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ANNAMALAI UNIVERSITY

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B.Sc. Computer Science

FIRST YEAR

BASICS OF INFORMATION TECHNOLOGY

BASICS OF INFORMATION TECHNOLOGY

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1.0 Introduction

Computer is one of the greatest inventions in human history. They are the new source of Technology, which helps to fill the gap of innocence among people. The ultimate purpose of inventing computers is to make calculations easier. Their presence is vital in today's society. Those who have **computer** knowledge have a competitive edge. And those who don't have it should seek it out. The computer is an amazing machine that can help you to perform so many different tasks in so many areas of your life. Whether you want to track an investment, publish a newsletter, design a building or resolve complex scientific problems accurately in a short time, you can use a computer to do it. These powerful tools built of silicon, metal and plastic are so pervasive that virtually no business or organization can function effectively without them. Even in our homes, computers are becoming increasingly indispensable tools.

We are rapidly becoming a "computer society". Until recently computers were found only in environmentally controlled rooms behind locked doors. Only computer professionals dared enter these secured premises. In contrast, today, computers are found in millions of homes and just about every office. In fact there is a computer for one in every eight people in the world. Eventually all of us will have at least one computer and will use it everyday for work and leisure.

1.1 Objectives

Students can get the clear idea about the world of computer and the tremendous knowledge about this. They can get the good understanding about the Generation, History, Evaluations of computers, and External and Internal parts of Computers. Their basic knowledge about the various types of operating systems (OS). Also this unit explains the following concepts of computers.

- Hardware Devices
- Software
- Examples of Operating System
- Computer Networking

1.2 Contents

1.2.1. Computers – a definition

In layman's language, the computer is a fast calculating device that can perform arithmetic operations. Although the computer was originally invented mainly for doing high speed and accurate calculations, it is not just a calculating device. The computer can perform any kind of manipulations involving arithmetic and logical operations on data. It gets the data through an input device, processes it according to the instructions given and gives the information as output. We can define a computer as follows:

"A Computer is an electronic device capable of performing arithmetic and logical operations. It accepts raw data as input (in the form of digital data) and processes it according to the sequence of instructions given by the programmer/user and provides the desired information as output. Computers also include the means for storing data"

The terminology used in the above definition is summarized in the table below.

Term	Meaning
Input	Data and instructions given to computer
Digital	Digital describes electronic technology that generates, stores, and processes data in terms of two states i.e. positive and non positive
Data	A set of basic facts and entities which by themselves have no meaning
Processes	Instance of a program running in a computer for manipulation of data
Instructions	Order given to a computer processor by a computer program to perform a task
Information	Data that has a meaning/value in some context for its receiver
Output	Information obtained after processing of data

Classification of Computers

The classification of computers is based on the following four criteria:

a. According to Purpose
b. According to Size and Storage capacity
c. According to Technology used
d. According to Historical Advancement

Based on these criteria, the classification of computers is illustrated in table 1.1 and discussed below.

(A) Purpose

Depending upon use of computers for different purposes, they can be classified as mentioned below:

1. General Purpose Computers

Computers that follow instruction for general requirements such as sales analysis, financial accounting, invoicing, inventory, management information etc. are called General Purpose Computers. Almost all computers used in offices for commercial, educational and other applications are general-purpose computers.

2. Special Purpose Computers

Computers, which are used for performing a particular task alone, are called Special Purpose Computers. They are programmed in the manufacturing stage itself for doing this work. They cannot be programmed for other works. Automatic cash Tellers, Telephone tariff analyzer; Autonomous Mobile Robots are some examples of special purpose computers.

(B) Size and Storage Capacity

According to the size and memory/storage capacity computers are of the following four types:

1. Super Computer

Supercomputer is the biggest and fastest, which is mainly designed for complex scientific applications. It has many CPUs (Central Processing Units), which operate in parallel to make it the fastest computer. It is typically used for the following applications.

- Defense
- Electronic Design
- Energy Management
- Petroleum Exploration and production

Some of the examples of supercomputers are CRAY-3, XMP-14, PARAM-9000 and PARAM-10000.

2. Mainframe Computer

Mainframe computers are very large and fast computers but smaller and slower than supercomputers. They are used in a centralized location where many terminals (Input / Output devices) are connected with a single CPU and thus, allow different users to share the single CPU. They have very high memory (Several Hundred Megabytes) and can support thousands of users. They are mainly used for following applications.

- Banking Applications
- Railway and Airline Reservations
- Commercial Applications of large industries/companies

Some of the examples of mainframe computers are IBM 3090, IBM 4381, IBM 4300 and IBM Es-9000.

3. Minicomputers

Minicomputers are computers, which have multiterminal facilities. They have only one CPU but possess many terminals and keyboards. If it has 7 terminals, then 7 persons can use the computer at a time. Minicomputers are designed to be of medium

scale, smaller and generally slower than mainframe computers. The cost of a minicomputer is less when compared to mainframe.

Therefore, it is mainly used in applications where processing can be distributed among several minicomputers rather than using a mainframe computer.

Some of the examples of minicomputers are PDP-1, IBM AS/400, DEC Micro VAX.

4. Microcomputers

A microcomputer is the smallest digital computer, which uses a microprocessor as its CPU. Microprocessor is a single chip (Integrated Circuit) CPU. Microcomputer is popularly called Personal Computer (PC). It can be used both as a stand-alone machine and a terminal in a multi-user environment. Microcomputers are becoming very popular now-a-days due to very high processing power and memory. Today, a powerful microcomputer may be used as a substitute for mini or mainframe computer.

Some of the examples of a minicomputer are: 8088, 8086, Pentium Pro (P5), Pentium II (P6).

(C) Technology used

According to the technology used, computers are of the following three types:

1. Analog Computers

Analog computers are special purpose computers that represent and store data in continuously varying physical quantities such as current, voltage or frequency. They are mostly used for process control applications. The physical quantities such as pressure, temperature etc are represented by different electric lines with corresponding voltages. Analog computers are also used for scientific and engineering applications. Some of the examples of analog computers are given below.

a) **Thermometer**: Simple analog computer used to measure temperature. In thermometer, the mercury moves up or down as the temperature varies.

b) **Speedometer**: Car's speedometer is another example of analog computer where the position of the needle on dial represents the speed of the car.

Digital Computers

Digital computers are mainly general-purpose computers that represent and store data in discrete quantities or number. In these computers all processing is done in terms of numeric representation (Binary digits) of data and information. Although the user enters data in decimal or character form, it is converted into binary digits (0's and 1's). Almost all the computers used at present are digital computers.

2. Hybrid Computers

Hybrid Computers incorporate the technology of both analog and digital computers. These computers store and process analog signals which have been converted into discrete numbers using analog to digital converters. They can also convert the digital

numbers into analog signals or physical properties using digital -to-analog converters. Hybrid computers are mainly used in artificial intelligence (robotics) and computer added manufacturing (e.g. Process control).

Criteria	**Ist Gen Computer**	**IInd Gen Computer**	**IIIrd Gen Computer**	**IVth Gen Computer**	**Vth Gen Computer**
Speed	Slowest	Slow	Medium	Faster	Fastest
Reliability	Unreliable	Less Reliable	More Reliable	Most Reliable	Yet to be Judged
Availability	Out dated	Out dated	Out dated	Current	Yet to be built
Size	Largest	Large	Medium	Smallest	Medium
Basic Electronic Component	Vacuum Tubes or valves	Transistors	Integrated Circuits (ICs)	Very Large Scale Integration (VLSI)	Ultra Large Scale Integration (ULSI)

Table 1.1 Characteristics of Various Generations of Computers

(D) Historical Advancement

According to the historical advancement, computers are of the following types

1. Zeroth Generation Computers
2. First Generation Computers
3. Second Generation Computers
4. Third Generation Computers
5. Fourth Generation Computers
6. Fifth Generation Computers

A detailed description on this Generation of Computers is explained in the section 1.2 History of Computers.

Uses of Computers

During the last four decades, computers have revolutionized and used almost all disciplines of our life; computers have made possible many scientific, industrial and commercial advances that would have been impossible otherwise. They are being used in many areas of application viz. business, industry, scientific research, defense, space,

communications, medicine, education etc. The utilization of computers in different fields is summarized in the following table:

Area	Uses of Computers
Industry	Uses on electricity, steel, paper, printing, engineering and other industries for production, inventory control and related applications
Space	Used to design computerized space satellites, rockets and related technology
Business	Used in banks, airports, share markets, hotels, Govt. Offices for computerizing business applications like MIS, Payroll, Inventory, and Financial Accounting etc.
Telecommunication	Used in ISDN, E-mail, Internet, Intranet, VSAT, Videoconferencing, Paging, Cell phones etc
Data Communication	Used to Computerize Geographically separated offices through networking
Defense	Used to Computerize warplanes, ships, radar and many Advanced weapons
Publishers	Used for Desk Top Publishing (DTP) for designing and printing of books
Engineering	Used for CAD (Computer Aided Designing)/CAM (Computers Aided Manufacturing) by engineering companies

Table 1.2 Uses of Computers

1.2.2 History of Computers

The Computer evolved as a result of man's search for a fast and accurate calculating device. The abacus was probably the original mechanical counting device invented in Asia many centuries ago. In 1617, John Napier, a Scottish mathematician invented a mechanical calculator called the “Napier's bones”. Thereafter, many kinds of computers have been designed and built during the evolution of the modern digital computer. In order to provide a framework for the growth of computer industry, the computer era has been referred to in terms of generations. Computers are classified into

the following six types based on their historical advancement and electronic components used.

1.2.3 Generation of Computers

a) Zeroth Generation Computers

The Zeroth generation of computers (1642-1946) was marked by the invention of mainly mechanical computers. Pascaline was the first mechanical device, invented by Blaise Pascal, a French mathematician in 1642. In 1822, Charles Babbage, an English mathematician, designed a machine called Difference Engine, to computerize tables of numbers for novel navigation. Later on, in the year 1834, Babbage attempted to build a digital computer called Analytical Engine.

The Analytical Engine had all the parts of a modern computer i.e. it had four components the store (Memory unit), the mill (computation unit), the punched card reader (input unit) and the punched / printed output (output unit). As all basic parts of a modern computer were thought out by Charles Babbage, he is known as the Father of Computers. In later years, Herman Hollerith invented a machine for counting during the 1880 US census. This was called the Tabulating Machine. In 1944, Howard A. Eiken invented the first American general-purpose electro-mechanical computer called Mark I and later on its successor, Mark II. The zeroth generation of computers or the era of mechanical computers ended in 1946 when vacuum tubes were invented.

b) First Generation Computers

The first generation of Computers (1946-1954) was marked, by the use of vacuum tubes or valves as their basic electronic component. Although these computers were faster than earlier mechanical devices, they had many disadvantages. First of all, they were very large in size. They consumed too much power and generated too much heat, when used for even short duration of time. They were very unreliable and broke down frequently. They required regular maintenance. The first generation of computers became out dated, when in 1954, the Philco corporation developed transistors that can be used in place of vacuum tubes.

Examples:

- ENIAC (Electronic Numerical Integrator and Calculator) - 1946
- EDSAC (Electronic Delay storage Automatic Calculator) - 1949
- EDVAC (Electronic Discrete Variable Automatic Computer) - 1951
- 1AS Machine built by Von Neumann – 1952

c) Second Generation Computers

The second generation of computers (1954-64) was marked by the use of transistors in place of vacuum tubes. These computers are mainly characterized by the change from vacuum tubes to transistor technology. However, several other important developments also occurred which are summarized below:

- The transistor, which was invented in 1948 at AT & T Bell Laboratories, gradually replaced vacuum tubes in the design of switching circuits.
- Cathode ray tube memories and delay line memories were replaced by magnetic ferrite coves and magnetic drums as the technologies used in main memories.
- The use of index registers and floating-point arithmetic hardware became widespread.
- The Machine-independent "high level" programming such as ALGOL, COBOL and FORTRAN were introduced to simplify programming.
- Special processors (I/O processors) were introduced to supervise input-output operations, thus freeing the CPU from many time-consuming housekeeping functions.
- Computer manufacturers began to provide system software such as computers, subroutine libraries and batch monitors.

The second-generation computers, due to the above-mentioned reasons, were smaller in size and generated less heat than the first generation computers. Although they were slightly faster and more reliable than earlier computers, they too had many disadvantages. They had limited storage capacity, consumed more power and were also relatively slow in performance. Like first generation computers, they also required regular maintenance and their components had also to be assembled manually. It was discovered in 1964 that a number of transistors could be sealed up into a tiny package called an Integrated Circuit (IC) or a chip. The second-generation computers became out-dated after the invention of ICs.

Examples:

- PDP-1, developed by DEC was the first minicomputers
- NCR 304 (Notional Cash Register) was first all transistor used computer

d) Third Generation Computers

The third generation of computers (1964-1980) was marked by use of integrated circuits in place of transistors. Some of the features of third generation computers are

a. **Integrated Circuits** (ICs) began to replace Discrete Transistor Circuits used in second-generation machines. Results were substantial and physical size and costs were reduced.

b. **Semiconductor** (IC) memories began to augment and finally replaced ferrite coves in main memory designs. The two main types are Read Only Memories (ROMs) and read and write memories also called Random Access Memories (RAMs).

c. A technique called Microprogramming became popular which simplified the design of CPUs and increased their flexibility.

d. Access to a variety of techniques for concurrent or parallel processing like pipelining and multiprocessing. Results were accelerating speed at which programs could be executed.

e. Efficient methods for automatic sharing of the facilities or resources of a computer system processors and memory space were developed and incorporated into operating systems.

As hundreds of transistors could be put on a single small circuit, ICs became more compact than transistors. The third generation computers therefore removed many drawbacks of the second-generation computers. They were even smaller in size; generated very less heat and required very less power as compared to the earlier two generations of computers. These computers were also still faster and even more reliable. But they too had some disadvantages. They still had less storage capacity, relatively slower performance and thus could not fulfill the requirements of the users and programmers.

Examples:

- IBM 360, developed by IBM in 1964
- PDP-8, developed by DEC in 1965
- PDP-11, developed by DEC in 1970

e) Fourth Generation Computers

The fourth generation of computers (1978-till date) was marked by the VLKSI Era. In the 1960s the dominant technology for manufacturing computer components was the integrated circuit (IC). This technology evolved steadily from ICs containing just a few transistors to those containing hundreds of thousands of transistors; the latter case is termed "Very Large Scale Integration", or VLSI. The impact of VLSI technology on computer design has been profound. It has made it possible to fabricate an entire CPU, main memory or similar device with a single IC that can be mass-produced at a very low cost. This has resulted in new classes of machines such as inexpensive personal computers, and high performance parallel processors that contain thousands of CPUs.

All present day computers are fourth generation of computers. These computers are very powerful having a high memory and a fast processing speed. Although the fourth generation computers offer too many advantages to the users, they still have one main disadvantage. The major drawback of these computers is that they have no intelligence on their own. Scientists are now trying to remove this drawback by making computers with artificial intelligence.

Examples:

- IBM PC, developed in 1981 was the first industry standard personal computer, having Intel 8088 memory chip
- 386, developed in 1985, had Intel 80386 memory chip
- 486, developed in 1989, had Intel 80486 memory chip

- Pentium developed in 1995, has Pentium (80586) memory chip

f) Fifth Generation Computers

The Fifth Generation Computers are still under the research and developmental stage. These computers have artificial intelligence. They will use ULSI (Ultra Large Scale Intelligence) chips in place of VLSI chips. One ULSI chip contains millions of components on a single IC. The most important feature of Fifth Generation computers is that they will use intelligent software.

This software will enable the user to tell computer what to do and not 'How to do' by using intelligent programming and knowledge based problem solving techniques. So, the programmer or users would not require giving each and every instruction to the computer for solving a problem. These computers will also have user interface in form of speed in natural languages.

Example:

- ROBOTS have few features of fifth generation computers

1.2.4 Computer Peripherals

Typical computer architecture is given below with all Data flow and Command flow (in Figure 1.1).

The computer system, on the whole, consists of four main parts namely

1. Hardware Devices
2. Software
3. Data
4. Users

The first two parts namely **Hardware Devices** and **Software** are discussed in detail in section 1.4 and section 1.5 respectively. The remaining two parts - data and users are discussed below:

- **Data**: Data consists of two facts, which the computer can manipulate and process into information that is useful to people. Computerized data is digital, meaning that it has been reduced to digits, or numbers. The computer stores and reads all data as numbers. Although computers use data in digital form, they convert data into forms that people can understand, such as text, numerals, sounds and images.

- **Users**: People are the computer's operator or users. Some types of computers can operate without much intervention from people but personal computers are designed specially for the people.

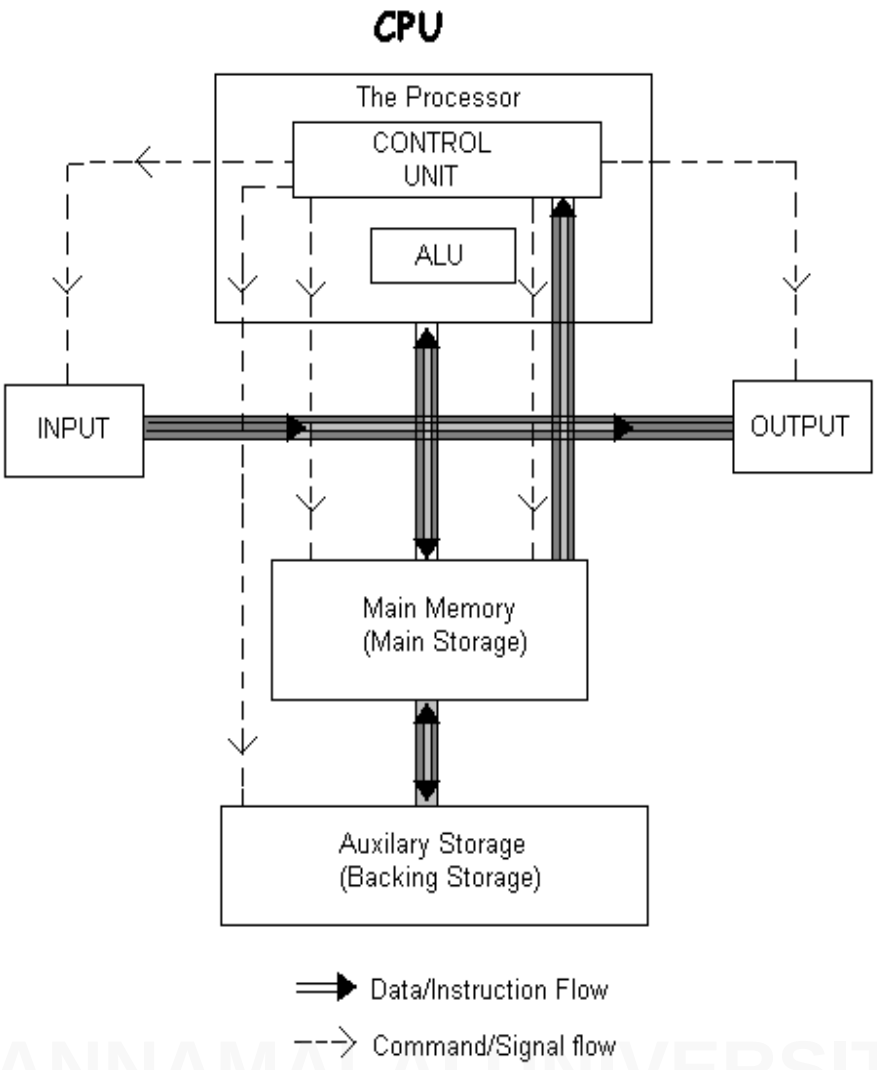


Figure 1.1

Hardware Devices

Hardware refers to any physical component of a computer. In today's computer industry, a wide variety of hardware components are available for microcomputers. The hardware components of a microcomputer can be classified into the following types namely,

- Input Devices
- Output Devices
- Processor
- Memory
- Storage Devices

Input Devices

Input devices are used to input data, information and instructions into the RAM. We may classify these devices into the following two broad categories.

(i) Basic Input Devices
(ii) Special Input Devices

The Structure and function of the common input devices of these two categories are discussed in detail.

i. Basic Input Devices

The input devices, is one of the prerequisites for input operations, which may be called Basic Input Devices. The chief input device such as keyboard and Mouse are used to enter any input to the computer. Today, every PC has a keyboard and mouse as the basic input devices.

a) Keyboard

Keyboard is the main input device of a computer. It contains 3 types of keys- alphanumeric keys, special keys and function keys. Alphanumeric keys are used to type all alphabets, numbers and special symbols. Special keys such as <Shift>, <Ctrl>, <Alt>, etc are used for special functions. Function keys such as <F1>, <F2>, <F3> etc. used to give special commands depending upon the software used.

b) Mouse

Mouse is another important input device. It is a pointing device used to move cursor, draw sketches/diagrams, selecting a text/object/menu item etc. on monitor screen while working on windows. Mouse is a small, palm size box containing 3 buttons and a ball underneath which senses the movement of the mouse and sends corresponding signals to CPU on pressing the buttons.

ii. Special Input Devices

The input devices, which are not essential to operate a PC, are called special Input Devices. These devices are used for various special purposes and are generally not required for basic input operations. Some of these devices are discussed below.

a) Trackball

A trackball works like a mouse, as the roller is on the top with selection buttons on the side. It is also a pointing device used to move the cursor and works like a mouse. For moving the cursor in a particular direction, the user spins the ball in that direction. It is sometimes considered better than mouse because it requires little movement and less desktop space.

b) Light Pen

Light Pen (similar to a pen) is a pointing device, which is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When its tip is moved over the monitor screen and pen button is pressed, its photocell-sensing element detects the screen location and sends the corresponding signal to the CPU.

c) Joystick

Joystick is also a pointing device, which is used to move cursor position on a monitor screen. Joystick is a stick having a spherical ball both at its lower and upper ends. The joystick can be moved in all four directions. The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Design (CAD) and computer games.

d) Scanner

Scanner is widely used on DTP applications. It is used for digitizing images such as photographs, forms, documents etc. into computer memory. Some scanners can also read text by converting them to digital code. The scanners are very useful for converting the typed pages into word processing files. Graphic scanners convert a printed image into video image without converting into digital code.

e) Bar Code Reader

Bar Code Reader is an optical scanner used for reading bar-coded data (data in form of light and dark lines). The bar-coded data consists of a numbers of bars of varying thickness and spacing between them. The bar code reader reads the bar coded data and converts into electrical pulses, which are then processed by the computer.

f) Voice-Input Devices

Voice-Input devices are the latest input devices that can recognize the human voice. They are very useful but are not popular due to storage of limited vocabularies and variations in the way of pronouncing words by different persons

Output Devices

Output devices are hardware components, which are used to display or print the processed information. The structure, function and uses of the common output devices are given below

a) Monitor

Visual Display Unit (VDU) commonly called monitor is the main output device of a computer. It consists of a Cathode Ray Tube (CRT), which displays characters as an output. It forms images from tiny dots called pixels that are arranged in a rectangular form. The sharpness of the image (screen resolution) depends upon the number of pixels. Some common types of monitors are CGA (Color Graphics Adapter), VGA (Video Graphics Adapter), MDA (Monochrome Display Adapter).

b) Printer

Printer is the most important output device, which is used to print information on paper. Printers are essential for getting output of any computer-based application

Types of Printers

There are many types of printers that are classified on various criteria as below (Figure 1.2).

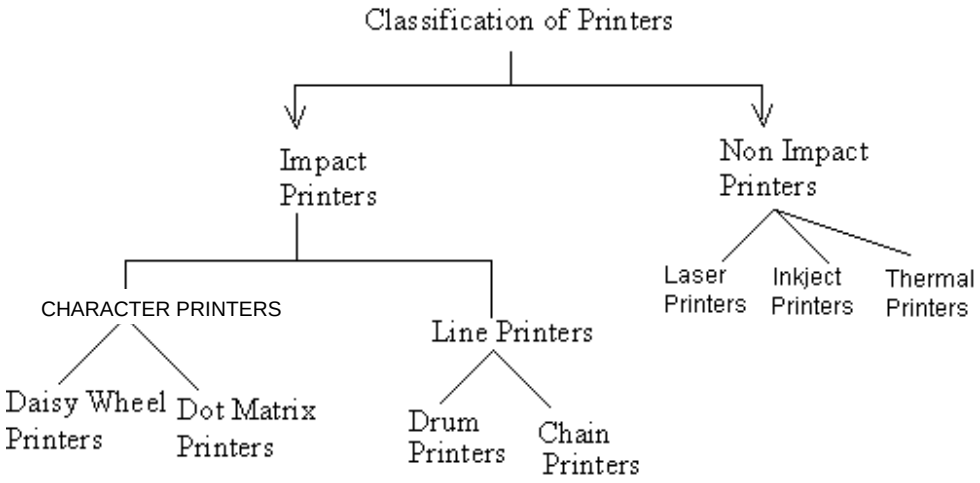


Figure 1.2

a) Impact Printers

The printers that print the characters by striking against the ribbon and onto the paper are called Impact Printers. These printers are of two types: (i) Character and (ii) Line printers.

i. Character Printers

These printers print one character at a time. These printers are again of two types - Daisy Wheel and Dot Matrix Printers.

- **Daisy Wheel Printers**

These printers print the characters by a mechanism that uses a plastic or metal hub with spokes called daisy wheel. The characters are embossed on the radiating spokes and printed by striking these spokes against the ribbon and paper.

- **Dot Matrix Printers**

These Printers Print the characters by putting dots onto the paper. They do not give better printing quality than daisy wheel printers, but are faster in speed. The printing speed of a dot matrix printer can be upto 360 cps (characters per second).

ii. Line Printers

These Printers Print one line at a time. Their printing speed is much more than character printers. They are again of two types - Drum Printer and chain Printers

- **Drum Printers**

These printers print the line by a rotating drum having a lief of characters for each print position. The hammers strike each character of the drum simultaneously so that entire line is printed for one full rotation of the drum. These printers are also called Band Printers

- **Chain Printers**

These printers print the line by a rotating chain having ring characters for each print position. Their printing mechanism is similar to drum printers. The printouts obtained from these printers, have uneven character spacing but even line height

b) Non-Impact Printers

The printers that print the character without striking against the ribbon and onto the paper are called non-impact printers. These printers print a complete page at a time and therefore also called Page Printers.

Page Printers are of three types –

a) Laser Printers
b) Inkjet Printers and
c) Thermal Printers

a) Laser Printers

These printers look and work like photocopiers. They are based on laser technology, which is the latest development on high speed and high quality printing. In these printers, a laser beam is used to write the image on a paper. First, the image is formed by electrically changing thousands of dots on a paper by laser beam. Then, the paper is sprayed with a laser having the opposite charge and is passed over a heated roller to make the image permanent.

b) Ink Jet Printer

These printers print the characters by spraying the paper with electrically charged ink. These printers give better quality than character printers but not better than laser printers. They are cheaper than laser printers, hence used widely in many offices. They also offer an option of using color cartridges for multi color printing.

c) Thermal Printers

These printers print the characters by melting a wax-based ink off a ribbon on to a special heat sensitive paper. They give letter quality printing but are relatively expensive in maintenance than other printers.

Processors / CPU

The CPU is the main component or "brain" of a computer, which performs all the processing of input data. Its function is to fetch examine and then execute the instruction stored in the memory of a computer. In microcomputers, the CPU is built on a single chip or Integrated Circuit (IC) and is called a Microprocessor. The CPU consists of the following distinct parts.

(a) Arithmetic Logic Unit: The Arithmetic and logic unit of CPU is responsible for all arithmetic operations like addition, subtraction, multiplication and division as well as logical operations such as less than, equal to and greater than . Actually all calculations and comparisons are performed in the Arithmetic Logic Unit.

(b) Control Unit: The control unit is responsible for controlling the transfer of data and instructions among other units of a computer. It is also considered as the "Central Nervous System" of computer, as it manages and co-ordinates all the units of the computer. It obtains the instructions from the memory, interprets them and directs the operation of the computer.

(c) Registers: Registers are small high speed circuits (Memory Locations) which are used to store data, instructions and memory addresses (Memory Location Numbers). When ALU performs arithmetic and logical operations Registers can store one word of data (1 word = 2 bytes and 1 byte = 8 bits) until it is over written by another word depending on the processors capability. The number and type of register vary from one CPU to another.

(d) Buses: Data is stored as a unit of eight bits (BIT stands for Binary Digit i.e. 0 or 1) in a register. Each bit is transferred from one register to another by means of a separate wire. This group of eight wires, which is used as a common way to transfer data between registers, is known as a bus. In general terms, bus is a connection between two components to transmit signal between them. Bus can be of three major types viz. Data Bus, Control Bus and Address Bus. The data bus is used to move data, address bus to move address memory location and control bus to send control signals between various components of a computer.

(e) Clock: Clock is another important component of CPU, which measures and allocates a fixed time slot for processing each and every micro operation (smallest function operation). In simple terms, CPU is allocated one or more clock cycles to complete a micro-operation. CPU executes the instructions in synchronization with the clock pulse.

Memory Unit

Memory unit is that component of a computer system, which is used to store the data, instructions and information before, during and after processing by ALU. It is actually a work area (physically a collection of integrated circuits) within the computer, where the CPU stores the data and instructions. It is also known as a Main/Primary/Internal Memory.

It is of the following three types.

a) Read Only Memory (ROM)
b) Random Access Memory (RAM)
c) Complementary Metal Oxide Semiconductor Memory (CMOS)

a. Read Only Memory

Read Only Memory is an essential component of the memory unit. The computer has no intelligence or memory and requires instructions, which are given by man. Whenever the computer is switched on, it searches for the required instructions. The memory, which has these essential instructions, is known as Read Only Memory (ROM). The memory is permanent and is not erased when the system is switched off. ROM contains a number of programs (set of instructions). The most important program of ROM is the Basic Input Output System (BIOS), which activates the hardware such as keyboard, monitor, floppy disk etc in communicating with the system and application software.

- **Types of ROM:**

  There are many types of ROM available for microcomputers like Mask ROM, PROM, EPROM, EEPROM and EAPROM.

i. **Mask ROM**: Mask ROM is the basic ROM chip. In this type of ROM, the information is stored at the time of its manufacturing.

ii. **PROM**: PROM stands for the Programmable Information and it is stored by programmers after it's manufacturing. It also cannot be altered or erased later on.

iii. **EPROM**: EPROM stands for Erasable Programmable Read Only Memory. It is similar to PROM, but its information can be erased later on by ultra violet and it can be reprogrammed.

iv. **EEPROM**: EEPROM stands for Electronically Erasable Programmable Read Only Memory. It is similar to EPROM, but its information can be erased by using a high voltage current.

v. **EAPROM**: EAPROM stands for Electrically Alterable Read Only Memory. As compared to EPROM and EEPROM, the information stored in EAPROM can be altered later.

b. Random Access Memory (RAM)

Random Access Memory (RAM) is another important component of the Memory Unit. It is used to store data and instructions during the execution of programs. Contrary to ROM, RAM is temporary and is erased when the computer is switched off. RAM is a read/write type of memory and thus can be read and written by the user/programmer. As it is possible to randomly use any location of this memory it is known as Random Access Memory.

- **Types of RAM:**

There are two types of RAM used in PCs - Dynamic and Static RAM.

i. **Dynamic RAM (DRAM)**: The information stored in Dynamic RAM has to be refreshed every few milliseconds, otherwise it is erased. DRAM has a higher storage capacity and is cheaper than static RAM.

ii. **Static RAM (SRAM)**: The information stored on Static RAM need not be refreshed, but it remains stable as long as power supply is provided. SRAM is costlier but has higher speed than DRAM.

c. Complementary Metal Oxide Semiconductor Memory

Complementary Metal Oxide Semiconductor (CMOS) Memory is used to store the system configuration, date, time and other important data. When the computer is switched on, BIOS matches the information of CMOS with the peripheral devices and displays error in case of mismatching.

Storage Devices

There are many storage devices, which are used with microcomputers. Some of the common storage devices are

a) Floppy Disk

Floppy Disk (FD) is another common storage device, which is small, flexible and easily removable. It is made of a plastic disk coated with magnetic material, which is sealed inside a square plastic jacket. It is called as 'floppy' because it is soft having flexible physical property. Data can be written on or read from this floppy by a device called floppy Disk Device (FDD), which is fixed inside the computer.

There are many types of floppies depending upon their sizes and storage capacities. The original floppy developed by IBM, is an 8^{o} floppy, but the most popular

size available for present day PCs are 5 1/4" and 3 1/2". The storage capacity of floppies vary from 360 KB to 1.44 B. The floppies can store data on both sides (Double-sided floppies) or on single side (Single-side floppies) depending upon the floppy device. Double-sided floppy devices are most frequently used in present day PCs. The latest floppy device that packs two high-density floppy devices (5.25 and 3.5 inch).

b) Compact Disk

Compact Disk (CD) is the latest storage device, used to store data, information and software, which can only be read and not changed or erased. It is an optical read only memory made up of a resin. Therefore it is actually called Compact Disk Read Only Memory (CD-ROM). However, the information is stored on CDs by using an expensive drive called CD-ROM drive. Nowadays compact disks are very popular storage devices for microcomputers because a large number of software including multimedia, audio and graphics software is available only on these disks. CDs can store a large volume of data (up to 680 MB), which is almost the same as a storage capacity of a 640 MB Hard Disk.

c) Winchester Disk (Hard Disk)

Winchester Disk is the most common storage device of present day microcomputers. It is popularly called the Hard Disk Drive (HDD) or sometimes Fixed Disk Drive. It is fixed inside the computer and is not easily removable. It is used for storing the software and data inside the computer. It is also known as 'Winchester Disk' probably because this drive was first made by IBM at Harsley Laboratory located near Winchester in England.

Winchester Disk consists of one or more disk platters, an access mechanism and read/write heads, which are sealed in a case. Hard disk size depends upon the disk platter's sizes (such as $5^{1/2}$, $3^{1/2}$, $2^{1/2}$ inch etc). The $3^{1/2}$ inch size platter is common with PCs and $2^{1/2}$ inch with laptop/portable computers. Read/Write head is used to write any information on the disk surface or to read it back

d) Magnetic Tape

Magnetic Tape is the oldest storage device available for microcomputers. It is generally used to store a large volume of data that is needed to be sequentially accessed and processed. The tape is made up of a plastic ribbon coated with an iron-oxide material, which can be magnetized. The data stored on tape can be read as well as erased and written again. Magnetic tape is a sequential access storage device; hence it is not possible to read the data randomly or directly. Therefore, magnetic tapes are suitable only for storing data for backups and batch-made applications and not for on-line applications.

e) Video Disk

Video Disk is used to store text, video and audio data. It is widely used for training applications as if can be played like a phonograph record.

f) DVD ROM / RAM Disk

DVD ROM and DVD RAM disks are optical disks having a storage capacity of 47 GB and 5.2 GB respectively. These disks are becoming the next generation's new standard for higher capacity removable media. They are ideal for storage of huge amount of information required for multimedia applications.

1.2.5 Software

Software is a program or set of instruction, which is required to use the computer. Many types of software are available for various applications. The software development field is so advanced that day-by-day existing software are becoming outdated as new software are coming in the market. Softwares are broadly classified in to two types namely System Software and Application Software. These two types of software are discussed below:

System Software

Software that is required to control the working of hardware and aid in effective execution of a general user's applications are called System Software. This software performs a variety of functions like file editing, storage management, resource accounting, I/O management, database management etc. Some of the examples of system software are DOS (Disk Operating System, Windows, BASIC, COBOL and PC Tools). This is developed by System Programmers. System Software can be further categorized into the following three types.

a. System Management Software
   (Operating System, Operating Environments)
b. System Development Software
   (Language Translators, Application Generators, CASE Tools)
c. System Software Utilities

a) System Management Software

The System Management software, which involves operating system, is discussed in detail in section 1.6.

b) System Development Software

The System Development Software are discussed below.

i. **Language Translators**: Language Translators are categorized into three types.

   Assemblers: Assemblers translate the Assembly language code (source program) into Machine language code (object program). After assembling, a linker program is used to convert the object program into an executable program. The Microsoft assembler program (MASM) and Borland Turbo assembler program (TASM) are two popular assemblers.

Interpreters: Instructions of a high level language are coded in many statements. At the time of their execution, they are converted statement by statement into machine code, by using system software, called interpreters. For example, programs written in BASIC language are executed by using BASICA or QWBASIC. Interpreters programs written in some fourth generation languages, like dBASE III plus are also executed using dBASE interpreter.

Compilers: In contrast to interpreters, compilers provide faster execution speed. Compilers do not translate and execute the instructions at the same time. They translate the entire program (source code) into machine code (object code) using linker; the object code is converted into executable code. Compilers are widely used in translating codes of high level languages (e.g. COBOL, FORTRAN, PASCAL, etc) and fourth generation languages (dBASE IV, Foxpro etc). As compared to interpreters or assemblers, compilers are preferred in development of application software.

c) System Software Utilities

System Software Utilities support the operation of a computer. They provide many features including file management capabilities, data compression, diagnostic routines, virus detection and removal, text editing, performance, monitoring and spooling. Some of the important types of utilities are discussed below.

i. **File Management Utilities**: These utilities provide file management capabilities like copying, comparing, searching, listing and sorting the files. Although these features are offered by many operating systems, utility programs provide better user-friendly environment along with some additional features. NORTON utilities and PC Tools are the most commonly used file management utilities.

ii. **Data Compression Utilities**: These utilities compress or decompress files that are stored on floppy and hard disks. As compressed files take up very less space on disks, data compression utilities are widely used during copying of data from hard disks to floppy disks. PKZIP/PKUNZIP programs are commonly used examples of data compression utilities.

iii. **Diagnostic Utilities**: These utilities can detect bugs (errors in hardware/software) in computers. For instance, the problem of floppy and hard disks can easily be detected by a popular utility program called Norton Disk Doctor (NDD). QAplus and Disk Manager (DM) are other examples of utilities that can detect and remove any bugs in storage devices, software and other components of computers.

iv. **Text Editing Utilities**: These utilities are used to create, edit and print the non-document texts such as programs, data etc. Norton Editor (NE) is the most common example of text editor. Most operating systems, including DOS, also has in-built text editor program.

v. **Spooling Utilities**: In multi-user/networking environment, the input and output devices are generally slow. In such an environment, the processing of computer is also slowed down. To control the computer from being showed down, the spooling programs are used. Spooling (Simultaneous Peripheral Operations Online) program is used to buffer data for the printer and remote batch terminals. This program sends the output to the disk and printer does not interact with CPU during printing. Spooling utilities are used mainly in computer systems with multi-user/networking environment.

Application Software

Whenever an organization purchases computers, besides an operating system certain application softwares are also required to be purchased. This software is needed for general purpose like word processing, database management, and spreadsheets etc, which are known as Application Software. Some of the importance of different application software is given below:

a) Word Processor Packages

Word processors are application software, which are used for word processing. Word processing is the most widely used technique for typing, editing, storing, formatting, manipulating and printing documents with the assistance of a computer and printer. It is the most efficient means of generating documents electronically.

b) Database Management Packages

A Database is a logical term used to refer to a collection of organized and related information. A Database Management System is a system that allows you to access the data in a Database. In any Business, certain piece of information about Customer, Product, Price and so on are called database. Shortly Data Base Management System is defined as software that organizes and maintains the data in a database for providing the information.

c) Spreadsheet Packages

Business applications require a lot of calculation work. In a manual system, it is done on a sheet of paper with rows and columns, which are called a 'spreadsheet'. Spreadsheet packages use the concept of an electronic spreadsheet. An electronic spreadsheet is a very big sheet consisting of thousands of rows and columns which are used to store information in the memory of a computer. Like databases, electronic spreadsheets have now become an essential tool in developing a computerized management information system.

d) Office Automation Packages

Word processors, spreadsheets and Database Management Packages are generally called office Automation Packages/Software Tools or office suites. MS Office and Lotus SmartSuite are two most popular examples of office Automation Packages.

Microsoft office (MS-Office) Professional is a package that contains five powerful general-purpose application packages. It includes Word, Excel, PowerPoint, Access and Mail. We shall discuss it in detail in Unit-II.

Lotus Smart Suite is another popular office Automation package that contains five powerful application packages. It includes word Pro, Lotus 1-2-3, Freelance Graphics, Approach and Organizer.

Corel Office, an office suite contains Word Perfect, Quattra Pro, Paradox, Corel Draw, Netscape Navigator, Presentations, Corel Flow, Sidekick and other application packages. Sidekick is the first popup program (TSR- 'Terminate and Stay Resident' in memory) used for editing programs and non-document files.

1.2.6 Operating System

Operating system is a set of programs, which provides an easy to use interface between the users and the computer system and manages the computer resources in order to achieve a maximum efficiency of the computer system. An operating system is a part of the system software and has become an integral part of a computer system.

In short, an operating system acts as a manager of both hardware and software resources of a computer system and facilitates the execution of application programs.

Thus, an operating system is computer software that controls the hardware, manages the system, resources and executes the programs in response to users' commands.

The software resources of a computer system include compilers, assemblers, loaders, linkers etc and it is the operating system that makes these resources available to an application program. These software resources are complex programs supplied by the manufacturer and are a part of the system software.

The operating system is also a part of the system software and consists of programs, also called routines. An operating system contains I/O routines, memory management routines, scheduling routines, command interpreter routines and routines to invoke other programs of the system software as and when required by an application program. Another important program included in an operating system is an EDITOR, which enables the user creates and edits the application programs.

Now, if an application program requires the use of the computer system resources, it has to communicate its requirement of resources to the operating system, which provides these resources to the application program.

Need for an Operating System

To appreciate the need of an operating system, one has to look at the radical difference between the working of earlier and the modern computers systems.

The earlier computer systems were dedicated systems in the sense that at a time the computer could execute only one program. The next program had to wait till the

execution of the program in computer memory was completed. Suppose a program under execution required some input data, then the program execution would halt temporarily to fill the input data, which was supplied. During this time, the CPU remained idle resulting in wastage of precious computer time. Similarly when a program after execution was undergoing the output operation, the CPU still remained idle. This wastage of CPU time was irritating because in early times there were a few computers.

Now, modern computers, unlike earlier computer systems are capable of handling a large number of programs at a time. These programs to be executed are placed in computer memory which requires memory management so that the programs can be stored in memory in such a way that these programs do not interfere destructively with each other. Apart from this, a CPU can perform only one task at a time. Hence it is required to allot a certain CPU time slice to the programs in memory that are waiting execution.

In this situation if the execution of a particular program is stopped due to an error or for want of an input data, the CPU takes the other program for execution. Apart from this most of the programs need input/output operations and if each user has to write his own I/O routine, it will result in wastage of a good deal of time.

All these tasks of memory management, allotment of CPU time to various programs and performing of I/O operations are taken care of by an operating system.

Types of Operating System

Many types of operating systems are available for computers, which can be divided into the following two types.

(a) Single user Operating Systems
(b) Multi-user Operating Systems

a) Single-User Operating Systems

These operating systems are used mainly for computers having only one terminal (stand-alone PCs). MS-DOS (Microsoft Disk Operating System) and PC DOS (Personal Computer Disk Operating System) are the two important single user operating systems. Both systems are almost identical and are simply called DOS. OS/2 and Windows NT are other popular single-user multi-tasking operating systems for microcomputers.

i. **MS-DOS**: MS-DOS, developed by Microsoft Inc' in 1981 is the most widely used operating system of IBM-compatible microcomputers. The latest version of MS-DOS is 7.

ii. **PC-DOS**: PC-DOS is essentially the same operating system as MS-DOS, but developed and supplied by IBM for its PCs.

iii. **OS/2**: OS/2 is a single user, multi-tasking operating system, developed jointly by IBM and Microsoft. This provides a unique feature of multi-

tasking, where several programs can be seen simultaneously. It was the 1st OS that provided users with a Graphical User Interface (GUI).

iv. **Windows NT**: Windows NT (New Technology) is the single user 32-bit multi-tasking operating system for 386 and above, developed by Microsoft Inc. Windows NT was driven by a need to exploit the tremendous power of 32-bit microprocessors and runs applications, which are developed for DOS and Windows.

b) Multi-user Operating System

These operating systems are used for those computers (Micro to Mainframe), which have many terminals (Multi-user Systems). The popular operating systems used for multi-user system are UNIX, NETWARE, MVS, OS/400, VMS and LINUX.

i. **UNIX:** UNIX is a highly successful operating system for multi-user systems. Actually, it is more popular among scientific and engineering users rather than business users. In 1980, Microsoft developed its own version of UNIX for 2863, which is called as XENIX.

ii. **Netware:** Netware is a group of network operating system developed by Novell Inc. that provides multi-user capabilities.

iii. **MVS (Multiple Virtual Storage):** MVS is one of the most complex multi-user operating systems ever developed for IBM mainframes. In MVS, each job (Time sharing user or batch program) is assigned its own virtual storage space.

iv. **OS/400:** OS/400 is the IBM's Operating system for its AS/400 computer.

v. **VMS (Virtual Memory Storage):** VMS Operating system is used on DEC's VAX series of minicomputers.

vi. **LINUX:** LINUX is a 32-bit UNIX like operating system that has been developed recently for microcomputers. It is the world's first free operating system developed and maintained by thousands of people worldwide.

Operating System Techniques

There are several techniques used in Multi-user operating systems for enabling many users to concurrently share the single or multiple CPU (E.g. Multiprogramming and Multiprocessing). Some techniques are used in single-user operating system to handle multiple tasks. We shall discuss these common techniques used in different operating systems.

a) Multiprogramming

It is a process by which single CPU works on two or more programs simultaneously. Using this technique, the operating system keeps the CPU busy. Multiprogramming allows the processor to handle either multiple batch jobs at a time

(Batch Multiprogramming) or multiple interactive jobs shared among multiple users (Time sharing Multiprogramming). Time-sharing is a technique that allows a CPU to simultaneously support the activities of several users by allocating fixed time slots (in milliseconds). Examples of operating systems that support multiprogramming are OS/2, UNIX and Macintosh 7.

b) Multiprocessing

It refers to the use of two or more CPUs to perform a co-coordinated task simultaneously. For (E.g.) MVS, VMS and Windows NT support multiprocessing.

c) Multitasking

It refers to the ability of an operating system to execute two or more tasks concurrently. In multitasking environment, the user opens new applications without closing the previous ones and the information can be easily moved among a number of applications. For example, Win NT and OS/2 operating systems use this technique.

1.2.7 Networking

The merging of computers and communications has had a profound influence on the way computer systems are organized. The concept of the "Computer Center" as a room with a large computer to which users bring this work for processing is now totally obsolute. The old model of a single computer serving all of the organizations computational needs has been replaced by one in which a large number of separate but interconnected computers do the job. The systems are called computer networks.

Two computers are said to be interconnected if they are able to exchange information. The connection need not be through a copper wire; fibre optics, microwaves and communication satellites can also be used. By requiring the computers to be autonomous, we wish to exclude from our definition systems in which there is a clean master/slave relationship. If one computer can forcibly start, stop or control another, the computers are not autonomous. A system with one control connection and many slaves is not a network; nor is it a large computer with remote printers and terminals. A detailed description of computer networks is given in the unit-v where different types of computer networks are explained.

1.2.8 Windows Operating System

Some versions of the Windows Operating system is discussed below.

Windows Operating System

Windows is the most popular system software that provides graphical user interface. Windows provides an interface, which is similar to Macintosh user interface. In such interface, each active application is displayed in windows on the screen. The application window can be opened, hidden, closed, moved, resized, minimized or maximized. The user can run several applications simultaneously, each in its own window. Windows allow the user to share data among different applications. Windows

provides an interactive environment, where the user is engaged in continuous dialog with the computer. In windows, although both keyboard and mouse are used as input device, the mouse is the primary tool for selecting and running window applications.

The different versions of windows are Windows 1.x, Windows 2-x, Windows 3.0, Windows 3.1, Windows 3.11, and Windows for Workgroups 3.11, Windows 95, Windows 98 and Windows NT. Windows 1.x, 2.x and 3.0 were the earlier attempts from Microsoft Inc. for creating graphical user interface but were not very successful. Windows 3.1 and higher versions provide powerful and multi featured GUI capabilities. Windows NT may appear the same as Windows 3.1, but it is based on entirely a different concept.

The various types of windows operating system are given below.

a) Windows 3.1 / 3.11 and Windows for Workgroups 3.11

Windows 3.1 is generally misunderstood as an operating system, but actually it is not an operating system Windows 3.1 is a graphic based operating environment that replaces the DOS interface. In order to run Windows 3.1, DOS must be installed on the computer. It also provides non-preemptive multitasking features, which allow users to run several programs at one. Windows 3.11 is the successor of Win 3.1 with a trivial difference.

b) Windows 95

Windows 95 is a much-awaited replacement for Win 3.1. It is a new 32-bit operating system from Microsoft, released in 1995. Windows 95 provides the following important features.

i. **Built in Networking:** Windows 95 has sophisticated 32-bit built-in network components, that allow operating both as a client-server network and peer-to-peer network operating system. In client-server approach, there is a central computer acting as a file server, with which workstations called clients are attached.

ii. **Multimedia functions:** Windows 95 provides all multimedia controls and functions. Multimedia is the way of disseminating information in form of text, audio, graphics/animated graphics and full motion video.

iii. **Memory Protection:** Memory protection feature of Windows 95 ensures that one application do not crash other applications in memory.

iv. **Plug and Play:** Windows 95 automatic does the hardware configuration process, by knowing the kind of printers, mouse and other peripherals. This feature is known as 'Plug and Play'.

v. **OLE (Object Linking and Embedding):** OLE is the key technology for Windows 95. It is the Microsoft's standard for creating compound documents (compound document is a document made from different programs) in windows.

c) Windows NT

The Microsoft Windows NT operating system is a 32-bit pre-emptive multi-tasking operating system for modern microprocessors. NT is portable to a variety of

processor architectures. One or more versions of NT have been ported to Intel 386 and higher, MIPS R4000, and Power PC. Key goals for the system are portability, security, compliance, multiprocessor support, extensibility, international support and compatibility with MS-DOS and MS-Windows applications. NT uses micro-Kernel architecture, so enhancements can be made to one part of the operating system without greatly affecting other parts of the system. NT is not a multi-user operating system.

The two versions of NT are Windows NT workstation and Windows NT server. They use the same kernel and operating-system code, but NT server is configured for client-server applications and can act as an application server on Netware and Microsoft LANs. Versions 4.0 of NT Server incorporates Internet web-server software and the Windows 95 user interface. In 1996, more NT server licenses were sold than all versions of UNIX licenses. Some of the key features of Windows NT are as follows.

i. **Extensibility:** Extensibility is an important property of any operating system that hopes to keep up with advancements in computing technology so that changes are facilitated over time; NT is implemented using a layered architecture. The programs written for MS-DOS, Microsoft Windows, can all run on NT on the appropriate environment. Because of the modular structure, additional environmental subsystems can be added without any adverse effect.

ii. **Portable:** An operating system is portable if it can be moved from one hardware architecture to another with relatively few changes. NT is designed to be portable.

iii. **Reliability:** Reliability is the ability to handle error conditions, including the ability of the operating system to protect itself and its users from defective or malicious software. NT is designed to resist defects and attacks by using hardware protection for virtual memory and software protection mechanisms for operating system resources. Also, NT comes with a file system called the native NT file system (NTFs) that recovers automatically from many kinds of file system errors after a system crash.

iv. **Compatibility:** Windows NT provides source-level compatibility to applications that follow the IEEE standard. They can be compiled to been on NT without changing the source code.

v. **Performance:** NT is designed to afford good performance. The subsystems that comprise NT can communicate with one another efficiently by a local-procedure-call facility that provides high-performance message passing.

vi. **International support:** NT is also designed for international use. It provides support for different locales via the national language support (NLS) API. NLS API provides specialized routines to format dates, time and money in accordance with various national customs.

1.2.9 LINUX Operating System

LINUX is quote possibly the most important free software achievement since the original space war, or more recently, emacs. It has developed into an OS for business

education and personal productivity. Linux is no longer meant only for UNIX wizards who sit for hours in front of a glowing console. Linux is a Unix operating system clone that runs on a variety of platforms especially personal computers with Intel 80386 or better processor. It supports a wide range of software, from Tex, to the X window system, to the GNU C/C++ compiler, to TCP/IP. It is a versatile bona fide implementation of Unix, freely distributed under the terms of GNU General Public License.

What makes Linux so different is that it is a free implementation of Unix. It was and still is developed cooperatively by a group of volunteers, primarily on the Internet who exchange code, report bugs and fix problems in an open-ended environment.

A Brief History of LINUX

Unix is one of the most popular operating systems worldwide because of its large support base and distribution. It was originally developed at AT&T as a multitasking system for minicomputers and mainframes in the 1970s but since then it has grown to become one of the most widely used operating systems, anywhere, despite sometimes confusing interface with lack of central standardization.

Linux is a free version of Unix developed primarily by Linux Torvalds at the University of Helsinki in Finland, with the help of many UNIX programmers and wizards across the Internet. Linux books and feels much like any other Unix system, and indeed Unix compatibility has been a major design goal of the Linux project. However Linux is much younger than most systems. Its development began only in 1991 when the self-contained kernel for the 80386 processor was wrote and christened.

Early in its development, Linux's source code was made available for free on the Internet. As a result, its history has been one of collaboration by many users from all around the world, corresponding almost exclusively over the Internet. From an initial Kernel that partially implemented a small subset of the Unix system services, Linux has grown to include evermore Unix functionality.

In its early days, Linux development evolved largely around the central operating system Kernel the core executive that manages all system resources and that interacts directly with the hardware. Much more than this Kernel is needed to produce a full operating system of course. It is useful to make the distinction between the Linux Kernel and a Linux system. The Kernel in Linux is an entirely original piece of software developed from scratch by a Linux community; the Linux system, as we known it today, includes a multitude of components, some written from scratch, others borrowed from other development projects or created in collaboration with other teams.

The basic Linux system is a standard environment for applications and for user programming but it does not enforce any standard means of managing the available functionality as a whole. A Linux has matured; there has been a need for another layer of functionality on top of the Linux system. A Linux distribution includes all the standard components of the Linux system, plus a set of administrative tools to simplify the initial installation and subsequent upgrading of Linux and to manage installation and reinstallation of other packages on the system.

Linux Architecture

The Linux system is composed of three main bodies of code, in line with most traditional UNIX implementations.

- The Kernel is responsible for maintaining all the important abstractions of the operating system, including such things as virtual memory.
- The system libraries define a standard set of functions through which applications can interact with the Kernel and which implement much of the operating system functionality that does not need the full packages of Kernel code.
- The system utilities are programs that perform individual, specialized management tasks. Some system utilities may be invoked just once to initialize some aspect of the system; others may run permanently, handling such tasks as responding to incoming network connections, accepting logon requests from terminals or updating files.

The figure illustrates the various components that make up a full Linux system. The most important distinction here is between the kernel and everything else. All the kernel code executes in the processors privileged mode with full access to all the physical resources of the computer. Linux refers to this privileged mode as kernel mode, equivalent to the monitor mode. Under Linux, no user mode is built into the kernel. Any operating system support code that does not need to run in kernel mode is placed in the system libraries instead.

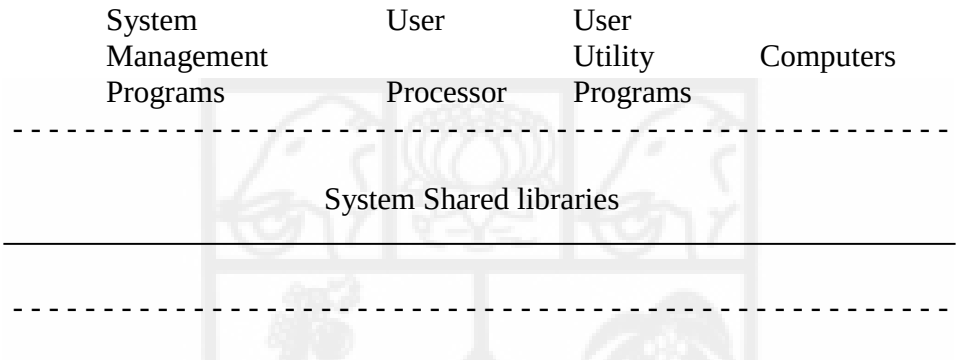
Although, various modern OS have adopted a message passing architecture for their kernel internals, Linux retains UNIX is historical model. The Kernel is created as a single, monolithic binary. The main reason is to improve performance. Just because the entire kernel shares the same melting point it does not imply that there is no scope for modularity. The Linux kernel can load modules dynamically at run time to pull in a needed piece of code just in the same way the user applications can load shared libraries at run time. The kernel does not necessarily need to know in advance which modulus may be loaded-they are truly independent loadable components.

The Linux kernel forms the core of the Linux operating system. It provides all the functionality necessary to run processes, and it provides system services to give arbitrated and protected access to hardware resources. The kernel implements all the features that are required to quality as an operating system. On its own, however, the operating system provided by the Linux Kernel looks nothing like a Unix system. It misses many of the extra features of UNIX, and the features provided are not necessarily provided in the format in which a Unix application expects them to appear. The operating system interface visible to running applications is not directly maintained by the kernel. Rather, applications make calls to the system libraries, which in turn call the operating system services as necessary.

The system libraries provide many types of functionality. At the simplest level, they allow applications to make kernel system service requests. Making a system call involves transferring control from unprivileged user mode to privileged kernel mode; the

details of this transfer vary from architecture to architecture. The libraries take care of collecting together the system-called arguments and if necessary, arranging those arguments in the special form necessary to make the system call.

Finally the Linux system includes a wide variety of user mode programs- both system utilities and user utilities. The system utilities include all the programs necessary to initialize the system, such as those to configure network devices or to load kernel modules. Continually running server programs also count as system utilities, such as programs, which handle user login requests, incoming network connections and the printer queues.



(a) Linux Architecture

Figure 1.3

1.2.10 Visual Editor

Visual Editor is a full screen text editor available on all Unix systems.

Why use Visual Editor?

- It is there on all Unix systems; works on any terminal
- If you know Visual Editor, you know much of awk, sed, grep for free
- Small, fast, dependable but very powerful (especially for touch typists)
- Consistent and tiny command set-works on all keyboards

When not to use Visual Editor?

- When you are writing LISP code (Loop mode is inferior to Evnacs)
- When you are editing binaries (Visual Editor chokes on huge lines)
- When you have forgotten the commands (no online help)

Examples:

Anything you do with Visual Editor is by definition cool stuff.

Cool Stuff:

(a) Indenting Incoming Mail

You have seen those > signs that people like to use before the lines of an included mail message. Here is a line that does it in Visual Editor.

: l, { s | ^ | > |

If you want to use > only upto the current line, replace the "$" with a "." If you want a space after the > sign, you should replace the ">" with a ">". If your mailer (like /usr/ucb/mail) prepends included mail message with a tab, than replace, "^" with "^[tab]".

(b) Changing input upto a Comma

Say you want to change all the text in a sentence upto a comma. Rather than deleting this text and then inserting new text, try the following:

Cf [new input] [ESC]

This does the job in one shot, you can replace the "," with any other letter.

(c) Editing Multiple Files in Visual Editor

Although Visual Editor does not allow multiple windows, editing multiple files is not a problem start Visual Editor up with: "vi file1 file 2 …" and make sure that "aw" is set (either in exec or with: set aw inside VI).

