easily.

Mouse pointer When your mouse pointer looks like an I-beam you should be able to move it freely on the screen. This is used for either placing the cursor at the desired place take the mouse pointer there and click) or choosing any command either from the menu or from toolbars. The mouse pointer changes shape when in the process of doing certain tasks and the cursor disappears.

TOOLBARS AND THEIR ICONS

Word Standard Toolbar

New
Creates a new document based on normal template.
Alternative: File → New
Shortcut → Ctrl + N

Open
Opens an existing document or template.
Alternative: File → Open
Shortcut → Ctrl + O

Save
Saves the active document or template.
Alternative: File → Save
Shortcut → Ctrl + S

E-Mail
It sends the contents of the document as the body of the e-mail message.
Alternative: File → Send To → Mail

Print
Prints the active document using current defaults.
Alternative: File → Print
Shortcut → Ctrl + P

Print preview
Displays full pages as they are printed.
Alternative: File → Print Preview
Shortcut → Ctrl + F2

Spelling
Checks the spelling in the active document.
Alternative: Tools → Spelling and Grammer
Shortcut → F7

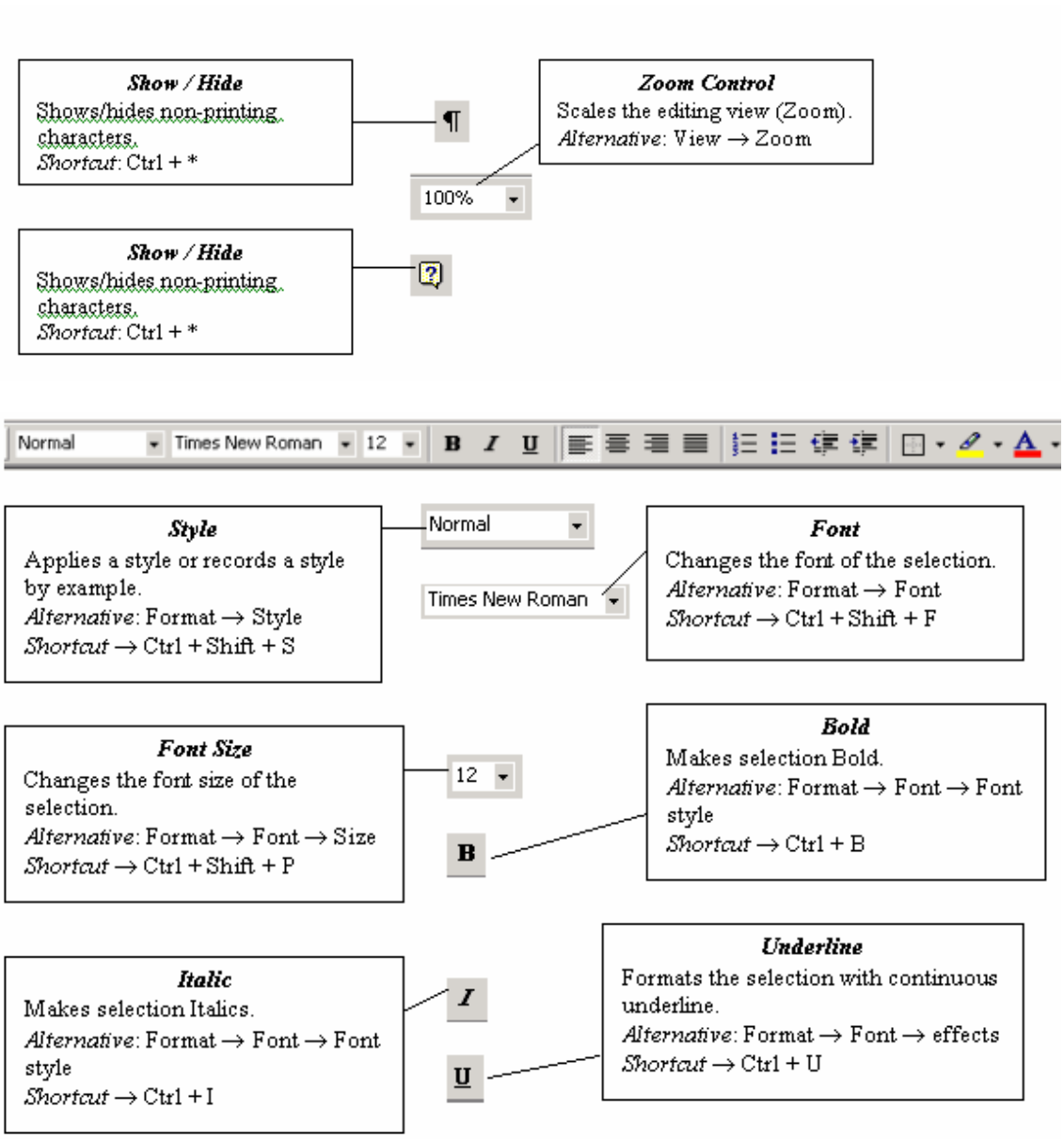
Cut
Cuts the selection and puts it on the Clipboard.
Alternative: Edit → Cut
Shortcut → Ctrl + X

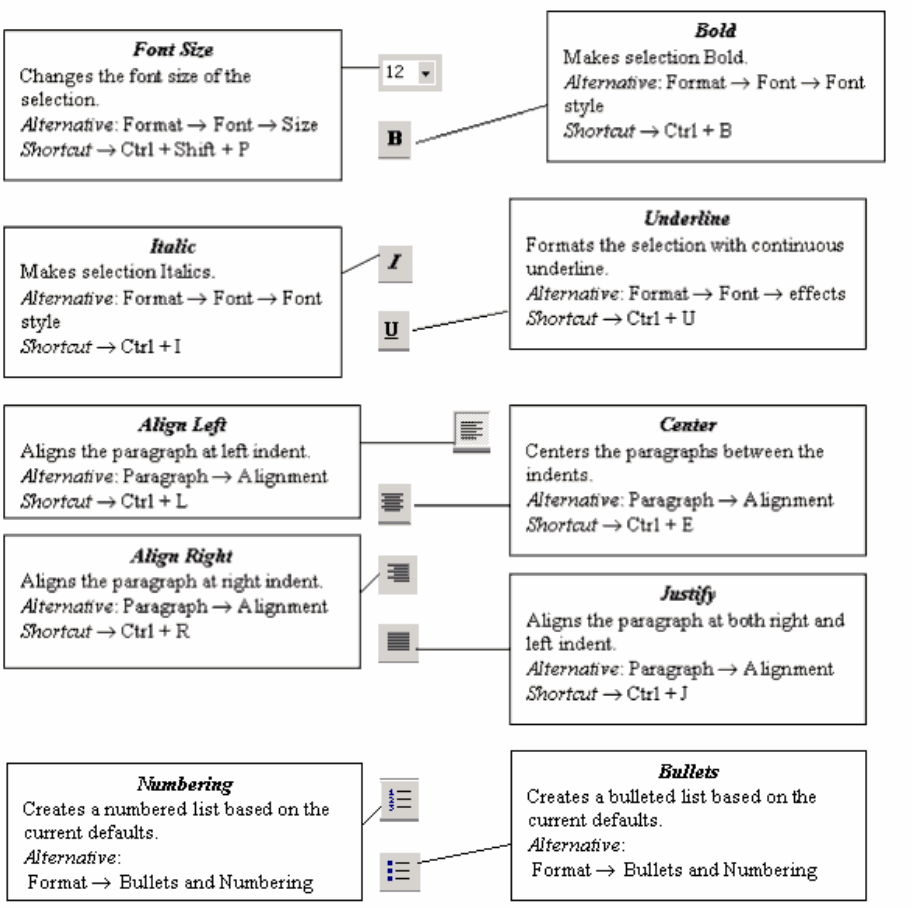
Copy
Copies the selection and puts it on the Clipboard.
Alternative: Edit → Copy
Shortcut → Ctrl + C

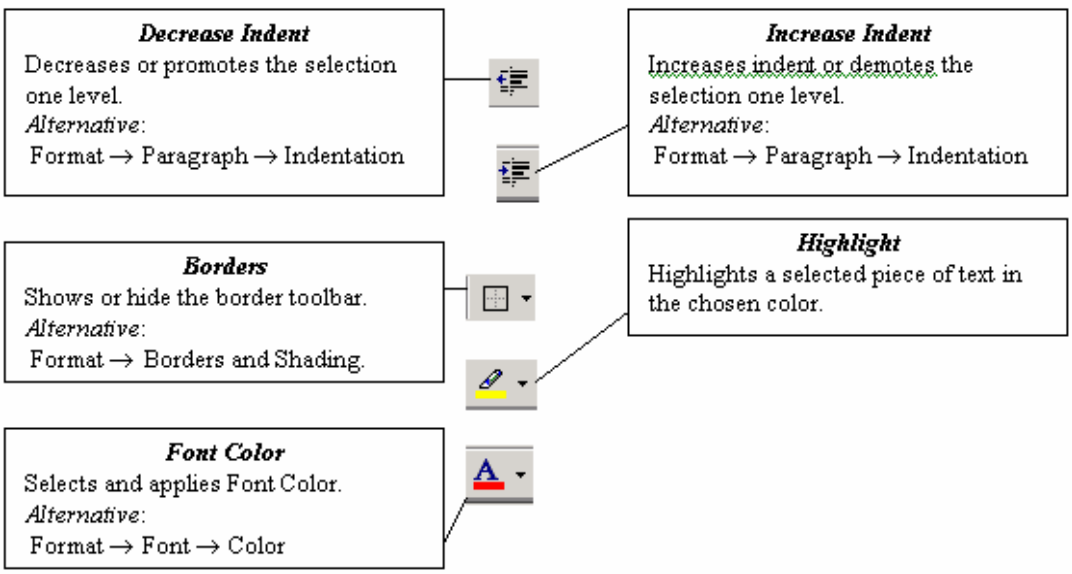
Paste
Insert the Clipboard contents at the insertion point.
Alternative: Edit → Past
Shortcut → Ctrl + V

Format Painter
Copies the formatting of the selection to a specified location.
Shortcut → Ctrl + Shift + C

Undo
Reverses certain commands.
Alternative: Edit → Undo
Shortcut → Ctrl + Z


Show / Hide
Shows/hides non-printing characters.
Shortcut: Ctrl + *
¶
Zoom Control
Scales the editing view (Zoom).
Alternative: View → Zoom
100%
Show / Hide
Shows/hides non-printing characters.
Shortcut: Ctrl + *
Normal
Times New Roman
12
B
I
U
Style
Applies a style or records a style by example.
Alternative: Format → Style
Shortcut → Ctrl + Shift + S
Normal
Times New Roman
Font
Changes the font of the selection.
Alternative: Format → Font
Shortcut → Ctrl + Shift + F
Font Size
Changes the font size of the selection.
Alternative: Format → Font → Size
Shortcut → Ctrl + Shift + P
12
B
Bold
Makes selection Bold.
Alternative: Format → Font → Font style
Shortcut → Ctrl + B
Italic
Makes selection Italics.
Alternative: Format → Font → Font style
Shortcut → Ctrl + I
I
U
Underline
Formats the selection with continuous underline.
Alternative: Format → Font → effects
Shortcut → Ctrl + U


Font Size
Changes the font size of the selection.
Alternative: Format → Font → Size
Shortcut → Ctrl + Shift + P
12
B
Bold
Makes selection Bold.
Alternative: Format → Font → Font style
Shortcut → Ctrl + B
Italic
Makes selection Italics.
Alternative: Format → Font → Font style
Shortcut → Ctrl + I
I
U
Underline
Formats the selection with continuous underline.
Alternative: Format → Font → effects
Shortcut → Ctrl + U
Align Left
Aligns the paragraph at left indent.
Alternative: Paragraph → Alignment
Shortcut → Ctrl + L
Center
Centers the paragraphs between the indents.
Alternative: Paragraph → Alignment
Shortcut → Ctrl + E
Align Right
Aligns the paragraph at right indent.
Alternative: Paragraph → Alignment
Shortcut → Ctrl + R
Justify
Aligns the paragraph at both right and left indent.
Alternative: Paragraph → Alignment
Shortcut → Ctrl + J
Numbering
Creates a numbered list based on the current defaults.
Alternative:
Format → Bullets and Numbering
Bullets
Creates a bulleted list based on the current defaults.
Alternative:
Format → Bullets and Numbering


Decrease Indent
Decreases or promotes the selection one level.
Alternative:
Format → Paragraph → Indentation
Increase Indent
Increases indent or demotes the selection one level.
Alternative:
Format → Paragraph → Indentation
Borders
Shows or hide the border toolbar.
Alternative:
Format → Borders and Shading.
Highlight
Highlights a selected piece of text in the chosen color.
Font Color
Selects and applies Font Color.
Alternative:
Format → Font → Color

File management

Creating a New Document

- Click on File Menu
- Select and click New option
- Otherwise click  button on the standard toolbar

Opening an Existing Document:

- Click File Menu
- Select and click Open option
- Otherwise click  button on the Standard toolbar.
- Double click on the file from the open window

Saving a Document

- Click File Menu
- Select and click Save button.
- Otherwise click button on the Standard toolbar.

Moving through the document

- Open any word document. You can move the cursor to any location on the screen by using the arrow keys on the keyboard.
- Right arrow key is used to move one position to the right of the cursor
- Left arrow key is used to move one position to the left of the cursor.
- Up arrow key is used to move one position to the top of the cursor.
- Down arrow key is used to move one position to the down of the cursor.
- Page Up key is used to move down the screen at a time
- Page down key is used to move up the screen at a time

- Hold down Ctrl key and press Home to move to beginning of the document.
- Hold down Ctrl key and press End to move to end of the document.
- You can move to any position on the screen by moving the cursor with the mouse.
- You can use scroll bars to scroll the text upward and down ward.

Closing a Document

- Click File menu
- Select and click Close button.
- Otherwise click on menu bar 

Editing Word document

Cut, Copy and Paste options

These options will allow you to Cut or Copy a piece of text from one location and to paste at a new location.

To do these functions,

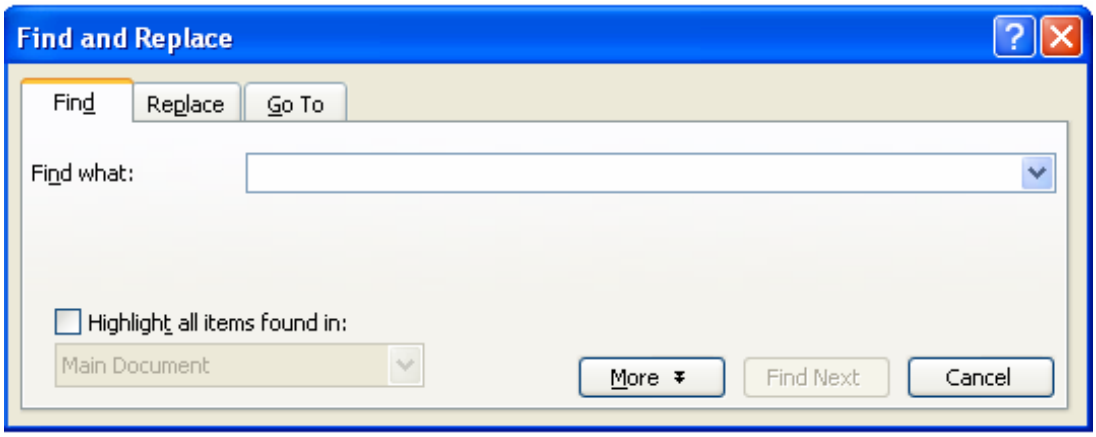
- Place the cursor at the beginning of the text to be selected.
- Drag the mouse pointer over the text. The text will now appear in reverse video as shown below:

- Click Edit menu and then click on Cut option (or) click  icon on the Standard Toolbar. Move the cursor to the place where you want the text to be pasted.
- Click Edit menu and then click Paste option (or) click  icon on the Standard Toolbar.
- For copying the text from one location to other location the same procedure is to be followed. The difference between Cut and Copy is that while using the Cut option the text will be removed from its original location and pasted at a new location, whereas

when using Copy option, a copy of the selected text is pasted at new location without disturbing the original text.

Searching text

- Open any document.
- Click Edit menu and then click Find option. You will get a screen as shown below.

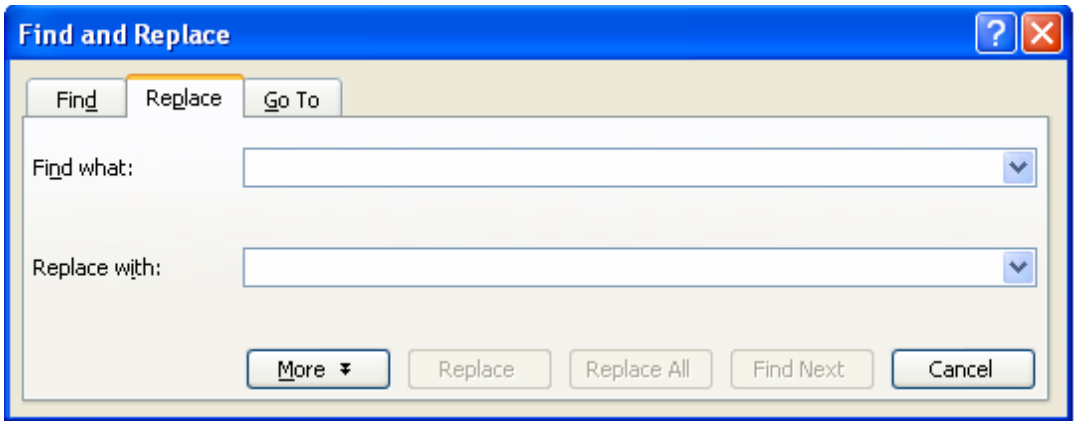


- In Find What text box type the word you want to find and then click Find Next button.
- Continue clicking Find Next button until you get the screen shown below.

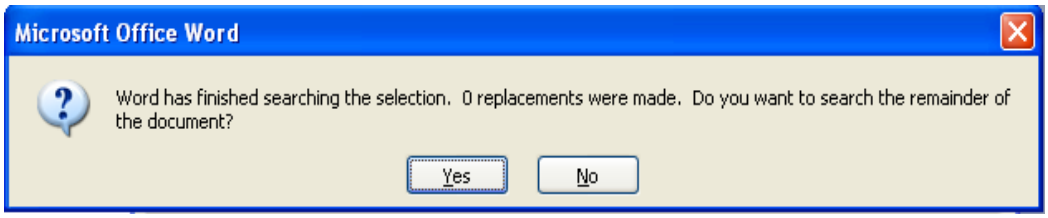
- Click OK button and then click X to close Find and Replace dialog box.

Replacing text

- Open any word document.
- Click Edit menu and then click Replace option. You will get the dialog box as shown below and type the word with which you want to replace.



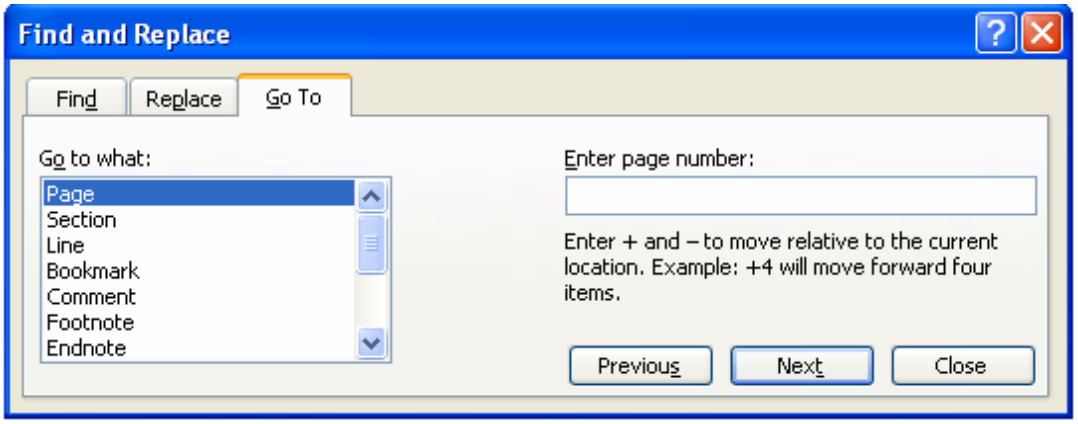
❖ Click Replace All button once. You get the below dialog box.



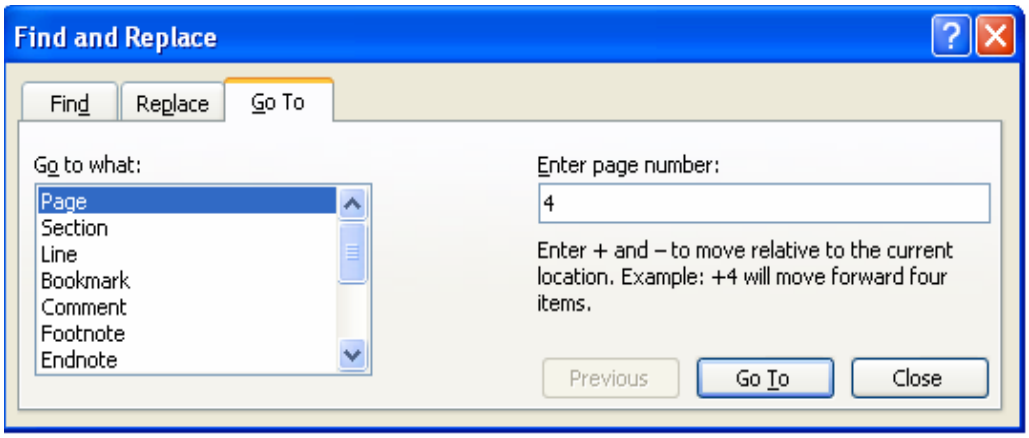
❖ Click OK button and then click X to close Find and Replace dialog box.

Moving the cursor to a specific page

❖ If your word document contains more than one page, you can directly go to specified page by clicking Edit menu and then clicking Go to option. You will get the dialog box as shown below.



❖ In the Enter page number text box, type the required page number as shown below.



- Click Go To button. Cursor will immediately jump to page 4.
- Click Close button to close Find and Replace dialog box.

Formatting documents

Bold, Underline and Italicize the selected text

- Open a word document.
- Block the text by first clicking at the start of the text and holding the left mouse button and drag to the desired position and then release the left mouse button. The selected area will be highlighted.
- Move the mouse pointer to the button on the standard toolbar and click once.
- Move the mouse pointer outside your text and click to release the highlighting. Your text will now appear in BOLD FACE.
- Like this you can underline or italicize the desired text by using the buttons on standard toolbars

Left aligning, centering, right aligning and justifying text

Left Centre Right Justify

- Open a word document.

- Block the text by first clicking at the start of the text and holding the left mouse button and drag to the desired position
- and then release the left mouse button. The selected area will
- be highlighted.
- Move the mouse pointer to Align Left button on the toolbar and click once. Your selected text will be left aligned.
- Move the mouse pointer to Align right button on the toolbar and click once. Your selected text will be right aligned.
- Move the mouse pointer to Center button on the toolbar and click once. Your selected text will be centered.
- Move the mouse pointer to Justify button on the toolbar and click once. Your selected text will be justified.

Creating Bulleted and Numbered list

- If a list of items are to be numbered automatically it can be done using Numbered List option

Ex: Microsoft Office consists of

MS-Word

MS-Excel

MS-PowerPoint

MS-Access

MS-Outlook

- The above text is to be selected with mouse.
- Click on the Numbered List button on the toolbar 
- Move out of the text and click to release the highlighting.

- Your text will now look like this

1. MS-Word
2. MS-Excel
3. MS-PowerPoint
4. MS-Access
5. MS-Outlook

- Now re-select the text
- Click the Bulleted List button on the toolbar. 
- The numbers should be replaced with bullets as shown below

- MS-Word
- MS-Excel
- MS-PowerPoint
- MS-Access
- MS-Outlook

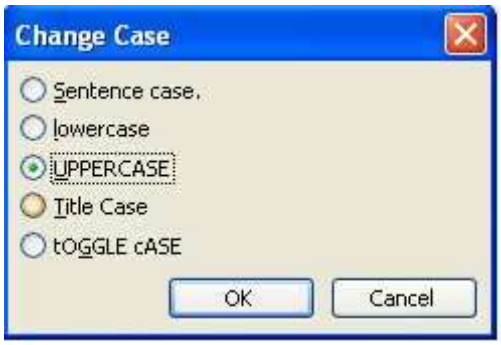
Indenting Paragraphs

- Select a paragraph with the mouse.
- Click on the Right (increase) Indent button on the toolbar. 
- Leave the highlighting on and click once more on the Right Indent button.
- Click once on the Left Indent button. Your text should now be indented by one Tab stop. Each time you click, the paragraph is moved one tab stop.

Changing case of text

- You can change the selected text into either UPPERCASE, lowercase, Title case or tOGGLE cASE

- Highlight the text. Select the Format menu option
- Choose Change Case option. You will get the dialog box shown below.



- From the list of options select UPPERCASE to convert lower case into uppercase.

Indenting text with tabs

- Type your name and address as you would at the head of a letter, but aligned with the left margin e.g.

