

MBA/PGDIM First Year
Paper - III

COMPUTER APPLICATIONS



मध्यप्रदेश भोज (मुक्त) विश्वविद्यालय – भोपाल
MADHYA PRADESH BHOJ (OPEN) UNIVERSITY - BHOPAL

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- | | |
|---|---|
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Assistant Professor
IEHE, Bhopal | 3. Dr. Sharad Gangele
Professor
RKDF University, Bhopal |
| 2. Dr. Amit Kumar Mandle
Assistant Professor
IEHE, Bhopal | |



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| 3. Dr. Kishor John
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Professor
RKDF University, Bhopal |



COURSE WRITERS

Sanjay Saxena, Renowned Author of over 130 books on Information Technology

Units: (1.0-1.6.1, 2.6-2.12, 5.3.2, 5.5-5.10)

Vivek Kesari, Assistant Professor, Galgotia's GIMT, Institute of Management & Technology, Greater Noida

Units: (1.6.2-1.6.3, 1.7-1.14, 2.0-2.5, 3, 4, 5.0-5.2, 5.3.1, 5.4.1)

Rajneesh Agrawal, Senior Scientists, Department of Information Technology, Government of India

Units: (5.3, 5.4, 5.4.2-5.4.3)

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Phone: 0120-4078900 • Fax: 0120-4078999

Regd. Office: A-27, 2nd Floor, Mohan Co-operative Industrial Estate, New Delhi 1100 44

• Website: www.vikaspublishing.com • Email: helpline@vikaspublishing.com

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INTRODUCTION

Today, the fact that computers have made a big impact on many aspects of our lives can hardly be questioned. They have opened up an entire world of knowledge and information that is readily accessible. Thus, information about computers—right from the first mechanical adding machine to the latest microprocessors—has become imperative for students as well as anybody who has something to do with a computer system.

Today, we are using the fifth generation of computers. The term ‘generation’ is used to distinguish between varying hardware and software technologies. The hardware by itself cannot do any calculation or manipulation of data without being instructed what to do and how to do it. Thus, there is a need of software in a computer system. The software used in a computer system is grouped into applications software, system software and utility software.

We have tried to familiarize students with the basic components of a computer system, which include the control unit, memory and processor, input and output devices. Input devices are used to transfer information into the memory unit of a computer. Output devices are electromechanical devices that accept data from the computer and translate it into a form that can be understood by the outside world. Different concepts related to the processor (CPU); such as bus structures, general register organization are also discussed. The differences among the various types of computers, such as notebooks computer, personal computers, mainframe computers and supercomputer are also discussed.

An operating system is the most essential part of any computer system. It is the software that acts as an interface between the user and the computer. The main purpose of an operating system is to provide an environment in which a user can execute programs in a convenient and efficient manner. A computer system consists of two major segments: the hardware and the software. The hardware comprises all the machines/equipment associated with the computing environment. The major components include the Central Processing Unit (CPU), the memory and the Input/output (I/O) devices. The software comprises of system and application programs, such as compilers, text editors, Word processors, spreadsheets, database systems and so on.

The term ‘Microsoft office’ refers to all tools and methods that are applied to office activities which make it possible to process written, visual and audio data in a computer aided manner. They process data, store information, solve complex mathematical problems, track inventory and even control temperature and lighting in office buildings. All this can be done with the help of various computer office application programs/software, such as Microsoft Word, Microsoft Excel and Microsoft PowerPoint. Microsoft Office 2007 supports ‘Ribbon Interface’ which provides GUI features for menu bar. Microsoft Office Word, a Word processor, was designed by Microsoft. Creating and editing document features are very helpful in Microsoft Word 2007 and hence used frequently. Microsoft Excel 2007 is an electronic spreadsheet that runs on a personal computer. A workbook is the

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Microsoft Excel file in which you enter and store related data. You can also use it to perform mathematical calculations quickly. Microsoft PowerPoint 2007 allows for creation of professional, effective and creative business presentations that can be used for corporate or sales presentations and trainings.

The study of computer networks and the Internet becomes essential to know more about computing techniques and communication technologies. It is now inevitable for everybody, from high-tech company professionals to beginners, to have a good insight of the principles of computer networks to become aware of how it can be used in the growth of networking and thereafter Internet which has influenced almost every aspect of life. Conveniences like ATM services, Internet, wireless telephony and electronic mail could not have been possible without computer networks.

This book, *Computer Applications*, follows the SIM format wherein each Unit begins with an Introduction to the topic followed by an outline of the 'Objectives'. The detailed content is then presented in a simple and an organized manner, interspersed with 'Check Your Progress' questions to test the understanding of the students. A 'Summary' along with a list of 'Key Terms' and a set of 'Self-Assessment Questions and Exercises' is also provided at the end of each unit for effective recapitulation.

UNIT 1 COMPUTER APPRECIATION AND ORGANIZATION

*Computer Appreciation
and Organization*

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Structure

- 1.0 Introduction
- 1.1 Objectives
- 1.2 History of the Development of Computers
- 1.3 Concepts of Computer Systems
 - 1.3.1 Capabilities and Limitations of Computers
- 1.4 Generations of Computers
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1.0 INTRODUCTION

Early computers were meant to be used only for calculations. Simple manual instruments like the abacus have aided people in doing calculations since ancient times. Early in the Industrial Revolution, some mechanical devices were built to automate long tedious tasks, such as guiding patterns for looms. Modern computers can perform generic sets of operations known as programs. These programs enable computers to perform a wide range of tasks. The first computers were used primarily for numerical calculations. However, as any information can be numerically encoded, people soon realized that computers are capable of general calculations.

A computer is a machine that can store and process information. Computer is a fast electronic calculating machine which accepts digital input, processes it. Most computers rely on a binary system that uses two variables, 0 and 1, to complete tasks such as storing data, calculating algorithms, and displaying

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information. Computers comes in many different shapes and sizes, from handheld smartphones to supercomputers weighing more than 300 tons. The most powerful computers can perform extremely complex tasks, such as simulating nuclear weapon experiments and predicting the development of climate change. The development of quantum computers, machines that can handle a large number of calculations through quantum parallelism (derived from superposition), would be able to do even more complex tasks. Computer Organization includes the high level aspects of a design, such as memory system, the bus structure and the design of the internal CPU. Computer Types. A computer system is like any other system, consists of an inter-related set of components. The system is best characterized in terms of structure-the way in which they are interconnected and function-operation of individual component.

In this unit, you will learn about the history of development of computers, capabilities and limitations of computer systems, various generations of computers, different types of computers, main components of computer, hardware of a computer, different types of computer software, basic I/O devices and computer organization.

1.1 OBJECTIVES

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

- Discuss the history of development of computers
- Understand the capabilities and limitations of computer systems
- Describe the various generations of computers
- Explain the different types of computers
- Discuss the main components of computer
- Define the term hardware of a computer
- Understand the different types of computer software
- Explain the different types of I/O devices
- Describe the functions of scanners and its types
- Understand the purpose and functions of CRT terminals
- Define non-CRT displays
- Understand the functions of a printer, its types as well as the working of impact and non-impact printers
- Analyze the computer organization
- Explain bus structure and different bus organizations
- Elaborate on the memory location and address
- Define central processing unit
- Discuss the general register organization

1.2 HISTORY OF THE DEVELOPMENT OF COMPUTERS

The first mechanical adding machine was invented by Blaise Pascal in 1642. Later, in 1671, Baron Gottfried Wilhelm von Leibniz of Germany invented the first calculator. Around this time, Herman Hollerith came up with the concept of punched cards, which were extensively used as an input medium in mechanical adding machines.

Charles Babbage, a 19th century professor at Cambridge University, is considered the father of the modern digital computer. During this period, mathematical and statistical tables were prepared by a group of clerks. However, utmost care and precautions, could not eliminate human errors.

In 1842, Babbage came up with his new idea of the Analytical Engine, which was intended to be completely automatic. This machine was capable of performing basic arithmetic functions. But, these machines were difficult to manufacture because the precision engineering required to manufacture them was not available at that time.

The following is a brief description of the various generations of computers.

- **Mark I Computer (1937-44):** This was the first fully automatic calculating machine designed by Howard A. Aiken and the design of which was based on the technique of punching card machinery. In this technique, both mechanical and electronic components were used.
- **Atanasoff-Berry Computer (1939-42):** This computer was developed by Dr. John Atanasoff to solve certain mathematical equations. It used forty-five vacuum tubes for internal logic and capacitors for storage.
- **ENIAC (1943-46):** The Electronic Numerical Integrator and Computer (ENIAC) was the first electronic computer developed for military requirements and was used for many years to solve ballistic problems.
- **EDVAC (1946-52):** One of the drawbacks of ENIAC was that its programs were wired on boards, which made it difficult to change them. To overcome the drawbacks of ENIAC, the Electronic Discrete Variable Automatic Computer (EDVAC) was designed. The basic idea behind this concept was that sequences of instructions could be stored in the memory of the computer for automatically directing the flow of operations.
- **EDSAC (1947-49):** Professor Maurice Wilkes developed the Electronic Delay Storage Automatic Calculator (EDSAC), by which addition and multiplication operations could be accomplished.
- **UNIVAC I (1951):** The UNIVERSal Automatic Computer (UNIVAC) was the first digital computer to be installed in the Census Bureau in 1951 and was used continuously for 10 years. In 1952, International Business Machines (IBM) introduced the 701 commercial computers. These computers could be used for scientific and business purposes.