Move to a new file by issuing a: new filename. Your place will be kept in the old file as you move to the new file. To yank from one file to paste into another, use named buffers.

1.3 Revision Points

Classification of Computers

Computers are classified four main categories:
They are

1) According to Purpose
2) According to Size and Storage capacity
3) According to Technology used
4) According to Historical Advancement

According to Purpose category

1. General Purpose Computers

Computers that follow instruction for general requirements such as sales analysis, financial accounting, invoicing, inventory, management information etc. are called General Purpose Computers.

2. Special Purpose Computers

Computers which are used for performing a particular task alone, are called Special Purpose Computers.

Size and Storage Capacity

According to the size and memory/storage capacity computers are of the following four types:

1. Super Computer

Super computer is the biggest and fastest, which is mainly designed for complex scientific applications.

2. Mainframe Computer

Mainframe computers are very large and fast computers but smaller and slower than super computers.

3. Mini Computers

Mini computers are computers, which multiterminal facilities. They have only one CPU but possess many terminals and keyboards.

4. Micro Computers

A Micro Computers is the smallest digital computer, which uses a microprocessor as its CPU. Microprocessor is a single chip (Integrated Circuit) CPU. Micro computer is popularly called Personal Computer (PC).

Technology used

According to the technology used, computers are of the following three types:

1. Analog Computers

Analog computers are special purpose computers that represent and store data in continuously varying physical quantties such as current, voltage or frequency.

2. Digital Computers

Digital computers are mainly general-purpose computers that represent and store data in descrete quantities or number.

3. Hybrid Computers

Hybrid computers incorporate the technology of both analog and digital computers. These computers store and process analog signals which have been converted into discrete numbers using analog to digival converters.

Input/Output Devices

Computers have I/O Unit, which contains the Keyboard, Joystick, Monitor, Printer etc., those devices are called pheripherals also.

Arithmetic and Logical Unit (ALU)

CPU contains the ALU. It takes the responsibility for all arithmetic operations like addition, subtraction, multiplication and division as well as logical operations such as less than, equal to and greater than.

Memory Unit

Memory Unit is one of the most important units of CPU. This unit stores all the information or data. Memory unit is classified in two different categories.

1) Primary Memory
2) Secondary Memory

Compilers, Interpreter and Assemblers

Compilers translate the entire program into machine code using linker, the machine code is converted into executable code. Compilers provide faster execution speed.

Interpreters: Instructions of a high level language are coded in many statements. At the time of their execution, they are converted statement by statement into machine code, by using system software, called interpreters.

Assemblers: Assemblers translate the Assembly language code (source program) into Machine language code. After assembling, a linker program is used to convert the machine program into an executable program.

Operating System

Operating system is a set of programs, which provide a bridge between the users and the computer system. An operating system is a part of the system software and has become an integral part of a computer system.

Net Working

A computer network is a system for communication among two or more computers. These networks may be fixed (cabled, permanent) or temporary (as via modems).

1.4 Intext Questions

1. Define a Computer?
2. Explain the Classification of Computers with examples.
3. Explain why, “CPU is the brain of computer”?
4. Explain the following:

   RAM
   Applicatin Software

LINUX Architecture
Visual Editor
Computer Networking

5. Distingush between the following.

   Analog / Digital Computers
   System / Application Software
   RAM / ROM
   Hardware / Software

6. Explain the usage of computers.
7. Explain the various types of printers based on their criteria.
8. What is an Operating System? Explain its importance.
9. Briefly explain the types of Operating Systems.

1.5 Summary

- Computer is one of the greatest inventions in human history. They are the new source of Technology, which helps to fill the gap of innocence among people. We are rapidly becoming a "computer society". Until recently computers were found only in environmentally controlled rooms behind locked doors
- The Computer evolved as a result of man's search for a fast and accurate calculating device.
- The CPU is the main component or "brain" of a computer, which performs all the processing of input data.
- Software is a program or set of instruction, which is required to use the computer. Many types of software are available for various applications
- An operating system is a part of the system software and has become an integral part of a computer system.
- The concept of the "Computer Center" as a room with a large computer to which users bring this work for processing is now totally absolute.

1.6) Terminal Exercises

1. Write a short notes about Super computers.
2. CPU is _____ of Computer System.
3. Light pen is _____ device.
4. Write the units are available in CPU.

5. Write a short note about ROM
6. Chose the best answer
    1. Floppy Disk
        a) Storage Device, b) Input Device, c) Output Device
    2. Operating System is a
        a) System Development Software, b) System Management Software,
        c) System Software Utilities
7. Write a short note about the interpreter.
8. Unix is a _____ user Operating System
9. Which following device is output
    1) Key board
    2) Printer
    3) Light pen
    4) Joy stick

1.7 Supplementary Materials

1. Computer Fundamentals by B. Ram (Revised Third Edition)
2. Fundamentals of Computer Aided Engineering B. Raphael and I.F.C. Smith

1.8 Assignments

1. Comparative study between Operating System with Multiuser Operating System.
2. Full Display of CPU and its parts has to show for students, which give more understanding about it.

1.9 Reference Book

1. Sanjay Saxena “A First Course in Computers”, Vikas Publishing House, New Delhi.

Unit I

1.0 Introduction

Computer is one of the greatest inventions in human history. They are the new source of Technology, which helps to fill the gap of innocence among people. The ultimate purpose of inventing computers is to make calculations easier. Their presence is vital in today's society. Those who have **computer** knowledge have a competitive edge. And those who don't have it should seek it out. The computer is an amazing machine that can help you to perform so many different tasks in so many areas of your life. Whether you want to track an investment, publish a newsletter, design a building or resolve complex scientific problems accurately in a short time, you can use a computer to do it. These powerful tools built of silicon, metal and plastic are so pervasive that virtually no business or organization can function effectively without them. Even in our homes, computers are becoming increasingly indispensable tools.

We are rapidly becoming a "computer society". Until recently computers were found only in environmentally controlled rooms behind locked doors. Only computer professionals dared enter these secured premises. In contrast, today, computers are found in millions of homes and just about every office. In fact there is a computer for one in every eight people in the world. Eventually all of us will have at least one computer and will use it everyday for work and leisure.

1.1 Objectives

Students can get the clear idea about the world of computer and the tremendous knowledge about this. They can get the good understanding about the Generation, History, Evaluations of computers, and External and Internal parts of Computers. Their basic knowledge about the various types of operating systems (OS). Also this unit explains the following concepts of computers.

- Hardware Devices
- Software
- Examples of Operating System
- Computer Networking

1.2 Contents

1.2.1. Computers – a definition

In layman's language, the computer is a fast calculating device that can perform arithmetic operations. Although the computer was originally invented mainly for doing high speed and accurate calculations, it is not just a calculating device. The computer can perform any kind of manipulations involving arithmetic and logical operations on data. It gets the data through an input device, processes it according to the instructions given and gives the information as output. We can define a computer as follows:

"A Computer is an electronic device capable of performing arithmetic and logical operations. It accepts raw data as input (in the form of digital data) and processes it according to the sequence of instructions given by the programmer/user and provides the desired information as output. Computers also include the means for storing data"

The terminology used in the above definition is summarized in the table below.

Term	Meaning
Input	Data and instructions given to computer
Digital	Digital describes electronic technology that generates, stores, and processes data in terms of two states i.e. positive and non positive
Data	A set of basic facts and entities which by themselves have no meaning
Processes	Instance of a program running in a computer for manipulation of data
Instructions	Order given to a computer processor by a computer program to perform a task
Information	Data that has a meaning/value in some context for its receiver
Output	Information obtained after processing of data

Classification of Computers

The classification of computers is based on the following four criteria:

a. According to Purpose
b. According to Size and Storage capacity
c. According to Technology used
d. According to Historical Advancement

Based on these criteria, the classification of computers is illustrated in table 1.1 and discussed below.

(A) Purpose

Depending upon use of computers for different purposes, they can be classified as mentioned below:

1. General Purpose Computers

Computers that follow instruction for general requirements such as sales analysis, financial accounting, invoicing, inventory, management information etc. are called General Purpose Computers. Almost all computers used in offices for commercial, educational and other applications are general-purpose computers.

2. Special Purpose Computers

Computers, which are used for performing a particular task alone, are called Special Purpose Computers. They are programmed in the manufacturing stage itself for doing this work. They cannot be programmed for other works. Automatic cash Tellers, Telephone tariff analyzer; Autonomous Mobile Robots are some examples of special purpose computers.

(B) Size and Storage Capacity

According to the size and memory/storage capacity computers are of the following four types:

1. Super Computer

Supercomputer is the biggest and fastest, which is mainly designed for complex scientific applications. It has many CPUs (Central Processing Units), which operate in parallel to make it the fastest computer. It is typically used for the following applications.

- Defense
- Electronic Design
- Energy Management
- Petroleum Exploration and production

Some of the examples of supercomputers are CRAY-3, XMP-14, PARAM-9000 and PARAM-10000.

2. Mainframe Computer

Mainframe computers are very large and fast computers but smaller and slower than supercomputers. They are used in a centralized location where many terminals (Input / Output devices) are connected with a single CPU and thus, allow different users to share the single CPU. They have very high memory (Several Hundred Megabytes) and can support thousands of users. They are mainly used for following applications.

- Banking Applications
- Railway and Airline Reservations
- Commercial Applications of large industries/companies

Some of the examples of mainframe computers are IBM 3090, IBM 4381, IBM 4300 and IBM Es-9000.

3. Minicomputers

Minicomputers are computers, which have multiterminal facilities. They have only one CPU but possess many terminals and keyboards. If it has 7 terminals, then 7 persons can use the computer at a time. Minicomputers are designed to be of medium

scale, smaller and generally slower than mainframe computers. The cost of a minicomputer is less when compared to mainframe.

Therefore, it is mainly used in applications where processing can be distributed among several minicomputers rather than using a mainframe computer.

Some of the examples of minicomputers are PDP-1, IBM AS/400, DEC Micro VAX.

4. Microcomputers

A microcomputer is the smallest digital computer, which uses a microprocessor as its CPU. Microprocessor is a single chip (Integrated Circuit) CPU. Microcomputer is popularly called Personal Computer (PC). It can be used both as a stand-alone machine and a terminal in a multi-user environment. Microcomputers are becoming very popular now-a-days due to very high processing power and memory. Today, a powerful microcomputer may be used as a substitute for mini or mainframe computer.

Some of the examples of a minicomputer are: 8088, 8086, Pentium Pro (P5), Pentium II (P6).

(C) Technology used

According to the technology used, computers are of the following three types:

1. Analog Computers

Analog computers are special purpose computers that represent and store data in continuously varying physical quantities such as current, voltage or frequency. They are mostly used for process control applications. The physical quantities such as pressure, temperature etc are represented by different electric lines with corresponding voltages. Analog computers are also used for scientific and engineering applications. Some of the examples of analog computers are given below.

a) **Thermometer**: Simple analog computer used to measure temperature. In thermometer, the mercury moves up or down as the temperature varies.

b) **Speedometer**: Car's speedometer is another example of analog computer where the position of the needle on dial represents the speed of the car.

Digital Computers

Digital computers are mainly general-purpose computers that represent and store data in discrete quantities or number. In these computers all processing is done in terms of numeric representation (Binary digits) of data and information. Although the user enters data in decimal or character form, it is converted into binary digits (0's and 1's). Almost all the computers used at present are digital computers.

2. Hybrid Computers

Hybrid Computers incorporate the technology of both analog and digital computers. These computers store and process analog signals which have been converted into discrete numbers using analog to digital converters. They can also convert the digital

numbers into analog signals or physical properties using digital -to-analog converters. Hybrid computers are mainly used in artificial intelligence (robotics) and computer added manufacturing (e.g. Process control).

Criteria	**Ist Gen Computer**	**IInd Gen Computer**	**IIIrd Gen Computer**	**IVth Gen Computer**	**Vth Gen Computer**
Speed	Slowest	Slow	Medium	Faster	Fastest
Reliability	Unreliable	Less Reliable	More Reliable	Most Reliable	Yet to be Judged
Availability	Out dated	Out dated	Out dated	Current	Yet to be built
Size	Largest	Large	Medium	Smallest	Medium
Basic Electronic Component	Vacuum Tubes or valves	Transistors	Integrated Circuits (ICs)	Very Large Scale Integration (VLSI)	Ultra Large Scale Integration (ULSI)

Table 1.1 Characteristics of Various Generations of Computers

(D) Historical Advancement

According to the historical advancement, computers are of the following types

1. Zeroth Generation Computers
2. First Generation Computers
3. Second Generation Computers
4. Third Generation Computers
5. Fourth Generation Computers
6. Fifth Generation Computers

A detailed description on this Generation of Computers is explained in the section 1.2 History of Computers.

Uses of Computers

During the last four decades, computers have revolutionized and used almost all disciplines of our life; computers have made possible many scientific, industrial and commercial advances that would have been impossible otherwise. They are being used in many areas of application viz. business, industry, scientific research, defense, space,

communications, medicine, education etc. The utilization of computers in different fields is summarized in the following table:

Area	Uses of Computers
Industry	Uses on electricity, steel, paper, printing, engineering and other industries for production, inventory control and related applications
Space	Used to design computerized space satellites, rockets and related technology
Business	Used in banks, airports, share markets, hotels, Govt. Offices for computerizing business applications like MIS, Payroll, Inventory, and Financial Accounting etc.
Telecommunication	Used in ISDN, E-mail, Internet, Intranet, VSAT, Videoconferencing, Paging, Cell phones etc
Data Communication	Used to Computerize Geographically separated offices through networking
Defense	Used to Computerize warplanes, ships, radar and many Advanced weapons
Publishers	Used for Desk Top Publishing (DTP) for designing and printing of books
Engineering	Used for CAD (Computer Aided Designing)/CAM (Computers Aided Manufacturing) by engineering companies

Table 1.2 Uses of Computers

1.2.2 History of Computers

The Computer evolved as a result of man's search for a fast and accurate calculating device. The abacus was probably the original mechanical counting device invented in Asia many centuries ago. In 1617, John Napier, a Scottish mathematician invented a mechanical calculator called the “Napier's bones”. Thereafter, many kinds of computers have been designed and built during the evolution of the modern digital computer. In order to provide a framework for the growth of computer industry, the computer era has been referred to in terms of generations. Computers are classified into

the following six types based on their historical advancement and electronic components used.

1.2.3 Generation of Computers

a) Zeroth Generation Computers

The Zeroth generation of computers (1642-1946) was marked by the invention of mainly mechanical computers. Pascaline was the first mechanical device, invented by Blaise Pascal, a French mathematician in 1642. In 1822, Charles Babbage, an English mathematician, designed a machine called Difference Engine, to computerize tables of numbers for novel navigation. Later on, in the year 1834, Babbage attempted to build a digital computer called Analytical Engine.

The Analytical Engine had all the parts of a modern computer i.e. it had four components the store (Memory unit), the mill (computation unit), the punched card reader (input unit) and the punched / printed output (output unit). As all basic parts of a modern computer were thought out by Charles Babbage, he is known as the Father of Computers. In later years, Herman Hollerith invented a machine for counting during the 1880 US census. This was called the Tabulating Machine. In 1944, Howard A. Eiken invented the first American general-purpose electro-mechanical computer called Mark I and later on its successor, Mark II. The zeroth generation of computers or the era of mechanical computers ended in 1946 when vacuum tubes were invented.

b) First Generation Computers

The first generation of Computers (1946-1954) was marked, by the use of vacuum tubes or valves as their basic electronic component. Although these computers were faster than earlier mechanical devices, they had many disadvantages. First of all, they were very large in size. They consumed too much power and generated too much heat, when used for even short duration of time. They were very unreliable and broke down frequently. They required regular maintenance. The first generation of computers became out dated, when in 1954, the Philco corporation developed transistors that can be used in place of vacuum tubes.

Examples:

- ENIAC (Electronic Numerical Integrator and Calculator) - 1946
- EDSAC (Electronic Delay storage Automatic Calculator) - 1949
- EDVAC (Electronic Discrete Variable Automatic Computer) - 1951
- 1AS Machine built by Von Neumann – 1952

c) Second Generation Computers

The second generation of computers (1954-64) was marked by the use of transistors in place of vacuum tubes. These computers are mainly characterized by the change from vacuum tubes to transistor technology. However, several other important developments also occurred which are summarized below:

- The transistor, which was invented in 1948 at AT & T Bell Laboratories, gradually replaced vacuum tubes in the design of switching circuits.
- Cathode ray tube memories and delay line memories were replaced by magnetic ferrite coves and magnetic drums as the technologies used in main memories.
- The use of index registers and floating-point arithmetic hardware became widespread.
- The Machine-independent "high level" programming such as ALGOL, COBOL and FORTRAN were introduced to simplify programming.
- Special processors (I/O processors) were introduced to supervise input-output operations, thus freeing the CPU from many time-consuming housekeeping functions.
- Computer manufacturers began to provide system software such as computers, subroutine libraries and batch monitors.

The second-generation computers, due to the above-mentioned reasons, were smaller in size and generated less heat than the first generation computers. Although they were slightly faster and more reliable than earlier computers, they too had many disadvantages. They had limited storage capacity, consumed more power and were also relatively slow in performance. Like first generation computers, they also required regular maintenance and their components had also to be assembled manually. It was discovered in 1964 that a number of transistors could be sealed up into a tiny package called an Integrated Circuit (IC) or a chip. The second-generation computers became out-dated after the invention of ICs.

Examples:

- PDP-1, developed by DEC was the first minicomputers
- NCR 304 (Notional Cash Register) was first all transistor used computer

d) Third Generation Computers

The third generation of computers (1964-1980) was marked by use of integrated circuits in place of transistors. Some of the features of third generation computers are

a. **Integrated Circuits** (ICs) began to replace Discrete Transistor Circuits used in second-generation machines. Results were substantial and physical size and costs were reduced.

b. **Semiconductor** (IC) memories began to augment and finally replaced ferrite coves in main memory designs. The two main types are Read Only Memories (ROMs) and read and write memories also called Random Access Memories (RAMs).

c. A technique called Microprogramming became popular which simplified the design of CPUs and increased their flexibility.

d. Access to a variety of techniques for concurrent or parallel processing like pipelining and multiprocessing. Results were accelerating speed at which programs could be executed.

e. Efficient methods for automatic sharing of the facilities or resources of a computer system processors and memory space were developed and incorporated into operating systems.

As hundreds of transistors could be put on a single small circuit, ICs became more compact than transistors. The third generation computers therefore removed many drawbacks of the second-generation computers. They were even smaller in size; generated very less heat and required very less power as compared to the earlier two generations of computers. These computers were also still faster and even more reliable. But they too had some disadvantages. They still had less storage capacity, relatively slower performance and thus could not fulfill the requirements of the users and programmers.

Examples:

- IBM 360, developed by IBM in 1964
- PDP-8, developed by DEC in 1965
- PDP-11, developed by DEC in 1970

e) Fourth Generation Computers

The fourth generation of computers (1978-till date) was marked by the VLKSI Era. In the 1960s the dominant technology for manufacturing computer components was the integrated circuit (IC). This technology evolved steadily from ICs containing just a few transistors to those containing hundreds of thousands of transistors; the latter case is termed "Very Large Scale Integration", or VLSI. The impact of VLSI technology on computer design has been profound. It has made it possible to fabricate an entire CPU, main memory or similar device with a single IC that can be mass-produced at a very low cost. This has resulted in new classes of machines such as inexpensive personal computers, and high performance parallel processors that contain thousands of CPUs.

All present day computers are fourth generation of computers. These computers are very powerful having a high memory and a fast processing speed. Although the fourth generation computers offer too many advantages to the users, they still have one main disadvantage. The major drawback of these computers is that they have no intelligence on their own. Scientists are now trying to remove this drawback by making computers with artificial intelligence.

Examples:

- IBM PC, developed in 1981 was the first industry standard personal computer, having Intel 8088 memory chip
- 386, developed in 1985, had Intel 80386 memory chip
- 486, developed in 1989, had Intel 80486 memory chip

- Pentium developed in 1995, has Pentium (80586) memory chip

f) Fifth Generation Computers

The Fifth Generation Computers are still under the research and developmental stage. These computers have artificial intelligence. They will use ULSI (Ultra Large Scale Intelligence) chips in place of VLSI chips. One ULSI chip contains millions of components on a single IC. The most important feature of Fifth Generation computers is that they will use intelligent software.

This software will enable the user to tell computer what to do and not 'How to do' by using intelligent programming and knowledge based problem solving techniques. So, the programmer or users would not require giving each and every instruction to the computer for solving a problem. These computers will also have user interface in form of speed in natural languages.

Example:

- ROBOTS have few features of fifth generation computers

1.2.4 Computer Peripherals

Typical computer architecture is given below with all Data flow and Command flow (in Figure 1.1).

The computer system, on the whole, consists of four main parts namely

1. Hardware Devices
2. Software
3. Data
4. Users

The first two parts namely **Hardware Devices** and **Software** are discussed in detail in section 1.4 and section 1.5 respectively. The remaining two parts - data and users are discussed below:

- **Data**: Data consists of two facts, which the computer can manipulate and process into information that is useful to people. Computerized data is digital, meaning that it has been reduced to digits, or numbers. The computer stores and reads all data as numbers. Although computers use data in digital form, they convert data into forms that people can understand, such as text, numerals, sounds and images.

- **Users**: People are the computer's operator or users. Some types of computers can operate without much intervention from people but personal computers are designed specially for the people.

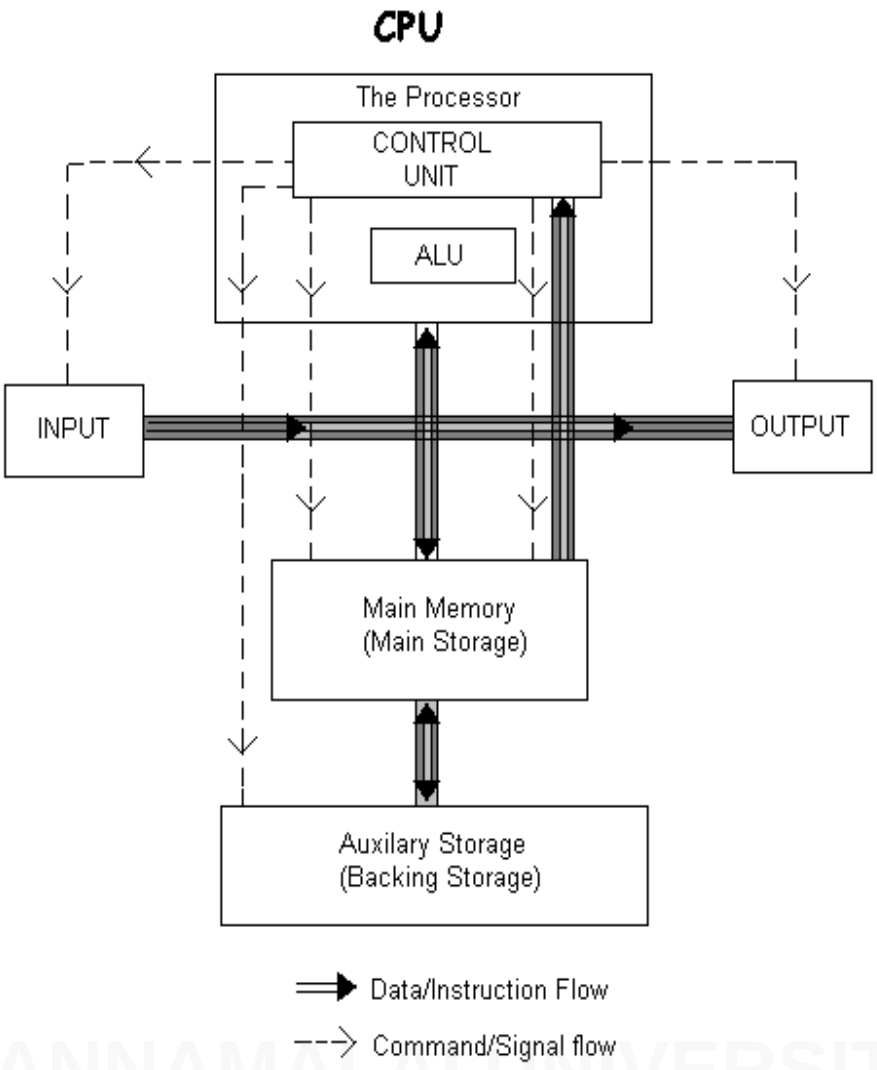


Figure 1.1

Hardware Devices

Hardware refers to any physical component of a computer. In today's computer industry, a wide variety of hardware components are available for microcomputers. The hardware components of a microcomputer can be classified into the following types namely,

- Input Devices
- Output Devices
- Processor
- Memory
- Storage Devices

Input Devices

Input devices are used to input data, information and instructions into the RAM. We may classify these devices into the following two broad categories.

(i) Basic Input Devices
(ii) Special Input Devices

The Structure and function of the common input devices of these two categories are discussed in detail.

i. Basic Input Devices

The input devices, is one of the prerequisites for input operations, which may be called Basic Input Devices. The chief input device such as keyboard and Mouse are used to enter any input to the computer. Today, every PC has a keyboard and mouse as the basic input devices.

a) Keyboard

Keyboard is the main input device of a computer. It contains 3 types of keys- alphanumeric keys, special keys and function keys. Alphanumeric keys are used to type all alphabets, numbers and special symbols. Special keys such as <Shift>, <Ctrl>, <Alt>, etc are used for special functions. Function keys such as <F1>, <F2>, <F3> etc. used to give special commands depending upon the software used.

b) Mouse

Mouse is another important input device. It is a pointing device used to move cursor, draw sketches/diagrams, selecting a text/object/menu item etc. on monitor screen while working on windows. Mouse is a small, palm size box containing 3 buttons and a ball underneath which senses the movement of the mouse and sends corresponding signals to CPU on pressing the buttons.

ii. Special Input Devices

The input devices, which are not essential to operate a PC, are called special Input Devices. These devices are used for various special purposes and are generally not required for basic input operations. Some of these devices are discussed below.

a) Trackball

A trackball works like a mouse, as the roller is on the top with selection buttons on the side. It is also a pointing device used to move the cursor and works like a mouse. For moving the cursor in a particular direction, the user spins the ball in that direction. It is sometimes considered better than mouse because it requires little movement and less desktop space.

b) Light Pen

Light Pen (similar to a pen) is a pointing device, which is used to select a displayed menu item or draw pictures on the monitor screen. It consists of a photocell and an optical system placed in a small tube. When its tip is moved over the monitor screen and pen button is pressed, its photocell-sensing element detects the screen location and sends the corresponding signal to the CPU.

c) Joystick

Joystick is also a pointing device, which is used to move cursor position on a monitor screen. Joystick is a stick having a spherical ball both at its lower and upper ends. The joystick can be moved in all four directions. The function of joystick is similar to that of a mouse. It is mainly used in Computer Aided Design (CAD) and computer games.

d) Scanner

Scanner is widely used on DTP applications. It is used for digitizing images such as photographs, forms, documents etc. into computer memory. Some scanners can also read text by converting them to digital code. The scanners are very useful for converting the typed pages into word processing files. Graphic scanners convert a printed image into video image without converting into digital code.

e) Bar Code Reader

Bar Code Reader is an optical scanner used for reading bar-coded data (data in form of light and dark lines). The bar-coded data consists of a numbers of bars of varying thickness and spacing between them. The bar code reader reads the bar coded data and converts into electrical pulses, which are then processed by the computer.

f) Voice-Input Devices

Voice-Input devices are the latest input devices that can recognize the human voice. They are very useful but are not popular due to storage of limited vocabularies and variations in the way of pronouncing words by different persons

Output Devices

Output devices are hardware components, which are used to display or print the processed information. The structure, function and uses of the common output devices are given below

a) Monitor

Visual Display Unit (VDU) commonly called monitor is the main output device of a computer. It consists of a Cathode Ray Tube (CRT), which displays characters as an output. It forms images from tiny dots called pixels that are arranged in a rectangular form. The sharpness of the image (screen resolution) depends upon the number of pixels. Some common types of monitors are CGA (Color Graphics Adapter), VGA (Video Graphics Adapter), MDA (Monochrome Display Adapter).

b) Printer

Printer is the most important output device, which is used to print information on paper. Printers are essential for getting output of any computer-based application

Types of Printers

There are many types of printers that are classified on various criteria as below (Figure 1.2).

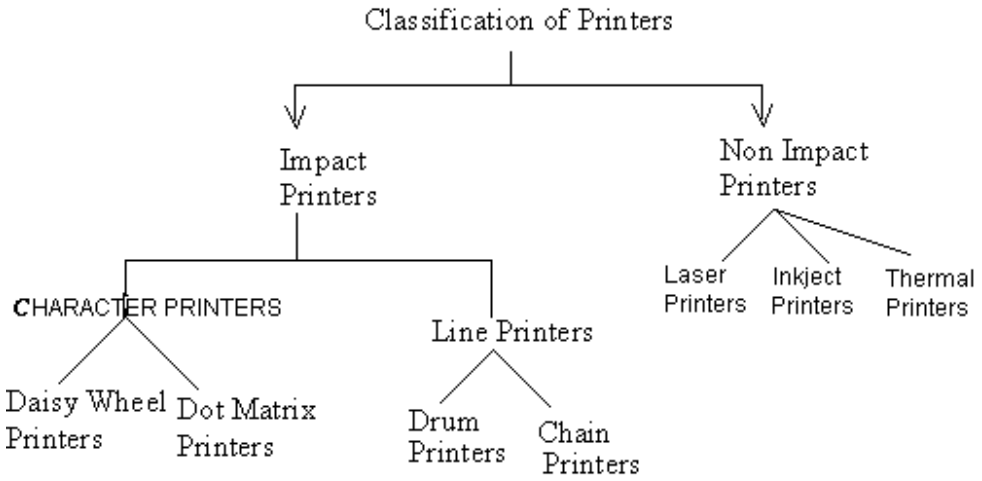


Figure 1.2

a) Impact Printers

The printers that print the characters by striking against the ribbon and onto the paper are called Impact Printers. These printers are of two types: (i) Character and (ii) Line printers.

i. Character Printers

These printers print one character at a time. These printers are again of two types - Daisy Wheel and Dot Matrix Printers.

- **Daisy Wheel Printers**

These printers print the characters by a mechanism that uses a plastic or metal hub with spokes called daisy wheel. The characters are embossed on the radiating spokes and printed by striking these spokes against the ribbon and paper.

- **Dot Matrix Printers**

These Printers Print the characters by putting dots onto the paper. They do not give better printing quality than daisy wheel printers, but are faster in speed. The printing speed of a dot matrix printer can be upto 360 cps (characters per second).

ii. Line Printers

These Printers Print one line at a time. Their printing speed is much more than character printers. They are again of two types - Drum Printer and chain Printers

- **Drum Printers**

These printers print the line by a rotating drum having a lief of characters for each print position. The hammers strike each character of the drum simultaneously so that entire line is printed for one full rotation of the drum. These printers are also called Band Printers

- **Chain Printers**

These printers print the line by a rotating chain having ring characters for each print position. Their printing mechanism is similar to drum printers. The printouts obtained from these printers, have uneven character spacing but even line height

b) Non-Impact Printers

The printers that print the character without striking against the ribbon and onto the paper are called non-impact printers. These printers print a complete page at a time and therefore also called Page Printers.

Page Printers are of three types –

a) Laser Printers
b) Inkjet Printers and
c) Thermal Printers

a) Laser Printers

These printers look and work like photocopiers. They are based on laser technology, which is the latest development on high speed and high quality printing. In these printers, a laser beam is used to write the image on a paper. First, the image is formed by electrically changing thousands of dots on a paper by laser beam. Then, the paper is sprayed with a laser having the opposite charge and is passed over a heated roller to make the image permanent.

b) Ink Jet Printer

These printers print the characters by spraying the paper with electrically charged ink. These printers give better quality than character printers but not better than laser printers. They are cheaper than laser printers, hence used widely in many offices. They also offer an option of using color cartridges for multi color printing.

c) Thermal Printers

These printers print the characters by melting a wax-based ink off a ribbon on to a special heat sensitive paper. They give letter quality printing but are relatively expensive in maintenance than other printers.

Processors / CPU

The CPU is the main component or "brain" of a computer, which performs all the processing of input data. Its function is to fetch examine and then execute the instruction stored in the memory of a computer. In microcomputers, the CPU is built on a single chip or Integrated Circuit (IC) and is called a Microprocessor. The CPU consists of the following distinct parts.

(a) Arithmetic Logic Unit: The Arithmetic and logic unit of CPU is responsible for all arithmetic operations like addition, subtraction, multiplication and division as well as logical operations such as less than, equal to and greater than . Actually all calculations and comparisons are performed in the Arithmetic Logic Unit.

(b) Control Unit: The control unit is responsible for controlling the transfer of data and instructions among other units of a computer. It is also considered as the "Central Nervous System" of computer, as it manages and co-ordinates all the units of the computer. It obtains the instructions from the memory, interprets them and directs the operation of the computer.

(c) Registers: Registers are small high speed circuits (Memory Locations) which are used to store data, instructions and memory addresses (Memory Location Numbers). When ALU performs arithmetic and logical operations Registers can store one word of data (1 word = 2 bytes and 1 byte = 8 bits) until it is over written by another word depending on the processors capability. The number and type of register vary from one CPU to another.

(d) Buses: Data is stored as a unit of eight bits (BIT stands for Binary Digit i.e. 0 or 1) in a register. Each bit is transferred from one register to another by means of a separate wire. This group of eight wires, which is used as a common way to transfer data between registers, is known as a bus. In general terms, bus is a connection between two components to transmit signal between them. Bus can be of three major types viz. Data Bus, Control Bus and Address Bus. The data bus is used to move data, address bus to move address memory location and control bus to send control signals between various components of a computer.

(e) Clock: Clock is another important component of CPU, which measures and allocates a fixed time slot for processing each and every micro operation (smallest function operation). In simple terms, CPU is allocated one or more clock cycles to complete a micro-operation. CPU executes the instructions in synchronization with the clock pulse.

Memory Unit

Memory unit is that component of a computer system, which is used to store the data, instructions and information before, during and after processing by ALU. It is actually a work area (physically a collection of integrated circuits) within the computer, where the CPU stores the data and instructions. It is also known as a Main/Primary/Internal Memory.

It is of the following three types.

a) Read Only Memory (ROM)
b) Random Access Memory (RAM)
c) Complementary Metal Oxide Semiconductor Memory (CMOS)

a. Read Only Memory

Read Only Memory is an essential component of the memory unit. The computer has no intelligence or memory and requires instructions, which are given by man. Whenever the computer is switched on, it searches for the required instructions. The memory, which has these essential instructions, is known as Read Only Memory (ROM). The memory is permanent and is not erased when the system is switched off. ROM contains a number of programs (set of instructions). The most important program of ROM is the Basic Input Output System (BIOS), which activates the hardware such as keyboard, monitor, floppy disk etc in communicating with the system and application software.

- **Types of ROM:**

  There are many types of ROM available for microcomputers like Mask ROM, PROM, EPROM, EEPROM and EAPROM.

i. **Mask ROM**: Mask ROM is the basic ROM chip. In this type of ROM, the information is stored at the time of its manufacturing.

ii. **PROM**: PROM stands for the Programmable Information and it is stored by programmers after it's manufacturing. It also cannot be altered or erased later on.

iii. **EPROM**: EPROM stands for Erasable Programmable Read Only Memory. It is similar to PROM, but its information can be erased later on by ultra violet and it can be reprogrammed.

iv. **EEPROM**: EEPROM stands for Electronically Erasable Programmable Read Only Memory. It is similar to EPROM, but its information can be erased by using a high voltage current.

v. **EAPROM**: EAPROM stands for Electrically Alterable Read Only Memory. As compared to EPROM and EEPROM, the information stored in EAPROM can be altered later.

b. Random Access Memory (RAM)

Random Access Memory (RAM) is another important component of the Memory Unit. It is used to store data and instructions during the execution of programs. Contrary to ROM, RAM is temporary and is erased when the computer is switched off. RAM is a read/write type of memory and thus can be read and written by the user/programmer. As it is possible to randomly use any location of this memory it is known as Random Access Memory.

- **Types of RAM:**

There are two types of RAM used in PCs - Dynamic and Static RAM.

i. **Dynamic RAM (DRAM)**: The information stored in Dynamic RAM has to be refreshed every few milliseconds, otherwise it is erased. DRAM has a higher storage capacity and is cheaper than static RAM.

ii. **Static RAM (SRAM)**: The information stored on Static RAM need not be refreshed, but it remains stable as long as power supply is provided. SRAM is costlier but has higher speed than DRAM.

c. Complementary Metal Oxide Semiconductor Memory

Complementary Metal Oxide Semiconductor (CMOS) Memory is used to store the system configuration, date, time and other important data. When the computer is switched on, BIOS matches the information of CMOS with the peripheral devices and displays error in case of mismatching.

Storage Devices

There are many storage devices, which are used with microcomputers. Some of the common storage devices are

a) Floppy Disk

Floppy Disk (FD) is another common storage device, which is small, flexible and easily removable. It is made of a plastic disk coated with magnetic material, which is sealed inside a square plastic jacket. It is called as 'floppy' because it is soft having flexible physical property. Data can be written on or read from this floppy by a device called floppy Disk Device (FDD), which is fixed inside the computer.

There are many types of floppies depending upon their sizes and storage capacities. The original floppy developed by IBM, is an 8^{o} floppy, but the most popular

size available for present day PCs are 5 1/4" and 3 1/2". The storage capacity of floppies vary from 360 KB to 1.44 B. The floppies can store data on both sides (Double-sided floppies) or on single side (Single-side floppies) depending upon the floppy device. Double-sided floppy devices are most frequently used in present day PCs. The latest floppy device that packs two high-density floppy devices (5.25 and 3.5 inch).

b) Compact Disk

Compact Disk (CD) is the latest storage device, used to store data, information and software, which can only be read and not changed or erased. It is an optical read only memory made up of a resin. Therefore it is actually called Compact Disk Read Only Memory (CD-ROM). However, the information is stored on CDs by using an expensive drive called CD-ROM drive. Nowadays compact disks are very popular storage devices for microcomputers because a large number of software including multimedia, audio and graphics software is available only on these disks. CDs can store a large volume of data (up to 680 MB), which is almost the same as a storage capacity of a 640 MB Hard Disk.

c) Winchester Disk (Hard Disk)

Winchester Disk is the most common storage device of present day microcomputers. It is popularly called the Hard Disk Drive (HDD) or sometimes Fixed Disk Drive. It is fixed inside the computer and is not easily removable. It is used for storing the software and data inside the computer. It is also known as 'Winchester Disk' probably because this drive was first made by IBM at Harsley Laboratory located near Winchester in England.

Winchester Disk consists of one or more disk platters, an access mechanism and read/write heads, which are sealed in a case. Hard disk size depends upon the disk platter's sizes (such as $5^{1/2}$, $3^{1/2}$, $2^{1/2}$ inch etc). The $3^{1/2}$ inch size platter is common with PCs and $2^{1/2}$ inch with laptop/portable computers. Read/Write head is used to write any information on the disk surface or to read it back

d) Magnetic Tape

Magnetic Tape is the oldest storage device available for microcomputers. It is generally used to store a large volume of data that is needed to be sequentially accessed and processed. The tape is made up of a plastic ribbon coated with an iron-oxide material, which can be magnetized. The data stored on tape can be read as well as erased and written again. Magnetic tape is a sequential access storage device; hence it is not possible to read the data randomly or directly. Therefore, magnetic tapes are suitable only for storing data for backups and batch-made applications and not for on-line applications.

e) Video Disk

Video Disk is used to store text, video and audio data. It is widely used for training applications as if can be played like a phonograph record.

f) DVD ROM / RAM Disk

DVD ROM and DVD RAM disks are optical disks having a storage capacity of 47 GB and 5.2 GB respectively. These disks are becoming the next generation's new standard for higher capacity removable media. They are ideal for storage of huge amount of information required for multimedia applications.

1.2.5 Software

Software is a program or set of instruction, which is required to use the computer. Many types of software are available for various applications. The software development field is so advanced that day-by-day existing software are becoming outdated as new software are coming in the market. Softwares are broadly classified in to two types namely System Software and Application Software. These two types of software are discussed below:

System Software

Software that is required to control the working of hardware and aid in effective execution of a general user's applications are called System Software. This software performs a variety of functions like file editing, storage management, resource accounting, I/O management, database management etc. Some of the examples of system software are DOS (Disk Operating System, Windows, BASIC, COBOL and PC Tools). This is developed by System Programmers. System Software can be further categorized into the following three types.

a. System Management Software
   (Operating System, Operating Environments)
b. System Development Software
   (Language Translators, Application Generators, CASE Tools)
c. System Software Utilities

a) System Management Software

The System Management software, which involves operating system, is discussed in detail in section 1.6.

b) System Development Software

The System Development Software are discussed below.

i. **Language Translators**: Language Translators are categorized into three types.

   Assemblers: Assemblers translate the Assembly language code (source program) into Machine language code (object program). After assembling, a linker program is used to convert the object program into an executable program. The Microsoft assembler program (MASM) and Borland Turbo assembler program (TASM) are two popular assemblers.

Interpreters: Instructions of a high level language are coded in many statements. At the time of their execution, they are converted statement by statement into machine code, by using system software, called interpreters. For example, programs written in BASIC language are executed by using BASICA or QWBASIC. Interpreters programs written in some fourth generation languages, like dBASE III plus are also executed using dBASE interpreter.

Compilers: In contrast to interpreters, compilers provide faster execution speed. Compilers do not translate and execute the instructions at the same time. They translate the entire program (source code) into machine code (object code) using linker; the object code is converted into executable code. Compilers are widely used in translating codes of high level languages (e.g. COBOL, FORTRAN, PASCAL, etc) and fourth generation languages (dBASE IV, Foxpro etc). As compared to interpreters or assemblers, compilers are preferred in development of application software.

c) System Software Utilities

System Software Utilities support the operation of a computer. They provide many features including file management capabilities, data compression, diagnostic routines, virus detection and removal, text editing, performance, monitoring and spooling. Some of the important types of utilities are discussed below.

i. **File Management Utilities**: These utilities provide file management capabilities like copying, comparing, searching, listing and sorting the files. Although these features are offered by many operating systems, utility programs provide better user-friendly environment along with some additional features. NORTON utilities and PC Tools are the most commonly used file management utilities.

ii. **Data Compression Utilities**: These utilities compress or decompress files that are stored on floppy and hard disks. As compressed files take up very less space on disks, data compression utilities are widely used during copying of data from hard disks to floppy disks. PKZIP/PKUNZIP programs are commonly used examples of data compression utilities.

iii. **Diagnostic Utilities**: These utilities can detect bugs (errors in hardware/software) in computers. For instance, the problem of floppy and hard disks can easily be detected by a popular utility program called Norton Disk Doctor (NDD). QAplus and Disk Manager (DM) are other examples of utilities that can detect and remove any bugs in storage devices, software and other components of computers.

iv. **Text Editing Utilities**: These utilities are used to create, edit and print the non-document texts such as programs, data etc. Norton Editor (NE) is the most common example of text editor. Most operating systems, including DOS, also has in-built text editor program.

v. **Spooling Utilities**: In multi-user/networking environment, the input and output devices are generally slow. In such an environment, the processing of computer is also slowed down. To control the computer from being showed down, the spooling programs are used. Spooling (Simultaneous Peripheral Operations Online) program is used to buffer data for the printer and remote batch terminals. This program sends the output to the disk and printer does not interact with CPU during printing. Spooling utilities are used mainly in computer systems with multi-user/networking environment.

Application Software

Whenever an organization purchases computers, besides an operating system certain application softwares are also required to be purchased. This software is needed for general purpose like word processing, database management, and spreadsheets etc, which are known as Application Software. Some of the importance of different application software is given below:

a) Word Processor Packages

Word processors are application software, which are used for word processing. Word processing is the most widely used technique for typing, editing, storing, formatting, manipulating and printing documents with the assistance of a computer and printer. It is the most efficient means of generating documents electronically.

b) Database Management Packages

A Database is a logical term used to refer to a collection of organized and related information. A Database Management System is a system that allows you to access the data in a Database. In any Business, certain piece of information about Customer, Product, Price and so on are called database. Shortly Data Base Management System is defined as software that organizes and maintains the data in a database for providing the information.

c) Spreadsheet Packages

Business applications require a lot of calculation work. In a manual system, it is done on a sheet of paper with rows and columns, which are called a 'spreadsheet'. Spreadsheet packages use the concept of an electronic spreadsheet. An electronic spreadsheet is a very big sheet consisting of thousands of rows and columns which are used to store information in the memory of a computer. Like databases, electronic spreadsheets have now become an essential tool in developing a computerized management information system.

d) Office Automation Packages

Word processors, spreadsheets and Database Management Packages are generally called office Automation Packages/Software Tools or office suites. MS Office and Lotus SmartSuite are two most popular examples of office Automation Packages.

Microsoft office (MS-Office) Professional is a package that contains five powerful general-purpose application packages. It includes Word, Excel, PowerPoint, Access and Mail. We shall discuss it in detail in Unit-II.

Lotus Smart Suite is another popular office Automation package that contains five powerful application packages. It includes word Pro, Lotus 1-2-3, Freelance Graphics, Approach and Organizer.

Corel Office, an office suite contains Word Perfect, Quattra Pro, Paradox, Corel Draw, Netscape Navigator, Presentations, Corel Flow, Sidekick and other application packages. Sidekick is the first popup program (TSR- 'Terminate and Stay Resident' in memory) used for editing programs and non-document files.

1.2.6 Operating System

Operating system is a set of programs, which provides an easy to use interface between the users and the computer system and manages the computer resources in order to achieve a maximum efficiency of the computer system. An operating system is a part of the system software and has become an integral part of a computer system.

In short, an operating system acts as a manager of both hardware and software resources of a computer system and facilitates the execution of application programs.

Thus, an operating system is computer software that controls the hardware, manages the system, resources and executes the programs in response to users' commands.

The software resources of a computer system include compilers, assemblers, loaders, linkers etc and it is the operating system that makes these resources available to an application program. These software resources are complex programs supplied by the manufacturer and are a part of the system software.

The operating system is also a part of the system software and consists of programs, also called routines. An operating system contains I/O routines, memory management routines, scheduling routines, command interpreter routines and routines to invoke other programs of the system software as and when required by an application program. Another important program included in an operating system is an EDITOR, which enables the user creates and edits the application programs.

Now, if an application program requires the use of the computer system resources, it has to communicate its requirement of resources to the operating system, which provides these resources to the application program.

Need for an Operating System

To appreciate the need of an operating system, one has to look at the radical difference between the working of earlier and the modern computers systems.

The earlier computer systems were dedicated systems in the sense that at a time the computer could execute only one program. The next program had to wait till the

execution of the program in computer memory was completed. Suppose a program under execution required some input data, then the program execution would halt temporarily to fill the input data, which was supplied. During this time, the CPU remained idle resulting in wastage of precious computer time. Similarly when a program after execution was undergoing the output operation, the CPU still remained idle. This wastage of CPU time was irritating because in early times there were a few computers.

Now, modern computers, unlike earlier computer systems are capable of handling a large number of programs at a time. These programs to be executed are placed in computer memory which requires memory management so that the programs can be stored in memory in such a way that these programs do not interfere destructively with each other. Apart from this, a CPU can perform only one task at a time. Hence it is required to allot a certain CPU time slice to the programs in memory that are waiting execution.

In this situation if the execution of a particular program is stopped due to an error or for want of an input data, the CPU takes the other program for execution. Apart from this most of the programs need input/output operations and if each user has to write his own I/O routine, it will result in wastage of a good deal of time.

All these tasks of memory management, allotment of CPU time to various programs and performing of I/O operations are taken care of by an operating system.

Types of Operating System

Many types of operating systems are available for computers, which can be divided into the following two types.

(a) Single user Operating Systems
(b) Multi-user Operating Systems

a) Single-User Operating Systems

These operating systems are used mainly for computers having only one terminal (stand-alone PCs). MS-DOS (Microsoft Disk Operating System) and PC DOS (Personal Computer Disk Operating System) are the two important single user operating systems. Both systems are almost identical and are simply called DOS. OS/2 and Windows NT are other popular single-user multi-tasking operating systems for microcomputers.

i. **MS-DOS**: MS-DOS, developed by Microsoft Inc' in 1981 is the most widely used operating system of IBM-compatible microcomputers. The latest version of MS-DOS is 7.

ii. **PC-DOS**: PC-DOS is essentially the same operating system as MS-DOS, but developed and supplied by IBM for its PCs.

iii. **OS/2**: OS/2 is a single user, multi-tasking operating system, developed jointly by IBM and Microsoft. This provides a unique feature of multi-

tasking, where several programs can be seen simultaneously. It was the 1st OS that provided users with a Graphical User Interface (GUI).

iv. **Windows NT**: Windows NT (New Technology) is the single user 32-bit multi-tasking operating system for 386 and above, developed by Microsoft Inc. Windows NT was driven by a need to exploit the tremendous power of 32-bit microprocessors and runs applications, which are developed for DOS and Windows.

b) Multi-user Operating System

These operating systems are used for those computers (Micro to Mainframe), which have many terminals (Multi-user Systems). The popular operating systems used for multi-user system are UNIX, NETWARE, MVS, OS/400, VMS and LINUX.

i. **UNIX:** UNIX is a highly successful operating system for multi-user systems. Actually, it is more popular among scientific and engineering users rather than business users. In 1980, Microsoft developed its own version of UNIX for 2863, which is called as XENIX.

ii. **Netware:** Netware is a group of network operating system developed by Novell Inc. that provides multi-user capabilities.

iii. **MVS (Multiple Virtual Storage):** MVS is one of the most complex multi-user operating systems ever developed for IBM mainframes. In MVS, each job (Time sharing user or batch program) is assigned its own virtual storage space.

iv. **OS/400:** OS/400 is the IBM's Operating system for its AS/400 computer.

v. **VMS (Virtual Memory Storage):** VMS Operating system is used on DEC's VAX series of minicomputers.

vi. **LINUX:** LINUX is a 32-bit UNIX like operating system that has been developed recently for microcomputers. It is the world's first free operating system developed and maintained by thousands of people worldwide.

Operating System Techniques

There are several techniques used in Multi-user operating systems for enabling many users to concurrently share the single or multiple CPU (E.g. Multiprogramming and Multiprocessing). Some techniques are used in single-user operating system to handle multiple tasks. We shall discuss these common techniques used in different operating systems.

a) Multiprogramming

It is a process by which single CPU works on two or more programs simultaneously. Using this technique, the operating system keeps the CPU busy. Multiprogramming allows the processor to handle either multiple batch jobs at a time

(Batch Multiprogramming) or multiple interactive jobs shared among multiple users (Time sharing Multiprogramming). Time-sharing is a technique that allows a CPU to simultaneously support the activities of several users by allocating fixed time slots (in milliseconds). Examples of operating systems that support multiprogramming are OS/2, UNIX and Macintosh 7.

b) Multiprocessing

It refers to the use of two or more CPUs to perform a co-coordinated task simultaneously. For (E.g.) MVS, VMS and Windows NT support multiprocessing.

c) Multitasking

It refers to the ability of an operating system to execute two or more tasks concurrently. In multitasking environment, the user opens new applications without closing the previous ones and the information can be easily moved among a number of applications. For example, Win NT and OS/2 operating systems use this technique.

1.2.7 Networking

The merging of computers and communications has had a profound influence on the way computer systems are organized. The concept of the "Computer Center" as a room with a large computer to which users bring this work for processing is now totally obsolute. The old model of a single computer serving all of the organizations computational needs has been replaced by one in which a large number of separate but interconnected computers do the job. The systems are called computer networks.

Two computers are said to be interconnected if they are able to exchange information. The connection need not be through a copper wire; fibre optics, microwaves and communication satellites can also be used. By requiring the computers to be autonomous, we wish to exclude from our definition systems in which there is a clean master/slave relationship. If one computer can forcibly start, stop or control another, the computers are not autonomous. A system with one control connection and many slaves is not a network; nor is it a large computer with remote printers and terminals. A detailed description of computer networks is given in the unit-v where different types of computer networks are explained.

1.2.8 Windows Operating System

Some versions of the Windows Operating system is discussed below.

Windows Operating System

Windows is the most popular system software that provides graphical user interface. Windows provides an interface, which is similar to Macintosh user interface. In such interface, each active application is displayed in windows on the screen. The application window can be opened, hidden, closed, moved, resized, minimized or maximized. The user can run several applications simultaneously, each in its own window. Windows allow the user to share data among different applications. Windows

provides an interactive environment, where the user is engaged in continuous dialog with the computer. In windows, although both keyboard and mouse are used as input device, the mouse is the primary tool for selecting and running window applications.

The different versions of windows are Windows 1.x, Windows 2-x, Windows 3.0, Windows 3.1, Windows 3.11, and Windows for Workgroups 3.11, Windows 95, Windows 98 and Windows NT. Windows 1.x, 2.x and 3.0 were the earlier attempts from Microsoft Inc. for creating graphical user interface but were not very successful. Windows 3.1 and higher versions provide powerful and multi featured GUI capabilities. Windows NT may appear the same as Windows 3.1, but it is based on entirely a different concept.

The various types of windows operating system are given below.

a) Windows 3.1 / 3.11 and Windows for Workgroups 3.11

Windows 3.1 is generally misunderstood as an operating system, but actually it is not an operating system Windows 3.1 is a graphic based operating environment that replaces the DOS interface. In order to run Windows 3.1, DOS must be installed on the computer. It also provides non-preemptive multitasking features, which allow users to run several programs at one. Windows 3.11 is the successor of Win 3.1 with a trivial difference.

b) Windows 95

Windows 95 is a much-awaited replacement for Win 3.1. It is a new 32-bit operating system from Microsoft, released in 1995. Windows 95 provides the following important features.

i. **Built in Networking:** Windows 95 has sophisticated 32-bit built-in network components, that allow operating both as a client-server network and peer-to-peer network operating system. In client-server approach, there is a central computer acting as a file server, with which workstations called clients are attached.

ii. **Multimedia functions:** Windows 95 provides all multimedia controls and functions. Multimedia is the way of disseminating information in form of text, audio, graphics/animated graphics and full motion video.

iii. **Memory Protection:** Memory protection feature of Windows 95 ensures that one application do not crash other applications in memory.

iv. **Plug and Play:** Windows 95 automatic does the hardware configuration process, by knowing the kind of printers, mouse and other peripherals. This feature is known as 'Plug and Play'.

v. **OLE (Object Linking and Embedding):** OLE is the key technology for Windows 95. It is the Microsoft's standard for creating compound documents (compound document is a document made from different programs) in windows.

c) Windows NT

The Microsoft Windows NT operating system is a 32-bit pre-emptive multi-tasking operating system for modern microprocessors. NT is portable to a variety of

processor architectures. One or more versions of NT have been ported to Intel 386 and higher, MIPS R4000, and Power PC. Key goals for the system are portability, security, compliance, multiprocessor support, extensibility, international support and compatibility with MS-DOS and MS-Windows applications. NT uses micro-Kernel architecture, so enhancements can be made to one part of the operating system without greatly affecting other parts of the system. NT is not a multi-user operating system.

The two versions of NT are Windows NT workstation and Windows NT server. They use the same kernel and operating-system code, but NT server is configured for client-server applications and can act as an application server on Netware and Microsoft LANs. Versions 4.0 of NT Server incorporates Internet web-server software and the Windows 95 user interface. In 1996, more NT server licenses were sold than all versions of UNIX licenses. Some of the key features of Windows NT are as follows.

i. **Extensibility:** Extensibility is an important property of any operating system that hopes to keep up with advancements in computing technology so that changes are facilitated over time; NT is implemented using a layered architecture. The programs written for MS-DOS, Microsoft Windows, can all run on NT on the appropriate environment. Because of the modular structure, additional environmental subsystems can be added without any adverse effect.

ii. **Portable:** An operating system is portable if it can be moved from one hardware architecture to another with relatively few changes. NT is designed to be portable.

iii. **Reliability:** Reliability is the ability to handle error conditions, including the ability of the operating system to protect itself and its users from defective or malicious software. NT is designed to resist defects and attacks by using hardware protection for virtual memory and software protection mechanisms for operating system resources. Also, NT comes with a file system called the native NT file system (NTFs) that recovers automatically from many kinds of file system errors after a system crash.

iv. **Compatibility:** Windows NT provides source-level compatibility to applications that follow the IEEE standard. They can be compiled to been on NT without changing the source code.

v. **Performance:** NT is designed to afford good performance. The subsystems that comprise NT can communicate with one another efficiently by a local-procedure-call facility that provides high-performance message passing.

vi. **International support:** NT is also designed for international use. It provides support for different locales via the national language support (NLS) API. NLS API provides specialized routines to format dates, time and money in accordance with various national customs.

1.2.9 LINUX Operating System

LINUX is quote possibly the most important free software achievement since the original space war, or more recently, emacs. It has developed into an OS for business

education and personal productivity. Linux is no longer meant only for UNIX wizards who sit for hours in front of a glowing console. Linux is a Unix operating system clone that runs on a variety of platforms especially personal computers with Intel 80386 or better processor. It supports a wide range of software, from Tex, to the X window system, to the GNU C/C++ compiler, to TCP/IP. It is a versatile bona fide implementation of Unix, freely distributed under the terms of GNU General Public License.

What makes Linux so different is that it is a free implementation of Unix. It was and still is developed cooperatively by a group of volunteers, primarily on the Internet who exchange code, report bugs and fix problems in an open-ended environment.

A Brief History of LINUX

Unix is one of the most popular operating systems worldwide because of its large support base and distribution. It was originally developed at AT&T as a multitasking system for minicomputers and mainframes in the 1970s but since then it has grown to become one of the most widely used operating systems, anywhere, despite sometimes confusing interface with lack of central standardization.

Linux is a free version of Unix developed primarily by Linux Torvalds at the University of Helsinki in Finland, with the help of many UNIX programmers and wizards across the Internet. Linux books and feels much like any other Unix system, and indeed Unix compatibility has been a major design goal of the Linux project. However Linux is much younger than most systems. Its development began only in 1991 when the self-contained kernel for the 80386 processor was wrote and christened.

Early in its development, Linux's source code was made available for free on the Internet. As a result, its history has been one of collaboration by many users from all around the world, corresponding almost exclusively over the Internet. From an initial Kernel that partially implemented a small subset of the Unix system services, Linux has grown to include evermore Unix functionality.

In its early days, Linux development evolved largely around the central operating system Kernel the core executive that manages all system resources and that interacts directly with the hardware. Much more than this Kernel is needed to produce a full operating system of course. It is useful to make the distinction between the Linux Kernel and a Linux system. The Kernel in Linux is an entirely original piece of software developed from scratch by a Linux community; the Linux system, as we known it today, includes a multitude of components, some written from scratch, others borrowed from other development projects or created in collaboration with other teams.

The basic Linux system is a standard environment for applications and for user programming but it does not enforce any standard means of managing the available functionality as a whole. A Linux has matured; there has been a need for another layer of functionality on top of the Linux system. A Linux distribution includes all the standard components of the Linux system, plus a set of administrative tools to simplify the initial installation and subsequent upgrading of Linux and to manage installation and reinstallation of other packages on the system.

Linux Architecture

The Linux system is composed of three main bodies of code, in line with most traditional UNIX implementations.