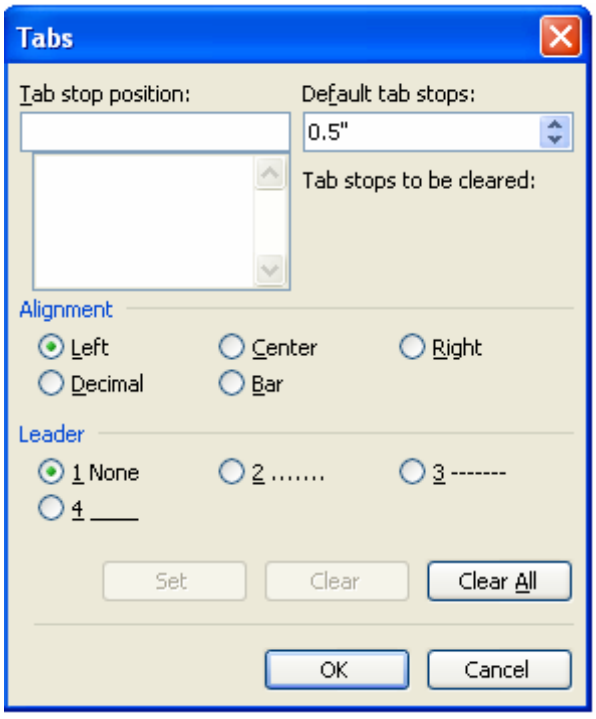
K.Manohar

H.No 10-334/3, V.P. Nagar,

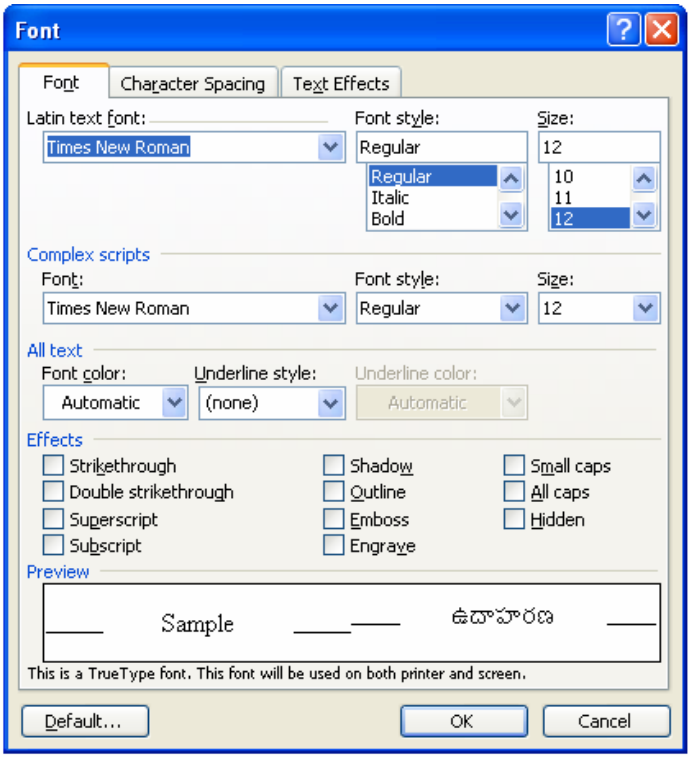
Malakpet,

Hyderabad.

- Move the cursor to the start of each line and press the Tab key. Just as with the right indent button, your text will move right. How much it moves will depend on the tab settings, which you can change in the Format, Tabs menu as shown below.



Font Controlling



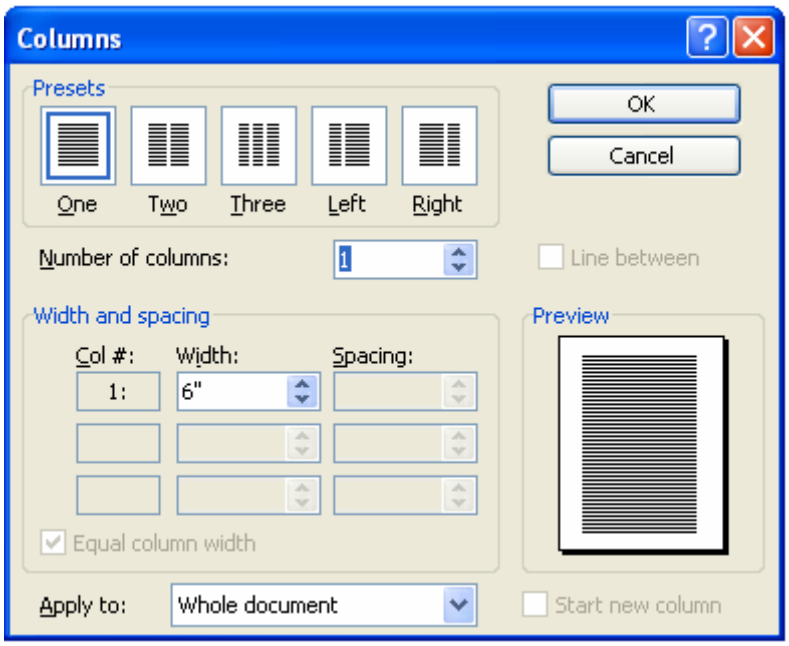
- To get different character styles we can change Font type
- Click on Format menu
- Select Font option. You will get the screen as shown above.
- You can set Font type, Font Style and Font size and Color of the selected text.
- Click OK button.

Note: The above options are also available on the Formatting Toolbar

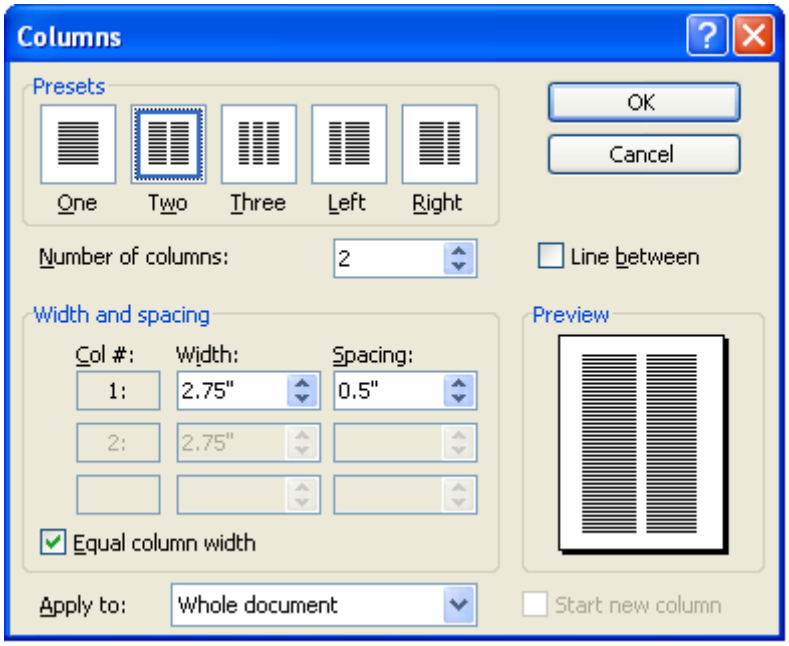
Font style Font Type Font size Color

Creating column wise documents

- Open any word document file.
- Click Format menu and click Columns option. You will get a screen as shown below:



❖ In the Presets tab, select Two option to get below screen.

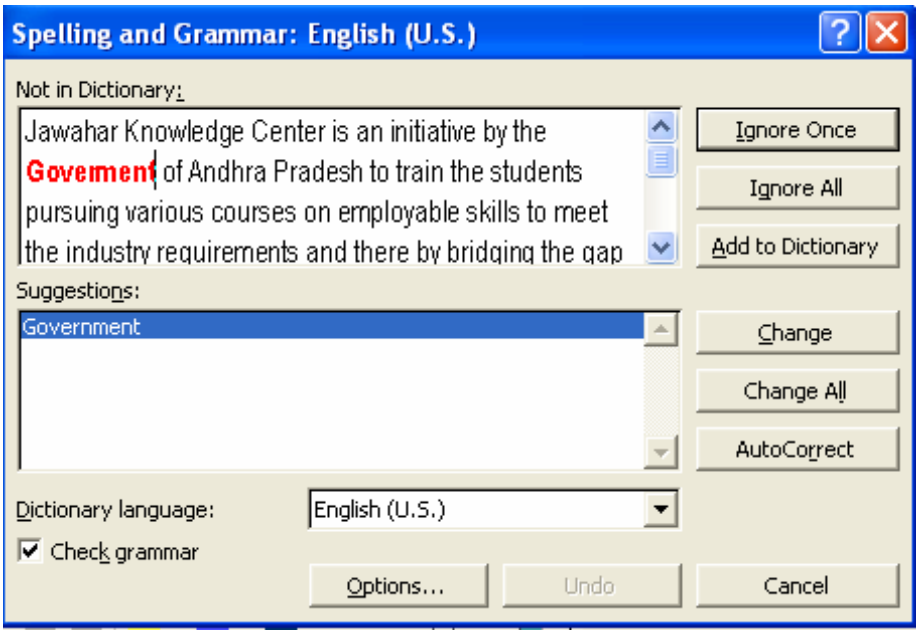


❖ Click OK button.

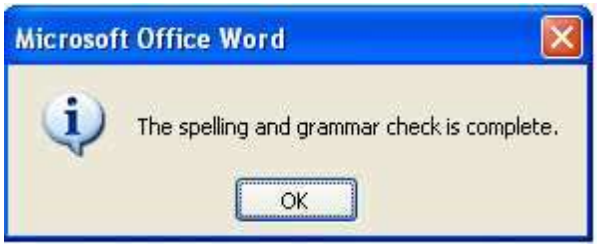
❖ Your document will be converted to two-column document.

Spelling and Grammar Checking of word document

- Open any word document.
- Click Tools menu and then click Spelling and Grammar option. You will get the below dialog box.
- Note all words that appear red color in First box are spelling mistakes. If you want to accept the suggested word, in the second box click on Change. If not, click Ignore button. You can also add a word to the dictionary by clicking on the Add button.



- Continue this process until you get the dialog box, shown below:

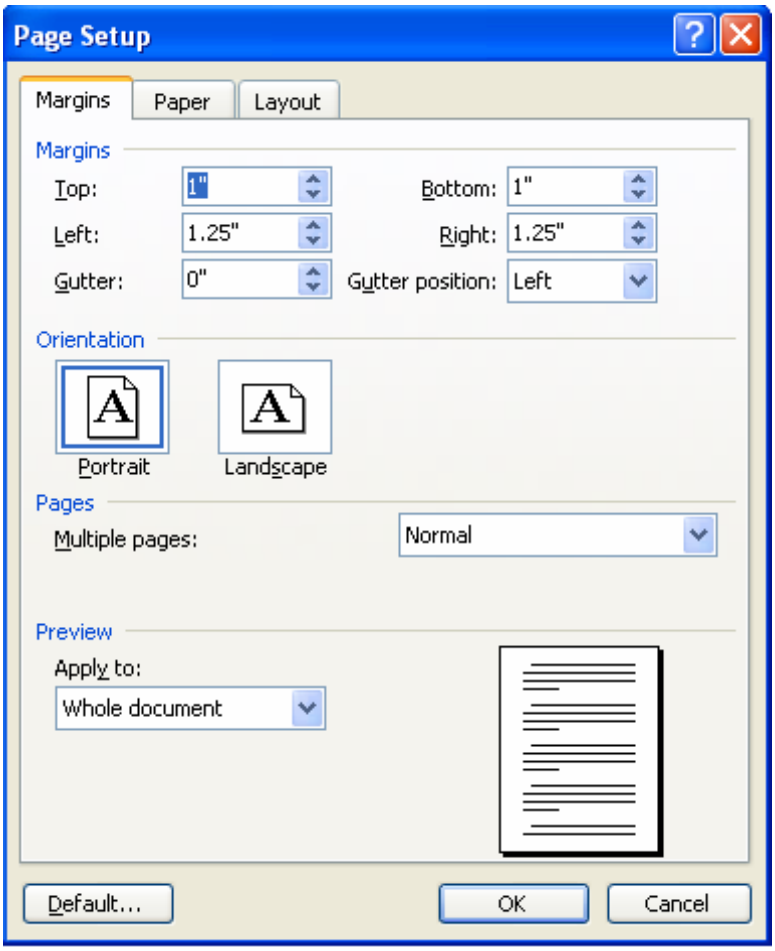


- Click OK button.
- Save your work when the spell-check is complete, so that the corrections are saved.

PRINTING DOCUMENT

Set Page Setup options

- Click File menu
- Select and click Page Setup option. You will get the following screen.

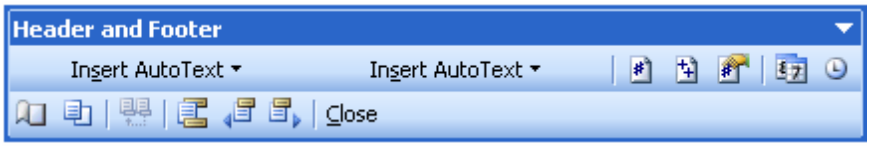


- Here you can set margins (top, bottom, right and left), paper size, paper source and layout.
- Click OK button.

Creating Header and footer

- You can create header and footer that include text or graphics. For example, page numbers, the date, a company logo, the document's title or file name, the author's name, and so on. You can use the same header and footer throughout a document or change the header and footer for part of the document. For example, use a unique header or footer on the first page, or leave the header or footer off the first page. You can also use different headers and footers on odd and even pages or for part of a document.

The Header and Footer tool bar is



To Create header or footer

Create a header or footer

1 On the **View** menu, click **Header and Footer.**

2 To create a header, enter text or graphics in the header area. Or click a button on the **Header and Footer** toolbar.

To insert	Click
Page numbers	**Page Numbers**
The current date	**Date**
The current time	**Time**
Common header or footer items, such as running total page numbers (Page 1 of 10), the file name, or the author's name	**Insert AutoText,** point to **Header,** and then click the item you want.

3 To create a footer, click **Switch Between Header and Footer** to move to the footer area. Then repeat step 2.

4 When you finish, click **Close.**

Creating different footers or headers for even and odd pages

Create different headers or footers for odd and even pages

1 On the **View** menu, click **Header and Footer.**

2 On the **Header and Footer** toolbar, click **Page Setup**.

3 Click the **Layout** tab.

4 Select the **Different odd and even** check box, and then click **OK.**

5 If necessary, move to the **Even Page Header** area or **Even Page Footer** box.

» How?

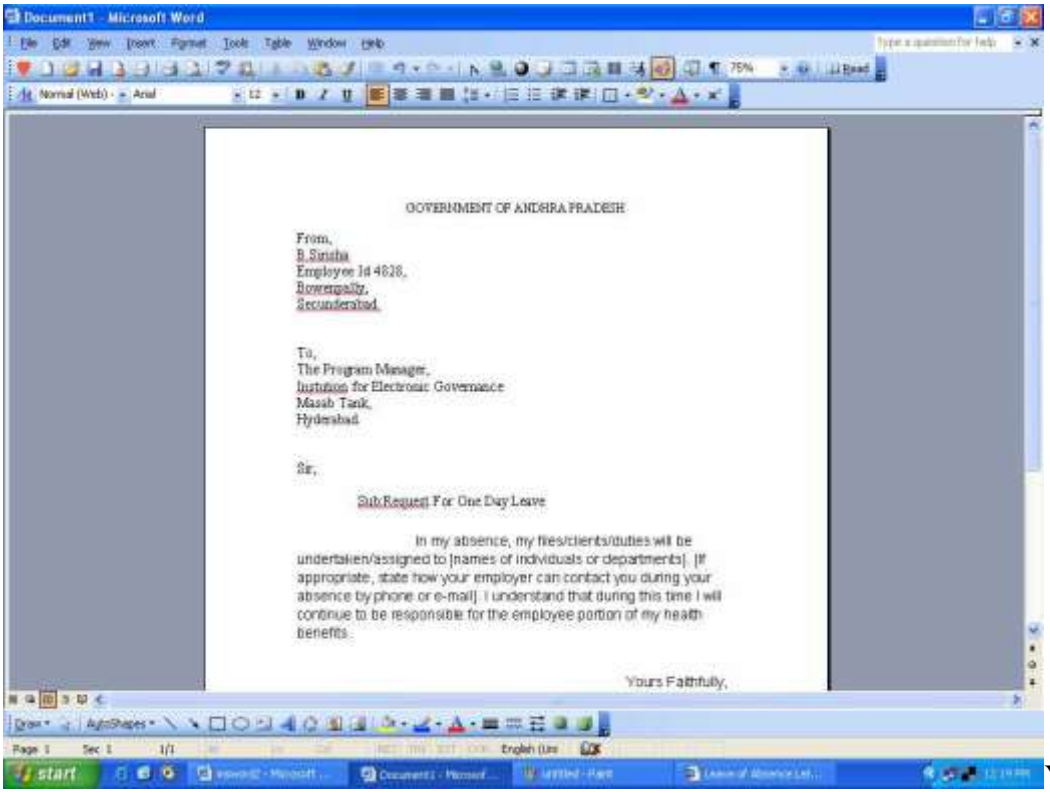
6 Create the header or footer for each even-numbered page.

» How?

7 To move to the header or footer for each odd-numbered page, click **Show Next** on the **Header and Footer** toolbar. Then create the header or footer you want.

Preview document

- Open any word document.
- Click File menu and then click Print Preview option. You will get a screen similar to this.



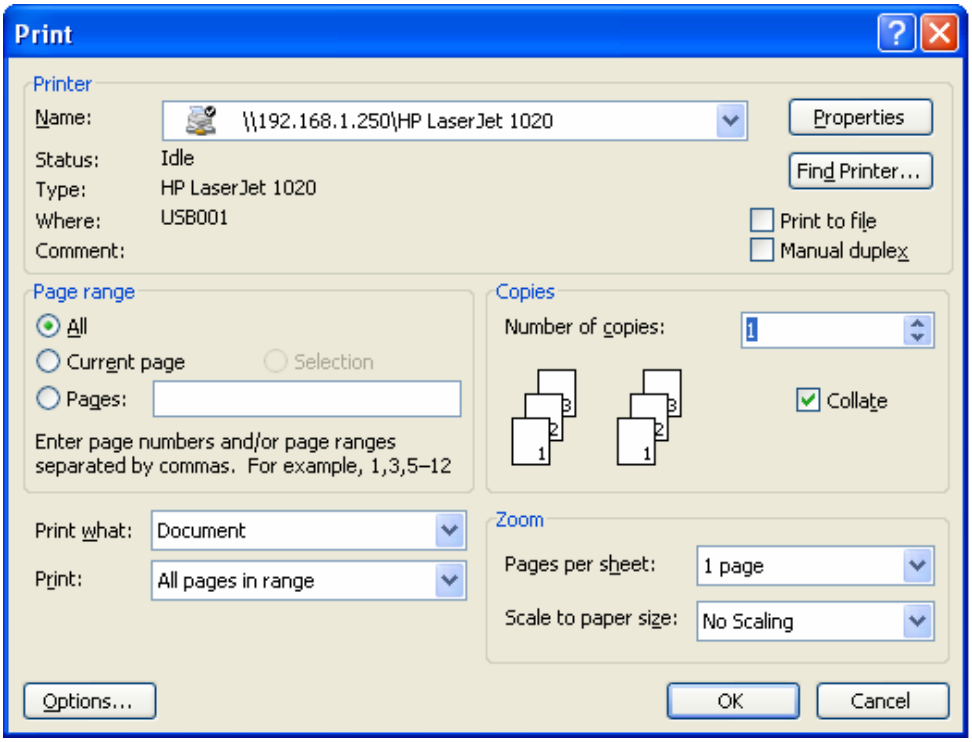
You won't be able to read your text, as preview is just for checking the layout. If you move the mouse pointer into the page a tiny magnifying glass icon appears. If you click on this, it magnifies the selected page.

- Press PgDn to move through your document if it is more than one page long.
- If you need to make changes before printing, click the Close button to return to your document

Print document

- Click File menu
- Click Print option.

❖ You will get a screen shown as below.



❖ In the above figure you can set default Printer name or you can select other printers from the drop down menu. You can set which pages to print, how many copies to print, the page range like "1-3,5-7", whether to print all pages and so on.

❖ Before printing, make sure your printer is switched on, is loaded with the appropriate paper [A4], and is on-line.

❖ If you are satisfied with the layout of your document, click on the Print icon on the toolbar to obtain a printout. You should see a message on screen showing that your file is being prepared for printing.

❖ Click OK button.

INSERTING PICTURES INTO THE DOCUMENT

Inserting Clip arts

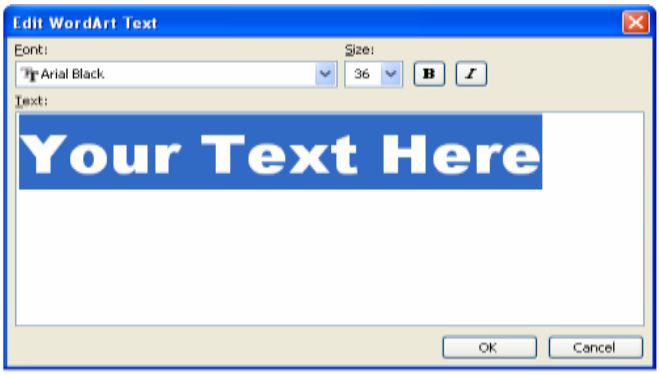
❖ Click Insert menu, click picture and then click Clip Art. You will get screen as shown below

❖ Select the picture and then click Insert button. The selected picture will be inserted at the cursor position.

Inserting WordArt

❖ Click Insert menu, click picture and then click WordArt. You will get a screen as shown below:

- Select a WordArt Style format and then click OK button to get the below screen.



- Here enter your own text (for example type Welcome)and then click OK button.

Dragging Margins on the Ruler

- Change to Page Layout view
- Choose View Ruler, if the ruler is not visible
- Point to transition area (where the grey area turns white) on the ruler. The mouse pointer changes to double headed arrow.

Drag the margin to the desired position using the mouse. Watch the change in the Ruler's dimension as you drag.

Page Breaks

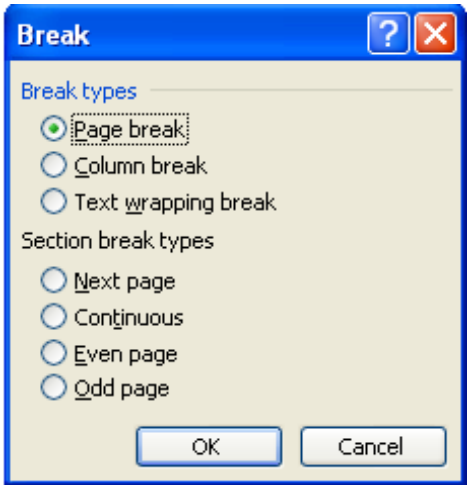
Page Breaks are the places in your document where one page ends and a new page begins. Many things affect where page breaks will occur. Factors include the size of your paper, Margin setting, Paragraph Formats and section breaks.

Page breaks appear as dotted lines in Normal view.

Forcing Page Breaks

- Move cursor to the place of the break.
- Choose Insert → Break

The Page Break dialogue box appears as below.



- Click OK & the page break appears in the required position.
- To insert page breaks press Ctrl+Enter. Page Break will be inserted at the place of the cursor.

CREATING TABLES

Tables are preferred when compared to using spacebar or tab for alignment to give a table format, but Word has another excellent feature for alignment called "Tables". This feature is used to create financial reports, catalogues, accounts etc.

Tables consist of rows and columns. The text can be typed in the cells. The size, shape and appearance of a cell are controllable features. You can also convert a text to a table and a table back to text. It also supports importing and exporting data onto a spreadsheet.

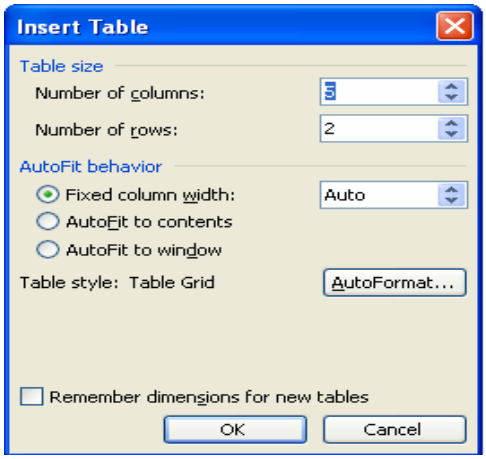
To create a table using Insert Tables Button

- Move the cursor to the place where you want to insert the table
- Choose tables button  from the Standard Toolbar
- Drag the mouse to highlight the desired number of rows and columns in the tables menu

❖ Release the button. An empty table is inserted.

To create a table using table menu

❖ Choose Insert table from Table Menu. You will find a dialog box as shown below:



❖ Now type the Number of Columns and rows as you require and set column width Auto. So that the Column with will be equal to the width of the text. Now click OK.

An empty table is inserted in the document. Now inserting rows, columns, deleting rows and widening the columns is very easy.