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1.3 CONCEPTS OF COMPUTER SYSTEMS

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A computer is a programmable machine designed to automatically process a sequence of various arithmetic or logical operations. The interface between the computer and the human operator is known as the user interface. A computer consists of memory which stores information and data in the form of text, images and graphics, and audio and video files. CPU or Central Processing Unit performs the arithmetic and logic operations with the help of sequencing, and control unit that can change the order of operations based on the information that has been stored in memory. Peripheral devices allow information to be entered from an external source and allow the results of operations to be sent out. A Central Processing Unit or CPU executes a series of instructions to read, manipulate and store the data. The control unit, Arithmetic Logic Unit or ALU, memory registers and basic Input/Output or I/O devices are collectively known as a Central Processing Unit or CPU. Devices that provide input or output to the computer are known as peripherals. On a Personal Computer or PC, peripherals include input devices, such as the keyboard and mouse, and output devices, such as visual display unit or monitor and printer. Hard disk drives, floppy disk drives and optical disk drives serve as memory devices. A graphics processing unit is used to display 3-Dimensional or 3-D graphics. Modern desktop computers contain various smaller computers that assist the main CPU in performing I/O operations. Memory refers to the physical devices which are used to store programs, sequences of instructions or data, such as programs in a computer. Data is stored either in hard disk or in secondary memory devices, such as tape, magnetic disks and optical disks, Compact Disk Read Only Memory or CD-ROM and Digital Versatile/Video Disc or DVD-ROM. Memory is associated with addressable semiconductor memory, i.e., integrated circuits consisting of silicon based transistors.

Basic Functions of a Computer

There are three basic functions of a computer are as follows:

- **Data Processing:** A computer must be able to process data.
- **Data Storage:** A computer must be able to store data. Even if data is supplied to a computer on the fly, for processing and producing the result immediately, the computer must be able to store that data temporarily. Apart from short term data storage, it is equally important for a computer to perform a long term storage function to store different files.
- **Data Movement:** A computer must be able to move data between itself and the outside world. The computer operating environment consists of devices that serve as data sources or destinations. When data is received from or delivered to a machine that is directly linked to a computer, the process is known as input/output and the devices used for this purpose are referred as input/output devices. When data moves over longer distances to or from a remote machine the process is known as data communication.

1.3.1 Capabilities and Limitations of Computers

The increasing popularity of the computer has proved that it is a powerful and useful tool. Its usefulness is due to its following features:

- **Speed:** Computers are very fast. They can process millions of instructions every second. The speed is related to the amount of data it processes and the time it takes to complete the processing task.
- **Storage:** Computers can store vast amounts of information in the form of files, which can be recalled at any time. These files help in easy and speedy retrieval of information. This type of storage is known as electronic storage system.
- **Accuracy:** In addition to being fast, computers are also accurate. The degree of accuracy for a particular computer depends upon its design. Most errors in computers are non-technical. Generally, programmers are responsible for these errors.
- **Diligence:** Computers are diligent as they can perform any complicated task accurately without making any error. Computers do not suffer from carelessness, boredom or tiredness. Moreover, their efficiency does not decrease with age.
- **Versatility:** Computers perform various tasks depending upon the instructions fed into them and their hardware characteristics. They are capable of performing any task, provided the task is reduced to a series of logical steps. A computer can be used to prepare a Word document and in between called to search for another document that is stored in its memory. It can perform both tasks simultaneously.
- **No IQ:** Computers do not have their own intelligence and their I.Q. (Intelligence Quotient) is zero. Hence, the user can and has to decide what tasks a computer should perform.
- **No Feelings:** Computers have no feelings because they are machines. They cannot make judgements as they process on the basis of a set of instructions, called programs, provided by the users.

Though computers can do better than human beings in terms of accuracy, speed and memory, but even then there are certain limitations of computer systems because they depend on human beings for their operations and functions. The following are some of the limitations of computers:

- Human beings program them for efficient, accurate and fast functioning.
- Computers cannot think intelligently and work independently like human beings.
- They follow instructions given by programs or by users.
- They can neither take decisions nor can correct wrong instructions.
- Programmers or users maintain and update them.
- As with many other modern appliances, computers also need electric power to run.

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1.4 GENERATIONS OF COMPUTERS

Table 1.1 will help you understand the generation of computers.

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Table 1.1 Generation of Computers

Generation	Time	Hardware	Software	Features	Examples
I	1942-1955	Vacuum Tubes	Machine Language (Binary Language)	High-speed electronic switching device; memory type was electromagnetic; bulky in size; generated a large amount of heat; frequent technical faults; required constant maintenance; used for scientific purposes; air-conditioning required	ENIAC, EDVAC, EDSAC, UNIVAC I
II	1955-1964	Transistors	High-level languages FORTRAN, COBOL, ALGOL, SNOBOL	Better electronic switching devices than vacuum tubes; made of germanium semiconductors; memory type was magnetic cores; powerful and more reliable; easy to handle; much smaller than vacuum tubes; generated less heat as compared to vacuum tubes; used for business and industries for commercial data processing; air-conditioning required	Livermore Atomic Research Computer (LARC), IBM
III	1964-1975	Integrated Circuits (ICs) made up of transistors, resistors and capacitors fixed on single silicon chip	High-level languages PL/1, PASCAL, BASIC, VISUAL BASIC, C, C++, C#, Java	ICs were smaller than transistors; consumed less power; dissipated less heat as compared to transistors; more reliable and faster than earlier generations; capable of performing about 1 million instructions per second; large storage capacity; used for both scientific and commercial purposes; air-conditioning required	Mainframe, Minicomputers
IV	1975-1989	Microprocessor made up of Large Scale Integration Circuits (LSI) and Very Large Scale Integration Circuits (VLSI)	Advanced Java (J2EE, JDO, JavaBeans), PHP, HTML, XML, SQL	Microprocessor had control on logical instructions and memory; semiconductor memories; personal computers were assembled; used in LAN and WAN to connect multiple computers at a time; used graphical user interface; smaller, more reliable and cheaper than third-generation computers; larger primary and secondary storage memories; had Computer Supported Cooperative Working (CSCW); air-conditioning not required	Personal Computers (PCs), LAN, WAN, CSCW
V	1989-Present	Ultra Large Scale Integration (ULSI), Optical Disks	Artificial Intelligence, PROLOG, OPS5, Mercury	PCs were assembled – portable and non-portable, powerful desktop PCs and workstations; less prone to hardware failure; user-friendly features – Internet, e-mailing; air-conditioning not required	Portable PCs, Palmtop Computers, Laptop

1.5 TYPES OF COMPUTERS

Computers can be classified on the basis of their size, processing speed and cost. The various types of computers are:

- Personal computers
- Workstations
- Notebook/laptop computers
- Tablet PC
- PDA
- Mainframe computers
- Supercomputers

1.5.1 Analog

Analog computers are generally used in industrial process controls and to measure physical quantities, such as pressure, temperature, etc. An analog computer does not operate on binary digits to compute. It works on continuous electrical signal inputs and the output is displayed continuously. Its memory capacity is less and can perform only certain type of calculations. However, its operating speed is faster than the digital computer as it works in a totally different mode.

Analog computers perform computations using electrical resistance, voltage, etc. The use of electrical properties signifies that the calculations can be performed in real time or even faster at a significant fraction of the speed of light. Typically, an analog computer can integrate a voltage waveform using a capacitor which ultimately accumulates the charge. The basic mathematical operations performed in an electric analog computer are summation, inversion, exponentiation, logarithm, integration with respect to time, differentiation with respect to time, multiplication and division. Hence in the analog computers, an analog signal is produced which is composed of DC and AC magnitudes, frequencies and phases. The starting operations in an analog computer are done in parallel. Data is represented as a voltage that is a compact form of storage.

1.5.2 Digital

Digital computers are commonly used for data processing and problem solving using specific programs. A digital computer stores data in the form of digits (numbers) and processes. It is in the discrete form from one state to the next. These processing states involve binary digits which acquire the form of the existence or nonexistence of magnetic markers in a standard storage devices, on-off switches or relays. In a digital computer, letters, words, symbols and complete texts are digitally represented, i.e., using only two digits 0 and 1. It processes data in discrete form and has a large memory to store huge quantity of data.

The functional components of a typical digital computer system are input-output devices, main memory, control unit and arithmetic logic unit. The processing of data in a digital computer is done with the help of logical circuits, which are also termed as digital circuits. All the circuits processing data in side a computer function in an extremely synchronized mode; which is further controlled using a steady oscillator acting as the computer's 'clock'. The clock rate of a typical digital computer ranges from several million cycles per second to several hundred million cycles, whereas the clock rate of fastest digital computers are about a billion cycles per second. Hence, the digital computers operate on very high speed and are able to perform trillions of logical or arithmetic operations per second to provide quick solution to problems, which is not possible for a human being to do manually.