- The Kernel is responsible for maintaining all the important abstractions of the operating system, including such things as virtual memory.
- The system libraries define a standard set of functions through which applications can interact with the Kernel and which implement much of the operating system functionality that does not need the full packages of Kernel code.
- The system utilities are programs that perform individual, specialized management tasks. Some system utilities may be invoked just once to initialize some aspect of the system; others may run permanently, handling such tasks as responding to incoming network connections, accepting logon requests from terminals or updating files.

The figure illustrates the various components that make up a full Linux system. The most important distinction here is between the kernel and everything else. All the kernel code executes in the processors privileged mode with full access to all the physical resources of the computer. Linux refers to this privileged mode as kernel mode, equivalent to the monitor mode. Under Linux, no user mode is built into the kernel. Any operating system support code that does not need to run in kernel mode is placed in the system libraries instead.

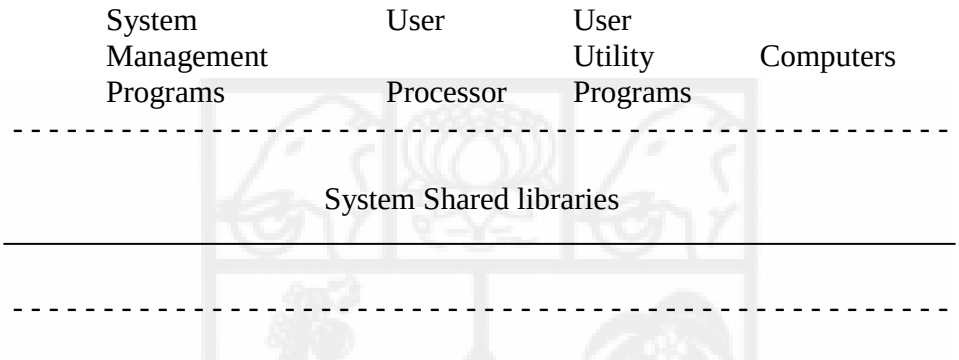
Although, various modern OS have adopted a message passing architecture for their kernel internals, Linux retains UNIX is historical model. The Kernel is created as a single, monolithic binary. The main reason is to improve performance. Just because the entire kernel shares the same melting point it does not imply that there is no scope for modularity. The Linux kernel can load modules dynamically at run time to pull in a needed piece of code just in the same way the user applications can load shared libraries at run time. The kernel does not necessarily need to know in advance which modulus may be loaded-they are truly independent loadable components.

The Linux kernel forms the core of the Linux operating system. It provides all the functionality necessary to run processes, and it provides system services to give arbitrated and protected access to hardware resources. The kernel implements all the features that are required to quality as an operating system. On its own, however, the operating system provided by the Linux Kernel looks nothing like a Unix system. It misses many of the extra features of UNIX, and the features provided are not necessarily provided in the format in which a Unix application expects them to appear. The operating system interface visible to running applications is not directly maintained by the kernel. Rather, applications make calls to the system libraries, which in turn call the operating system services as necessary.

The system libraries provide many types of functionality. At the simplest level, they allow applications to make kernel system service requests. Making a system call involves transferring control from unprivileged user mode to privileged kernel mode; the

details of this transfer vary from architecture to architecture. The libraries take care of collecting together the system-called arguments and if necessary, arranging those arguments in the special form necessary to make the system call.

Finally the Linux system includes a wide variety of user mode programs- both system utilities and user utilities. The system utilities include all the programs necessary to initialize the system, such as those to configure network devices or to load kernel modules. Continually running server programs also count as system utilities, such as programs, which handle user login requests, incoming network connections and the printer queues.



(a) Linux Architecture

Figure 1.3

1.2.10 Visual Editor

Visual Editor is a full screen text editor available on all Unix systems.

Why use Visual Editor?

- It is there on all Unix systems; works on any terminal
- If you know Visual Editor, you know much of awk, sed, grep for free
- Small, fast, dependable but very powerful (especially for touch typists)
- Consistent and tiny command set-works on all keyboards

When not to use Visual Editor?

- When you are writing LISP code (Loop mode is inferior to Evnacs)
- When you are editing binaries (Visual Editor chokes on huge lines)
- When you have forgotten the commands (no online help)

Examples:

Anything you do with Visual Editor is by definition cool stuff.

Cool Stuff:

(a) Indenting Incoming Mail

You have seen those > signs that people like to use before the lines of an included mail message. Here is a line that does it in Visual Editor.

: l, { s | ^ | > |

If you want to use > only upto the current line, replace the "$" with a "." If you want a space after the > sign, you should replace the ">" with a ">". If your mailer (like /usr/ucb/mail) prepends included mail message with a tab, than replace, "^" with "^[tab]".

(b) Changing input upto a Comma

Say you want to change all the text in a sentence upto a comma. Rather than deleting this text and then inserting new text, try the following:

Cf [new input] [ESC]

This does the job in one shot, you can replace the "," with any other letter.

(c) Editing Multiple Files in Visual Editor

Although Visual Editor does not allow multiple windows, editing multiple files is not a problem start Visual Editor up with: "vi file1 file 2 …" and make sure that "aw" is set (either in exec or with: set aw inside VI).

Move to a new file by issuing a: new filename. Your place will be kept in the old file as you move to the new file. To yank from one file to paste into another, use named buffers.

1.3 Revision Points

Classification of Computers

Computers are classified four main categories:
They are

1) According to Purpose
2) According to Size and Storage capacity
3) According to Technology used
4) According to Historical Advancement

According to Purpose category

1. General Purpose Computers

Computers that follow instruction for general requirements such as sales analysis, financial accounting, invoicing, inventory, management information etc. are called General Purpose Computers.

2. Special Purpose Computers

Computers which are used for performing a particular task alone, are called Special Purpose Computers.

Size and Storage Capacity

According to the size and memory/storage capacity computers are of the following four types:

1. Super Computer

Super computer is the biggest and fastest, which is mainly designed for complex scientific applications.

2. Mainframe Computer

Mainframe computers are very large and fast computers but smaller and slower than super computers.

3. Mini Computers

Mini computers are computers, which multiterminal facilities. They have only one CPU but possess many terminals and keyboards.

4. Micro Computers

A Micro Computers is the smallest digital computer, which uses a microprocessor as its CPU. Microprocessor is a single chip (Integrated Circuit) CPU. Micro computer is popularly called Personal Computer (PC).

Technology used

According to the technology used, computers are of the following three types:

1. Analog Computers

Analog computers are special purpose computers that represent and store data in continuously varying physical quantties such as current, voltage or frequency.

2. Digital Computers

Digital computers are mainly general-purpose computers that represent and store data in descrete quantities or number.

3. Hybrid Computers

Hybrid computers incorporate the technology of both analog and digital computers. These computers store and process analog signals which have been converted into discrete numbers using analog to digival converters.

Input/Output Devices

Computers have I/O Unit, which contains the Keyboard, Joystick, Monitor, Printer etc., those devices are called pheripherals also.

Arithmetic and Logical Unit (ALU)

CPU contains the ALU. It takes the responsibility for all arithmetic operations like addition, subtraction, multiplication and division as well as logical operations such as less than, equal to and greater than.

Memory Unit

Memory Unit is one of the most important units of CPU. This unit stores all the information or data. Memory unit is classified in two different categories.

1) Primary Memory
2) Secondary Memory

Compilers, Interpreter and Assemblers

Compilers translate the entire program into machine code using linker, the machine code is converted into executable code. Compilers provide faster execution speed.

Interpreters: Instructions of a high level language are coded in many statements. At the time of their execution, they are converted statement by statement into machine code, by using system software, called interpreters.

Assemblers: Assemblers translate the Assembly language code (source program) into Machine language code. After assembling, a linker program is used to convert the machine program into an executable program.

Operating System

Operating system is a set of programs, which provide a bridge between the users and the computer system. An operating system is a part of the system software and has become an integral part of a computer system.

Net Working

A computer network is a system for communication among two or more computers. These networks may be fixed (cabled, permanent) or temporary (as via modems).

1.4 Intext Questions

1. Define a Computer?
2. Explain the Classification of Computers with examples.
3. Explain why, “CPU is the brain of computer”?
4. Explain the following:

   RAM
   Applicatin Software

LINUX Architecture
Visual Editor
Computer Networking

5. Distingush between the following.

   Analog / Digital Computers
   System / Application Software
   RAM / ROM
   Hardware / Software

6. Explain the usage of computers.
7. Explain the various types of printers based on their criteria.
8. What is an Operating System? Explain its importance.
9. Briefly explain the types of Operating Systems.

1.5 Summary

- Computer is one of the greatest inventions in human history. They are the new source of Technology, which helps to fill the gap of innocence among people. We are rapidly becoming a "computer society". Until recently computers were found only in environmentally controlled rooms behind locked doors
- The Computer evolved as a result of man's search for a fast and accurate calculating device.
- The CPU is the main component or "brain" of a computer, which performs all the processing of input data.
- Software is a program or set of instruction, which is required to use the computer. Many types of software are available for various applications
- An operating system is a part of the system software and has become an integral part of a computer system.
- The concept of the "Computer Center" as a room with a large computer to which users bring this work for processing is now totally absolute.

1.6) Terminal Exercises

1. Write a short notes about Super computers.
2. CPU is _____ of Computer System.
3. Light pen is _____ device.
4. Write the units are available in CPU.

5. Write a short note about ROM
6. Chose the best answer
    1. Floppy Disk
        a) Storage Device, b) Input Device, c) Output Device
    2. Operating System is a
        a) System Development Software, b) System Management Software,
        c) System Software Utilities
7. Write a short note about the interpreter.
8. Unix is a _____ user Operating System
9. Which following device is output
    1) Key board
    2) Printer
    3) Light pen
    4) Joy stick

1.7 Supplementary Materials

1. Computer Fundamentals by B. Ram (Revised Third Edition)
2. Fundamentals of Computer Aided Engineering B. Raphael and I.F.C. Smith

1.8 Assignments

1. Comparative study between Operating System with Multiuser Operating System.
2. Full Display of CPU and its parts has to show for students, which give more understanding about it.

1.9 Reference Book

1. Sanjay Saxena “A First Course in Computers”, Vikas Publishing House, New Delhi.

1.10 Learning Activity

This activities have been done by small group of people

1. Functionality of CPU.
2. Difference between ROM and RAM
3. Networking concept.

1.11 Key Words

- **VLSI** - Very Large Scale Integration
- **CAD –** Computer Aided Designing
- **CAM** – Computer Aided Manufacturing
- **ROM –** Read only Memory
- **RAM –** Random Access Memory
- **ALU –** Arithmetic and Logical Unit

Unit II

2.0 Introduction

Microsoft Office 2000 consists of group of applications developed by Microsoft Corporation to cater to the needs of the entire office environments. The designing is done with the aim of building a common web based interface and sharing the data between the applications as and when required. MS-**Office** is designed to give maximum productivity with minimum hassle. With the use of MS-**Office,** we can create business documents to virtually meet any needs, handle complex financial analysis, and to produce professional presentation.

MS Office includes the following applications:

- ➔ **Microsoft Word,** a Word Processor
- ➔ **Microsoft Excel,** an Electronic Spreadsheet
- ➔ **Microsoft Access,** a Database Manager
- ➔ **Microsoft PowerPoint,** a Graphics and Animation Controller

2.1 Objectives

Students can get the knowledge about MS Office. They can get the good understanding, and working procedure for Word Processor, Spreadsheet, Database and Power Point slide Presentation. By Knowing this unit they will get basic about the entire office package and the effectiveness of computers. More this unit give the pictorial and view about the following stuffs

- Microsoft Word (Document)
- Microsoft Excel (Spreadsheet)
- Microsoft Access (Database)
- Microsoft PowerPoint (Power Point Presentation)

2.2 Contents

2.2.1 Microsoft Word

MS-Word is a *Word Processing* Package.

Document is a huge art. To succeed in such an art we need tools like word processors that will help us present the text in various beautiful styles and alignment. There are various word processors that will help us to present the text in various beautiful styles and alignment. There were various word processors previously used. Some of them are

- **WordStar**
- **WordPerfect**
- **Professional Write**
- **Lotus AmiPro**

MS Word is a powerful window based word processor that helps us to create

- Letters, Charts, Tables and Documents.

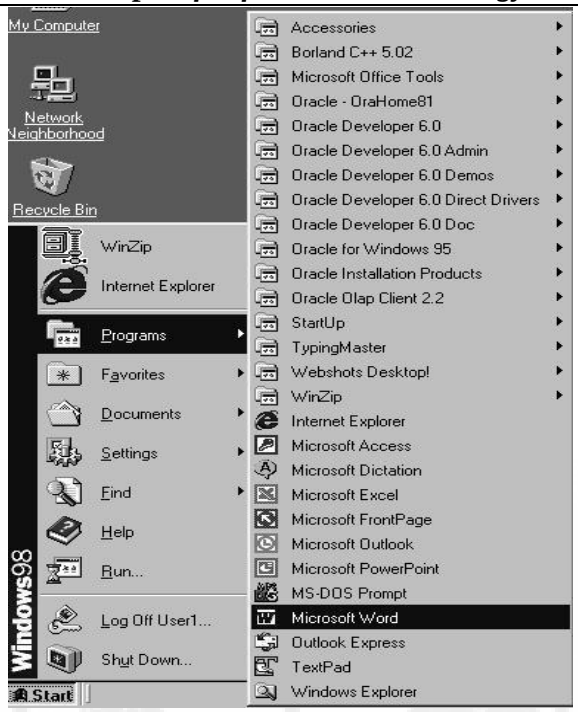
MS Word is very helpful in the following features

- Spell Check
- Auto correct
- Text Formatting
- Insertion of Pictures and Shapes
- Indent text
- Bulletining
- Graphs
- Mail Merging and Label
- Creating Tables

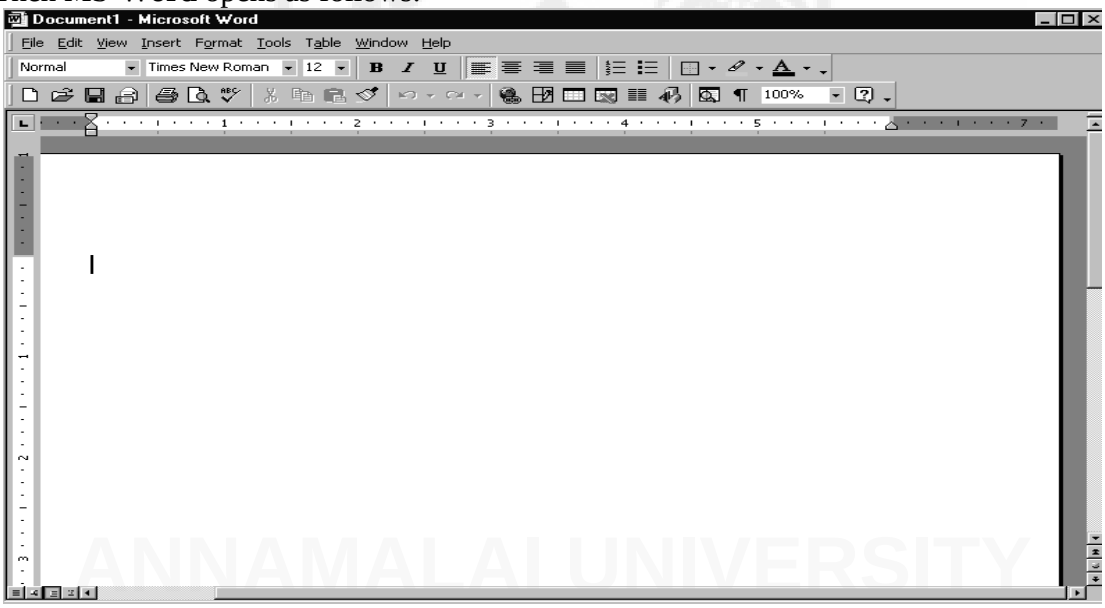
With the MS-**Word's** Powerful features, we can do anything, from quickly jotting down notes to create a complex report that includes tables, pictures and charts.

Starting MS-Word

Choose **Start → Programs → Microsoft Word,** the MS-word opens as shown below.



Then MS-**Word** opens as follows:



We can start working with MS-Word in the above window.

To Save Document

After we have finished typing the document, we have to save the document for later use. If you are saving a new document, by default **Word** gives its name as **Document1**. We can supply any name to the document, which we are going to save. The default extension of a Word Document is **'.doc'.**

In order to save the document click **File → Save.** If we are saving the Document for the first time, Word displays a dialog box asking you the name of the file and the location (path tells us the place) where the file is to be stored.

Using Save & Save As

If the file has already been saved with a name, and we chooses **Save** option from the **File Menu, Word** will not ask for a name. Instead, it will save the contents with the same name.

If we choose **Save As** option from the **File Menu, Word** will ask for a name enabling the document to be saved under a new name.

To Quit Word

To quit from **Word** click **File → Exit** or press **Alt + F4.**

Formatting Text

Selecting Text

You can select the text by using the mouse or the keyboard. If you are using the mouse, follow the steps below to select a block of text:

- Place the cursor on the desired spot
- Click and hold the left button of the mouse
- Slide the mouse over the text till you want to select
- Release the mouse button and see the selected text displayed in reverse video

Reversing Actions

Two very useful tools for editing documents are Word's **Undo** and **Redo** commands. These commands do exactly as their names imply; the Undo command undoes your last action, and the Redo command redoes the action. For example, if you've accidentally deleted a paragraph, click the **Undo** button from the **Edit menu** and the entire paragraph reappears. If you decide, after reading the paragraph again, that you were better off without it, click the **Redo** button from the **Edit menu** and it's deleted all over again.

Editing Text

The first field on the formatting toolbar shows the font's **style.** In the illustration shown above, the text style is "Normal." The next field shows the text's **font**, that is, the typeface; in the illustration, the font is Times New Roman. To change the font, click the arrow next to the current font name, and select a different one from the drop down list. The list shows the fonts you used most recently first, and then all the fonts in alphabetical order.

To change the size of the font, use the **font size** field to the right of the font type field. Fonts are measured in "points," with 72 points to an inch. Most documents uses 10 or 12-point font. You can type a new number in the Font Size field or select a size from the drop down list.

Click the three formatting buttons to make text **bold [B]**, *italic* **[*I*]**, or underline **[U].**

To change the color of your text, click the **font color** button on the far right of the toolbar. To select a different color, click the arrow next to the button and choose from the drop down list.

You can use the highlighter button on the right side of the formatting toolbar to call attention to blocks of text. The highlighter is designed for proofreading or adding comments to a document. Click the button, and select a block of text. The text becomes a bright color on the screen. The highlighter is probably best for reading documents online. If you do leave the text highlighted and print a black and white copy of your document, the highlighted text has a gray box around it.

Tip: Keep an eye on the formatting toolbar as you work. It shows how the text will be formatted when you type. For example, when the Bold Button is on, **everything you type is bold.**

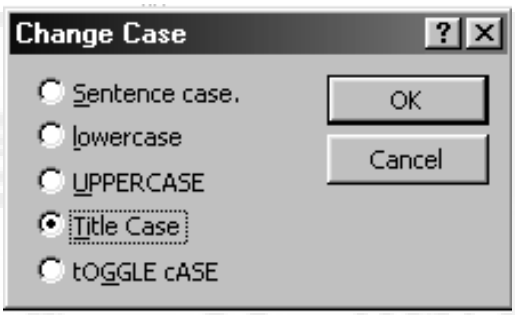
Formatting Characters

For additional character formatting options, select **Font...** from the **Format** menu, and then select the **font** tab. The font tab has the same formatting options available on the formatting toolbar but it also has others. As you make changes, the preview area in the bottom of the dialog box shows how your text will look. You can select a special **Underline** style for your text on this tab. You can use different **Effects** such as emboss, engrave, superscript (as with the 2 in $e=mc^2$), or subscript (as with the 2 in H_2O). If you define text as hidden, it shows up on-line only if Show/Hide Paragraphs is turned on and prints only if you specify that it should in the Print Options menu. (To print hidden text, select Print from the **File** menu, click the **Options** button, and select **Hidden Text**.) Additional animated features are also available on the **Animation** tab (known as **Text Effects** in Word 2000). Animated effects like **shimmers** and **sparkles** will stand out if you're looking at it on-screen, but none of these features print.

Changing Case

You can change the text as lower case, UPER CASE, Toggle case, Title Case and Sentence case. To do this

1. Select the word(s) which you want to change the case
2. Click **Format → Change case**
3. Choose the way you want to change the case from the Radio Button options



Paragraph Formatting

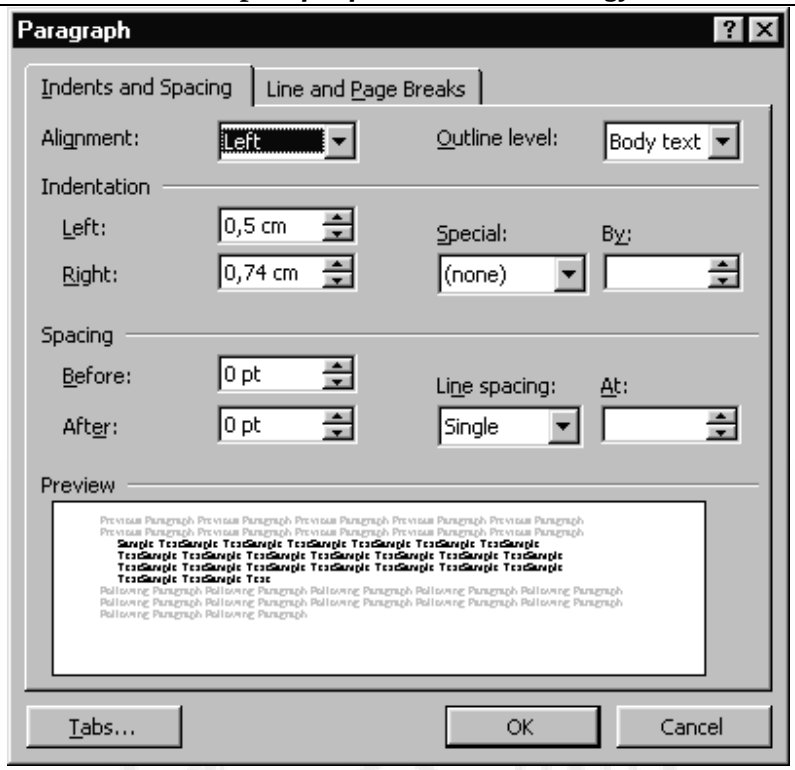
Paragraph formatting includes setting tabs and indents, alignment, numbering, bulleting, and borders. If you want to have several rows of text lined up so that each line begins at the same place, you must use paragraph formatting (tabs and indents) to control the spacing. To select a single paragraph for formatting, simply place the insertion point in that paragraph. To format multiple paragraphs, extend the selection into at least a portion of all the paragraphs you want to format. As with other formatting, you have many options for getting the job done. To set many paragraph formatting options at once, select **Paragraph** from the **Format** menu. You can also change formatting options using toolbars and the **Ruler**. Turn the ruler **off** and **on** from the **View** menu.

Indents

Indentations in paragraphs are aligned with the tabs set in the document. To move these indentations, you need to modify the tab setting. To indent the first line of a paragraph only, simply press **TAB**.

To indent the whole paragraph from the left margin, click on this button  . Each time you press on this button, the cursor will move to the next tab. To stop the indentation of a paragraph, press **ENTER** and the cursor will return to the left margin.

To indent a paragraph from the left and right margins, go to the **Paragraph...** option in the **Format** menu. The following dialogue box will appear:



You can indicate the type of indentation you want for the left or right margin in the **Indentation** box. These indentations can be set before or after entering the text, but make sure the cursor is at the beginning of the paragraph. You can also set an indentation from the right margin using the same dialogue box. You may need to set paragraph indents for a bibliography, footnotes, or résumé. You may also want the first line of every paragraph indented from the margin while the rest of the paragraph stays flush with the margin.

Page Formatting

Change the page-number format, such as **1, i**, or **a.**

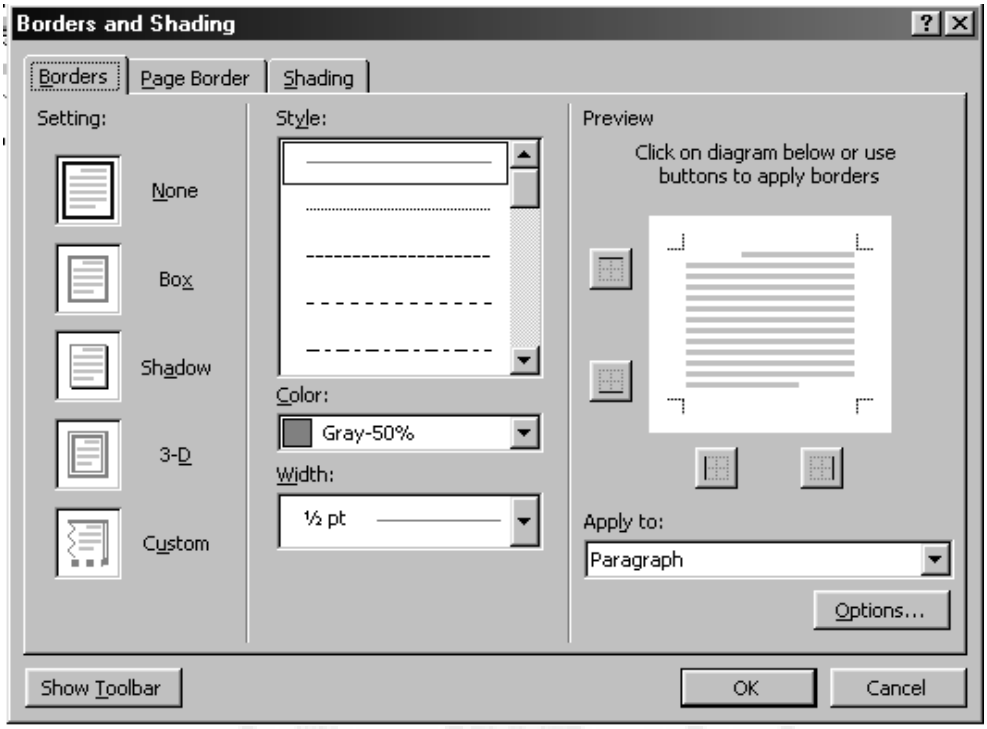
For example, you can use roman numerals for the table of contents and Arabic numerals for the rest of the document.

1 On the Insert menu, click Page Numbers
2. Click Format
3. In the Number format box, click the format you want

Tips: You can restart page numbering with 1 for each chapter or section. You can also set border for the page. To do this

1. On the format menu click border and shading
2. Click border

3. Choose the type of border you want



Header and Footer

A header or footer is text that prints at the top (a header) or bottom (a footer) of every page of a document. A header or footer can show the page number, or it can contain chapter titles, authors' names, or any other information you desire. Word offers several header/footer options:

- The same header/footer on every page of the document.
- One header/footer on the first page of the document and a different header/footer on all other pages.
- One header/footer on odd-numbered pages and a different header/footer on even-numbered pages.

Adding or Editing a Header or Footer

To add a header or footer to your document, or to edit an existing header or footer, follow these steps:

1. Select **View → Header and Footer**. Word displays the current page's header enclosed by a nonprinting dashed line Regular document text are dimmed, and the Header and Footer toolbar is displayed. On the toolbar, click the Switch button to switch between the current page's header and footer.

2. Enter the header or footer text and formatting using the regular Word editing techniques.
3. If you want the date, time, or page number, click the appropriate button on the toolbar.
4. Click the Show Next and Show Previous buttons on the Header and Footer toolbar to switch between the various sections. As you edit, each header or footer will be labeled (for example, "First Page Header", "Odd Page Footer").
5. When finished, click the Close button on the toolbar to return to the document.

Bullets and Numbering

Numbered and bulleted lists are useful formatting tools for setting off lists of information in a document; **Word** automatically creates these elements. Use bulleted lists for items that consist of related information, but are in no particular order. Use numbered lists for items with a specific order.

Tabs

Inserting Tabs

If you want to create a tab or indent a paragraph, you must use tabulations. By default, tabs are placed at 1.27 cm (0.5 inch) intervals. You can modify these tab stops by deleting or moving them, or by inserting new ones.

The tab function is available by selecting the **Tabs** option in the **Format** menu.

Tables

Inserting a Table

You can insert a new empty table at any location within your document. To do this, follow these steps:

1. Move the insertion point to where you want the table.
2. Select **Table → Insert → Table**. The Insert Table dialog box is displayed.
3. In the Number of Columns and Number of Rows boxes, click the arrows or enter the number of rows and columns the table should have. (You can adjust these numbers later if you wish.)
4. In the Column Width box, select the desired width for each column, in inches. Select Auto in this box to have the page width evenly divided among the specified number of columns.
5. Select OK. A blank table is created with the insertion point in the first cell. For example, shows a blank table with 4 rows and 3 columns.

Working in a Table

When the insertion point is in a table cell, you can enter and edit the text as you would in the rest of the document. The text entered in a cell automatically wraps to the next line within the column width. Navigate in a table using the special key combinations listed below:

Press this	**To**
Tab	Move to the next cell in a row.
Shift+Tab	Move to the previous cell in a row.
Alt+Home	Move to the first cell in the current row.
Alt+PgUp	Move to the top cell in the current column.
Alt+End	Move to the last cell in the current row.
Alt+PgDn	Move to the last cell in the current column.

If the insertion point is at the edge of a cell, you can also use the arrow keys to move between cells.

Automatic Table Formatting

The AutoFormat command makes it a snap to apply attractive formatting to any table:

1. Place the insertion point anywhere in the table.

2. Select **Table AutoFormat** from **Table** menu. The Table AutoFormat dialog box is displayed.

3. The Formats box lists the available table formats. As you scroll through the list, the Preview box shows the appearance of the highlighted format.

4. In the lower section of the dialog box are a number of formatting options. Select and deselect options as needed until the preview shows the table appearance you want.

5. Select OK. The selected formatting is applied to the table.

Finding And Replacing

Find

You can search for a particular text throughout your document using **find** option. For example, you are writing a 40 pages report and you want to find and edit the text **New York Sales Office** in your document, then you'll quickly find it by searching for "New York." Word's default is to search the entire document. If the text is selected, the search will be limited to the selection.

Replace

Use the Replace command to search for instances of text, and to replace them with new text. Imagine that you're almost finished with your 400-page novel, and decide to change the main character's name from Brad to Lance. This command will save a lot of time for you.

Editing and Proofing Text

Using the Spelling Checker

The spelling checker lets you verify and correct the spelling of words in your document. Word checks words against a standard dictionary and lets you know when it encounters an unknown word. You can ignore it, change it or add it to the dictionary.

To check spelling in a portion of a document, select the text to check. To check the entire document, first move the insertion point to the start of the document by pressing Ctrl + Home.

Then:

1. Select **Tools → Spelling** or press F7 or click the Spelling button on the toolbar. Starts checking words beginning at the insertion point.
2. If a word found in the document is not in the dictionary, it becomes highlighted in the text and the Spelling dialog box displays.
3. In the Spelling dialog box, the Not in Dictionary box displays the word that is not found in the dictionary. If the spelling checker has found any likely replacements, they are listed in the Suggestions list box. In the dialog box, you have the following options:
    - To ignore the highlighted word and continue, select Ignore.
    - To ignore the highlighted word and any other instances of it in the document, select Ignore All.
    - To change the highlighted word, type the new spelling in the Change To box or highlight the desired replacement word in the Suggestions list box. Then select Change (to change the current instance of the word) or Change All (to change all instances of the word in the document).
    - To add the word to the dictionary, select Add.

4. The spelling checker proceeds to check the rest of the document. When it finishes checking, it displays a message to that effect. To cancel spell checking at any time, select Cancel in the Spelling dialog box.

Fast Check! To check the spelling of a single word, double-click the word to select it, then press F7.

Short Cut Keys

By using keyboard shortcuts we can save an enormous amount of time. Working with the keyboard is faster than working with the mouse. Keyboard shortcuts are keystrokes that activate a command directly and they pass the menu. Keystrokes that are used to open a menu, such as **Alt** plus a key, are referred to as accelerator keys.

The shortcut key for each tool is displayed in the Screen Tips boxes that appears when the user points out at an icon on a toolbar.

Sl.No	Task	Key Combination
1	Create a new document	Ctrl+N
2	Open a document	Ctrl+O
3	Save a document	Ctrl+S
4	Help	F1
5	Make text bold	Ctrl+B
6	Make text italics	Ctrl+I
7	Underline text	Ctrl+U
8	Left align text	Ctrl+L
9	Right align text	Ctrl+R
10	Center align text	Ctrl+E
11	Justify text	Ctrl+J
12	View normal	Ctrl+Alt+N
13	View outline	Ctrl+Alt+O
14	Print Preview	Ctrl+Alt+I
15	Print	Ctrl+P
16	Undo	Ctrl+Z
17	Redo	Ctrl+Y
18	Closing a document	Ctrl+W

Mail Merging

Merging can go by many names, so don't be confused if someone mentions “mail merge,” “print merge,” or “form letters”—they are all the same thing. When people use mail merge by that name or by any other, they are usually trying to generate either form letters or mailing labels.

Form Letters

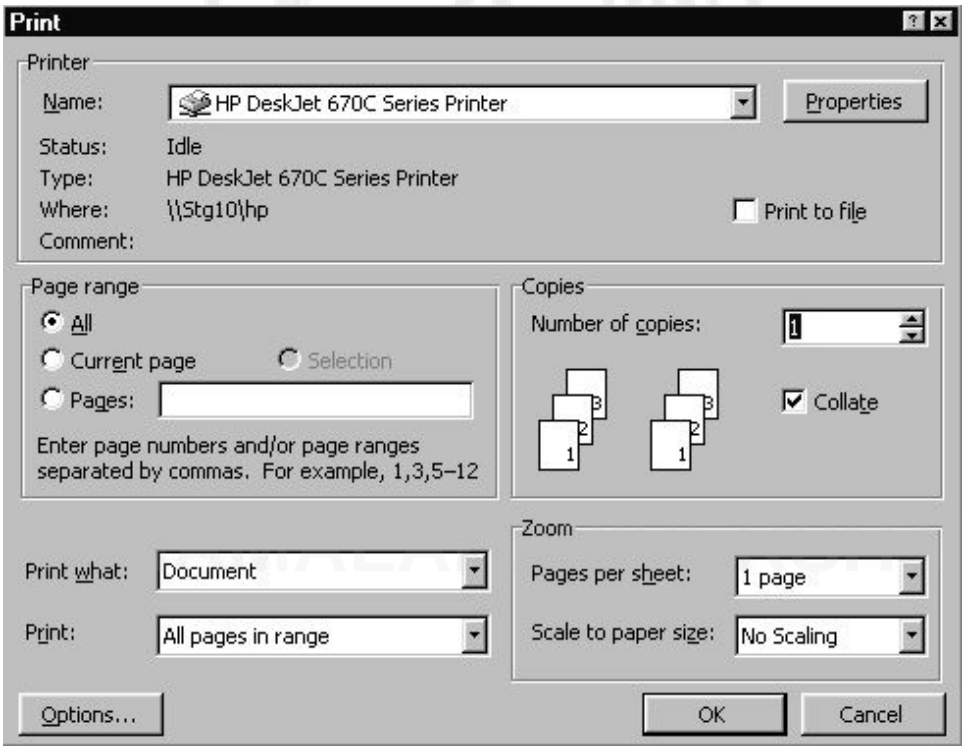
You can use merging to create a form letter, complete with individualized information, by combining a main document with a data document. For example, if the main document is an overdue payment notice, the data document could be a list of customer names, their addresses, account numbers, and the amounts of overdue payments. In this example, merging the main document with the data document results in a series of similar overdue notices that contain information relevant to a particular individual.

Address Labels

You can also use merging to create mailing labels or to address envelopes automatically, all using a single data file. In address labels, the main document would be the layout of the sheet of labels. The data document would be the names and addresses to appear on the labels.

Printing a Document

To print a Document click **File → Print** or **Ctrl + P**



After selecting the needed options click **ok** button to start printing.

Getting Help

To answer questions while working, open the **Help** menu and select **Contents and Index.** A list of available help topics appears, from which you choose the one you need. The **Index** includes letter buttons to help you move quickly through the alphabetical index listing of help items. Many help windows include a button called **Example and Practice,** which will provide you with an interactive demonstration on the topic you are viewing.

The **Answer Wizard** is also useful if you are not familiar with the program's terminology. Simply type in a question and the Answer Wizard will locate the appropriate key words or phrases in the **Help** Index.

Word 2000 Help

The Help system has changed quite a bit since Word 97. Veteran Excel users should know that the **Contents and Index** option is no longer available from the **Help** menu and, unless you customize Word 2000, you must consult the **Office Assistant** with any questions you have.

Office Assistant

Click on the **Office Assistant's** icon, and it will ask you, "What would you like to do?" Type your question into the space provided, and click on **Search** or press the **Enter** key. It will then provide a list of options related to your question. Clicking on any of these topics opens the Excel **Help** window, which displays detailed, topic-specific information. Clicking on any underlined text will link to more help screens. Excel-related vocabulary appears in blue; if you click on any blue term, a pop-up note containing the definition and other descriptive information appears.

The back and forward buttons on the Microsoft Excel **Help** toolbar function just like these buttons do in a web browser application, taking you back and forth between pages that you've opened. During the course of your wanderings in **Help**, the topic list that the **Office Assistant** offered earlier may have disappeared. Click on the Assistant's icon to bring that information back into view.

2.2.2 Microsoft Excel

MS Excel is an *Electronic Spreadsheet.*

Applications of Electronic Spreadsheet

There are numerous applications possible using electronic spreadsheets. A few of the common applications are given below:

- Pay bills
- Income tax calculations
- Invoices or bills Account
- Statements Inventory Control
- Cost Benefit analysis Financial
- Accounting Tender Evaluation
- Result analysis of students

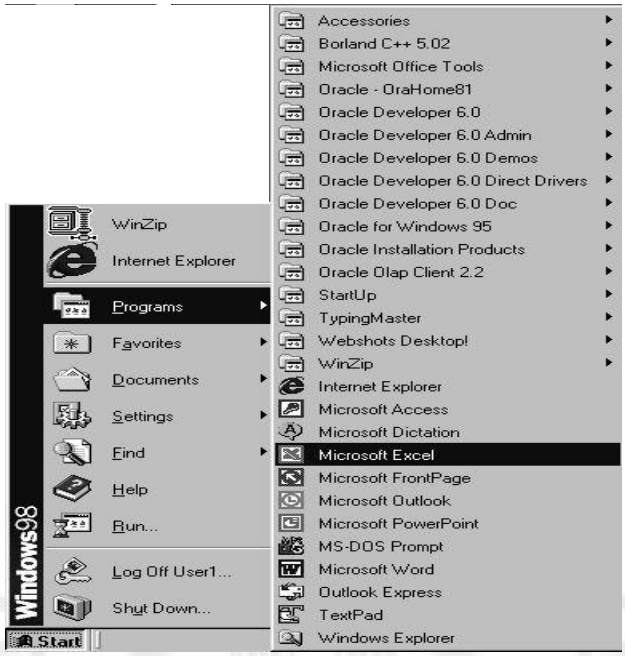
Features Of MS-Excel

Microsoft Excel is a spreadsheet program with sophisticated charting and database functions that allows you to quickly and easily perform these tasks:

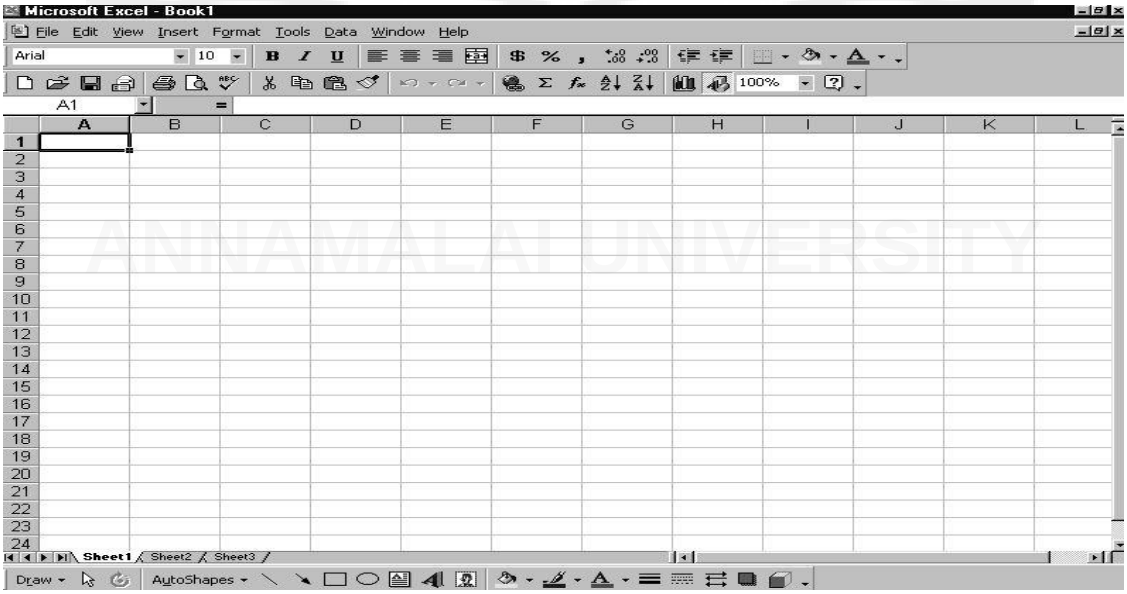
- Perform both simple and complex calculations
- Filter data from a database or spreadsheet list
- Chart data in numerous formats.

Starting MS-Excel

Choose **Start → Programs → Microsoft Excel,** the MS-Excel opens as shown below.



Then MS-**Excel** opens as follows:



The Toolbar in Excel 2000

The Standard and Formatting toolbars share the same row in Excel 2000. While all of the Standard toolbar is displayed, the Formatting toolbar is truncated.

You can see all of the formatting options by clicking once on the double-arrows on the right end of the toolbar. Perhaps you don't mind the extra space that two rows of Toolbars take up and would rather have the formatting options displayed in full. Go to the Tools menu, and select Customize. Click on the Options tab, and click on the check next to Standard and Formatting toolbars share one row. Press the Close button; you can now apply any of the formatting options on the toolbar.

The Name Box and Formula Bar

Located directly below the toolbars are the Name Box and the Formula Bar. The Name Box displays the name of the active cell or selected range, and can be used to name a cell range and as a shortcut to a cell or range of cells. The drop down menu next to the name box may be used to locate previously named regions. The Formula Bar is an area where you can enter text, labels, numbers, and formulas.

What is a Workbook?

Workbooks and Worksheets

The workbook is a collection of sheets that enables you to organize your work better. A workbook can contain worksheets, charts, macros, or other types of sheets--you can have up to 255 sheets in one workbook. The Sheet Tab, which is to the left of the horizontal scroll bar, shows you a list of sheets in the current workbook.

Entering Data

You can enter data into a cell in two different ways:

1. Click once to select the cell and start typing. The data will appear in two locations: in the cell itself and in the Formula Bar. The data is placed into the cell when you hit the Return key or the Enter key, the Tab key, or any of the direction keys (Arrow keys).

2. You may also use the **Form**. . . under the **Data** menu.

Editing Data

To edit the contents of a cell, click on it, and its contents will appear in the Formula Bar. Once the cell contents appear, you can edit them in the Formula Bar using the normal Windows editing techniques. Note that individual words of the formula or label can easily be replaced or retyped in the Formula Bar. To edit a single word, double-click on it and either retype it or press the Delete key to remove it. Editing can also be done within a cell by simply double-clicking on the cell, which places the cursor within the cell.

Clearing Cells

To clear the contents of a cell, click on it, and choose the **Clear**... command from the **Edit** menu. This command brings up a dialog box asking what to remove from the selected cell: formats, contents, or everything. If you use the Delete key, Excel assumes that you want to clear contents of the cell(s), but does not clear any formatting you may have added. Do not use the spacebar to clear cells; it adds a space to the cell rather than emptying it, which may play havoc with any calculations you perform on your data.

Saving a Workbook

To save your Excel workbook, choose **Save**... from the **File** menu or the **Save** tool from the toolbar. The saving rules follow the same as in MS-Word.

Closing a Workbook

To close your Excel workbook, choose **File → close**.

Quitting From MS-Excel

To quit from excel click **file → exit**. If you exit without saving your data then excel will ask whether you want to save, if you want to save then click yes, if you don't want to save, then click no and if you do not want to exit from excel, then click cancel.

Cell References

A reference identifies a cell or a range of cells on a worksheet and tells Microsoft Excel where to look for the values or data you want to use in a formula. With references, you can use data contained in different parts of a worksheet in one formula or use the value from one cell in several formulas. You can also refer to cells on other sheets in the same workbook, to other workbooks, and to data in other programs. References to cells in other workbooks are called external references. References to data in other programs are called remote references.

By default, Microsoft Excel uses the A1 reference style, which labels columns with letters (A through IV, for a total of 256 columns) and labels rows with numbers (1 through 65536). To refer to a cell, enter the column letter followed by the row number. For example, D50 refers to the cell at the intersection of column D and row 50. To refer to a range of cells, enter the reference for the cell in the upper-left corner of the range, a colon (:), and then the reference to the cell in the lower-right corner of the range. The following are examples of references.

To refer to	**Use**
The cell in column A and row 10	A10
The range of cells in column A and rows 10 through 20	A10: A20
The range of cells in row 15 and columns B through E	B15: E15
All cells in row 5	5:5
All cells in rows 5 through 10	5:10
All cells in column H	H: H
All cells in columns H through J	H: J

You can also use a reference style where both the rows and the columns on the worksheet are numbered. R1C1 style is useful for computing row and column positions in macros and can be useful for showing relative cell references. In R1C1 style, Microsoft Excel indicates the location of a cell with an "R" followed by a row number and a "C" followed by a column number.

Notes

1. Depending on the task you want to perform in Microsoft Excel, you can use either relative cell references, which are references to cells relative to the position of the formula, or absolute references, which are cell references that always refer to cells in a specific location.

2. You can use the labels of columns and rows on a worksheet to refer to the cells within those columns and rows, or you can create descriptive names to represent cells, ranges of cells, formulas, or constant values.

Formulas

An expression that can contain any combination of numbers, bookmarks that refer to numbers, fields resulting in numbers, and the available operators and functions. The expression can refer to values in a table and values returned by functions.

Calculation and Order of Operations

The first mathematical concept you need to learn before using a spreadsheet is how computers calculate numbers. In creating mathematical expressions, you must observe some simple rules to calculate correct answers. The following order is used to calculate mathematical expressions:

Entering Formulas

To enter a formula in a cell, click on the cell, type the = character, and enter the formula. If you forget to enter the initial = sign, Excel will treat the expression like a text string: it won't be calculated. Don't waste keystrokes re-entering numbers into your formulas that you've already used elsewhere on the sheet. Instead, replace the number with the cell address containing the number. That way, if the number changes, the formula remains correct. For example, =A1+B1 adds the numbers in cells A1 and B1 and puts the answer wherever you enter this formula.

Tips: Do not bother entering those cell addresses by hand. When you're ready to include a cell address as you're entering a formula, simply click on the cell (or select a range of cell) in the sheet itself. The corresponding cell address then appears in the formula. Then click back in the formula bar to resume work.

The mathematical symbols or "operators" that Excel recognizes are as follows:

- + Addition
- - Subtraction
- * Multiplication
- / Division
- ^ Exponentiation

Functions

You can create a wide variety of formulas in Microsoft Excel, from formulas that perform a simple arithmetic operation to formulas that analyze a complex model of formulas.

A formula can contain functions, which are predefined formulas that perform simple or complex calculations. To perform multiple calculations simultaneously and then return one or more results, use an array formula.

Entering Functions

Functions have three parts: the first is the = sign, which tells Excel that a formula or function follows. The second is the function name, such as SUM for addition or AVERAGE for determining the average of a series of numbers. The third is the argument on which the particular function operates. The argument contains cell references to let the function know which data to calculate. The argument must also be enclosed in parentheses. Again, it is of utmost importance to remember to start all formulas and functions with the = sign. Some examples of functions are =SUM (B4, G43, T70); =COS (A2); =AVERAGE (B1:B10). You can type functions in the formula bar, directly into the cell or use the Function Wizard to help you create the desired results.

Copying Formula

When you copy a formula, absolute cell references do not change; relative cell references will change.

1. Select the cell that contains the formula you want to move or copy.
2. Point to the border of the selection.
3. To move the cell, drag the selection to the upper-left cell of the paste area. Microsoft Excel replaces any existing data in the paste area.

To copy the cell, hold down CTRL as you drag.

Tips: You can also copy formulas into adjacent cells by using the fill handle. Select the cell that contains the formula, and then drag the fill handle over the range you want to fill.

Creating Charts

In simple words chart is defined as a picture that is used for representing numeric data in a simple and understanding manner. Chart contains the overall summary of the numeric data stored in a workbook or worksheet. Before you start a chart, you must first input the data from which the chart will be drawn. Do this just as you would for creating any Excel worksheet. To create the chart, Excel will plot sets of data from your worksheet called *data series*.

What Type of Chart Should You Use?

Excel has 16 types of charts that you can select and use. The selection of chart type is usually driven by the data, although there are no hard and fast rules for determining the chart type you should use. Experiment! It is extremely easy to change your chart type selection. Then use the one, which displays your data and conveys your message in the simplest way possible.

Below is a brief description of chart types and their general use:

Area	Good for depicting magnitude of change over time.
Bar	Shows the value of two or more items at the same point in time. Good for depicting dramatic difference between positive and negative values.
Column	Shows two or more values side by side.
Line	Illustrates trends over time.
Pie	Represents your data as a percentage of the total.
Doughnut	The appearance of a pie, but displaying more than one series.
Radar	Depicts frequency and change relative to a central point.
Scatter	Depicts two values and tries to show relationships, usually independent of time.
Combination	Allow you to layer one type of chart over another.
3-D	Dramatic use of some of the above charts. But be careful, as they can be hard to read and distort the perspective of your data.
Surface	A 3D surface shows trends in values across 2 dimensions in a continuous curve.
Stock	Requires 3 series of values in the order of high low close.
Bubble	Compares three sets of values. It is similar to a scatter plot chart with the 3rd value displayed as a size of a bubble.
Cylinder/Cone/ Pyramid	Creates a column chart with a cylindrical, conical, or pyramidal shape.

Printing Excel Files

If you want to print a single copy of the current worksheet on your default printer, select Print from the toolbar to send the file directly to the printer. If you would like to make choices about the number of copies you want, print a certain selection or range of pages, or make a choice among printers, then choose Print... from the File menu. Once the dialog box appears, make the necessary choices and click OK.

Print Preview

Print Preview, which is found in the File menu (and also as a tool on the standard toolbar), puts up a miniature preview screen of the worksheet. You can use the Zoom option to magnify and examine any particular part of the page. You can also print from the Print Preview by clicking on the Print option.

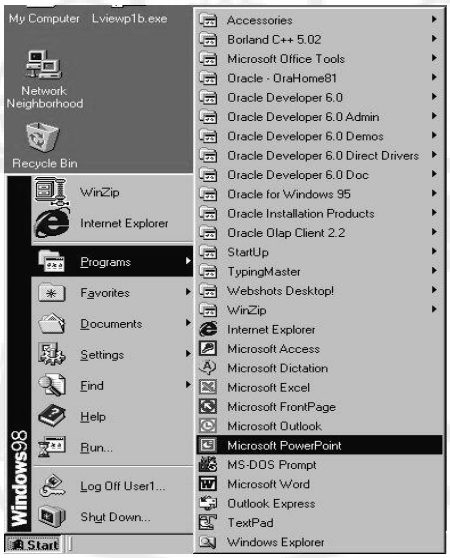
2.2.3 Microsoft PowerPoint

MS PowerPoint is a component of **Microsoft – Office** that helps us to create professional-looking presentation material. This helps to create, update and sort slide-based presentations. PowerPoint streamlines a few of the task and provides some handy prefabricated layouts, color schemes and font choices. This presentation package can be used for creating a handy and attractive presentation.

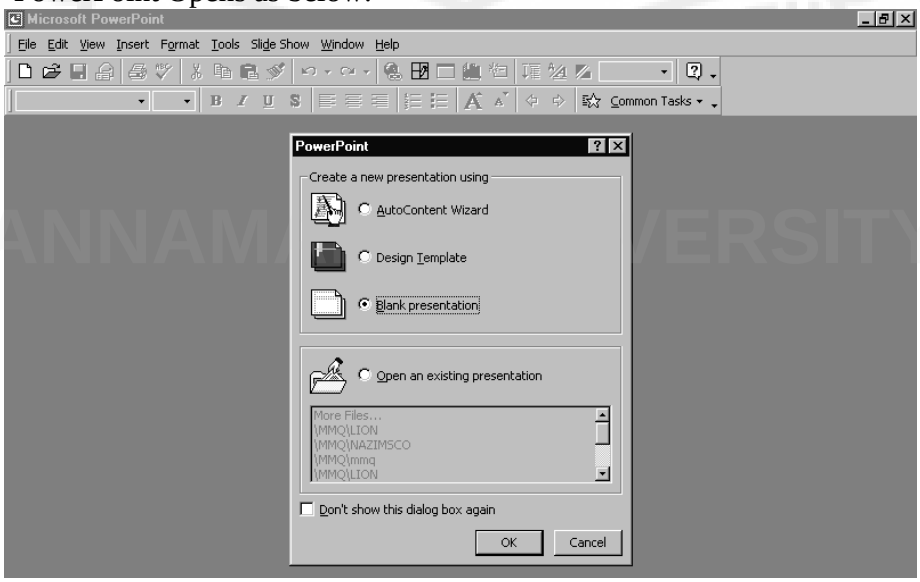
A **Presentation** is a **PowerPoint** file, which consists of one or more slides, along with information on any special effects you have selected. A slide is like a page of our presentation. It can also consist of text, graphics, clip art, charts, or multimedia effects.

Starting MS-PowerPoint

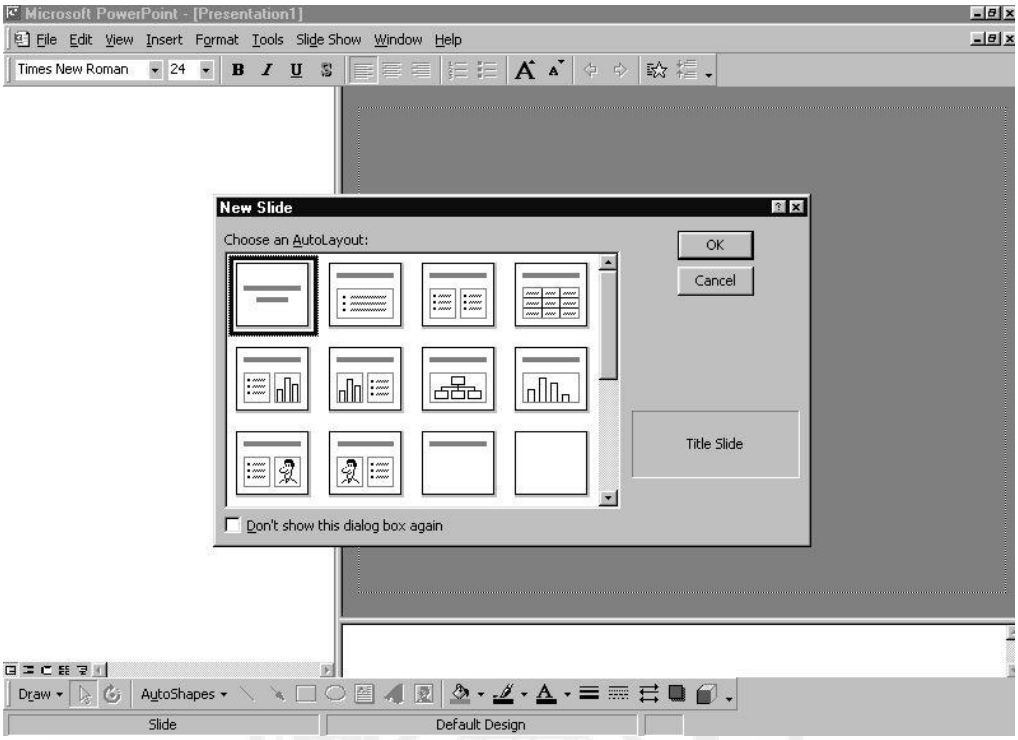
Choose **Start → Programs → Microsoft PowerPoint,** the MS-PowerPoint opens as shown below.



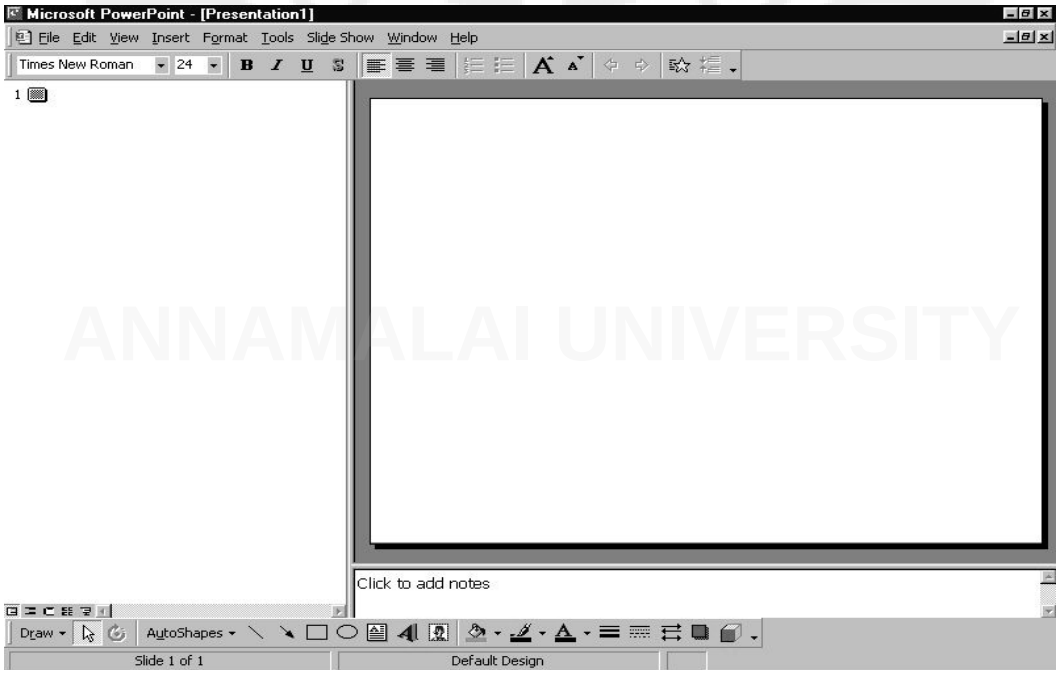
The MS-PowerPoint Opens as below:



Notice that initially you have four options where you can select the type of the presentation file you would like to open. Let us discuss Blank Presentation. You will get the following screen as soon as you choose the Blank Presentation option.



The type of the slide on being selected will open the slide of that type in the main window (for example a blank slide is opened in the following figure).



To Create a Presentation using the AutoContent Wizard

The difference between selecting Blank presentation and Auto content Wizard is that, the Auto content wizard provides the information from various topics. The person who chooses the Auto content wizard need not know about the content which he wants to create.