Insert Rows

❖ Place the cursor in the table, where rows are to be inserted

❖ Choose Table and click Insert Rows option to insert rows in the table

Delete Rows

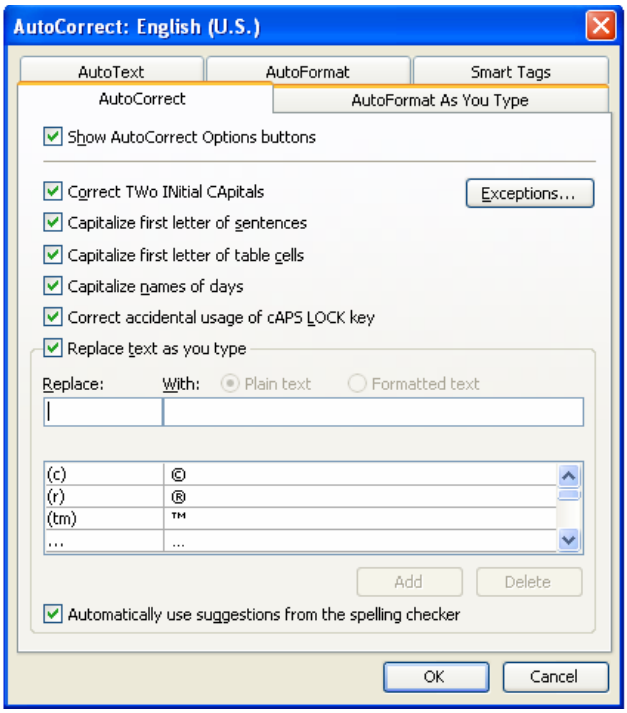
❖ Select the Row which is to be deleted

❖ Click Table and click Delete cells option.

In the same way you can do with columns also.

AUTO CORRECT

AutoCorrect stores a list of common typographical errors and their spellings. When you



make an error, Word detects it and inserts the correctly spelled version of the word. You can add words to the AutoCorrect list, based on the mistakes you make. Look at the AutoCorrect dialog box. Note that tm within parenthesis is automatically replaced by ™ with trademark symbol. To Add an AutoCorrect

- Click Tools then click AutoCorrect, type the word in the place provided for Replace and with Options then click Add and then click OK. You can Delete an AutoCorrect option if you don't want it.

AUTOFORMAT

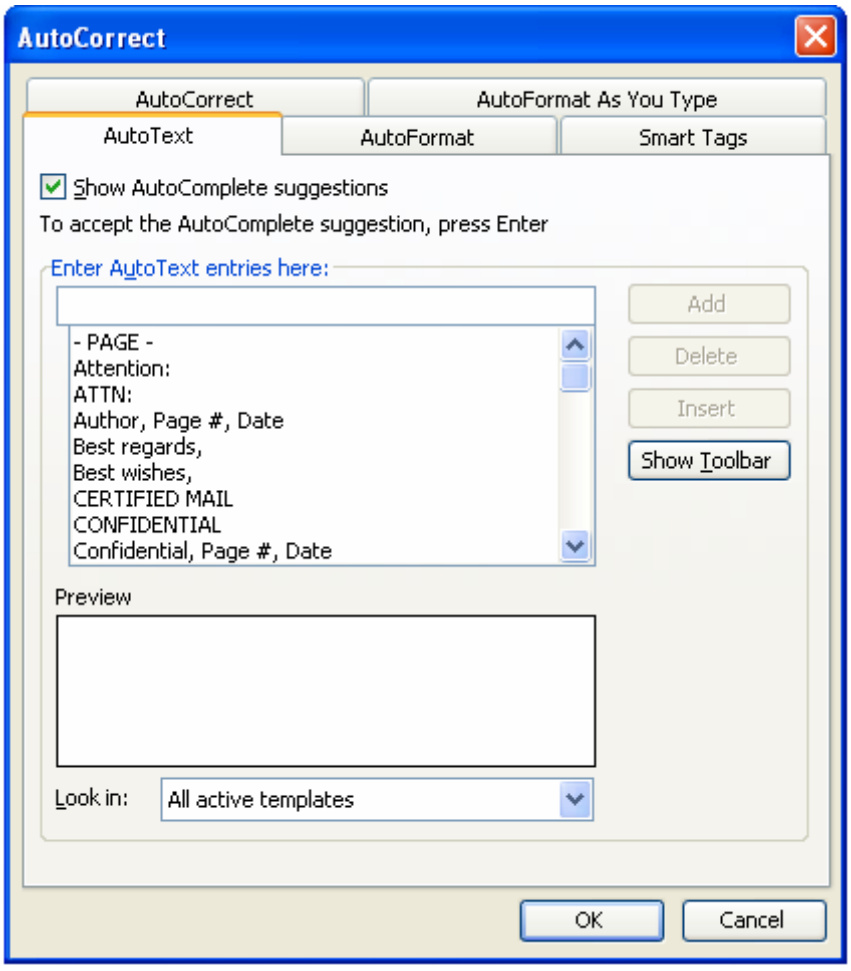
Use AutoFormat to reformat an entire document using a selected document template as a basis for the changes. Templates are supplied with Word, or you can create your own templates based on a document in which styles are applied to text, headings, lists and other text and graphic elements within the document. You can use Format/Style Gallery to view and apply available style templates to your document. Autoformat applies a style to every paragraph and heading. It typically replaces indentations created with spaces or tabs with paragraph indents, asterisks and dashes with bullets, and so on.

AUTO TEXT

The AutoText feature lets you store commonly used passages, such as addresses, contract clauses, etc.,

and insert them whenever needed with a click of your mouse to create an AutoText entry.

- ❖ Select a graphic or text block such as your name and address in your document.
- ❖ Pick the Insert / AutoText menu selection: The Auto Text dialog box is displayed as shown below



- ❖ Type a Short name in the Name box and click Add.

To use Stored Auto Text

- ❖ Type the short name of your Auto text and Highlight it.
- ❖ Click Insert/ AutoText from menu and then click Insert. The text is inserted in place of the selected AutoText name.

To remove an AutoText item

- ❖ Pick Insert/AutoText to get the AutoText dialog box.
- ❖ Pick an AutoText name and click Delete and Close.

6.4 MICROSOFT ACCESS 2003

A database manager is a computer program for storing information in an easily retrievable form. It is used mainly to store text and numbers (for example, the Library catalogue, which includes the author, title, class number and accession number for each book). Most modern database managers also allow the storage of other types of information such as dates, hyperlinks, pictures and sounds. As well as being able to store data, a database allows you to select information quickly and easily (for example, a list of the books written by a particular author or those on a certain subject). Finally, it may allow you to produce printed summaries (reports) of the information selected.

When setting up your own database, it is important to plan its use in advance. This is particularly important if you are setting one up which will be used by other people. Among the things which you should consider are:

- What information you will need to store
- What information you want to get out
- Who the data is intended for and how other users will use it
- Whether you want to restrict access to parts of the data to some users only
- Who is allowed to add or change data
- If your data refers to actual people, it may need to be registered under the *Data Protection Act*

Although you can change the specifications of your database as you develop it, you will save yourself a lot of work if as much as possible is planned in advance.

Microsoft Access is a relational database management system (which allows you to link together data stored in more than one table). It is fully supported by IT Services and is available for departmental purchase under the Microsoft *Select Agreement*.

Starting Microsoft Access

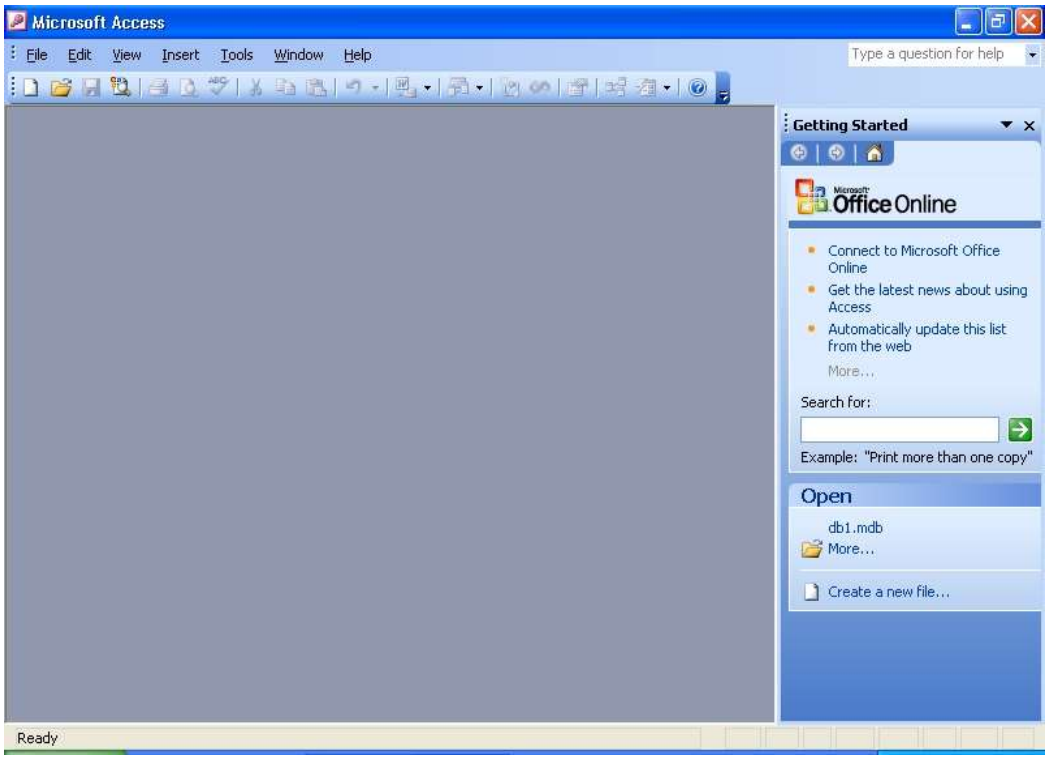
If you are using an IT Services machine, login as usual by entering your *username* and *password*. Then, to start up the program:

1. Open the Windows **Start** menu and choose **All Programs**
2. Select **Microsoft Office** then **Microsoft Office Access 2003**

Tip: You can drag the **Microsoft Access** entry from the menu onto the *Desktop* to create an icon for future easy access.

The Access Screen

On entering Access, you are presented with a blank screen, apart from the menus, toolbar and *Getting Started Task Pane* (on the right). You can now either create a new database or open an existing one. In this course you are going to use an existing database, to see how it is set up and how it can be used. When setting up your own new database, you can start off with a blank database or, for certain business applications, use a template wizard.



1. Click on the **[Open]** button (or open the **File** menu and select **Open...**)
2. An *Open* window appears - change *Look in:* to **User (D:)**
3. *Double click* on the folder called **Training** to open it
4. Click on **example.mdb** from the list which appears and press **<Enter>**

   or click on **[Open]**

*Note: For those using these notes on a computer not run by IT Services, the example file can be downloaded from the link provided at step **4** above.*

Users are welcome to take a copy of the example file if they want to practice.

The Database Window

The next screen which appears shows the *Database* window. This controls navigation within a particular database. A database is made up of several *objects*, grouped into a single file:

- **Tables** - hold the raw data
- **Queries** - extract part of the raw data to produce *dynasets* - dynamic sets of data which can change each time the query is run (to reflect any changes to the data in the tables)

- **Forms** - user-friendly layouts to display data on the screen (either in a table or from a query)
- **Reports** - output files, ready for printing
- **Pages** - for creating/editing WWW pages
- **Macros** - lists of commands to perform particular functions
- **Modules** - programs which expert users write in a programming language called Access Basic to perform tailor-made functions not generally available

The objects are accessed using the *buttons* down the left of the *Database* window. As you use the different components, the menu bar and buttons on the toolbar change appropriately. Currently, the *Tables* are listed. Pages, Macros and Modules are not dealt with in this *Beginners'* course.

Database Window: 

Tip: The **[Database Window]** button always takes you back to the

Database window.

Part 1: Using an Existing Table

Begin by investigating the table named **students**. This contains data

relating to imaginary students in a fictitious department in the University, but it could equally be members of a club or just information about your friends and relatives. To examine the table, check the name is highlighted, then press **<Enter>** or click on **[Open]**. You can also open a table by *double clicking* on its name.

A new screen, the *Table* window, appears revealing the data set out in a table. This method of display (known as *Datasheet View*) shows the data in columns and rows, similar to a spreadsheet. There are a number of entries (*records*), one for each student, which each take up one line or row of the table. For each student, various items of data are recorded in columns - each column contains one variable (or *field*).

Immediately below the data is the *status bar*, which shows you are positioned at Record 1 (of 390). The *current record* is indicated by an arrow in the column to the left of the data. You can move the indicator down to the next record by clicking on the button immediately to the right of the number 1 on the status bar. The next button to the right takes you to the end of the table - click on this and you should be at Record 390. Matching buttons on the left take you back a single record and back to Record 1 - try out these too. You can also move up and down using the arrow keys on the keyboard. The scroll bar down the right edge of the table window moves the display up and down.

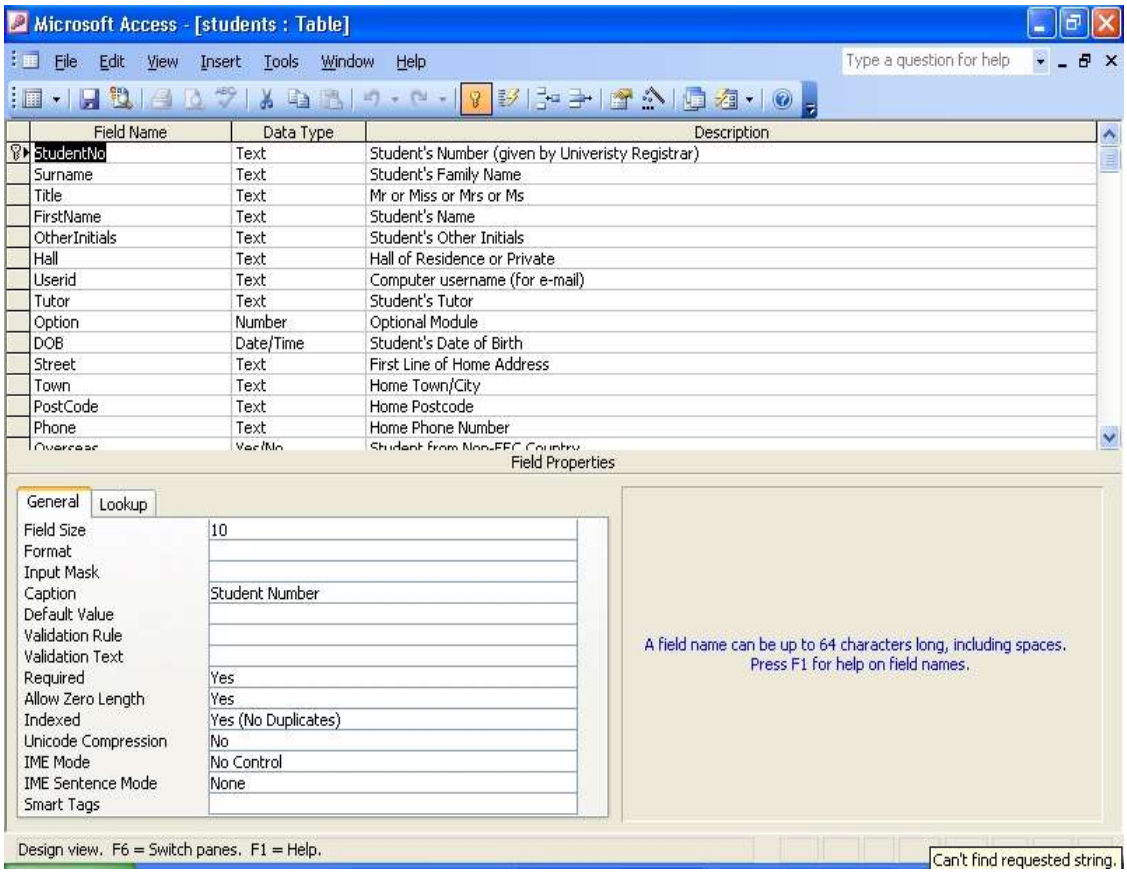
Another scroll bar is provided at the foot of the window for moving the display to the left and right when the records extend over more than one screen. If you want to move from field to field across a record, you can use the **<*right arrow*>** and **<*left arrow*>** keys or **<Tab>** and **<Shift Tab>**. The **<End>** key takes you to the last field, the **<Home>** key to the first. **<Page Up>** and **<Page Down>** take you up and down a screen, while **<Ctrl Home>** and **<Ctrl End>** take you to the first field of the top record and final field of the last record, respectively.

View:  **or** 

To see exactly what each record contains and how it has been set up:

1. Click on the **[View]** button (the first on the toolbar, or use **Design View** in the **View** menu)

The *Table Design* window lists the field names, indicates their data types and also shows the *field properties*. The screen appears as below:



The fields (and properties) are as follows:

- **StudentNo**: A *text* field containing each student's personal id, as allocated by the University Registrar's Office. Text fields are the commonest type of fields and can be used to store any characters (letters, punctuation, numbers etc). Numbers should be stored as *text* if not being used in calculations. This field is set up to hold up to 10 characters and a *Caption* is used to expand the field name. This number uniquely identifies each student - the *Required* property has been set to **Yes** and *Indexed* is set to **Yes (No Duplicates)**. This field has also been used to set up a *Primary Key*, which you will learn more about later.

Tip: It's good practice not to include spaces in field names (or in the names of tables / queries / forms / etc). Instead, make use of *Captions* to expand the field name (to include any spaces). Not only do you have less characters to type but it makes manipulation of the data much easier if you find you need to use more advanced database features.

2. Press <***down arrow***> to move to the next field (then repeat this for each field):

- **Surname**: A *text* field containing the Family Name of each student.

  This field is can hold up to 25 characters

- **Title**: Another *text* field but this time for up to 4 characters. Here, we know the possible values (Mr/Mrs/Miss/Ms) and can set up a *Validation Rule* to check that the data entered is correct - if it is not, the *Validation Text* is displayed. A *Default Value* (Mr) has also been set

- **FirstName**: Another *text* field for student's first name - up to 20 characters

- **OtherInitials**: A *text* field for any other initials - up to 6 characters

- **Hall**: Another *text* field where the possible values are known (the University only has certain Halls of Residence) so a *Validation Rule* has been set - up to 12 characters. A *Default Value* (Private) has also been set

- **Userid**: This is the student's computer username, which doubles as an e-mail address - a *text* field for up to 8 characters

- **Tutor**: The student's tutor - again a *text* field for up to 20 characters

- **Option**: A *number* field which points towards different optional course modules the student can study. Numbers can be stored using different field sizes; here, as the number of options is small (and always +ve) a *byte* is used - see the Appendix for a full explanation. A slightly different *Validation Rule* is used to check the data entered

- **DOB**: The data type here is *Date/Time*, which has been set up in *Medium Date* format. Note that a *Caption* is used to expand the field name.

- **Street**: First line of the student's home address - a *text* field storing up to 50 characters

- **Town**: The student's home town/city - a *text* field storing up to 20 characters

- **PostCode**: The student's home post code - a *text* string storing up to

  10 characters

- **Phone**: The student's home telephone number - note that even though this is a number it is

stored as *text* (you won't be doing any mathematical calculations with it!)

- **Overseas**: A *Yes/No* (or logical) field storing whether the student is from an EEC country or not. The *Default Value* is set to *No*.
- **Notes**: For any other pieces of information - for longer pieces of text, a

  memo is used
- **Photograph**: Graphics (eg a passport photograph) are stored as *OLE Objects*

Other data types exist which are not included here, namely: *currency*,

autonumber and *hyperlink* (see the Appendix for details).

Tip: Note that the student's surname is stored separately from the first name (similarly each line of the address is in a separate field). Information should always be stored in its component parts. You can then, for example, sort by surname then first name, or reference the students formally (ie Mr

X) or informally. You will see later how to combine this data into a single field, if you need to.

To close the *Table Design* window and return to the top of the datasheet:

3. Click again on the **[View]** button (or use **Datasheet View** from the **View** menu) - note that the icon on the button changes as you move between *Design* and *Datasheet* view

Searching for a Particular Record

Find: 

To search for a particular record, you should first move to the field you want to search:

1. Press **<Tab>** to move to the *Surname* field
2. Click on the **[Find]** button (or press **<Ctrl f>** or use **Find...** in the **Edit**

   menu) and a *Find and Replace* window will appear
3. The cursor is already positioned in the *Find What:* box - type in **Smith**

The default options should already be set correctly. The *Look In:* box shows the search is restricted to the current *Surname* field (alternatively, you can search the whole table). In the *Match:* box, you can

choose to match the *Whole Field*, *Any Part of Field* or the *Start of Field*. *Search:* is set to *All* records; the other options are *Up* and *Down*. *Match Case* lets you distinguish capitals from lower case (if you need to). Finally, *Search Fields as Formatted* is useful for finding data as displayed (a date format, for example). Note that you also have access to a *Replace* tab for editing data.

4. Press **<Enter>** for [**Find Next**] and the search should be carried out
5. Press **<Enter>** again and another *Smith* will be found
6. Keep pressing **<Enter>** until you get the message that the search item is not found

Obviously, this is not a very elegant way of retrieving information from the database - but it works! To close the *Find* window:

7. Press the **<Esc>** key or click on [**Cancel**] - or click on the **[Close Window]** button
8. Finally, press **<Ctrl Home>** to move back to the first record

Sorting

The records, as you have seen them so far, are shown in the order that they were first entered into the database - as the data came from the Registrar's Office, it is in Student Number order. For this reason, it wouldn't have been easy to search for *Smith* simply by scrolling through the records (and imagine trying to find a book in the Library if they were all listed by

their accession number!). If the data is sorted, however, then you can scroll through the records to search for a particular one.

Quick Sort

Sort Ascending:  **Sort Descending:** 

To sort any field into alphabetical/numeric order, a quick sort facility is provided. First, you have to move to the column on which the sort is to be based:

1. Press **<Tab>** to move to the *Surname* field
2. Click on **[Sort Ascending]** (or use **Sort** then **Sort Ascending** from the

Records menu)

The names of the students are now in alphabetical order. Note that only the screen display is sorted - the records are still stored in the order in which they were typed, and they always will be.

3. Use **Remove Filter/Sort** in the **Records** menu to reset the data to its original unsorted order

Changing the Display Order Permanently

If you want to keep the new display order for the next time you open the table, all you have to do is close the table, saving the changes to its design. Try this next:

1. Move to the field you want sorted (eg *Surname*)
2. Click on **[Sort Ascending]** (or **[Sort Descending]** if you want the data in reverse order)
3. Close the table by clicking on its **[Close]** button (or use **Close** from the

   File menu)
4. Save the changes to the table design when asked - press **<Enter>** or click on **[Yes]**
5. At the *Database* window, **[Open]** the table again - you should find it in the new order

Note: it's very easy to accidentally save unwanted changes to the table design (if you perform a quick sort on another field, for example). Use **Remove Filter/Sort** to get back your original table.

Sorting in a Query

Sorts can also be carried out and stored in a *query*. Moreover, within a query you *must* set an explicit sort otherwise the records are displayed in their original order of entry. Queries are particularly useful where you have more than one field you need sorted - a simple quick sort only lets you sort on the one field (you can't for example sort by surname then firstname). By using a query you can produce a display sorted on any of the fields and can even create complex sorts within sorts. You will be looking at queries shortly, and carrying out sorts in them, so there is no need to carry out an example here.

Indexes

An index, like in a book, is used to speed up searching, sorting and grouping data - one should be set

on any fields used frequently in these ways. What happens is that Access records the sort order in a hidden file so that it doesn't need to repeat the sort each time. Indexes also perform a second useful function in that they can be used to guard against duplicate data entry. They are always used when a field is set up as a *Primary Key*. Try setting up an index on another field:

1. Click on the **[View]** button to switch back to *Design View*
2. Note that the *StudentNo* field already has an index - set to *Yes (No Duplicates)*. As this is used as the *Primary Key*, it must have this setting

The *Surname* field has an index of **Yes (Duplicates OK)**. This field is frequently used for sorting and duplicate values are allowed - as you have already seen with *Smith*. Try setting an index on *Hall* - another field likely to be used in sorting/selecting:

3. Click on the *Hall* field and, using the *list arrow*, set *Indexed* to **Yes (Duplicates OK)**
4. Next click on the *Userid* field and note the index here is set to **Yes (No Duplicates)**. The values in this field should be unique and the index will ensure this
5. Click on the **[View]** button again to switch back to *Datasheet View*.

   When asked, press **<Enter>** or click on **[Yes]** to save the changes to the design of the table

Adding, Editing and Deleting Records

New Record:  **Delete Record:** 

Whenever you make any changes (additions, deletions or edits) to a table, it is the original data file that you are altering. Unlike most other applications, a database does not make a working copy of the file first. For this reason, it is essential to keep a back-up copy of your file (to which you can always return), just in case you make mistakes when carrying out amendments.

To add a new record to the database, use the **[New Record]** button (to the right of **[Find]** or the far right button on the status bar) or **New Record** from the **Insert** menu. New records are always added at the end of the existing data. As soon as you start to type, Access creates a new empty record (marked with an asterisk), while the current record indicator changes from an arrow to a pencil:

1. Click on the **[New Record]** button - you should now be on Record 391
2. Type in a number for the *StudentNo* (anything under 1000 will do) then press **<Enter>** (or ***<right arrow>*** or **<Tab>**) to move to *Surname*
3. Type in your own name then move to *Title* (press **<Tab>**, **<Enter>** or ***<right arrow>***)
4. Repeat step **3** until you have filled out most of the record

Note that some fields already have a default value. To change a value in a field you simply type in a new one. Note also that some fields (eg *Hall* and *Option*) can only accept certain values, others (eg *StudentNo*, *Surname* and *FirstName*) *cannot* be left blank.