1.5.3 Hybrid

Hybrid computers are the combination of digital and analog computers. A hybrid computer uses the best features of digital and analog computers. It helps the user to process both continuous and discrete data. Hybrid computers are generally used for weather forecasting and industrial process control.

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The digital component basically functions as a controller to provide logical operations, whereas the analog component functions as a solver to provide solutions of differential equations. Remember that the hybrid computers are different from hybrid systems. The hybrid system is a digital computer equipped with an analog-to-digital converter for input and a digital-to-analog converter for output. The term 'hybrid computer' signifies a mixture of different digital technologies to process specific applications with the help of various specific processor technologies.

1.5.4 General Purpose

Workstations are high-end, general-purpose computers designed to meet the computing needs of engineers, architects and other professionals who need computers with greater processing power, larger storage and better graphic display facilities. These are commonly used for Computer-Aided Design (CAD) and for multimedia applications such as creating special audio-visual effects for television programmes and movies. A workstation looks like a PC and can be used by only one person at a time. The characteristics of a workstation, which are often used to differentiate it from a PC are as follows:

- **Display facility:** Most workstations have a large-screen monitor (21 inches or more) capable of displaying high-resolution graphics as compared to PCs, which have a small-screen monitor (19 inches or less).
- **Storage capacity:** Workstations have a larger main memory than PCs, which have only a few hundred MB of main memory. The hard disk capacity of workstations is also more than that of PCs.
- **Processing power:** The processing power of workstations is several times greater than that of PCs.
- **Operating system:** PCs can run any of the five major operating systems—MS-DOS, MS-Windows, Windows-NT, Linux and Unix—but all workstations generally run the Unix operating system or a variation of it such as AIX (used in IBM workstations), Solaris (used in SUN workstations) and HPUX (used in HP workstations).
- **Processor design:** PCs normally use CPUs based on the Complex Instruction Set Computer (CISC) technology, whereas workstation CPUs are based on the Reduced Instruction Set Computer (RISC) technology.

1.5.5 Special Purpose

A special purpose computer is a digital or an analog computer specifically designed to perform desired specific task. These are high-performance computing systems with special hardware architecture, which is dedicated to solve a specific problem. This is performed with the help of specially programmed FPGA chips or custom VLSI chips. They are used for special applications, for example, astrophysics computations, GRAPE-6 (for astrophysics and molecular dynamics), Hydra (for playing chess), MDGRAPE-3 (for protein structure computations), etc.

1.5.6 Micro, Mini, Mainframe and Supercomputers

Microcomputers

Microcomputers are developed from advanced computer technology. They are commonly used at home, classroom and in the workplace. Microcomputers are called home computers, personal computers, laptops, personal digital assistants, etc. They are powerful and easy to operate. In recent years, computers were made portable and affordable. The major characteristics of a microcomputer are as follows:

- Microcomputers are capable of performing data processing jobs and solving numerical programs. Microcomputers work rapidly like minicomputers.
- Microcomputers have reasonable memory capacity which can be measured in megabytes.
- Microcomputers are reasonably priced. Varieties of microcomputers are available in the market which can be as per the requirement of smaller business companies and educational institutions.
- Processing speed of microcomputers is measured in megahertz. A microcomputer running at 90MHz works approximately at 90 MIPS.
- Microcomputers have drives for floppy disk, compact disk and hard disks.
- Only one user can operate a microcomputer at a time.
- Microcomputers are usually dedicated to one job. Millions of people use microcomputers to increase their personal productivity.
- Useful accessory tools, such as clock, calendar, calculator, daily schedule reminders, scratch pads, etc., are available in a microcomputer.
- Laptop computers, also called notebook computers, are microcomputers. They use the battery power source. Laptop computers have a keyboard, mouse, floppy disc drive, CD drive, hard disk drive and monitor. Laptop computers are expensive in comparison to personal computers.

Minicomputers

Minicomputers are a scaled-down version of mainframe computers. The processing power and cost of a minicomputer are less than that of the mainframe. The minicomputers have big memory sizes and faster processing speed compared to the microcomputer. Minicomputers are also called workgroup systems because they are well suited to the requirements of the minor workgroups within an organization. The major characteristics of a minicomputer are as follows:

- Minicomputers have extensive problem solving capabilities.
- Minicomputers have reasonable memory capacity which can be measured in megabytes or gigabytes.
- Minicomputers have quick processing speeds and operating systems facilitated with multitasking and network capabilities.
- Minicomputers have drives for floppy disk, magnetic tape, compact disk, hard disks, etc.

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- Minicomputers can serve as network servers.
- Minicomputers are used as a substitute of one mainframe by big organizations.

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Mainframe Computers

Mainframe computers are generally used for handling the needs of information processing of organizations like banks, insurance companies, hospitals and railways. This type of system is placed in a central location with several user terminals connected to it. The user terminals act as access stations and may be located in the same building Figure 1.1.



Fig. 1.1 Mainframe Computer

Mainframe computers are bigger and more expensive than workstations. They look like a row of large file cabinets and need a large room with closely monitored humidity and temperature levels. A mainframe system of lower configuration is often referred to as a minicomputer system. The various components of a mainframe computer are as follows:

- **Host, front-end and back-end computers:** A mainframe system consists of several computers, such as a host computer that carries out most of the computations and has direct control over all other computers. The front-end portion is used for handling communications to and from all the user terminals connected to the mainframe computer. The back-end portion is used to handle data input/output operations. The host computer and other computers are located in the systems room, to which entry is restricted to system administrators and maintenance staff only.
- **Consoles:** Console terminals are directly connected to the host computer and are mainly used by the system administrator to perform certain administrative tasks like installing new software on the system, taking system backups and changing the configuration of the system.
- **Storage devices:** A mainframe computer has several magnetic disk drives directly connected to the back-end computer. The host computer, via the back-end computer, accesses all data to and from these magnetic disks. In addition, a mainframe computer also has a few tape drives and a magnetic tape library (located in the systems room) for restoration and backup of data. The tape drives are located in the users' room, so that users' tapes can be used for input and output.
- **User terminals:** User terminals are used to access the required stations, which may be located at different locations. Since mainframe computers

support multiprogramming with time-sharing, they can run different operating systems and can be accessed by multiple users simultaneously.

- **Output devices:** A mainframe computer has several output devices like printers and plotters, connected to the back-end computer, so that these devices are accessible to the user for taking their outputs. A plotter is a device that prints vector graphics on paper using ink pens and pencils on mechanical arms mainly used for large size printouts of architectural and engineering drawings.

Supercomputers

Supercomputers are the most powerful and expensive computers available today. They are primarily used for processing complex scientific applications that involve tasks with highly complex calculations and solving problems with mechanical physics, such as weather forecasting and climate research systems, nuclear weapon simulation and simulation of automated aircrafts. Military organizations, major research and development centres, universities and chemical laboratories are major users of supercomputers.

Supercomputers use multiprocessing and parallel processing technologies to solve complex problems promptly. They use multiprocessors, which enable the user to divide a complex problem into smaller problems. A parallel program is written in a manner that can break up the original problem into smaller computational modules. Supercomputers also support multiprogramming, which allows simultaneous access to the computer by multiple users. Some of the manufacturers of supercomputers are IBM, Silicon Graphics, Fujitsu and Intel.

1.5.7 Personal Computers

A PC (Personal Computers) is a small single-user microprocessor-based computer that sits on your desktop and is generally used at homes, offices, and schools. As the name implies, PCs were mainly designed to meet the personal computing needs of individuals. Personal computers are used for preparing normal text documents, spreadsheets with predefined calculations and business analysis charts, database management systems, accounting systems and also for designing office stationary, banners, bills and handouts. Children and youth love to play games and surf the Internet, communicate with friends via e-mail and net telephony and do many other entertaining and useful tasks.

The configuration varies from one PC to another depending on its usage. However, it consists of a CPU or system unit, a monitor, a keyboard and a mouse. It has a main circuit board or motherboard (consisting of the CPU and the memory), hard disk storage, floppy disk drive, CD-ROM drive and some special add-on cards (like Network Interface Card) and ports for connecting peripheral devices like printers.

PCs are available in two models—desktop and tower. In the desktop model, the monitor is positioned on top of the system unit, whereas in the tower model the system unit is designed to stand by the side of the monitor or even on the floor to save desktop space. Due to this feature, the tower model is very popular

Some popular operating systems for PCs are MS-DOS, MS-Windows, Windows-NT, Linux and Unix. Most of these operating systems have the capability

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of multitasking, which eases operation and saves time when a user has to switch between two or more applications while performing a job. Some leading PC manufacturers are IBM, Apple, Compaq, Dell, Toshiba and Siemens.