You can go through all the option in the Auto content Wizard and finally you will arrive with some number of slides with the related topics.

Viewing Presentations

There are three ways to view your presentations in PowerPoint. The views are accessed from the View menu or from the buttons in the lower-left corner of the PowerPoint 2000 screen.

- Normal view is the view to use when you are designing a presentation slide by slide. In Normal view, you see the Outline in the left pane, the slide in the upper-right pane, and the notes in the lower-right pane. The Normal view makes it easy to organize a presentation in outline format and add notes to each slide.
- Slide Sorter view shows the entire set of slides on the screen, so that you can check the order and consistency of the slides.
- Slide Show view puts the presentation together as a slide show, so you can view the finished presentation, complete with sound and animation.

Adding Text to Slides

Using Text Placeholders

You can insert text on slides by selecting an Auto Layout with text placeholders. Text placeholders are formatted for titles or bulleted lists. The text formatting, which includes the font, alignment and bullets, depends on the design template you selected.

To add text to a slide in Slide View, simply click on a text placeholder (In PowerPoint 2000's Normal View you can simply type in your text next to the numbered slide icon on the left hand screen). The directions on the placeholder will disappear, leaving an empty text box with a flashing insertion point. Begin typing. Text automatically wraps as you reach the right border of the placeholder. When you're done, click anywhere else on the slide. To edit text, move the mouse pointer over the text (note that it becomes an I-beam), click and edit.

Using the Text Tool 

You can use the Text Tool on the Drawing toolbar to add text outside of text placeholders. In Slide View, click the Text Tool and move the mouse pointer to the point on the slide where you want to insert text. Click to make a label/caption or drag to make a text box that will wrap the words. Then begin typing and, when you're done, click anywhere else on the slide.

Adding Slide Objects

You can incorporate elements, such as graphics and even sound and video into your slides in one of two ways:

- Select an Auto Layout containing a placeholder for an object. Some placeholders are for specific objects such as clip art, graphs, tables, organizational charts or media clips while other placeholders are for all types of objects.
- Select the desired object (Clip Art, Picture, Movie, Sound, Microsoft Graph, Microsoft Word Table, Object) from the Insert menu. Clicking on Object... from the Insert menu brings up the Insert Object dialog box, which lists all the different types of objects that can be embedded in PowerPoint slides.

You create embedded objects using another application while you are working in PowerPoint. (This requires that you have the application installed on your machine.) The object's application menu and toolbars appear on the screen and may temporarily replace the PowerPoint menu and toolbars. When you're finished, click anywhere else on the slide to return to PowerPoint.

To edit embedded objects you have created, double-click on the object. Again, the object's application menu and toolbars appear. Make the changes and when you're done, click anywhere else on the slide.

Clip Art 

You can put graphic images from Microsoft ClipArt Gallery on your slides. To add clip art to a slide:

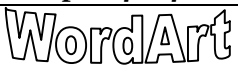
- Double-click on a Clip Art placeholder,
- Under the Insert menu, choose Picture, then Clip Art and
- Click the **Insert Clip Art** button on the Standard toolbar shown here.

ClipArt Gallery opens. You can limit your search by choosing a category. Select the picture you want and click **Insert**. ClipArt Gallery closes and the image you selected appears on the slide.

If you want to change the clip art on a slide, double-click on it and ClipArt Gallery opens. Select a different picture and click Insert.

Pictures: 

You can put scanned images or art created from other programs on your **PowerPoint** slides. Select **Picture** from the **Insert** menu, choose **From Scanner** and use the MS-Office photo editor after opening the file from your computer.

WordArt Object: 

WordArt takes is a tool within PowerPoint that gives words 3-D effects and certain texture fills. After clicking on the WordArt button on the Drawing toolbar, you will then be asked to choose your style of WordArt. Finally, you will be asked to choose font and size after typing your text. PowerPoint will place your selection on your slide at this time.

You can add text with special effects in your slides using Microsoft WordArt. There are at least three ways to put word art in your PowerPoint presentation: You can select **Insert/Picture/Word Art** from the menu or choose **Object** from the **Insert** menu or double-click on an **Object** placeholder. In the **Insert Object** dialog box, select **Create New** and choose the latest version of **Microsoft WordArt** from the **Object Type** list. The WordArt dialog box and menus appear. Type the text and click on **Update Display**. Choose the special effects you want from the WordArt toolbar. When you're done, click anywhere else on the slide.

Working in Different Views

You can switch between five views of your presentation; each view gives you a different way of looking at and working with your presentation. To toggle between views, choose the desired view format from the **View** menu or click the appropriate button to the left of the horizontal scrollbar (shown here to the left). From left to right, the views are **Slide View**, **Outline View**, **Slide Sorter View**, **Notes Pages View** and **Slide Show View**.

Slide View

In Slide View (the main screen of PowerPoint 2000's "Normal View"), you can add graphics to your slides as well as type, edit and format text. **PowerPoint** displays the Formatting and Drawing toolbars in addition to the Standard toolbar. The presentation appears on the screen one slide at a time. The left side of the Status bar displays the page number of the current slide. To move to other slides, drag the elevator on the vertical scrollbar or click the **Previous Slide** or **Next Slide** button below the scrollbar.

Outline View

Working in Outline View (the left side of PowerPoint 2000's "Normal View") is a good way to organize and develop the content of your presentation. To insert text, click where you want to add text and type. Bullet and their editing are very easy in this view. Creating sub-levels along with promoting and demoting text can be done here as well. You can also print a copy of your outline. In this view, you see only the title and body text of each slide. The Drawing toolbar closes and the Outlining toolbar opens. This works much like the Microsoft Word Outlining toolbar.

Slide Sorter View

In Slide Sorter View, you can efficiently perform tasks such as reordering slides and adding builds, transitions, and slide timings for electronic presentations. You cannot work on text and visual elements of individual slides in this view. **PowerPoint** displays miniature versions of each slide. In addition to the Standard toolbar, **PowerPoint** displays the Slide Sorter toolbar.

Notes Pages View

In Notes Pages View (the bottom section of PowerPoint 2000's "Normal View"), you can create pages that you can print and use as a guide during your presentation. Each page contains an image of the corresponding slide and a placeholder for your notes.

Slide Show View

You use Slide Show view to deliver your presentation as an on-screen electronic slide show or to look at each slide full-screen. Click the mouse button to advance to the next slide. If you've reached the last slide or press the **Esc** key on the keyboard, you return to the previous view.

Delivering an On-Screen Show

To deliver your presentation as an on-screen electronic slide show, open the presentation in PowerPoint; select **Slide Show** from the **View** menu. By choosing **Setup Show** from the **Slide Show** menu you can choose which slides you want to show during the presentation.

During the Presentation

To move to the next slide, click the mouse button or press N on the keyboard. To get a menu of available slide show commands, click the right mouse button or this icon that appears on the lower left side of the screen.

- To go directly to a particular slide, select **Go To**, **Slide Navigator** from the menu. On the **Slide Navigator** dialog box, select the slide and click **Go To**.
- To annotate a slide during a show, select **Pen** from the menu and the mouse pointer toggles to a pen. Click and drag to write or draw on the slide. To return to advancing the slides, switch back to the arrow by selecting **Arrow** from the menu.

You can deliver an on-screen show on a computer that doesn't have **PowerPoint** installed using the **PowerPoint** Viewer, freeware that you can distribute with your presentation. You can create disks that contain the presentation and **PowerPoint** Viewer. Select **Pack** and **Go** from the **File** menu and the **Pack** and **Go Wizard** guides you through the process.

Slide Timings:


When delivering an electronic slide show, you have the option of manually advancing the slides or using slide timings. In Slide Sorter view, click the **Rehearse Timings** button on the Slide Sorter toolbar and rehearse the delivery of your presentation. The Rehearsal window that stays on the screen during the slide show keeps track of the time elapsed since a slide appeared on screen. At the end of the slide show, **PowerPoint** gives you the total time of the presentation and the option to record the slide timings. If you record the slide timings, they will appear in Slide Sorter View. To manually revise the timing set for a particular slide, select it in Slide Sorter View and click the **Slide Transition** button on the Slide Sorter toolbar. Then enter a number in the Advance Automatically after box. To use the slide timings during a slide show, choose **Use Slide Timings** on the Slide Show dialog box.

Transitions are special audiovisual effects that occur when moving from slide to slide during an electronic presentation. To add a transition to a selected slide in Slide Sorter View, click the **Slide Transition** button on the Slide Sorter toolbar. From the Transition dialog box, you can choose the effect and speed of the transition and a sound to accompany the visual effect. A transition icon appears below the slide miniature of a slide with transition. You can preview the transition on the miniature by clicking on the icon. If you want the same transition on all your slides, choose **Select All** from the **Edit** menu and then add the transition.

Saving Your Presentation

To save your presentation, choose **Save** from the **File** menu. The save rules follow the same restriction like MS-Word or MS-Excel.

Opening a Presentation

To begin working with **PowerPoint** by opening an existing presentation, select **Open an Existing Presentation** from the **PowerPoint** startup dialog box and click **OK**. If **PowerPoint** is already running, choose **Open** from the **File** menu or click the **Open** button on the Standard toolbar.

You can open several presentations at a time. To switch between open presentations, select the file name from the **Window** menu.

Getting Help

To access on-line help; select **Microsoft PowerPoint Help Topics** from the **Help** menu. You can type in a help request in our own words using the **Answer Wizard** as well. And don't be afraid of the paper clip, star, Einstein look-a-like, or whatever may pop up as your assistant. To access any of these options, click on the help button on the standard toolbar.

2.2.4 Microsoft Access

Information at the right time plays a major role in any growing organization. The convenient, effective & organized way to manage this information is through DBMS.

Database Management System (DBMS) is a program that allows user to define, manipulate and process the data in a database in order to produce meaningful information. There are many different types of DBMS, ranging from small system, that run on personal computers to huge systems that run on mainframes. For Example; Dbase, Oracle, DB2 and Access.

Microsoft Access is a Relational Database Management System (RDBMS) designed to run in Microsoft Windows. As yet, Access does not have a version for Macintosh. Unlike older Database Management Systems for IBM-compatibles, Access takes advantage of Windows' graphical interface to simplify complex database operations and does not require you to learn sophisticated programming languages. Access contains powerful querying and connective capabilities that allow you to easily manipulate the data in your database. Access' graphical interface also helps to design sophisticated forms and reports that would facilitate effective data presentation both on-screen and in publication-quality documents.

Working with Database and Tables

Databases

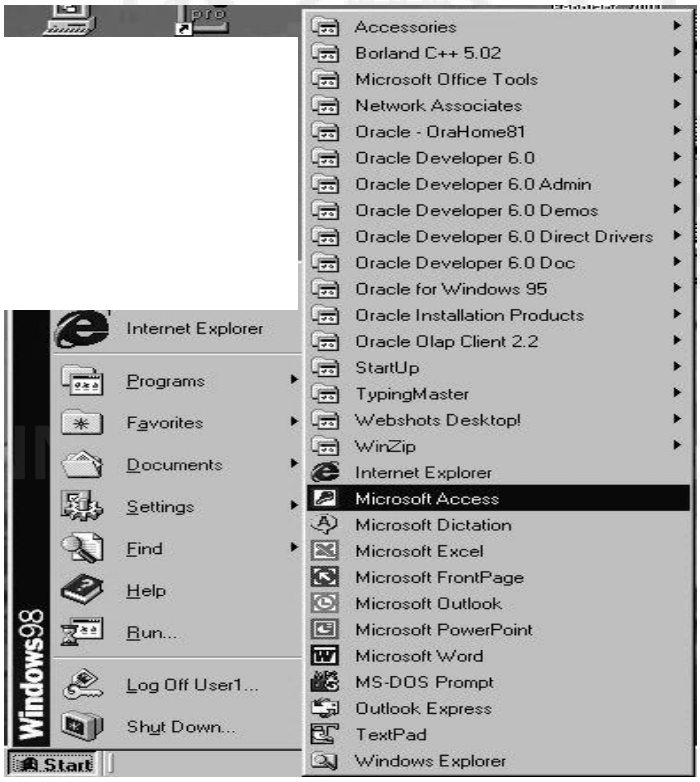
A database is a collection of information related to a particular subject or purpose, such as tracking customer orders or maintaining a music collection. If your database isn't stored on a computer or only parts of it, you may be tracking information from a variety of sources, which you have to coordinate and organize yourself.

What are Tables?

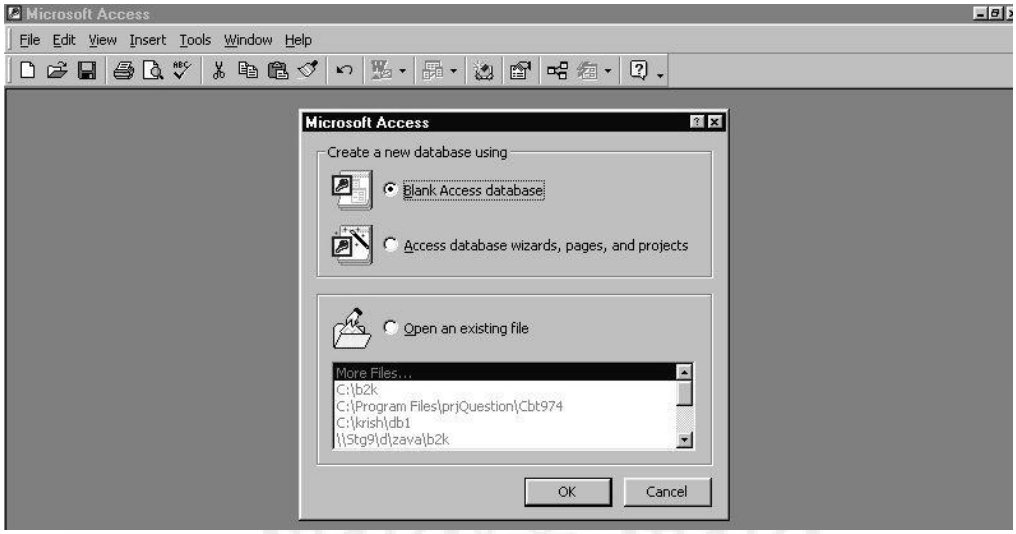
Data are always stored in tables. All other object types are built on top of your tables. They display the data inside your tables and write changed data back into your tables. Each table contains information about one subject, such as employees, members of the class of 1998, or addresses. Most relational databases have many tables; each stores different information about a related subject. One table might store customer names and addresses while another stores customer orders. Tables are made up of records, which contain all of the information about a single item, such as an employee or address. Each record is then subdivided into fields, which are the smallest increments of useful and discrete data in your database. It is always a good idea to make the fields as precise as you possibly can in the beginning. If you were designing an address book, then it would be better to include three fields for First Name, Middle Name, and Last Name, rather than to include only one field for a person's name.

Starting MS-Access

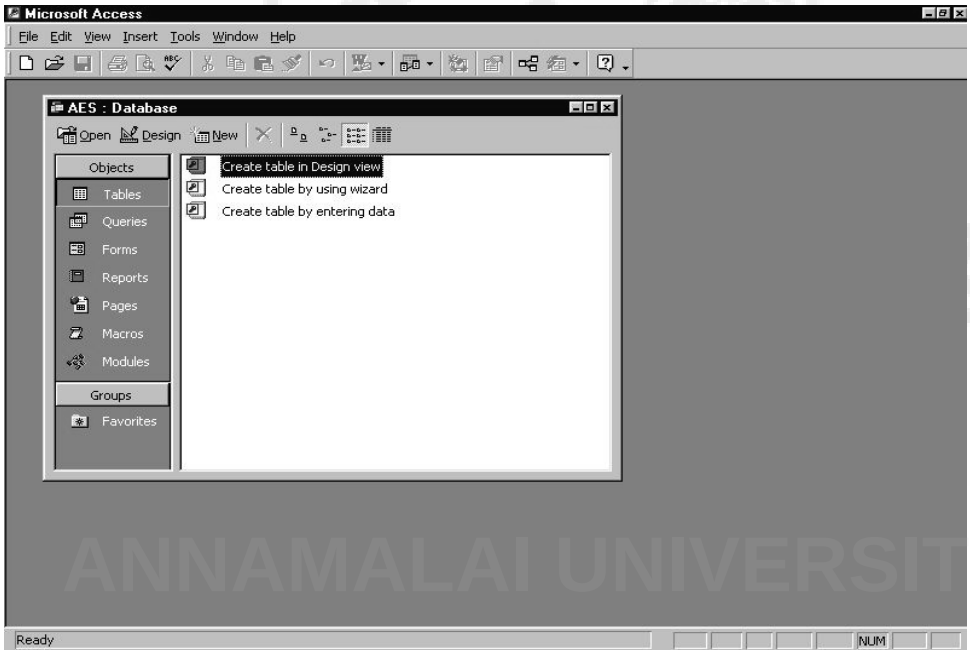
Choose **Start →Programs → Microsoft Access,** the MS-Access opens as shown below.



The MS-Access opens as below:



Select the option Blank Access Database in the above figure The blank database will ask for a name, for example if you name the database as "AES" the database window will look as below.



Creating New Tables

When you create a table, you should think carefully about the kind of data it will contain and how you want to use that data later on. Access makes designing certain kinds of tables easier for you by providing Wizards that automatically create tables for uses as diverse as personal exercise logs, medical records, contact lists, student/class rolls, and cataloging record and book collections. The Wizards works fine for many tables, but you will find that creating your own tables offers much more flexibility for your database.

Creating Tables with the Table Wizard

1. In the Database window, click the Table button (or choose Tables from the View menu).
2. Choose the New button.
3. Choose the Table Wizard button.
4. Follow the directions in the Wizard dialog boxes for adding fields to your table.

Creating tables without the Table Wizard

1. In the Database window, click the Table button.
2. Choose the New button.
3. Choose the Design View button or the Datasheet View button.
4. The table's Design window or Datasheet will appear.

Design View: Changing Table Properties

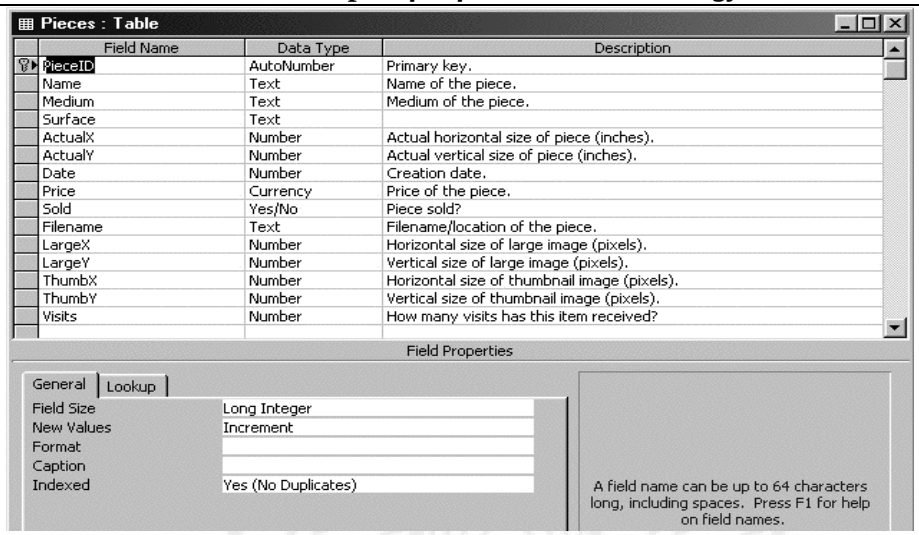
While you can choose to create a table in either Datasheet or Design View, the Design Window offers much more flexibility in creating a database. The first noticeable difference between the design window and the database window is that the standard toolbar has been replaced by the Table Design toolbar. This toolbar offers several shortcuts to make designing tables easier. The Table Design window itself is divided into two principal parts: the area for creating field names and descriptions, and the Field Properties area below it.

Field Names

The Field Name is a descriptive identifier for a field that can be up to 64 characters (letters or numbers) including spaces. The names should be descriptive enough that anyone can easily identify them when viewing or editing records. For example, LastName, FirstName, Street, City or HomePhone. To create a new field, simply position your cursor in a blank cell and enter a new name.

Field Descriptions

A Field Description, an even more descriptive identifier for the field, helps you make your tables easier to understand and update. For example, if you are making a database of all the records you own and have a Name field, you might clarify that entry by describing it as "The title of the album, CD, or tape." This optional field is actually much more important than you think. As you or your users traverse the fields in your tables (or later in your forms), this description will appear in the bottom left-hand corner of the screen, giving those who may not understand your field names a better idea of what information should be entered into the field. Accordingly, you might want to flesh out your field descriptions, even giving them an example to work from ("The year of release (e.g., 1999).").



Data Types

After you name a field, you choose a data type for the data to be contained in the field. When you choose a field's data type, you are deciding following aspects:

- What kind of values to allow in the field. You cannot store text in field with the Number data type.
- How much storage space Access should set aside for the data in that field.
- What types of operations can be performed on the values in that field. Access can find the sum of Number or Currency values but not of Text values.
- Whether Access can index or sort data in the field. Access cannot sort or create an index for Memo or OLE Object fields.

The following table summarizes each data type.

Data Type	Stores	Size
Text	Alphanumeric characters	Up to 255 characters (255 bytes)
Memo	Alphanumeric characters that are usually several sentences in length	Up to 64,000 bytes (large text fields). NOTE: *Memo field is not searchable!*
Number	Numeric values (integer or fractional)	1, 2, 4, or 8 bytes
Date/Time	Dates and Times (various formats)	8 bytes
Currency	Monetary values	8 bytes
AutoNumber	A numeric value that is automatically incremented for each record added	4 bytes

Yes/No	Simple yes or no, true or false	1 bit (8 bits = 1 byte)
OLE object	OLE objects, graphics, or other binary data	Up to 1 gigabyte
Hyperlink	Addresses for documents that you want to link to that are stored outside your database	Up to 2048 characters
Lookup Column	Creates a drop-down list of values to choose from in Datasheet View	Up to 255 characters

Datasheet View: Adding and Saving Records

The other way to look at your table is in the Datasheet view. Generally, you want to use the Design view to work on layout and other formatting options. The Datasheet view is most helpful for entering new records and editing old records in a table. To switch to Datasheet view, choose Datasheet from the View menu or click the Datasheet View button on the toolbar.

Adding a Record

1. Make sure that your cursor is situated in the first blank cell on the table, and then enter the desired data. If you are using an existing database, the "first blank cell" is at the bottom of the table. Watch the graphics symbol in the record selectors box just to the left of your record. It will change from the arrowhead, which indicates that it is the current record, to a pencil, which indicates that you are editing this record. Note: It will still be a pencil even if it is the first time that you have entered the record. If the locked record symbol appears, then the record has been locked by another user, and you do not have access to it.

2. To get into the next field of the record, press <Tab> or use the mouse and click on the next cell. If you want to return to an earlier field, then press <Shift> + <Tab>.

3. To save a record, you do not need to do anything more than move to the next record after entering data in the record's last field. You can also save the record by closing the table. You do not need to save the table to save any changes you have made to the records inside it. Saving the table saves only design changes to the table.

Warning If you reboot your machine or exit Access while editing a record, you will lose the record.

Editing a Record

1. Select the record that you wish to edit by clicking in the specific field you want to change.
2. Type in the new data for that field.
3. When you move to another record, the new data will overwrite the previous data.

Note: When editing data, Access will not prompt or remind you that any old information will be lost.

Adding / Deleting Fields

You can also add and delete fields in Datasheet view, but you do not have the same control over specifying parameters that you do in Design view. To create a new field in Datasheet view, either go to the Insert menu and choose Insert Column, or right-click the mouse where you want to add the new column and choose Insert Column from the menu displayed. To delete a field in Datasheet view, select the field by clicking in the field heading, go to the Edit menu and select Delete Column. You can also right-click the mouse on the field heading and choose Delete Column from the displayed menu.

Joining Tables

Join Multiple Tables and Queries in a Query

- In query Design view, drag a field from the field list for one table or query to the equivalent field (a field of the same or compatible data type containing similar data) in the field list for the other table or query.

With this type of join, Microsoft Access selects records from either tables or queries only when the values in the joined fields are equal.

Creating a Forms

When you build a database, the most fundamental concept is to understand what each part of it does. In Access, you have tables that contain the data, queries that allow you to select and organize your data, and forms and reports that allow you to present your data to the world. Forms and Reports function as the front-end to your tables and queries. They are based on an underlying table or query and offer more flexible formatting options.

Like paper forms, Access forms collect and organize information. Forms gives you a way to enter data into your database, display the data for review, and print it out. Forms are designed to make on-screen data entry and retrieval easier, as well as simplifying movement around your database application. With Access, you can present information in just the way that you want by combining text, pictures, lines, boxes, and color to create a fully interactive on-screen environment.

Sorting and Filtering

Sorting Records in Form

In Form view, to sort the records in a field, it does one of the following:

- To sort in ascending order, click Sort Ascending.
- To sort in descending order, click Sort Descending.

Note: In a form, you can sort on only one field at a time; in a datasheet, you can select two or more adjacent columns at the same time, and then sort them. Microsoft Access sorts records starting with the leftmost selected column. When you save the form or datasheet, Microsoft Access saves the sort order.

Filtering

Filter records by selecting values in a form, subform or datasheet.

1. In a field on a form, subform or datasheet find one instance of the value you want records to contain in order to be included in the filter's results.
2. Select the value, and then click Filter By Selection on the toolbar. How you select the value determines what records the filter returns. For more information on selecting values, click.
3. Repeat step 2 until you have the set of records you want.

Notes

- When you save a table or form, Microsoft Access saves the filter. You can reapply the filter when you need it; the next time you open the table or form.

- When you save a query, Microsoft Access saves the filter, but it does not add the filter criteria to the query design grid. You can reapply the filter after you run the query, the next time you open it.

- You can also filter for records that do not have a certain value. After selecting a value, right-click it, and then click Filter Excluding Selection.

Working with Report

A Report provides a way to retrieve selected information that you have stored and present that information. Examples of reports that we use every day include mailing labels, invoices, receipts, and sales summaries. You can base a report on either a table or a query; reports are designed to printed out rather than viewed on a computer screen, so they need to be carefully planned to make sure that you use them most effectively and meaningfully. Since you will be using reports to make presentation quality documents, they need to possess enough design flexibility to allow you to get the right message across to your audience. Fortunately, Access also comes with several pre-planned report layouts that you can set up in a few minutes using Report Wizards.

Access gives you several methods of retrieving information from your database and displaying it. You can use a table, a query, a form, or a report. To look at all of the entries in your database using a spreadsheet-like view, use a table. To see only a portion of your data in spreadsheet-like view, use a query. To see your data one record at a time, use a form. To group your data and present it in an attractive format, use a report. In most situations, none of these descriptions will describe exactly what you are trying to do, so you should generally assume that reports will be used anytime you need to print carefully formatted information.

Like queries, reports do not store the data they present. They keep only the design features that you specify. This allows you to save the design as a kind of template that you can use over again. Once you save the report design, it stays the same, but you will retrieve current data from the table or query each time you print the report. Access reports are especially useful if you need to:

- Organize and present data in groups.
- Calculate running totals, group totals, grand totals, and percentages of totals.
- Include sub reports and graphs.
- Present your data in an attractive format with pictures, lines, and special fonts.

This option is easy if you use Access's pre-designed templates, but can be difficult to do from the scratch.

2.3 Revision Points

Mail Merge

Mail merge gives the option or provides the facilities to send a document to many list. They are generating letter, forms and mailing labels. Merging can go by many names, so don't be confused if someone mentions "mail merge", "print merge" or "form letters" - they are all the same thing.

Shortcut Keys

Using the shortcut keys we can do the operations in quick manner instead of using mouse. Some important and useful shortcut keys are listed below.

- Open the document – Ctrl + O
- Sage the document – Ctrl + S
- Copy – Ctrl + C
- Cut – Ctrl + X
- Paste – Ctrl + V
- Justify the text – Ctrl + J
- Print – Ctrl + P
- Spelling Check – Alt + F7

Workbooks and Worksheets

The workbook is a collection of sheets that enables you to organize your work better. A workbook can contain worksheets, charts, macros, or other types of sheets – you can have up to 255 sheets in one workbook. The Sheet Tab shows you a list of sheets in the current workbook. Each sheets contains rows and columns

Functions

Function includes all types of arithmetic calculations, comparisons etc. It will help you to do all kind of works in excel cell.

Custom Animation

It helps to set the effects for texts, word art, pictures, charts and graphs. You can give the animation effects, sound effects and order of the display in presentations.

Data and Database

Data is nothing but collection of related information. Database can be allowed to store the data in rows and column format.

Data type

MS Access having different types of data. Alphabetic, Numeric, Date, Logical etc., you can store any kind of data type in your access database.

2.4 Intext Questions

1. Open an existing file in your system and save the document in different name by making some changes in the document.
2. Use Cut, Copy & Paste to make a new file from an old file from an old file.
3. Include page numbers in the footer of the document or worksheet.
4. What are the steps to create a table in MS-Word?
5. Make your own presentation with animation controls & special effects.
6. Create a table for storing data of a particular student details.

2.5 Summary

- Microsoft Office 2000 consists of group of applications developed by Microsoft Corporation to cater to the needs of the entire office environments. The important applications are i) Microsoft Excel, ii) Microsoft PowerPoint, iii) Microsoft Access.
- There is numerous applications possible using electronic spreadsheets. A few of the common applications are pay bills, Income tax calculations, Invoices or bills Account, Statements Inventory etc., Control.
- MS PowerPoint is a component of Microsoft – Office the helps us to create professional-looking presentation material. This helps to create, update and sort slide-based presentations.
- Database Management System (DBMS) is a program that allows user to define, manipulate and process the data in a database in order to produce meaningful information

2.6) Terminal Exercises

1. We can process the text using _____

   a) MS Access b) MS PowerPoint c) MS Word d) None

2. To check the spelling you can use _____ shortcut key

   a) Alt+Tab b) Alt+F7 c) Alt+F1 d) Alt+O

3. An Excel book contains _____ sheets

   a) 255 b) 266 c) 26 d) 325

4. Which of the following symbols are Arithmetic Symbols?

   a) + b) # c) % d) 325

5. What is the shortcut key for Slide Show?

   a) F5 b) F1 c) F3 d) F8

6. Write data types available in MS Access

7. Choose the Valid Numeric data

   a) aa b) 8A c) 90 d) -23

2.7) Supplementary Material

1. "The Complete Reference" by Jennifer Ackerman Kettell, Guy Hart- Davis, Curt Simmons

2.8 Assignments

1. Prepare a document with the help of EDIT and FORMAT menu in MS-Word.
2. Prepare a Weekly Accounts table using MS Excell
3. Design a Power Point Presentation about the POPULATION in India.
4. Create a database called STUDENT
   i) sname – Character – 25
   ii) enno – number – 15
   iii) address – character – 50
   iv) dob – date – default
5. Using the above table prepare a REPORT

2.9 Reference Books

1. Ron Manisfield, "Working in Microsoft Office" TATA McGraw Hill, 1997.
2. Vishnupriya Singh & Meenakshi Singh, "DTP Course" Asian Publishers, Delhi, First Edition, 1997.

2.10 Learning Activities

The following concepts would be explained by group of people

1. Data Type
2. Database
3. Arithmetic Calculations

211 Key Words

- **RDBMS** - Relational Database Management System
- **Database** - It's a collection of related information's
- **Format** - It is used to manipulate the text
- **Graph** - Graphical Representation of Data

Unit III

3.0 Introduction to Multimedia

Many people have heard the term multimedia but do not really know what it means. This is probably because the term has been connected with many technological tools. Multimedia means different things to different people. Some associate multimedia with video game while others with voice-activated devices.

'Multi' means more than one, 'media' means a form of communication. Multimedia means the integration of at least two media. These media can include text, photos, graphics, sound, music, animation and full motion video. Multimedia can arguably be distinguished from traditional motion pictures or movies both by the scale of the production (multimedia is usually smaller and less expensive) and by the possibility of audience interactivity or involvement (in which case, it is usually called interactive multimedia). Interactive elements can include voice commands, mouse manipulation, text entry, touch screen, video capture of the user, or live participation (in live presentations).

Multimedia tends to imply sophistication (and relatively more expense) in both production and presentation than simple text-and-images. Multimedia presentations are possible in many contexts, including the web, CD-ROMs and live theater.
Since any website can be viewed as a multimedia presentation, however any tool that helps to develop a site in multimedia form can be classed as multimedia software and the cost can be less than for standard video productions.

3.1 Objective

Students can acquire knowledge about multimedia and its techniques like Imaging, Sound and Animation. They will definitely have good understanding and skills in Desktop publishing, Mailing Network and Topology. They can get some more like

- Various Graphics Techniques in Multimedia
- Data Communication Packages
- Layers
- DTP
- LAN, WAN
- Computer Networking
- Networking Devices

3.2 Contents

3.2.1 Features Multimedia

Interactivity is the amount of control the user has over the presentation of information "Interactive multimedia" refers to multimedia for user control.

The three most common classifications of interactive multimedia are:

- A linear presentation is one in which the author decides the sequence and manner in which an information is presented. The user controls only the pace.
- A programmed branching program is one in which the user has some control over the sequence of presentation by selecting from a group of choices such as from a main menu. The author still maintains the control of deciding what to include in the choices available at any point in the program.
- Hypermedia can be thought of as a web of interrelated information in which the user is in almost complete control of the pace, sequence and content of the presentation. Links provide the random access of information.

Not all multimedia is interactive. Seven levels of multimedia are identified in Table 3.1 and only two of them are interactive. Levels 1 and 2 utilize black and white or color text and graphics and are displayed onscreen as static – that is there is movement associated with these elements. Software that helps to produce multimedia at these two levels includes Delta Graph, Freelance Graphs, PowerPoint and Word-perfect presentations.

Type	Level	Elements
Static	1	Black and White Text and Graphics
	2	Color Text and Graphics
Animated	3	Simple Animated Text and Graphics
	4	Video and Animation
	5	Authored Video and Animation
Interactively	6	Input required from audience on a group basis
	7	Input required from audience through individual interactive

Table 3.1: Multimedia Levels

Multimedia levels 3,4 and 5 utilize some form of video and animation. Software that helps produce multimedia at these three levels includes the software listed for levels 1 and 2 along with Action, Astound, Charisma and V media: Additional support programs such as Adobe Photoshop, Illustrator or strata Studio pro can also be used.

Multimedia levels 6 and 7 encompass some form of interactivity, either through group or individual interaction. Software that helps to produce multimedia at these levels includes Apple Media Kit, Authority Multimedia, and Course Builder and Multimedia

Tool book. A Graphical web browser would belong to level 7 since it provides input through individual interaction in the hypermedia links.

Applications of Multimedia

Multimedia can be used in just about any situation where computers are being used to deliver information, and a number where they are not traditionally used. It may just be used to enhance areas that were previously text only, for example presentations or information kiosks. Multimedia e-mail and video conferencing allows information to be communicated better. Collaborative working tools are becoming cheaper and more widely available, and many video conferencing applications now allow application sharing. Multimedia is widely used in education, (see below) from preschool to postgraduate. Interactive multimedia allows students to explore data, and simulations allow the students to work on experiments. This can be particularly useful in a distributed environment with distance learning. Multimedia can also be used to enhance data presentation and data analysis, for example, by converting the images from a satellite to sound; it becomes much easier to hear discrepancies in that data.

Educational Uses of Multimedia

Educational uses of multimedia are rapidly increasing. Its power to present information in ways not previously possible and its integration of resources, allow for the creation of rich learning environments.

- In the past, a teacher or student had to consult many sources and use several media to access the needed information. By integrating media and utilizing hypermedia we are able to create user controlled information on-demand learning environments.
- Problems occur because of poorly designed programs, resistance to change within organizations, and the lack of technology on which to run multimedia software.
- As technology costs come down, designers become better at producing programs, and users become much more familiar with using multimedia. We see growing acceptance of it in educational settings.

Current uses of multimedia in education include:

- CBT (Computer Based Training)
- Reference Systems
- Simulations
- Virtual Environments

"Edutainment" is a hybrid of education and entertainment. It provides relatively equal emphasis on enjoyment and learning. Many products for home learning fall into this category.

3.2.2 Images

Making Still Images

Still images may be small or large, or even full screen. They may be colored, placed at random on the screen, evenly geometric or oddly shaped. Still images may be a single tree on a wintry hillside; stacked boxes of text against a gray, tartan, or Italian marble background. Whatever their form, still images are generated by the computer in two ways; as bitmaps (or paint graphics), and as vector-drawn (or just plain drawn) graphics. These two methods are explained below in detail.

Vector Graphics

Vector Graphics are built up from primitives, basic drawing instructions such as line, rectangle, and ellipse. These primitives may be grouped together to form objects. All vector graphics are computer generated. They can be produced by many packages including computer-Aided Design (CAD) packages to generate architects' drawings for example. They can also be produced by many drawing packages such as CorelDraw! And are good for storing diagrams.

In a vector format each primitive is described; a vector format file consists of a series of commands such as rectangle x1, y1, x2, y2, x1, y1 etc which are the parameters which determine where and how big the rectangle will be. There may also be colors associated with the command. This allows complex drawings to be stored as very compact files.

These drawings can usually be resized easily without losing any information, since it is just a matter of scaling the parameters. The size of a vector graphics file is directly related to the number of objects it contains, and a file with many objects will not only be large, but also take much longer to reconstruct

Vector graphics can be used to represent 'real world' images, but this requires a great deal of processing, as it is difficult to break these down into simple shapes. These images are usually stored in bitmaps or pixmaps.

Bitmaps and Pixmaps

Bitmaps, which are also known as raster graphics, are composed of a matrix of dots called pixels. For a monochrome image each pixel is either black or white, but for color images each pixel can be any color from a given range. The color depth of the image depends on the amount of memory used to store each pixel. For example, in an image with an 8bit color depth each pixel can be one of 256 different colors, 16bit = 32,768 colors, 24bit = 16.7 million colors. Color look-up tables (CLUT) or palettes are often stored with pixmaps. These are an array of colors described as accurately as possible and referred to by specifying their position in the array.

The main advantage of bitmaps is that they can store very large amounts of information; a bitmap of sufficient resolution can store every detail of a scanned photograph. Their main disadvantage is the large amount of space it takes to do this. The amount of space needed to store a bitmap depends on the resolution, i.e., the number of horizontal and vertical pixels, and its color depth. A 640x480 bitmap with 256 colors will need 8x640x480=2,457,600 bits or 300K of storage space. Although 640x480 was until recently quite a common resolution for computer screens, it is quite a low resolution as far as the human eye is concerned. To store a truly realistic image, a much higher resolution, and therefore much more storage space, is required.

The second disadvantage of bitmaps is that they usually degrade when they are resized. If the bitmap is shrunk some pixels have to be discarded, which means loosing information. If it is expanded pixels have to be created. Giving the new pixel a color based on that of its neighbors usually does this. This tends to create a blocky effect. Bitmaps can be created in a number of ways. Paint and drawing packages usually store images as bitmaps. They can be images, which have been scanned in or digitized from a photograph, piece of artwork or a video, or capturing a screen snapshot form .Your computer could generate them.

File Formats and Compression

As bitmaps are very large, they are often stored in compressed formats. Compression methods can be divided into two main types, lossless and lossy. Lossless techniques do not loose any information, so the image can be recreated exactly. The simplest example is run-length encoding (RLE). If an image has large areas of the same color, rather than storing the color for each pixel, in RLE the color is stored once with the number of times it is repeated. There are a number of other forms of lossless compression, such as Huffman and LZW.

GIF (Graphics Interchange format) is a common format that uses LZW compression, but cannot strictly be considered to be lossless as it is restricted to 256 colors. This restriction means it is not suitable for photo-realistic images that will be displayed on machines capable of displaying more than 256 colors. Unless an image is very simple, lossless compression will not give good compression ratios, usually not more than 4:1 i.e., the compressed image is a quarter the size of the uncompressed image. Recently there has been a lot of talk about GIF and the LZW (Lempel-Ziv-Welch) patent. LZW is a form of compression that lies at the heart of GIF, and a number of other compression formats. LZW compression was originally patented in 1985, and Unisys now owns the patent, and from this year all products using it (unless they are freeware) will have to be licensed and this includes shareware packages. However, products prior to 1995, and free products do not have to be licensed. You do not need a license to store as the makers of the software will have obtained view GIF files, the appropriate licenses. Any software which uses LZW compression is affected by this patent which includes software which reads/writes some types of TIFF and Postscript and the Unix compress utility, but again, free software does not need to be licensed.

Lossy compression methods give much better compression ratios, but information is discarded in the compression resulting in some loss of quality. JPEG (Joint Photographic Expert Group) is an ISO (International Standards Organization) standard form of lossy compression. In JPEG compression the file is first compressed using a method called DCT (Discrete Cosine Transform), which is a lossless method, but the resulting information is then quantized. This is a lossy step, which accounts for most of the compression. This lossy compression leads to loss of detail, which is most noticeable at sharp edges and straight lines. It is, therefore, not really suitable for text and line drawings. However, it does offer very good compression ratios, which can be changed to preserve quality, and does not have the 256-color limit of GIF and is therefore suitable for photographic type images.

Some common file formats are shown in the table below. Some of the formats were developed for particular products but have become widely accepted elsewhere.

Bitmap	**Vector**
BAP – Microsoft Windows bitmap GIF – Graphics Interchange Format PCX – PC Paintbrush PICT – Macintosh TGA – Targa TIFF – Tagged Image File Format JPEG.JPG – ISO standard compression XBM – X Windows	CGM – Computer Graphics Metafile DXF – Used by CAD Packages WMF – Windows Metafile. Postscript HPGL

Most packages will read lots of different formats, and there are many conversion utilities available to effectuate conversion among them. Whichever format you choose may well depend on the capabilities of the applications you are using, but if possible you should use standard, non-application specific formats if possible. This will make your images available to a wider range of people and also ensure you will still be able to use them if you change applications. You should also be aware of space considerations. A windows bitmapped file (BMP) is uncompressed and much larger than the same image stored as JPEG file. However, compressed files must be decompressed to view them, and the time taken to do this may in some cases outweigh the size considerations.

Hardware Requirements

This section looks at some of the hardware associated with capturing and displaying images.

Graphics Adaptors

PCs

Graphics adaptors, often also called video cards, which do not refer to motion video, are usually the limiting factor in display. The VGA standard provides 16 colors at 640x480, or 256 colors at 320x200. This is insufficient for most multimedia applications, and most will be using super-VGA (SVGA). For example the MPC II industry standard calls for a graphics card that can display at least 640x480 with 64K colors. SVGA is not a standard, and consequently the drivers, which have been produced to support it, vary a great deal, and different drivers are needed for each card. When looking at the resolution a card can support, make sure it supports it in non-interlaced mode. Interlaced modes were designed to be used with special monitors with slow phosphors, and on normal monitors there will be noticeable flicker.

The color depth a card can support depends on the amount of memory it has. Most cards now come with at least 1M of VRAM (Video Random Access Memory), and these will usually be able to support up to 1024x768 with 256 colors, or 640x480 with 32,768 colors. Cheaper cards may use DRAM (Dynamic Random Access Memory) which have a single data port. VRAM has a second data port specially designed for the display refresh, making it much faster. It is becoming more common to find cards with 2M, and these will be able to support more colors, for example 1024x768 with 16 million colors. The actual resolutions and colors supported will, however, still depend on the drivers that are available. Some programs, such as Microsoft Windows, come with drivers for common graphics cards, but you may depend on the drivers supplied by the card manufacturers.

Many cards claim to be graphics accelerators. These cards have an extra IC on them, which does the calculations necessary to determine what parts of video memory need updating. This means it does not rely on the CPU and the amount of data transferred between the video card and computer is reduced, leading to faster screen redraw. Like all cards they must have the correct drivers, and you should check that the drivers work with the software you would be using.

One of the biggest problems with PC design is the Industry Standard Architecture (ISA) expansion bus. All I/O communications go through this, and it restricts communication to 8MHz and 2 bytes at a time, even if the CPU is running at 60MHz. A number of alternatives to this have been proposed. The IBM designed Micro Channel Architecture (MCA) which was more expensive and not used by other vendors, is now being phased out. To compete with IBM Extended ISA (EISA) was designed. While this supported 32bit data transfer, it still ran at only 8MHz, and like MCA is now being phased out. Two new PC architectures are now available. VESA's Video Local Bus (VL-Bus) and Peripheral Component Interconnect (PCI), PCI is an open industry standard that was developed and is supported by many companies, including Apple and IBM.

VESA have defined a standard for VL-Bus, which is being offered by a number of manufacturers, though some still offer their own local bus solution. A VL-Bus graphics card is particularly faster than ISA when you are using true color, and when images are copied from memory to screen. The main drawback of VL-Bus is that it ultimately still depends on the old architecture. PCI is offered by many companies and is thought to be superior to VL-bus, offering 64bit data transfer, though it is more expensive. PCI is processor independent and can be implemented on a range of platforms. It is likely that PCI will begin to become more common and replace the other types in future, though currently it is restricted to high-end machines. When buying a new machine you should look for one, which provides VL-Bus or PCI slots.

Mac

All Macs can deliver 8bit color depth. For multimedia you need to expand this to 16 or 24 bits, by adding extra VRAM. This is possible with all Macs above the LC II. Macs use NuBus architecture. Mac Quadras and Power Macs use NuBus '90, a more recent, faster implementation of the NuBus technology. The new versions of the Power Mac will also have PCI slots.

Scanners

Some scanners consist of a row of charge-coupled devices (CCD) that detect the presence of light as a light bar is passed over the paper to be scanned. The horizontal resolution of a scanner is determined by how close the CCDs are together, and vertically by how slowly the light bar passes over the paper. The physical limit for CCD placement is currently 600 dpi, and higher resolutions are achieved by interpolation (averaging) in hardware or software. In gray scale scanners, the CCDs can detect the amount of light failing on them. Color scanners are basically the same with red, green and blue filters, and can either do all three in one pass or take three passes.

Scanners come in two main types, hand-held or flatbed, with color and gray-scale versions available. Hand-held scanners are cheaper, but require the user to make several passes over the image (depending on size). The scanner software then joins the passes together to make one image. It is found that the hand-held scanner had trouble joining the parts seamlessly, and was sometimes unable to join them at all.

When choosing a scanner you will need to look at the color depth and the dpi of the scan. A good scanner will offer 24 bit at 400 or more dpi. However, remember that the figures given will be the maximum the scanner is capable of and may not always be available. For example a hand held scanner may not be able to scan at its maximum resolution and stitch passes together well. If a scanner can scan at several resolutions, scanning time will certainly increase with resolution. Remember also that the file size will increase with resolution, and scanning a full page at 400 dpi may generate several hundred megabytes. It is not always necessary to scan at maximum resolution, if the image is to be displayed half its actual size, this effectively doubles the resolution.

Digital cameras

Digital cameras, also known as still video cameras, take still photographs and put them directly onto digital media without using film. The images are usually saved to a floppy or hard disk, and can then be downloaded onto your computer. Perhaps the best-known one is the Canon Ion range, but there are a number of others available, including those, which allow a standard SLR camera to be fitted to the front, so producing better quality output.

Monitors

A good quality monitor can represent a large part of the cost of a system, so it is worth knowing what to look for when choosing one. For multimedia applications it is wise to use a larger monitor, particularly if you are using programs in a GUI, where you may have several windows open at once. Some monitors may claim to have a maximum resolution of 1280x1024, but this may be larger than the number of individual dots that can be displayed, and in fact reflect only the video band width.

Refresh Rate

The monitor should use a rate of at least 60Hz(i.e., the screen is redrawn 60 times a second), and preferably 70-75Hz, in order to prevent any flicker. The actual refresh rate also depends on the resolution, as a greater bandwidth is required to display the same capable of using these refresh rates.

Resolution

This is affected by dot pitch and bandwidth. The dot pitch is the distance between adjacent RGB phosphor dot groups. The smaller the dot pitch, better is the potential resolution. The bandwidth required is proportional to the number of pixels per second. Therefore, higher refresh rates and/or resolutions require higher bandwidths. Poor bandwidth can cause the picture to lack sharpness, and small characters to be illegible.

Focus

Focus is difficult to measure, but look for variations in sharpness between the center and edges of the screen. High-end monitors may have ‘dynamic focus’ and ‘dynamic beam forming’ which will help to reduce focus problems.

Power Supply

The monitor’s power supply is also very important. When the screen changes brightness, for example going from a very dark image to light one, the monitor’s power supply has to work harder, and if the supply is not well regulated, the voltage may drop, affecting picture shape. Viewing video particularly requires a stable power supply.

Magnetic Fields

Monitors are susceptible to magnetic fields, to the extent that monitors designed to work in one part of the world will show color patches in another part due to differences in the earth magnetic field. So be careful when placing speakers near monitors.

3.2.3 Sound

What is Sound?

If a tree falls in the forest and no living creature is there to hear it, does it make a sound? The answer is no. Sound is a perceptual phenomenon only. When a tree falls or a person speaks, or a violin string vibrates, the surrounding air is disturbed causing changes in air pressure that are called sound waves. When sound waves arrive at our ears they cause small bones in our ears to vibrate. These vibrations then cause nerve impulses to be sent to the brain where they are interpreted as sound.

How is Sound Recorded?

Sound waves can be transduced (converted to another form) using a microphone. A microphone is similar to the human ear in that it has a diaphragm, which vibrates in response to changes in air pressure. The movements of the diaphragm within an electromagnetic field cause changes in electrical voltage. These changes can be directed to a tape recorder, which alters the magnetic particles on the tape to correspond to the voltage changes. A "picture" of the sound then exists on the tape. When you press play on the tape recorder, the "picture" is read back as a series of voltage changes, which are then sent to a speaker. The voltage changes cause an electromagnet within the speaker to push and pull on a diaphragm. The movement of the diaphragm then causes air pressure changes, which our ears interpret as the original sound. This process is known as analog recording because the picture of the sound on the tape is analogous to the original changes in air pressure caused by the sound event.

Usually we represent sound visually as a waveform .The height is called the amplitude and represents volume. The distance between cycles is called the period or wavelength. The number of cycles per second is called frequency and is interpreted by our ears as pitch. Frequency is measured in Hertz (Hz) or kilohertz (kHz). The waveform below is a simple sine wave. Typically sounds are more complex in appearance

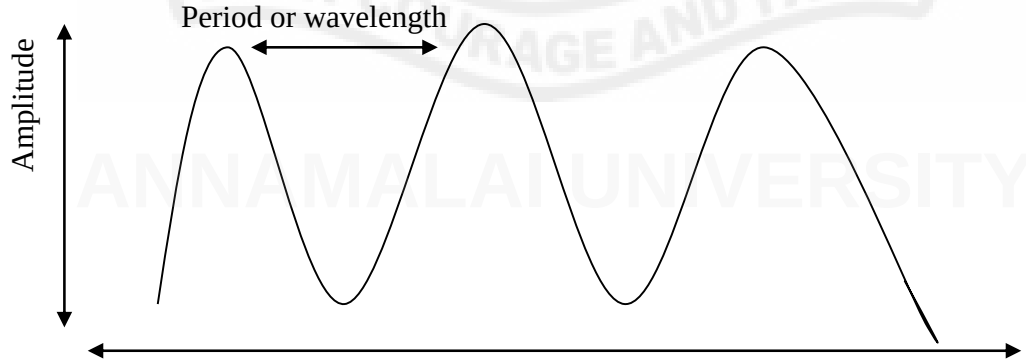
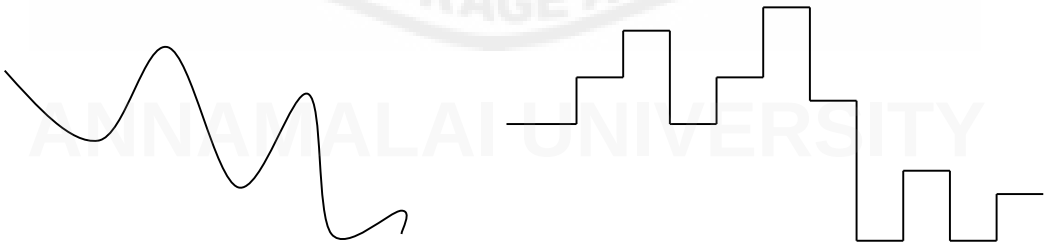


Figure 3.1: Waveform

Digital recording differs from analog recording in that the "picture" of the sound is created by measuring the voltage changes coming from the microphone and assigning numbers to each measurement. The term "sampling" is used to describe the process of measuring an electrical signal's voltage thousands of times per second at a given level of precision (resolution). The number of measurements per second is called the "sampling rate" and is expressed as kilohertz (kHz). Sampling rates range from 5 kHz with higher rates being used for the best quality recordings. Harry Nyquist (1889-1976), a Swedish-born U.S. communications engineer, discovered that the frequency range of a digitized sound is limited to one-half the sampling rate. Since humans can hear frequencies in a range of 20 hertz to about 20 kilohertz, it is necessary to sample at more than 40 kilohertz to capture the full range of frequencies perceptible to the human ear.

The number of measurements per second, however, is only part of the picture. The degree of precision within each measurement is also important. This is known as "sampling resolution". Sampling resolution is used to divide the total range of the electrical voltage into discrete parts. Common sampling resolutions in use today are 8-bit and 16-bit. Sampling at 8-bits divides the voltage into 256 parts (2 to the 8th power). Sampling at 16-bits divides the voltage into 65,536 parts (2 to the 16^{th} power). Higher sampling resolutions also capture a wider dynamic range. For example an 8-bit digitizer will only capture sounds up to 48 decibels (DB). Any portion of the sound that is louder than 48 DB will be clipped and the resulting sample will sound distorted. 16-bit digitizers, however, capture up to 96 DB of volume. The dynamic range of the human ear extends to 120 DB.

Quantization is the term that describes the process of measuring the amplitude of a sound and rounding off the measurements according to the sampling resolution. For example, an 8-bit sound digitizer will assign integer values of between 0 and 255 for the amplitude of each sample. The result is that the original smooth waveform is reconstructed as a staircase shape with only 256 discrete levels of amplitude and noise is introduced into the signal. 16-bit digitizers, on the other hand, assign amplitude values on a scale of 0 to 65,535. At that level of precision, the reconstructed waveform is almost identical to the original and almost no noise is introduced.



Original Waveform **Quantized Waveform**

Figure 3.2

An analog-to-digital converter makes all of these measurements. The measurements can then be stored as binary numbers in a file on a computer's hard disk. To play back the sound, the computer sends the information in the file to a digital-to-analog converter that reproduces the original electrical signal. That signal is then sent to a speaker, which produces the sound as described earlier.

Maximum precision per measurement combined with maximum sampling rates produces the highest quality recordings. To describe a digital recording of a sound, therefore, one can speak of the sampling rate and resolution. For example, sound recorded at a sampling rate of 22 kHz with 8-bit resolution is considered to be of a quality similar to that of a telephone call. Sound recorded at 44 kHz and 16-bits is considered the minimum quality for compact disc recordings because it captures the full range of human hearing. In multimedia production work, II kHz, 8-bit sound is sometimes acceptable for speech recordings and 22 kHz, 8-bit resolution or 11 KHz, 16-bit resolution is often considered acceptable for music. For the highest-level multimedia work, however, nothing short of 44 kHz, 16-bit sound is acceptable.

When sound waves strike a microphone, they are converted to an electrical signal, which is measured many thousand times per second by an analog-to-digital converter chip. The measurements are stored in the computer as binary numbers.

The higher the quality of sound, the more space it takes to store the sound. A compact disc can store about 74 minutes of stereo sound at 44 kHz, 16-bit. If you reduce the quality to 22 kHz, 8-bit stereo sound, however, you can store approximately 300 minutes of audio on the same disc. In other words, one minute of stereo sound takes 10 megabytes of storage at 44 kHz, 16-bit quality, and only 2.5 megabytes of storage at 22 kHz, 8-bit quality. When producing sound for multimedia, therefore, one must consider not only sound quality, but also how the sound will be distributed. If your multimedia program will be distributed on CD then you may have enough storage space to justify using the best quality. If the program will be distributed on disk or through the Internet, however, you would consider using lower quality sound to avoid having to distribute many disks or subject your users to long download times.

Sound File Formats

When sound is digitally recorded to a hard disk, the recording software assigns a file format. Sound files are either RAM-based or Disk-based. To play back a RAM-based file, your computer must have enough random access memory (RAM) to hold the entire file. For example a computer with 8 megabytes of RAM might not be able to play a large RAM-based sound file but a computer with 16 megabytes of RAM might have no problem with it. As a result, RAM-based sound file formats are appropriate for use with short sound samples. On the Macintosh, System 7 sound and SND resource are common RAM-based file formats. System 7 sounds are used to generate the various beeps and alert sounds used on the Macintosh. SND resources are often used as sound resources in HyperCard stacks. A Macintosh sound recording program, such as Macromedia's Sound Edit 16 or the freeware Sound Handle 1.0.3 can be used to create SND resources that can be saved directly into the resource fork of a HyperCard stack. System 7 and SND file formats are most commonly used with 22 kHz, 8-bit sound samples.

Disk-based sound file formats allow you to record music of any length and quality. You are only limited by the amount of available storage space on your hard drive. Disk-based sound file formats are ideal for longer and/or higher-quality samples. AIFF (Audio Interchange File Format) is one of the most commonly used disk-based file formats on Macintosh, Windows, and even Unix computers. Stereo AIFF sound files recorded at 44 kHz, 16-bit quality is ideal for multimedia productions that will be distributed in CD. Monophonic AIFF sound files recorded at 22kHz. 16-bit quality is better for multimedia productions that will be distributed via the Internet because their file sizes are smaller than higher-quality samples. If you use the Internet frequently you have probably encountered sound files in WAV and AU formats. The WAV format is used by Microsoft Windows and the AU file format is used by computers running the UNIX operating system. Sound editing software can convert among these and many other file formats.

MIDI

MIDI (musical Instrument Digital Interface) is a communications standard developed in the early 1980s for electronic musical instruments and computers. It allows music and sound synthetics from different manufacturers to communicate with each other by sending messages along cables connected to the devices. MIDI provides a protocol for passing detailed description of a musical score, such as the notes, sequence of notes and the instrument that will play these notes. But MIDI data is not digitized sound; it is a shorthand representation of music stored in numeric form. A MIDI file is a list of time stamped commands that are recordings of musical actions (the pressing down of a ponds key or a sustain pedal, for example, or the movement of a control wheel or slider) that, when sent to a MIDI playback device, results on sound. A concise MIDI message can cause a complex sound as sequence of sound to play on an instrument or synthesizer, so MIDI files tend to be significantly smaller than equivalent digitized waveform files.

MIDI Vs Digital Audio

In contract to MIDI data, digital audio data is the actual representation of a sound, stored in the form of thousands of individual numbers called samples. The digital data represent the instantaneous amplitude (or loudness) of a sound at discrete slices of time. Because it is not device dependent digital audio, it is not the same sound every time it is played.

MIDI data are to digital audio data what vector or drawn graphics are to bitmapped graphics. That is, MIDI data are device – dependent digital data. Just as the appearance of vector graphics differ depending on the printer device or display screen, the sounds produced by MIDI music files depend on the particular MIDI device used for playback. Digital data, on the other hard, sounds more or less identical regardless of the play system.