The *Photograph* field can hold a picture. The best way to add one is via the *Clipboard* (ie **Copy** and **Paste**). If you use the menu system (choosing **Object...** from the **Insert** menu) then it may appear as an icon which you then have to *double click* to open. As pictures cannot be displayed in *Datasheet View* anyway, don't try filling out this field here.

Note: An alternative method for entering new data is provided by the **Data Entry** command in the **Records** menu. With this, an empty table is displayed into which you type in the data. The best method for entering data, however, is via a *form*, which you will be meeting later.

To delete the current record (in this case your own):

1. Click on the **[Delete Record]** button (to the right of **[New Record]** on the toolbar)

Deleting records from a database is potentially very dangerous as they are erased once and for all, hence you are given one final chance to change your mind:

2. Press **<Enter>** for **[Yes]** to confirm the deletion

Note that you can't now use **[Undo]** to recover the record. If you have several records to delete:

3. Using the mouse, point to the left-hand edge of the first record to delete (where the current record indicator is held) - you will find that the mouse cursor changes to an arrow

4. Hold down the mouse button - the record is marked (it becomes white on black) - then drag through the records required
5. To delete them, click on the **[Delete Record]** button (or just press the

   <Delete> key or use **Delete** from the **Edit** menu)
6. When asked to confirm the deletions, this time click on **[No]** and the records will reappear

Note: Records must be next to each other in order to delete them (you cannot use *<Ctrl> click* like you can in other Microsoft software, though

<Shift> click can be used to select a block of records). You will see next how to select a subset of non-contiguous records, which you could then delete.

Selecting Records

Databases offer you the facility of extracting sub-sets of records according to some pre-set conditions - in the Library, for example, you can search for all the books written by a particular author or all those dealing with a given subject. Access offers you two methods for selection, *Quick Select using a Filter* and *Selection using a Query*.

Quick Select

Filter by Selection:  **Remove Filter:** 

Simple selections can be made directly on the table itself, using a filter. Try out a few examples:

1. Press **<Ctrl Home>** to move to the first record
2. Move across to the *Hall* field - to find all the students living in a particular hall
3. Using the ***<down arrow>*** key, select the Hall of Residence you require

   (or you could use **[Find]** to search for a particular Hall)
4. Click on the **[Filter by Selection]** button (to the right of **[Sort**

   Descending])

Note that at the bottom of the screen it says *Record 1 of XX (Filtered)*. To turn off the filter:

5. Click on the highlighted **[Remove Filter]** button (to the left of **[Find]**) You can also filter on part of a field - for example, you might want all the students registered in 2004.

6. Move to the *Userid* field

7. Find a record containing **04** and drag through the figures to select them

   (ie just *04*)

8. Click on the **[Filter by Selection]** button to carry out the filter

If you now also wanted to find the students in this year who had a particular tutor:

9. Move to the *Tutor* field

10. Move down to a record with the required tutor (or use **[Find]**)

11. Click on the **[Filter by Selection]** button

Note that this command is also available from **Filter** in the **Records** menu. Another command here (which is not on a toolbar button) is **Filter Excluding Selection**.

Having made your required selection, there are several things you might want to do next. For example, you might want to delete these records - even though they are not next to each other in the full dataset, you could drag through them here and delete them as before (but don't do so here).

Another thing you might want to do is to print off the data. However, you probably wouldn't want all of the fields, so you'll see next how to hide unwanted columns.

Changing the Fields Displayed

Tables often contain a lot of data, only some of which may be required. You can control which fields are shown and which hidden. Here, you may want just the student name and hall of residence:

1. Click in any *StudentNo* record then open the **Format** menu and choose

   Hide Columns

To hide several adjacent columns in one go:

2. Position the mouse cursor into the *Userid* column heading (the pointer changes shape to a down

arrow)

3. Hold the mouse button down and drag through the remaining column headings to the end - the columns go black
4. Open the **Format** menu and again choose **Hide Columns**

If you want to change the order of the fields on the screen, you can either use *cut and paste* or, more simply, *drag and drop*. Both these techniques should be familiar to the Microsoft Office user. To list the students starting with their full name (including title) in the correct order:

5. Click on the *Surname* column heading to select the column
6. Move the mouse cursor back into the column heading, hold down the mouse button then (with the button still depressed) drag the column to the right to a position immediately before the *Hall* field
7. Let go of the mouse button to drop the field in its new position

Note: you are only changing the screen display - the data is still stored in its original order.

Finally, you might want to print your list. First, it's a good idea to preview it:

8. Click on the **[Print Preview]** button - the mouse cursor becomes a magnifier

You will notice that Access automatically adds a header and footer to your page, which you may or may not want. Normally you would now print your list, but here:

9. Click on the **[Close]** button to turn off the preview

To redisplay some of the hidden fields:

10. Open the **Format** menu and choose **Unhide Columns ...**
11. Click in the box against a hidden column to redisplay it
12. Once all the required fields are ticked, press **<Esc>** or click on **[Close]**

Tip: The simplest way to redisplay all the fields is to close the table without saving the changes to its design. When you reopen it, it will appear in its original format.

Advanced Filters

The relationship between queries and filters is a very close one. You can in fact save a filter as a query by turning on the advanced filter option. This can be a useful aid in designing a query. Save the current filter (students with a set tutor who came in 2004), as an introduction to queries.

To save the filter:

1. Open the **Records** menu, choose **Filter** then **Advanced Filter/Sort...**

A *Filter Design* window appears. This is very similar to the *Query Design* window, which you will be using next. Examine how the criteria have been set up.

2. Open the **File** menu and choose **Save as Query**
3. Save the filter as **Tutor04** (press **<Enter>** for **[OK]**), then **[Close]** the filter window
4. Close the **students** table - don't save the changes to the design (click on **[No]**)

To rerun the filter:

6. Move to **Queries** in the *Objects* list of the *Database* window
7. Select **Tutor04** and press **<Enter>** to **[Open]** it
8. End by closing the query - click on its **[Close]** button

Once a filter has been saved as a query, it's easy to modify its design if necessary.

Using a filter in this way is straightforward but a little limited. You can't, for example, find all the students with either Tutor *X* or Tutor *Y*. To do more complicated selections such as this you have to use a *Query*. Queries also offer various other facilities, as you will see.

Selection using a Query

New Object:  **Run:** 

To introduce you to queries (which may look a little complicated at first, but which are in fact very easy), try repeating some of the selections you have just done. There are four ways to start a query:

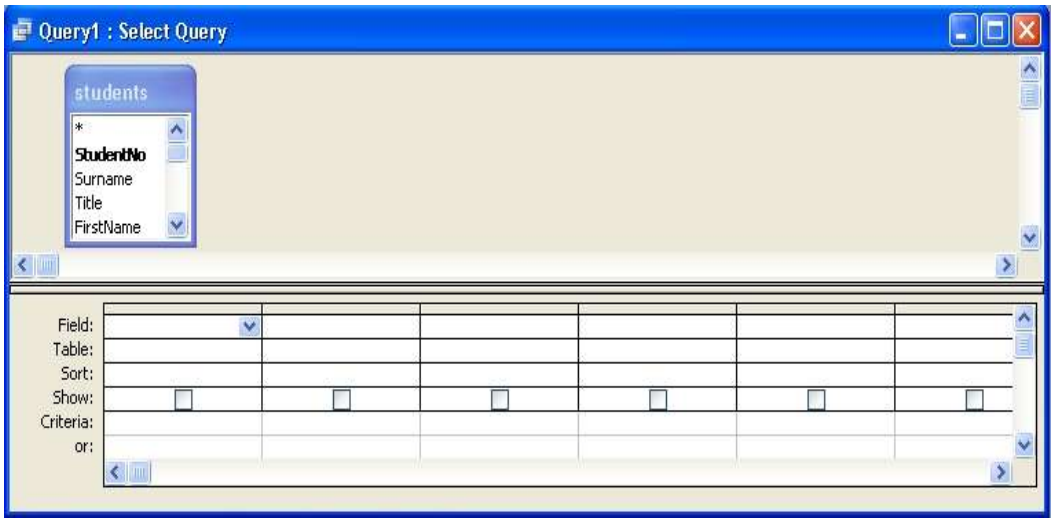
- You can use the **[New Object]** button, choosing **Query**

- You can choose **[Create query in Design view]** from **Queries** in the *Objects* list
- You can choose **[Create query by using wizard]** from **Queries** in the *Objects* list
- You can click on the **[New]** button when viewing **Queries** in the *Objects* list

Here, try the first method:

1. Click on **Tables** in the *Objects* list and check the **students** table is selected
2. Click on the *list arrow* attached to the **[New Object]** button on the right and choose **Query**
3. In the next window, accept the default *Design View* - press **<Enter>** or click on **[OK]**

Note: Whenever you start up a query from a table, the query is automatically based on that table.



The *Select Query* window may look a little confusing, but in fact it's very simple to use. The cursor should be flashing in the *Field:* row in the lower part of the screen waiting for you to define which fields are to be displayed. The first quick selection you carried out was to display all the data for students in a particular hall of residence, so try to repeat that here:

1. Click on the *list arrow* on the right of the *Field:* cell and choose

   students.*

The *asterisk* notation means *all* the fields in the *students* table (if you only wanted certain fields displayed you must choose them individually).

You are going to select all students from a particular hall, so you need the *Hall* field in a separate column to set up the selection criteria. Another way to fill up a field is to drag it from the **students** field list in the top half of the *Select Query* window. You can try this next:

2. Scroll down to display the **Hall** field then drag it from the **students** list to the *Field:* row in the second column. Release the mouse button to drop the field heading into position
3. Unset the *Show:* box in column 2 by clicking anywhere in the cell (the check box will become blank) - if you don't, the hall will appear twice as it's already in **students.***
4. Move down to *Criteria:* in column 2 and type the name of the required hall - eg **Childs**
5. To carry out the query, click on the **[Run]** button (or you can click on

   [View] to move from *Design View* to *Datasheet View*)

The main difference between this query and the earlier quick select is that you can keep it for future use - quick select just applies a filter to the

underlying table whereas a query can be saved as a separate entity. You can build up a range of queries and then run them as required - for example, next term or next year you might want a new list of students living in a particular hall of residence.

6. Click on the query window's **[Close]** button (or use **Close** from the **File**

   menu)
7. When asked, press **<Enter>** or click on **[Yes]** to save the query
8. Save the query as **Hall** - press **<Enter>** or click on **[OK]**

Note: You can't give a table and query the same name. Now try re-running the query:

9. At the *Database* window click on **Queries** in the *Objects* list

10. Select the **Hall** query and press **<Enter>** or click on **[Open]** - you have your results again

Parameter Queries

The selections you have carried out so far have only met fixed criteria - in this case: *Show me the students who live in Childs (or whichever) Hall*. With a query, however, you can change the criteria each time you run it by making it a *parameter query*. The design is very similar to what you have already seen except that instead of setting a fixed criteria Access asks for the information at run time. Modify the Hall query to do this:

1. With the *Hall* query still open, click on the **[View]** button to change to the *Design View*
2. Click in the *Criteria:* field in the second (Hall) column and **<Delete>** the current criteria
3. Type in a new criteria saying: **[Which Hall?]**

   Note: square brackets tell Access that this is a question, to be displayed at run time.
4. Click on the **[Run]** button (or switch to *Datasheet View*)
5. When asked the question *Which Hall?* type in the required hall of residence - eg **Bridges**
6. Press **<Enter>** or click on **[OK]** and the query will be run

Normally, you would run the query each time from the *Database* window (or from a user-friendly interface - a form called a *switchboard*). Here, however, to run the query again:

7. Click on the **[View]** button to change to the *Design View*
8. Click on the **[Run]** (or **[View]**) button again
9. Type in the name of a different hall - eg **Windsor** - and press **<Enter>**

   or click on **[OK]**

As you can see, this query is much more useful than when it only worked for a set hall.

More Complex Queries

Next, try some more complicated queries. What if you want to have an alternative criteria? For example, you might want a list of students living in *either* one hall *or* another. To do this, you have to set up criteria on two different lines.

1. Click on the **[View]** button to change to *Query Design*
2. In the *second* line of the *Criteria:* in column two, type: **[or?]** for a second question
3. Click on the **[Run]** button (or switch to *Datasheet View*)
4. When asked *Which Hall?* type in the name of the first hall - eg **Wells**

   (press **<Enter>**)
5. When asked *or?* type in the name of another hall - eg **Wessex** (press

   <Enter>)
6. You now have the students from both halls - **[Close]** the query, saving the new design

You have seen how to match values in a query but you can also use criteria such as greater than, less than, not equal to, between one value and another, or matching part of a field. For example, how do you set up a

query to pick out the students who came in 2004? The answer is that you have to use a special notation called *Like*.

The **Like** notation indicates that the words which follow must be embedded within the data in that field for a record to be selected - wildcards (* or ?)

can be used to denote characters which may precede or follow the required text. ? represents a single character whereas * represents any number of characters. For example, **Like C*** could be used to give you all the students with names beginning with the letter *C*, while **Like *son** would match students whose names ended with *son*. For the 2004 students:

1. Check you are viewing *Queries* in the *Database* window
2. *Double click* on **Create query in Design view** or use **[New]** and accept *Design View*
3. In the *Show Table* window, click on the *Tables* tab, select **students**

   and **[Add]** it

Because the query wasn't started from a table you have to add it explicitly this time.

4. Press **<Esc>** or click on **[Close]** to close the *Show Table* window

5. Set the *Field:* in the first column to **students.***

Tip: A third way to set up the fields is to *double click* on the field names in the field list in the top half of the *Select Query* window. This automatically fills up the next empty *Field:*

6. Set the *Field:* in the second column to **Userid**
7. Move down to *Sort:* and type **a** to get a list sorted on the students' usernames
8. Turn off *Show:* by unticking the box
9. In *Criteria:* in the second column type: ***04*** and press **<Enter>**

   (Access automatically changes this to **Like "*04*"** for you)
10. Click on the **[Run]** button to run the query - or switch to *Datasheet*

    View

To set up a second condition on this subset of data (eg 2004 students who have a particular tutor) is very easy. Whereas alternative conditions are set up on different lines, simultaneous conditions must be set up on the *same* criteria line:

11. Click on the **[View]** button to move back to *Design View*
12. Set the *Field:* in the third column to **Tutor**
13. Turn off *Show:* by unticking the box
14. In *Criteria:* in the third column, top line, type: **[Which Tutor?]** - or set a fixed value
15. Click on the **[Run]** button to run the query - or switch to *Datasheet*

    View
16. When asked *Which Tutor?* type in the name of a tutor (eg **Foot**) - press

    <Enter> for **[OK]**
17. **[Close]** the query, saving it as **2004**

Adding a New (Calculated) Field

Earlier, you did a very simple selection to show just the student's name and hall of residence. You are going to repeat that next, to demonstrate how to include only certain fields in a query. One fault with the original example was that the students' names (first name and surname) were printed in separate columns. In a query you can calculate a new field, joining these together:

1. Check you are viewing *Queries* in the *Database* window
2. *Double click* on **Create query in Design view** or use **[New]** and accept *Design View*
3. In the *Show Table* window, click on the *Tables* tab, select **students**

   and **[Add]** it - press **<Esc>** to **[Close]** the window
4. In *Field:* in column one, type: **FullName: FirstName & " " & Surname** (don't forget the space between the double quotes or the names will merge into a single word) - press **<Enter>**

Tip: You should always use an ampersand (&) rather than plus (+) sign when joining text together. Though both appear to work, plus signs can occasionally cause problems.

5. Set the *Field:* in the second column to **Hall**
6. Set the *Field:* in the third column to **Surname** - you need surname for sorting your list into alphabetic order, however, you don't want it displayed twice
7. Set *Sort:* in column 3 to **Ascending** - type **a** in this cell
8. Turn off *Show:* in column 3 by unticking the box
9. Click on the **[Run]** button to run the query - or switch to *Datasheet*

   View
10. *Double click* on the dividing line between the column headings to widen the *FullName* column

With a query you can sort on more than one field if you want - a sort within

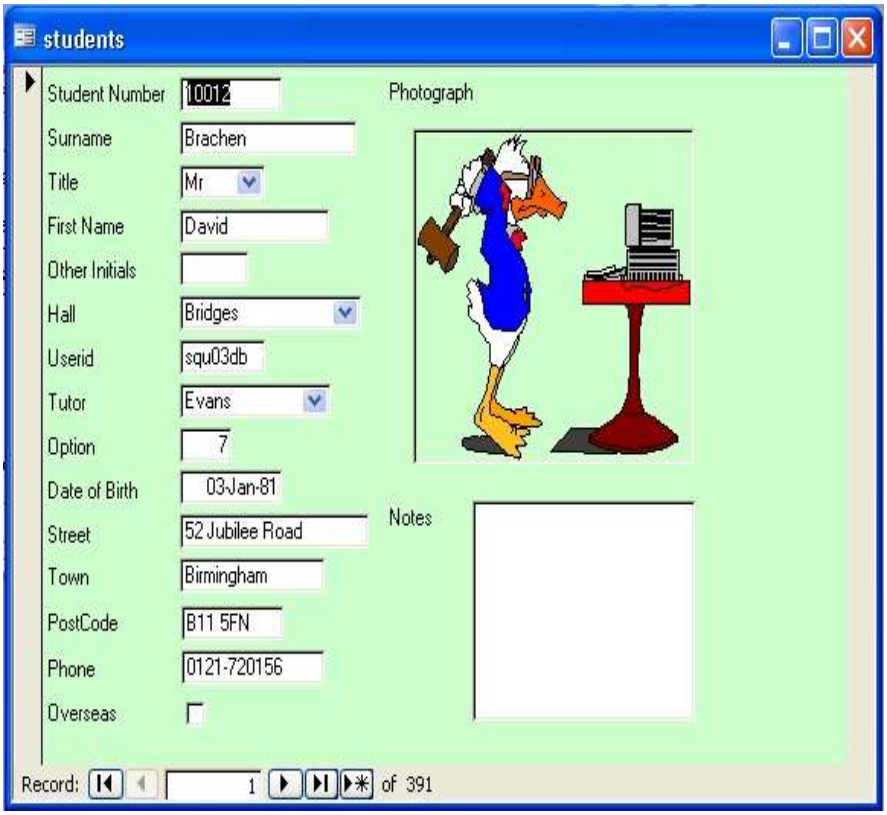
a sort. Here, you might want to sort first by Surname and then by FirstName (for example, if you move down to the students named *Berry* - use **<Page Down>** - you will see they are out of order). Sorts are carried out from left to right across the columns in the query - if the fields are not in the correct order, simply drag and drop them as required.

11. Click on the **[View]** button to move back to *Design View*
12. Set the *Field:* in the fourth column to **FirstName**
13. Set **Sort:** in the fourth column to **Ascending** - type **a** in the cell
14. Turn off *Show:* in column 4 by unticking the box
15. Click on the **[Run]** button (or switch to *Datasheet View*) again to see the results
16. Check the *Berry's* then **[Close]** the query, saving it as **Names**

Using a Form

The next object to investigate is a *Form*. Forms are used to facilitate data input and allow you to set up your own data entry screen. Forms can also be used for queries. A data entry form has already been set up for the students table:

1. At the *Database* window, click on **Forms** in the *Objects* list
2. Select the **students** form and press **<Enter>** to **[Open]** it



A user-friendly screen is displayed, with a title at the top and the various fields listed and boxed. The menus, commands and buttons work as they did before, allowing you to move around, add new records, delete records, filter, sort and search etc.

3. Move to the *Surname* field (press **<Enter>**, **<Tab>** or **<*right* or *down arrow*>**)
4. Click on **[Sort Ascending]** to sort the forms into alphabetical order
5. **[Close]** the form then reopen it - the sort order remains, as it did with the table

Forms also provide short-cuts to data entry, including letting you select from a list of valid values. Use this form type in your own information again:

6. Click on the **[New Record]** button or use **New Record** from the **Insert**

   menu
7. Fill in the fields with your own information, as you did before
8. In the *Title* field, select the required title using the *list arrow*
9. In the *Hall* field, start typing the name of the hall and watch Access select from the list of possible values (alternatively, choose from the list using the *list arrow*)
10. The *Tutor* field also has a *list arrow* attached
11. The *Overseas* field appears as a check box - click on it to set it on if necessary
12. In the *Notes* field, type several lines of text (type rubbish text, if you

    like) and watch how the box accommodates it. Press **<Tab>** to move to the next field (the **<*down or right arrow*>** keys don't work, while

    <Enter> gives you a new paragraph!)
13. For a *Photograph*, as you probably haven't got a picture file handy, press **<Alt PrintScreen>** to dump the current window then **[Paste]** it from the *Clipboard* into the field
14. End by deleting your own record - click on the **[Delete Record]** button

    (press **<Enter>** for **[Yes]** - or click on **[No]** if you want to keep it)

Form Design

Though forms are very easy to use, they are not that easy to design. Fortunately, Access has wizards to do most of the work for you. However, if you wish to modify a wizard-designed form, you will find it very difficult until you are familiar with the program. To view the form design:

1. Click on the **[View]** button to move to *Design View*
2. Note that Access provides you with a *Toolbox* to help you with the design

You are not going to modify the design of this form - you will see how to later, in Part 2 of these notes. For the moment:

3. Click on the **[View]** button to move back to *Form View*

Filter by Form

Filter by Form:  **Apply Filter:**  **Clear Grid:** 

When using forms, if you want to select a subset of the records using a filter, you can still use the **[Filter by Selection]** button as before. However, this isn't very convenient if you want to base the filter on information not displayed on the current form. Here, for example, you might want to search for all the students living in Wells Hall (which isn't the hall on the current record). Access provides a special filter button for use with forms (the middle of the three filter buttons).

1. Click on the **[Filter by Form]** button (the middle one of the three filter buttons)
2. If the form is not empty, click on the **[Clear Grid]** button
3. Click on the *list arrow* attached to the *Hall* field and select **Wells**
4. Click on the **[Apply Filter]** button - you should now have just 21 records (use **<Page Down>** to move through them)
5. Click on the **[Remove Filter]** button to see all the records - note that the same button is used for applying or removing a filter
6. Close the form by clicking on its **[Close]** button - or use **Close** from the

   File menu

Note that you are not asked to save the changes to the design of the form (you are with a table). Any

sorting is saved automatically; any filtering is discarded. Note also that you can use **[Filter by Form]** on a table. Here you are given a blank record into which you type the required criteria.

Using a Report

The fourth object button in the *Database* window is *Report*. This allows you to create (and store) reports which can then be printed.

1. Click on **Reports** in the *Objects* list

A report for the students table has already been prepared (you will see how to create a report later):

2. Check **students** is highlighted it and press **<Enter>** for **[Preview]** - you may need to **[Maximize]** the window
3. The mouse button acts as a zoom facility - position the magnifying glass over a particular piece of text and click on the mouse button to magnify it
4. Use **<Page Down>** or the page selection buttons at the foot of the

   Preview window to move to other pages

To see how the report is designed:

5. Click on the **[View]** button to move to *Design View*

Note how similar the *Report Design* and *Form Design* windows are - you have the same *Toolbox* to draw the various components. Again, you will see how this is done later.

6. Click on the **[View]** button again to move back to *Print Preview*
7. Close the Report - click on its **[Close]** button or use **Close** from the

   File menu

Part 2 : Creating a New Table

In this next section you will be creating your own table (and form). You will then type in a couple of records - the rest you will retrieve from a file.

Designing the Table

As much as possible of a table design should be done in advance on paper. Here, however, you will

be creating the table on the screen so that you can see the stages as they are implemented. The table you are going to create contains information about the Halls of Residence at the University. In Part 3 of these notes, you will see how to link this information to the data in the **students** table:

1. Click on **Tables** in the list of *Objects* in the *Database* window
2. In this window, click on **[New]** for a new table

You are now offered various alternatives (the first three of which can also be accessed from special buttons on the tables tab in the *Database* window):

- *Datasheet View* creates a dummy datasheet for you, with the fields named as *Field1*, *Field2* etc. As you enter data into the fields, Access recognizes the type of data entered and allocates a *Data Type* to it (eg if you type a date, the field will be set up as a Date/Time field). To name the fields, double click on each column heading and type in its new name
- *Design View* lets you do everything yourself, from scratch
- *Table Wizard* has predefined *Sample Tables* (eg Employees, Addresses, Inventories) for both Business and Personal applications. Each sample table has suggested fields, which you may or may not want to include in your own table design. Wizards have the disadvantage that they sometimes try to be too clever and are very much geared to the American market (eg Addresses have States, not Counties)
- *Import Table* and *Link Table* allow you to import data from or link the table to another file, respectively. This file could be an Excel spreadsheet, for example, or another database

To understand the fundamentals of table design:

3. Choose **Design View** - press **<Enter>** or click on **[OK]**
4. The first field is for the name of the hall - type in **Name** and press **<Enter>**

Note: It's important that you name the fields exactly as specified in these notes for one of the later

exercises to work.