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Types of personal computers

Notebook/laptop computers

Notebook computers are battery-operated personal computers. Smaller than the size of a briefcase, these are portable computers and can be used in places like libraries, in meetings or even while travelling. Popularly known as laptop computers, or simply laptops, they weigh less than 2.5 kg and can be only 3 inches thick. Notebook computers are usually more expensive as compared to desktop computers though they have almost the same functions, but since they are sleeker and portable they have a complex design and are more difficult to manufacture. These computers have large storage space and other peripherals such as serial port, PC card, modem or network interface card, CD-ROM drive and printer. They can also be connected to a network to download data from other computers or to the Internet. A notebook computer has a keyboard, a flat screen with Liquid Crystal Colour (LCD) display (Refer Figure 1.2), and can also have a trackball and a pointing stick.

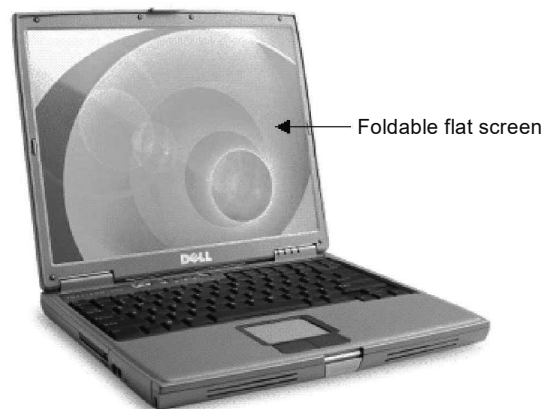


Fig. 1.2 Laptop Computer

A notebook computer uses the MS-DOS or WINDOWS operating system. It is used for making presentations as it can be plugged into an LCD projection system. The data processing capability of a notebook computer is as good as an ordinary PC because both use the same type of processor, such as an Intel Pentium processor. However, a notebook computer generally has lesser hard disk storage than a PC.

Tablet PC

Tablet PC is a mobile computer that looks like a notebook or a small writing slate but uses a stylus pen or your finger tip to write on the touch screen. It saves whatever you scribble on the screen with the pen, as shown in picture in the same way as you have written it. The same picture can then be converted to text with the help of a HR (hand recognition) software.

PDA

A Personal Digital Assistant (PDA) is a small palm sized hand-held computer which has a small colour touch screen with audio and video features. They are nowadays used as smart phones, web enabled palmtop computers, portable media players or gaming devices.

Most PDAs today typically have a touch screen for data entry, a data storage/memory card, bluetooth, Wi-Fi or an infrared connectivity and can be used to access the Internet and other networks.

Check Your Progress

1. What was the new idea that Charles Babbage came up with in 1842?
2. What are arithmetic logic units?
3. What is the function of the control unit?
4. Define the term Tablet PC.

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1.6 COMPUTER BASICS

Computers have undergone great transformation over the past decade; however, the basic logical structure remains the same. A computer primarily constitutes of three integral components, viz. input devices, Central Processing Unit (CPU) and output devices. The CPU constitutes of the main memory, the arithmetic logic unit and the control unit.

Apart from these three basic components, computers have secondary storage devices known as auxiliary storage or backing storage that store data and instructions on a long-term basis.

The following are the primary functions of a computer:

- **Inputting:** The process in which the user specify a set of commands to process data into the computer system.
- **Storing:** The process of recording data and information so that it can be retrieved for use whenever required.
- **Processing:** This process implies performing arithmetic or logical operations on data to convert them into useful information. Arithmetic operations include addition, subtraction, multiplication and division, and logical operations include comparisons, such as equal to, less than and greater than, etc.
- **Outputting:** This is the process of providing results to the user. These can be in the form of visual display and/or printed reports.
- **Controlling:** This refers to directing the sequence and the manner in which all the previous functions are carried out.

A detailed description of the components that perform these tasks is as follows.

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1. Input Unit

Programs and data are required to be present in a computer system before any operation can be performed. A program denotes the set of instructions which the computer has to carry out and data is the information on which these instructions are to be operated. If the task is to rearrange a list of telephone subscribers in alphabetical order, the sequence of instructions that will guide the computer through this operation is the program, while the list of names to be sorted is the data.

The input unit is responsible for transferring data and instructions from the external environment into the computer system. Instructions and data enter the input unit through the particular input device used (keyboard, scanner, card reader, etc.). These instructions and data are then converted into binary codes (computer acceptable form) and sent to the computer system for further processing.

2. Central Processing Unit

The central processing unit is known as the brain of the computer. It is an important part of the computer and includes the control unit, the ALU and the primary memory that are described as follows:

- **Main Memory (Primary Storage):** The main memory or the primary storage of the computer system is responsible for storing all the instructions and data. The data is then transferred to the Arithmetic Logical Unit (ALU) for processing. After this, the final output is again stored back in the primary storage, until it is further sent to the output device.

The primary storage also temporarily stores any intermediate result generated by the ALU. So data and instructions move frequently between the ALU and the primary storage before the processing is complete. It should be noted that no processing occurs within the primary storage.

- **Arithmetic Logic Unit:** In addition to the basic four arithmetic operations, viz. addition, subtraction, multiplication and division, the ALU also performs logic comparison operations including equal to, lesser than or greater than.
- **Control Unit:** The function of the control unit is to ensure that according to the stored instructions, the right operation is done on the right data at the right time. The control unit receives instructions and commands from the programs in the primary memory, processes them and ensures that the commands are executed in the desired order by all the other units of the computer system. In effect, the control unit is comparable to the central nervous system of the human body.

3. Output Unit

Computers understand, process data and return the output in a binary form. The basic function of the output unit is to convert these results into a human readable form before providing the output through various output devices, such as terminals and printers.

The storage capacity of the primary memory of the computer is limited. Often, it is necessary to store large amounts of data. So, additional memory, called secondary storage or auxiliary memory, is used in most computer systems.

Secondary storage is storage other than the primary storage. These are peripheral devices connected to and controlled by the computer to allow permanent storage of data and programs. Usually, hardware devices like magnetic tapes and magnetic disks fall in this category.

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1.6.1 Parts of a Computer System

In order to transfer data to the memory of the computer input devices are used. The Arithmetic Logic Unit (ALU) is responsible for calculations, to which this data from the memory is stored. Once the calculations are done, the data is transferred back to the memory. The memory is responsible for storing data, according to which different functions are carried out. This memory is also known as the main memory or the Immediate Access Store (IAS).

The control unit is responsible for controlling various computer operations, which involves accepting instructions, interpreting and processing of this information in the correct parts of the computer. The main function of the control unit is to make sure that the instructions are correctly followed and all operations are done exactly according to the correct instructions at the correct time. This process leads to outcomes that are stored in memory. Figure 1.3 displays a computer system.



Fig. 1.3 A Computer System

(i) Motherboard

The main PCB (Printed Circuit Board) is sometimes alternatively known as a logical board or a main board of a Personal Computer. In fact, any complex electronic system is known as a motherboard. It includes a flat fibreglass platform which hosts the CPU (Central Processing Unit), the main electronic components, device controller chips, main memory slots, slots for attaching the storage devices and other subsystems. Figure 1.4 displays a motherboard.

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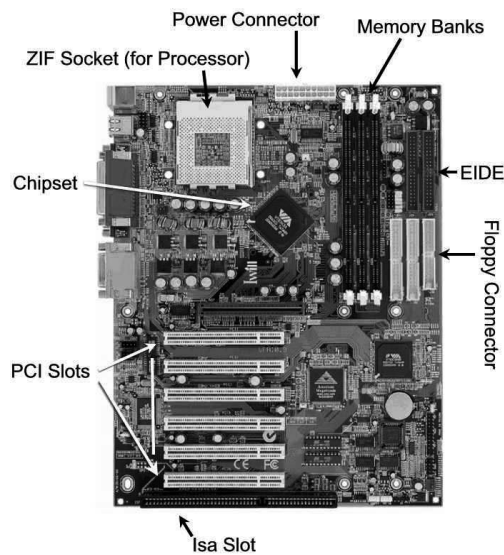


Fig. 1.4 A Motherboard

(ii) Sockets and Ports

- **Main Power Socket:** The top part of the rear of the computer locates the main power cable socket, which supplies power from the electric mains to the computer system. This socket is the part of the main power supply unit of the computer.
- **Monitor Power Socket:** The socket that supplies the power from the computer system to the computer monitor and is located below the main power cable socket. However, you might not find this socket in all computers and you can plug in the monitor directly in main power supply.
- **PS/2 Mouse Port:** Next you will find a small, round, green colored port with seven holes and a small logo of the mouse printed next to it. This is where your PS/2 mouse will be plugged in.
- **PS/2 Keyboard Port:** Right next to it you will find another similar purple colored port with the keyboard logo printed next to it. This is where your PS/2 keyboard will be plugged in.
- **Fan Housings:** You will notice two fan housings at the back of your computer. One fan housing is a part of the power supply unit and the other will be somewhere below it to cool off the heat generated by the CPU.
- **Serial Ports:** It is a 9-pin connector normally used to attach the old serial port mouse, hand-held scanners, modems, joysticks, game pads and other such devices.
- **Parallel Port:** It is a 25-pin connector used to attach parallel port printers, modems, external hard disk drives, etc.