MIDI has several advantages over digital audio and two huge disadvantages

MIDI files are much more compact than digital audio files, and the size of a MIDI file is completely independent of playback quality. In general, MIDI files will be 200 to 1000 times smaller than quality digital audio files.

In some cases, MIDI files may sound better than digital audio files. Hence the MIDI sound source is of high quality.

You can charge the length of a MIDI file (by varying its tempo) without charging the pitch of the music or degrading the audio quality. MIDI data is completely editable right down to the level of an individual note.

Now for the disadvantages: Because MIDI data is not sound, you can be certain that playback will be accurate only if the MIDI playback device is identical to the device used for production. Even with the General MIDI standard, the sound of a MIDI instrument varies according to the electronics of the playback device and the sound generation method it uses. Also, MIDI cannot easily be used to play back spoken dialog, although expensive and technically tricky digital samples are available.

3.2.4 Video

What are Moving Images?

Moving images are an illusion. When we view an animation or video we are viewing a series of still pictures presented in rapid succession. The success of the illusion is dependent on the quality of the individual images and the rate at which they are presented.

- **Animation**

Animation is generally a series of 8-bit graphic images created in a graphics program. The images can then be compiled into an animated GIF file or QuickTime movie file for use in multimedia presentations and on the World Wide Web. Frame rates in animations will vary according to the content. For example, an animation that features type will frequently pause one or more seconds between frames to allow the user to read the type. Animations of moving characters can be successful with frame rates as low as 4 frames per second.

- **Video**

Video can be captured using a standard video recorder and then digitized using video digitizing hardware within a multimedia computer. For video to be effective the frame rate must be at least 10 frames per second and the bit depth of the individual frames must be 16 or greater. The dimensions of the digitized video can be as small as 160 by 120 or as large as 640 by 480 pixels.

Full-screen, full-motion video ("broadcast quality ") is said to exist when each frame is 640 pixels wide by 480 pixels tall, each pixel has a color range of 24-bits, and the frames are presented at a rate of 30 per second. The amount of disk space needed to store broadcast quality video is truly enormous. A grid of 640 by 480 pixels contains 307,200 pixels. If each pixel uses 24-bits to represent color then a single frame uses 7,372,800 bits or 921,600 bytes (one byte = eight bits). 30 frames would then use 27,648,000 bytes or nearly 28 megabytes. At this rate, one minute of broadcast quality video would consume 1,658,880,000 bytes or 1.65888 gigabytes of hard disk storage. Most computers today ship with between 4 and 12 gigabytes of storage making their hard drives inadequately small for storing broadcast quality video.

Fortunately, multimedia video doesn't have to be of broadcast quality to be usable. By reducing the grid to 320 by 240 or even 160 by 120, reducing the frame rate to 20 or 15 frames per second, and lowering the color depth (bit depth) to 16 bits for standard video and 8 bits for computer animations, the storage requirements become much more manageable. By using various compression schemes the storage requirements can be even further reduced. For example, a typical "talking head" video features a person on a stable background. Compression/Decompression Schemes (codecs) might use a technique called "frame differencing" to store only those elements of each frame which are different from the previous frame. Compression can greatly reduce storage requirements often with little loss of picture quality.

Types of Video

Analogue Video

Analogue video can come from a videodisc player, videotape recorder or live television. There are two main standards for storing analogue video. Phase Alternating Line (PAL), used in the UK and most of Europe. National Television System Committee (NTSC) is used in North and South America and Japan. There is also a third standard, SECAM used in France. Some video players and videodisc players can now play both PAL and NTSC format videos.

In NTSC a single frame consists of 525 horizontal scan lines. The picture is laid down on the screen in two passes, first odd numbered lines, then even at 60 passes/s or 60Hz. Using two passes like this is known as interlacing which helps prevent flicker. Normally a computer monitor will be non-interlaced, that is all the lines are drawn in one pass. PAL uses 625 lines with a frame rate of 25 frames/s. Like NTSC it is interlaced at 50Hz.

High Definition Television (HDTV) will probably be the next standard. This provides 1200 lines, using a 16:9 aspect ratio (wide screen), rather than the 4:3 currently used. Currently there are three different HDTV standards, two of which are analogue and the third digital.

Digital Video

As with images there are a variety of digital video formats, mostly produced by commercial companies. Since digital video files are very large, the formats all include some kind of compression, and formats such as AVI – Microsoft's Video for Windows and Apple's QuickTime use several different kinds of compression.

The ISO compression standard for video is called MPEG (Moving Pictures Expert Group). An interim standard, MPEG-1 was released some time ago. MPEG-2 allows compression of the soundtrack with the video. There are three types of frame in MPEG, I (intra), P (predicted) and B (bi-directional) frames. The I frames are encoded as a still image, using DCT encoding. The P frames are predicted from the most recent I or P. The B frames are predicted from the closet two I or P frames (past and future). This helps to improve the signal to noise ratio (SNR), particularly at low bit rates, though it does increase computational complexity and bandwidth. A typical sequence of frame might be IBBPBBPBBPBBIBB…. Since in order to decode a B frame you need the I or P frame that comes after it, the frames are not sent in sequential order. MPEG-1 audio will support 2 channels and sampling rates of 32,44.1 and 48KHz, and the compression ratio is usually 1:6, giving 96kbits/s. MPEG-2 is similar to MOEG-1, but has been extended to cover a wider range of applications. Whereas MPEG-I was optimized for delivery on CD-ROM at 1.15 Mbits/s, MPEG-2 typically works at 4 Mbits/s. MPEG-2 audio will supply up to 5 full bandwidth channels and up to 7 commentary channels, and also allows half sampling rates (e.g. 22.05KHz). MJPEG or Motion JPEG simply means each frame of the video has been compressed using JPEG.

DVI is a proprietary standard based on the Intel i750 chipset. It was used by a number of video capture cards, such as those by Action Media, but is now no longer supported. AVI (Audio Video Interleaved) plays full-motion video and audio in a small window at about 15 frames/s (software alone). Video usually consists of a video track and two audio tracks.

Hardware Requirements

Analogue

Video Cameras

Standard camcorders can be used to produce video provided they have a 'video out' facility. It is better to capture the video directly, rather than going through tape first. The signal from a video camera contains three channels of color information, and if these are transmitted separately, it is called RGB (red, green, blue). This gives the highest quality video. The video can also be transmitted as two chroma channels and one brightness. This is component video. When the signals are mixed it is called composite video. S- VHS and Hi-8 video formats keep the color and luminance information on two separate tracks, giving better quality than VHS. Hi-8 is better quality than S-VHS and you can make unlimited VHS copies from it without the degradation that occurs when copying from VHS to VHS.

One of the most important accessories for a camcorder will be from a VHS to VHS. One of the most important accessories for a camcorder will be a zoom lens. This should be of a good quality possibly, as there are differences in resolution and optical quality. Standard consumer zoom lenses are usually around 6 or 8:1.

Video Discs / Laser Discs

Laserdiscs have been in the market since 1978, and the largest market is in the US and Japan. They store movies or stills, or a combination of the two as analogue, either in NTSC or PAL format, and offer much better quality the standard VHS tapes. They can also contain an analogue or digital sound track (with NTSC you can have both). Many of the current laserdisc players can play either PAL or NTSC discs. The most common form of disc is 12" double sided, but there are also 8" and 5" discs available. The discs can be constant linear velocity (CLV) or constant angular velocity (CAV). CLV is most common form for movies, as CLV discs can hold 60 minutes of video per side, but they are only suitable for continuous play. CAV hold only about half as much, as the recording density is reduced towards the outer edge, but individual frames can be randomly accessed, and therefore these are often used for storing still images. A CAV disc can hold about 54,000 images. Unless it is stated, commercial discs are not resource discs, and the images off them should not be used without permission from the copyright holders.

Video Overlay boards

In order to display analogue video on a computer monitor a video overlay board is required. Most boards have chroma keys, where one colour is chosen and that colour becomes transparent, allowing the video window to be seen through the computer image. Video boards can often digitize frames from the video. For example the Screen Machine II board (available for both PC and Mac) can capture a frame at full (736x560), half or quarter screen size to several file formats. When capturing a frame in this way, if you do not know what size the final image will be, capture it at full screen to maximize quality. If you know however that the final image will only be displayed at 320x200 for example, then capturing it at half size will give equally good quality.

The main advantage of using analogue video and an overlay board is the availability of high quality full screen and full motion video. However, delivering video in this way will be more expensive than digital video.

Digital
DVI

DVI (Digital Video Interactive) allows full screen playback of motion video at 30 frames/second and a synchronized sound track through a special card. DVI was developed by Intel who also produced the Action Media II DVI card, which contains the i750 chipset. This card is no longer supported, but software is available from Intel's FTP site to convert from DVI to AVI.

MPEG Compression

There are a number of MPEG hardware compression and playback cards available for a range of systems. Hardware compression is much faster, and allows greater resolution than in software and is of better quality. Hardware playback also allows playback at more frames/second with larger windows and often supports the full MPEG audio capabilities. For example the Reel Magic PC card provides video and sound playback in a 320x200 pixel window at 30 frames/second.

Other Accelerators

Hardware accelerators are available for Microsoft's Video for Windows, which will allow AVI files to be played full screen at 30 frames/second, for example PC Prime Time.

3.2.5 Desktop Publishing Basics

What is Desktop Publishing?

Desktop Publishing (or DTP in short) in theory, means publishing with just the equipment that will fit on the desk. In practice, it means any part of personal publishing using the new computer based publishing technology. In other words, Desktop Publishing is to create a document ready for printing using a desktop computer. A number of computer programs are now available that can be run on a PC to accomplish this task. These programs assemble a finished publication from pieces that are most often developed on other specialized programs.

The bank concept of desktop publishing is that simple word processors process words, drawing programs create drawings scanners scan images, and bitmap editors edit bitmap images. Then a DTP program formats them and puts them all together in a final publication, often adding additional elements such as footnotes, cross-references, a table of contents and an index. The computer output is printed on a laser printer and then given to an offset printing press. Alternatively, you can get the computer output printed to a desk as a print file and take the disk to a printing agency for printing on a high-resolution printer.

Desktop Publishing Programs

Although most DTP programs include at least some of the same features as the other types of applications that contribute to the final product, each of these tools has its own specific role. It is a more convenient to use a program particularly oriented for a specific role. Some of the commonly used programs are explained below:

- **Drawing Programs:**

Graphic artists primarily use drawing programs. Their programs are able to

- Create and manipulate complex graphics.
- Import and export a wide variety of graphic file formats.
- Integrate with paint and image manipulation programs.
- Manage text as a graphic element.
- Provide graphics – oriented special features such as sophisticated editing tools, color management, and special visual effects.

- **Word Processors:**

Authors use word processors; report writers, and business professionals, word processing programs have only limited ability to work with graphics elements. These programs perform the following:

- Help you create and manipulate text.
- Offer infinitive entry of text and quick processing of text.
- Flow text automatically from online, column or page to the next line.
- Provide text oriented special feature such as search and replace, spelling and grammar check.

- **DTP Programs:**

These are useful for publishers for making page layouts and for printing use DTP Programs. These programs offer

- Integration of all elements from diverse sources such as word processors and graphics program.
- On screen layout and formatting of text and graphics.
- Precision control of text and graphics placement on the page.
- Consistent, reputable styles and layout on long structured document such as book, directories and dictionaries.

Steps in Desktop Publishing

Desktop Publishing (DTP) combines text, Graphics and advanced formatting to create visually appealing documents. When your desktop publishes a document, you do the following basic tasks, which are explained in the following paragraphs.

Determining Page Layout

Before you begin working with the actual text, you should determine how you want the final document to look. It may help to sketch the layout in pencil. Some programs include a toolbox with icons and buttons for designing a master-page on – screen.

Page elements include margins, columns, headers or footers, and page size. When determining margins, you must consider any folding or binding that the final document will have. You must decide whether to use one or two columns, or more than two. Layout decisions also include whether to use a header or footer and what information it should contain.

- **Entering Text and Graphics:**

Both text and graphics can be directly entered into many word processing and desktop publishing programs. However, it is usually easier to use a word processing program to enter text, and a graphics program to prepare graphics. Then you can import the graphics and text into the page. Graphics include drawings, graphs, photographs (scanned into an appropriate file format) and clip art. Clip art images are basic pictures of everyday objects. Graphics images are usually placed with frames or graphics boxes so that you can easily position the images.

- **Formatting:**

Deciding what font to use is an important formatting consideration. As in word processing software, a font is a complete set of characters with the same typeface, style and size. Because fonts convey different messages, it is important to select an appropriate font for your message. Some fonts are display fonts; others are body text fonts. Display fonts are eye catching, and help focus attention, but they are difficult for sustained reading. Body text fonts are not decorative; they are designed to be read easily with the same amount of space even though some characters are smaller and don't need as much space. Proportional fonts take different amounts of space, based on their shape and needs of each character. For example, the letter I requires less space than the letter m.

Spacing is another important consideration in formatting. Spacing generally refers to the spaces not used by the characters. For readability, you need to consider both the line length and the leading space between the lines. The longer the line, the more leading you need. Kerning, also called tracking or character spacing, is the adjustment of the spaces between characters and words. The kerning that is performed automatically in the body of the text is usually adequate. In headlines or titles, however manual kerning is done to improve readability.

- **Saving and Printing:**

With any program, the document should be served on disk as one works on the document. Saving the finished document before printing it is important. After any necessary screen changes and modifications, the publication is printed out on a laser printer. A major difference between the conventional and desktop publishing must be noted here. With conventional publishing, text hard copy occurs at the beginning of the process. With desktop publishing, text hardcopy only need occur towards the end of the project. The task of a desktop publisher usually ends with the printing of the master document on a laser printer.

3.2.6 Page Layout Programs

What is a Page Layout?

A layout is a composition of inter-related elements on a page. The term element here refers to each type of thing on the page. These elements include the page number in a bold face, running headers in italics at the top of each page, captions for tables and graphics, and graphic elements themselves such as lines, frames and pictures because all these elements are inter-related, a decision about one affects decisions about others. Knowledge of principles of page layout techniques is therefore necessary for achieving good layout. Figure 3.3 shows a typical two-page layout of a book type publication.

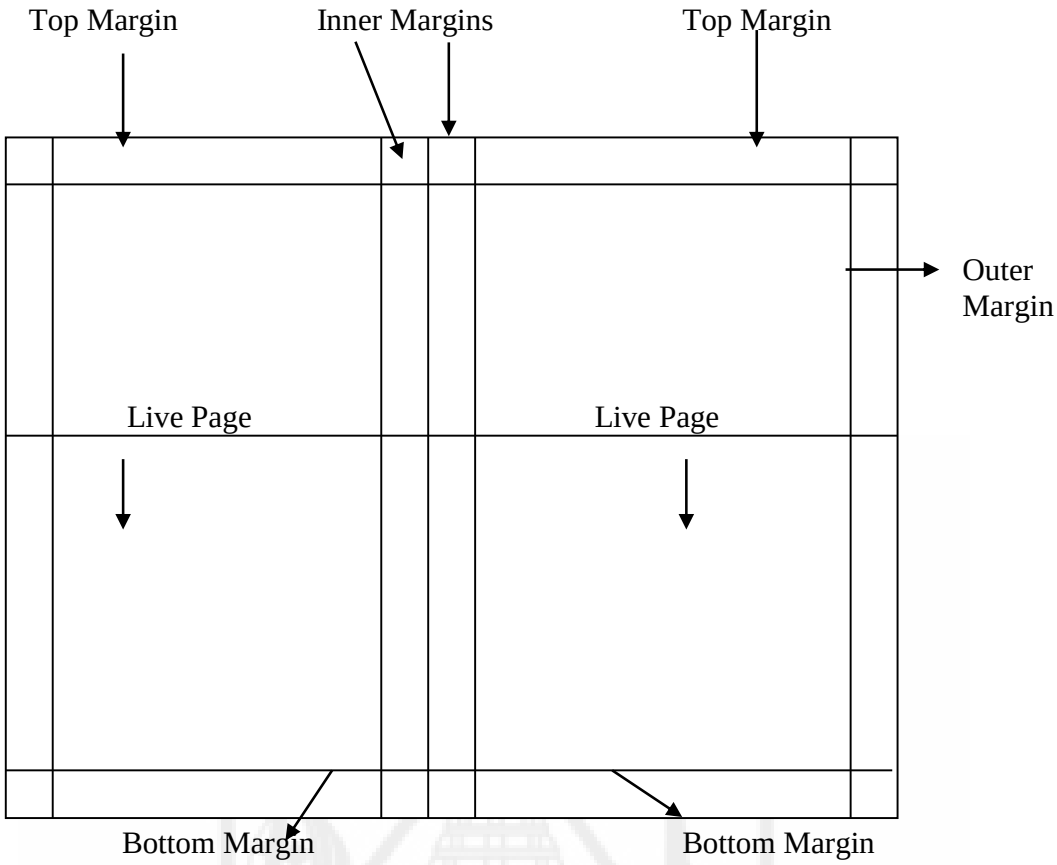


Figure 3.3

As shown in Figure 3.3, live areas in a page are the area in which most of the elements are arranged. Margins are the borders of space around the live area. The inside margin is the one closest to the binding or centerfold. The term gutter is often used in book publishing to mean the inside margin. Usually it refers to the space between columns. Reference elements, such as page numbers, chapter numbers etc., are often placed in the top and bottom margins. Within the live area are the text, visuals and graphic elements.

Text refers to the body of type, which is generally in paragraph form. Visuals as a catchall term is used which includes photos, drawings, diagrams and other non-text images. Graphic elements are content free visuals such as bars, bullets and boxes that help direct the eye.

Portrait and Landscape

Portrait and Landscape refer to the way the paper is handled for making the document. Most designs use paper in the portrait mode in which the paper is held vertically so that its width is less than its height. In the landscape mode, the paper is held horizontally and in this mode the width is larger than the height. Laser printers usually print pages is the portrait mode. They can also print them in the landscape mode if the software can tell the printer to print the text and graphics in landscape mode. Page layout programs used for DTP do provide this facility.

In desktop publishing, page layout begins with the selection of the paper size. That, of course, depends on the size of the document to be made, but an important factor to consider is the size of paper the printer could accept.

Dot matrix printers accept loose sheets as well as continuous paper on rolls or fan folded. Some models can accept wider paper also. They are mostly used for preparing large statements like a balance sheet. Laser printers accept cut sheets only. Commercially available cut sheet sizes are given in Table 3.2.

TYPE	SIZE (in mm)	SIZE (in inches)
A1	594x841	23.4x33.1
A2	420x594	16.5x23.4
A3	297x420	11.7x16.5
A4	210x297	8.3x11.7
A5	148x210	5.8x8.3
B5	176x250	6.93x9.84

Table 3.2: Commercially available Cut Sheets

Commonly used laser printers do not accept paper sheets bigger than A4 or letter size. There are two options open for making larger size documents. One is to design the document in small sections, print them on laser printer and then paste them in their correct position on a pasteboard, Page layout programs like PageMaker and venture Publisher provide the second option. They allow the user to design the document on a bigger size paper, and then make the laser printer print the document in four pages with sufficient overlap to enable the user to cut and paste them to make a complete document.

The Page Maker

Aldus Paul Brainerd coined the term "desktop publishing", and the program he conceived has set the standard for other programs since its introduction on the Mac in 1985. The way Aldus' PageMaker works, it is well suited for newsletters and magazines. PageMaker treats everything as graphics. Hence anything can be placed anywhere, directly or rotated or reversed. In short, PageMaker tries to follow the same procedure that someone designing a newsletter in a traditional manner do. However, these steps are very different from what is traditionally considered as editing. The actual text has only small part in the graphic look of the printed piece. The initial newsletter design must be created, as independently well-designed frame into which your text graphics can flow. Some of the salient features of PageMaker are given below:

- **Design Consistency:**

One thing that makes a good newsletter design is consistency in style. PageMaker will assist in this. It begins by setting up the newsletter by selecting the page size, page orientation (wide or tall), margin widths, single or double-sided page format, and publication length (the number of pages and pagination). PageMaker provides the page sizes that are most frequently used: Letter, Legal, A4 and Tabloid.

Collections of newsletter layout template are available for PageMaker. These are designs that can be used as it is, or easily modified to fit the particular needs of the user.

- **Measurement Options:**

PageMaker allows you several measurement options. This gives a choice to work with inches, millimeters or picas and points. The default setting is Picas and points because it is the standard for print production. Also rulers on the screen can be chosen. This presents vertical and horizontal scales that indicate the current location of the cursor, thereby allowing the user to refer to the exact location of each element of design and maintain consistency. It is also possible to place as many ruler guides horizontally and vertically as needed. These guides show as dotted lines on the screen but they do not get printed in the document.

- **Viewing Modes:**

PageMaker allows you several viewing options. You can view and work on your publication in a variety of different magnifications such as fit in window, 25-, 50-, 75-, actual size and 200- percent, selectable from a drop down menu. The actual size option provides the closest approximate as to how the page actually prints. However, because of screen resolution, which is much lower than that of the laser printer, discrepancies do occur. The other magnifications are useful for different tasks, depending on how much of the page and what degree of accuracy you need for your particular purpose. For instance, using the 200 of view can help clean up graphics you created within PageMaker. Selecting "show facing pages" allows you to view how the opposing pages of a double-sided publication will look.

- **Manipulating the Text:**

The text placed within PageMaker can be manipulated easily once you've placed a story within your column guide, you can change where that column begins or ends by simply pulling up or down the markers (which function like window shades). You can resize the required words or paragraphs, shade them and reverse them. You can also wrap text around a graphic leaving a small margin on all sides of the graphic.

Ventura Publisher

Ventura has several big advantages over other DTP software, especially for Laser Jet owners. It is clearly the fastest program on the market. In desktop publishing, speed means smoothness and smoothness means ease of use. It is really the speed that makes Ventura such a great tool. Ventura does have some significant drawbacks. One is the difficulty of learning the program. Ventura is ideally suited for a particular suit of work, namely, producing those long, highly structured annuals knows as "technical documentations" Ventura gives the technical document publishers exactly what they used in a publishing program - automatic chapter, page, sub-head, caption and footnote numbering, automatic table of contents and index generation, easy merging of computer. generated graphics and scanned images with text and compatibility with multiple word processor files.

Ventura also works nicely for other sorts of documents as well. Ventura actually works better than any of the specialized forma generation programs. For whipping up a

quick invoice or order form, it is quicker, more accurate, and allows more options for boxes and shading. Ventura also functions nicely as a page make-up program for newsletter style layouts in which two or three articles begin in the first page and then flow independently in subsequent paper.

- **Frames in Ventura:**

Ventura places everything, text and graphics, in frames. Frames are essentially boxes, with borders that may be visible or invisible. Every page itself is frame, and to this first underlying frame, more frames can be head to hold elements of text organics. Ventura's use of frames provides you with unending freedom to make changes and adjustments in a document. You can reposition a frame by pointing anywhere within it with the mouse, clicking a mouse button, and then dragging the mouse (with frame in tow) to its new home. Text automatically hyphenates and reformats around the new frame.

- **Handling Text:**

Once you have specified the parameters of the underlying frame, you can begin adding text and pictures. Rather than typing text directly into Ventura, most people will probably prefer to generate text using their familiar word-processing program, and then load the text into Ventura for formatting. Ventura can accept files in any of the major word processing formats-Microsoft word, word perfect. WordStar- as well as plain ASCII files. Files from different word processors can be used in a simple document. For the most part, any character formatting such as bold, italics, underlining, or superscript specified in the original document is preserved by Ventura. Other sorts of formatting, such as line spacing, are ignored. Tabs in original files may cause problems. Ventura will attempt to recognize them but may not interpret them in exactly the same way as the word processor does.

The well come aspect of Ventura's method of handling the text and graphics files is that it preserves them in their original formats rather than translating them into a new Ventura format. To store formatting information, Ventura creates a separate file containing pointers to other files. This method of file handling makes it possible to cope with one of the traditional problems of the technical documentation department-the last minute change. Finally, the method saves disk space, since a single version of a file is used both for word processing and for Ventura formatting.

- **Handling Graphics:**

Pictures created by Graphics programs or digitized by a scanner are loaded into frames using the same command used to load pictures. Ventura recognized two types of pictures, those stored in bitmapped form (as pattern of dots)- Ventura calls these images – and those stored in object form (as Geometric commands)- called line art by Ventura.

Once loaded into a frame, a graphic can be easily cropped, merely by using the mouse to more the edge of its frame. You can also stretch or shrink images to exact dimensions by selecting new scaling factors. One excellent feature is the ability to "anchor" graphics vis-à-vis text. Anchoring allows graphics to be tied to specific locations in test. Thus, when a document is revised and pagination changes, the graphics automatically, reposition themselves to stay with the text to which they have been attached.

3.2.7 Desk Top Publishing

Word Processor Packages

Word processors are application software, which are used for word processing. Word professing is the most widely used technique for typing, editing, storing, formatting, manipulating and printing documents with the assistance of computer and printer. It is the most efficient means of generating documents electronically.

Word-processing programs enables us to write, edit, format, save and print a document with ease. A high quality document can be produce by sing word processing software than by using a typewriter. The basic reason being that word processing software separates document creation from document printing.

With a word processing program you can enter your work without being concerned about how the document will look. Instead of listening for a typewriter's warning bell to tell you when to begin a new line, you can continue to type. The software program recognizes when to begin a new line and automatically moves words to the next line. This capability is called word wrap. The only time you need to press the enter key is at the end of a paragraph. In most word processing programs, wherever you press enter you create a new paragraph. The term paragraph simply means a unit of text that begins and ends with an enter keystroke. In addition, a word processing program automatically determines when to begin a new page. When you include footnotes, footers, or headers, the software adjusts the size of the page and begins each new page correctly.

Editing your document is much easier and more efficient with a word processing program while editing, you can use either insert mode or type over mode. In insert mode, the software moves the rest of the text to the right as you type the new material. In type over mode, the new material replaces the existing text. Editing includes deleting text. Three ways of deleting the text are possible. You can use the Delete key and push the character to the right of the cursor. You can use the Backspace key to delete the character to the lift of the cursor or you can mark (highlight) one or more consecutive characters and delete them all at one. With each method, the remaining characters are moved over to fill the space where the deletion occurred.

Editing may include moving characters, words, phrases, sentences, paragraphs, or large blocks of text from one place to another within a document or even between documents. Moving text is often called cutting and pasting because the process involves cutting the text from one area and pasting it in another area.

Advantages of Word Processing

Word processing offers several advantages over typewriting. Using the word processing technique, the user can

- Edit the text as when required.
- Move or copy any part of the text from one location/file to another location /file.
- Insert or delete the spaces /text.
- Wrap words to the next line (word wrapping) and justify text to the right margin (justification).
- Select different types of fonts and size of characters.
- Adjust the margins and page lengths for the desired output.
- Find the required word/ group of words and replace with another word/group of words.
- Check the spelling of any word of the document.
- Store (save) the document on disk and print single or multiple copies.
- Print letters with same text and different names and addresses (mail merging).

Besides the above main features, there are many more benefits of world processing depending upon the word processor used.

Examples of Common Word Processors

There is a wide range of word processors available for both DOS and Windows environment. Word star, software, Akshar, MS word, Word perfect and AmiPro are some of the common examples of word processors.

Word star, the most common and popular DOS-based word processor is developed by the MicroPro International Corporation, In USA, there are different versions of word star like 1.x, 2.x, 3.x, 4.0, 5.0, 6.0 and 7.0 but the releases 4.0 (also known as word star professional) and 7.0 (the latest one) are the most popular among users. Software and Akshar are also DOS – based English and Hindi word processors respectively developed by an Indian Company, Softech.

Among the windows-based word processors, MS word, word perfect and AmiPro are the leaders in the markets (DOS based versions of these packages are also available). MS word, developed by Microsoft Inc, is a part of MS office Professional package. Word 6 for windows 3.1 and word 7 for Windows 95 are the most popular versions of word.

Word perfect (latest version 6) developed by word Perfect Corporation, which provides almost the same features as MS word is also very popular among users. AmiPro (latest version 3.0) or word pro developed by Lotus Corporation, is another full-fledged, multi-featured word processor for windows. The most important word processors are listed in

WORD PROCESSOR	DESCRIPTION
Word	Popular windows-based word processor.
WordStar	Simplest DOS-based word processor.
Soft Word	Similar to word star developed by an India Co.
Akshar	Popular Hindi / English word processor developed by an Indian company.
Word Perfect	Most widely used windows-based word processor.
AmiPro	Full fledged, multi-featured windows-based word processor with DTP features.

Table 3.3: Common Word Processors

3.2.8 Graphics for DTP

What are Graphics?

Graphics are elements that add interest to your page or highlight your point to clarify your text. A graphic element can be a photograph, an artwork, a pie chart in a business proposal, an illustration for a story, a fanciful border for a special invitation, or a specially designed letter for personal stationery.

White space is also a graphic element and an important consideration in design. What you leave out of a page is as important as what you put in it for graphics. For example, a page full of type, top to bottom, single-spaced, with no margins, no white space, no images, and no special emphasis on any aspect of the content will not invite anyone to read it. The same information can be presented well with illustration or sidebars, margins with a border, or other elements to bring it to life.

Use of graphics in a document depends on many factors. These include the type of subject matter, availability of illustrations, and method to be used for printing; type of paper, and cost of publication, all these factors need a serious consideration before using graphics in a publication.

Creating Graphics on Computers

The most commonly used method to create illustrations in desktop publishing is to draw or paint them on a computer. Several programs are now available that provide you tools to draw or paint on the computer screen.

Computers allow artists and untrained artists alike to do things that would be impossible with any other single tool. For example, commercial artists who design newsletters, brochures, invitations, books, advertisements, pattern designs, or any product requiring types design and / or images on a page, may need to do some or all of the following functions:

- Cut, paste, reproduce, shrink, enlarge or rearrange.

They may also need to use the following tools:

- Paint, ink, charcoal, pencil, brush, glue, eraser, airbrush and type.

The graphics software enables the user to emulate all these functions without any tools other than the computer and printer. And the flexible editing capabilities for facilitate graphic designers to experiment with many variations in a relatively short period of time compared to the old methods of pen, ink and other materials.

Besides the speed in creating graphics with graphics software, you can combine the operations of entering data, type setting and graphics in one process. It is a far different procedure from typing a page, going to a typesetter, pasting it up and changing it.

Graphics Creation Programs

Computer programs for generating graphics can be draw program or paint programs. The ways in which these programs conduct their business, however, are as different as night and day.

- **Draw Programs:**

Programs in the first category produce graphics based on curves. They are called vector-drawing programs and are said to produce vector art. Examples are Gem Draw, CorelDraw and AutoCAD.

When you create a circle in a drawing program, the program knows that it is a circle, with x- and y- coordinates, a radius a circumference, an outline, and an interior colors (called fill). You can easily change the size, shape or colors of the circle without compromising its integrity-it still knows that it is supposed to be a circle. All information about what you draw is stored in the form of mathematical equations.

- **Paint programs:**

Programs in the second category generate graphics in the form of dots. They are called paint programs or image editors, and are said to produce bitmapped output. Windows paintbrush, Publishers Paintbrush, and Corel Photo-point are examples of this kind of programs.

In paint programs, you are in a different world. When you lay down individual dots on your electronic canvas, you are in fact painting. The circle you create in a paint program is a collection of dots, lined up in rows, each dot with a specific color. Taken together, the dots might happen to look like a circle, but there are no essential properties identifying it as a circle.

Paint programs generate graphics in the form of dots. They are also called image editors, and are said to produce bitmapped art. A good thing about paint programs is that they are very easy to use. You draw on the screen in the same way as you draw on paper with pencil and erase with an eraser. Tools for drawing straight lines, curved lines, squares, rectangles, circles, ellipses, and rectangle or squares with round covers are available right on the screen. You can vary thickness of lines, fill closed areas with different shades and colors, and even create clouds like things with the spray tools available. You can erase or cut or copy any part of the drawing and paste it anywhere else and any number of times. You can flip the drawings horizontally or vertically. Fancy borders can be created easily by multiplying a small pattern. You can even write a text in a number of type styles and sizes and manipulate or graphics.

3.2.9 Print Production

The task of a desktop publisher usually ends with the printing of the master document on a laser printer. Printing shops does duplication of the document. However, if a desktop publisher is familiar with the techniques used in print production, he prepares his publication to give best results when printed by the print shop.

The master pages printed on a laser printer are used by print shops for preparing plates for printing. The modern DTP software gives a large number of facilities to generate text and graphics and print a composite page on a laser printer. However, in many cases you may have to include a photograph or the artwork may not be available in the size to be printed in the final document. In those cases, the artwork is supplied separately, usually covered with a translucent paper on which crop markings and instructions about enlargement/reduction are given. The printer uses this information to incorporate the picture in the correct size and at the right place in the document.

Mostly three kinds of printers are used in DTP work. They are: dot matrix printers, inkjet printers and laser printers.

Dot Matrix Printers

Until recently, dot matrix printers were almost entirely restricted for creating high-speed draft material. Today, even at astonishingly high speeds, some dot matrixes printers are capable of very lose to letter quality printing. Dot matrix printers can print text as well as graphics. However their use in desktop publishing is restricted to printing text for edition and correction.

The printing head contains a number of tiny pins. Each pin prints a dot on paper when, under computer control, a hammer inside the head strikes that pins. Characters get printed as the head travels from left to right, and in some cases, when it travels in the reverse direction as well.

Laser Printers

It is the laser printer that started the DTP revolution. Laser printers can print text and graphics on plain papers and on transparent plastic sheets with high definition. These print outs are then used as masters to make plates for offset printing. Laser printers also print characters as made up of dots. However, in this case, the dots are very tiny. The most common resolution is 300 dots per inch in either direction. This much of resolution can print text with good definition and reasonably good graphics. Laser printers are non-impact devices and hence very quiet. The underlying principles of operation are essentially the same as for Xerox and other copying machines.

The graphics from a laser printer are generally superior to the best available with dot matrix machines, but are still a far cry from the reproductions in most magazines. At 600 dots per inch, they cannot print half tones. It is also true that the expectations from relatively short-run desktop publications are much less demanding. For purposes of printing graphs, bar charts, and explanatory drawings, both dot matrix and laser printers are adequate. Another problem in printing of graphics is the memory. A two-by-two inch black spot will have as many as 600 x 600 = 3,60,000 dots and you need 45 Kb of printer memory to store this information before printing. Hence, if you want to print full-page graphics, you should have 2 to 8 megabytes of printer memory. Laser printers of 600 dpi will need four times as much memory as needed by 300 dpi printers.

Inkjet Printers

Inkjet / Bubble jet printers work in the same way as dot matrix printers. The difference is that in place of pins, these printers have tiny nozzles through which ink is squinted out on paper, thereby printing characters and graphics directly. No ribbon or carbon is required. The way the squirting of ink is done differs. Some printers use heat, others use piezoelectric crystals which contract when a signal is applied and push out the ink. What matters is the quality of the printing and the cost per copy. These printers fan print high quality text, but printing of graphics is not very satisfactory. Using print heads having multiple inkwells having inks of different colors, these printers can give good color printing instantaneously.

3.2.10 Data Communications Packages

Large organizations are generally spread over several office locations. In order to computerize such geographically separated offices, various data communication facilities are required. The transfer of data and information from one computer to another over a communication link is known as data communication. Data communication has become essential for an organization due to several reasons. The major reason for needing data communication is that it is the fastest and the most cost saving medium for sending data and messages to various geographically separated offices. There are several types of communication media through which data can be transmitted from one place to another. Some of the common data transmission media are wire pairs. Coaxial cables, Microwave Transmission, and Communication satellite. Wire pairs are used in local telephone communication for transmitting digital data for short distances. Coaxial cables fare groups of specially wrapped insulated wires, which transmit data at very high rates.

Microwave transmission is the popular medium, which is used to transmit data through the electromagnetic waves. A communication satellite is a microwave relay station placed precisely at 36,000 km above the earth. It is the most widely used medium for sending data across a wide area on the earth.

Telecommunication refers to the electronic transmission of all forms of information, including digital data, voice, sound and video from one location to another over some form of transmission media. The transmission media may be a telephone line or microwave signal. The importance of telecommunications in businesses and personal purposes in increasingly rapid with new developments and technologies. ISDN (Integrated Services Digital Network), e-mail, Internet, Intranet, Video conferencing, Paging and Cellular technologies have become very popular during last few years. Some of the widely used telecommunication technologies.

- **E-mail:**

Electronic mail (e-mail) is a very widely used technology for sending messages or documents from one location to another by using computers. E-mail services are either available within intra-office network (e.g.: local area network) or through an outside vendor. Within an organization, the employees use a pc for sending their messages from one electronic mailbox to another. By using e-mail services from a vendor, the e-mail subscriber enters the message into the computer and addresses to the recipient's computer by quoting thee-mail code. More information with respect to e-mail is explained in unit IV.

- **Internet / Intranet:**

Internet and Intranet are the most recent telecommunication technologies, which have brought a technological revolution not only in all offices but also in homes. Internet is the world's largest network of million computers all over the world connected through telephone lines. Intranet, on the other hand, is a network of computers within the closed perimeters of the office.

- **Teleconferencing Systems:**

Teleconferencing systems are the latest office automation technologies for conducting meetings of widely separated people through a communication channel. These systems enable people to communicate audio, video or image information in a conversation-taking place between two or more locations. The teleconferencing systems are of three types – Audio Teleconferencing, Video conferencing and computer conferencing.

Audio teleconferencing is simply a conference phone call systems with such type of conferencing. Participants can only hear the voice and cannot see the participants. With video conferencing systems, the participants not only hear the voice but also see each other. The communication takes place either in one way or multi way modes. In one-way mode, which is also known as multi-point video conferencing, two or more locations can send or receive the information simultaneously. Some types of teleconferencing systems use computers for conducting meetings, which are known as computer conferencing systems.

In these systems, the participants use either e-mail or electronic Bulletin Boards for sending and receiving information. The messages are entered into the computers using e- mail facility and an electronic conversation takes place among participants. The messages can also be posted on a computer system, called Electronic Bulletin Board that maintains the list of messages.

3.2.11 Computer Networking Basics

Introduction to Computer Networking

The merging of computers and communications has had a profound influence on the way computer systems are organized. The concept of the "Computer Center" as a room with a large computer to which users bring their work for processing is now totally obsolete. The old model of a single computer serving all of the organization's computational needs has been replaced by one in which a large number of separate but interconnected computers do the job. These systems are called computer networks.

Two computers are said to be inter connected if they are able to exchange information. The connection need not be via a copper wire; fiber optics, microwaves, and communication satellites can also be used. By requiring the computers to be autonomous, we wish to exclude from our definition systems in which there is a clear master / slave relation.

There is considerable confusion in the literature between a computer network and a distributed system. The key distinction is that in a distributed system, the existence of multiple autonomous Computers is transparent (i.e. not visible) to the user. He can type a command to run a program, and it runs. It is up to the operating system to select the best processor, find and transport all the input files to that processor, and put the results in the appropriate place.

In other words, the user of a distributed system is not aware that there are multiple processors; it looks virtually unprocessed. Allocation of jobs to processors and files to disks, movement of files between where they are stored and where they are needed and all other system functions must be automatic.

With a network, users must explicitly log on to one machine, explicitly submit jobs remotely, explicitly move riles around and generally handle all the network management personally. With a distributed system, nothing has to be done explicitly; it is all automatically done by the system without the user's knowledge.

Growth of Computer Networking

Computer networks have been growing explosively. Two decades ago, few people had access to a network now; computer communication has become an essential part of our infrastructure. Networking is used in every aspect of business, including advertising, production, shipping, planning, billing and accounting. Consequently most corporations have multiple networks. The growth in networking has an economic impact as well. Data networks have made telecommuting available to individuals and have changed business communication.

In addition, an entire industry has emerged that develops networking technologies, products and services. The popularity and importance of computer networking has produced a strong demand in all jobs for people with more networking expertise. Companies need workers to plan, acquire, install, operate and manage the hardware and software systems that comprise computer networks and Internets. In addition, computer programming is no longer restricted to individual computers; programmers are expected to design and implement application software that can communicate with software on other computers.

Computer networking is a complex subject. Many technologies exist, and each technology has features that distinguish it from others. Multiple organizations have created networking standards independently, which are not all that compatible. Many companies have created commercial networking products and services that use the technologies in unconventional ways. Finally, networking is complex because multiple technologies exist that can be used to interconnect two or more networks. As a result, many combinations of networks are possible.

Types of Computer Networking

In general, a network technology is classified into one of the three broad categories, depending on size of networks that can be created.

- A Local Area Network (LAN) can span a single building or campus.
- A Metropolitan Area Network (MAN) can span a single city.
- A Wide Area Network (WAN) can span sites in multiple cities, countries or continents.

To appreciate the distinction, it is important to understand how the size of a network is measured. Although LAN technologies are designed to be used at a single site, techniques exist that can extend the distance spanned. In particular, a satellite bridge can connect two segments of a LAN over an arbitrary distance. However, a bridged LAN is not considered a wide Area technology because bandwidth limitations prevent a bridged LAN from serving arbitrarily many computers that are arbitrarily many sites.

The key issue that separates WAN technologies from LAN technology is scalability – a WAN must be able to grow as needed to connect many sites spread across large geographic distances, with many computers at each site. For Example, a WAN should be able to connect all the computers in a large corporation that has offices or factories at dozens of locations spread across thousands of square miles. Furthermore, a technology is not classified as a WAN unless it can deliver reasonable performance for large size networks. That is, a WAN does not merely connect to many computers at many sites- it must provide sufficient capacity to prevent the computers to communicate simultaneously.

A Metropolitan Network falls between these two categories of LAN and WAN. MAN or Metropolitan Area Network is basically a bigger version of a LAN and normally uses similar technology. It might cover a group of nearby corporate offices or a city, and might be either private or public. A MAN can support both data and voice and might even be related to the local cable television network a key aspect of a MAN is that there is a broadcast medium to which all the computers are attached. This greatly simplifies the design compared to other kinds of networks.

- **Internet Works**

Each network technology is designed to fit a specific set of constraints. For example, LAN technologies are designed to provide high-speed communication across short distance, while WAN technologies are designed to provide communication across large areas. Consequently, no single networking technology is best for all needs. A large organization with diverse networking requirements needs multiple physical networks. More important, if the organization chooses the type of network that is best for each task, the organization will have several types of networks. For (e.g.) a LAN technology Ethernet might be the best solution for connecting computers in an office, but a frame relay service might be used to interconnect computers in one city with computers in another.

The chief problem with multiple networks should be obvious: a computer attached to a given network can only communicate with other computers attached to the same network. The problem became evident in the 1970's as large organizations began to acquire multiple networks. An employee was given access to multiple screens and keyboards, and the employee was forced to move from one computer to another to send a message across the appropriate network. Consequently, most modern computer systems allow communication between any two computers analogous to the way a telephone system provides communication between any two telephones known as universal service, This is the concept of fundamental networking. With universal service, a user on any computer in any part of an organization can send messages or details as any other user. Further, a user does not need to change computer systems when changing tasks-all information is available to all computers. As a result, users are more productive.

Despite the incompatibility among networking technology researches have revised a scheme that provides universal service among heterogeneous networks. Called internetworking, the scheme uses both hardware and software. Additional hardware systems are used to interconnect a set of physical networks. Software on all the attached components then provides universal service. The resulting system of connected physical network is known as an inter network or Internet.

The goal of internetworking is universal service across heterogeneous network. To provide universal service among all computers on an Internet, routers must agree to forward information from a source in one network to a specific destination on another. The task is complex because addressing schemes used by the under lying network can differ. As a result, protocol software is needed on computers and routers to make universal service possible.

3.2.12 Local Area Networking Technology and Networking Topology

What is Local Area Network?

The history of computer networking changed dramatically during the late 1960's and early 1970's when researchers developed a form of computer communication known as Local Area Networks (LANs). Devised as alternatives to expensive, dedicated point-to-point connections, the designs differ fundamentally from long-distance networks because they rely on sharing the network.

They are generally privately summed networked within a single building or campus of up to a few kilometers in size. Each LAN consists of a single shared medium, usually cable, to which many computers attach. The computers take turns using the medium to send packets. LANs are widely used to connect personal computers and workstations in company offices and factories to share resources (e.g. Printers) and exchange information. LANs are restricted in size, which means that the worst-case transmission time is bounded and known in advance. Knowing this bound makes it possible to use certain kinds of designs that would not otherwise be possible. It also simplifies network management LAN often use a transmission technology consisting of a single cable to which all the machines are attached. Traditional LANs run at speeds of 10 to 100 mbps, have low delay (tens of microseconds) and make very few errors. Newer LANs may operate at higher speeds, up to hundreds of megabits/sec.

Significance of LANs and Locality of Reference

The Significance of LANs can be stated simply:

Local Area Network technologies have become the most popular form of computer networks. LANs now connect more computers than any other primitive type of network.

One of the reasons so many LANs have been installed is economy. LAN technologies are both inexpensive and widely available. However, the main reason is that demand for LANs is high and this can be attributed to a fundamental principle of computer networking known as locality of reference. The locality of reference principle states that communication among a set of computers is not random, but instead follows two patterns. First, if a pair of computers communicates once, the pair is likely to communicate again in the near future and then periodically. The pattern is called temporal locality of reference to imply a relationship over time. Second, a computer tends to communicate most often with other computers that are nearby. The second pattern is called physical locality of reference to emphasize the geographic relationship. The locality of reference principle is easy to understand because it applies to human communication. For example, people communicate most often with others who are physically nearby. (e.g.. Working together). Further more, if an individual communicates with some one (e.g. A friend or family members), the individual is likely to communicate with the same person again.

LAN Topologies

Because many LAN technologies have been invented, it is important to know how specific technologies are similar and how they differ. To help understand similarities each network is classified into a category according to its topology or general shape. The three topologies, which are most often used with LANs, are described below:

Star Topology

A network uses a star topology of all computers that attach to a central point. Figure 3.4 illustrates the concept.

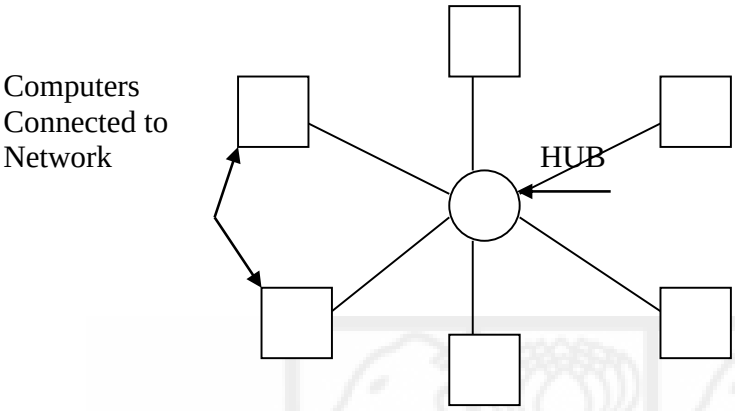


Figure 3.4

Figure 3.4 Illustrates the star topology in which each computer attaches to a central point called a hub.

Because a star-shaped network resembles the spokes of a wheel the center of a star network is often called a hub. A typical hub consists of an electronic device that accepts data from a sending computer and delivers it to the appropriate destination. In practice, star networks seldom have a symmetric shape on which the hub is located at an equal distance from all computers. Instead, a hub often resides in a location separate from the computers attached to it.

Ring Topology

A network that uses a ring topology arranges for computers to be connected in a closed loop-a cable that connects the first computer to a second computer, another cable connects the second computer to a third, and so on until a cable connects the final computer back to the first. The term ring arises because one can imagine the computers and the cables connecting them arranged in a circle as Figure 3.5 illustrates.

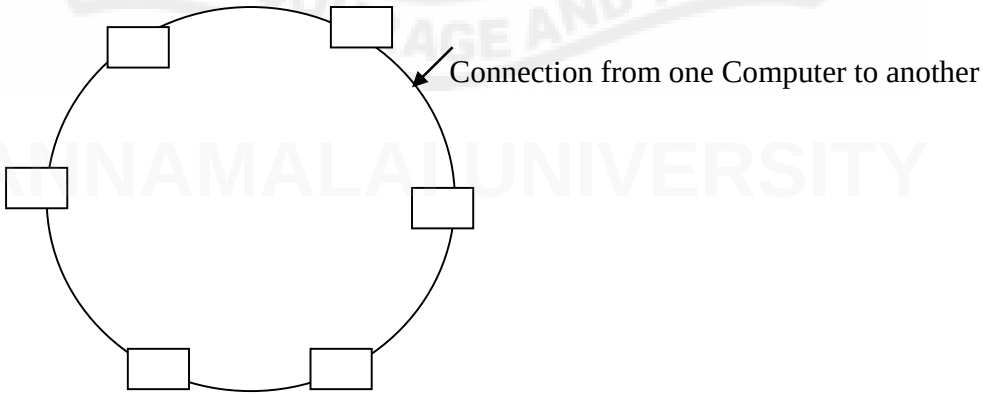


Figure 3.5

Figure 3.5 illustrates a ring topology in which computers are connected in a closed loop. Each computer connects directly to two others

It is important to understand that the ring, like the star topology, refers to logical connections among computers, not physical orientation-the computers and connections in a ring network needs not be arranged in a circle. Instead, the cable between parts of computers in a ring network may follow a hallway or rise vertically from one floor of a building to another. Furthermore, if one computer is far from others in the ring, the two cables that connect the distant computer may follow the same physical path.

Bus Topology

A network that uses a bus topology usually consists of a single, long cable to which computers attach. Any computer attached to a bus can send a signal down the cable, and all computers receive the signal. Figure 3.6 illustrates the topology. Because all computers attached to the cable can sense an electrical signal, any computer can send date to any other computer. Of course, the computers attached to a bus network must co-ordinate to ensure that only one computer sends a signal at anytime or chaos results.

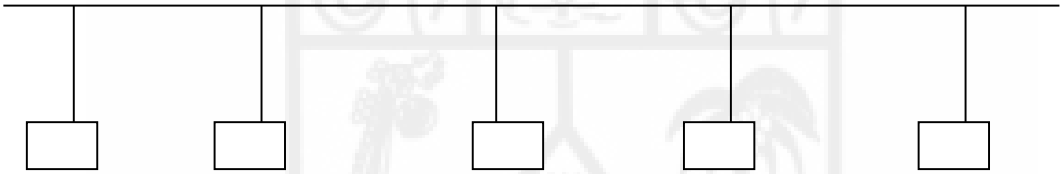


Figure 3.6: Illustration of a bus topology on which all computers attach to a single cable

Reason for Multiple Topologies

Each topology has advantages and disadvantages. A ring topology makes it easy for computers to coordinate access and to detect whether the network is operating correctly. However, an entire ring network is disabled if one of the cables is cut. A star topology helps protect the network from damage to a single cable because each cable connects only one machine. A bus requires fewer wires than a star, but has the same disadvantage as ring. A network is disabled if someone accidentally cuts the main cable.

3.2.13 Wide Area Network Technology and Routing

What is Wide Area Network?

A wide Area Network or WAN spans a large geographical area, often a country or continent. It contains a collection of machines intended for running user (i.e. application) programs. These machines are called hosts. The hosts are connected by a communication subnet, or just subnet for short. The job of the subnet is to carry messages from host to host; just as the telephone system carries words from speaker to listener. By separating the pure communication aspects of the network (the subnet) from the application aspects (the hosts), the complete network design is greatly simplified.

In most wide area network the subnet consists of two distinct components transmission lines and switching elements. Transmission lines (also called circuits, channels or trunks) more bits between machines.

The switching elements are specialized computers used to connect two or more transmission lines. When data arrive on an incoming line, the switching element must choose an outgoing line to forward them on. Unfortunately, there is no standard terminology used to name these computers. They are variously called packet switching nodes, intermediate systems and data switching exchanges, among other things.

In most WANs, the network contains numerous cables or telephone lines, each one connecting to a pair of routers. If two routers that do not share a cable nevertheless wish to communicate, they must do this indirectly, via other routers. When a packet is sent from one router to another via one or more intermediate routers, the packet is received at each intermediate routers in its entry, stored there until the required output line is free and then forwarded. Nearly all-wide area networks (except those using satellites) have store-and forward subnets. When the packets are small and all are of the same size, they are often called cells.

Physical Addressing in a WAN

From the view of an attached computer, a WAN network operates similar to a LAN. Each WAN technology defines the exact frame format a computer uses when sending and receiving data. Furthermore, each computer connected to a WAN is assigned a physical address. When sending a frame to another computer, the sender must supply the destination's address.

Many WANs use a hierarchies addressing scheme that makes forwarding more efficient. Hierarchical addressing divides an address into multiple parts. The simplest hierarchical scheme partitions an address into two parts, the first part identifying a packet switch, and the second part identifying a computer attached to that packet switch.

For Example, Figure 3.7 shows two-part hierarchical addresses assigned to computers connected to a pair of packet switches.

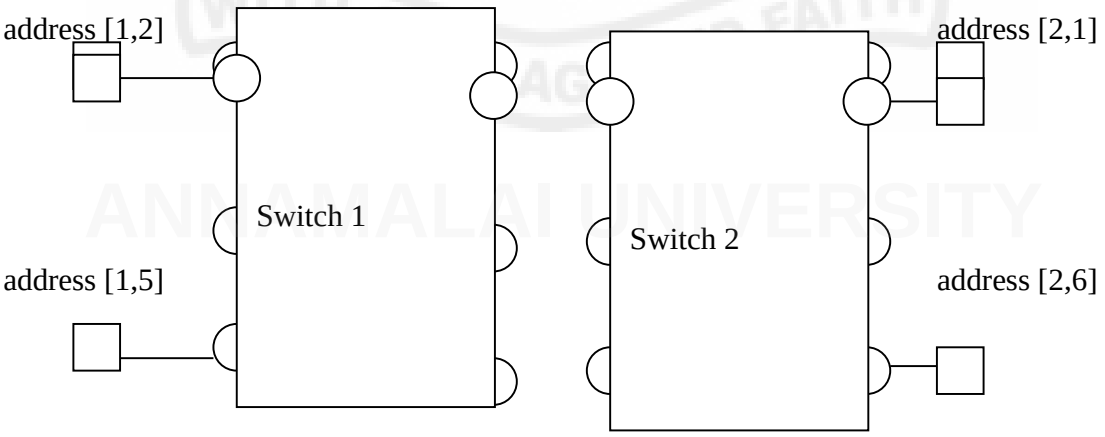


Figure 3.7

Figure 3.7 Example of hierarchical addresses in WAN. Each address consists of two parts; the first part identifies a packet switch, and second part identifies a computer connected to the switch.

The figure shows each address as a pour of decimal integers. A computer connected to port 6 on packet switch 2 is assigned address (2,6). In practice, an address is represented as a single binary value, with some bits of the binary value used to represent the first part of the address and other bits used to represent the second part. Because each address is represented as a single binary value, users and application programs can teat the address, as a single integer-they do not need to know that addresses are assigned hierarchically.

Routing in a WAN

The capacity of a WAN must be increased as additional computers are connected to the network. To handle a few additional computers, the capacity of an individually switch can be increased by adding I/o interface hardware or a faster CPU. Such changes can accommodate small increase in the size of the network; large increases require new packet switches. The fundamental concept that makes it possible to build a WAN with large capacity arises because the switching capacity can be increased without adding individual computers. In particular, packet switches can be added to the interior of a network to handle load. Such switches do not need to have computers attached. Such packet switches are known as interior switches, and call packet switches to which computers attach directly exterior switches.

For a WAN to work correctly, both interior and exterior packet switches must have a routing table and both types must forward packets. Furthermore, values in the routing table must guarantee the following:

Universal routing. The routing table in a switch must contain a next – hop route for each possible destination.

Optimal routes. In a switch, the next-hop value in the routing table for a given destination must point to the shortest path to the destination. The easiest way to think about routing in a WAN is to imagine a graph that model the network. Each node in the graph corresponds to a packet switch in the network. If the network contains a direct connection between a pair of packet switches, the graph contains an edge or link between the corresponding nodes. For example, Figure 3.8 shows an example WAN and the corresponding graph.

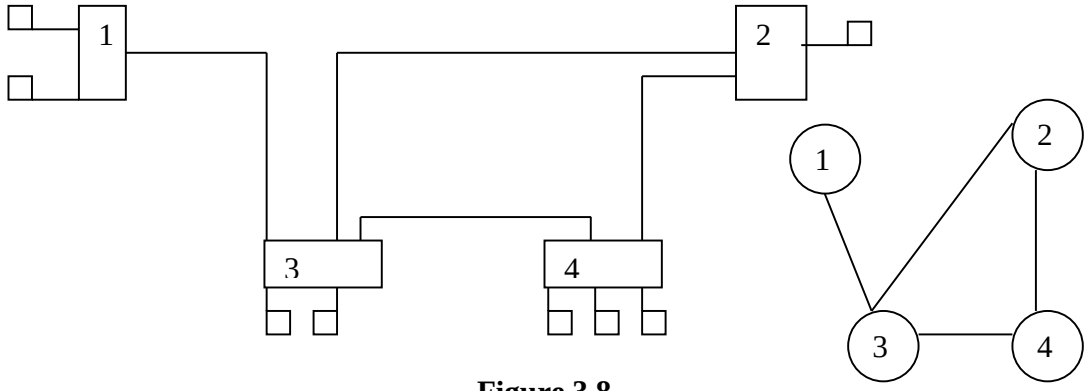


Figure 3.8

Figure 3.8. The network and the corresponding graph. Each node in the graph corresponds to a packet switch and each edge between two nodes represents a connection between correspond switch.

Example of WAN Technology

Many technologies have been created for experimental and production use in wide Area Networks. Some of these are explained below:

ARPANET

Packet switched WANs are less than thirty years old. In the late 1960s, the Advanced Research Projects Agency (ARPA) funded research on networking for the US department of Defense. A major ARPA research project developed a wide Area Network to determine whether packet switching technology could be used in battlefield conditions. Known as the ARPANET, the network was one of the first packet switches WANs. Although by current standards ARPANET was slow, the project left a legacy of concepts, algorithms, and terminology that are still on use.

Frame Relay

Long – distance carriers provide several high-speed wide area network services. On such service, Frame Relay is designed to accept and deliver blocks of data, where each block can contain up to 8k octets of data. Part of the motivation for the large data size arises because the inventors designed Frame Relay service for use in bridging LAN segments. An organization with offices in two cities can obtain a Frame Relay connection for each office and then use the connection to forward packets from a LAN segment at one site to a LAN segment at the other.

SMDS

Switched Multi-megabit Data Service (SMDS) is another high-speed wide area data service offered by long distance carriers. Instead of voice traffic. SMDS is designed to operate at the highest speeds. For example, header information in a packet can require a significant amount of the available bandwidth. To minimize header overhead, SMDS uses a small header and allows each packet to contain up to 9188 octets of data. SMDS also defines a special hardware interface used to connect computers to the network. The special interface makes it possible to deliver data as fast as a computer can handle it.

ATM

A significant wide area technology is known as Asynchronous Transfer Mode (ATM). ATM is an attempt to design a single technology that can be used to provide voice, video and data services across a wide area. ATM designers faced a difficult challenge because the three intended uses have different sets of requirements. For example, both voice and video require low delay and low fitter (i.e. low variance in delay that makes it possible to deliver audio and video smoothly without jumping from one frame to the best), but video requires a much higher data rate than audio.