5. The *Data Type* is **Text** by default - press **<Enter>** as this is what you want for this field
6. The *Description* is optional - type in **Name of Hall of Residence** if you want
7. Move down to the *Field Properties*

Tip: Key **<F6>** can be used to *Switch* panes - or you can use the mouse.

8. Set a *Field Size* of **12** and press **<Enter>**

If you need to increase the field size at some time in the future there should be no problem. However, if you ever choose to decrease it then you could lose some data.

9. Set up a *Caption* of **Name of Hall** then *Required* to **Yes**
10. Set *Indexed* to **Yes (No Duplicates)** - it's worth putting an *index* on this field since it is likely to be used for sorting and it also insures that the data for a particular hall is not entered twice
11. Move to the second row - press **<F6>** and **<Enter>**, or use the mouse
12. Set the *Field Name* to **Warden** and the *Data Type* to **Text**

You could now fill in the *Description* and set some *Properties* but, to speed things up, just leave the settings for this (and subsequent fields) as they are.

13. Press **<*down arrow*>** to move to the third field
14. Set the *Field Name* to **Phone** and the *Data Type* to **Text**
15. Press **<*down arrow*>** to move to the fourth field
16. Set the *Field Name* to **Road** and the *Data Type* to **Text**
17. Press **<*down arrow*>** to move to the fifth field
18. Set the *Field Name* to **Town** and the *Data Type* to **Text**
19. Press **<*down arrow*>** to move to the sixth field
20. Set the *Field Name* to **Students**, the *Data Type* to **Number** (for a *Description* add **Number of students living in the Hall**) and the *Field Size* property to **Integer**

21. Move to the seventh field
22. Set the *Field Name* to **Meals**, the *Data Type* to **Yes/No** (for a *Description* add **Are meals provided?**) and the *Default Value* property to **Yes**

Note: The *Lookup* tab in the *Field Properties* allows you to set up a different *Display Control* on a form or table. For a *Yes/No* field, this is set to *Check Box* but can be *Text* or *Combo Box*:

23. For the *Meals* field, click on the *Lookup* tab and set *Display Control* to

    Text Box

Setting up a Primary Key

Primary Key: 

Whenever you design a new table, it's a good idea to set up a *Primary Key* on one of the fields. Primary Keys help Access uniquely identify each individual record in a table and hence work more efficiently. If a table doesn't contain a unique identifier then Access will ask to set up an ID field for you. Here, the *Halls of Residence* table already has a unique field - the name of the hall:

1. Click on the **Name** field (row 1)
2. Click on the **[Primary Key]** button - a key symbol appears in the *field indicator* column
3. Click on the **[View]** button to move to *Datasheet View*
4. When asked (press **<Enter>** for **[Yes]**), save the table as **HoR** - press

   <Enter> or click on **[OK]**

You could now type in your data, if you wanted to. Using a datasheet isn't very friendly, however, so try setting up a special *data-entry form*. A form gives you more control over what data is entered and can be designed to cut down on typing mistakes, as you saw with the students form.

Creating a Data Entry Form

There are two simple ways of creating a form, you can either use a *Form Wizard* or *AutoForm*. AutoForm is a very quick and easy way to produce a form - it does so at the click of a button:

1. With the **HoR** table still open, click on the *down arrow* attached to the **[New Object]** button and choose **AutoForm** - the form appears instantaneously in a new window
2. Click on its **[Close]** button to **Close** the form - don't save it this time

   (click on **[No]**) as you will be creating the form using a *Wizard* next
3. Close the **HoD** table by again clicking on its **[Close]** button

The *Form Wizard* is equally easy to use and offers you various additional options.

1. At the *Database* window, click on **Forms** in the *Objects* list and then on

   [New]
2. In the *New Form* window, click on the *list arrow* and set the data source for the form to **HoR**
3. Click on **Form Wizard** then press **<Enter>** or click on **[OK]**

You are now asked which fields you want to appear on your form (here you have the choice - *AutoForm* gave you them all). As it happens, for a data entry form, you need all the fields:

4. Click on the double arrow **[>>]** to move them all (alternatively select individual fields in the order you want and use the [>] button) - press

   <Enter> or click on **[Next>]**
5. Choose a *layout* for your form (explore the alternatives, if you like, but ignore *PivotTable* and *PivotChart*) - **Columnar** is best (press **<Enter>** or click on [**Next>**])
6. Set a *style* for your form - choose **Standard** (press **<Enter>** or click on

   [**Next>**])
7. Add a title - accept **HoR** (press **<Enter>** to **[Finish]**)

The form is now opened for you to use. As it stands it is neat and simple, but a little boring - in fact it's exactly the same as that produced using *AutoForm*. To improve it

Toolbox:  **Label:** 

8. Click on the **[View]** button (to move to *Design View*)

9. Enlarge the *Form Design* window - click on the **[Maximize]** button (to the left of **[Close]**)

Forms have three (sometimes more) sections - a *header*, *footer* and the *detail*. The data itself is entered into the detail section; the header and footer can be used for titles etc. To add a title:

10. Position the mouse over the border between the *Form Header* and *Detail* - the cursor should change shape to a double-headed arrow. Hold the mouse button down and drag the border down one unit (there's a scale on the left-hand side)
11. Click once on the **[Label]** tool in the *Toolbox* - the mouse pointer now has an A attached

Tip: If you accidentally close the *Toolbox*, you can redisplay it by clicking on the **[Toolbox]** button (or select **Toolbox** from the **View** menu).

12. Move the pointer into the form header (top left corner) and click once
13. A small label box is drawn - type your form title: **Halls of Residence - The University of Reading**
14. Press **<Enter>** and the label box is completed
15. Change the **[Font Size]** (eg to **14** point) and click on **[Bold]** to make the title more imposing
16. To display the enlarged title, *right click* on the label box and choose **Size** then **To Fit** (this command can also be issued via the **Format** menu)

To add colour:

17. *Right click* on the *label* box and choose **Font/Fore Color** - pick a colour to apply to your title
18. *Right click* on the header background (away from the label) and choose a **Fill/Back Color**
19. Repeat the process to change the colour of the detail background, other labels/text boxes etc

Tip: Use the **[Format Painter]** to copy the colour scheme of one label or text box to the others - this speeds things up and gives a better overall design.

20. Press **<Ctrl s>** (or click on the **[Save]** button) to save the changes to the design of the form - the name of the form is picked up automatically as **HoR**
21. Click on the **[View]** button to move to *Form View*

The form is now ready for you to type in the data.

Entering Data Using the Form

You are now going to use the form to enter a couple of data records:

1. For the first record, type in the following: Name: **Bridges** (and press **<Enter>**)

   Warden: **Dr R.P.B. Smith** (**<Enter>**) Phone: **x8647** (**<Enter>**)

   Road: **Whiteknights Road** (**<Enter>**) Town: **Reading RG6 6BG** (**<Enter>**) Students: **458** (**<Enter>**)

   Meals: the *option box* is already set on for **Yes**

2. Press **<Enter>** to move on to the second record, which is as follows: Name: **Childs** (and press **<Enter>**)

   Warden: **Prof A.L. Jones** (**<Enter>**) Phone: **x8800** (**<Enter>**)

   Road: **Upper Redlands Road** (**<Enter>**) Town: **Reading RG1 5JW** (**<Enter>**) Students: **458** (**<Enter>**)

   Meals: again, the *option box* is already set on for **Yes**

This is all you are going to enter explicitly; the remaining records are going to be *imported* from a data file created using another package.

3. Close the *Form* window by clicking on the **[Close Window]** button
4. Click on the **[Restore Window]** button (the middle one of the three in the top right corner of the window) to return the *Database* window to a smaller size

Importing Data

Access allows you to bring in information from other sources - this is called importing. Databases vary on how they bring in the data and on which sort of files they can import. If you have a really large dataset, it is a good idea to try importing a small section to a new table first and only if that works successfully to try to import it all.

Access can import data in various formats, including Dbase (another widely-used database) and

HTML (from web pages). Microsoft Excel spreadsheet files can be imported directly. Here, the data has been saved as *tab separated values*, which is a standard format which any spreadsheet (or indeed word processor) should be able to produce. Other basic formats

include *comma separated values* and just plain *text*. One thing to note when importing a file is that the first line may contain headings - Access has an option to cope with this and can use them for field names.

You should currently be back at the Database window. To *add* the data to an existing table (or create a *new* table) from a file:

1. At the *Database* window, click on **Tables** in the *Objects* list and choose

   [New]

2. Click on **Import Table** then press **<Enter>** or click on **[OK]**
3. Check that the current directory is set to **Training** on the **D:** drive (if using a lab PC; if not, the file can be downloaded via the hyperlink at step **5**)
4. Change the *Files of type:* box to read **Text Files** by using the *list arrow*

   attached

5. Select the file called **halls.txt** then press **<Enter>** to **[Import]** it
6. The *Import Text Wizard* now starts up. This has several stages, as follows:

   a. Choose whether the data is character (eg tab, comma or space) delimited or fixed width (where extra spaces have been used to line up the data in columns) - press **<Enter>** or click on **[Next>]** for *Delimited*

   b. Choose the delimiter (here, *tab* is correctly chosen) and whether or not the *First Row Contains Field Names* (**here, it does, so**

      ***click* to set it**) - press **<Enter>** for **[Next>]**

      Tip: If you are adding to an existing table and the first row doesn't match the table field names then import them as an extra record, which you later delete.

c. You are now asked whether you want a new table or to add to an existing one. Click on the *list arrow* and set *In an Existing Table:* to **HoR** - press **<Enter>** for **[Next>]**

d. The final step of the wizard confirms the table name (or lets you type in a new one, if creating a new table) - press **<Enter>** for **[Finish]**

You should have imported 14 new records - press **<Enter>** for [**OK**] to move on.

7. At the *Database* window, select and [**Open**] the **HoR** table to see the new records
8. Resize the columns by double clicking on the column heading dividers
9. End by closing the table - click on its **[Close]** button, saving the changes to the layout of the table (press **<Enter>** for **[Yes]**)

Note: you can also export data from Access for another package to read using **Export...** from the **File** menu. Amongst the formats available are Excel and character or tab delimited (suitable for many applications, including SAS, SPSS and Minitab).

Part 3: Relating Tables Together

A relational database management system lets you store information in many tables which can then be linked together. This is particularly useful when you have information which is either heavily duplicated or sparse (many records having empty fields). For example, if you have an inventory

of equipment, it's better to record information about the suppliers (the name, address, phone/fax numbers, contact etc) in a separate file. Then, in your inventory, you need only record the name of the supplier to find out the

other information. As each supplier will be supplying several pieces of equipment, this avoids massive data duplication.

It's the same situation here with the students. There is no need to store information about Halls of Residence for each student - that can be picked up from the *HoR* table. You'll see next how this is done. The aim of the exercise is to create a list of students, living in hall, such that you can send them a letter to their University address.

1. Click on **Queries** in the *Objects* list at the *Database* window

2. *Double click* on **[Create query in Design view]** or use **[New]** then

   Design View

3. **[Add]** both the **HoR** and **students** tables to your query - press **<Esc>**

   or click on **[Close]**

You next have to join the two tables together on a common field. Joins can be created between tables when you design the database (in a special *Relationships* window), or made in a query (in which case they only apply to that particular query).

Tables are automatically joined in a query if two fields have the same name. Here, however, the common field (the Hall of Residence) is called *Hall* in the *students* table but *Name* in the *HoR* table. In this case you have to create the join manually by dragging the field name from one table over to the corresponding name in the other table.

4. Position the cursor over the **Name** field in the **HoR** table
5. Hold down the mouse button and drag the field over the **Hall** field in the

   Students table

When you release the mouse button, a *join line* appears. If you made a mistake, simply click on the join line to select it then press **<Delete>** and try again. Now you need to set up your query:

6. In column 1, set the *Field:* to **FirstName** from the **students** table
7. In column 2, set the *Field:* to **Surname** from the **students** table
8. In column 3, set the *Field:* to **Hall** from the **students** table
9. In column 4, set the *Field:* to **Road** from the **HoR** table
10. In column 5, set the *Field:* to **Town** from the **HoR** table
11. Sort the data by Hall - set *Sort:* to **Ascending** in column 3
12. Click on **[Run]** to run the query - you should find 265 records are displayed (if you spelt Bridges and Childs correctly - the 125 students living in private accommodation are excluded)
13. Click on the query window's **[Close]** button, saving it as **Addresses**

Creating a Report

Earlier you viewed an existing report; now, try to generate some yourself. Reports are saved within the database - you can then modify them at some later date if you need to tidy up the layout, for example. Note that you can also export data to Word or Excel via **Office Links** in the **Tools** menu.

Access gives you the opportunity of designing your own reports from

scratch (using *Design View*), however, unless you are an expert, don't even attempt this. It's much easier to use *AutoReport* or a *Report Wizard* and then modify the design if you really need to.

Using AutoReport

Begin by creating a report for the *HoR* table using *AutoReport*.

1. At the *Database* window, click on **[Reports]** in the *Objects* list and choose **[New]**
2. Use the list arrow to select the **HoR** table
3. Click on *AutoReport: Tabular* then press **<Enter>** or click on **[OK]**

A report is automatically produced for you. It looks fine, so there is no need to change the *design* unless you really want to.

4. Click on the report window's **[Close]** button, saving it as **HoR**

AutoReport gives you a very simple report. By using the *Report Wizard* instead, however, you can set various other options (as you found with the *Form Wizard*). You'll look at this next.

Using Report Wizards

To demonstrate the Report Wizard, you are going to produce a report listing the students by their hall of residence, with the hall address only appearing once for each group of students:

1. At the *Database* window, click on **[Reports]** in the *Objects* list
2. *Double click* on **[Create report by using wizard]** or use **[New]** and the

   Report Wizard
3. Use the *list arrow* to select the **Addresses** query
4. The Report Wizard now goes through six steps:

a. Move across the fields you want on your report. Here, you want all the fields, so click on **[>>]** - press **<Enter>** or click on **[Next>]**

b. Step two allows you to set grouping levels. You only need a list of names for each hall, so use the address fields for grouping (these then appear once for each list of names) - move across *Hall, Road* and *Town* (using **[>]**) then press **<Enter>** or click on **[Next>]**

c. *Sort by:* **Surname** and then **FirstName** - press **<Enter>** or click on **[Next>]**

d. Choose a *Layout*: **Align Left 1** is fine - press **<Enter>** or click on **[Next>]**

e. Choose a *Style* for your report (eg **Formal**) - press **<Enter>** or click on **[Next>]**

f. Call your report **Addresses** - press **<Enter>** or click on **[Finish]**

The resultant report may not be exactly what you want (in fact it looks terrible) but it's easier to modify a design than to create one from scratch. Here, for example, there is no need for the boxes round the headings (or indeed the headings themselves), the address for each hall needs to be in the same style and lined up properly, and the list of students should be on the left of the page.

5. Click on the **[View]** button to see the *Design View*
6. Open the **View** menu and select **Report Header/Footer** then click on **[Yes]** to delete these sections (they aren't needed here)
7. Click on the *Hall* label (the box on the left) in the *Hall Header* and **<Delete>** it
8. Click on the *Hall* text box in the *Hall Header* and, using the mouse or ***<arrow keys>***, move it to the far left
9. Repeat steps **7** and **8** for the *Road* and the *Town* boxes
10. Using the mouse in the ruler on the left, drag down through the *Town Header* (very top to very bottom), then *<Shift> click* on the *Town* text box (to unselect it) and **<Delete>** everything else
11. Click on the *Hall* text box in the *Hall Header* then on the **[Format Painter]** button (the brush

to the right of **[Paste]**) and click on the *Road* text box to paint the format

12. *Right click* on the *Road* text box and choose **Size ...** then **To Fit**
13. Repeat steps **11** and **12** on the *Town* text box
14. Finally, click on the *FirstName* text box (to select it) then, using the mouse or ***<arrow keys>***, move it to the far left - you may also need to move the *Surname* slightly to the right
15. Reduce the height of the *Detail* area slightly - position the mouse on the top of the *Page Footer* (it changes shape to a double-headed arrow), hold down the mouse button and drag the border up just a little

To force each hall onto a separate page:

16. *Right click* on the *Hall Header* and choose *Properties*
17. Set *Force New Page* to **Before Section** then **[Close]** the *Properties* window
18. Finally, click on the **[Print Preview]** button to see the changes you have made
19. Click on the window's **[Close]** button, saving the changes to the design of the report

Tip: For a multi-column layout, open the **File** menu and choose **Page Setup...**. Then, on the *Columns* tab, set the *Number of Columns* and *Width* as appropriate (eg to columns to 2 and width to 7.9) and change the *Column Layout* to **Down then Across**.

Next, try using a special wizard to generate the address labels for the students.

1. At the *Database* window, click on the **[Reports]** tab and choose **[New]**
2. Use the list arrow to select the **Addresses** query
3. Click on the *Label Wizard* then press **<Enter>** or click on **[OK]**
4. The Label Wizard now goes through five steps:
    a. Setup the size for your labels - check *Filter by manufacturer:* is set to **Avery**, change the *Units of Measure* to **English** and select the *Product number:* for your labels (eg **5160**) - press

<Enter> or click on **[Next>]**

b. Setup the *Font name* and *Font size* etc which you require (here leave them as they are) - press **<Enter>** or click on **[Next>]**

c. Move the fields across to a *Prototype Label* by clicking on the

arrow provided:

- move across *FirstName*, press the **<spacebar>**, then *Surname*

- press **<Enter>**

- move across *Hall* then press **<spacebar>** and type **Hall** - press **<Enter>**

- move across *Road* - press **<Enter>**

- move across *Town* - click on **[Next>]**

d. *Sort by:* **Hall** and then **Surname** - press **<Enter>** or click on

[Next>]

e. Call your report **Labels Addresses** - press **<Enter>** or click on

[Finish]

5. Press **<Enter>** (for **[OK]**) to cancel the warning message

6. View the report then click on its **[Close]** button to close the report

Tip: Getting Access reports looking exactly the way you want can be very time-consuming. It may be easier to do the formatting in Word - from the **Tools** menu choose **Office Links** then **Publish it with Microsoft Office**

Word. You can also send data to Excel if you want to carry out an analysis of the information.

Leaving Access

You should now be back at the *Database* window, where you could continue to work on the student's database, adding further tables and queries and producing more reports. When you have completely finished your work, open the **File** menu and issue a **Close** command. This closes any opened tables etc. and ensures that the database file is properly shut down.

You could now go on to use or create another database, but the course is now over so open the **File** menu and choose **Exit**. Finally, on the public machines, don't forget to **Log Off**.

6.5 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. What is the program that enables you to create, access and manage a database called …….
2. When an Access file is saved, ……. file format it takes.
3. In MS-Access, the rows in a table represent …….
4. A Strip of buttons across the top of the main window is called ……..
5. …… tab consists of Spelling and grammar, thesaurus etc.

B. State whether the following statements are True or False:

1. Print Preview of Word does not allow you to do any editing.
2. The spelling and grammar check can only be done once the text is selected.
3. Graphics cannot be placed in headers and footers in MS-Word.
4. Clicking on any cell will highlight the selected print area.
5. You can only select cells that are adjacent to each other.

6.6 SUMMARY

Microsoft word is a widely used commercial word processor designed by Microsoft. It is a paid software that helps in preparing, editing, storing and printing documents quickly and with accuracy. A word processor lets a user change words or phrase, move whole sections of text from one place to another, store blocks of text, align margins. Use of MS word has changed the look and feel of official correspondence, reports and proposals etc. to a great extent. Microsoft excel is a software program developed by Microsoft corp. that allow users to organize, format and calculate data with formulas using a spread sheet system. This software has the same basic features as every other spread sheet, and uses a collection of cells arranged into rows and columns to organize data. An excel document is called a workbook. A workbook always has at least one worksheet. Worksheets are the grid where a user can store and calculate data. Microsoft access is used for data base management system. It stores data in form of tables.

6.7 KEYWORDS

Application Software: An application is any program, or group of programs, that is designed for the end user.

System Software: System software is a type of computer program that is designed to run a computer's hardware and application programs.

DBMS: Database Management System (DBMS) is a software for storing and retrieving users' data while considering appropriate security measures.

Spreadsheet: Spreadsheets present tables of values arranged in rows and columns that can be manipulated mathematically using both basic and complex arithmetic operations and functions.

MS-Word: Microsoft Word or MS-WORD (often called Word) is a Graphical word processing program that users can type with. Its purpose is to allow users to type and save documents.

6.8 SELF-ASSESSMENT TEST

1. What do you understand by Word processing? Give examples.
2. Describe the important features of Ms-Word.
3. Describe the various options available in the main menu bar of Ms-Word.
4. What are the different types of toolbar in MS word?
5. Define two methods to start Ms-Word.
6. What do you understand by Spread sheet?
7. Describe the important features of MS Excel.
8. What are the different types of toolbar in MS Excel?
9. Describe the important features of MS access.
10. What are the different types of toolbar in MS Access?

6.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress A:

1. Database Management System
2. .mdb
3. Record
4. Ribbon
5. Review

Check Your Progress B:

1. True
2. False
3. False
4. True
5. False

6.10 REFERENCES/SUGGESTED READINGS

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2. By - Paul Mcfedries, "Formulas & Functions MS Office Excel 07" Pearson Education India, 1990.
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4. Dr. S.S. Srivastava, "MS-Office" Firewall Media, 2008.
5. https://www.tutorialspoint.com/word/index.htm
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Course Code: BC 104	Author : Mr. Balwant
Lesson: 7	Vetter: Prof. Dharminder Kumar

COMPUTER NETWORKS

Structure

7.0 Learning Objectives

7.1 Introduction

7.1.1 Data communication

7.1.2 Components

7.1.3 Data representation

7.1.4 Data flow

7.1.5 Computer Network

7.2 Internetwork

7.3 Hardware and software requirement for network

7.3.1 Hardware requirement

7.3.2 Software requirement

7.3.2.1 Local operating system

7.3.2.2 Networking operating system

7.3.2.3 Protocol suite

7.4 Network topologies

7.5 Check your Progress

7.6 Summary

7.7 Keywords

7.8 Self-Assessment Test

7.9 Answers to Check Your Progress

7.10 References/Suggested Readings

7.0 Learning Objectives

In this lesson you will learn about

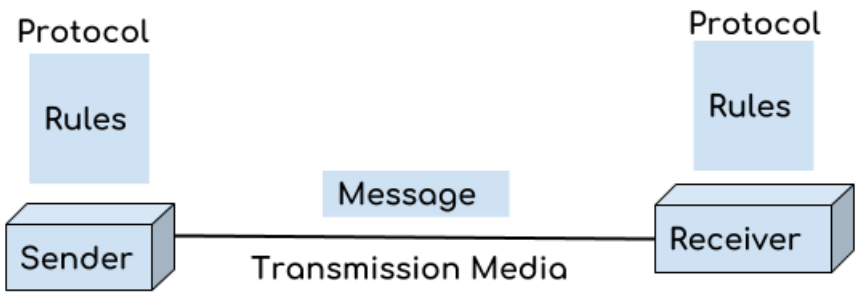
- ✓ Data communication and its components
- ✓ Data representation and data flow
- ✓ Features and classification of computer network
- ✓ Types of computer networks
- ✓ What is an internetwork?
- ✓ Hardware and software requirement for network
- ✓ Network topologies

7.1 INTRODUCTION

7.1.1 Data Communication: When we communicate, we are sharing information. This sharing can be local or remote. Between individuals, local communication usually occurs face to face, while remote communication takes place over distance.

7.1.2 Components:

A data communications system has five components.



1. **Message**. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.

2. **Sender.** The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.

3. **Receiver.** The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.

4. **Transmission medium.** The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves

5. **Protocol.** A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices. Without a protocol, two devices may be connected but not communicating, just as a person speaking French cannot be understood by a person who speaks only Japanese.

7.1.3 Data Representation:

Information today comes in different forms such as text, numbers, images, audio, and video.

Text:

In data communications, text is represented as a bit pattern, a sequence of bits (0s or 1s). Different sets of bit patterns have been designed to represent text symbols. Each set is called a code, and the process of representing symbols is called coding. Today, the prevalent coding system is called Unicode, which uses 32 bits to represent a symbol or character used in any language in the world. The American Standard Code for Information Interchange (ASCII), developed some decades ago in the United States, now constitutes the first 127 characters in Unicode and is also referred to as Basic Latin.

Numbers:

Numbers are also represented by bit patterns. However, a code such as ASCII is not used to represent numbers; the number is directly converted to a binary number to simplify mathematical operations. Appendix B discusses several different numbering systems.

Images:

Images are also represented by bit patterns. In its simplest form, an image is composed of a matrix of pixels (picture elements), where each pixel is a small dot. The size of the pixel depends on the *resolution*. For example, an image can be divided into 1000 pixels or 10,000 pixels. In the second case, there is a better representation of the image (better resolution), but more memory is needed to store the image. After an image is divided into pixels, each pixel is assigned a bit pattern. The size and the value of the pattern depend on the image. For an image made of only black and white dots (e.g., a chessboard), a 1-bit pattern is enough to represent a pixel. If an image is not made of pure white and pure black pixels, you can increase the size of the bit pattern to include gray scale. For example, to show four levels of gray scale, you can use

2-bit patterns. A black pixel can be represented by 00, a dark gray pixel by 01, a light gray pixel by 10, and a white pixel by 11. There are several methods to represent color images. One method is called RGB, so called because each color is made of a combination of three primary colors: *red,* green, and blue. The intensity of each color is measured, and a bit pattern is assigned to it. Another method is called YCM, in which a color is made of a combination of three other primary colors: yellow, cyan, and magenta.