- **Audio Jacks:** There are three audio jacks in your computer system. One jack is used for connecting your speakers or headphones, the second is used to connect the microphone and the third to connect to another audio device, such as a music system.
- **LAN Port:** The LAN port is where the RJ45 connector of your LAN cable is plugged in to connect your computer to other computers or the Internet.
- **USB Ports:** The USB port is designed to connect multiple peripheral devices in a single standardized interface and has a plug and play option that allows devices to be connected and disconnected without having to restart or turning off the computer. It has replaced many serial and parallel port devices, such as mouse, printers, modems, joysticks, game pads, scanners, digital cameras and other such devices.
- **VGA Port:** This is a 15-pin connector that connects the signal cable of the monitor to the computer.

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Figure 1.5 displays monitor and CPU power cables and sockets.

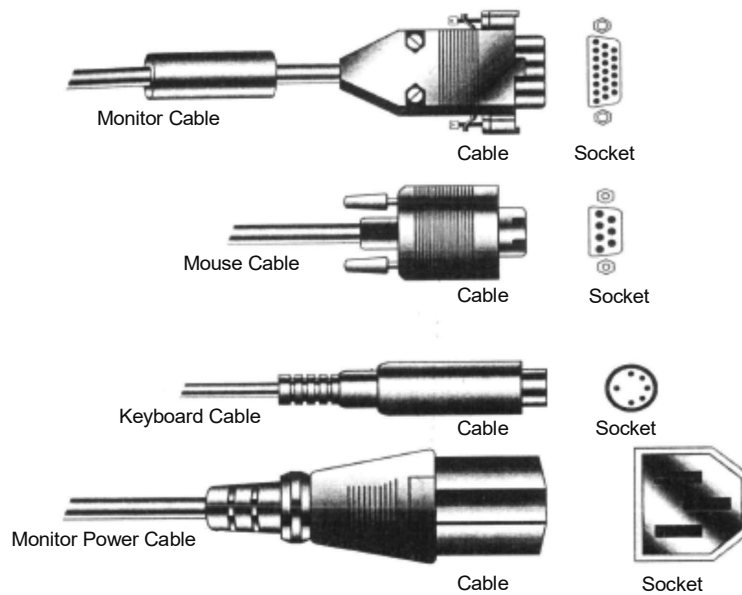


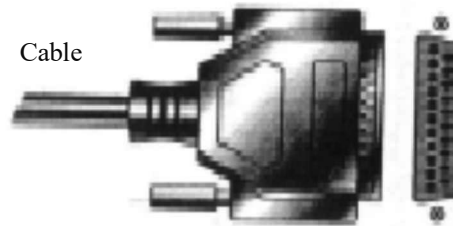
Fig. 1.5 Monitor and CPU Power Cable and Sockets

Figure 1.6 displays a LAN cable and a printer cable and its socket.

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LAN Cable



Printer Cable and Socket

Fig. 1.6 LAN Cable and Printer Cable with Socket

CPU

The primary function of the computer is executing programs. The programs or the set of instructions are stored in the computer's main memory and are executed by the CPU. The CPU processes the set of instructions along with any calculations and comparisons to complete the task. Additionally, the CPU controls and activates various other functions of the computer system. It also activates the peripherals to perform input and output functions. Figure 1.7 displays major components of the CPU.

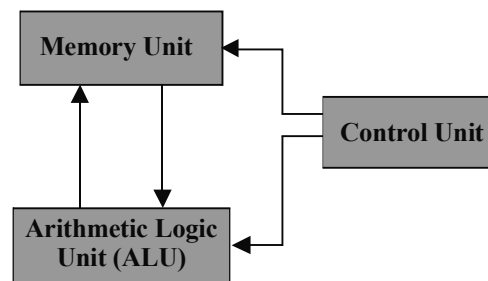


Fig. 1.7 Major Components of a CPU

Memory

Storage and retrieval of instructions and data in a computer system is the responsibility of the *memory*. In order to store data and instructions, the CPU constitutes many registers, though these are capable of storing very few bytes. All computers need storage space for temporarily storing instruction and data during the execution of the program as the CPU can process data at a speed that is much faster than the speed at which data can be transferred from disks to registers. This could lead to the CPU remaining free most of the time if the data was located in secondary storage including magnetic tapes and disks. The primary or the main memory is the temporary storage located in the computer hardware. Secondary

storage or auxiliary memory constitutes devices that can give backup storage, such as magnetic tapes and disks. The memory is classified as follows:

- (i) **Internal Processor Memory:** A small set of high-speed registers placed inside a processor and used for storing temporary data while processing.
- (ii) **Primary Storage Memory:** The main memory of the computer which communicates directly with the processor. This memory is large in size and fast, but not as fast as the internal memory of the processor. It comprises a couple of integrated chips mounted on a printed circuit board plugged directly on the motherboard. Random Access Memory (RAM) is an example of primary storage memory.
- (iii) **Secondary Storage Memory:** This stores all the system software and application programs and is basically used for data backups. It is much larger in size and slower than primary storage memory. Hard disk drives, floppy disk drives and flash drives are a few examples of secondary storage memory.
- (iv) **Memory Capacity:** Capacity, in computers, refers to the number of bytes that it can store in its main memory. This is usually stated in terms of Kilobytes (KB) which is 1024 bytes or Megabytes (MB) which is equal to 1024 KB (10,48,576 bytes). The rapidly increasing memory capacity of computer systems has resulted in defining the capacity in terms of Gigabytes (GB) which is 1024 MB (1,07,37,41,824 bytes). Thus a computer system having a memory of 256 MB is capable of storing $(256 \times 1024 \times 1024)$ 26,84,35,456 bytes or characters.

Processors Used in PCs

The most significant part of the computer is the Central Processing Unit or the CPU. The CPU is mostly a microprocessor-based chip located on a single or sometimes a multiple printed circuit boards and is an internal component of the system. It is directly connected to the motherboard; however, the compatibility of the mother board and the CPU depends on the specific series of the latter. Due to the tremendous amount of heat generated by the CPU, it contains a heat sink and a cooling fan.

Popular microprocessors include Intel and AMD, which manufacture IBM compatible CPUs.

The brands of CPUs listed are not the only differentiating factors, between different processors. There are various technical aspects to these processors which allow us to differentiate between CPUs of different power, speed and processing capability. Accordingly, each of these manufacturers sells numerous product lines offering CPUs of different architecture, speed, price range, etc. The following are the most common aspects of modern CPUs that enable us to judge their quality or performance:

- **32 or 64-Bit Architecture:** A bit is the smallest unit of data that a computer processes. 32 or 64-bit architecture refers to the number of bits that the CPU can process at a time.
- **Clock Rate:** The speed at which the CPU performs basic operations, measured in Hertz (Hz) or in modern computers Megahertz – MHz or Gigahertz – GHz.

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- **Number of Cores:** CPUs with more than one core are essentially multiple CPUs running in parallel to enable more than one operation to be performed simultaneously. Current ranges of CPUs offer up to eight cores. Currently, the Dual core (i.e., two cores) CPU is most commonly used for standard desktops and laptops and Quad core (i.e., four cores) is popular for entry level servers.
- **Additional Technology or Instruction Sets:** These refer to unique features that a particular CPU or range of CPUs offer to provide additional processing power or reduced running temperature. These range from Intel's MMX, SSE3 and HT to AMD's 3DNow and Cool'n Quiet.

These technical factors are the basic way to judge how a CPU will perform. It is important to consider multiple factors when looking at a CPU rather than just the clock speed or any one specification on its own. It is easy for a single-core processor to run music videos, Internet applications or games individually, but when multiple applications are run together, it starts to slow down. A system running on a dual-core processor would be able to multitask better than a single-core processor, while it is very easy for an 8-core processor to run all these applications plus a lot more without showing any signs of slowing down. However, Intel's 4-core processors are actually two dual-core processors combined in a single processor, whereas AMD's 4-core processors are actually four processors built in a single chip.

A combination of the above mentioned specifications, along with the operating systems that the processor supports and the specific purpose for which the computer is to be used, are the factors to be considered when deciding which CPU is the most suitable for your needs.

1.6.2 Hardware and Software of a Computer System

Computer hardware refers to the physical components that make up a computer system. They are the building blocks of personal computers. These are typically installed into a computer case, or attached to it by a cable or through a port. In the latter case, they are also referred to as peripherals. Various hardware components are as follows:

1. **Case:** A computer case (also known as a computer cabinet, tower, system unit or simply case) is the box that contains most of the components of a computer (excluding the monitor, keyboard and mouse).
2. **Power Supply Unit (PSU):** It converts AC electric power to low voltage DC power for the internal components of the computer. A power supply unit provides regulated power at the several voltages required by the motherboard and accessories, such as disk drives and cooling fans.
3. **Motherboard:** The motherboard is the main component inside the case. It connects the other parts of the computer including the CPU, the RAM, the disk drives (CD, DVD, hard disk, etc.) as well as any peripherals connected via the ports or the expansion slots. Components directly attached to the motherboard include:

- **CPU:** It performs most of the calculations which enable a computer to function. It is also known as brain of the computer.
- **Chipset:** It mediates communication between CPU and other components of system.
- **RAM:** RAM stands for Random Access Memory. It stores the data and commands that is actively used by CPU.
- **ROM:** ROM stands for Read Only Memory. It stores the BIOS (Basic Input Output System) instructions. It includes process of booting of the system.
- **Buses:** Bus connects the CPU to other internal components and also to expansion cards slot for graphics and sound card.
- **Ports:** It is used for connecting external peripherals.