As with other WAN technologies, an ATM network uses switches as the primary building block. A switch has multiple ports; each port can be connected to another switch or to a computer. To achieve the highest bit rates, most ATM networks use optical fiber as the interconnection media.

3.2.14 Protocols and Layering

Need for Protocols

Basic communication hardware consists of mechanisms that can transfer bits from one point to another. However using raw hardware to communicate is analogous to programming by entering is and us- it is cumbersome and inconvenient. To aid programmers, computers attached to network use complex software that provides a convenient, high – level interface for applications. The software handles most low-level communication details and problems automatically, making it possible for applications to communicate easily. Thus, most application programs rely on network software to communicate; they do not interact with network hardware directly.

All parties are involved in communication exchanging messages (e.g. The language to be used and the rules for when messages can be sent). Such an agreement is called a protocol. The term is applied to computer communications as well: a set of rules that specify the format of messages and the appropriate actions required for each message is known as a network protocol or a computer communication protocol. The software that implements such rules is called protocol software. An individual network protocol can be simple (e.g. An agreement to use ASCII when transferring text file) or complex (E.g. An agreement to use a complicated mathematical function to encrypt data).

Protocol Suites

Instead of having a single, giant protocol that specifies complete details for all possible forms of communication, designers have chosen to divide the communication problem into sub pieces and to design a separate protocol for each sub piece. Doing so makes each protocol easier to design, analyze, implement and test. Dividing communication software into multiple protocols increases flexibility because it allows subsets of protocols to be sued as needed.

The division into separate protocols must be chosen carefully to ensure that the resulting communication system is efficient and effective. To avoid duplication of effort, each protocol should handle part of the communication problem not handled by other

protocols. To make efficient implementation possible, protocols should be designed so that they can share data structures and information. Finally, the combination of protocols should handle all possible hardware failures or other exceptional conditions.

How can one guarantee that protocols will work well together? The answer lies in an overall design plan; instead of developing each protocol in isolation, protocols are designed and developed in complete, cooperative sets called suites or families. Each protocol in a suite solves one part of the communication problem; together, they solve the entire communication problem. Furthermore, the entire suite is designed to make interactions among protocols efficient.

Several tools have been developed to help protocol designers understand subparts of the communication problem and plan an entire protocol suite. One of the most important tools is called the layering model. In essence, a layering model describes one way the communication problem which can be divided into sub pieces, called layers.

A protocol suite can be designed by specifying a protocol that corresponds to each layer.

Layering of Protocols

When protocols are designed according to a layering model, the resulting protocol software follows the layered organization. The protocol software on each computer is divided into modules, with one module corresponding to each layer. More important, layering determines the interactions among modules, but in theory when protocol software sends or receives data, each module only communicates with the module for the next highest layer and the module for the next lowest. Thus, outgoing data passes down though each layer, and incoming data passes up through each layer. Figure 3.9 illustrations the concept:

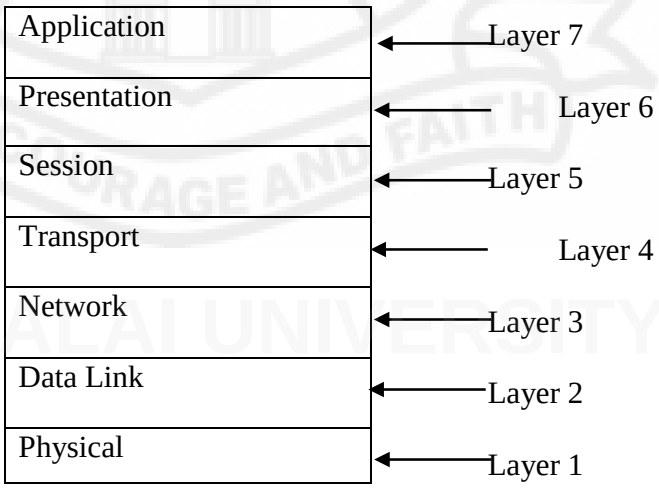


Figure 3.9: Protocol Layering

The details of each layer is summarized below:

Layer 1: Physical

Layer 1 corresponds to basic network hardware.

Layer 2: Data Link

Layer 2 protocols specify how to organize data into frames and how to transit frames over a network.

Layer 3: Network

Layer 3 Protocols specify how addresses are assigned and how packets are forwarded from one end of the network to another.

Layer 4: Transport

Layer 4 protocols, which specify how to handle details of reliable transfer, are among the most complex protocols.

Layer 5: Session

Layer 5 protocols specify how to establish a communication session with a remote system. Specifications for security details such as authentication using passwords belong in layer 5

Layer 6: Presentation

Layer 6 protocols specify how to represent data. Such protocols are needed because different brands of computers use different internal representations for integers and characters. Thus layer 6 protocols are needed to translate from the representation on one computer to the representation on another.

Layer 7: Application

Each Layer of 7 protocols specifies how one particular application uses a network. For example, the specification for an application that transfers files from one computer to another belongs in layer 7. The protocol specifies the details as to how an application program on one machine makes a request (e.g. How to specify the name of the desired file) and how the application on another machine responds.

Common Protocols

The most common protocols are:

- Ethernet
- Local Talk
- Token Ring
- FDDI
- ATM

- **Ethernet**

The Ethernet protocol is by far the most widely used. Ethernet uses an access method called CSMA/CD (Carrier Sense Multiple Access/Collision Detection). This is a system where each computer listens to the cable before sending anything through the network. If the network is clear, the computer will transmit. If some other node is already transmitting on the cable, the computer will wait and try again when the line is clear. Sometimes, tow computers attempt to transmit at the same instant. When this happened a collision occurs. Each computer then backs off and waits a random amount of time before attempting to retransmit. With this access method, it is normal to have collisions. However, the delay caused by collisions and retransmission is very small and does not normally affect the speed of transmission on the network. The Ethernet protocol allows for linear bus, star, or tree topologies. Data can be transmitted over twisted part, coaxial, or fiber optic cable at a speed for 10 Mbps.

- **Fast Ethernet**

To allow for an increased speed of transmission, the Ethernet protocol has developed a new standard that supports 100 Mbps. This is commonly called Fast Ethernet. Fast Ethernet requires the use of different, more expensive network concentrators/hubs and network interface cards. In addition, category 5 twisted pair or fiber optic cable is necessary. Fast Ethernet is becoming common in schools that have been recently wired.

- **Gigabit Ethernet**

The most recent development in the Ethernet standard is a protocol that has a transmission speed of 1 Gbps. Gigabit Ethernet is primarily sued for backbones on a network at this time. In the future, it will probably be used for workstation and server connections also. It can be used with both fiber optic cabling and copper. The 1000BaseTX and the copper cable used for Gigabit Ethernet are expected to become the formal standard in 1999.

- **Local Talk**

Local Talk is a network protocol that was developed by Apple Computer, Inc. for Macintosh computers. The method used by Local Talk is called CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance). It is similar to CSMA/CD except that a computer signals its intent to transmit before it actually dies. Local Talk adapters and special twisted pair cable can be used to connect a series of computers through the serial port.

The Macintosh operating system allows the establishment of a peer – to – peer network without the need for additional software. With the addition of the server version of AppleShare software, a client/server network can be established. The Local Talk protocol allows for linear bus, star or tree topologies using twisted pair cable. A primary disadvantage of Local Talk is speed. Its speed of transmission is only 230 Kbps.

- **Token Ring**

IBM developed the Token Ring protocol in the mid-1980s. The access method used involves token passing. In Token Ring, the computers are connected so that the signal travels around the network from one computer to another in a logical ring. A single electronic token moves around the ring from one computer to the next. If a computer does not have information to transmit, it simply passes the token on to the next workstation. If a computer wishes to transmit and receives an empty token, it attaches data to the token. The token then proceeds around the ring until it comes to the computer for which the data is meant. At this point, the receiving computer captures the data. The Token Ring protocol requires a star-wired ring using twisted pair or fiber optic cable. It can operate at transmission speeds of 4 Mbps or 16 Mbps. Due to the increasing popularity of Ethernet, the use of Token Ring in school environments has decreased.

- **FDDI**

Fiber Distributed Data Interface (FDDI) is a network protocol that is used primarily to interconnect two or more local area networks, often over large distances. The access method used by FDDI involves token passing. FDDI uses a dual ring physical topology. Transmission normally occurs on one of the rings; however, if a break occurs, the system keeps information moving by automatically using portions of the second ring to create a new complete ring. A major advantage of FDDI is speed. It operates over fiber optic cable at 100 Mbps.

- **ATM**

Asynchronous Transfer Mode (ATM) is a network protocol that transmits data at a speed of 155 Mbps and higher. ATM works by transmitting all data in small packets of a fixed size; whereas, other protocols transfer variable length packets. ATM supports a variety of media such as video, CD-quality audio, and imaging.

ATM employs a star topology, which can work with fiber optic as well as twisted pair cable. ATM is most often used to interconnect two or more local area networks. It is also frequently used by Internet Service Providers to utilize high-speed access to the Internet for their clients. As ATM technology becomes more cost-effective, it will provide another solution for constructing faster local area networks.

3.2.15 Networking Devices

Router

A router is a device or, in some cases, software in computer, that determines the next network point to which a packet should be forwarded toward its destination. The router is connected to at least two networks and it decides which way to send each information packet based on its current understanding of the state of the networks it is connected to. A router is located at any gateway (where one network meets another), including each Internet point-of-presence. A router is often included as part of a network switch.

A router may create or maintain a table of the available routes and their conditions and use this information along with distance and cost algorithms to determine the best route for a given packet. Typically, a packet may travel through a number of network points with routers before arriving at its destination. Routing is a function associated with the Network layer in the standard model of network programming, and the Open Systems Interconnection (OSI) model. A layer–3 switch is a switch that can perform routing functions.

An edge router is a router that interfaces with an asynchronous transfer mode (ATM) network. A router is a network bridge combined with a router.

Repeater

A common problem in the networking world is that of weakening electrical signals. Electrical signals traveling though wires (such as copper wires used in most networks) weaken due to the wire's electrical resistance. This effect limits the lengths of the cable that can be used. A repeater will overcome this limit, when there is a need to connect two computers at a larger distance.

A repeater is connected to two cable segments. Any electrical signal reaching the repeater from one segment will be amplified and retransmitted to the other segment.

The amount of repeaters that can be chained together is limited. This is because most network types assume a maximum segment length and propagation time. For instance, each Ethernet network type imposes a maximum time limit for each electrical signal to reach the entire network.

Using repeaters slows the signal's propagation, and thus the amount of repeaters should be limited. The upside of repeaters is that they are very simple to manufacture and therefore cheap. The downside of repeaters, which are dumb electrical devices, is that they do not "understand" the nature of the electrical signals they are amplifying. Repeater may encounter 3 types of electrical input signals, which represent

- Properly formatted data that should be repeated to the repeater's other segment. (i.e. when the data's target is on the repeater's other segment)
- Properly formatted data that should not be repeated to the repeater's other segment. (i.e. when the data's target is not on the repeater's other segment)
- Improperly formatted data or noise, which should not be repeated.

The repeater will repeat (retransmit) all 3 types of signals while it should only repeat the first one. This, needlessly, increases network traffic.

Bridge

In telecommunication networks, a bridge is a product that connects a local area network (LAN) to another local area network that uses the same protocol (for example, Ethernet or taken ring). You can envision a bridge as being a device that decides whether a message from you to someone else is going to the local area network in our building or to someone on the local area network in the building across the street.

A bridge examines each message on a LAN "Passing" those known to be within the same LAN and forwarding those known to be on the other interconnected LAN (or LANs).

In bridging networks, compute or node addresses have no specific relationship to location. For this reason, messages are sent out to every address on the network and accepted only by the intended destination node. Bridges learn which addresses are on which network and develop a learning table so that subsequent messages can be forwarded to the right network.

Bridging networks are generally always interconnected local area networks since broadcasting every message to all possible destinations would flood a larger network with unnecessary traffic. For this reason, router networks such as the Internet use a scheme that assigns addresses to nodes so that a message or packet can be forwarded only in one general direction rather than be forwarded in all directions.

A bridge works at the data-link (physical network) level of a network, copying a data frame from one network to the next network along the communications path.

Gateway

A gateway is a network point that acts as an entrance to another network. On the Internet, a node or stopping point can be either a gateway node or host (end-point) node. Both the computers of Internet users and the computers that serve pages to users are host nods. The computers that control traffic within your company's network or at your local Internet service provider (ISP) are gateway nodes.

In the network for an enterprise, a computer server acting as a gateway node is often also acting as a proxy server and firewall server. A gateway is often associated with both a router, which knows where to direct a given packet of data that arrives at the gateway and a switch, which furnishes the actual path in and out of the gateway for a given packet.

3.3 Revision Points

Multimedia

Multimedia means the integration of at least two media. These media can include text, photos, graphics, sound, music, animation and full motion video.

File Formats and Compressions

As bitmaps are very large, they are often stored in compressed formats. GIF (Graphics Interchange Format) is a common format that uses LZW compression, but cannot strictly be considered to be loss less as it is restricted to 256 colors.

Microphone

A microphone is similar to the human ear in that it has a diaphragm, which vibrates in response to changes in air pressure

MIDI (Medical Instrument Digital Interface)

MIDI is a communications standard developed in the early 1980s for electronic musical instruments and computers. It allows music and sound synthetics from different manufacturers to communicate with each other by sending messages along cables connected to the devices.

DTP (Desk Top Publishing)

Desktop Publishing is to create a document ready for printing using a desktop computer.

E-mail (Electronic Mail)

E-mail is a very widely used technology for sending messages or documents from one location to another by using computers.

Router

A router is a device or, in some cases, software in computer, that determines the next network point to which a packet should be forwarded toward its destination.

3.4 Intext Questions

1. What is Multimedia? Explain its usage.

2. What is moving image? Explain with its types.

3. Explain the difference between MIDI vs. Digital Audio.

4. State the advantages & disadvantages of Word Processors.

5. Explain the role of Laser Printer.

6. What are the types of tele-conferencing?

7. Write short notes on the following:
   a. Vector Graphics
   b. Digital Cameras
   c. Ventura Publisher
   d. Types of Computer Networking

8. State the significance of LAN and explain its topologies?

9. What is a protocol? Explain the layering model?

10. What is a router?

3.5 Summary

- Multimedia tends to imply sophistication (and relatively more expense) in both production and presentation than simple text-and-images
- Multimedia can be used in just about any situation where computers are being used to deliver information, and a number where they are not traditionally used
- Still images may be small or large, or even full screen. They may be colored, placed at random on the screen, evenly geometric or oddly shaped.
- Sound waves can be transuded (converted to another form) using a microphone. A microphone is similar to the human ear in that it has a diaphragm, which vibrates in response to changes in air pressure
- MIDI (musical Instrument Digital Interface) is a communications standard developed in the early 1980s for electronic musical instruments and computers.
- Moving images are an illusion. When we view an animation or video we are viewing a series of still pictures presented in rapid succession.
- The bank concept of desktop publishing is that simple word processors process words, drawing programs create drawings scanners scan images, and bitmap editors edit bitmap images.
- Word processors are application software, which are used for word processing. Word professing is the most widely used technique for typing, editing, storing, formatting, manipulating and printing documents with the assistance of computer and printer
- Graphics are elements that add interest to your page or highlight your point to clarify your text
- The task of a desktop publisher usually ends with the printing of the master document on a laser printer
- The transfer of data and information from one computer to another over a communication link is known as data communication
- The merging of computers and communications has had a profound influence on the way computer systems are organized.
  1) LAN 2) WAN 3) MAN
- An agreement is called a protocol. The term is applied to computer communications as well: a set of rules that specify the format of messages and the appropriate actions required for each message is known as a network protocol or a computer communication protocol

3.6) Terminal Exercises

1. Write few applications of Multimedia.
2. What is Expansion of JPEG?
3. Human can hear frequencies in the rante of _____ hertz to _____ k hertz
    a) 30 to 70
    b) 20 to 20
    c) 50 to 90
    d) 40 to 40
4. Write a short notes about Animation?
5. DTP Standards for
    a) Development Technique Process
    b) Desk Top Product
    c) Desk Top Publishing
    d) Desk Top Program
6. Write a short notes about E-mail.
7. What is the difference between Internet and Intranet?
8. Write names of the different topologies.
9. What is Router?
10. What is Gateway?

3.7) Supplementary Material

1. "Interactive Multimedia in Education and Training" edited by Sanjaya Mishra, Ramesh Sharma.
2. "Data Communications and Networking" by Behrouz A Forouzam, Sophia Chung Fegan.

3.8 Assignments

1. Write an assignment about Current Trend in Multimedia and its growth.
2. Develop some animation stuffs with sound effects.
3. Using DTP, students create a small advertisement banner.

3.9 Reference Books

1. Linda Tway, Sapphire Pacific Lajolla, "Multimedia in Action", Academic Press, 1995.
2. Neil Randall, "Teach yourself the internet in a week", Prentice Hall of India, Second edition, 1996.
3. Vishndpriya Singh & Meenakshi Singh, "DTP Course", Asian Publishers, Delhi, First Edition, 1997.

3.10 Learning Activities

The following concepts would be explained by group of people

1. Any type of Topology
2. Layers
3. Difference between LAN, WAN and MAN
4. ATM

3.11 Key Words

- **CBT** - Computer Based Training
- **GIF** - Graphics Interchange Format
- **MCA** - Micro Channel Architecture
- **MAN** - Metropolitan Area Network

Unit IV

4.0 Introduction to Internet

What is Internet?

Internet can be defined as the networks of network and thereby constitutes the world's largest network. It is actually a collection of thousands of networks that spans the globe, connecting educational & commercial institutions, as well as individuals and small businesses to a wide range of computer services, resources, and information. It is so large and complex and well beyond the comprehension of a single human being. Presently over 50 million highly educated people are connected to Internet in over 180 countries. Internet offers information on virtually any subject in the world from Agriculture to Satellites. There are three ways to describe the Internet:

- From the practical or commercial point of view, the Internet is a series of files that are stored electronically on accessible computers. These files contain information that can be searched, read, and/or retrieved electronically.
- From the social point of view, the Internet is a tool, which millions of people from all over the world use for communicating with each other by sharing ideas and information.
- From the technical point of view, the Internet is a collection of interconnected computer networks, or a "networks." By using specialized software, telephone lines and high speed dedicated data lines, and employing the standard rules or "protocols" these machines can "talk" to each other instantaneously.

BYTE magazine terms it "The Greatest Show on Earth" in its July 1995 issue. Bill Gates, founder of Microsoft and one of the world's richest men quoted in the Times of India of 23rd August 1995: "The surging popularity of INTERNET is the most significant development since the IBM PC was introduced in 1981. Like the PC, the INTERNET is a tidal wave. It will wash over the computer industry and drowning many who do not learn to swim in its waves".

4.1 Objective

Students obtain the basic knowledge about Internet and its application. They will have plenty of knowledge and skills on ISD, FTP, TCP/IP etc., and also they will have the basic understanding about web development tools and HTML tags. They also get the following.

- Internet Services, addressing
- Web browsers
- Email Fundamentals

4.2 Contents

4.2.1 Brief History of Internet

The Beginning: ARPANET

The U.S. Department of Defense laid the foundation to the Internet. In 1957, the U.S. government formed the Advanced Research Projects Agency (ARPA), a segment of the Department of Defense charged with ensuring U.S. leadership in science and technology with military applications. In 1969, ARPA established ARPANET, the forerunner of the Internet.

ARPANET was a network that connected major computers at the University of California at Los Angeles, the University of California at Santa Barbara, Stanford Research Institute, and the University of Utah. Within a couple of years, several other educational and research institutions joined the network.

In response to the threat of nuclear attack, ARPANET was designed to allow continued communication if one or more sites were destroyed. Unlike today, when millions of people have access to the Internet from home, work, or their public library, ARPANET served only computer professionals, engineers, and scientists who knew their way around its complex workings.

Evolution

Throughout the 1970s, developers created the protocols used to transfer information over the Internet. By the early 1980s Usenet newsgroups and electronic mail were born. Most users were affiliated with universities, although libraries began to connect their catalogs to the Internet, too. During the late 1980s, developers created indices, such as Archie and the Wide Area Information Server (WAIS) to keep track of the information on the Internet. To give users a friendly, easy-to-use interface to work with, the University of Minnesota created its Gopher, a simple menu system for accessing files, in 1991. The World Wide Web came into being in 1991, thanks to developer Tim Berners-Lee and others at the European Laboratory for Particle Physics, also known as Conseil Europeenne pour la Recherche Nucleaire (CERN). The CERN team created the protocol based on hypertext that makes it possible to connect content on the Web with hyperlinks. Berners-Lee now directs the World Wide Web Consortium (W3C), a group of industry and University representatives that oversees the standards of Web technology.

Early on, the Internet was limited to non-commercial uses because largely the National Science Foundation, the National Aeronautics and Space Administration provided its backbone, and the U.S.Department of Energy and funding came from the government. But as independent networks began to spring up, users could access commercial Web sites without using the government-funded network. By the end of 1992, the first commercial online service provider, Delphi, offered full Internet access to its subscribers, and several other providers followed.

In June 1993, the Web boasted just 130 sites. A year later, the number had risen to nearly 3,000. As of April 2000, there were more than 2.7 million sites on the web. This is the history of the Internet.

Internet Capabilities

The usefulness of the Internet depends directly on the products or services of each business. The benefits of Internet vary according to the varieties of business.

Creating a Client Base

Finding new clients and new client bases is not always an easy task. It involves a careful market analysis, Product marketing and consumer base resting. The Internet is a readily available repository of several million people from all walks of life. New clients or customers from this massive group can be found easily if the people were educated about the presence of the Internet and its significance.

Product Analysis

Many users also do product analysis and comparisons and report their findings on the Internet. Very often, you can find at least one other person who may be familiar with a product you are currently testing or about to purchase. First hand reports on the functionality of such products can be got even before spending a good sum.

Market Analysis

The large number of users of Internet is in itself an analysis of the market for a new product or service idea. These surveys can reach great many people with little effort on the part of the surveyors. Once a product is already marketed, the level of satisfaction that users have received from the product can be easily examined.

Expert Advice and Help

Beyond product analysis, there are also a great many experts on the Internet who make their presence widely known and easily accessible. Very often you can get free advice and help for problems, which might involve high sum for private consulting.

Recruit New Employees

The Internet has many job lists and resumes online for prospective employers. New resumes are constantly posted to the Usenet groups to inform the availability of new skills.

Rapid Information Access

Accessing information over the Internet is much faster on most occasions than transmissions and transfers via fax or postal courier services. Information from countries around the world can be accessed and interactive connections to remote computer systems can be made from just about anywhere.

Wide Scale Information Dissemination

Documents on computers on the Internet can be placed and made instantly accessible to millions of users. The popularity of access of the information is only limited by public awareness of its accessibility, and content. Hypertext documents provide an effective method to present information to subscribers or the general populace.

Creating World Wide Web documents and registering your site with larger Web sites makes larger the availability of the documents to a client base than the circulation of many major newspapers.

Rapid Communications

Electronic Mail has proved to be an effective solution to the problem of telephone talk (in cases when the person concerned is not available). Contacting others through e - mail has provided a new method of communication which has both the speed of telephone conversations and still provides the semi - permanence of postal mail. Email can be sent from just about any place where there is an Internet service or access. Therefore businessmen or travelers on the go can keep in touch with up to the minute details of the office or site.

Cost-effective Document Transfer

Transferring on-line documents through the Internet takes a very short period of time and this saves a lot of money over postal or courier services, which can also suffer late deliveries, loss or damage. If a document transfer fails on the Internet, you can always try again since the cost of the transfer is the same. Most, if not all, Internet access providers do not charge by the raw number of bytes transferred across their link unlike other commercial information services.

New Business Opportunities

Many entrepreneurs are continuously on the lookout for new and innovative ideas as viable commercial ventures. Users on the Internet are constantly coming out with such new ideas not only because of the research traditions of the Internet but also because of the cooperative atmosphere that surrounds the Internet.

4.2.2 ISDN, PP, TCP/IP

How does Internet Work?

Connecting computers could be accomplished if every computer had a unique address much like your street address. In theory, all the computers in the world could be connected to one really long wire, and they could all talk to each other. There are several reasons why this won't work, one of them being that there would be too many machines trying to talk at the same time and they would interfere with each other. The wire doesn't have enough "bandwidth" - information capacity - to handle all the traffic.

The Internet is a gigantic collection of millions of computers, all linked together on a computer network. The network allows all of the computers to communicate with one another. A home computer is usually linked to the Internet using a normal phone line and a modem that talks to an Internet Service Provider **(ISP).** A computer in a business or university has a Network Interface Card **(NIC)** that directly connects it to a Local Area Network **(LAN)** inside the business. The business then connects its LAN to an ISP using a high-speed phone line like a **T1 line.** A T1 line can handle approximately 1.5 million bits per second, while a normal phone line using a modem can handle 30,000 to 50,000 bits per second. ISPs then connect to larger ISPs, and the largest ISPs maintain fiber-optic "backbones" for an entire nation or region. Backbones around the world are connected through fiber optic lines, undersea cables or satellite links. In this way, every computer on the Internet is connected to every other computer on the Internet.

4.2.3 Hardware Requirements for Internet

To use the Internet you need the following things:

- Computer
- Modem
- Telephone System

Computer

To access the Internet, the following minimum configuration is needed.

- A computer with at least 16 megabytes (32 or more is even better) of RAM. The computer will need to run several large programs at once, so it needs all the brain power (RAM) it can muster. RAM is the best performance-booster you can add to your computer.
- A color monitor that displays at least 16-bits or thousands of colors. (Better: 24-bits or millions of colors.) This will be a factor of the VRAM in the system. In most cases at least 2-4 Megs of VRAM for millions of colors on a larger monitor is preferred. Higher your monitor resolution better will be the clarity on the screen.
- A hard disk with plenty of storage space (think of your hard disk as a big filing cabinet) for the software you will use and all those files you'll be downloading. At least 6 gigabytes capacity hard disk is recommended. The latest browser downloads are about 12 megabytes.
- A Stereo speaker since the World Wide Web is also a multimedia medium Another necessity these days is a CD-ROM drive (standard now on most PCs) because there is so much software available on CD-ROM and installations from high-capacity CDs are much easier and faster.

Modem

Data inside a computer is stored in a form that is different from data transmitted over a phone line. Computer data is stored in a DIGITAL format, while phone lines transmit data in an ANALOG format. (Information is said to be digital if it can be represented by discrete numbers. Data is analog if it is represented by quantities that vary continuously. When two computers are connected over a phone line, the data coming out of the computer is digital and, before it can be transmitted over the phone line, it must be converted back to analog data. At the other end analog data must be converted back to digital data before the other computer can accept it.

The process of converting from a digital format to analog format is called MODULATION. And the process of converting analog data back to its digital form is called DEMODULATION. Thus the device, which acts as an interface between our computer and the phone system, is called a **"modulator/demodulator"** or **"modem".**

There are two types of modems: **internal and external**. An **internal modem** resides on an adaptor card, which fits in to an expansion slot inside your computer. An **external modem** is a small box connected to the computer with a cable. It requires a cable and must be plugged into an electrical outlet.

Choosing between an internal and external modem is the first of two considerations. The other is to make sure that the right speed is got. Modem speeds are expressed in BITS PER SECOND, or BPS. There are several standard modem speeds. They are 2400 bps, 9600 bps, 28800 bps and 56600 bps. Sometimes people use the abbreviation "K" (as in metric system) to stand for "1000". Thus the last two modem speeds are usually referred to as 28.8 Kbps and 56.6 Kbps. Any modem that is slower than 28.8 Kpbs is not worth buying.

Telephone System

In order to access Internet, the next most important hardware requirement is the telephone system. Basically there are two types of telephone system available for establishing an Internet connection. They are briefly described below.

1. A Dedicated Telephone Line

Many people already have access to the Internet because they work at a place where the computers are connected to a network with Internet access. However most people do not have facilities. Instead, they use the Internet by connecting to another computer over a phone line. This is accomplished by running a communications program on our computer to dial the phone. Another computer answers the phone, and our program (on computer) talks to a program on the other end and establishes a connection. Now whatever work is needed to be done over the Internet would be done, during which the remote computer provides access to the Net. Once the work is finished, the connection can be broken by telling the communications program to hang up. Once a system like this is set up, just starting our program on the computer and telling it to dial can initiate the Internet connection. Besides the communications program, a MODEM is needed which is a hardware device acting as an interface between our computer and the telephone system and the telephone line itself. The details of what a Modem is and their purposes are explained in detail in section 4.2.2.2.

2. ISDN

ISDN (Integrated Services Digital Network) is a type of telephone service, which is an alternative to a regular phone line. The great advantage of ISDN is that it allows us to connect to another computer at a speed, which is much faster than even the fastest modem. ISDN is considered as an alternative to using a modem with a regular phone line because it is digital and it is a lot faster. Moreover, a single ISDN line can support up to eight devices and (in theory) up to 64 different telephone numbers.

Organization of ISDN

While using computer to access Internet over a regular phone line, a modem acts as an interface between the computer and the telephone system. The reason being computers use digital data, while phone lines carry analog data. The modem converts the digital signal from the computer into the analog signal used by the phone line. However with an ISDN, we are better off because it is digital and hence no conversion from digital to analog is needed. As a result it is faster.

ISDN services are generally delivered in one of the two ways: a BASIC RATE INTERFACE (BRI), or a PRIMARY RATE INTERFACE (PRI). A PRI is an expensive, large-scale service suitable for a company needing to connect many computers and other devices. A single ISDN line provides a number of CHANNELS, each of which offers a specific amount of bandwidth.

A BRI (Basic Rate Interface) provides three channels: two B channels and one D channel. The B channels carry voice conversations, fax transmissions and so on. The D channel is used for the control of ISDN itself. It is used for sending the set up and signaling information back and forth between the telephone system and the devices. In other words, the D channel is used to control the other ISDN channels. The name "D channel" stands for "data channel".

Interfaces for Using ISDN

With ISDN, we need two different interfaces. First, a special device called an NT-1 to act as the interface between all of the equipment and the outside ISDN line. The devices are connected to the NT-1 and the NT-1 is connected to the ISDN wall jack. The NT-1 requires its own power supply.

The second ISDN interface needed is called a Technical Adaptor. Its job is to convert signals from the computer into ISDN data. The terminal adaptor connects to the NT-1, which in turn connects to the ISDN wall jack. The terminal adaptor acts as an interface between a communication device and the NT-1. But if a computer is designed to be "ISDN-ready", a terminal adaptor is not needed because this functionality is built into the computer.

Software Requirements

As already mentioned, to connect the computer to the telephone system, either a dedicated telephone line (with a modem) or an ISDN line (which requires special equipment) is needed. To start with, a communications program is run to dial the phone and establish a connection with a remote Internet host. In most cases, an account from an Internet Service Provider is to be arranged. An Internet Service Provider (ISP) is a company that sells Internet access to the public. Basically there are two types of Internet accounts namely

- PPP Account
- Shell Account

These two types of account are described in detail below.

PPP Account

The first type of Internet account is the PPP Account. The PPP (Point-to-Point-Protocol) Account connects the computer right onto the Internet. A computer becomes a full-fledged Internet host during the time it is connected. This means that, for the duration of Internet session, the computer is a part of the Net, just like a computer directly connected with a cable. The only difference is that the computer is connected through a phone line. But, as for the rest of the Net is concerned, you are on the Net and other Internet computers can communicate with your computer directly. This means that the client programs you use to access the various Internet services run on your computer. For example, if you use a PC with Microsoft Windows, you would run Windows programs to act as your client. The best thing about a PPP connection is that you can use as many clients as you want at the same time. For example, you could start four programs - a web client, a gopher client, a mail client and an ftp client - and /or you could run two separate web clients at the same time. The right way to think about a PPP connection is as a tunnel into the Net. You run whatever client programs you want on your computer, and, when they need to send or receive information, they use the tunnel. The nature of the tunnel is such that it will support as many clients as you want to use.

Shell Account

The second type of Internet account is called a shell Account. With this type of account, you actually do your work on the remote computer. Your computer is not on the Net itself. Rather, your computer emulates a terminal, which allows you to work directly with the remote host. The only program that runs on your computer is the terminal emulation. All the Internet clients actually run on the remote computer. This allows you to use your keyboard and display (monitor) to work with the remote host. As the programs are not on your own computer, full advantage of the characteristics of your computer cannot be utilized. You are limited to the capabilities of the terminal your computer is emulating. Unfortunately, this means you can use only text-based programs. This means all your Internet clients can display only characters, giving them a plain appearance. There will be no fancy windows and pull-down menus. Another disadvantage to shell account is that, since you must run your client programs on the remote host, it is not convenient to use multiple client programs simultaneously. But with a PPP Account, you can run as many clients as you want on your own computer.

In spite of the above disadvantages, there are some advantages to this type of Account. First, to use the Net you must arrange for an account from an Internet Service Provider. Virtually these providers use Unix computers to act as hosts. With a shell account, you are using the remote host directly, and, hence, you have access to a Unix computer on the Internet. Second, graphical systems are nice, but they are inherently slower than text-based systems. This is because it takes a lot more information to display pictures and drawings than it does to display some characters, and, whenever you access a remote Internet service, you must wait for that information to be sent back to your client.

TCP/IP

TCP/IP is a collection or suite of protocols used to communicate across a network. The entire protocol is named TCP/IP after the two original protocols. Transmission control Protocol (TCP) and Internet Protocol (IP). Typically, the TCP/IP is broken down into four layers as given below.

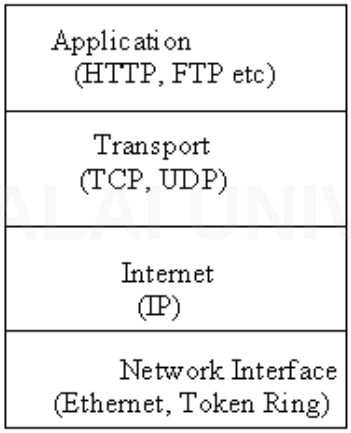


Figure 4.1: The Four Layers of the TCP/IP Model

From the diagram, it is observed that the protocols are layered. The reason is that layering protocols simplifies the task of communicating over the network and it allows for reuse of layers that are not specific to a particular location. Each layer is responsible for a different aspect of the transmission and each layer insulates the layers above it from some detail of network communication. For instance, whether a program is using HTTP or FTP protocol in the application layer, they both use the same underlying protocols - TCP, IP and Ethernet. The combination of all layers is referred to as a protocol stack. As data moves through the protocol stack, each layer attaches its own information. The information added by each layer is called a header. Once all layers have attached their header to the data, the package of information that results is called a packet. Once the data has been encapsulated inside a packet, it is transmitted across the network. At the destination, each layer removes its header from the packet and passes it up the stack. This process continues until the data is handled back to the application at the highest layer. The application was not interested in the headers attached by other layers; it was simply looking for data. However these headers were necessary in order to properly transport the information across the network. Each of the layers of TCP/IP is explained below:

Network Interface Layer

The network interface layer handles the lowest-level details of communication across the network. This layer consists of the network device driver (software) and the network Interface card (hardware). An Ethernet device driver and network card is a good example of an implementation of the network interface layer. Together these two pieces ensure the proper transmission of data across whatever medium is being used (coaxial cable, twisted pair, fiber optics, etc). The network interface layer insulates all layers above it from the complexities of interfacing with various network hardware and transmission mediums.

Internet Layer

The Internet layer is responsible for transmitting packets across the network. In the TCP/IP model, the Internet layer uses a protocol named IP (Internet Protocol). This protocol defines exactly how a packet must be structured if it is to be understood by an IP network. The Internet layers job is to build a packet that conforms to the standard IP protocol. An IP packet, also called a datagram, contains a great deal of information. This information includes the length of the header the total length of the packet, the type of service, time to live (how many times routers will forward the packet), checksum (for error detection), source address, destination address and much more

Transport Layer

The transport layer manages the manner in which data flows between hosts. Though the Internet layer does an excellent job routing network packets, it does not provide any mechanism to ensure their arrival. If guaranteed arrival is desired, that functionality must be provided in the transport layer. Within the TCP/IP model, there are two extremely different transport protocols - TCP and UDP (User Datagram Protocol).

TCP is a reliable protocol that guarantees the arrival of network packets. This guarantee is possible due to the connection-oriented approach implemented by the Transmission Control Protocol. Before any data is sent via the TCP protocol, a connection between the two hosts must first be established.

This connection verifies that the destination host is listening and that there is a valid network path whereby the data can reach the destination. The source machine waits for an acknowledgement from the destination host for every packet sent. If no acknowledgement is received or the destination requires a retransmission, the packet is sent again. **User Datagram Protocol** is the second protocol employed in the transport layer. UDP is an unreliable, connectionless protocol. UDP is referred to as "connectionless" because similar to mailing a letter, no connection is established between the source and destination when a packet is sent. Unlike TCP, this protocol does not automatically ensure a valid network path through which the packet can be delivered.

Application Layer

The application layer is responsible for providing services particular to an application. HTTP is an excellent example of an application level protocol. HTTP defines how a web client (or browser) communicates with a web server. In addition to HTTP, some examples of application layer protocols include FTP for file transfers, Telnet for remote login, and NNTP for news groups, and SMTP for sending e-mail, and POP 3 for receiving e-mail.

Internet Service Provider (ISP)

An ISP (Internet Service Provider) is a company that provides individuals and other companies access to the Internet and other related services such as Web site building and virtual hosting. An ISP has the equipment and the telecommunication line access required to have POP on the Internet for the geographical area served. The large ISPs have their own high speed leased likes so that they are less dependent on the telecommunication providers and can provide better service to their customers. Among the largest national and regional ISPs are AT and T world Net, IBM Global Network, MCI, Netcom, UONet and PSINet.

The larger ISPs interconnect with each other through MAE (ISP switching centers run by MCI world com) or similar centers. The arrangements they make to exchange traffic are known as peering agreements. There are several very comprehensive lists of ISPs worldwide available on the web.

An ISP is also sometimes referred to as an IAP (Internet Access Provides). ISP is sometimes used as abbreviation for Independent Service Provider to distinguish a service provider that is an independent, separate company from a telephone company. (The underlined terms POP and Virtual hosting have been defined below for better understanding of the definition of ISP).

POP: A point-of-presence (POP) is an access point to the Internet. A pop necessarily has a unique Internet Protocol address. The number of POPs that an ISP has is sometimes used as a measure of its size or growth safe.

Virtual Hosting: On the Internet, virtual hosting is the provision of web server hosting service so that a company does not have to purchase and maintain its web server and connections to the Internet. A virtual hosting provider is sometimes called a web or Internet "space provider". Typically, virtual hosting provides a customer (who wants a web site) with domain name registration assistance, multiple domain names that map to the registered domain name and optionally web site creation services.

4.2.4 Internet Services

Internet services are of varying stages of maturity. So the applications/services have been classified here as "Historic", "Classic" and "Hot".

Historic Internet Services

In spite of the fact that Internet is still not too old, technology changes so quickly that several "once hot" technologies have run out of gas on the information superhighway. Some of them are described below.

Gopher

The Gopher system is a powerful tool that allows the user to access many of the resources of the Internet in a simple, consistent manner. The Gopher system was developed at the University of Minnesota in April 1991. Within a short time of its development the gopher system became popular all over the world and thousands of gopher servers were established. Like other Internet tools, Gopher system uses clients and servers. To access the system, you run a program called GOPHER CLIENT. The Gopher client displays the menus and carries out the requests. Each time, a selection is made from a menu, the gopher client contacts a GOPHER SERVER to request for the information on behalf of the user.

How does Gopher Works?

Working with a Gopher client is easy. All you need to do is make one selection after another from a series of menus. Within a menu, the individual items can refer to specific information, or services, or to a completely different menu. When you make a selection, your client does whatever is necessary to carry out the request. For e.g. if you select a menu item that represents a text file, your client will get that file-wherever it happens to be on the Internet-and displays the information on the screen.

. Archie

Archie was an early server based search utility that allowed a user to search for files on anonymous FTP sites. Archie worked by regularly connecting to a list of sites providing anonymous FTP service and retrieving lists of the files offered by each site. These lists of file and directory names were then stored on the Archie server and used to respond to the search commands you type into the Archie program. As the Internet grew and the World Wide Web evolved Archie fell out of fashion and usefulness.

How does an Archie Works?

Conceptually, the workings of Archie are surprisingly simple at regular intervals, special programs connect to every known anonymous ftp host; and download a full directory listing of all the public files. These lists are stored in what is called the "Internet Archie Database" when you ask Archie to look for a file; all it needs to do is check the database. The various Archie server sites around the world each keep track of the anonymous ftp hosts in a certain portion of the Internet. For example, the Australian Archie host keeps track of all the Australian anonymous ftp hosts.

Veronica

Veronica is a gopher-based resource that allows you to search gopher space for menu items that contain specified words. The first version of veronica was developed in November 1992 at the university of Nevada. Veronica is a server based search utility that lets the user to specify a set of words and then searches through titles in Gopher space for those words. Veronica stands for very easy Rodent-Oriented Network-wide Index to computerized Archives.

How Veronica Works?

Veronica is usually pretty easy to use. All one has to do is to find a veronica resource in a menu and select that item. Windows will be presented into which, the type of search pattern can be typed. Veronica will check its database, find all the items that contain the search pattern, and send them to the user in the form of a menu. Thus, the result of a veronica search is a menu of regular gopher items, each of which contains the search pattern the user had specified.

4.2.5. Classic Internet Services

Classic Internet service packages are true staples of the Internet world. These services emerged early in the life of the network. They basically deal with basic communication and data transfer function. Examples are described below:

E-Mail

The Internet is a valuable tool for accessing information, but it also opens a whole new world of communications to it users. Using electronic mail (e-mail) a person can engage in conversations with people all over the world. Yet, because of its convenience, it is also a powerful tool for even local communication. To send an e-mail message to someone, his/her email address should be known. An email address is made up of three parts. The user's ID (or username) which comes before an @ sign, the @ sign itself, and the name of the computer where the user receives e-mail. Each computer connected to the Internet has its own unique address. Because of these unique addresses, e-mail can be delivered clear across the world through the Internet, much in the same way as giving your street address, town, and postal code allows physical mail to be delivered to you. An example of an email address is:

Johndoe@some.computer.edu

Every character irrespective of whether upper or lower case, is important. The ID is to the left of the @ sign. It is often a shortened version of the persons' name, such as their first initial and last name or their first name and last letter. However, many people are allowed to choose their Ids and use nicknames. In some cases the ID may be generated automatically by the computer and thus be a set of letters and numbers such as ab123. The person's home computer address is to the right of the @ sign and usually has some connection to the site where the user has his/her email account. This computer name is often called the "host" or "domain" name. (For a detailed report on e-mail refer section 4.5)

How E-Mail Works?

After a user composes an e-mail message and specifies recipients, e-mail software transfers a copy of the message to each recipient. In most systems, two separate pieces of software are required. A user interacts with an e-mail interface program when composing or reading messages. The underlying e-mail system contains a mail transfer program that handles the details of sending a copy of a message to a remote computer. When a user finishes composing an outgoing message, the e-mail interface places the message in a queue that the mail transfer program handles.

The mail transfer program waits for a message to be placed on its queue, and then transfers a copy of the message to each recipient. Sending a copy of a message to a recipient on the local computer is trivial because the transfer program can append the message to the user's mailbox. Sending a copy to a remote user is more complex. The mail transfer program becomes a client that contacts a server on the remote machine. The client sends the message to the server, which places a copy of the message in the recipient's mailbox.

When a mail transfer program contacts a server on a remote machine, it forms a TCP connection over which it communicates. Once the connection is in place, the two programs follows the Simple Mail Transfer Protocol (SMTP) that allows the sender to identify itself, specify recipients, and transfers an e-mail message.

Usenet

Usenet is a large collection of discussion groups involving millions of people from all over the world. Each discussion group is centered on a particular topic. In total, Usenet has more than 13,000 different groups. Many of these are of regional or local Internet. Although Usenet is used primarily for discussion groups, it is still popular only as a news-oriented item. It is often referred to as the NEWS or NETNEWS, even though there is little real news in the sense of a newspaper. Similarly, the Usenet discussion groups are usually referred to as NEWSGROUPS, or, more simply, GROUPS. Within each newsgroup, the individual contributions are called ARTICLES or POSTINGS.

How Usenet Works?

To read Usenet articles, a program called a NEWSREADER is used. The newsreader acts as an interface. It tells which newsgroups to read, one at a time. The news that is read is kept on the news servers that is connected to all messages and are kept on large hard drives. The amount of hard drives determines how many newsgroups can be kept and how long messages are kept. The lesser, the hard disk space, lesser the number of newsgroups the server can handle and the shorter time messages stay available for reading.

File Transfer Protocol (FTP)

FTP is a protocol used to transfer data over the Internet (as is HTTP and SMTP). It gets its name from its usage to move files between servers. If you need to move a large file or document, FTP is most certainly the way to go. FTP is a two-way protocol in that you can both send and receive files and control both processes.

How FTP Works?

When you run an FTP program, you simply tell it which server to connect to and it does. Sometimes, you have to enter a specific log in and password. Other times you can log in with just an e-mail address. Once you are logged in, you are presented with a directory structure that you have access to. You can navigate the directory structure and depending on the system, pull files off the server or put files on to the server (get and put). The files will then be copied from one location to the other (typically, from the server to your hard drive). It's analogous to copying files from one directory or folder on your computer to another, except that one of the folders could be on a server three thousand miles away. FTP specifies three modes for data transmission:

- Stream mode, which treats the file as a sequence of bytes. This mode can be used with any type of data type. When the file structure is of type Record, special two byte control characters are used to indicate the end of a record (EOR) and the end of a file (EOF). If the file structure is of type File, the EOF is indicated by the sending computer closing the data connection.
- Block mode, in which the file is transmitted as a number of block. Each block is preceded by a header, which contains the size of the block and a description. The descriptor also has a bit that indicates whether the data is reliable. This bit is used when voluminous data, such as geologic or atmospheric data being read off a medium, results in a media error.
- Compressed mode, which is used to transfer files efficiently and utilize network bandwidth optimally. The compression is fairly simple, where a string of x replications of a data byte is compressed into 2 bytes

FTP Sites

Just as the Internet uses the **Hyper Text Transfer Protocol (HTTP)** to transfer Web pages between computers, it uses the **File Transfer Protocol (FTP)** to transfer files. FTP is the method of choice for file movement across the 'Net.

The files you seek to transfer may contain anything: Supreme Court decisions, shareware programs, or recipes. They may have different formats and come from different operating systems. FTP seamlessly does the translation and transfer.

A **Uniform Resource Locator (URL)** is a standardized naming, or addressing, system for documents and media accessible over the Internet. URLs for FTP sites look similar to those used for Web sites, but they begin with ftp://rather than http://. Many Web sites have **hyperlinks** (icons or text that, when clicked, automatically opens another file) to files you can access with FTP, if you click one of these links; it launches an FTP program to transfer the file.

Examples of FTP addresses are:

ftp://is.internic.net	(for information about the Internet)
ftp://arhive.umich.edu	(Software)
ftp://uiarchive.cso.uiuc.edu	(Project Gutenberg texts)
ftp://rtfm.mit.edu	(frequently asked questions)

In the past, FTP was difficult to use. You had to run a special FTP utility, and then log in to an FTP site (a remote computer) with an ID and password.. Next, you had to use a series of obscure FTP commands--**cd** to change directories, **dir** or **Is** (list) to display a directory, **get** to retrieve a file--to navigate the site.

Fortunately, time has made things simpler. For starters, sites providing "anonymous FTP" have proliferated. At these locales, administrators have set up simple guest accounts for everyone. Just use "anonymous" as your name, and your E-mail address as your password. The most important aspect of this is that Web browsers now do FTP for you. They mask the complexity behind a familiar interface. For instance, they log you in as "anonymous" and supply the password.

Let's try a few examples to see how FTP works. We'll assume *Netscape Navigator* is our Launch you onto the Web by the usual means. In your browser's URL box, type **ftp://archive.umich.edu** and press ENTER. The top line tells you you're in the root directory (/) of an FTP site. Whether the site offers FTP or the Web, you're essentially navigating the directory structure of a remote system. It's the same as navigating your hard drive, but the symbol for a directory is a forward rather than backward slash. Below the directory identifier you may find a brief greeting or set of instructions. Some sites limit your access to certain hours or impose other restrictions, be sure to follows these rules.

Below this header you'll see a list of items in the root directory. As in a typical DOS directory, there's a mixture of files and subdirectories. You can tell which is by the icon on the left. A folder denotes a subdirectory and a blank page denotes a generic file. A page with writing indicates a text, HTML, or PostScript file; while one with "010" on it indicates an executable program.

For FTP purposes, *Microsoft Internet Explorer* works about the same as Navigator. There are minor differences in the way the two browsers present at FTP site. Internet Explorer tells you the site's name in the top line but doesn't display icons, and provides less file information.

Hot Internet Software

Hot Internet software is the software receiving the most attention at any given time. Currently, there is one hot software to talk about (though it does encompass numerous technologies!):

World-Wide Web (WWW)

The World-wide Web is a worldwide collection of documents linked together by their use of 'links' or words that point to other documents. It consists of interconnected pages of information located on computers (called servers) throughout the Internet. These documents (Web pages) contain text, graphics, and even sound and video.

It uses HTTP (**H**yper **T**ext **T**ransfer **P**rotocol) to transfer the information from server to server. The information is written in HTML (**H**yper **T**ext **M**arkup **L**anguage), a language understood by the web browsers.

How WWW Works?

Web pages are kept on servers across the world. A page in Texas may have a link to a page in Germany, which may contain an image kept on a server in China. When you visit a web site, that server sends the text of the document you requested to your web browser. Your web browser then interprets the text (which is written in HTML) to display the web page on your screen. When the page contains images, the browser will request that the server send those images to it (or it will contact another server, if the images lie elsewhere). For the most part, web pages are open to any one to read and several search engines are available to help you find these pages. To view web pages, you need a web browser. The two most popular ones are Netscape's Navigator and Microsoft's Internet Explorer. Both support the latest *official* version of HTML as well as several of their own special tags. Netscape is available for most platforms including Windows 95/NT, Macintosh, Linux, and OS/2. MSIE is available for Windows 95/NT, and Macintosh. You can also make your own web pages. Several Web Development tools have been discussed in detail in section 4.6.

4.2.6. Internet Addressing

What is Internet Addressing?

Internet addresses are one of the resources critical to the operation of the Internet and as such, are becoming increasingly controversial. Like telephone number, Internet addresses are globally unique and define the end points of communication, however unlike telephone numbers, Internet addresses are not generally used by the public except for the occasional one time software or hardware configuration.

To guarantee uniform addressing for all hosts, protocol software defines an addressing scheme that is independent of the underlying physical addresses. Although an Internet addressing scheme is an abstraction created by software, protocol addresses are used as destinations for the virtual Internet analogous to the way hardware addresses are used as destinations on a physical network. To send a packet across an Internet, the sender places the destination's protocol address in the packet and passes the packet to protocol software for delivery. The software uses the destination protocol address when it forwards the packet across the Internet to the destination computer.

Uniform addressing helps create the illusion of a large, seamless network because it hides the details of underlying physical network addresses. Two application programs can communicate without knowing either hardware address. The illusion is so complete that some users are surprised to learn that protocol addresses are supplied by software and are not part of the computer system.

IP Address and Host Name

In the TCP/IP protocol stack, addressing is specified by the Internet Protocol (IP). The IP standard specifies that each host is assigned a unique 32-bit number known as the Host's Internet Protocol Address, which is often abbreviated IP address, or Internet address. Conceptually, each 32-bit IP address is divided into two parts: a prefix and suffix; the two level hierarchy is designed to make routing efficient. The address prefix identifies the physical network to which the computer is attached. While the suffix

identifies an individual computer on that network, (that is each physical network in an Internet is assigned a unique value known as a network number) the network number appears as a prefix in the address of each computer attached to the network. Furthermore, each computer on a given physical network is assigned a unique address suffix.

Although no two networks can be assigned the same network number and no two computers on the same network can be assigned the same suffix, a suffix value can be used on more than one network. For e.g. if an internet contains three networks, they might be assigned network numbers 1,2 and 3. Three computers attached to network 1 can be assigned suffixes 1,3 and 5 while three computers attached to network 2 can be assigned suffixes 1,2 and 3.

The IP address hierarchy guarantees two important properties:

- Each computer is assigned a unique address (i.e., a single address is never assigned to more than one computer).
- Although network number assignments must be coordinated globally, suffixes can be assigned locally without global co-ordination.

Though numeric addresses are easy for a computer to work with, they are extremely difficult for humans to remember. For this reason, it is possible to assign an alias, known as a hostname, to an IP address. For instance the IP address of 207.46.131.15 signifies the domain name www.microsoft.com. Certainly, the latter is much easier to remember.

The first portion of the host name/domain name (www in this case) is arbitrary. It's meaning is interpreted by the server.

Another common value for this position is ftp for file transfer services such as ftp source stream.com. Though terms like www and ftp are commonly used, the server does not use this data to determine the type of service to provide. The type of service (E.g. HTTP, FTP, Telnet) is determined by the port on which the connection was established.

The final string, .com is referred to as top-level domain. The top-level domain defines the type of organization. Some common top-level domains are explained in the table.

Common Top Level Domain

Domain	Description
• com	For commercial enterprises
• edu	Educational facilities such as universities and technical colleges
• gov	Non-military govt. organization
• net	Network facilities such as ISPs and network integrators
• org	Non-profit organization

Figure 4.2

Lastly, the middle string combined with the top-level domain (Microsoft) creates a unique domain name that allows Internet users around the world to locate a site.

Domain Name System (DNS)

The Domain Name System (DNS) is an Internet-wide system for the resolution of hostnames and IP addresses. It is also called Domain Name Service. DNS is a distributed database system that translates host names to IP addresses and IP addresses to hostnames. DNS is also the standard Internet mechanism for storing and accessing several other kinds of information about host; it provides information about a particular host to the world at large. For example, if a host cannot receive mail directly, another machine will receive mail for it and pass it on; that information is communicated with DNS.

DNS clients include any program that needs to do any of the following:

- Translate a host name to an IP address
- Translate an IP address to a hostname
- Obtain other published information about a host

Fundamentally, any program that uses hostname can be a DNS client. This includes essentially every program that has anything to do with networking, including both client and server programs for Telnet, SMTP, FTP, and almost any other network service. DNS is thus a fundamental networking service, upon which other network services rely.

How DNS Work?

The procedure goes like this: When a client needs a particular piece of information (e.g. the IP address of host ftp. Somewhere example) it asks its local DNS server for that information. The local DNS server first examines its own cache to see if it already knows the answer to the client's query. If not, the local DNS server asks other DNS servers, in turn, to discover the answer to the client's query. When the local DNS server gets the answer, it caches the information it got and sends the answers to the client. For example, to find the IP address, for ftp somewhere example, the local DNS server first asks one of the public root name servers as to the name-serving machine for the example domain. It then asks one of those example name servers whose machines are name servers for the somewhere example domain and then it asks one of those name servers for the IP address of ftp. Somewhere example. This is how the DNS works.

4.2.7 E-Mail Fundamentals

The Internet is a valuable tool for accessing information, but it also opens a whole new world of communications to its users. Using electronic mail (e-mail) a person can engage in conversations with people all over the world. Yet, because of its convenience, it is also a powerful tool for even local communication. With typical telephone communications you may be either interrupted by a call, or may return a call only to find that the other person is not available." Electronic mail though, sits on the server computer until you are ready to read it and it will then wait patiently on the person's computer until they have time to read it.

To send an e-mail message to someone you must know his/her email address. An email address is made up of three parts. The user's ID (or username), which comes before an @ sign, the @ sign itself, and the name of the computer where the user receives email. Each computer connected to the Internet has its own unique address.

Because of these unique addresses, e-mail can be delivered across the world through the Internet; much the same way allows physical mail to be delivered to you by giving your street address, town, and postal code. An example of an email address is: Johndoe@some.computer.edu. In order to read your email, you need to use a mail reader program on your computer.

Reading E-mail

Reading your email is typically quite simple. Once the mail software is setup correctly all you usually need to do is open the mail program. While most mail programs automatically check for email when you start them, sometimes you will have to tell it to check for new messages under one of the headings on your menu bar.

If you have any messages you should see them listed on the screen or in your "In" box after the program has downloaded the messages. To read the first message, all you usually need to do is hit return. At the top of each message is a header with information about the origin, date, and routing of each message. Below is a sample message header:

From johndoe@some.computer.edu (John Doe)
To: class110@another.place.com
Subject: we're here!!

Date: Mon, 16 Oct 95 20:31:48 MDT

Note that the id corresponding to " To " will be the id of the person to whom the message was sent.

Note the time and date of the message and whom it is "From." If you use the Reply function of your software package, your reply message will automatically be sent to this person. Listservs are electronic mailing lists used for group interaction. Some listservs add a From line with the list's address in it so that replies will come back to the listserv instead of going back to the individual who originally sent the message. Be aware that when you reply to a message your response may be seen by a large number of people if it goes back to a listserv.

The sender chooses the subject. It usually tells what the message is about.

Other headers may also be seen but usually are not important for basic message handling. For instance, "Received:" headers indicate the systems through which the message was routed and can be helpful if your reply is returned to you as undeliverable but otherwise aren't of particular interest. Unless you wish to keep an e-mail message for a specific purpose, it is good practice to delete it once it has been read.

Sending an E-mail Message

Generally there are three options for sending a person message. If you have already received a message from them and you want to respond to their comments, you can use the "reply" button or option, which automatically address your message to the sender so that you don't need to type in their email address. Or, if you want to send someone a message from whom you don't have a message, you can choose the "new" button or option to send them an original message. You will need to know their e-mail address though, and enter it in the To field. And finally, if you want to pass along a message from someone to another person who might be interested in seeing it, you can "forward" a message.

Replying

If you currently have an e-mail message in the In box of your mail reader to which you'd like to respond, you can just click on the Reply button or find it on a pop-up menu in most Windows.

Sending a New Message

When sending a new message, you will be presented with the same type of format as the reply except that none of the blanks will have information in them. You need to know the e-mail address of the person to whom you want to send the message. If the person has the same host computer as you, then all you need to type in is the person's ID. IF the person is on a different host, then type in the full email address. You can use more than one email address in the To line in order to send the message to multiple people. Normally you must separate the multiple email addresses by commas or spaces.

Forwarding

On certain occasions, you may want to pass along a message you receive to someone else who might be interested in the information. Like sending a new message you will need to enter the e-mail address of the person to whom you are sending the message. However, like a reply, the subject line will already be entered for you and the text of the forwarded message will appear in the body of the message. If need be, you can add additional text to the body in order to explain why you are forwarding the message to the person. As with replies, you can change the subject from the one automatically assigned if you desire.

Saving and Printing an E-mail Message

While it is generally a good idea to delete old e-mail message after you read and respond as needed to them, there will be occasions when you want to save the messages. You can usually save a message in two different ways. In an "e-mail folder" within your email program, allowing you to group related messages together for easy reference, or to your hard disk as a separate text file.

Printing a Message:

You have several options for printing your e-mail depending on how you are accessing your mail and the software you are using. A few of them are:

Option I - Print It:

Use of mail reader's print command. When you are viewing the message you wish to print, click on the print button.

Option II - Print Selection:

If you follow option I above and don't get output to your printer, highlight the text that was dumped to the screen and then look for a "print selection" option in your software. If you have this option, use this option to print the selection directly to your printer.