Audio:

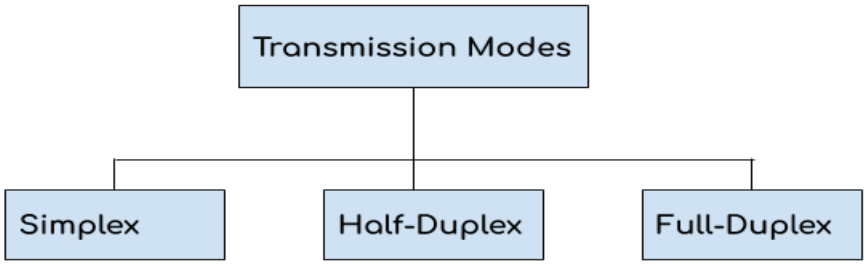
Audio refers to the recording or broadcasting of sound or music. Audio is by nature different from text, numbers, or images. It is continuous, not discrete. Even when we use a microphone to change voice or music to an electric signal, we create a continuous signal. We can change audio to a digital or analog signal.

Video:

Video refers to the recording or broadcasting of a picture or movie. Video can either be produced as a continuous entity (e.g., by a TV camera), or it can be a combination of images, each a discrete entity, arranged to convey the idea of motion. Again we can change video to a digital or an analog signal.

7.1.4 Data Flow

Communication between two devices can be simplex, half-duplex, or full-duplex as shown in Figure

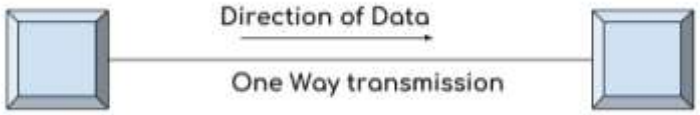


Simplex:

- In simplex mode the data transmits in one direction only, from one system to another system.
- The sender device that sends data can only send data and cannot receive it. On the other hand, the receiver device can only receive the data and cannot send it.
- Television is an example of simplex mode transmission as the broadcast sends signals to our TV but never receives signals back from our TV. This is a unidirectional transmission.

Advantages of Simplex Mode:

- The full capacity of the transmission medium is utilized as the transmission is one way and cannot have traffic issues.



Simplex Mode

Disadvantages of Simplex Mode:

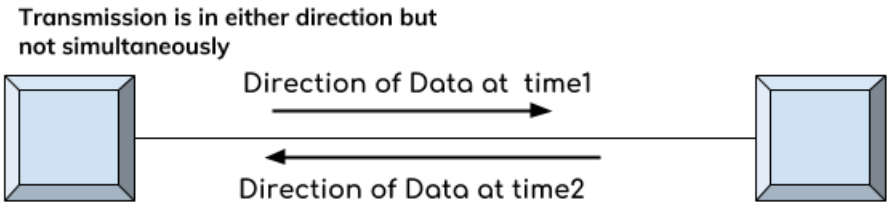
No bidirectional communication is possible. Two devices cannot communicate with each other using simplex mode of transmission.

Half-Duplex:

- In half duplex mode transmission can be done both ways which means if two systems are connected with half-duplex mode of transmission, they both can send and receive data but not at

the same time.

- If one device is sending data, then other device cannot send data until it receives the data which is already in transmission. You can say that the communication is not simultaneous.
- The radio communication device that our soldiers use at the battle fields are the examples of half duplex mode transmission as they send message and then say over and then the person on other hand send his message and this way they communicate but not simultaneously like we used to do on mobile.



Half-Duplex Mode

Advantages of Half-Duplex mode:

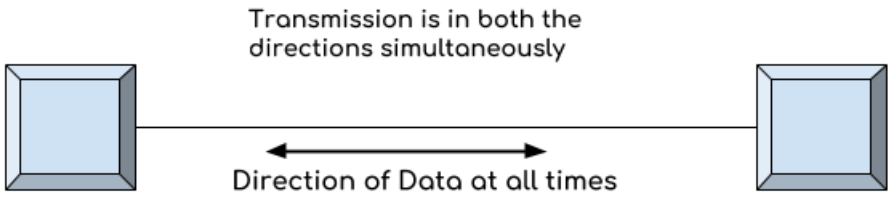
- Both devices can send and receive data.
- Whole bandwidth can be utilized as at a time only one signal transmits.

Disadvantages of Half-Duplex mode:

The disadvantage in half duplex mode is that the other device cannot send data until it receives the data which is already in transmission, this can cause delays to the communication.

Full-Duplex:

- In full duplex mode both the connected devices can send and receive data simultaneously. The mobile phone we use is an example of full duplex mode where we can communicate simultaneously.
- Both the devices can send and receive the data at the same time.



Full-Duplex Mode

Advantages of Full Duplex mode: No delays in communication as both can send and receive data simultaneously.

Disadvantages of Full Duplex mode: No proper bandwidth utilization as the same line is used for sending and receiving data at the same time.

7.1.5 COMPUTER NETWORK

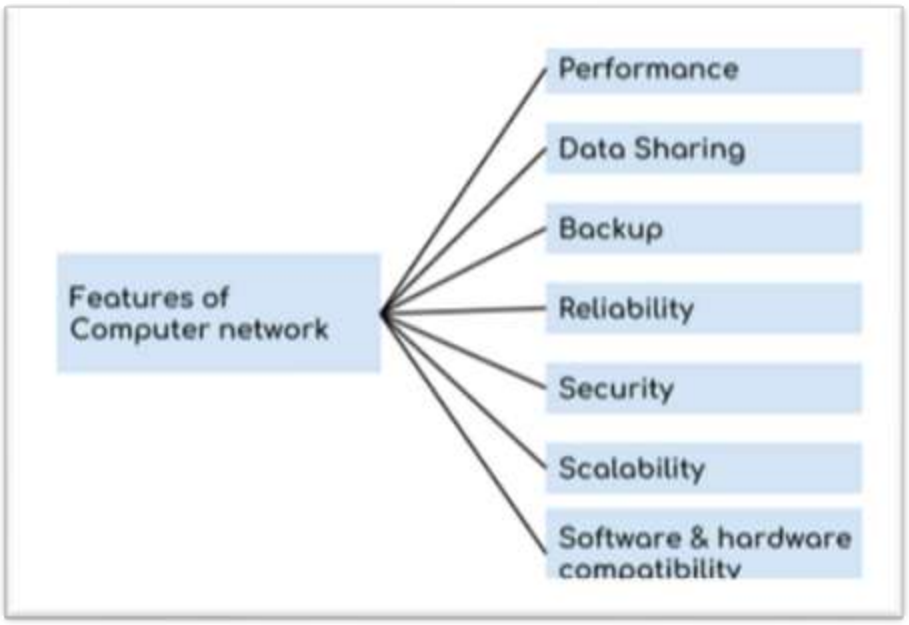
A computer network is a group of devices connected with each other through a transmission medium such as wires, cables etc. These devices can be computers, printers, scanners, Fax machines etc. The purpose of having computer network is to send and receive data stored in other devices over the network. These devices are often referred as nodes.

7.1.5.1 Features of a Computer Network

A network has following features.

Performance: Performance of a computer network is measured in terms of response time. The response time of sending and receiving data from one node (computer in a computer network are often referred as node) to another should be minimal.

Data Sharing: One of the reason why we use a computer network is to share the data between different systems connected with each other through a transmission media.



Backup: A computer network must have a central server that keeps the backup of all the data that is to be shared over a network so that in case of a failure it should be able to recover the data faster.

Software and hardware compatibility: A computer network must not limit all the computers in a computer network to use same software and hardware, instead it should allow the better compatibility between the different software and hardware configuration.

Reliability: There should not be any failure in the network or if it occurs the recovery from a failure should be fast.

Security: A computer network should be secure so that the data transmitting over a network should be safe from unauthorized access. Also, the sent data should be received as it is at the receiving node, which means there should not be any loss of data during transmission.

Scalability: A computer network should be scalable which means it should always allow to add new computers (or nodes) to the already existing computer network. For example, a company runs 100 computers over a computer network for their 100 employees, let's say they hire another 100 employees and want to add new 100 computers to the already existing LAN then in that case the local area computer network should allow this.

7.1.5.2 Classification of Computer Networks

Computer networks are classified based on various factors. They include:

- Geographical span
- Inter-connectivity
- Administration
- Architecture

Geographical Span

Geographically a network can be seen in one of the following categories:

- It may be spanned across your table, among Bluetooth enabled devices, Ranging not more than few meters.
- It may be spanned across a whole building, including intermediate devices to connect all floors.
- It may be spanned across a whole city.
- It may be spanned across multiple cities or provinces.
- It may be one network covering whole world.

Inter-Connectivity

Components of a network can be connected to each other differently in some fashion. By connectedness we mean either logically, physically, or both ways.

- Every single device can be connected to every other device on network, making the network mesh.
- All devices can be connected to a single medium but geographically disconnected, created bus-like structure.
- Each device is connected to its left and right peers only, creating linear structure.
- All devices connected together with a single device, creating star-like structure.
- All devices connected arbitrarily using all previous ways to connect each other, resulting in a hybrid structure.

Administration

From an administrator's point of view, a network can be private network which belongs a single autonomous system and cannot be accessed outside its physical or logical domain. A network can be public, which is accessed by all.

Architecture

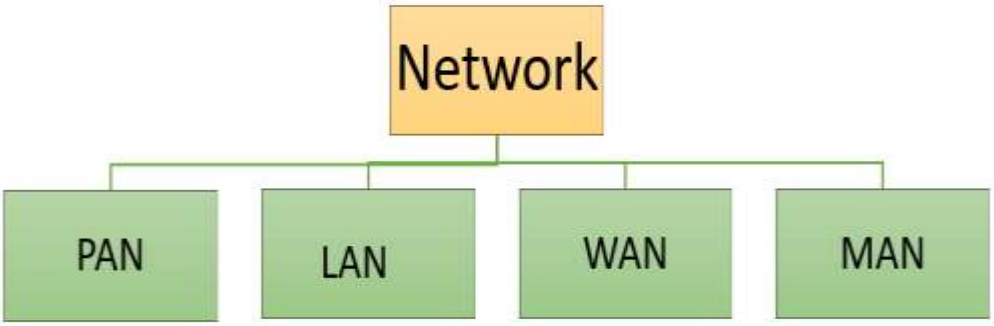
Computer networks can be discriminated into various types such as Client-Server, peer-to-peer or hybrid, depending upon its architecture.

- There can be one or more systems acting as Server. Other being Client, requests the Server to serve requests. Server takes and processes request on behalf of Clients.
- Two systems can be connected Point-to-Point, or in back-to-back fashion. They both reside at the same level and called peers.
- There can be hybrid network which involves network architecture of both the above types.

7.1.5.3 TYPES OF COMPUTER NETWORK

Generally, networks are distinguished based on their geographical span. A network can be as small as distance between your mobile phone and its Bluetooth headphone and as large as the internet itself, covering the whole geographical world.

A computer network can be categorized by their size. A computer network is mainly of four types:



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

PAN (Personal Area Network)

PAN is a computer network formed around a person. It generally consists of a computer, mobile, or personal digital assistant. PAN can be used for establishing communication among these personal devices for connecting to a digital network and the internet.

Characteristics of PAN

- It is mostly personal devices network equipped within a limited area.
- Allows you to handle the interconnection of IT devices at the surrounding of a single user.
- PAN includes mobile devices, tablet, and laptop.
- It can be wirelessly connected to the internet called WPAN.
- Appliances use for PAN: cordless mice, keyboards, and Bluetooth systems.

Disadvantages of PAN

Here are important cons/ drawback of using PAN network:

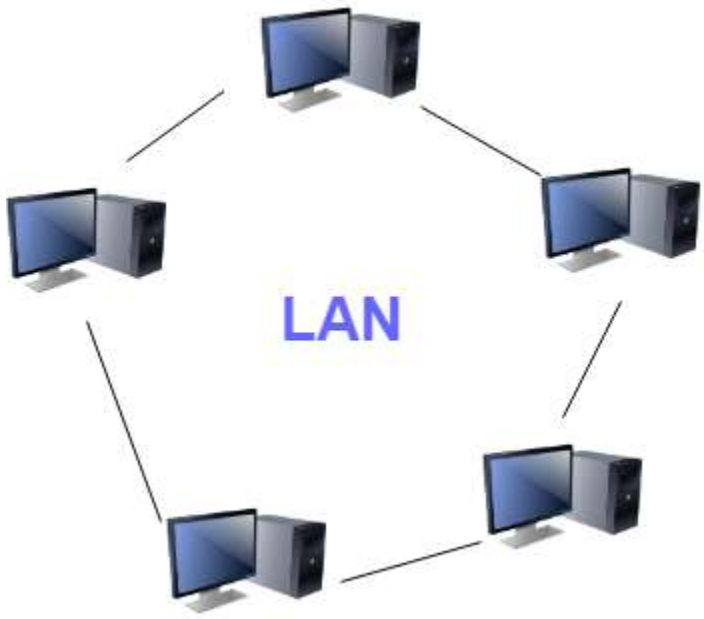
- It may establish a bad connection to other networks at the same radio bands.
- Distance limits.

LAN (Local Area Network)

LAN or Local Area Network connects network devices in such a way that personal computer and workstations can share data, tools and programs. The group of computers and devices are connected

together by a switch, or stack of switches, using a private addressing scheme as defined by the TCP/IP protocol. Private addresses are unique in relation to other computers on the local network. Routers are found at the boundary of a LAN, connecting them to the larger WAN. Data transmits at a very fast rate as the number of computers linked are limited. By definition, the connections must be high speed and relatively inexpensive hardware (Such as hubs, network adapters and Ethernet cables). LANs cover smaller geographical area and are privately owned. One can use it for an office building, home, hospital, schools, etc. LAN is easy to design and maintain. A Communication medium used for LAN has twisted pair cables and coaxial cables. It covers a short distance, and so the error and noise are minimized.

Early LAN's had data rates in the 4 to 16 Mbps range. Today, speeds are normally 100 or 1000 Mbps. Propagation delay is very short in a LAN. The smallest LAN may only use two computers, while larger LANs can accommodate thousands of computers. A LAN typically relies mostly on wired connections for increased speed and security, but wireless connections can also be part of a LAN. The fault tolerance of a LAN is more and there is less congestion in this network. For example: A bunch of students playing Counter Strike in the same room (without internet).



Characteristics of LAN

Here are important characteristics of a LAN network:

- It is a private network, so an outside regulatory body never controls it.
- LAN operates at a relatively higher speed compared to other WAN systems.
- There are various kinds of media access control methods like token ring and Ethernet.

Advantages of LAN

Here are pros/benefits of using LAN:

- Computer resources like hard-disks, DVD-ROM, and printers can share local area networks. This significantly reduces the cost of hardware purchases.
- You can use the same software over the network instead of purchasing the licensed software for each client in the network.
- Data of all network users can be stored on a single hard disk of the server computer.
- You can easily transfer data and messages over networked computers.
- Local Area Network offers the facility to share a single internet connection among all the LAN users.

Disadvantages of LAN

Here are the important cons/ drawbacks of LAN:

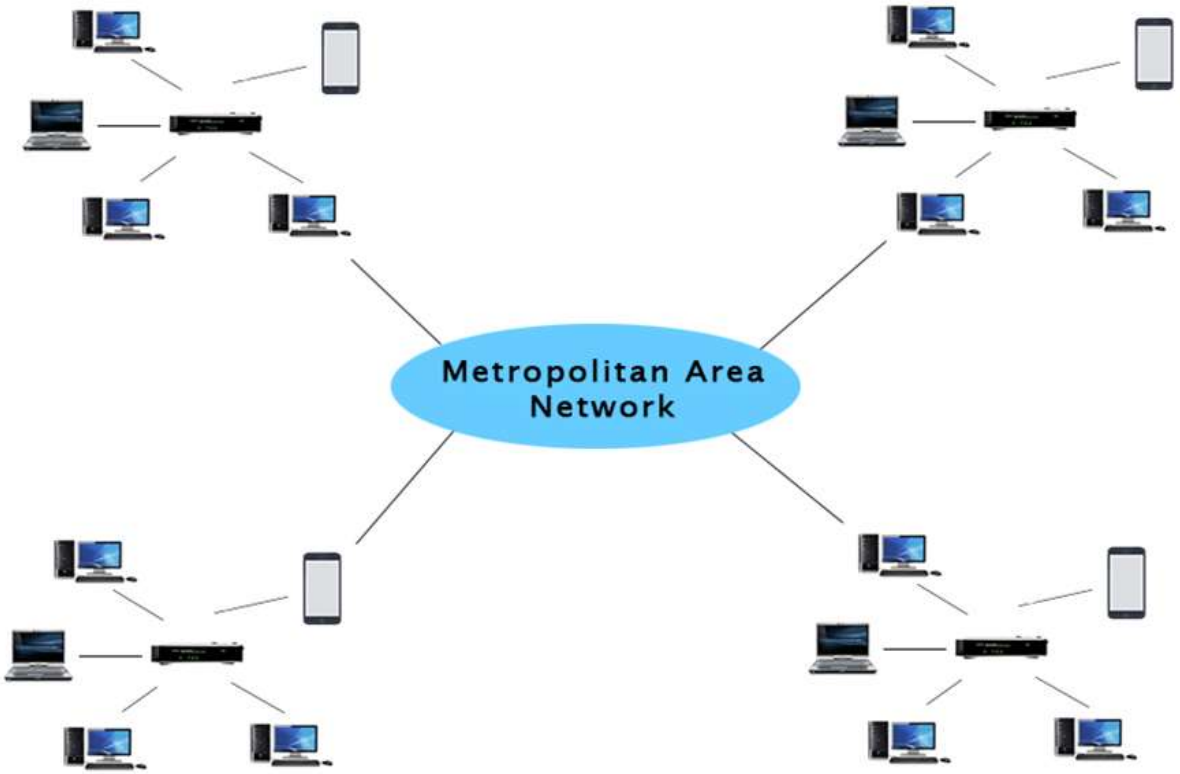
- LAN will indeed save cost because of shared computer resources, but the initial cost of installing Local Area Networks is quite high.
- The LAN admin can check personal data files of every LAN user, so it does not offer good privacy.
- Unauthorized users can access critical data of an organization in case LAN admin is not able to secure centralized data repository.
- Local Area Network requires a constant LAN administration as there are issues related to software setup and hardware failures

MAN (Metropolitan Area Network)

MAN or Metropolitan area Network covers a larger area than that of a LAN and smaller area as compared to WAN. It connects two or more computers that are apart but resides in the same or different cities. It covers a large geographical area and may serve as an ISP (Internet Service Provider). MAN is

designed for customers who need a high-speed connectivity. Speeds of MAN ranges in terms of Mbps. It's hard to design and maintain a Metropolitan Area Network.

The fault tolerance of a MAN is less and also there is more congestion in the network. It is costly and may or may not be owned by a single organization. The data transfer rate and the propagation delay of MAN is moderate. Devices used for transmission of data through MAN are: Modem and Wire/Cable. Examples of a MAN are the part of the telephone company network that can provide a high-speed DSL line to the customer or the cable TV network in a city.



Characteristics of MAN

- It generally covers towns and cities (50 km)
- Communication medium used for MAN are optical fibers, cables etc.
- Data rates adequate for distributed computing applications.

Advantages of MAN

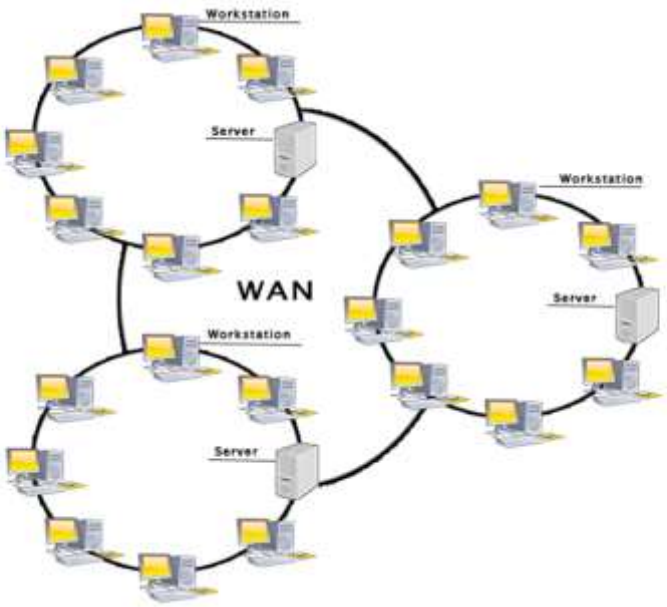
- Extremely efficient and provide fast communication via high-speed carriers, such as fiber optic cables.
- It provides a good back bone for large network and provides greater access to WANs.
- The dual bus used in MAN helps the transmission of data in both directions simultaneously.
- A MAN usually encompasses several blocks of a city or an entire city.

Disadvantages of MAN

- More cable required for a MAN connection from one place to another.
- It is difficult to make the system secure from hackers and industrial espionage(spying) graphical regions.

WAN (Wide Area Network)

WAN or Wide Area Network is a computer network that extends over a large geographical area, although it might be confined within the bounds of a state or country. A WAN could be a connection of LAN connecting to other LAN's via telephone lines and radio waves and may be limited to an enterprise (a corporation or an organization) or accessible to the public. The technology is high speed and relatively expensive.



There are two types of WAN: Switched WAN and Point-to-Point WAN. WAN is difficult to design and maintain. Similar to a MAN, the fault tolerance of a WAN is less and there is more congestion in the network. A Communication medium used for WAN is PSTN or Satellite Link. Due to long distance transmission, the noise and error tend to be more in WAN.

WAN's data rate is slow about a 10th LAN's speed, since it involves increased distance and increased number of servers and terminals etc. Speeds of WAN ranges from few kilobits per second (Kbps) to megabits per second (Mbps). Propagation delay is one of the biggest problems faced here. Devices used for transmission of data through WAN are: Optic wires, Microwaves and Satellites. Example of a Switched WAN is the asynchronous transfer mode (ATM) network and Point-to-Point WAN is dial-up line that connects a home computer to the Internet.

Characteristics of WAN

- It generally covers large distances (states, countries, continents).
- Communication medium used are satellite, public telephone networks which are connected by routers.

Advantages of WAN

- Covers a large geographical area so long distance business can connect on the one network.
- Shares software and resources with connecting workstations.
- Messages can be sent very quickly to anyone else on the network. These messages can have picture, sounds or data included with them (called attachments).
- Expensive things (such as printers or phone lines to the internet) can be shared by all the computers on the network without having to buy a different peripheral for each computer.
- Everyone on the network can use the same data. This avoids problems where some users may have older information than others.

Disadvantages of WAN

- Need a good firewall to restrict outsiders from entering and disrupting the network.
- Setting up a network can be an expensive, slow and complicated. The bigger the network the more expensive it is.

- Once set up, maintaining a network is a full-time job which requires network supervisors and technicians to be employed.
- Security is a real issue when many different people have the ability to use information from other computers. Protection against hackers and viruses adds more complexity and expense.

7.2 INTERNETWORK

A network of networks is called an internetwork, or simply the internet. It is the largest network in existence on this planet. The internet hugely connects all WANs and it can have connection to LANs and Home networks. Internet uses TCP/IP protocol suite and uses IP as its addressing protocol. Present day, Internet is widely implemented using IPv4. Because of shortage of address spaces, it is gradually migrating from IPv4 to IPv6.

Internet enables its users to share and access enormous amount of information worldwide. It uses WWW, FTP, email services, audio, and video streaming etc. At huge level, internet works on Client-Server model.

Internet uses very high speed backbone of fiber optics. To inter-connect various continents, fibers are laid under sea known to us as submarine communication cable.

Internet is widely deployed on World Wide Web services using HTML linked pages and is accessible by client software known as Web Browsers. When a user requests a page using some web browser located on some Web Server anywhere in the world, the Web Server responds with the proper HTML page. The communication delay is very low.

Internet is serving many proposes and is involved in many aspects of life. Some of them are:

- Web sites
- E-mail
- Instant Messaging
- Blogging
- Social Media
- Marketing
- Networking
- Resource Sharing

- Audio and Video Streaming

7.3 HARDWARE AND SOFTWARE REQUIREMENT FOR NETWORK

Computer networks components comprise both physical parts as well as the software required for installing computer networks, both at organizations and at home. Some important hardware components are NIC, switch, cable, hub, router, and modem. Depending on the type of network that we need to install, some network components can also be removed. For example, the wireless network does not require a cable. The software components are network operating system and protocols.

7.3.1 Hardware Requirement

Following are the major components required to install a network:

7.3.1.1 NIC: A network interface card (NIC) is a hardware component without which a computer cannot be connected over a network. It is a circuit board installed in a computer that provides a dedicated network connection to the computer. It is also called network interface controller, network adapter or LAN adapter.

Purpose

- NIC allows both wired and wireless communications.
- NIC allows communications between computers connected via local area network (LAN) as well as communications over large-scale network through Internet Protocol (IP).
- NIC is both a physical layer and a data link layer device, i.e. it provides the necessary hardware circuitry so that the physical layer processes and some data link layer processes can run on it.