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Secondary Storage Devices

Computer data storage refers to computer components and recording media that retain digital data.

Fixed Media

- **Hard Disk Drives:** A Hard Disk Drive (HDD) is a device for storing and retrieving digital information, primarily computer data. It consists of one or more rigid rapidly rotating discs, coated with magnetic material and with magnetic heads arranged to write data to the surfaces and read it from them.
- **RAID Array Controller:** It is a device to manage several internal or external hard disks and optionally some peripherals in order to achieve performance or reliability improvement in what is called a RAID array.

Removable Media

- **Optical Disc Drives:** Optical disc drives are used for reading from and writing to various kinds of optical media, including Compact Discs, such as CD-ROMs, DVDs, DVD-RAMs and Blu-ray Discs. Optical discs are the most common way of transferring digital video, and are popular for data storage as well.
- **Floppy Disk Drives:** Floppy disk drives are used for reading and writing to floppy disks, an outdated storage media consisting of a thin disk of a flexible magnetic storage medium.
- **Zip Drives:** They are an outdated medium-capacity removable disk storage system, for reading from and writing to Zip disks.
- **USB:** USB flash drives are plugged into a USB port and do not require a separate drive. USB flash drive is a small, lightweight, removable and rewritable flash memory data storage device integrated with a USB interface.
- **Memory Card Readers:** They are used for reading from and writing to memory card. Memory card is a flash memory data storage device used to store digital information.
- **Tape Drives:** They are drives to read and write data on a magnetic tape and are used for long term storage and backups.

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Software of a Computer System

A computer cannot operate without any instructions and is based on a logical sequence of instructions in order to perform a function. These instructions are known as a 'computer program', and constitute the computer software. The sequences of instructions are based on algorithms that provide the computer with instructions on how to perform a function. Thus, it is impossible for a computer to process without software, a term attributed to John W. Tukey in 1958.

Different kinds of software designs have been developed for particular functions. Popular computer software include interpreter, assembler, compiler, operating systems, networking, word processing, accounting, presentation, graphics, computer games, etc. The computer software is responsible for converting the instructions in a program into a machine language facilitating their execution.

Software engineers develop computer software depending on basic mathematical analysis and logical reasoning. Before implementation, the software undergoes a number of tests. Thus, the programming software allows you to develop the desired instruction sequences, whereas in the application software the instruction sequences are predefined. Computer software can function from only a few instructions to millions of instructions; for example, a word processor or a Web browser. Figure 1.8 shows how software interacts between user and computer system.

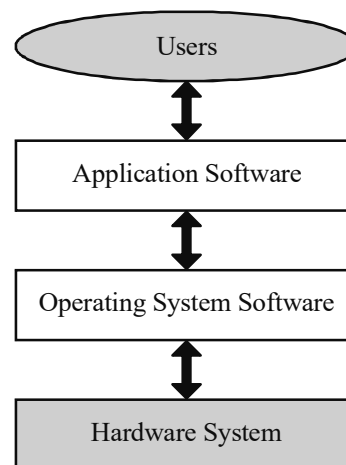


Fig. 1.8 Interaction of Software between User and a Computer System

On the functional basis, software is categorized as follows:

- **System Software:** It helps in the proper functioning of computer hardware. It includes device drivers, operating systems, servers and utilities.
- **Programming Software:** It provides tools to help a programmer in writing computer programs and software using various programming languages. It includes compilers, debuggers, interpreters, linkers, text editors and an Integrated Development Environment (IDE).
- **Application Software:** It helps the end users to complete one or more specific tasks. The specific applications include industrial automation, business software, computer games, telecommunications, databases, educational software, medical software and military software.

Types of Computer Software

Today, software is a significant aspect of almost all fields including business, education, medicine, etc. The basic requirement for software is a distinct set of procedures. Thus, software can be used in any domain that can be described in logical and related steps and every software is developed with the aim of catering to a particular objective, such as data processing, information sharing, communication, etc. Software is based on the type of applications that are as follows:

- **System Software:** This type of software is involved managing and controlling the operations of a computer system. System software is a group of programs rather than one program and is responsible for using computer resources efficiently and effectively. Operating system, for example, is system software, which controls the hardware, manages memory and multitasking functions and acts as an interface between applications programs and the computer.
- **Real-Time Software:** This is based on observing, analysing and controlling real life events as they occur. Manually, a real-time system guarantees a response to an external event within a specified period of time. The real-time software, for instance, is used for navigation in which the computer must react to a steady flow of new information without interruption. Most defence organizations all over the world use real time software to control their military hardware.
- **Business Software:** This kind of software is functional in the domain of management and finance. The basic aspect of a business system comprises payroll, inventory, accounting and software that permits users to access relevant data from the database. These activities are usually performed with the help of specialized business software that facilitates efficient framework in the business operation and in management decisions.
- **Engineering and Scientific Software:** This software has developed as a significant tool used in the research and development of next generation technology. Applications, such as study of celestial bodies, study of undersurface activities and programming of orbital path for space shuttle, are heavily dependent on engineering and scientific software. This software is designed to perform precise calculations on complex numerical data that are obtained during real-time environment.
- **Artificial Intelligence (AI) Software:** Certain problem solving techniques are non-algorithmic in nature and primarily require this type of software. The solutions to such problems normally cannot be arrived at using computation or straightforward analysis. Such problems need particular problem solving techniques including expert system, pattern recognition and game playing. Also, it constitutes various kinds of searching techniques, such as the application of heuristics. The function of AI is to add certain degree of intelligence into the mechanical hardware to have the desired work done in an agile manner.

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- **Web-based Software:** This category of software performs the function of an interface between the user and the Internet. There are various forms in which data is available online, such as text, audio or video format, linked with hyperlinks. For the retrieval of Web pages from the Internet a Web browser is used, which is a Web-based software. The software incorporates executable instructions written in special scripting languages, such as Common Gateway Interface (CGI) or Active Server Page (ASP). Apart from providing navigation on the Web, this software also supports additional features that are useful while surfing the Internet.
- **Personal Computer (PC) Software:** This software is primarily designed for personal use on a daily basis. The past few years have seen a marked increase in the personal computer software market from normal text editor to word processor and from simple paintbrush to advance image editing software. This software is used mostly in almost every field, whether it is database management system, financial accounting package or a multimedia based software. It has emerged as a versatile tool for daily life applications.

Software can also be classified in terms of the relationship between software users or software purchasers and software development.

- **Commercial Off-The-Shelf (COTS):** This comprises the software without any committed user before it is put up for sale. The software users have less or no contact with the vendor during development. It is sold through retail stores or distributed electronically. This software includes commonly used programs, such as word processors, spreadsheets, games, income tax programs, as well as software development tools, such as software testing tools and object modelling tools.
- **Customized or Bespoke:** This software is designed for a specific user, who is bound by some kind of formal contract. Software developed for an aircraft, for example, is usually done for a particular aircraft making company. They are not purchased 'off-the-shelf' like any word processing software.
- **Customized COTS:** In this classification, a user can enter into a contract with the software vendor to develop a COTS product for a special purpose, that is, software can be customized according to the needs of the user. Another growing trend is the development of COTS software components—the components that are purchased and used to develop new applications. The COTS software component vendors are essentially parts stores which are classified according to their application types. These types are listed as follows:
 - **Stand-Alone Software:** A software that resides on a single computer and does not interact with any other software installed in a different computer.
 - **Embedded Software:** A software that pertains to the part of unique application involving hardware like automobile controller.
 - **Real-Time Software:** In this type of software the Operations are executed within very short time limits, often microseconds, e.g., radar software in air traffic control system.

- **Network Software:** In this type of software, software and its components interact across a network.

Figure 1.9 illustrates the various types of customized COTS.