4.2.8 Web Page Creation / Web Development Tools

Commercial tools aimed at the web are entering the market place at a furious pace, each competing for visibility. Some of the commonly available and widely used web development tools are:

- Web Browsers, Web Servers, HTTP Protocol, HTML

Types of Web Browsers

A browser is the computer program (Interface) used to explore the World Wide Web. Web browsers are applications that run on a user's personal computer to provide the interactive graphical interface for searching, finding, and viewing text documents, sounds, animations and other multimedia resources on the web. The browser program translates documents containing the HTML language into words and images on the screen. Browsers are the "window to the web" for Internet users around the world. The different classes of browsers are given below:

(a) Graphical Browsers

Graphical browsers display pictures, play sounds and show animations. They are multimedia presentation tools. Multimedia features place high demands on data transmission and storage hardware. It takes a lot of transmission time as well as disk space to utilize video and high fidelity sound. Commonly used graphical browsers are:

1. Navigator

Currently Netscape's Navigator browser is the most widely used graphical browser on the web. The Netscape Communications Corporation, a subsidiary of America Online, also distributes Navigator as part of its communicator package of desktop software.

2. Internet Explorer

The other popular graphical browser is Microsoft's Internet Explorer. These two browsers, Netscape's Navigator and Microsoft's Internet Explorer, are major players in the current "browser users" being fought on the web.

3. Mosaic

The first popular graphical browser, called Mosaic, was developed by National Center for Supercomputing Applications (NCSA) at the university of Illinois. This browser is no longer being revised, but can be downloaded from the web site.

(b) Text-only Browsers

There is strong support for text only browsers by the original community of Internet users. They maintain that the web exists to share information and that most information can be more quickly shared if users don't have to wait for large graphic files to cross the web. Commonly used text only browser is lynx. Lynx was developed at the university of Kansas for computer platforms using the UNIX operating system. It ignores all HTML references to colors, pictures, sounds or videos.

(c) Non Visual Browsers

Web weavers must also be aware of non-visual applications for the Internet. A new generation of personal computer will come equipped with speech synthesizers. These systems will not only be used by visually impaired users, but also by normal people working away from their computer screens.

Web Servers

A web server, also known as an HTTP server, responds to requests from a web browser by returning HTML images, applets or other data. The web server is also responsible for enforcing security policies, storing frequently requested files in cache, logging requests and much more. Some of the most popular servers include the following.

1. Fast Track: Fast Track is the "personal edition" Web server from Netscape intended for low-traffic sites with lower functionality requirements.
2. Microsoft Internet Information Server (IIS). It is Microsoft's entry into web server market. The biggest drawback to IIS is that it is available only on the Windows NT platform. IIS provides several simple scripting options for customizing a web site.
3. The Apache web Server: It is an industrial strength, public domain HTTP server for UNIX and Windows NT. Since its inception, the Apache web server has evolved to become arguably the fastest, most functional and most popular HTTP server on the web.
4. Java Web Server: Java Web Server is an HTTP server implemented in Java. The Java nature of this server allows it to be run on a wide array of platforms. In addition to the standard functionality supported by other HTTP servers, the Java Web Server supports a revolutionary new way of extending the server's functionality with server-side applications.

HTTP Protocol

Hypertext Transfer Protocol is a stateless, TCP/IP based protocol used for communicating on the World Wide Web. HTTP defines the precise manner in which Web clients communicate with Web Servers. The HTTP protocol follows a very simple request/response paradigm. To better illustrate an HTTP conversation between a browser and a server, it passes through the following four stages.

1. The client opens a connection to the server. Since TCP connections are established down in the transport layer of the protocol stack, there is not a lot of HTTP specific activity in this stage. By default, the connection on the server is made to port 80 (the well known HTTP port), unless otherwise specified.
2. The client makes a request to the server. The request can be broken into three parts: the request method, the resource name, and the protocol. GET is an HTTP method requesting the server to send a file. Because a TCP connection to the server is established in the previous stage, it is assumed that the requested resource resides on the server with which the browser is currently connected.

3. The server responds to the request. The server responds with a status code, various header fields, and if possible, the contents of the requested file. Every HTTP response includes a status code. The combination of the status code line plus all header fields is known as the HTTP header. Header fields convey same information about the server or the requested resource.
4. The connection is closed. The TCP connection may be closed either by the server or the client or both. Usually, it is the server that terminates the connection after the response has been sent.

HTML

HTML, or Hyper Text Markup Languages, is the language used to create hypertext documents on the World Wide Web. HTML describes the semantic value of a document such as the layout of the page or the relative size of fonts. HTML allows you to format text, add rules, graphics, sound, and video and save it all in a text-only ASCII file that any computer can read. The key to HTML is in the tags, which are like keywords enclosed in less than (<) and greater than (>) signs that indicate what kind of content is coming up. For a detailed discussion on HTML and its tags, refer section 4.7.

4.2.9 Introduction to HTML

What is HTML?

HTML is a document layout and hyperlink-specification language. It tells the browser how to display the contents of the document, including text, images, and other support media. The language also tells how to make a document interactive through special hypertext links, which connects the document with other documents on either our own computer or someone else as well as with other Internet resources, like FTP and Gopher.

HTML, in fact stands for Hypertext Markup Language. Each of these terms has got its own meaning. H-stands for hyper document. A hyper document is one that contains links to other "things" or places either within or outside the document. The T stands for "text". These are the words we would like to display on the computer's screen. HTML evolved as a screen-oriented subset of the standard generalized Markup Language (SGML). It allows "portability across platform" meaning that it allows all sorts of computers anywhere in the world to view documents containing HTML codes. The ML in HTML stands for "Markup Language". This term comes from the publishing industry and it is proofreader's marks. Editors use symbol like ¶ for the paragraph mark, to indicate a change in the way the text appears on the page. Instead of symbols, HTML uses letters bracketed in less-than (<) and greater than (>) signs, also called angle brackets. For example, HTML uses <P> to indicate the start of a new paragraph.

Essentials for Writing HTML

Two basic needs for writing an HTML page are the text editor and the browser to view that page. The text editor depends upon the operating system you are using. Some of the basic text editors for common operating system are:

Text Editors

DOS:

If you are using the Microsoft DOS or another version of DOS, you will probably have the access to a text editor called edit.

Windows:

In any version of windows use the notepad editor, which is in the accessories group. You can also use Microsoft Visual InterDev, Microsoft Front Page.

Macintosh:

On a Mac, use simple Text or Teach Text (they are just the same except that simple Text is used in the newer Mac system).

UNIX:

On UNIX, you can use Joe, Pico, Vi or Emacs editors.

Browsers:

The two most popular browsers are Internet Explorer (IE) and Netscape Navigator. Apart from these, other browsers used for viewing the web pages are Lynx (a text only browser), Mosaic (the first graphical browser on which both IE and Netscape are based). A detailed description of browsers is given in section 4.6.1.

4.2.10. HTML Terminology

Tags

One of the first terms in HTML terminology and very commonly used one is tag. Tags are HTML codes that are enclosed in angle brackets (< and >). These tags are used to layout the web page. For example the
 Tag adds a line break into the text. Other tags center text, insert graphics, or change the screen color. HTML tags are not case sensitive; <b> means the same as <B>. Tags come in two general types- **containers** and **empty** tags.

a. Empty Tags

The tag
 is an **empty** tag; it does not hold, or surround, any text.

b. Container Tags

The other type of tag, a container, has both a starting tag and an ending tag. Between the starting and ending tags is information that is controlled by the container. For example, the 'bold ' container tag is very useful while formatting text. It looks like this in HTML.

This text is <B> bold <B>

This container would produce the following when viewed by most browsers.
This text is **bold.**

The <B>bold<B>container makes the text it holds, or the contains appear in a bold font. Notice that the bold tag starts with what looks like an empty tag (<B>)and ends with a slightly different form of that tag. The ending tag has a forward slash before the tag character (</B>).

It is very important to place the ending tag correctly behind the desired text. In this case, if we leave off the ending tag, the browser would bold the rest of the text in the document.

Attributes

Empty or starting container tags can contain other HTML elements, called attributes, which are special codes that modify the related tag. For example, the paragraph <P> container identifies a paragraph of text. It has one attribute, align, which allows you to have the paragraph left justified, right justified or centered in the line like this:

<P align = "center"> Place this like in the middle of the page </P>

Ending container tags cannot have attributes

4.2.11 HTML Skeleton

The HTML document starts and ends with <html> and </html> tags. These tags tell the browser that the entire document is composed in HTML. All HTML documents have two main structures: a head and a body, each bounded in the source by the respectively named start and end tags. Any information about the document is put within the head and the contents to be displayed on the browser's window are put inside the body. For most documents, however, the important header element is the title. The title instantly tells the leader what the document is about. A simple HTML code is given below:

```
<html>
<head>
<title> Title of page </title>
</head>
<body>
        This is my first homepage
<b> This text is bold </b>
</body>
</html>
```

The first tag in your HTML document is <html>. This tag tells your browser that this is the start of an HTML document. The last tag in your document is </html>. This tag tells your browser that this is the end of the HTML document. The text between the <head> tag and the </head> tag is header information. The text between the <body> tags, is the text that will be displayed in your browser. The text between the <title> tags is the title of your document. The title is displayed in your browser caption. The text between the and tags will be displayed in a bold font.

In order to run the above HTML document and see the results, follow the following steps. If you are running windows, start Notepad and type the contents of the document. Save the file as "mypage html". Start your Internet browser select "Open" in the file menu of your browser. A dialog box will appear. Select "Browse" and locate the HTML file you have just created ,"mypage html". Select it and click "Open" and the browser will display the page.

4.2.12. Basic HTML Tags

Some of the basic HTML tags are explained below.

Headings

Headings are defined with the <h1> to <h6> tags. <h1> defines the largest heading. <h6> defines the smallest heading.

```
<h1> This is a heading </h1>
<h2> This is a heading </h2>
<h3> This is a heading </h3>
<h4> This is a heading </h4>
<h5> This is a heading </h5>
<h6> This is a heading </h6>
```

HTML automatically adds an extra blank line before and after a heading.

Paragraphs

Paragraphs are defined with the <p> tag

```
<P> This is a paragraph </P>
<P> This is another paragraph </P>
```

HTML automatically adds an extra blank line before and after a paragraph.

Line Breaks

The
 tag is used when you want to end a line, but don't want to start a new paragraph. The
 tag forces a line break wherever you place it.

```
<P> This <br> is a para <br> graph with line breaks </P>
```

The
 tag is an empty tag. It has no closing tag

Comments in HTML

The comment tag is used to insert a comment in the HTML source code. A comment will be ignored by the browser. You can use comments to explain your code, which can help you when you edit the source code at a later date.

```
<! ---- This is a comment >
```

Note that you need an exclamation point after the opening bracket, but not before the closing bracket.

4.2.13. Text Tags

One of the special things about the web is that you can format your pages in a logical way indicating which paragraphs of words are important rather than assigning specific fonts and sizes. Each individual browser then uses the formatting capabilities of the local computer to give emphasis in its own way. Text tags are of the following types

- Text formatting Tags
- Computer Output Tags
- Citations, quotations, Definition Tags

These tags are explained in detail below:

Text Formatting Tags

Some of the text formatting tags are:

1. <B> Tag:

Specifies that the text should be rendered in bold. The B element is a text level element and requires a closing tag.

Example: <B> This text displays boldface </B>

2. <big> Tag:

The use of Big element is to enlarge text. It requires a closing tag.

Example: <BIG> This text is bigger in size </BIG> then this text

3. Tag (Emphasis):

Indicates the content should be emphasized. It requires a closing tag.

Example: <EM> This text will be emphasized in some way </EM>

4. <i> Tag:

Specifies that the text should be rendered in italic. It requires a closing tag.

Example: <I> This text displays in italic </I>

5. <small> Tag:

Makes the text one size smaller, which is within the text. It requires a closing tag.

Example: This example is to explain the <small> small </small> tag

6. Tag:

Indicates that the text inside the tag should be given more emphasis. It gets more preference over <B> Tag.

Example: I am more stronger than him

7. <sub> Tag:

Used to indicate the subscripted section, using a smaller font than the current font.

Example: log ₁₀

8. <sup> Tag:

Used to indicate a superscripted section, using a smaller font than the current font.

Example: a ² -b ² = (a+b) (a-b)

Computer Output Tags

Some of the Computer Output Tags are,

1. <Code> Tag:

The code element displays text in a font used to represent computer code.

Example: <Code> Here is some text in a small, fixed-width font</code>

2. <kbd> Tag:

Renders text in a fixed-width font.

Example: <kbd> This text renders in a fixed width font </kbd>

3. <pre> Tag:

The pre tag helps maintain the original line breaks and spacing that has been inserted in the text.

Example:
```
<pre> This text is written
                in pre tag
                        so it will come as
                                formatted
</pre>
```

4. <plaintext> Tag:

Renders text in a fixed-width font without processing tags. If you want to show the HTML tags in your web page, you can use it.

Example:
```
<plaintext>
<Html>
<Head>
<Title> CSS </Title>
<Body>
<Html>
<Body> I am Good
</Body></Html>
```

Citation Tags

Some of the citation tags are:

1. <acronym> Tag:

It indicates the presence of an abbreviation.

Example: <acronym> CBI </acronym>

2. <address> Tag:

The address tag defines an address element.

Example: <address> This text will be italic </address>

3. <bdo> Tag:

The bi-directional override element controls the direction that text is displayed for foreign language (right to left or left to right).

Example:

<Bdo dir = "ltr"> This fragment is in English, WERBEH NI SI TNEMGARE SIHT </Bdo>

The Dir is an attribute required to indicate the direction of text; dir= "rtl" for right to left text or Dir = "ltr" for left to right text

4. <blockquote> Tag:

The blockquote element is used to set off a quotation that renders an indented text.

Example: <p> He said
<Blockquote> "Hi there!" </Blockquote>

5. <Cite> Tag:

Indicates a source that is being used as a citation. The text within <Cite> and </Cite> is usually rendered in italic.

Example: <Cite> Its font is different from the others </Cite>

6. <dfn> Tag:

Indicates the presence of a definition.

Example: <dfn> HTML stands for Hypertext Markup Language </dfn>

4.2.14. Links

Links are the distinguishing feature of the World Wide Web. They enable the current document to establish link with another document by a click on the hyperlink. Links are categorized as external link and Internal link. External links enable you to establish link with your document to another document, which is not on your own site. Whereas Internal links are the part of your site. External links is explained in section 4.7.7.1 and 4.7.7.2 where as internal links is explained in section 4.7.7.3.

The Anchor Tag and the href Attribute

HTML uses the <a> (Anchor) tag to create a link to another document.

An Anchor can point to any resource on the web such as an HTML page, an image, a sound file, a movie etc. The syntax of creating an anchor is as follows:

 Text to be displayed

The <a> tag is used to create an anchor .The href attribute is used to address the document to link to, and the words between the open and close of the anchor tag will be displayed as a hyperlink.

This anchor defines a link to yahoo.com

 Visit yahoo!

The line above will look like this in a browser:

Visit Yahoo!

The Target Attribute

With the target attribute, you can define where the linked document will be opened.

The line below will open the document in a new browser window.

 Visit Yahoo!

The Anchor Tag and the Name Attribute

The name attribute is used to create a named anchor. When using named anchors we can create links that can jump directly into a specified section on a page instead of letting the user scroll around to find what he/she is looking for. Syntax of a named anchor is as follows:

 check mail section

You should notice that a named anchor does not display in a special way.

To link to the named anchor, you add a # sign and the name of the anchor to the end of the URL, like this:

Check mail section

The line above will take the user straight to the text within the anchor.

 ----- within the file "html - link.asp"

4.2.15 Lists

As the name suggests, list is used to group some relative elements together. Basically, lists can be categorized into three categories.

- Unordered list
- Ordered list
- Definition list

Unordered List

An Unordered list is a list of items. The list items are marked with bullets (typically small black circles).

An unordered list starts with the <ul> tag. Each List item starts with the <li> tag.

```
<ul>
<li> Coffee </li>
<li> Milk </li>
</ul>
```

This is how it looks in a browser:

- Coffee
- Milk

Inside a list item you can put paragraphs, line breaks, images, links, other lists, etc.

Ordered Lists

An ordered list is also a list of items. The list items are marked with numbers. An ordered list starts with the <ol> tag. Each list starts with the <li> tag.

```
<ol>
<li> Coffee </li>
<li> Milk </li>
</ol>
```

This is how it looks in a browser:

1. Coffee
2. Milk

Definition Lists

A definition lists is not a list of items. This is a list of terms and explanation of terms.

A definition list starts with the <dl> tag. Each definition list term starts with the <dt> tag. Each definition-list definition starts with the <dd> tag

```
<dl>
<dt> Coffee </dt>
<dd> Black hot drink </dd>
<dt> Milk </dt>
<dd> White cold drink </dd>
</dl>
```

This is how it looks in a browser:

Coffee
    Black hot drink
Milk
    White cold drink

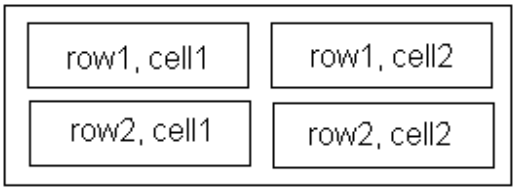
Inside a definition list (the <dd> tag)you can put paragraphs, line breaks, images, links, other lists, etc.

4.2.16. Tables

Tables are defined with the <table> tag. A table is divided into rows (with the <tr> tag), and each row is divided into data cells (with the <td> tag). The letters td stands for "table data", which is the content of a data cell. A data cell can contain text, images, lists, paragraphs, forms, horizontal rules, tables etc.

```
<table border = "1">
<tr>
<td> row1, cell1 </td>
<td> row1, cell2 </td>
</tr>
<tr>
<td> row2, cell1 </td>
<td> row2, cell2 </td>
</tr>
</table>
```

This is how it looks in a browser:



Tables and the Border Attribute

If you do not specify a border attribute, the table will be displayed without any borders. Sometimes this can be useful, but most of the time, you want the borders to show.

To display a table with borders you will have to use the border attribute.

```
<table border = "1">
<tr>
<td> Row1, cell1 </td>
<td> Row1, cell2 </td>
</tr>
</table>
```

Headings in a Table

Headings in a table are defined with the <th> tag.

```
<table border = "1">
<tr>
<th> Heading </th>
<th> Another Heading </th>
</tr>
<tr>
<td> row1, cell1 </td>
<td> row1, cell2 </td>
</tr>
<tr>
<td> row2, cell1 </td>
<td> row2, cel2 </td>
</tr>
</table>
```

This is how it looks in a browser:

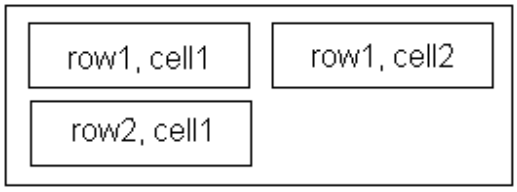
Heading	Another Heading
row1, cell1	row1, cell2
row2, cell1	row2, cell2

Empty Cells in a Table

Table cells with no content are not displayed very well in most browsers.

```
<table border = "1">
<tr>
<td> row1, cell1 </td>
<td> row1, cell2 </td>
</tr>
<tr>
<td> row2, cell1 </td>
</tr>
</table>
```

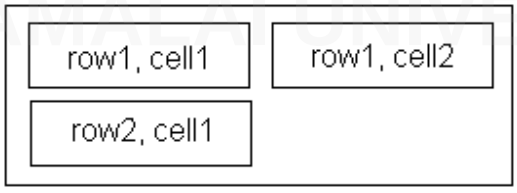
This is how it looks in a browser:



Note that the border around the empty table cell is missing. To avoid this, add a non-breaking space ( ) to empty data cells, to make the borders visible.

```
<table border = "1">
<tr>
<td> row1, cell1 </td>
<td> row1, cel2 </td>
</tr>
<tr>
<td> row2, cell1 </td>
<td>   </td>
</tr>
</table>
```

This is how if looks in a browser:



Spacing and Padding the Cells

Cell spacing adds space between cells, making the table bigger without changing the size of individual cells.

To add cell spacing:

Within the initial table tag, type CELLSPACING = n, where n is the number of pixels desired between each cell. The default value for cell spacing is 2 pixels.

To add cell padding:

Within the initial table tag, type CELLPADDING = n, where n is the number of pixels desired between the contents and the walls of the cell. The default value for cell padding is 1 pixel.

4.2.17. Forms

A form is an area that can contain form elements. Form elements are elements that allow the user to enter information (like text fields, text area fields, drop down menus, radio buttons, checkboxes etc) in a form.

A form is defined with the <form> tag.

```
<form>
        <input>
        <input>
</form>
```

Input Button

The most used form tag is the <input> tag. The type of input is specified with the type attribute. The most commonly used input types are explained below:

- **Text Fields:**

Text fields are used when you want the user to type letters, numbers, etc, in a form.

Example:

```
<form>
First name:
<input type = "text" name = "first name">
<br>
Last name:
<input type = "text" name = "last name">
</form>
```

This is how it looks in a browser

First name :

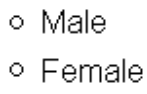
Last Name :

- **Radio Buttons:**

Radio buttons are used when you want the user to select one out of a limited number of choices.

```
Example:    <form>
            <input type = "radio" name = "sex" value = "male">Male
            <input type = "radio" name = "sex" value = "female">Female
            </form>
```

Here is how it looks in a browser. Note that only one option can be chosen.

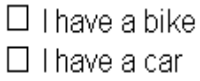


- **Check Boxes:**

Check boxes are used when you want the user to select one or more options from a limited number of choices.

```
Example:    <form>
            <input type = "checkbox" name = "bike" value = "yes">
            I have a bike
            <br>
            <input type = "checkbox" name = "car" value = "yes">
            I have a car
            </form>
```

This is how it looks in a browser:



The Form's Action Attribute and the Submit Button

When the user clicks on the "submit" button, the content of the form is sent to another file. The form's action attribute defines the name of the file to which the content of the form is to be sent. This file defined in the action attribute usually does something with the received input.

```
Example:    <form name = "input" action = "html-form-action.asp" method = "get">
            User name:
            <input type = "text" name = "user">
            <input type =  "submit" value = "submit">
            </form>
```

This is how it looks in a browser:

User Name : Submit

If you type some characters in the text field above, and click the "submit" button, you will send your input data to a page called "html-form-action.asp". That page will show you the received input.

The various form tags and their purpose is tabulated below:

Start Tag	Purpose
<form>	Defines a form for user input
<input>	Defines an input field
<text area>	Defines a text-area (a multi-line text input control)
<label>	Defines a label to a control
<fieldset>	Defines a fieldset
<lepend>	Defines a caption for a fieldset
<select>	Defines a selectable list (a drop down box)
<optgroup>	Defines an option group
<option>	Defines an option in the drop down box
<button>	Defines a push button

Figure 4.3

Menu Button

Creating menus for your users makes it easy for them to enter information or provide criteria for search. To create menus, in the FORM area of the HTML document, type the following.

```
<Select Name = "Name" Size = "n">
<Option Value = "value1"> Raj
<Option Value = "value2">Manoj
<Option Value = "value3">Rahim
</Select>
```

In Name = "name", name is the variable name for the menu that will identify the data which is to be collected by the server.

In size = "n", n represents the no. of items that should be initially visible in the menu.

In Value = "value1", "value2" etc, value is the name that will identify the data when it is collected by the server.

4.2.18 Frames

Frames are a method for dividing the browser window into smaller sub-windows, each displaying a different HTML document. With frames, you can display more than one HTML document in the same browser window. Each HTML document is called a frame, and each frame is independent of the other.

- Advantages:

1. The main advantage of frames is that they enable parts of the page to remain stationary while other parts scroll. This is useful for elements you may not want to scroll out of view, such as navigational options or banner advertising.

2. Frames unify resources that reside on separate servers. For instance, you may use frames to combine your own material with threaded discussion material generated by software on a vendor server.

- Disadvantages:

1. Frames are not supported by older browsers.

2. Frames may make site production more complicated because you need to produce and organize multiple files to fill a page.

Frame Tag

The <frame> tag defines what HTML document to put into each frame. It is defined within a <frameset>. The various attributes are:

1. Bordercolor = color name
   - sets the color for frames borders.

2. Longdesc =url
   - Specifies a link to a document containing a long description of the frame and its contents.

3. Marginwidth = number
   - Specifies the amount of space (in pixels) between the left and right edges of the frame and its content.

4. name = text
   - Assigns a name to the frame. This name may be referenced by targets within links to make the target document load within the named frame.

5. noresize:
   -Prevents users from resizing the frame. This one may be referenced by targets within the named frame.

6. src = url
   -Specifies the location of the initial HTML file to be displayed by the frame.

Frameset Tag

Defines a collection of frames or other framesets. The various attributes are:

1. Border = number

   - Sets frame border thickness (in pixels) between all the frames in a frameset (when the frame border is turned on).

2. Bordercolor = color name

   - Sets a border color for all the borders in a frameset.

3. Framespacing = number

   -Adds additional space (in pixels) between adjacent frames.

4. Rows = list | Cols = list

   - Establishes the number and sizes of rows in the frameset.

IFrame Tag

The <iframe> tag defines a floating frame within a document. This element requires a closing tag. Some of its attributes are

1. Align = top or bottom or middle or left

Aligns the online frame or the page within the flow of the text. Left and right alignment allows text to flow around the frame.

2. Frameborder = 1 or 0

Turns on or off the displaying of a 3-D border for the frame. The default is 1, which inserts the border.

3. Vspace = number

Used in conjunction with left and right alignment, this attribute specifies the amount of space (in pixels) to hold above and below the frame.

4. Width = number

Specifies the width of the frame in pixels or as a percentage of the window size.

4.2.19. Images

The greatest appeal of the World Wide Web and of HTML documents in particular is that they contain colorful images. The graphics we use in our web page must be in a format that operating systems can recognize. Presently the two most widely used formats on the web are GIF and JPEG.

Some of the tags and attributes of images are given below:

Image Tag and the Src Attribute

In HTML, images are defined with the <img> tag. The <img> tag is empty, which means that it contains attributes only and it has no closing tag. To display an image on a page, the Src attribute is to be used. Src stands for "source". The value of the Src attribute is the URL of the image you want to display on your page.

The Syntax of defining an image:

<img src = "url">

The URL points to the location where the image is stored. An image named "boat.gif" located in the directory "images" on www.graphics.com has the URL:

http://www.graphics.com/images/boat.gif

The browser puts the image where the image tag occurs in the document. If you put an image tag between two paragraphs, the browser shows the first paragraph then the image, and then the second paragraph.

The Alt Attribute

The alt attribute is used to define an "alternate text" for an image. The value of the alt attribute is an author-defined text.

<img src = "boat.gif" alt = "Big Boat">

The "alt" attribute tells the reader what he or she is missing on a page of the browser that can't load images. The browser will then display the alternate text instead of the image. It is a good practice to include the "alt" attribute for each image on a page, to improve the display and usefulness of your document for people who have text only browsers. The commonly used image tags are tabulated below:

Start Tag	Purpose
<img>	Defines an image
<map>	Defines an image map
<area>	Defines an area inside an image map

Figure 4.4

4.3 Revision Points

Internet

Internet can be defined as the networks of network and thereby constitutes the world's largest network.

Modem

The hardware device, which acts as an interface between our computer and the phone system, is called a "**modulator/demodulator"** or **"modem"**.

DNS (Domain Name System)

The Domain Name System (DNS) is an Internet-wide system for the resolution of hostnames and IP addresses. It is also called Domain Name Service. DNS is a distributed database system that translates host names to IP addresses and IP addresses to hostnames.

Browser

Browser is the computer program (Interface) used to explore the World Wide Web.

Web Servers

A web server, also known as an HTTP server, responds to requests from a web browser by returning HTML images, applets or other data.

HTML

HTML, or Hyper Text Markup Languages, is the language used to create hypertext documents on the World Wide Web.

Anchor Tag

HTML uses the <a> (Anchor) tag to create a link to another document.
 Text to be displayed .

4.4 Intext Questions

1. Explain the usage of Internet.
2. What is an email? How are e-mail messages sent and received?
3. Explain in detail the web browser and server.
4. Design a web page to create two frames. In one frame a table should be displayed and in the other a form should be displayed.
5. What is a Protocol?
6. What does HTML stand for?
7. Explain Text Formatting Tags.
8. What is the purpose of Image tag and Src attribute?
9. What is an ISP? Explain in detail.

4.5 Summary

- Internet can be defined as the networks of network and thereby constitutes the world's largest network
- Connecting computers could be accomplished if every computer had a unique address much like your street address. In theory, all the computers in the world could be connected to one really long wire, and they could all talk to each other
- Internet services are of varying stages of maturity. So the applications/services have been classified here as "Historic", "Classic" and "Hot".
- Internet addresses are one of the resources critical to the operation of the Internet and as such, are becoming increasingly controversial
- The Internet is a valuable tool for accessing information, but it also opens a whole new world of communications to its users.
- Commercial tools aimed at the web are entering the market place at a furious pace, each competing for visibility
- HTML is a document layout and hyperlink-specification language. It tells the browser how to display the contents of the document, including text, images, and other support media

4.6 Terminal Exercises

1. Write a short notes about Modem and its type?
2. ISDN Stands for _____
3. Write a note about TCP/IP
4. FTP is a _____
5. _____ Language understood by the Web Browsers.
6. What is IP?
7. _____ Tag is used to create link.
8. _____ Tag is used to create table.
9. Write a notes about HTML Frames
10. Which Tag is used to embed image in your web page?

4.7) Supplementary Material

1. "The HTML Sourcebook" Second Edition by Ian S. Graham.
2. HTML: The Complete Reference, TA Powell – 1999 – McGraw Hill Professional

4.8 Assignments

1. Prepare a Chart about Latest web browsers with their advantages and disadvantages
2. Create a web page using HTML tags.

4.9 Reference Books

1. Neil Randall, "Teach yourself the internet in a week", Prentice Hall of India, Second edition, 1996.
2. Vishndpriya Singh & Meenakshi Singh, "DTP Course", Asian Publishers, Delhi, First Edition, 1997.

4.10 Learning Activities

The following will be performed by group of people

Explain the Communication and Connectivity of Internet

4.11 Key Words

- **CERN** - Conseil Europeene Pour La Re cherche Nucl
- **NIC** - Network Interface Card
- **ISDN** - Integrate Services Digital Network
- **ARPANET** - Was a network that connect major computers at the University of California
- **TCP/IP** - Is a protocols used to communicate across the network
- **ISP** - **I**nternet **S**ervice **P**rovider
- **URL** - Is a standardized naming system for Internet
- **HTML** - **H**yper **T**ext **M**arkup **L**anguage

Unit V

5.0 Introduction

An Information System can be defined as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and to have an over-all control in an organization. In addition to supporting decision-making, coordination and control, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places and things within the organization or the environment surrounding it. By information we mean data that have been shaped into a form that is meaningful and useful to human beings. Data, in contrast, are streams of raw facts representing events occurring in organizations.

Three activities in an information system provides the information that the organization needs for making decisions, controlling operations, analyzing problems, and creating new products or services. These activities are input, processing and output. Input captures or collects raw data from within the organization or from its external environment. Processing converts this raw input into a more meaningful form. Output transfers the processed information to the people or activities where it will be used. Information system also requires feedback, which is the response (from the user) that is returned to the appropriate members of the organization to help them evaluate or correct the input stage.

5.1 Objective

After learning some basics about the computers and its functionalities. Now Students acquire the complete knowledge about MIS. And they grasp about various Computer Programming Languages. They also can have the knowledge about the following.

- Planning Issue
- Organization Issues
- Control Issues
- Data Objects, Variables and Constants
- Data Types
- Tamil Word Processors
- Tamil Web Browsers, Web Page and E-mail

5.2 Contents

5.2.1 Major Types of Information System

The presence of different specialization and levels in an organization necessitates different kinds of systems. No single system can provide all the information an organization needs. Figure 5.1 depicts the kind of systems found in an organization. In

the illustration, the organization is divided into strategic, management, knowledge, and operational levels Each of these are further divided into functional areas such as sales and marketing, manufacturing, finance, accounting and human resources.

There are four main types of information systems serving different organizational levels: Operational level systems, knowledge level systems, management – level systems, and strategic level systems.

Kinds of Information Systems **Groups Served**

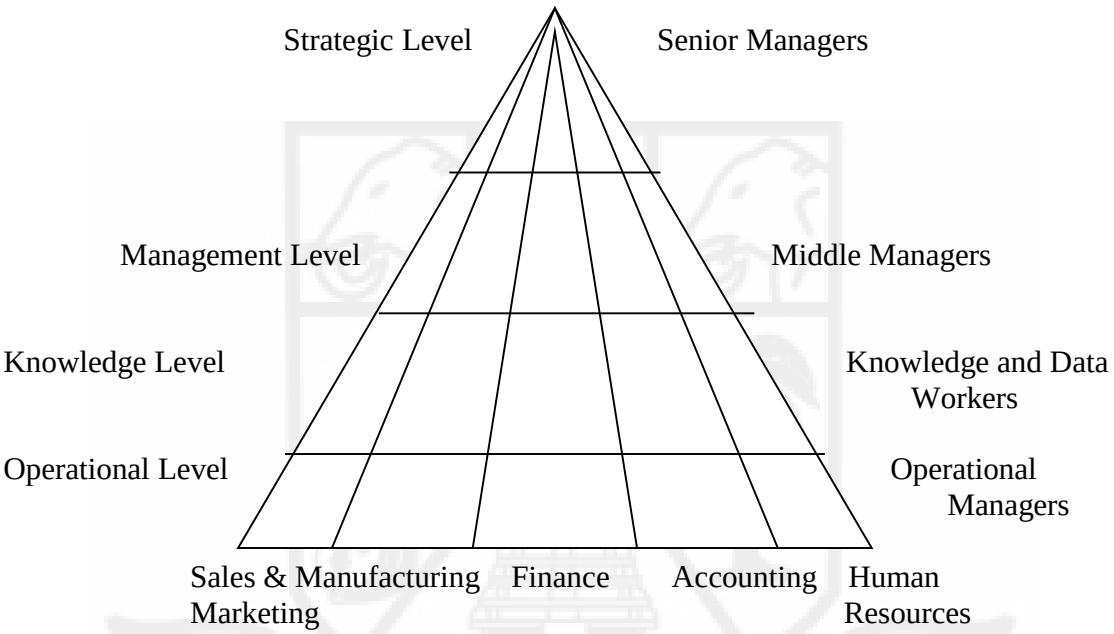


Figure 5.1: Types of Information System

Operational Level System

Operational Level System supports operational managers by keeping track of the elementary activities and transactions of the organization, such as sales, receipts, cash deposits, payroll and flow of materials in a factory. The principal purpose of the system at this level is to answer routine questions and to track the flow of transactions throughout the organization. (E.g.:) Transaction Processing System.

Transaction Processing System:

Transaction Processing System (TPS) is the basic business system that serves the operational level of the organization. A transaction processing system is a computerized system that performs and records the daily routine transactions necessary to conduct the business. Examples are sales order entry, hotel reservation systems, client information and shipping.

Knowledge Level System

Knowledge level system supports knowledge and data workers in an organization. The purpose of knowledge level system is to help the business firm integrate new knowledge into the business and to help the organization control the flow of paper work, especially in the form of work stations and office systems. (E.g.:) Knowledge Work And Office Automation System.

Knowledge Work and Office Automation System:

These systems serve the information requirements at the knowledge level of the organization. Knowledge work systems aid knowledge workers, whereas office automation systems primarily aid data workers.

In general knowledge work systems, such as scientific or engineering design workstations, promote the creation of new knowledge and ensure that new knowledge and technical expertise are properly integrated into the business

Office automation systems handle and manage documents (through word processing, DTP and digital filing), scheduling (through electronic calendars) and communication (through e-mail, voice mail or video conferencing).

Management Level System

Management Level System is designed to serve the monitoring, controlling decision-making and administrative activities of middle managers. These systems compare the current day's output with that of the past, say a month or a year ago. Management level systems typically provide periodic reports. (E.g.:) Management Information System and Decision Support System.

Management Information System:

Management Information Systems (MIS) serve the management level of the organization providing managers with reports and in some cases, with on line access to the organization's current performance and historical records. Typically, they are oriented almost exclusively to internal, not environmental or external events. MIS primarily serves the functions of planning, controlling and decision making at the management level. A detailed description of Management Information is given in section 5.2.

Decision Support System:

Any system that supports a decision is a Decision Support System (DSS). Like MIS, DSS serve the management level of the organization. Information systems support decisions in different ways and DSS is a class of systems that support decisions in a unique way.

DSS helps managers make decisions that are semi structured, unique or rapidly changing and not easily specified in advance. DSS have to be responsive enough to run several times a day in order to correspond to changing conditions. Clearly, by design, DSS have more analytical power than other systems; they are built explicitly with a variety of models to analyze data. A detailed description of DSS is given in section 5.6.

Strategic Level System

Strategic – Level system helps senior managers in tackling and addressing strategic issues and long-term trends, both in the firm and in the external environment. Their principal concern is to match changes in the external environment with organizational capability. (E.g.:) Executive Support System.

Executive Support System:

Senior managers use a category of information systems called Executive Support System (ESS) to make decisions. ESS serves the strategic level of the Organization. They address un-structured decisions and create a generalized computing and communications environment rather than providing any fixed application or specific capability. ESS is designed to incorporate data about external events such as competitors. They also draw summarized information from internal MIS and DSS. They filter and compress critical data, emphasizing the reduction of time and effort required to obtain information that are useful to executives. Although they have limited analytical abilities, ESS employs the most advanced graphics software and can deliver graphs and data from many sources immediately to a senior executive officer.

Integration of Systems

The relationship between various types of systems in an organization is illustrated in Figure 5.2. TPS is typically a major source of data for other systems whereas ESS is primarily a recipient of data from lower-level systems. The other types of systems may exchange data among one another as well. The systems should be integrated with one another that is, they should provide for the systematic flow of information among different systems.

In the real world, managers provide the level of integration needed to operate the business. Most systems are built in isolation from other systems. Organizations do not build all systems at once; the resources required to do so would be enormous. Organizations pay a penalty for this evolutionary approach to systems. Systems are often not integrated, as they sometimes need to be. This situation creates bottlenecks and inefficiencies in a firm's essential business activities. As organizations move towards centralizing, coordinating and controlling system evolution, they create more layers of management approval for systems and more bureaucracy in the process. Eventually, centralization reaches a saturation point, and organizations start allowing their divisions or operating units to develop systems on their own. In short, decisions to integrate systems, to centralize control, are like the tides, they ebb and flow in accordance with business conditions and values. There is no "one right level " of integration or centralization.

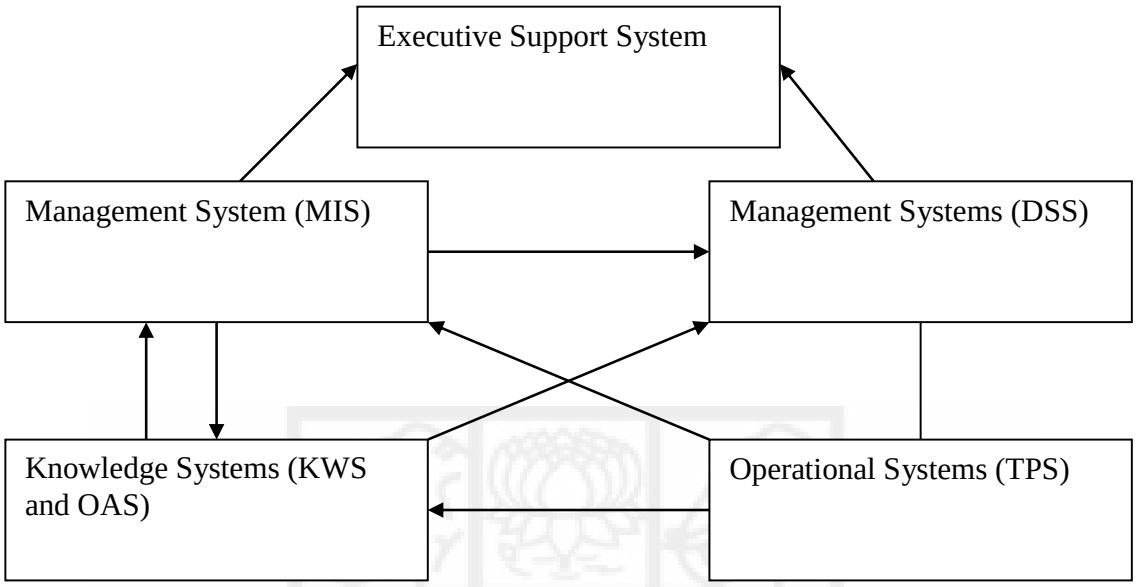


Figure 5.2: Integration of Systems

5.2.2 Management Information Concepts

Information Needs of Managers

What information does a manager need to manage effectively? The basic information needed by all managers is an understanding of the purpose of the organization i.e. its policies, its programs, its plans and its goals. But beyond these basic information requirements, the question of what information is needed can be answered only in broad general terms because individual managers differ in the ways in which they view information, in their analytical approaches to using it, and in their concept of organization of relevant facts.

An additional factor that complicates the subject of the information needed by the managers is the organizational level of the managerial job. In small organizations there are few managerial levels. And the managers tend to be generalists. That is, they are knowledgeable about most of the group activities. But as organizations grow in size, people with specialized knowledge are hired and additional managerial levels are created. Information that is satisfactory for many is often just acceptable when supplied to specialists. It thus becomes necessary to supply different types of information to people at different levels.

Top-level mangers still must have a general understanding of the organization's activities since they are charged with weighing risks and making many policy decisions on such matters as new product development, new plant authorizations, and so on. They need the type of information that will support these long strategic plans and decisions. Middle-level managers are responsible for making the tactical decisions that will allocate the resources and establish controls needed to implement the top-level plans.

And lower-level managers manage the day-to day operational decisions to schedule and control specific tasks. So different Managers need internal information with varying degrees of detail and need different mixes of internal and external information in order to make their decisions.

Properties of Useful Management Information

As a general rule, more the information serves to reduce the element of uncertainty in the decisions made by mangers at all levels, the greater is its value. But information is usually not free and the cost of acquiring information must usually be compared with the benefits to be obtained from its use. Generally speaking, information that possesses the properties of accuracy, timeliness, completeness and consciousness will be more valuable than information lacking one or more of these characteristics. However, compromises are often made in one or more of these properties for economic reasons.

Accuracy

Accuracy is the ratio of correct information to the total amount of information produced over a period. If 1000 items of information are produced and 950 of these items give a correct report of the actual situation, then the accuracy level is 0.95. Whether this level is high enough or not will depend on the information being produced. In the case of bank statements, greater accuracy must be obtained. In the case of the parts inventory, greater accuracy could be achieved, but this additional value of having a more accurate inventory might be less than the additional costs required to gather it.

Timeliness

Timeliness is another important characteristic. It is of little consolation to a manager if the information to be of use arrived too late even if it is accurate. Accuracy alone is not enough. How fast must be the response time of the information system? Unfortunately, it is once again impossible to give an answer, which will satisfy all the situations. In the case of regular reports, an immediate response time following each transaction would involve a steady outpouring of documents. Generally, the response time should be short enough so that the information does not lose its freshness and value, but it should be long enough to reduce the volume (and costs) and reveal important trends that signal the need for action.

Completeness

Most managers get frustrated in taking a decision sometimes by not having supporting information that is accurate, timely and complete. A better integration of the facts available at scattered points in a business and furnishing managers with more complete information is the goal of information systems designers.

Conciseness

Many traditional information systems have been designed on the assumption that lack of completeness is the most critical problem facing managers. This assumption has often led designers to employ an ineffective approach, peppering managers with more information than they can possibly use. Important information, along with relatively useless data, is often buried in stacks of detailed reports. Managers are then faced with the problem of extracting those items of information that they need. Concise information that summarizes the relevant data and points out areas of exception to normal or planned activities is what is often needed by – but less often-supplied to – today's managers.

MIS Design Considerations

The Management Information System (MIS) concept has been defined in a dozens of ways. Since one organization's model of an MIS is likely different from that of another, it is not surprising that their MIS definitions would also vary in scope and breadth. For our purpose, an MIS can be defined as a network of computer based data processing procedures developed in an organization and integrated as necessary with manual and other procedures for the purpose of providing timely and effective information to support decision-making and other necessary management functions.

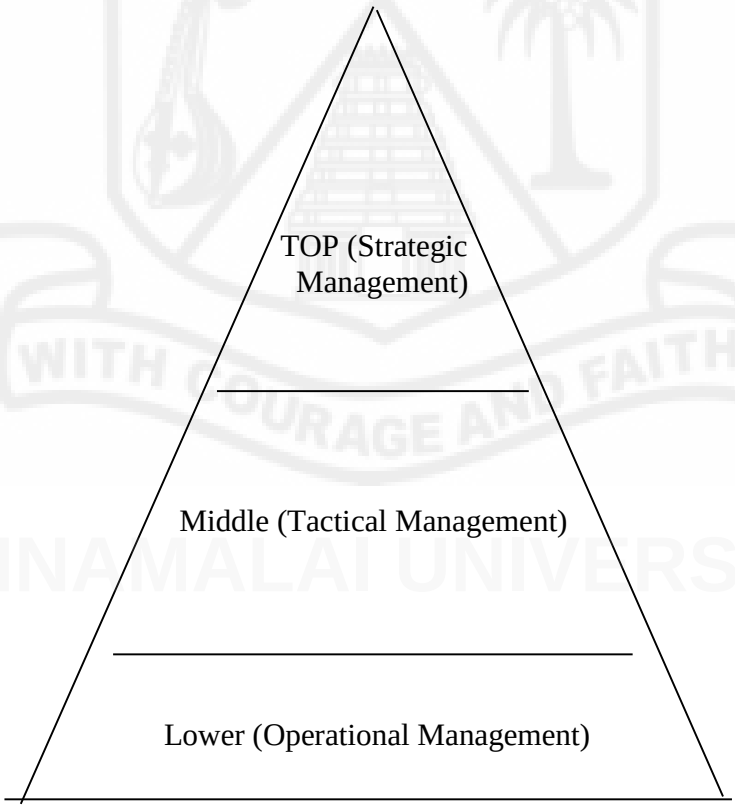


Figure 5.3 (a)

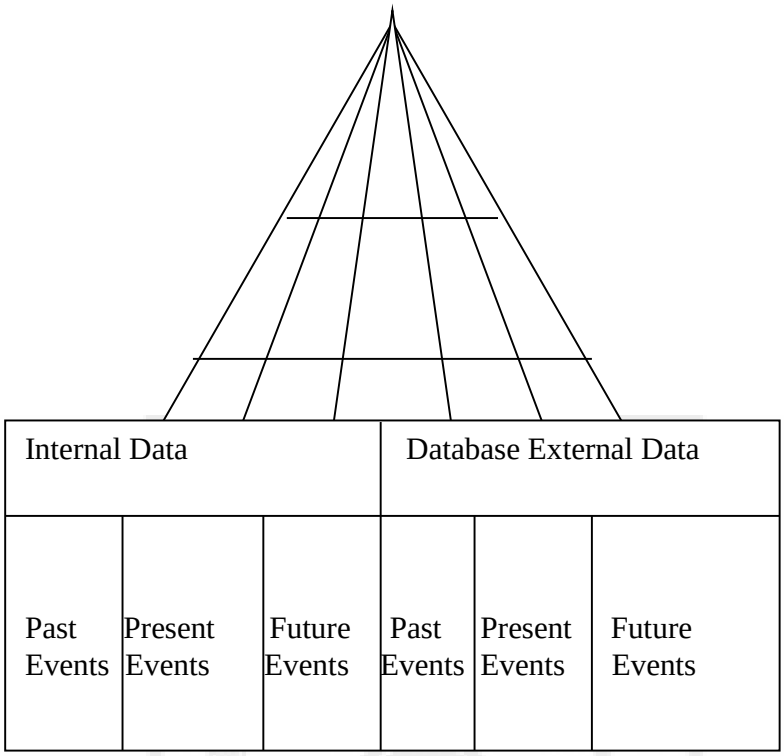


Figure 5.3(b)

Although MIS models differ, most of them recognize the concepts as shown in Figure 5.3.In addition to what might be termed the horizontal management structures shown in Figure 5.3 (a), an organization is also divided vertically into different specialties and functions which require separate information flows.

Combination of the horizontal managerial levels and the vertical specialties produce the complex organizational structure shown in Figure 5.3 (b). Underlying the structure is a database consisting, ideally of internally and externally produced data relating to past, present and predicted future events.

The formidable task of the MIS designer is to develop the information flow needed to support decision-making. Generally speaking, much of the information needed by mangers that occupy different levels and who have different responsibilities is obtained from a collection of existing information systems (*or systems). This system may be tied together very closely in an MIS. More often, however they are more loosely coupled (See Figure 5.4).

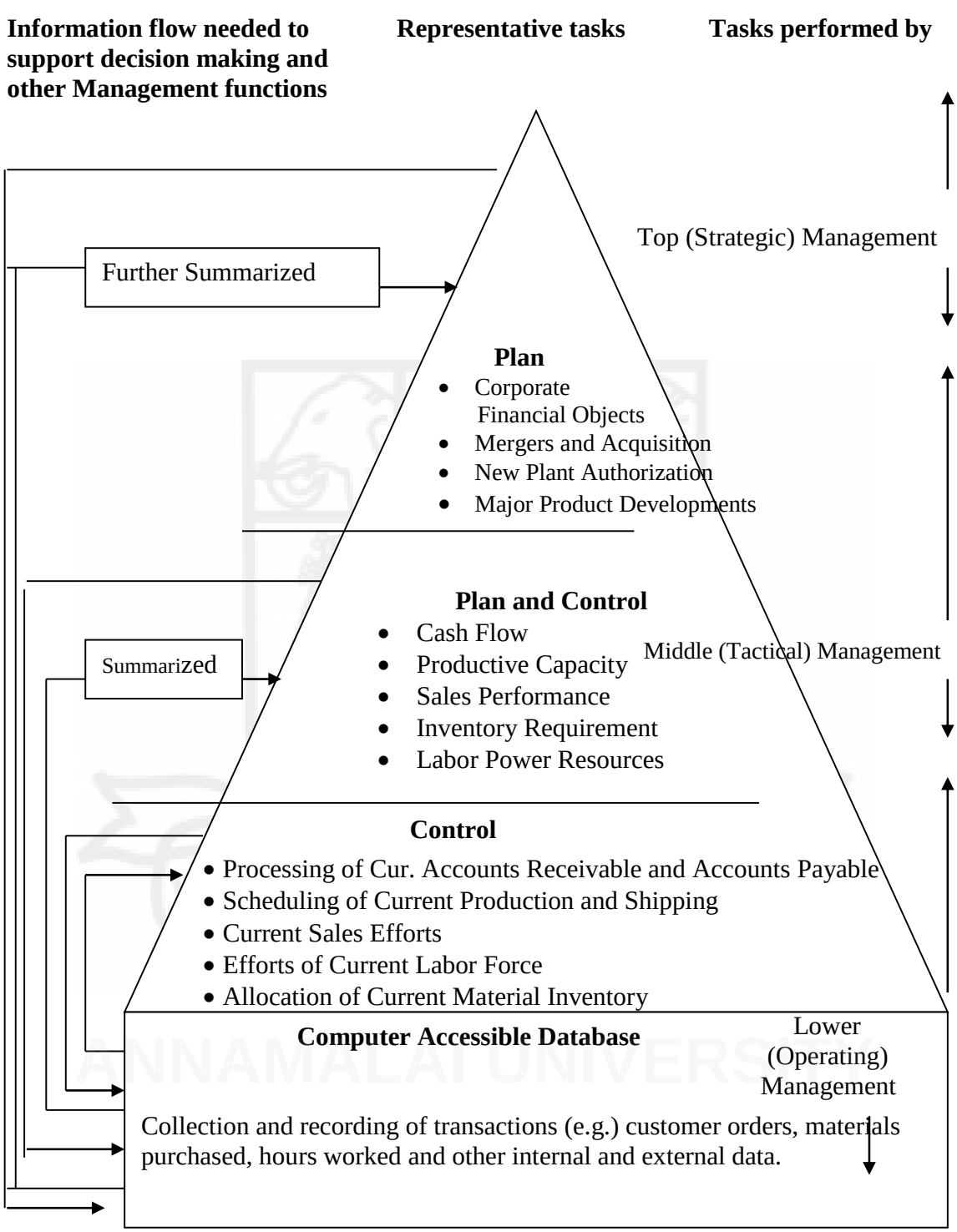

Information flow needed to support decision making and other Management functions
Representative tasks
Tasks performed by
Top (Strategic) Management
Further Summarized
Plan
Corporate Financial Objects
Mergers and Acquisition
New Plant Authorization
Major Product Developments
Plan and Control
Cash Flow
Productive Capacity
Sales Performance
Inventory Requirement
Labor Power Resources
Middle (Tactical) Management
Summarized
Control
Processing of Cur. Accounts Receivable and Accounts Payable
Scheduling of Current Production and Shipping
Current Sales Efforts
Efforts of Current Labor Force
Allocation of Current Material Inventory
Computer Accessible Database
Lower (Operating) Management
Collection and recording of transactions (e.g.) customer orders, materials purchased, hours worked and other internal and external data.

Figure 5.4

5.2.3 Planning Issues and the MIS

Issues Involved in Planning for MIS

A general idea of the task that MIS designers face as they draw up long-range plans for an organization's MIS can be obtained from Figure 5.3 and Figure 5.4. But some of the more specific issues that may be considered during the planning for an MIS are:

- Should MIS development be **"top-down"** or **"bottom-up"**? The **top-down** approach begins with studies of organizational goals and the types of decision managers make. The advantage of this approach is that it is a logical and sensible way to attack a problem, and it can make it easier to integrate system elements. The disadvantage is that it is difficult to define organizational goals and the decision-making activities of managers in the precise terms required for MIS design. The **bottom-up** approach on the other hand begins at the operating level with the existing procedures for processing transactions and updating files. The advantage of this approach is that smaller "bits" of work are tackled and the danger of building a complex and ineffective MIS is minimized. The disadvantage is that this approach may not lead to the development of high potential systems above the operating level.
- Can a single database be created to satisfy the different information needs of the three managerial levels? Most information systems today serve the needs of operating managers and to a lesser extent, middle managers. They provide internally produced data dealing with past and current activities. However, a growing number of MIS's are now using internal data and carefully developed planning models incorporating assumptions about external conditions to simulate responses to the "what if?" questions of top executives. A problem facing MIS planners is whether to attempt to organize and structure a single database to meet varying needs or to create different bases for different horizontal levels. Figure 5.5 shows the alternatives.
- Can different specialties share the same database? Can the MIS supply from a single database the information needed by marketing, production, finance, and personnel managers at different levels or must separate vertically oriented bases be designed for each speciality? Different functions have traditionally had their own information systems. Attempting to integrate these separate systems into one or more corporate data bases that will serve the broader needs of many managers is a formidable challenge. But the effort is being made.
- Can externally produced data be incorporated into a database? To be of value to higher-level managers, an MIS must supply information about the external world. The growing availability of external data in machine sensible form and/or the use of external data banks made more data available to the firm's MIS. It is the designer's responsibility to see that these new facts are incorporated into an MIS in meaningful ways.

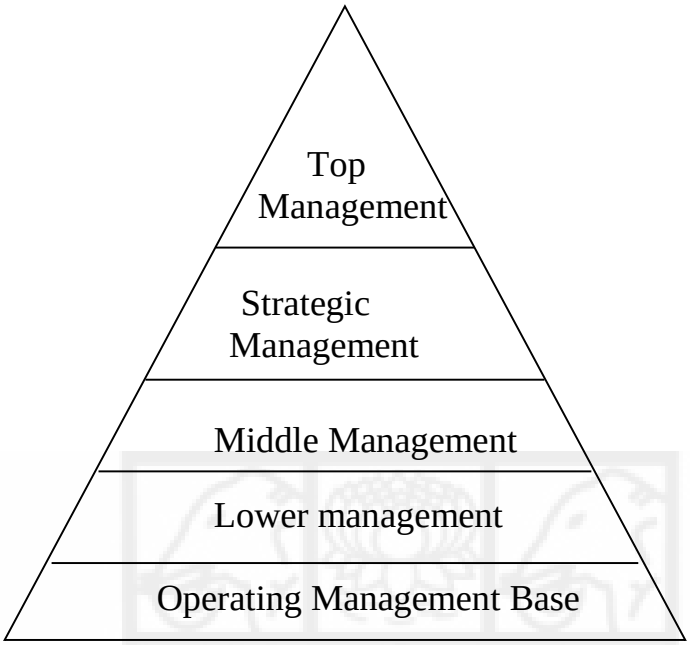


Figure 5.5: MIS Design Alternatives

To what extent should an attempt be made to solve the triangle"? That is to what extent should designers attempt to create an overall MIS that would simultaneously satisfy the information needs of most or all the segments shown in Figure 5.3(b). The complexity of the problems involved usually dictates that designers take a gradual and conservative approach.

How can an MIS help Managerial Planning?

When compared with earlier information systems, an MIS can have an impact on the quality of a manager's plans by:

1. **Causing faster awareness of problems and opportunities:** MIS can quickly signal out-of-control conditions requiring corrective action when actual performance deviates from what was originally planned. New plans can then be implemented to correct the situation(s). Masses of current and historical internal and external data can be analyzed statistically in order to detect opportunities.

2. **Enabling managers to denote more time to planning:** MIS can reduce paperwork. More attention may then be given to analytical and intellectual matters associated with planning.

3. **Permitting managers to give timely consideration to more complex relationships:** MIS gives the manager the ability to evaluate more possible alternatives and to consider the internal and external factors that may have a bearing on their outcome.

Managers can do a better job of identifying and assessing the probable economic and social effects of different courses of action. More complex relationships can now be considered and evaluated through the use of tools such as spread sheet software packages that provide quick answers to the "what of" questions posed by managers. In short, an MIS can furnish managers with planning information that could not have been produced at all a few years ago.

4. **Assisting in decision implementation:** MIS can assist in the development of the subordinate plans needed to implement decisions. Computer based techniques to schedule project activities have been developed and are now widely used. Through the use of such techniques, labour, materials, and other resources can be utilized and controlled effectively.

Planning and Decision Making Practices Supported by MIS

Computer based MIS now regularly back up the planning and decision-making activities of managers in a number of business areas. The components of MIS that assist managers in these activities are often called Decision Support Systems (DSS). Included between the planning and decision-making practices that may be supported is the use of simulation, expert systems, and information centers.

The Use of Simulation

Simulation is the use of a model in an attempt to identify and or reflect the behavior of a real person, process or system. In business, for example, managers may evaluate proposed projects or strategies by constructing theoretical models. They can then determine what happens to these models when certain conditions are given or when certain assumptions are tested. Simulation is thus a trial and error problem solving approach that is very useful in planning.

Simulation models have helped top executives decide, for example, whether or not to acquire a new plan. Among the dozens of complicating variables that would have to be incorporated into such models are facts and assumptions about the present and potential size of the total market, and the present and potential company share of this total market.

Simulation is also helpful to middle level mangers. For example, simulation models are used to improve inventory management. The problem of managing inventories is complicated because there are conflicting desires among organizational units. Managers can experiment with various approaches to arrive at more profitable inventory levels.