Types of network interface cards

While the standard NIC is a plastic circuit board that slides into a computer to connect with the motherboard, there are multiple ways the network connection can occur:

- Wireless - These are NICs that use an antenna to provide wireless reception through radio frequency waves. Wireless NICs are designed for Wi-Fi connection.

- Wired - These are NICs that have input jacks made for cables. The most popular wired LAN technology is Ethernet.
- USB - These are NICs that provide network connections through a device plugged into the USB port.
- Fiber optics - These are expensive and more complex NICs that are used as a high-speed support system for network traffic handling on server computers. This could also be accomplished by combining multiple NICs.

7.3.1.2 Hub

A Hub is a hardware device that divides the network connection among multiple devices. When computer requests for some information from a network, it first sends the request to the Hub through cable. Hub will broadcast this request to the entire network. All the devices will check whether the request belongs to them or not. If not, the request will be dropped.

The process used by the Hub consumes more bandwidth and limits the amount of communication. Nowadays, the use of hub is obsolete, and it is replaced by more advanced computer network components such as Switches, Routers.

7.3.1.3 Switch

A switch is a hardware device that connects multiple devices on a computer network. A Switch contains more advanced features than Hub. The Switch contains the updated table that decides where the data is transmitted or not. Switch delivers the message to the correct destination based on the physical address present in the incoming message. A Switch does not broadcast the message to the entire network like the Hub. It determines the device to whom the message is to be transmitted. Therefore, we can say that switch provides a direct connection between the source and destination. It increases the speed of the network.

7.3.1.4 Router

A router is a network layer hardware device that transmits data from one LAN to another if both networks support the same set of protocols. So a router is typically connected to at least two LANs and the internet service provider (ISP). It receives its data in the form of packets, which are data frames with

their destination address added. Router also strengthens the signals before transmitting them. That is why it is also called repeater.

7.3.1.5 Gateway

Gateway is a network device used to connect two or more dissimilar networks. In networking parlance, networks that use different protocols are dissimilar networks. A gateway usually is a computer with multiple NICs connected to different networks. A gateway can also be configured completely using software. As networks connect to a different network through gateways, these gateways are usually hosts or end points of the network. Gateway uses packet switching technique to transmit data from one network to another. In this way it is similar to a router, the only difference being router can transmit data only over networks that use same protocols.

7.3.1.6 Modem

Modem is a device that enables a computer to send or receive data over telephone or cable lines. The data stored on the computer is digital whereas a telephone line or cable wire can transmit only analog data.

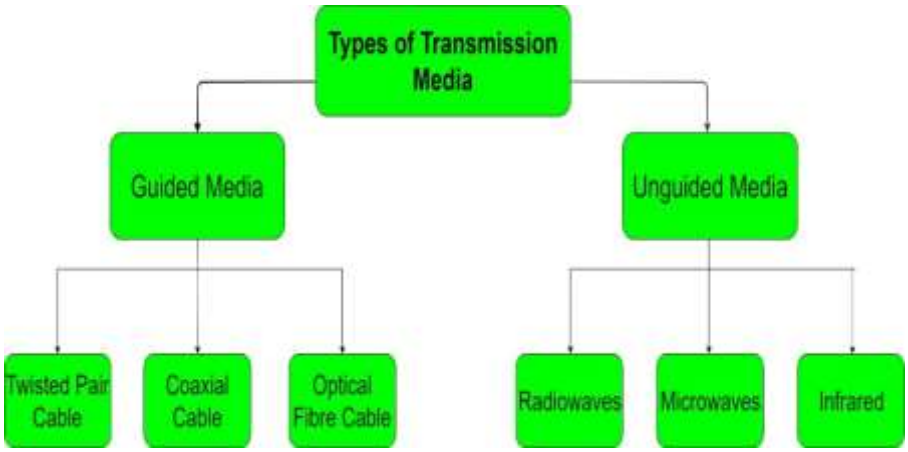
Digital Data Waveform

Analog Data Waveform

The main function of the modem is to convert digital signal into analog and vice versa. Modem is a combination of two devices − modulator and demodulator. The modulator converts digital data into analog data when the data is being sent by the computer. The demodulator converts analog data signals into digital data when it is being received by the computer.

7.3.1.7 Transmission media

In data communication terminology, a transmission medium is a physical path between the transmitter and the receiver i.e. it is the channel through which data is sent from one place to another. Transmission Media is broadly classified into the following types:



Guided Media:

It is also referred to as Wired or Bounded transmission media. Signals being transmitted are directed and confined in a narrow pathway by using physical links.

Features:

- High Speed
- Secure
- Used for comparatively shorter distances

There are 3 major types of Guided Media:

(i) Twisted Pair Cable: It consists of 2 separately insulated conductor wires wound about each other. Generally, several such pairs are bundled together in a protective sheath. They are the most widely used Transmission Media. Twisted Pair is of two types:

Unshielded Twisted Pair (UTP): This type of cable has the ability to block interference and does not depend on a physical shield for this purpose. It is used for telephonic applications.

Advantages:

- Least expensive
- Easy to install
- High speed capacity

Disadvantages:

- Susceptible to external interference
- Lower capacity and performance in comparison to STP
- Short distance transmission due to attenuation

Shielded Twisted Pair (STP): This type of cable consists of a special jacket to block external interference. It is used in fast-data-rate Ethernet and in voice and data channels of telephone lines.

Advantages:

- Better performance at a higher data rate in comparison to UTP
- Eliminates crosstalk
- Comparatively faster

Disadvantages:

- Comparatively difficult to install and manufacture
- More expensive
- Bulky

(ii) Coaxial Cable: It has an outer plastic covering containing 2 parallel conductors each having a separate insulated protection cover. Coaxial cable transmits information in two modes: Baseband mode (dedicated cable bandwidth) and Broadband mode (cable bandwidth is split into separate ranges). Cable TVs and analog television networks widely use Coaxial cables.

Advantages:

- High Bandwidth
- Better noise Immunity
- Easy to install and expand

- Inexpensive

Disadvantages: Single cable failure can disrupt the entire network

(iii) Optical Fiber Cable: It uses the concept of reflection of light through a core made up of glass or plastic. The core is surrounded by a less dense glass or plastic covering called the cladding. It is used for transmission of large volumes of data.

Advantages:

- Increased capacity and bandwidth
- Light weight
- Less signal attenuation
- Immunity to electromagnetic interference
- Resistance to corrosive materials

Disadvantages:

- Difficult to install and maintain
- High cost
- Fragile

Unguided Media

It is also referred to as Wireless or Unbounded transmission media. No physical medium is required for the transmission of electromagnetic signals.

Features:

- Signal is broadcasted through air
- Less Secure
- Used for larger distances

There are 3 major types of Unguided Media:

(i) Radio waves: These are easy to generate and can penetrate through buildings. The sending and receiving antennas need not be aligned. Frequency Range:3KHz – 1GHz. AM and FM radios and cordless phones use Radio waves for transmission.

(ii) Microwaves: It is a line of sight transmission i.e. the sending and receiving antennas need to be properly aligned with each other. The distance covered by the signal is directly proportional to the height of the antenna. Frequency Range:1GHz – 300GHz. These are majorly used for mobile phone communication and television distribution.

(iii) Infrared: Infrared waves are used for very short distance communication. They cannot penetrate through obstacles. This prevents interference between systems. Frequency Range:300GHz – 400THz. It is used in TV remotes, wireless mouse, keyboard, printer, etc.

7.3.1.8 Servers

Servers are computers that hold shared files, programs, and the network operating system. Servers provide access to network resources to all the users of the network. There are many different kinds of servers, and one server can provide several functions. For example, there are file servers, print servers, mail servers, communication servers, database servers, fax servers and web servers, to name a few. Sometimes it is also called host computer, servers are powerful computer that store data or application and connect to resources that are shared by the user of a network.

7.3.1.9 Clients

Clients are computers that access and use the network and shared network resources. Client computers are basically the customers (users) of the network, as they request and receive services from the servers. These days, it is typical for a client to be a personal computer that the users also use for their own non-network applications.

7.3.2 Software Requirement

Following are the major software components required to for a network:

7.3.2.1 Local Operating System

A local operating system allows personal computers to access files, print to a local printer, and have and use one or more disk and CD drives that are located on the computer. Examples are MS-DOS, Unix, Linux, Windows 10/8/7, Windows 98, Windows XP etc.

7.3.2.2 Networking Operating System

A network operating system (NOS) is an operating system that manages network resources: essentially, an operating system that includes special functions for connecting computers and devices into a local area network (LAN). The NOS manages multiple requests (inputs) concurrently and provides the security necessary in a multiuser environment. It may be a completely self-contained operating system, such as NetWare, Unix, Windows 2000, or Mac OS X, or it may require an existing operating system in order to function (e.g., Windows 3.11 for Workgroups requires DOS; LAN Server requires OS/2; LANtastic requires DOS). In addition to file and print services, a NOS may also offer directory services and a messaging system (email), as well as network management and multiprotocol routing capabilities.

7.3.2.3 Protocol Suite

A protocol is a rule or guideline followed by each computer for data communication. Protocol suite is a set of related protocols that are laid down for computer networks. The two popular protocol suites are:

i. OSI Model (Open System Interconnections)
ii. TCP / IP Model

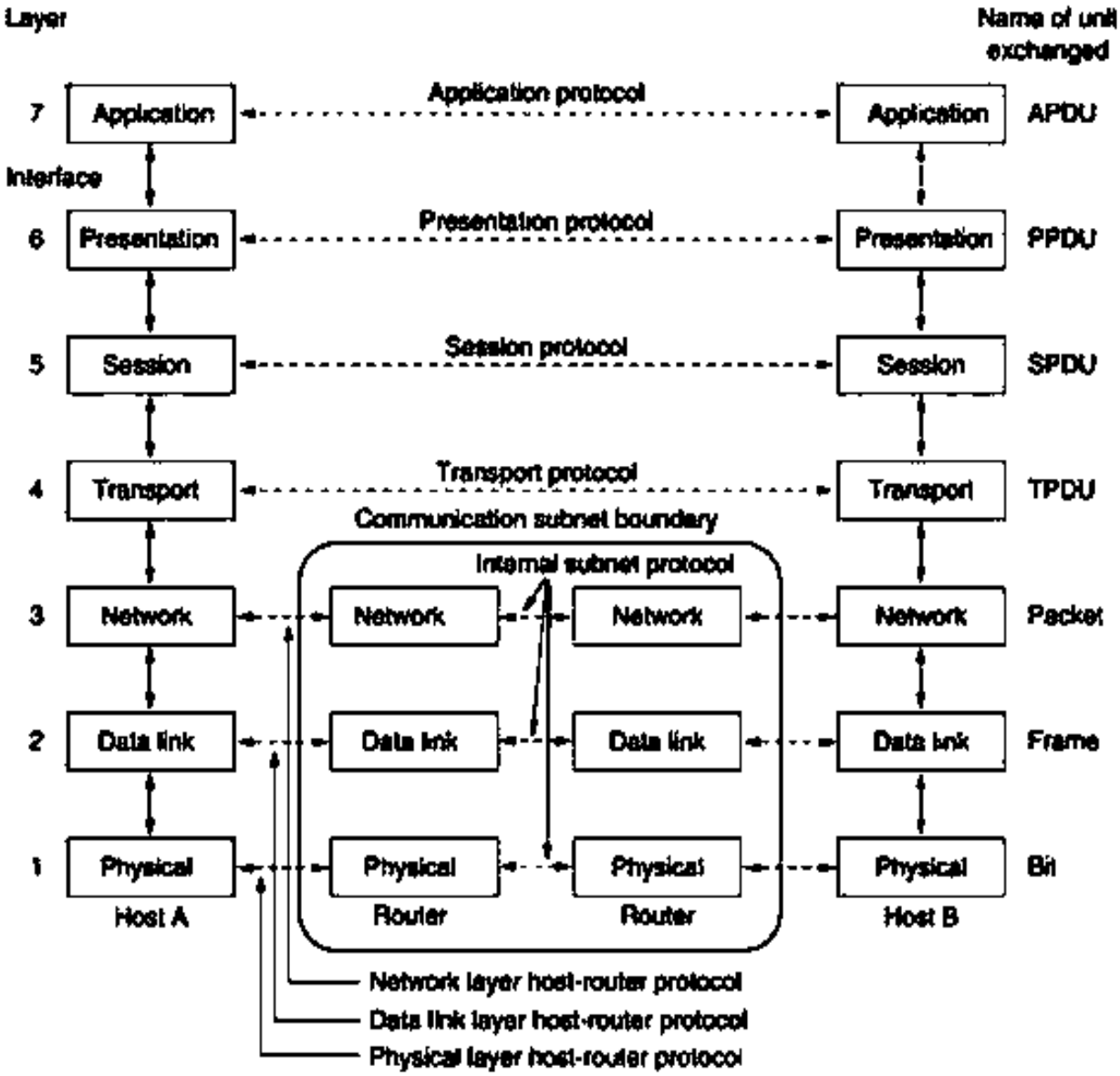
7.3.2.3.1 OSI Model

There are n numbers of users who use computer network and are located over the world. So to ensure, national and worldwide data communication, systems must be developed which are compatible to communicate with each other ISO has developed a standard. ISO stands for International organization of Standardization. This is called a model for Open System Interconnection (OSI) and is commonly known as OSI model.

The ISO-OSI model is a seven-layer architecture. It defines seven layers or levels in a complete communication system. They are:

1. Application Layer
2. Presentation Layer
3. Session Layer
4. Transport Layer
5. Network Layer
6. Datalink Layer
7. Physical Layer

Below we have the complete representation of the OSI model, showcasing all the layers and how they communicate with each other.



In the table below, we have specified the protocols used and the data unit exchanged by each layer of the OSI Model.

Layer	Name of Protocol	Name of Unit exchanged
Application	Application Protocol	APDU - Application Protocol Data Unit
Presentation	Presentation Protocol	PPDU - Presentation Protocol Data Unit
Session	Session Protocol	SPDU - Session Protocol Data Unit
Transport	Transport Protocol	TPDU - Transport Protocol Data Unit
Network	Network layer host-router Protocol	Packet
Data LInk	Data link layer host-router Protocol	Frame
Physical	Physical layer host-router Protocol	Bit

Physical Layer

Physical layer is the lowest layer of the OSI reference model. It is responsible for sending bits from one computer to another. This layer is not concerned with the meaning of the bits and deals with the setup of physical connection to the network and with transmission and reception of signals.

Functions of Physical Layer

Following are the various functions performed by the Physical layer of the OSI model.

- **Representation of Bits:** Data in this layer consists of stream of bits. The bits must be encoded into signals for transmission. It defines the type of encoding i.e. how 0's and 1's are changed to signal.
- **Data Rate:** This layer defines the rate of transmission which is the number of bits per second.
- **Synchronization:** It deals with the synchronization of the transmitter and receiver. The sender and receiver are synchronized at bit level.
- **Interface:** The physical layer defines the transmission interface between devices and transmission medium.
- **Line Configuration:** This layer connects devices with the medium: Point to Point configuration and Multipoint configuration.
- **Topologies:** Devices must be connected using the following topologies: Mesh, Star, Ring and Bus.
- **Transmission Modes:** Physical Layer defines the direction of transmission between two devices: Simplex, Half Duplex, Full Duplex.
- Deals with baseband and broadband transmission.

Data Link Layer

Data link layer performs the most reliable node to node delivery of data. It forms frames from the packets that are received from network layer and gives it to physical layer. It also synchronizes the information which is to be transmitted over the data. Error controlling is easily done. The encoded data are then passed to physical. Error detection bits are used by the data link layer. It also corrects the errors. Outgoing messages are assembled into frames. Then the system waits for the acknowledgements to be received after the transmission. It is reliable to send message.

The main task of the data link layer is to transform a raw transmission facility into a line that appears free of undetected transmission errors to the network layer. It accomplishes this task by having the sender break up the input data into data frames (typically a few hundred or few thousand bytes) and transmit the frames sequentially. If the service is reliable, the receiver confirms correct receipt of each frame by send back an acknowledgement frame.

Functions of Data Link Layer

- **Framing:** Frames are the streams of bits received from the network layer into manageable data units. This division of stream of bits is done by Data Link Layer.
- **Physical Addressing:** The Data Link layer adds a header to the frame in order to define physical address of the sender or receiver of the frame, if the frames are to be distributed to different systems on the network.
- **Flow Control:** A flow control mechanism to avoid a fast transmitter from running a slow receiver by buffering the extra bit is provided by flow control. This prevents traffic jam at the receiver side.
- **Error Control:** Error control is achieved by adding a trailer at the end of the frame. Duplication of frames are also prevented by using this mechanism. Data Link Layers adds mechanism to prevent duplication of frames.
- **Access Control:** Protocols of this layer determine which of the devices has control over the link at any given time, when two or more devices are connected to the same link.

Network Layer

The network Layer controls the operation of the subnet. The main aim of this layer is to deliver packets from source to destination across multiple links (networks). If two computers (system) are connected on

the same link, then there is no need for a network layer. It routes the signal through different channels to the other end and acts as a network controller. It also divides the outgoing messages into packets and to assemble incoming packets into messages for higher levels. In broadcast networks, the routing problem is simple, so the network layer is often thin or even non-existent.

Functions of Network Layer

- It translates logical network address into physical address. Concerned with circuit, message or packet switching.
- Routers and gateways operate in the network layer. Mechanism is provided by Network Layer for routing the packets to final destination.
- Connection services are provided including network layer flow control, network layer error control and packet sequence control.
- Breaks larger packets into small packets.

Transport Layer

The basic function of the Transport layer is to accept data from the layer above, split it up into smaller units, pass these data units to the Network layer, and ensure that all the pieces arrive correctly at the other end. Furthermore, all this must be done efficiently and in a way that isolates the upper layers from the inevitable changes in the hardware technology. The Transport layer also determines what type of service to provide to the Session layer, and, ultimately, to the users of the network. The most popular type of transport connection is an error-free point-to-point channel that delivers messages or bytes in the order in which they were sent. The Transport layer is a true end-to-end layer, all the way from the source to the destination. In other words, a program on the source machine carries on a conversation with a similar program on the destination machine, using the message headers and control messages.

Functions of Transport Layer

- **Service Point Addressing:** Transport Layer header includes service point address which is port address. This layer gets the message to the correct process on the computer unlike Network Layer, which gets each packet to the correct computer.

- **Segmentation and Reassembling:** A message is divided into segments; each segment contains sequence number, which enables this layer in reassembling the message. Message is reassembled correctly upon arrival at the destination and replaces packets which were lost in transmission.
- **Connection Control:** It includes 2 types:
  - Connectionless Transport Layer: Each segment is considered as an independent packet and delivered to the transport layer at the destination machine.
  - Connection Oriented Transport Layer: Before delivering packets, connection is made with transport layer at the destination machine.
- **Flow Control:** In this layer, flow control is performed end to end.
- **Error Control:** Error Control is performed end to end in this layer to ensure that the complete message arrives at the receiving transport layer without any error. Error Correction is done through retransmission.

Session Layer

The Session Layer allows users on different machines to establish active communication sessions between them. Its main aim is to establish, maintain and synchronize the interaction between communicating systems. Session layer manages and synchronize the conversation between two different applications. In Session layer, streams of data are marked and are resynchronized properly, so that the ends of the messages are not cut prematurely and data loss is avoided.

Functions of Session Layer

- **Dialog Control:** This layer allows two systems to start communication with each other in half-duplex or full-duplex.
- **Token Management:** This layer prevents two parties from attempting the same critical operation at the same time.
- **Synchronization:** This layer allows a process to add checkpoints which are considered as synchronization points into stream of data. Example: If a system is sending a file of 800 pages, adding checkpoints after every 50 pages is recommended. This ensures that 50-page unit is successfully received and acknowledged. This is beneficial at the time of crash as if a crash happens at page number 110; there is no need to retransmit 1 to100 pages.

Presentation Layer

The primary goal of this layer is to take care of the syntax and semantics of the information exchanged between two communicating systems. Presentation layer takes care that the data is sent in such a way that the receiver will understand the information(data) and will be able to use the data. Languages(syntax) can be different of the two communicating systems. Under this condition presentation layer plays a role translator. In order to make it possible for computers with different data representations to communicate, the data structures to be exchanged can be defined in an abstract way. The presentation layer manages these abstract data structures and allows higher-level data structures (eg: banking records), to be defined and exchanged.

Functions of Presentation Layer

- **Translation:** Before being transmitted, information in the form of characters and numbers should be changed to bit streams. The presentation layer is responsible for interoperability between encoding methods as different computers use different encoding methods. It translates data between the formats the network requires and the format the computer.
- **Encryption:** It carries out encryption at the transmitter and decryption at the receiver.
- **Compression:** It carries out data compression to reduce the bandwidth of the data to be transmitted. The primary role of Data compression is to reduce the number of bits to be 0transmitted. It is important in transmitting multimedia such as audio, video, text etc.

Application Layer

It is the top most layer of OSI Model. Manipulation of data(information) in various ways is done in this layer which enables user or software to get access to the network. Some services provided by this layer includes: E-Mail, transferring files, distributing the results to user, directory services, network resources, etc. The Application Layer contains a variety of protocols that are commonly needed by users. One widely-used application protocol is HTTP (Hypertext Transfer Protocol), which is the basis for the World Wide Web. When a browser wants a web page, it sends the name of the page it wants to the server using HTTP. The server then sends the page back. Other Application protocols that are used are: File Transfer Protocol(FTP), Trivial File Transfer Protocol(TFTP), Simple Mail Transfer Protocol(SMTP), TELNET, Domain Name System(DNS) etc.

Functions of Application Layer

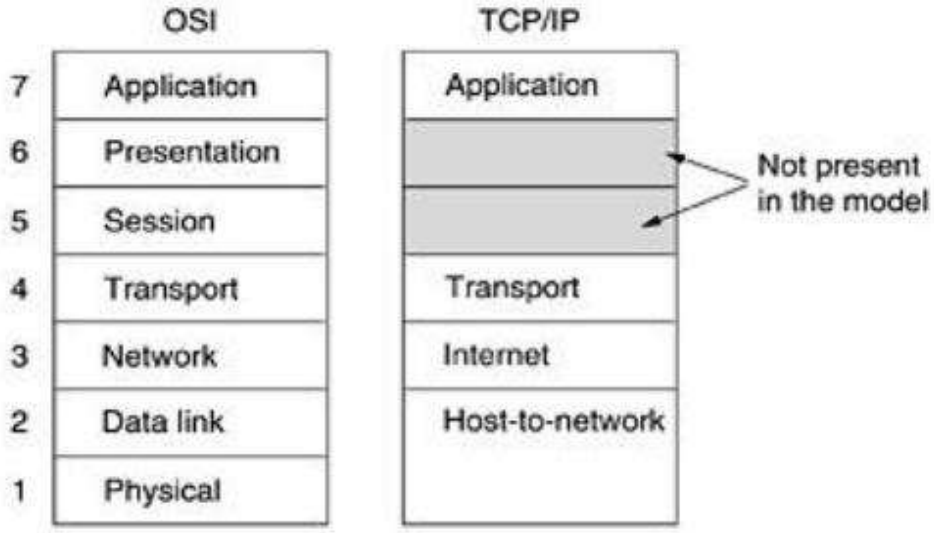
- **Mail Services:** This layer provides the basis for E-mail forwarding and storage.
- **Network Virtual Terminal:** It allows a user to log on to a remote host. The application creates software emulation of a terminal at the remote host. User's computer talks to the software terminal which in turn talks to the host and vice versa. Then the remote host believes it is communicating with one of its own terminals and allows user to log on.
- **Directory Services:** This layer provides access for global information about various services.
- **File Transfer, Access and Management (FTAM):** It is a standard mechanism to access files and manages it. Users can access files in a remote computer and manage it. They can also retrieve files from a remote computer.

7.3.2.3.2 The TCP/IP Reference Model:

The TCP/IP reference model was developed prior to OSI model. The major design goals of this model were,

- ✓ To connect multiple networks together so that they appear as a single network.
- ✓ To survive after partial subnet hardware failures.
- ✓ To provide a flexible architecture.

Unlike OSI reference model, TCP/IP reference model has only 4 layers. They are,



1. Host-to-Network Layer
2. Internet Layer
3. Transport Layer
4. Application Layer

Host-to-Network Layer:

The TCP/IP reference model does not really say much about what happens here, except to point out that the host has to connect to the network using some protocol so it can send IP packets to it. This protocol is not defined and varies from host to host and network to network.