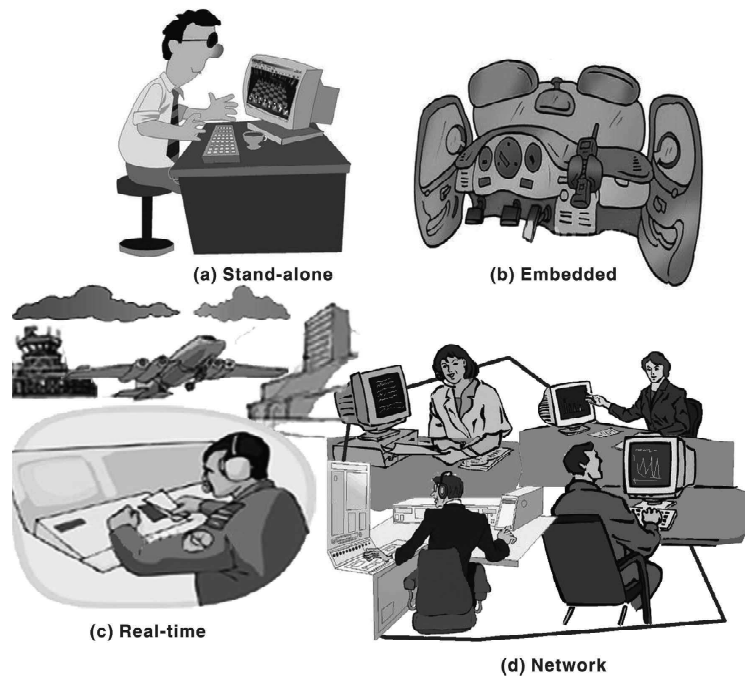


Fig. 1.9 Types of Customized COTS

System Software

System software constitutes all the programs, languages and documentation provided by the manufacturer in the computer. These programs provide the user with an access to the system so that he can communicate with the computer and write or develop his own programs. The software makes the machine user-friendly and makes an efficient use of the resources of the hardware. Systems software are permanent programs on a system and reduce the burden of the programmer as well as aid in maximum resource utilization. MS DOS (Microsoft Disk Operating System) was one of the most widely used systems software for IBM compatible microcomputers. Windows and its different versions are popular examples of systems software. Systems software are installed permanently on a computer system used on a daily basis.

Operating System

An Operating System (OS) is the main control program for handling all other programs in a computer. The other programs, usually known as ‘application programs’, use the services provided by the OS through a well-defined Application Program Interface (API). Every computer necessarily requires some type of operating system that instructs the computer about operations and use other programs installed in the computer. The role of an OS in a computer is similar to the role of the manager in an office for the overall management of the college.

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Any computer system can be broadly classified in terms of four component dimensions:

- (i) Hardware
- (ii) Operating system
- (iii) Application programs (like MS Word, Games, Calculator).
- (iv) Users (people who work on the computer).

Figure 1.10 displays the various components of the computer system.

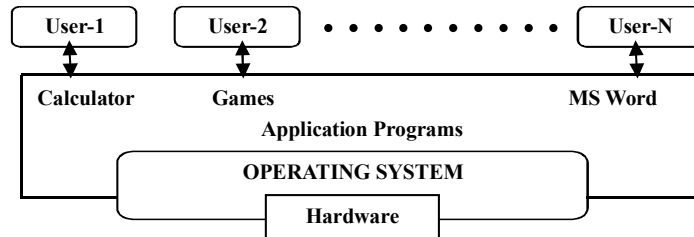


Fig. 1.10 Components of a Computer System

Application Software

Users install specific software programs based on their requirements; for instance, accounting software (like Tally) used in business organizations and designing software used by architects. All programs, languages and utility programs constitute software. With the help of these programs, users can design their own software based on individual preferences. Software programs aid in achieving efficient application of computer hardware and other resources.

1. Licensed Software

Although there is a large availability of open source or free software online, not all software available in the market is free for use. Some software falls under the category of **Commercial Off-The-Shelf (COTS)**. COTS is a term used for software and hardware technology which is available to the general public for sale, license or lease. In other words, to use COTS software, you must pay its developer in one way or another.

Most of the application software available in the market need a software license for use.

Software is licensed in different categories. Some of these licenses are based on the number of unique users of the software while other licenses are based on the number of computers on which the software can be installed. A specific distinction between licenses would be an Organizational Software License, which grants an organization the right to distribute the software or application to a certain number of users or computers within the organization, and a Personal Software License which allows the purchaser of the application to use the software on his or her computer only.

2. Free Domain Software

To understand this, let us distinguish between the commonly used terms Freeware and Free Domain software. The term 'freeware' has no clear accepted definition,

but is commonly used for packages that permit redistribution but not modification. This means that their source code is not available. Free domain software is software that comes with permission for anyone to use, copy, and distribute, either verbatim or with modifications, either gratis or for a fee. In particular, this means that the source code must be available. Free domain software can be freely used, modified, and redistributed but with one restriction: the redistributed software must be distributed with the original terms of free use, modification and distribution. This is known as 'copyleft'. Free software is a matter of freedom, not price. Free software may be packaged and distributed for a fee. The 'Free' here refers to the ability of reusing it — modified or unmodified, as a part of another software package. The concept of free software is the brainchild of Richard Stallman, head of the GNU project. The best known example of free software is Linux, an operating system that is proposed as an alternative to Windows or other proprietary operating systems. Debian is an example of a distributor of a Linux package.

Free software should, therefore, not be confused with freeware, which is a term used for describing software that can be freely downloaded and used but which may contain restrictions for modification and reuse.

A few types of application programs that are widely accepted these days, are:

1. Word Processing

A word processor is an application program used for the production of any type of printable text document including composition, editing, formatting and printing. It takes the advantage of a Graphical User Interface (GUI) to present data in a required format. It can produce any arbitrary combination of images, graphics and text. Microsoft Word is the most widely used word processing system.

Microsoft Word can be used for the simplest to the most complex word processing applications. Using Word, you can write letters and reports, prepare bills and invoices, prepare office stationery, such as letterheads, envelopes and forms, design brochures, pamphlets, newsletters and magazines, etc.

2. Spreadsheet

Excel is ideal for a task that needs a number of lists, tables, financial calculations, analysis and graphs. Excel is good for organizing different kinds of data, however it is numerical data that is best suited. Thus, Excel can be used when you not only need a tool for storing and managing data, but also analysing and querying it. In addition to providing simple database capabilities, Excel also allows you to create documents for the World Wide Web (WWW).

The menus, toolbars and icons of MS Excel are very similar (though not the same) to MS Word. This is in keeping with Microsoft's much hyped philosophy and strategy of offering users a totally integrated office suite pack. From the user's point of view, this means less time spent in learning the second package once you know the first, and almost effortless and seamless exchange of data between various components.

3. Presentation Graphics

PowerPoint is a presentation tool that helps create eye-catching and effective presentations in a matter of minutes. A presentation comprises of individual slides

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arranged in a sequential manner. Normally, each slide covers a brief topic. The term 'Free' software specifies the freedom of using the software by various computer users (private individuals as well as organizations and companies) granting them freedom and control in running and adapting the computing and data processing as per their needs. The key objective of free software is to grant freedom rights to users so that the users are free to run, copy, distribute, study, change and improve the software. For example, you can use PowerPoint software for preparing presentations and adding notes to the specific slides. Similarly, you have the option of either printing the slides—in case you want to use an overhead projector—or simply attach your computer to an LCD display panel that enlarges the picture several times and shows the output on a screen.

You have three options for creating a new presentation:

- (i) Begin by working with a wizard (called the **AutoContent Wizard**) that helps you determine the theme, contents and organization of your presentation by using a predefined outline, or
- (ii) Start by picking out a PowerPoint **Design Template** which determines the presentation's colour scheme, fonts and other design features, or
- (iii) Begin with a completely blank presentation with the colour scheme, fonts and other design features set to default values.

If you decide to choose the third option, PowerPoint designers have provided a wide assortment of predefined slide formats and Clip Art graphics libraries. Through these predefined slide formats, you can quickly create slides based on standard layouts and attributes.

PowerPoint shares a common look and feel with other MS Office components, and having once mastered Word and Excel, learning PowerPoint is almost like playing a game. And it is also easy to pick up data from Word and Excel directly into a PowerPoint presentation and vice versa.

Database Management Software

Nowadays, all large businesses require database management. When managing a large customer base, it is important to examine vital information like the busying pattern, cheap suppliers and the number of orders being received. In order to efficiently manage all these functions, MS Access is required.

As a first step, plan and create your database structure, identifying the required fields based on the type of data (numbers, alphanumeric, data, etc.), and the maximum width of each field. After determining the structure, you can create a table either in the design mode (which is customized) or you can use the table wizard and any of the predefined tables, with the required modifications.

Creating the tables through the table wizard is much faster and easier than through the design mode. However, if you use wizards you are somewhat restricted with the predefined settings already available.

Once you have created the table you can then use the form's wizard to create user friendly and aesthetically pleasing layouts for data entry. Creating forms

for data entry also ensures that the user inputs only the right kind of information and both data entry errors as well as typing work is minimized.

Once the forms have been created and relevant data has been entered, using these you can then use the report wizard to generate any kind of report. Using reports, you can not only organize and present your data in a more meaningful manner, but you can also use various standard functions like subtotals, totals, sorting to summarize your data.

Now to really fine-tune this Access application, you can create data access pages to enable people spread over a large geographical area to share and compile information using the Internet.

Computer Languages

A computer language essentially implies a language that is understandable to the computer. It is the computer's native language. Computer languages serve the same purpose as human languages. They are a means of communication. Let us understand the similarities and differences between computer languages and human languages.

Languages that we speak daily, such as English, Hindi, French or German are known as material or human languages. It constitutes words and rules known as lexicon and syntax, respectively. These words are joined to make meaningful phrases according to the rules of the syntax. A computer language also consists of lexicon and syntax, i.e., characters, symbols and rules of usage that allow the user to communicate with the computer.