The Use of Expert Systems

An expert system is a software package that includes (1) a store bases of knowledge in a specialized area, and (2) the capability to probe this knowledge base and make decision recommendations. The products of years of research in the field of artificial intelligence (AI) expert systems are only now beginning to appear in a few selected areas, but their future applications seem almost limitless.

To develop the knowledge base for an expert system, AI researches spend many months picking the brains of specialists to extract and structure the knowledge that is the basis for the specialist's expertise. Once a knowledge base is created and the software needed to manipulate the stored facts and ideas is in place, the expert system can take on the role of consultant to the system user.

The Use of Information Centers

Many organizations with large mainframe computers have established information centers to support the planning and decision-making activities of their employees. Generally set up as a service branch of an MIS department, an information center gives its users a direct online path into the organization's databases to retrieve the facts they need. In addition to showing end users how to achieve a degree of self-sufficiency in accessing the organizations databases the information center may also function as internal personal computer consultants.

5.2.4 Organizing Issues and the MIS

Centralizing / Decentralizing of Authority

The organizing function involves the grouping of people and other resources into logical and efficient units in order to carry out plans and achieve goals. In a manufacturing company, for example, people maybe grouped by the type of work (production, marketing), by geographic area (district sales offices), and by product line produced as sold. As MIS are designed and implemented, there is often a need to reconsider the answers to several important and interrelated organizing questions. The following questions assume prominence in the situations

- Will decision-making be centralized or decentralized?
- Will data processing be centrally located or dispersed?
- Will the data itself be centrally stored or dispersed?
- How will the MIS function be organized?

Authority is the right to give orders and the power to see that they are carried out. Centralization of authority in an organization refers to a concentration of the important decision-making powers in the hands of relatively few executives. Decentralization of authority, on the other hand, refers to the extent to which significant decisions are made at lower levels. In very small organizations all decision-making power is likely to be centralized in the hands of the owner. In larger organizations the amount of authority that is held at different levels can vary.

Centralizing / Dispersal of Data Processing Activities

In pre-computer days, each department was on a separately handled data processing activity and thus had a decentralized basis. When computers first appeared, the tendency was to maximize the use of expensive hardware by establishing one or more central processing centers to serve the organization's needs. Today the rapid reduction in hardware costs and the improvements being made in data communications services make it possible for organizations to structure their MIS around either a centralized or a more dispersed approach to data processing.

Closer an organization positions its data processing activities to the centralized approach, more likely it is to achieve the following benefits:

1. **Economics of Scale:**
   With adequate processing volume, the use of larger and more powerful computers may result in lower record processing costs.

2. **Effective Personnel Management:**
   It may be possible to concentrate fewer skilled programmers at a central site and make better use of their talents. A large computer center that utilizes the latest database management system and sophisticated MIS concepts may also be more challenging and appealing to computer professionals.

The decentralized approach is most likely to have the following benefits.

1. **Greater Interest and Motivation at User Levels:**
   Users in control of their own computers and MIS programs may be more likely to mountain the accuracy of input data and sue the equipment in ways that best meet their particular needs.

2. **Better Response to User Needs:**
   The standardization that is typically required for a centralized MIS may not be equally suitable for all users. With a more dispersed approach, special programs may be written to meet exact user needs.

3. **Less Downtime Risk:**
   Breakdowns in centralized equipment or communications links way leave the entire MIS inoperative. A similar breakdown on one user group, however, does not affect other operations.

Organizing the MIS Department

The organizations of the MIS department itself can take many forms depending on how an organization responds to the issues. Figure 5.6 gives us a framework from which combinations or further subdivisions may be made as needed.

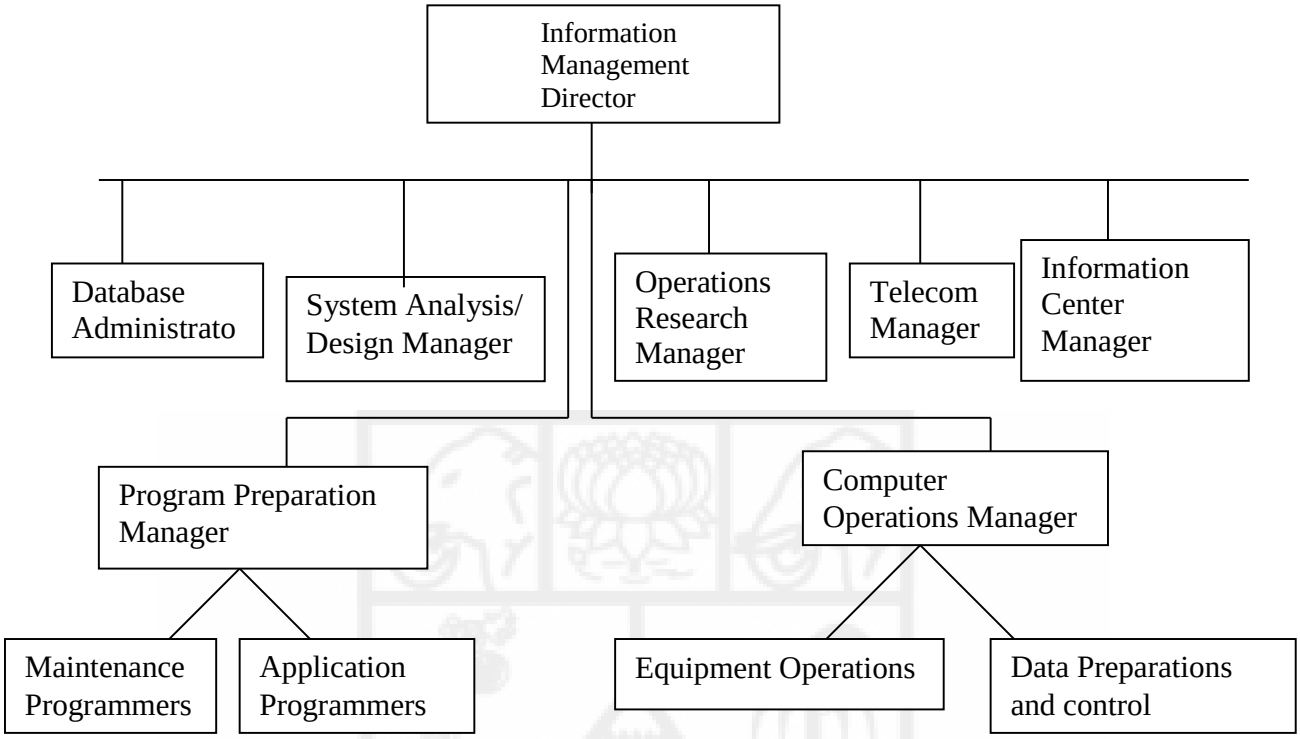


Figure 5.6: Possible Functional Organization of an MIS Department

The database administrative function is usually found in the MIS department. The activities of the DBA include establishing and controlling data definitions, defining the relationships between data items, and designing the data base security system to guard against unauthorized use. The system analysis/ design section acts as the vital interface between user groups and the other sections on the MIS department. The program preparation function is often subdivided into new applications and maintenance groups. The function of the computer-operations section is to prepare input data and produce output information on a continuing basis. The control of equipment time and the scheduling of processing activities are duties of the operations supervisor.

Operations research (OR) is the name given to the quantitative methodology and knowledge that is used to help managers make decisions. The telecommunications function can also be logically placed elsewhere. However, there is a growing tendency to place the responsibility for both computing and telecommunications services under a single information management executive.

Finally, the information center may be a unit of the MIS department that provides the end-user services. The information center may also be in charge of implementing and maintaining the micro to mainframe network. The term information resource management (IRM) is now being used to emphasize the belief that all the fragmented and overlapping information functions in an organization should be combined and placed under the control of a senior executive.

5.2.5 Control Issues and the MIS

The Control Process

Unlike planning which looks to the future, the control function looks at the past and the present. It is a follow-up to planning and a check on the past and current performance to see if planned goals are being achieved. The control process is thus based on the following steps:

1. Establishing predetermined goals or standards.
2. Measuring actual performance.
3. Comparing actual performance to the standards.
4. Making appropriate control decisions.

There are numerous control implications and issues associated with the use of MIS. A primary concern of managers is that the MIS supply them with the managerial control information they need to monitor the operations for which they are responsible. A second area of vital concern to mangers is to ensure that the internal control over the MIS itself is adequate so that it operates efficiently and maintains the integrity and security of data, records and other assets.

Managerial Control Implications

The output of an MIS can help a manager carry out the control steps in many ways. For example, better information can lead to better planning and the creation of more realistic standards. Simulation can help managers set goals by showing them the effects of alternative decisions when certain conditions are assumed. An MIS can also help manager's control by gathering and summarizing actual performance data promptly and accurately. Once performance data are read into the computer, it is possible for the machine to compare the actual performance with the established standards. Periodic reports showing this comparison can be prepared and triggered exception reports may be furnished to managers only when variations fall outside certain programmed limits.

It is also possible for MIS to signal when predetermined decisions should be carried out. For example, a program may specify that when the inventory of a basic part falls below a given level, an output message signals the need to reorder and indicates the reorder quantity. By thus relieving managers of many of the routine control tasks, the MIS frees them to devote more time to planning and leading the all-important human resources of the organization.

Internal Control Issues

In some systems, data processing is typically separated into several departments, with a number of employees being responsible for some portion of the total activity. For example, on the processing of a customer order, credit approval may come from one location, control of the inventory of ordered items may reside in another department, customer billing may be handled by a third group, and receipt of payment for items shipped in a fourth location.

The organizational structure separates those who initiate the order from those who record and carry out the transaction. And both of these groups are separated from those who receive payment. Such a division of activities makes it difficult for fraudulent people to go undetected since several people from different groups would have to be a party to any deception. Also, people in each department can check on the accuracy of others in the course of their routine activities. Thus, departmental reviews and crosschecks have achieved internal control.

But the use of an MIS makes it possible for processing steps to be integrated so that one or two groups may perform them all. With fewer departments involved, however, it may appear that the use of an MIS reduces internal control.

Controlling the MIS Department

The various types of MIS controls are:

Data Integrity Controls:

The purpose of these controls is to see that all input data are correctly recorded, all authorized transactions processed without additions or omissions, and all output is accurate, timely and distributed only to those authorized to receive it. Programmed processing controls are established to determine when valid data are lost, or when invalid or unauthorized data are entered for processing. Techniques involving the use of record counts, sequence checks, reasonable checks and so on, are used. The number of possible processing control is limited only by the programmer's imagination. Output controls are established as final checks on the accuracy and propriety of the processed information. Feedback from users and a variety of techniques are used**.**

Control of Operating Efficiency:

The same steps used to control any activity are used to control the efficiency of the MIS function. Departmental standards should be established for people and machines. Actual performance should then be measured. Measuring the performance of creative people is more an art than a science, and the approaches vary from one MIS facility to another. It is easier to measure shareware performance because special monitors are available for the purpose. Over worked (or underutilized) components and bottleneck situations can be identified through the use of these evaluation tools. Once performance measurements are available, they are compared to the standards, and appropriate control decisions are made as needed.

5.2.6 Decision Support Systems

What are Decision Support Systems?

In the 1970s a number of companies began developing information systems that were quite different from traditional MIS systems. These new systems were smaller, interactive and were designed to help users utilize data and models to discuss and decide semi structured and unstructured problems. By the late 1980's these early efforts to assist individual decision-making were extended to groups and entire organizations.

These systems are called Decision Support Systems (DSS). They assist management decision making by combining data, sophisticated analytical models, and user-friendly software into a single powerful system that can support semi structured or unstructured decision making. The DSS is under user control from, early inception to final implementation and daily use.

The philosophy of DSS is to give users the tools necessary to analyze important blocks of data, using easily controlled sophisticated models in a flexible manner. DSS are designed to deliver capabilities, not simply to respond to information needs. DSS are more targeted than the MIS systems. MIS systems provide managers with routine flow of data and assist in the general control of the organization. In contrast, DSS are tightly focused onto a specific decision or classes of decisions such as routing, querying evaluating and so forth. DSS promises user control of data, tools and sessions. Professionals still largely dominate MIS. Figure 5.7 summarizes the difference between DSS and MIS.

Dimension	DSS	MIS
Philosophy	Provide Integrated tools, data, models and language to users	Provide structured information to end users
System analysis	Establish what tools are used in the decision process	Identify information requirements
Design	Iterative process	Deliver system based on frozen requirements

Figure 5.7: Differences between DSS and MIS

Four core DSS capabilities are discussed below:

Representations

These are conceptualizations of information used in making decisions, such as graphs, charges, lists, reports and symbols to control operations.

Operations

Logical and mathematical manipulations of data, such as gathering information, generating lists, generating statistics and simulating alternatives.

Memory Aids

Databases views of data, workspaces, libraries, and links among work spaces and libraries and other capabilities to refresh and update memory.

Control Aids

Capabilities that allow the user to control the activities of the DSS. They include a soft ware language permitting user control of representations, operations and memory

In essence, a DSS is a decision-making scratch pad, backed up by databases that can be used to support many decision-making processes. It can be applied to problems with quantifiable dimensions that provide criteria for the evaluation of alternative solutions. The DSS helps the decision-makers identify the best alternative. This approach to DSS as a set of core capabilities goes to the heart of DSS philosophy and provides a benchmark against which we can compare and critique any DSS in any market place.

5.2.7 Programming Languages

What is a Programming Language?

A language is a system of communications. A programming language consists of all the symbols, characters and usage rules that permit people to communicate with computers. Some programming languages are created to serve a special purpose (eg. Controlling a robot), while others are more flexible general-purpose tools that are suitable for many types of applications. However, every programming language must accept certain types of written instructions that will enable a computer system to perform a number of familiar operations. That is, every language must have instructions that fall into the following familiar categories:

Input / Output Instructions:

Required to permit communication between I/O devices and the central processor, these instructions provide details on the type of input or output operation to be performed and the storage locations to be used during the operation.

Calculation Instructions:

Instructions to permit addition, subtraction, multiplication and division during processing are of course common in all programming languages.

Logic / Comparison Instructions:

These instructions are used to transfer program control and are needed in the selection and loop structures that are followed to prepare programs. During processing, two data items may be compared as a result of execution of a logical instruction. As it is known, program control can follow different paths depending on the outcome of a selection test (if R>o, than A, ElseB). A loop can be continued as terminated depending on the outcome of an exit condition test. In addition to the instructions in languages that set up tests or comparisons to effect the transfer of program control, there are also unconditional transfer instructions available that are not based on the outcome of comparison.

Storage / Retrieval and Movement Instructions:

These instructions are used to store, retrieve manmade data during processing. Data may be copied from one storage location to another and retrieved as needed. But even though all programming languages have an instruction set that permits these familiar operations to be performed, there is a marked difference to be found in the symbols, characters and syntax of machine languages, assembly languages, and high-level languages.

Types of Computer Languages

There are many types of computer languages, which can be categorized into following four types.

- Low-level languages (First and second generation languages)
- High level languages (Third Generation languages)
- User-friendly languages (Fourth Generation Languages)
- Object-oriented Languages (Fifth Generation Languages)

Low Level Languages

In early days of computers, only those languages, which could be directly executed on the computer, were used for programming. Languages, which computer can understand directly and are machine dependent are called Low-level languages. For example, machine Language and Assembly Language are two important low-level languages. Machine Languages is the oldest and most difficult of all the languages. It is also known as First Generation language. In machine language, all the instructions are given to computer in binary digits, and hence are directly understood by the computer. On the other hand, assembly language is easier than machine language, and is known as second Generation Language. In assembly language instructions are given using mnemonic operation codes (such as ADD, MUL etc) instead of binary digits. Low-level languages are mainly used for development of systems software.

High Level Languages

Development of applications using low-level languages requires a deep understanding of the hardware. In order to facilitate the programmers to write programs without knowing internal details of computer components, many languages were developed. These languages use common English words and are translated into low-level languages before processing by the computer. These languages, which the computer cannot understand directly and are not machine dependent, are called high-level language (HLL). These languages are also known as Third Generation Languages. Some of the common-high level languages are:

BASIC (Beginners **A**ll purpose **S**ymbolic **I**nstruction **C**ode**)**
COBOL (COmmon **B**usiness **O**riented **L**anguage**)**
FORTRAN (FORmula **TRAN**slator**)**
C (It does not stand for anything)

These languages were widely used for applications development but most of them are now outdated due to popularization of 4th GLs. The uses of the different 3 GLs are summarized in Figure 5.8.

Language	Uses
BASIC (Beginners All purpose Symbolic Instruction Code)	Used for all purposes (Commercial, Scientific, Educational, etc) by beginners
COBOL (Common Business Oriented Language)	Mainly used for development of commercial applications on all types of computers
FORTRAN (Formula translator)	Used for development of scientific (mathematical) applications
PASCAL (Name of a Scientist)	Used for both commercial and scientific applications
C (No full form)	Very powerful language for development of both system and application software.

Figure 5.8: Uses of 3 GLs (Third Generation Languages)

User Friendly Languages

Although high-level languages are simpler to codify than low-level languages, they still require a lot of time to learn programming syntax. Hence, these languages are beyond the reach of many computer users, who do not want to expertise in programming. Therefore, a new category of languages has been developed which are user-friendly, very easy to codify and simple to learn. These are called user-friendly languages and popularly known as 4 GLs (Fourth Generation Languages). Some of the common 4 GLs are dBase, Fox base, FoxPro, MS Access, Oracle, Sybase and Ingress. The uses of different 4 GLs are summarized in Figure 5.9.

Language	Uses
Dbase	Used for development of mainly single user Dos based database applications.
FoxBASE	Used for development of both single and multi-user Dos based database applications.
FoxPro	Used for development of both DOS and windows – based database applications.
Oracle	Used for development of relational database applications on any operating environment.
Sybase	Mainly used for development of on-line applications such as Decision support systems and Transaction processing.
Ingress	Used for development of relational database applications of VAX/UNIX operating system.

Figure 5.9: Uses of 4 GLs (Fourth Generation Languages)

Object Oriented Languages

We have discussed that the object oriented programming is the latest approach in programming. The languages, which are based on object oriented programming (OOP) approach are called Object Oriented Languages. They may be classified into firth generation languages. Object oriented languages are especially useful for development of GUI (Graphical User Interface) applications. These languages also offer a unique feature of Revisable code. Some of the popular object oriented languages are Small Talk, C++, Object COBOL, Object Pascal, Simulate, Eiffel, Java and Visual J++. Now a days for development of window based applications the uses of different object oriented languages are summarized on Figure 5.10.

Language	Uses
Small talk	Used for development of mainly graphical applications.
C++	Used for development of all types of objects Oriented applications.
Object COBOL	Used for development of object-oriented applications.
Object PASCAL	Used for general object – oriented applications.
Simulate	Malignly used in a research environment.
Eiffel	Used for general object oriented applications.
Visual J++	Very popular for development of windows based applications.

Figure 5.10: Uses of Object Oriented Languages (Fifth Generation Languages)

Language Translators

Regardless of the programming language used (except machine language) the symbolic instructions have to be translated into a form that can be executed by the computer. The software, which converts the codes of other languages into machine code are collectively called Language Translators. Language Translators are categorized into three types. They are:

- Assemblers
- Interpreters
- Compilers

Assemblers

Assemblers translate the assembly language code (source program) into machine language code (object program). After assembling, a linker program is used to convert the object program into an executable program. The Microsoft assembler program (MASM) and Borland Turbo assembler program (TASM) are two popular assemblers. Assemblers are used mainly in the development of system software.

Interpreters

Instructions of a high-level language are coded in many statements. At the time of their execution, they are converted statement by statement into machine code, by using system software called interpreters. For example, programs written in BASIC language are executed by using BASICA or GWBASIC interpreters. Programs written in some fourth generation languages, like DBASE III plus are also executed using dBASE interpreter.

Compilers

As contrast to interpreters, compilers provide faster execution speed. Compliers do not translate and execute the instructions at the same time. They translate the entire program (source code) into machine code (object code). Using linker, the object code is converted into executable code. Compilers are widely used in translating codes of high-level languages (e.g. COBOL, FORTRAN, PASCAL, Turbo / Microsoft C etc) and fourth generation languages (Dbase IV, FoxPro etc). As compared to interpreter or assemblers, Compilers are preferred in development of application software.

5.2.8 Low Level Languages Basics

Machine Level Language

A computer's machine language consists of strings of binary numbers and is the only one the CPU directly "understands". An instruction prepared in any machine language will have at least two parts. The first part is the command or operation, and it tells the computer what functions to perform. Every computer has an operation code or "OP code" for each of its functions. The second part of the instruction is the operand and it tells the computer where to find or store the data or other instructions that are to be manipulated. The number of operands or an instruction varies from each computer. In a single-operand machine, the binary equivalent of "ADD 0184" could cause the value in address 0184 to be added to the value stored in a register in the arithmetic – logic unit. In a two-operand machine, the binary representation for "ADD 0184 8672" could cause the value in address 8672 to be added to the number in location 0184. The single operand format is popular in the smallest microcomputers while the two-operand structure is likely to be available in most other machines.

The early computers were intolerant, considered from the point of view of today,s needs. Programmers had to translate instruction directly into the machine-language form that computers understood. For example, the programmer writing the instruction to "ADD 0184" for an early IBM machine would have written:

000100000000000010111000

In addition to remembering the dozens of code numbers for the commands in the machine's instruction set, a program was also forced to keep track of the storage locations of data and instructions. The initial coding often took months. It was therefore quite expensive, and often resulted in errors. Checking instructions to locate errors was as tedious as writing them initially. If a program had to be modified at a later date, the work involved could take weeks to finish.

Assembly Language

To ease the programmer's burden mnemonic operation codes and symbolic addresses were developed in the early 1950s. The word mnemonic refers to a memory aid. One of the first steps on improving the program preparation process was to substitute letter symbols – mnemonics for the numeric machine language operation codes. Each computer now has a mnemonic code, although of course, the actual symbols vary among modes and models. Machine languages are still used by the computer as they processes data, but assembly language software first translates the specified operation code symbol into its machine-language equivalent.

And this improvement sets the stage for further advances. If the computer could translate convenient symbols into basic operations why could not it also perform other clerical folding functions such as assigning storage addresses to data? Symbolic addressing is the practice of expressing an address not in terms of its absolute numerical location, but rather in terms of symbols convenient to the programmer.

Further, there was another improvement. The programmer turned over the task of assigning and keeping track of instruction addresses to the computer. The programmer merely told the machine the storage address number of the first program instruction and the assembly language software then automatically stored all others in sequence from that point. So if another instruction was added to the program later, it was not necessary to modify the addresses of all instructions that followed the point of insertion (as would have to be done in the case of programs written in machine language). Instead, the processor automatically adjusted storage locations the next time when the program runs.

Programs no longer assign actual address numbers to symbolic data items as they did earlier. Now they merely specify where they want the first location in the program to be and an assembly language program takes it from there, allocating locations for instructions and data.

This assembly program or assembler also enables the computer to convert the programmer's assembly languages instructions into its own machine code. A program of instructions written by a programmer in an assembly language is called a source program. After this source program has been converted into machine code by an assembler it is referred to as an object program. It is easier for programmers to write instructions in an assembly language than to prepare instructions in machine language codes. But two computer runs may be required before source program instructions can be used to produce the desired output.

Assembly languages have advantages over machine languages. They save time and reduce detail. Fewer errors are made and those that are made are easier to find. Assembly programs are easier for people to modify the machine language programs. But there are limitations. Coding in assembly language is time consuming. A big drawback of assembly languages is that they are machine-oriented. **i.e.,** they are designed for the specific model of processor being used. Programs might have to be recorded for a different machine.

5.2.9 Data Objects, Variables and Consonants

What are Data Objects?

A data object represents a container for data values, a place where data values may be stored and later retrieved. A data object is characterized by a set of attributes, the most important of which is its data type. The attributes determine the number and type of values that the data object may contain and also determine the logical organization of those values.

A data value might be a single number, character, or possibly a pointer to another data object. A data value is ordinarily represented by a particular pattern of bits in the storage of a computer. It is easy to confuse data objects and data values, and in many languages the distinction is not clearly made. The distinction is perhaps more easily seen by the difference in implementation. A data object is usually represented as storage in computer memory. A data value is represented by a pattern of bits. To say that a data object A contains the value B means that the block of storage representing A is set to contain the particular bit pattern representing B.

A data object participates in various bindings during its lifetime. While the attributes of a data object are invariant during its lifetime, the binding may change dynamically. The most important attributes and bindings are:
Type: This association is usually made at program translation time by associating the data object with the set of data values that the object may take.

Location: The binding to a storage location on memory where the data object is represented ordinarily is not directly modifiable by the programmer but is set up and may be changed by the storage management routines of the virtual computer.

Value: This binding is usually the result of an assignment operation.

Name: The binding to one or more names by which the object may be referenced during program execution is usually set up by declarations and modified by sub-program calls and returns.

Component: The binding of a data object to one or more data objects of which it is a component. This is often represented by a pointed value, and it may be modified by a change in the pointer.

Variables and Constants

A data object that is defined and named by the programmer explicitly in a program is termed a variable. A simple variable is an elementary data object with a name. We usually think of the value (of values) of a variable as being modifiable by assignment operation; i.e., the bonding of data object to value may change during its lifetime.

A constant is a data object with a name, which is bound to a value (or values) permanently during its lifetime. A literal (or literal constant) is a constant whose name is just the written representation of its value (eg. "22" is the written decimal representation of the literal constant which is a data object with value 21). A programmer-defined constant is a constant whose name is chosen by the programmer in a definition of the data object. Since the value of a constant is bound to its name permanently during its life – time, the translator also knows binding. Therefore, for a program written in C,

```
# define MAX 30
```

is known at translation time. The C compiler may make use of that information, knowing that the value may not be altered. Some times the compiler can use information about constant values to avoid generating code for a statement of expression. For example, in the if statement:

```
If (MAX<Z)  {……..}
```

The translator already having the data values for the constants MAX and 2, can compute that it is false as 30 is less than 2, and hence can ignore completely any code for the if statement.

Most programs today are still developed using the "batch processing" model. That is, the programmer assumes the following sequence of events.

1. The program is loaded into memory.
2. Appropriate external data (eg. tapes, disks) are made available to the program.
3. The relevant input data are read into variable in the program, the variables are manipulated, and then the result data are written back to their external format.
4. The Program terminates:
   The lifetime of the variables in the program are determined by the execution time of the program; however, the lifetime of the data often extends beyond that single execution. We say that data are persistent and continue to exist between executions of the program.

5.2.10 Data Types

What are Data Types?

A data type is a class of data objects together with a set of operations for creating and manipulating them. Although a program deals with particular data objects such as an array A, the integer variable X, the file F, a programming language necessarily deals more commonly with data types.

Every language has a set of primitive data types that are built into the language. In addition, a language may provide facilities to allow the programmer to define new data types. The basic elements of a specification of a data type are:

1. The attributes that distinguish data objects of that type.
2. The values that data objects of that type may have, and
3. The operations that define the possible manipulations of data objects of that type.

Attributes: Basic attributes of any data object, such as data type and name, are usually invariant during its lifetime. Some of the attributes may be stored in a descriptor as part of the data object during program execution; others may be used only to determine the storage representation of the data object and may not appear explicitly during execution.

Values: The type of a data object determines the set of possible values that it may contain. At any point during its lifetime, an elementary data object contains a single value from this set. The set of values defined by an elementary data type is usually an ordered set with the least value and the greatest value, and for any pair of distinct values, one is greater than the other. For example, for an integer data type, there is usually a greatest integer and similarly a least integer, which can be conveniently represented in memory, with the integers arranged in their usual numerical ordering.

Operations: The set of operations for a data type determine how data objects of that type may be manipulated. The operations may be primitive operations, which means the operations are specified as part of the language definition or may be programmer – defined operations, in the form of sub-programs or method declarations as part of class definitions. An operation is a mathematical function; for a given input argument (or arguments) it has a well-defined and uniquely determined result. Each operation has a domain, the set of possible input arguments, on which it is defined, and a range, the set of possible results that it may produce. The action of the operation defines the results produced for any given set of arguments.

Elementary Data Types

Data types are classified into two broad categories namely (a) Elementary Data Types and (b) Structured Data Types. Elementary Data Types are discussed in this section and Structured Data Types are discussed in the next section.

An Elementary data object contains a single data value. A class of data objects over which various operations are defined is termed as an elementary data type. Although each programming language tends to have a somewhat different set of elementary data types, the types real, integer, character Boolean, enumeration and pointer are often included, although the exact specification may differ significantly between two languages. For example, although most languages include a Boolean data type, it is treated quite differently in FORTRAN and C. Some of the commonly used elementary data types are explained below.

Numeric Data Types

Some form of numeric data is found in almost every programming language. Integer and real number types are the most common because they are often directly supported by the computer hardware. The properties of numeric data representations and arithmetic on computers differ substantially from the numbers and arithmetic operations discussed in ordinary mathematics. Two widely used numeric data types, namely integers and floating-point real numbers are discussed below:

- **Integers:** A data object of type integer usually has no other attributes besides its type. The set of integer values defined for the type forms an ordered subset, (within some finite bounds) of the infinite set of integers studied in mathematics. The maximum integer value is sometimes represented as a defined constant; eg. In Pascal is the constant maxim. The Value of maxim is chosen by the implementer to reflect the maximum integer value conveniently representable on the underlying hardware. Operations on integer data objects typically include the main groups:

  Arithmetic Operations: Binary arithmetic operations have the specification:

  Binop: integer * integer – integer where Binop may be addition (+), Subtraction (-), Multiplication (x), Division (/ of div). Unary operations have the specification:

  Unary Op: integer -integer

  where, for example, unary Op may be negation (-) of identity (+).
  Relational Operations: Each of the relational operations has the specification:

  Rel Op: Integer * Integer – Boolean

  Where Rel Op may be equal, not equal, less than, Greater – then. Less-than-or-equal, and greater-than-or-equal. The relational operation compares the values of its two argument data values and returns a Boolean (true of false value) data object as its result.
  Assignment: Assignment between integer data object may be specified as one of the following:

  Assignment: integer x integer - void
  Assignment: integer x integer - integer

  Bit Operation: In a language with a few primitive data types, integers fulfill many roles. In C, integers also play the role of Boolean values. Therefore, additional bit operations are also defined using the signature:
  Binop: integer x integer - integer

  Floating – Point Real Numbers: A Floating Point real number data type is often specified with only the single data type attribute real, as in FORTRAN, or float, as in C. As with type integer, the values form an ordered sequence from some hardware - determined minimum negative value to a maximum value, but the values are not distributed evenly across this range. Alternatively, the precision required for floating

– point numbers, in terms of the number of digits used in the decimal representation, may be specified by the programmer.

The same arithmetic, relational and assignment operations described for integers are usually also provided for real, although the Boolean operations are sometimes restricted. Due to round off issues, equality between two real numbers is rarely achieved. Programs that check for equality to exit a loop may never terminate. For this reason, the language designer may prohibit equality between two real numbers. In addition, most languages provide other operations as built –in functions, such as:

Sin: real – real (Sine function)
Max: real * real (max.value function)

Enumerations

We often want a variable to take on only one of a small number of symbolic values. For (eg) a variable student class might have only four possible values representing "freshman", "sophomore", "junior", and "senior"; Similarly a variable Employee sex might have only two values representing "male" and "female". In older languages such as FORTRAN and COBOL such a variable is ordinarily given the data type integer, and the values are represented as distinct, arbitrarily chosen integers. For (eg) freshman=1, sophomore=2, etc of Male =0, Female=1. The program then manipulates these values as integers. The use of sub ranges for these special types often saves on storage requirements. However, in such cases, the programmer is responsible for ensuring that no operations are applied to the integer variable that makes no sense in terms of the intended meaning. Assigning 2 to variable Employee Sex, or multiplying student class by Female (e.g. the integer1) would make no sense here, but would be allowed by the translator.

Languages such as Pascal, C, and C++ included an enumeration data type that allowed the programmer to define and manipulate such variables more directly. An enumeration is an ordered list of distinct values. The programmer defines both the literal names to be used for the values and their ordering, using a declaration such as the following in C:

enum Student Class {Fresh, Soph, Junior, Senior};

enum employees sex {Male, Female};

The basic operations on enumeration types are the relational operations (equal, less-then, greater-than, etc.,) assignment and the operations successor and predecessor, which give the next and previous value, respectively, in the sequence of literals defining the enumeration (and are undefined for the last and first values, respectively). The full set of relational operators is also defined enumeration types because the set of values is given an ordering in the type definition.

Booleans

Most languages provide a data type for representing true and false, usually called a Boolean or logical data type. The Boolean data type consists of data objects having one or two values, true or false. The most common operations on Boolean types include assignment as well as:

and: Boolean x Boolean – Boolean (Conjunction)
or: Boolean x Boolean - Boolean (Inclusive Disjunction)
not: Boolean – Boolean (Negation or Complement)

Other Boolean operations such as equivalence, exclusive or implication, nand (not and), and nor (not-or) are sometimes included.

Characters

Most data are input and output in character form. Conversion during input and output to other data types is usually provided, but processing of some data directly in character form is also important. Sequences of characters (character strings) are often processed as a unit. Provision for character – string data may be provided either directly through a character – string data type or through a character data type, with a character string considered as a linear array of characters.

A character data type provides data objects that have a single character as their value. The set of possible character values is usually taken to be a language-defined enumeration corresponding to the standard character sets reported by the underlying hardware and operating system, such as the ASCII character set. The ordering of the characters in this character set is called the collecting sequence for the character set. The collating sequence is important because it determines the alphabetical ordering given to character strings by the relational operations. Since the ordering includes all characters in the set, character strings that include space, digits, and special characters may be "alphabetical" as well.

Structured Data Types

A data type that is constructed as an aggregate of other data types called components is termed a structured data type. A component may be elementary or it may be another data structure; e.g. a component of an array may be a number or it may be a record, character string, or another array.

Many of the issues and concepts surrounding data structures in programming languages are the same as for elementary data types and have been treated in section 5.10.2. As with elementary data types, some are programmer defined while others are system defined during program execution. The bindings of data structures/types to values, to names, and to locations are important and somewhat more complex in this setting. The commonly used structured data types are explained below.

Vectors and Arrays

Vectors and arrays are the most common type of structured data type on programming languages. A Vector is composed of a fixed number of components of the same type organized as a simple linear sequence. A component of a vector is selected by giving its subscript, an integer (or enumeration value) indicating the position of the component in the sequence. A vector is also termed a one-dimensional array or linear array. A two – dimensional array or matrix has its components organized into a rectangular grid of rows and columns. Both a row subscript and a column subscript are needed to select a component of a matrix. Multidimensional arrays of three or more dimensions are defined in a similar manner.

Vectors

The attributes of a vector are:

a) Number of components, usually indicated implicitly by giving a sequence of sub script ranges, one for each dimension.

b) Data type of each component, which is a single data type, since the components are all of the same type.

The Subscript to be used to select each component is usually given as a range of integers, with the first integer designating the first component, the second designating the second component etc., This may be either a range of values or an upper bound with an implied lower bound. (E.g.) In C, an array declaration is as follows:

float a[10];

declares a C array of 10 components with subscripts ranging from 0 to 9.

The operation that selects a component from vectors are called subscripting and is usually written as the array of vector name followed by the subscript of the component to be selected e.g.[2]. However the subscript may generally be a computed value, in which case an expression may be given that computes the subscript e.g. a[I+2].

The subscription operation, discussed earlier, returns the I-value or location of the relevant data object. Other operations on vectors include operations to create and destroy vectors, assignment to components of a vector, and operations that perform arithmetic operations on pairs of vectors of the same size, such as addition of two vectors. Since vectors are of fixed size, insertion and deletion of components are not allowed; only the value of a component may be modified. Most languages provide only a limited set of such operations.

Multidimensional Arrays: A vector is an array of one dimension; a metric composed of rows and columns of components is a two-dimensional array; a three-dimensional array is composed of planes of rows and columns; similarly arrays of any number of dimensions may be constructed from arrays of fewer dimensions. Multidimensional array differs from a vector in its attributes only in that a subscript range for each dimension is required, as in the Pascal declaration:

B: array[1..10,-5..5] of real;

Selection of a component requires that one subscript can be given for each dimension E.g.: B[2,4]. A matrix is conveniently implemented by considering it as a vector of vectors; a three-dimensional array is a vector whose elements are vectors of vectors etc. All the sub-vectors must have the same number of elements of the same type.

Whether a matrix is viewed as a "column of rows" or a "row of columns" is important in some contexts (most often, where a metric is to be passed as an argument to a sub program written in another language). Most common is the column-of-rows structure in which the matrix is considered as a vector in which each element is a sub vector representing one row of the original matrix. This representation is known as a row-major order. In general an array of any number of dimensions is organized on row major order when the array is first divided into a vector of sub vectors for each element on the range of the first subscript, then each of these sub vectors is subdivided into sub sub-vectors for each element in the range of the second subscript, etc. column-major order is the representation in which the matrix is treated as a single row of columns.

The storage representation for multidimensional array follows directly from that for a vector. For a matrix, we store the data objects in the first row (assuming row – major order), followed by the data objects in the second row etc. The result is a single sequential block of memory containing all the components of the array in sequence. The descriptor for the array is the same as that for a vector, except that an upper and a lower bound for the subscript range of each dimension are needed.

Records

A data structure composed of a fixed number of components of different types is usually termed as Record.

Both records and vectors are forms of fixed-length linear data structures, but records differ in two ways.

1. The components of records may be heterogeneous i.e., of mixed data types, rather than homogeneous.

2. The components of records are named with symbolic names (identifiers) rather than indexed with subscripts.

The C syntax for a record declaration (struct in C) is fairly typical:

```
Structure Employee Type
{
int ID;
int Age;
float Salary;
char Dept;
} employee;
```

The declaration defines a record of type employee. The type consisting of four components of types integer, integer, real and character, with component names ID, Age, salary and Dept respectively. Employee is declared to be a variable of type employee type (subsequent declarations of other variable of type Employee type do not need to give the record structure for Employee Type). To select a component of the record, one writes in C:

Employee.ID
Employee.Salary

The attributes of a record are seen in the above declaration:

1. The number of components.
2. The data type of each component.
3. The selector used to name each component.

The components of a record are often called fields, and the component names then are the field names. Records are sometimes called Structures.

Component selection is the basic operation on a record, as in the selection

Employee.Salary

This operation corresponds to the subscripting operation for arrays, but with one difference. The "subscript" here is always a literal component name; it is never a computed value. For example, in the selection of the third component of the record Employee corresponds to the selection Vect[3] of the third component of a vector, but there is no selection for records that corresponds to Vect[I], where the value of I is computed.

Operations on entire records are usually few. Most commonly assignment of records of identical structure is provided.

Pointers

Pointers are a special class of variables. Pointer variables are simply variables whose values are pointers or addresses. Most often the value of a pointer variable points to a node in a dynamic data structure. Pointer variables are declared much like any other variable. When a pointer variable is declared, the declaration must indicate two items: (1) That the variable is a pointer variable and (2) The type of data which the pointer variable can point to.

A pointer variable is of no use unless there is something for it to point to. Pointers point to special kinds of variables called dynamically allocated variables, or more simply dynamic variables. Dynamic variables are like ordinary variables in many ways, but not in all ways. It is important to keep in mind two differences between dynamic variables and ordinary variables:

1. Dynamic variables are not declared. A program may use lots of dynamic variables, but the variables do not appears in any declaration with the usual word var. A dynamic variable has no name (nameless).

2. Dynamic variables are created during the execution of a program, and only at that time does a pointer variable actually have something to point to.

5.2.11 Tamil Word Processors

Introduction

Dravidian Languages such as Tamil use non-Roman letters as alphabets. Typing of text materials in computers of these Indian languages requires use of either specific font-faces and/or word-processing softwares. The term 'Tamil Computing' is used in a narrow sense to cover the area of word-processing of Tamil-related materials on computers. Tamil computing covers a much broader domain with applications in many areas: tools for larger databases of different kinds using Tamil script, multi-media kits involving Tamil, multi-lingual dictionaries and translation software's etc.

In the last two decades, many different fontfaces and desktop publishing (DTP) software have appeared for word-processing of Tamil along with different typing (input) methods. Some of these are based on simple recasting of the Tamil typewriter keyboard in the form of 7-bit fonts. Others are sophisticated 8-bit font/word-processing packages where the actual keystrokes and their relative sequence are interpreted to provide the required Tamil texts. These packages allow different modes of input including romanized/transiliterated input. Font Encoding, i.e., the exact location of different Tamil characters in the standard extended ASCII table (128 or 256 slots) in the Tamil font being used determines the 'output' content of the Tamil text irrespective of the mode of 'input'. Tamil text files created using one font/DTP package cannot be read using another font unless the font encoding scheme is identical between the two fonts in question.

There are a growing number of Tamil pages being put on the Internet. WWW is using fonts and packages with different font encoding schemes. So we are now in an unpleasant situation: One needs to acquire and install as many fonts as the number of Tamil web pages and archives available on the internet. Necessity for setting standards arises from the growing trend to exchange/share information between individuals placed in different parts of the world.

In the absence of any standard protocols by which the information storage is carried out at the font-encoding level, information exchange on a worldwide become too complex for many of the concerned individuals if not impossible. Majority of the end-users (Tamil community at large) are not well versed in technical aspects of data storage or transfer. So procedures have to be designed so that ordinary/common people can put up web pages and share information electronically in Tamil worldwide without getting involved too much into the technical nitty-gritty's. Any proposal for standardization needs to accommodate the current typing habits/preferences (some kind of backward compatibility).

Word Processing Using 7-Bit Tamil Fonts (Direct Output)

Since Tamil typewriters have been in use for many years before the advent of computers, it is logical that early approaches to Tamil computing involved implementing the classical typewriter in the form of 7-bit fonts. Various Tamil characters are placed under different Roman letters at the equivalent locations of the Tamil typewriter. Using the normal and shift-mode location of the standard keyboard obtain all of the Tamil alphabets.

While some of the alphabets are obtained in single keystroke, others are obtained by two or three keystroke operations. With such Tamil fonts, those who are accustomed to typing on Tamil typewriter can make the transition to Tamil computing without difficulty and loss of any typing speed. This trend is very strong in TamilNadu even today. Majority of Tamil computing use the Tamil typewriter keyboard layout(s). So any Tamil Computing Standardization efforts need to take this reality into account. There are many font faces of this type available: TAMILLASER of Prof.George Hart, ANANKU of P. Kuppuswamy (widely used in continental US), SARASWATHI OF Vijayakumar (widely used in Canada) are some examples. BHARATHI word processor for plain DOS computers was one of the early ones to appear (in early eighties) in Malaysia and Singapore region. VENUS is a recent, updated version of this word-processor running under windows environment.

The common logic in any keyboard layout design is to have most commonly occurring letters placed in the central/middle part of the keyboard (and less frequent ones moved to left/right extremes). This concept/logic was applied quite a while ago in the design of typewriters. In Tamil, one particular assignment was chosen:

Middle line ya, La, na, ka, pa modifier of aa, tha, ma, ta in middle line; nga, Ra, n^a, ca, va, na, ra, sa, zha, modifier for in in the top line and ii, la, o, u, e, ti, modifier for e, a, i, at the bottom line. There have been many re-examination of this concept of character placing for Tamil keyboard recently. Mohan Tambe of CDAC, Pune designed a keyboard layout for Indian languages using such an analysis. Naa. Govindasamy (host of this conference) has made similar analysis for Tamil and has designed the Kanian/IE/ Singapore Tamil Keyboard layout.

An alternative approach to Tamil typewriter keyboard layout involves phonetically linking Tamil characters to be typed to corresponding Roman letters. Thus you hit the key k to get ka, ma for ma, l for la, p for pa, k followed by I for ki, k followed by I to get kii and so on. For those who never used the Tamil typewriter, this approach can be intuitive and very appealing. Since Tamil characters of 7-bit are readily accessible via normal and shift-modes of the keyboard on all computers, I designed a phonetically based 7-bit font called MYLAI. The term'phonetic' is used in a slightly different context by many (e.g. participants of this conference Naa. Govindasaamy, Ravindran Paul). So we would use the abbreviation WYTIWYG (what you type is what you get) layout to refer to keyboard layouts based on the above-cited phonetic input method. The frequency of occurrence of Tamil characters in Tamil need not necessarily be the same as in English.

Word Processing Using 8-bit Font Faces (Direct Output)

If one counts the number of alphabets of Tamil, we have over 230 (13 vowel, 18 consonants and products (uyirmeis) derived from these. Tamil is one of the Indian languages where many of the compound (uyirei) alphabets have complex geometric structure (glyph) of their own. In 7-bit fonts with 128 slots, nearly half of them are not available for placing Tamil characters (first 32 slots reserved for control characters, qp places for roman numeral and another 10 or 12 for various key punctuation marks). For the number of Tamil alphabets to handle, the remaining positions are rather limited.

In 7-bit fonts, a number of uyormei letters are obtained simply by adding a modifier glyph to the parent consonant. Tamil Typewriter uses this concept extensively. 'Kerning' is a technique that allows controlled fusion of two successive characters. Unfortunately, kerning is not easily implemented on many computer platforms. Without kerning, the quality of the output for on-screen display and in print using such 7-bit platforms. Without kerning, the quality of the output for one-screen display and in print using such 7-bit fonts can be far from satisfactory, at least for commercial publishing houses. So, there have been efforts to go for fonts of 8-bit type. 7-bit and 8-bit fonts have their own merits and demerits.

Word Processors Based on Romanized Input (Interpreted Output)

ADAMI was one of the early Tamil word-processors for MS-DOW PCs produced by Dr.K. Srinivasan of Canada in early eighties (released in 1984 for CPM-80 computers to recast such transliterated text into Tamil. The Tamil text is to be typed using a plain ASCII transliteration scheme. Upon compiling/execution of the linked macro, this romanized text page is recast on screen in equivalent Tamil. One needs to return to the Romanized text mode to make the corrections if any. In a more recent version of this software called THIRU, the author provides a split screen, where the roman text being typed in the bottom half of the screen is continuously recast in the upper half in Tamil. ADHAWIN is another recent implementation of the same software but for windows-based PCs.

The transliteration scheme used in MADURAI is a subset of that used in ADAMI/ADHAWIN. The software operation used here is part of a general classification scheme called" romanized input/interpreted output" package.

For those who never wrote extensively in Tamil (and beginners who are not sure of exact uyirmei to use in writing Tamil worlds, e.g.na/Na), word processors that allow transliterated input is attractive. Adami, Madurai, Itrans, Xlib Tamil software mentioned earlier belong to this category. The last three freewares are popular amongst the UNIX user community. They are used in conjuncture with corresponding meta-fonts and TeX – type word- processing extensions, high quality print-outscan be obtained for the related texts.

MURASU ANJAL word-processing packages widely used in Malaysian, Singaporean Tamil Newspapers and Magazines are the products of Muthu Nedumaran presented at this conference. These packages belong to the group of "romanized input/interpreted output" tools. The inaimathi and related fontfaces used in these packages are of the 8-bit bilingual type. The first 128(0-127) slots are filled by roman characters as in basic ASCII and the related characters occupy the upper ASCII slots (128-255). By invoking the keyboard editor it is possible to access either of these two blocks. In the Tamil typing mode, the roman keyboard strokes and their relative sequence are continuously interpreted to present equivalent Tamil characters on screen. Thus you type 'kathai' to get the equivalent Tamil word.

Word Processors Based on Phonetic Keyboard Input (Interpreted Output)

There are now intelligent Tamil word-processors available where the large numbers of uyirmei alphabets are obtained by a sequential keying of the corresponding mei and uyir characters. Thus the keystrokes for consonant k followed by vowel I lead to appearance of compound character ki. Keyboard layouts of this kind have been called "phonetic". There are no characters for kokki's kombu's etc. The keyboard driver does the mapping and remapping based on the sequence of key press events. An advantage of this approach is that the numbers of keys to use to get all the uyirmeis are considerably less. Mohan Tambe (formerly of the Center for developments for Advanced Computing CDAC) was one of the early pioneers working on the keyboard layouts appropriate for Indian languages. His phonetic keyboard layout known as INSCRIPT was initially designed (in 1983) for Devanagiri script input. This has been adopted for use in the multi-lingual word-processors CDAC developed for Indian languages (cf.references to CDAC AND Inscript in the next section). THUNAIVAN word-processor of Ravindran Paul, IE PHONETIC KEYBOARD LAYOUT of Naa. Govindasamy, CHARACTER PHONETIC DEPENDENCIES/UARZAN keyboard editor of R. Shanmugalingam are different forms of implementation of this phonetically based keyboard input concept. When compared to wytiwyg keyboard implementation of this phonetically based keyboard input concept. When compared to wytiwyg keyboard layouts, phonetic layouts reduce considerably the number of keystrokes required to get the o-kara,oo-kara, ou-kara uyirmeis. Here you will type k followed by o or O. Two keystrokes give 3 characters.

Padhami Word Processor

Padhami is the Tamil word coined for word processing; it is India's first software with the entire user interface in an Indian Language, on a 32-bit environment.

Padhami 1.72 is a 32-bit; windows based Tamil word processor with never before seen features in Tamil computing such as:

1. Menu in Tamil
2. NLP (Natural Language Processing)
3. Sorting in Tamil
4. Database Processing in Tamil
5. Market Break Through
6. At a time, when Tamil Software was exorbitantly priced (Ranging from Rs.5000/- to Rs 15,000/-) Padhami was priced at Rs.1295/-(Rs.850/- for educational and Government Institutions). This again made competitors slash their prices by more than half.

Padhami is being sold in six countries, excluding India.

Padhami 2.0 Features

Word-Processor: Can be used for typing letters, documents, and email, in English or Tamil. Uses Narayanan scheme for transliteration. Supports all basic word-processing features.

MDI: Multiple documents can be opened at the same time.

Productivity: Great range of interface features, powerful region technology, and cutting-edge design, active Colors.

Matram1.1: Free until to convert old documents to tamilnet99 standards.

Windowless controls: Padhami uses lightweight controls; they do not have a window handle and do not consume system resources in the same way as windowed controls. Typically, when using windowless controls, you can use more controls in your application without affecting its efficiency.

Tools: Spell Checking, Grammar Checking, Index sort, Thesaurus, Mail merge, Print Labels, merge Documents. OST (On Screen Typing) Technology, Four Inputting methods (including Typewriter and Tamilnet99) 3D Charts. Bilingual Menu, Auto text Insert.

Cross application use: Type a document in Padhami, import in Microsoft-word or any application and using a driver (freely available) edit text directly in other Applications.

Ponmozhi Word Processor

Another widely used Tamil Word Processor is Ponmozhi. Some of its special features are:

- 9 Beautiful Monoligual and one Bilingual tree type fonts, all in the standard TAM and TAB codes.
- Can Transform a file between Monolingual and bilingual Fonts.
- Both Tamil 99 and typewriter keyboard are supported.
- An intelligent search forgives all the errors in ra, la, and na.
- A 7000 word Dictionary that helps the above can be viewed as such.
- In a file, a word can be searched specifically in a particular font or in any TAM fonts.
- A powerful sorting will sort correctly even when English is mixed can sort the first of cursor column.
- Uses can configure the working of cursor (2 ways).
- Normal and intelligent backspace (letter, stroke, symbol) and Delete (letter and symbol). This will make correction easy and typing a pleasure.
- Bulk replaces facility to reduce typing time.
- Can include sound file and pictures.
- Exhaustive explanation regarding the working of Tamil 99 keyboard. A special set of lessons for quick learning of this keyboard and every other information needed, are given under help.

5.2.12 Tamil Web Browsers and Web Pages

Currently there are two methods by which texts can be displayed directly in Tamil on a Web page:

1.Using graphics / image files.
2.Using Appropriate Tamil fonts.

With the availability of a number of Tamil fonts, there is a growing interest to display Tamil text materials directly in Tamil (instead of using transliterated/romanized texts) in worldwide web (WWW of simply web) pages. Now, let's have at the above two approaches.

Using Graphics / Image Files

The first is to use a graphic/image file (.jpg of .gif) to display the Tamil text. The image file is created using any of the graphic software's in conjunction with a Tamil font or even packages such as Xlibtamil. The advantage of this approach is that, the graphic display on a web page is system independent-can be read on all platforms (UNIX, Macintosh and windows pcs). Disadvantages are that the image files are quite large in size as compared to plain text files (hence longer time for complete access). Also the local usage of the displayed text material and word search using word processing programs not feasible. Typical examples of this approach are the Tamil thirukural Browser of Dr. Siddarthan Ramachandramurthi and Tamil web News page(s) of Cyrinus Joseph.

Using Tamil Fonts

Web pages can be in bilingual (Tamil English) format. For this method to have maximum utility, it is essential to have the same Tamil font to be available FREE in more than one computer platforms (Windows, Macintoshes and UNIX systems wheel web browsers are used). A minimum requirement for fonts is different font faces use the same key mapping. For example, the popular Tamil font Mylai is available FREE in identical form for use on Macintosh and Windows PCs. Till the recent version of HTML (3.0) came up, the Tamil pages could be displayed by using the "predefined" format of the HTML language. A fixed size font such as Helvetica or Courier is used to display the English/Roman part of the texts and a proportional type Tamil font is used to display the Tamil part of the web page. The " preformatted text" tag of HTML (<pre>) is to be invoked. The choices of fixed and proportional fonts are made locally using the preferences option of browsers such a Netscape. The preferences needs to be put back after viewing of the Tamil page(s) to Times or whatever font used before.

With the implementation of HTML 3.0 by the popular web browsers (Netscape 3.0 and Microsoft Internet Explorer 3.0), setting up web pages to display bilingual (Tamil along with English) is very simple. HTML language protocol 3.0 allows defining the font itself in the HTML text using the tag<font face="fontanamel, fontaname2, fontname3">. Three font faces can be specified in priority sequences. If the Tamil text part is enclosed by the appropriate Tamil font face begin and end tags, the browser will automatically load the appropriate Tamil font available locally and will display Tamil texts in Tamil along with the roman-font based texts.

5.2.13 Tamil E-Mail

GOOD NEWS for the people of TamilNadu. For they can now type Tamil in English. Yes, it is true. Now you can type your 'Epadi Irrukkae' in English and it gets transliterated, the words appear on the screen in Tamil language itself.

So, even those who do not know to write the language can now send Tamil e-mail, chat in Tamil and work in a community on the net that is full of Tamilians. www.tamil.com, www.chennai.net and www.tamilnadu.net will soon be operational along with www.tamilanjal.com. As of now Tamil is the second largest language used on the net. The world's first Web Based Tamil E-mail has been provided by Tamilanjal.com. As an example, the requirements of this web abed Tamil E-mail is given below.

Requirements

Tamilanjal requires a Java – Enabled Browser (Java1.1.5 or higher) and works with the following environments:

Operating System	**Browser**
Windows 95/98/NT	Netscape 4.04 & above
Window 95/98/NT	Internet Explorer 4.0
Windows 95/98/NT	Internet Explorer 5.0
Linux	Netscape
Solaris	Netscape
Unix	Netscape
Macintosh	Internet Explorer

Sending a Message

Use the following steps to send a message:

1.Enter the Sender's name, Sender's Email address, Recipient's name, Recipient's Email address & Subject in the respective fields.

2. Place the mouse cursor inside the message composition area (Text area with a gray border) and click the left button. Now, you can enter the message. Message can be composed in Tamil& English.

3. Num Lock key is used to toggle between Tamil and English mode.

When the keyboard is in Tamil mode, the characters being typed will appear in Tamil Font.

When the keyboard is in English mode, the Characters being typed will appear in English font.

Use Num Lock key to toggle between Tamil & English Mode,

Tamilanjal supports 3 different keyboard layouts.

Tamilanjal supports 2 types of sending the messages:

- Send Message using Java
- Send Message as Text

Send Message using Java

When this option is used, the mail recipient can directly view the Tamil message using any Java compatible email client software of browser. There is no need for the recipient to download any Tamil font.

Use this option if the recipient is using Java compatible email client software such as Microsoft Outlook 5.0 or Browser such as Microsoft Internet Explorer 5.0.

Send Message as Text

When this option is used, the message will be sent as text and the mail recipient can use any email client software (or any web-based email service) to read the Tamil message. The recipient requires the Indo Web Tamil font to read the message. If the Tamil font is already available in the recipient's system, then the message will appear directly in Tamil. Otherwise, the user has to download and install the Tamil font using the link available in the message.

After composing the message, select the 'Send Mail' button to send the message.

5.3 Revision Points

Information Systems

An Information System can be defined as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and to have an over-all control in an organisation.

MIS

MIS can be defined as a network of computer based data processing procedures developed in an organisation and integrated as necessary with manual and other procedures for the purpose of providing timely and effective information to support decision-making and other necessary management functions.

Simulation

Simulation is the use of a model in an attempt to identify and or reflect the behaviour of a real person, process or system.

Interpreter

Instructions of high-level language are coded in many statements. At the time of their execution, they are converted statement by statement into machine code, by using system software called interpreters.

Data Types

A data type is a class of data objects together with a set of operations for creating and manipulating them.

Boolean

Most languages provide a data type for representing true and false, usually called a Boolean or logical data type. The Boolean data type consists of data objects having one or two values, true or false.

Pointers

Pointers are a special class of variables. Pointer variables are simply variables whose values are pointers or addresses.

5.4 Intext Questions

1. What is an Information System? Explain the major types of IS.
2. Describe the Tamil Word Processor with an example.
3. What is MIS? Explain.
4. Discuss the different datatypes present in Programming Languages.
5. Explain briefly Generation of Languages.
6. What are Data Objects?

5.5 Summary

- Information System can be defined as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision-making and to have an over-all control in an organization
- Simulation is the use of a model in an attempt to identify and or reflect the behavior of a real person, process or system.
- A language is a system of communications. A programming language consists of all the symbols, characters and usage rules that permit people to communicate with computers.
- A computer's machine language consists of strings of binary numbers and is the only one the CPU directly "understands".
- A data type is a class of data objects together with a set of operations for creating and manipulating them
- Dravidian Languages such as Tamil use non-Roman letters as alphabets. Typing of text materials in computers of these Indian languages requires use of either specific font-faces and/or word-processing software

5.6 Terminal Exercises

1. Define Operation Research (OR)
2. Define MIS in Short Form.

3. Writer different type of computer languages
4. C is _____

    i. Assembly
    ii. Structural
    iii. Procedural
    iv. High level

5. Write a short notes about Interpreter.
6. What is Data Type?
7. Pointers can hold the address of another variable

    i. TRUE
    ii. FALSE

8. Write about array?
9. What is Vector?
10. _____ Word Processor is India's first software in Indian Language.

5.7) Supplementary Material

1. Management Information Systems : Managing Information Technology in E-Business Enterprise by James A. O'Brien.

5.8 Assignments

1. A case study – Information System

    MIS

2. Explain the Hierarchy of an Organisation using Chart diagram.

5.9 Reference Books

1. Ralph Stair, George Reynolds "Fundamentals of Information Systems" Third Edition, Publish date: April 27, 2005.

5.10 Learning Activities

There is no scenario to perform the learning activities

5.11 Key Words

- **TPS** - Transaction Processing Systems
- **MIS** - Management Information System
- **Accuracy** - Accuracy is the ratio of correct information to the total amount of information produced over a period
- **IRM** - Information Resource Management