Internet Layer:

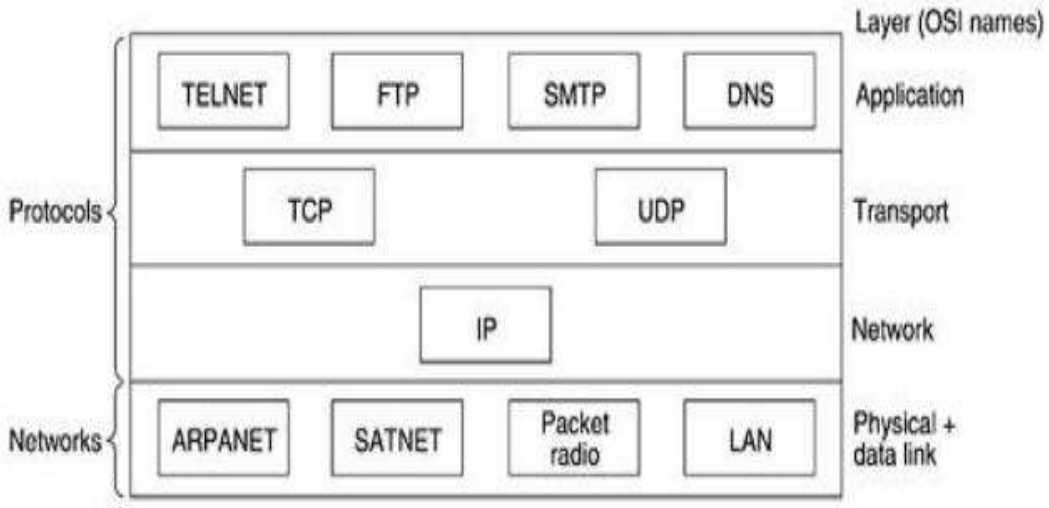
This layer, called the internet layer, is the linchpin that holds the whole architecture together. Its job is to permit hosts to inject packets into any network and have they travel independently to the destination (potentially on a different network). They may even arrive in a different order than they were sent, in which case it is the job of higher layers to rearrange them, if in-order delivery is desired. Note that "internet" is used here in a generic sense, even though this layer is present in the Internet.

The internet layer defines an official packet format and protocol called IP (Internet Protocol). The job of the internet layer is to deliver IP packets where they are supposed to go. Packet routing is clearly the major issue here, as is avoiding congestion. For these reasons, it is reasonable to say that the TCP/IP internet layer is similar in functionality to the OSI network layer. Fig. shows this correspondence.

The Transport Layer:

The layer above the internet layer in the TCP/IP model is now usually called the transport layer. It is designed to allow peer entities on the source and destination hosts to carry on a conversation, just as in the OSI transport layer. Two end-to-end transport protocols have been defined here. The first one, TCP (Transmission Control Protocol), is a reliable connection- oriented protocol that allows a byte stream originating on one machine to be delivered without error on any other machine in the internet. It fragments the incoming byte stream into discrete messages and passes each one on to the internet layer. At the destination, the receiving TCP process reassembles the received messages into the output stream. TCP also handles flow control to make sure a fast sender cannot swamp a slow receiver with more messages than it can handle. The second protocol in this layer, UDP User Datagram Protocol), is an

unreliable, connectionless protocol for applications that do not want TCP's sequencing or flow control and wish to provide their own. It is also widely used for one-shot, client-server-type request-reply queries and applications in which prompt delivery is more important than accurate delivery, such as transmitting speech or video. The relation of IP, TCP, and UDP is shown in below Fig. Since the model was developed, IP has been implemented on many other networks.



Application Layer

The TCP/IP model does not have session or presentation layers. On top of the transport layer is the application layer. It contains all the higher-level protocols. The early ones included virtual terminal (TELNET), file transfer (FTP), and electronic mail (SMTP), as shown in above Fig. The virtual terminal protocol allows a user on one machine to log onto a distant machine and work there. The file transfer protocol provides a way to move data efficiently from one machine to another. Electronic mail was originally just a kind of file transfer, but later a specialized protocol (SMTP) was developed for it. Many other protocols have been added to these over the years: The Domain Name System (DNS) for mapping host names onto their network addresses, NNTP, the protocol for moving USENET news articles around, and HTTP, the protocol for fetching pages on the World Wide Web, and many others.

7.4 NETWORK TOPOLOGIES

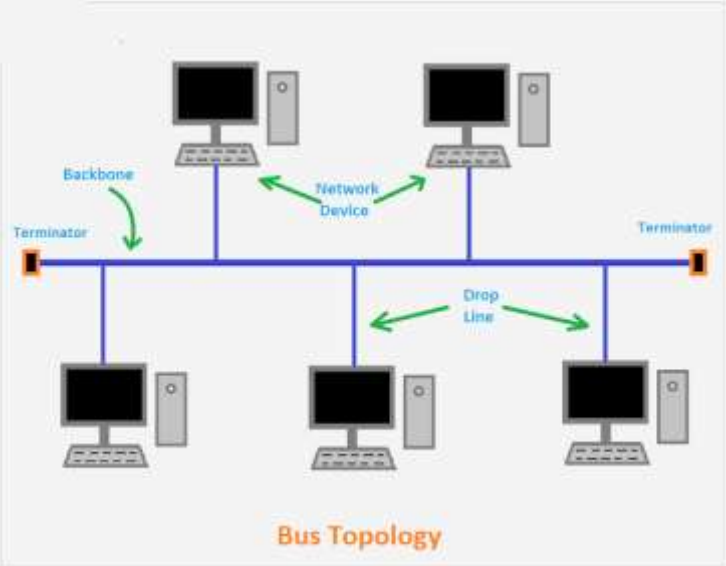
Network topology refers to the arrangement of computers connected in a network through some physical medium such as cable, optical fiber etc. Topology generally determines the shape of the network. The various types of network topologies are as follows:

1. Bus topology
2. Star topology
3. Ring topology
4. Mesh topology
5. Hierarchical topology
6. Hybrid topology

7.4.1 Bus Topology

In the bus topology, all the nodes are connected to the single backbone or bus with some medium such as twisted pair, coaxial cable etc.

When a node wants to communicate with the other nodes in the network, it simply sends a message to the common bus. All the nodes in the network then receive the message but the node for which it was actually sent only processes it. The other nodes discard the message. Figure shows the arrangement of computers in bus topology.



Advantages

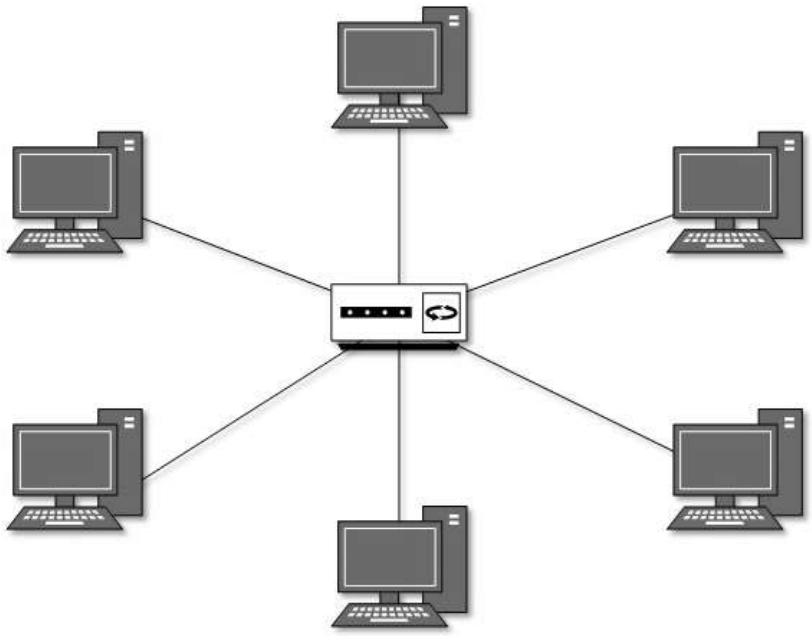
- The bus topology usually requires less cabling.
- The bus topology is relatively simple to configure and install.
- In the bus topology, the failure of one computer does not affect the other computers in the network.

Disadvantages

- The cable length is limited. This limits the number of network nodes that can be connected.
- This network topology can perform well only for a limited number of nodes. When the number of devices connected to the bus increases, the efficiency decreases.
- It is suitable for networks with low traffic. High traffic increases load on the bus, and the network efficiency drops.
- It is heavily dependent on the central bus. A fault in the bus leads to network failure.
- It is not easy to isolate faults in the network nodes.
- Each device on the network "sees" all the data being transmitted, thus posing a security risk.

7.4.2 Star Topology

In the star topology, all the nodes are connected to a common device known as hub. Nodes are connected with the help of twisted pair, coaxial cable or optical fiber. When a node wants to send a message to the other nodes, it first sends the message to the hub, which in turn forwards the message to the intended node. Each node in the network is connected with a point-to-point link to the centralized hub. The task of hub is to detect the faulty node present in the network. On the other hand, it also manages the overall data transmission in the network. Figure shows the arrangement of computers in the star topology.



Advantages:

- Due to its centralized nature, the topology offers simplicity of operation.
- It also achieves isolation of each device in the network.
- Adding or removing network nodes is easy, and can be done without affecting the entire network.
- Due to the centralized nature, it is easy to detect faults in the network devices.
- As the analysis of traffic is easy, the topology poses lesser security risk.
- Data packets do not have to pass through many nodes, like in the case of a ring network. Thus, with the use of a high-capacity central hub, traffic load can be handled at fairly decent speeds.

Disadvantages:

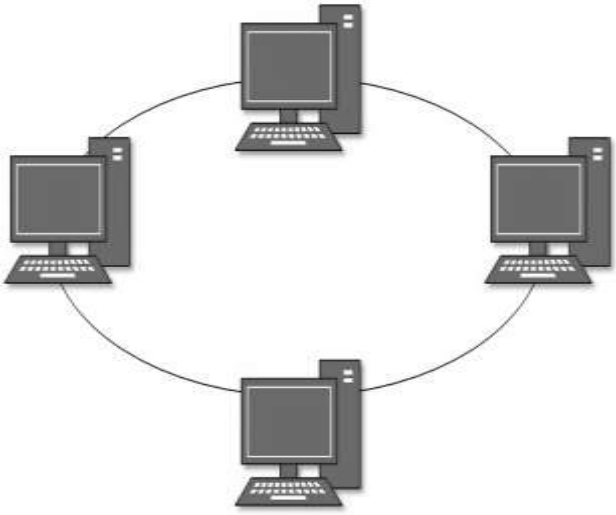
- In the star topology, the hub failure leads to the overall network crash.
- The star topology requires more amount of cable for connecting the nodes.
- It is expensive due to the cost of the hub.

7.4.3 Ring Topology

In the ring topology, the nodes are connected in the form of a ring with the help of twisted pair cable. Each node is connected directly to the other two nodes in the network. The node, which wants to send a message, first passes the message to its consecutive node in the network. Data is transmitted in the clockwise direction from one node to another. Figure shows the arrangement of computers in the ring topology. Each node incorporates a repeater, which passes the message to next node when the message is intended for another node.

Advantages:

- The data being transmitted between two nodes passes through all the intermediate nodes. A central server is not required for the management of this topology.
- The traffic is unidirectional and the data transmission is high-speed.
- In comparison to a bus, a ring is better at handling load.
- The adding or removing of network nodes is easy, as the process requires changing only two connections.
- The configuration makes it easy to identify faults in network nodes.
- In this topology, each node has the opportunity to transmit data. Thus, it is a very organized network topology.
- It is less costly than a star topology.



Disadvantages:

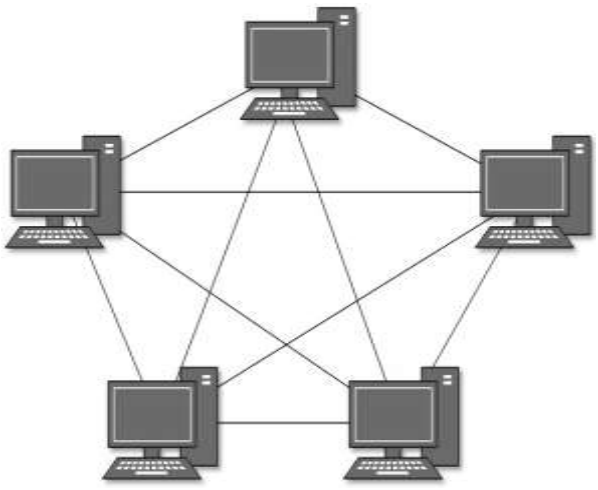
- The failure of a single node in the network can cause the entire network to fail.
- The movement or changes made to network nodes affect the entire network's performance.
- Data sent from one node to another has to pass through all the intermediate nodes. This makes the transmission slower in comparison to that in a star topology. The transmission speed drops with an increase in the number of nodes.
- There is heavy dependency on the wire connecting the network nodes in the ring.

7.4.4 Mesh Topology

In this type of topology, a host is connected to one or multiple hosts. This topology has hosts in point-to-point connection with every other host or may also have hosts which are in point-to-point connection with few hosts only.

Hosts in Mesh topology also work as relay for other hosts which do not have direct point-to-point links. Mesh technology comes into two types:

- Full Mesh: All hosts have a point-to-point connection to every other host in the network. Thus for every new host n(n-1)/2 connections are required. It provides the most reliable network structure among all network topologies.
- Partially Mesh: Not all hosts have point-to-point connection to every other host. Hosts connect to each other in some arbitrarily fashion. This topology exists where we need to provide reliability to some hosts out of all.



Advantages:

- The arrangement of the network nodes is such that it is possible to transmit data from one node to many other nodes at the same time.
- The failure of a single node does not cause the entire network to fail as there are alternate paths for data transmission.
- It can handle heavy traffic, as there are dedicated paths between any two network nodes.
- Point-to-point contact between every pair of nodes, makes it easy to identify faults.

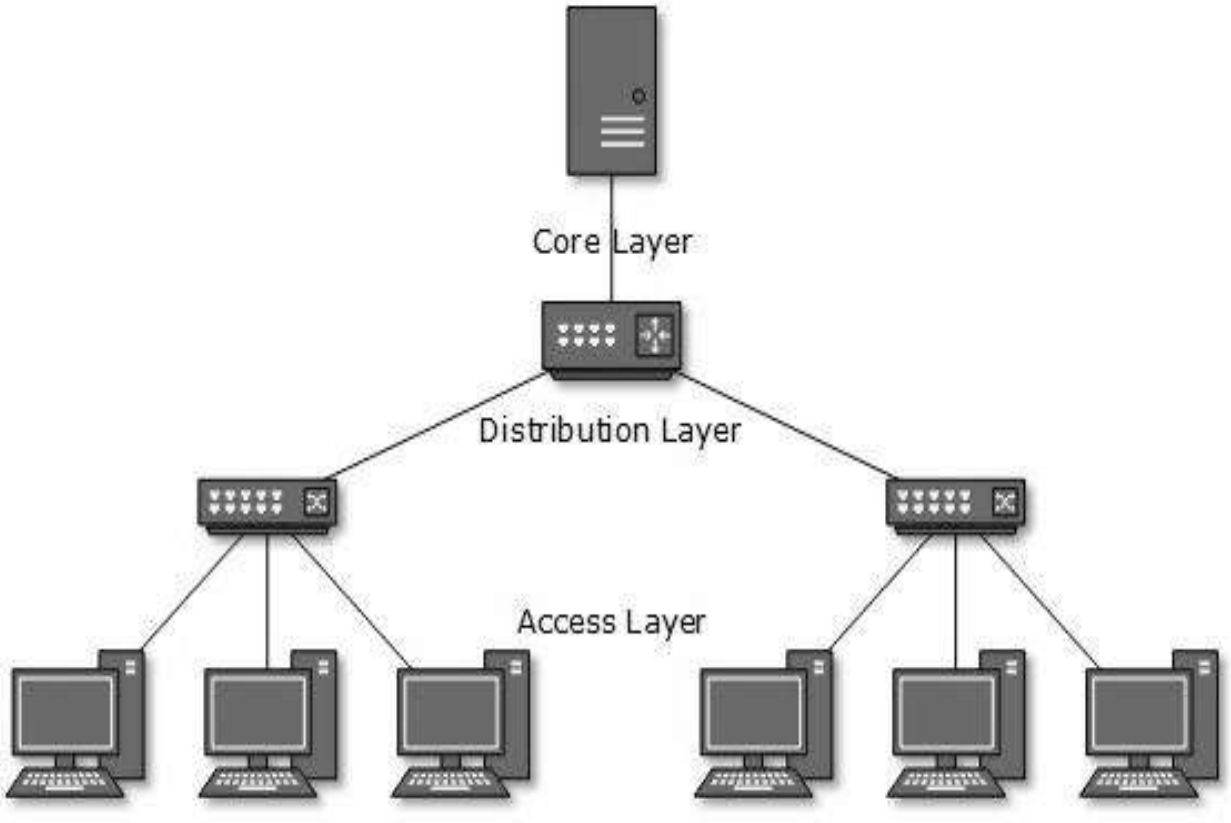
Disadvantages:

- The arrangement wherein every network node is connected to every other node of the network, many connections serve no major purpose. This leads to redundancy of many network connections.
- A lot of cabling is required. Thus, the costs incurred in setup and maintenance are high.
- Owing to its complexity, the administration of a mesh network is difficult.

7.4.5 Hierarchical Topology

Also known as tree Topology, this is the most common form of network topology in use presently. This topology imitates as extended Star topology and inherits properties of Bus topology.

This topology divides the network into multiple levels/layers of network. Mainly in LANs, a network is bifurcated into three types of network devices. The lowermost is access-layer where computers are attached. The middle layer is known as distribution layer, which works as mediator between upper layer and lower layer. The highest layer is known as core layer, and is central point of the network, i.e. root of the tree from which all nodes fork.



Advantages:

- The tree topology is useful in cases where a star or bus cannot be implemented individually. It is most-suited in networking multiple departments of a university or corporation, where each unit (star segment) functions separately, and is also connected with the main node (root node).
- The advantages of centralization that are achieved in a star topology are inherited by the individual star segments in a tree network.
- Each star segment gets a dedicated link from the central bus. Thus, failing of one segment does not affect the rest of the network.
- Fault identification is easy.
- The network can be expanded by the addition of secondary nodes. Thus, scalability is achieved.

Disadvantages:

- As multiple segments are connected to a central bus, the network depends heavily on the bus. Its failure affects the entire network.

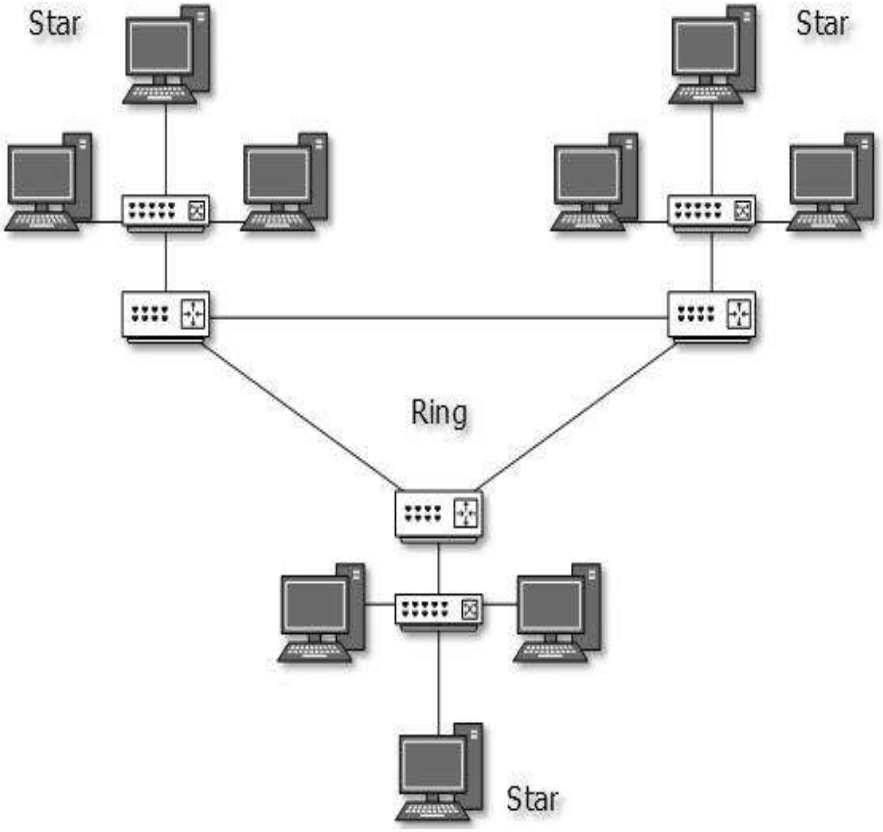
- Owing to its size and complexity, maintenance is not easy and costs are high. Also, configuration is difficult in comparison to that in other topologies.
- Though it is scalable, the number of nodes that can be added depends on the capacity of the central bus and on the cable type.

7.4.6 Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid topology. Hybrid topology inherits merits and demerits of all the incorporating topologies.

The below picture represents an arbitrarily hybrid topology. The combining topologies may contain attributes of Star, Ring, and Bus topologies. Most WANs are connected by means of Dual-Ring topology and networks connected to them are mostly Star topology networks. Internet is the best example of largest Hybrid topology.

Obviously, the advantages and disadvantages of a hybrid topology are a combination of the merits and demerits of the topologies used to structure it.



7.5 CHECK YOUR PROGRESS

A. Fill in the blanks:

1. Number of links to connect n nodes in a mesh topology is = _____.
2. _____is a set of rules that governs the communications between computers on a network.
3. _____ topology can be considered as an extension to BUS topology.
4. _____ is suitable for use in star and ring topologies
5. Coaxial cable is suitable for use in _____ topology.

B. State whether the following statements are True or False:

1. A peer to peer network is a group of computers that function both as client and server.
2. A MAN is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a LAN but smaller than the area covered by a WAN.
3. Microwave is a wireless technology that can be used to transmit data between two different computers.
4. Router is a device connecting two or more networks that facilitates the transfer of data in the form of packets.
5. A topology refers to the shape of the network in which all the computers are connected together.

7.6 SUMMARY

Computer networks can be used for numerous services, both for companies and for individuals. For companies, networks of personal computers using shared servers often provide access to corporate information. Typically, they follow the client-server model, with client workstations on employee desktops accessing powerful servers in the machine room. For individuals, networks offer access to a variety of information and entertainment resources. Individuals often access the Internet by calling up an ISP using a modem, although increasingly many people have a fixed connection at home. An up-and-coming area is wireless networking with new applications such as mobile e-mail access and m-commerce.

Roughly speaking, networks can be divided up into LANs, MANs, WANs, and internetworks, with their own characteristics, technologies; speeds, and niches. LANs cover a building and operate at high speeds. MANs cover a city, for example, the cable television system, which is now used by many people to access the Internet. WANs cover a country or continent. LANs and MANs are un-switched (i.e., do not have routers); WANs are switched. Wireless networks are becoming extremely popular, especially wireless LANs. Networks can be interconnected to form internetworks.

Network software consists of protocols, which are rules by which processes communicate. Protocols are either connectionless or connection- oriented. Most networks support protocol hierarchies, with each layer providing services to the layers above it and insulating them from the details of the protocols used in the lower layer. A model known as Open Systems Interconnect (OSI) was devised by the International Standards organization (ISO). This model would allow the sending and receiving of data between two computers. It works on a layer approach, where each layer is responsible for performing certain jobs and functions. The need of layered architecture arises because when data is sent from one computer to another, there are many different things involved. These are network adapters, voltages and signals on the cable, how the data is packaged, error control in case something goes wrong, and many other issues. By segmenting these issues into separate layers, it makes the task of designing network much easier. The OSI model, which allows dissimilar computers to transfer data between themselves, is divided into seven distinct layers. These layers are application, presentation, session, transport, network, data link and physical layer with their distinct functions. These functions are to provide applications with access to network, determine the format used to exchange data among computer over the network, allow connection disconnection to be established between applications, allow error free delivery of data and send data at correct destination.

TCP/IP is the protocol used by computers on the internet and may be considered as two separate protocols such as TCP and IP. Each computer has an IP address. A protocol is a set of rules that govern how computers talk to each other. TCP/IP is a widely used and very popular protocol. With TCP/IP, different computer systems can reliably exchange data on an interconnected network. It also provides a consistent set of application programming interfaces (APIs) to support application development. This means that software programs can use TCP/IP to exchange data. An example of this is web servers and web browsers, software applications that use TCP/IP to exchange data.

7.7 KEYWORDS

Transmission mode refers to the mechanism of transferring of data between two devices connected over a network.

Simplex transmission mode, the communication between sender and receiver occurs in only one direction.

Full duplex transmission mode, the communication between sender and receiver can occur simultaneously.

PAN is a computer network which generally consists of a computer, mobile, or personal digital assistant

LAN (local area network) is a group of computer and peripheral devices which are connected in a limited area

WAN (Wide Area Network) is another important computer network that which is spread across a large geographical area.

WLAN is a wireless local area network that helps you to link single or multiple devices using. It uses wireless communication within a limited area like home, school, or office building.

Network Topology is the schematic description of a network arrangement, connecting various nodes (sender and receiver) through lines of connection.

7.8 SELF-ASSESSMENT TEST

1. Explain the followings:
    a. LAN
    b. WAN
    c. MAN
    d. PAN
2. Explain the classification of computer networks.
3. Discuss the features of Computer Network.
4. What do you mean by data communication? Explain the various components of data communication system.

5. Explain the various transmission modes.
6. Describe the various hardware used in computer network.
7. Discuss the various software required for computer network.
8. What is OSI model? Explain the functions and services of each layer.
9. Discuss various types of network topologies in computer network. Also discuss various advantages and disadvantages of each topology.
10. Explain the TCP/IP reference model.

7.9 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress A:

1. n(n-1)/2
2. Protocol
3. Tree
4. Twisted pair
5. BUS

Check your Progress B:

1. True
2. True
3. True
4. True
5. True

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