The primary difference between a natural language and computer language is that natural languages have a large set of words (vocabulary) to choose from while computer languages have a limited or restricted set of words. Thus, fewer words but more rules characterize a computer language.

All problems to be solved by the computer needs to be broken down into discrete logical steps before the computer can execute them. The process of writing such instructions in a computer or programming language is called programming or coding.

Since as computer hardware has improved over the years, programming languages have also moved from machine-oriented languages (that used strings of binary 0s and 1s) to problem-oriented languages (that use common English terms). All computer languages can, however, be classified under the following categories:

- Machine Language (First Generation Language).
- Assembly Language (Second Generation Language).
- High-Level Language (Third Generation Language).

Classification of Computer Languages

Computer languages are classified as follows:

The computer can understand only a binary-based language. This is a combination of 0s and 1s. Instructions written using sequences of 0s and 1s constitute a are known as machine language. First-generation computers used programs written in machine language.

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A major drawback of machine language is that it is highly complex and difficult to use. Also, it consumes a lot of time and requires a substantial effort on the part of the programmer. Thousands of machine language instructions are needed to carry out simple tasks, such as listing a few addresses for mails. Any instruction in machine language is divided into two components:

- (i) **Command:** Also called the 'operation code' or opcode including addition, multiplication, etc.
- (ii) **Operand:** Refers to the address of the data on which the function has to be performed.

A general machine language instruction is presented as follows:

OP Code	Operand
001	010001110

The number of operands varies with each computer and is therefore computer dependent.

It can be concluded that in order to develop computer programs in machine language, the programmer will be required to remember a lot of operation codes and addresses of the data items based on the storage location and also information regarding the internal structure of the computer. Thus, using machine language can be highly complicated and liable to errors. Identifying these errors and introducing changes had become increasingly difficult leading programmers to seek better options.

Assembly Language

The development of assembly language marked the beginning of the evolution of programming languages. In assembly language mnemonics (symbolic codes) were used to present operation codes as well as strings of characters to represent addresses. Instructions in assembly language may appear as follows:

Operation	Operation address
READ	M
ADD	L

Certain important facts about assembly language are as follows:

- Assembly language was designed to replace each machine code by an understandable mnemonic and each address with a simple alphanumeric string. It was matched to the processor structure of a particular computer and was therefore (once again) machine dependent. This meant that programs written for a particular computer model could not be executed on another one. In other words, an assembly language program lacked portability.
- A program written in assembly language needs to be translated into machine language before the computer can execute it. This is done by a special program called 'Assembler' which takes every assembly language program and translates it into its equivalent machine code.
- The assembly language program is known as the source program, while the equivalent machine language program is known as the object program. It

may be useful to know that the assembler is a system program supplied by the computer manufacturer. Second-generation computers used assembly language.

- The lack of portability of programs (written using machine or assembly languages) between various computer systems led to the development of high level languages. Since they allowed a programmer to overlook a lot of low-level particulars of the hardware of the computer system, they were called high level language programs.
- It was obvious that if the syntax, mnemonics and rule and regulations of the programming language were closer to the natural language, it would be easier for the programmer to program and the lesser the possibility of introducing errors (or bugs) into the program. Hence, third generation languages, which were algorithmic and procedural, came into being in the mid-1950s. They were designed to solve a particular problem. They contained commands that are particularly suited to one type of application. For example, a number of languages were designed to process scientific or mathematical problems. Others emphasized on commercial applications. These languages varied very little between different computer systems, unlike machine or symbolic languages. But a compiler or an interpreter program was required to translate these machine codes. Once again, the high level program is called the source code while its equivalent machine language program is referred to as the object code.
- Easy-to-learn feature, machine independence, easier maintenance and portability contributed to the popularity of high level languages. Slow program execution was the main disadvantage since programs needed to be converted into machine language (by an interpreter or a compiler) before they could be executed.

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High Level Languages

Some of the high level languages have been discussed as follows:

The third generation programming language (3GL) is a refinement of a second generation programming language. The 3GL made the languages more programmers friendly. High level language is a synonym for third generation programming language. First introduced in the late 1950s, FORTRAN (FORMula TRANslation), ALGOL (ALGORithmic Language) and COBOL (COMmon Business Oriented Language) are early examples of 3GL. Most of popular and general purpose languages today, such as C, C++, C#, Java, BASIC and Pascal are also third generation languages. Most 3GLs support structured programming. The following are the examples of 3GL.

1. FORTRAN

FORTAN (FORmula TRANslation) was the first high -level language developed by John Backus at IBM in 1956.

FORTRAN has a number of versions with FORTRAN IV being one of the earlier popular versions. In 1977, the American National Standards Institute (ANSI) published standards for FORTRAN with a view to standardizing the form of the language used by manufacturers. This standardized version is called FORTRAN 77.

2. COBOL

COBOL (COMmon Business Oriented Language), the first language used for commercial applications, was developed under the leadership of Grace Hopper, a US Navy programmer, with a group of computer manufacturers and users in 1959. The maintenance and further growth of the language was handed over to a group called CODASYL (CONference on DATA SYstems Languages).

It is written using statements that resemble simple English and can be understood easily; for example, to add two numbers (stored in variables A and B), a simple statement in COBOL would be: ADD A TO B GIVING C.

COBOL was standardized by ANSI in 1968 and in 1974. COBOL became the most widely used programming language for business and data processing applications.

3. BASIC

BASIC (Beginner's All-purpose Symbolic Instruction Code) was developed as a teaching tool for undergraduate students in 1966 by John Kemeny and Thomas Kurtz, two professors at Dartmouth College. Eventually BASIC was used as the main language amongst the personal computer users.

A minimum version of BASIC was standardized by ANSI and is so simple that it has been incorporated in every subsequent version of BASIC. Some versions of BASIC include MBASIC (Microsoft BASIC) and CBASIC (Compiler based BASIC).

One of the newer versions of BASIC, commonly known as Visual Basic, has also evolved from the original BASIC language. It contains various statements and functions that can be used to create applications for a Windows or GUI environment.

4. PASCAL

PASCAL was designed by Nicholas Wirth, a Swiss professor, in 1971. It was developed as a more structured language used for teaching which Wirth named after the French mathematician Blaise Pascal, who also designed the first successful mechanical calculator. His primary aim was to provide a language that supported beginners learning good problem solving and programming techniques.

In addition to manipulation of numbers, PASCAL supports manipulation of vectors, matrices, strings of characters, records, files and lists, thereby supporting non-numeric programming. Hence, it has proved to be an attractive language for professional computer scientists.

PASCAL has been standardized by ISO (International Standards Organization) and ANSI.

5. PL/1

PL/1 (Programming Language 1) was developed by IBM in the 1960s and was the first language that was attempted to be used for a variety of applications rather than one particular area like business or science or artificial Intelligence.

6. LISP

LISP was developed in the early 1950s but was implemented in the 1959 by John McCarthy at the Massachusetts Institute of Technology. It became a standard language with the artificial intelligence community and was a program that could easily handle recursive.

7. C

This language was developed by Dennis Ritchie of Bell Laboratories in order to implement the operating system UNIX.

8. C ++

This language was developed by the Bjarne Stroustrup of Bell Laboratories by enhancing C. C++ is also used to write procedural programs like C but the reason for its increased popularity is perhaps because of its capability to handle the rigours of object-oriented programming. C and C++ are the most extensively used general-purpose languages amongst programming experts.

9. JAVA

Java is again an object-oriented language like the C++ but is a simplified version with extra features. It is less prone to programming errors. It was developed for

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writing programs that could be safely and easily executed through the Internet. It is free from any kind of common virus threats. It is basically a network-oriented language that can develop Website pages with enhanced multimedia features using small java programs known as java applets, Java is a secure to use over the Internet and is a platform independent language.

Generation of Computer Languages

Computer languages have changed with every changing generation of computers. Some of these new languages are:

1. Fourth Generation Languages (4 GL)

These are non-procedural languages, which suggests that they present the objective but not the procedure to achieve it. The main features of fourth generation languages are as follows:

- They constitute simple instructions.
- They are user-friendly, enabling the user to write programs and achieve the desired goal.
- They eliminate the need of a professional programmer for writing programs.

FORTH, was the first fourth generation language and was developed by Charles Morre, an American astronomer, in 1970.

Its main application is in the industrial and scientific control applications. Another example of fourth generation language is FOCUS.

2. Fifth Generation Languages (5 GL)

Fifth generation languages have developed as a result of research in the area of artificial intelligence. They are, however, early stage.

- (i) **PROLOG (PROgramming LOGic)**: It is a general purpose logic programming language. PROLOG is often associated with artificial intelligence and computational linguistics. It has a purely logical subset, called pure Prolog, as well as a number of extralogical features.

Prolog was developed in the early 1970s by two French computer scientists, Alain Colmerauer and Philippe Roussel.

Some of other popular languages include:

- (ii) **GPSS (General Purpose System Simulator)**: Used for modelling physical and environmental events.
- (iii) **SNOBOL (String Oriented Symbolic Language)**: Designed for pattern matching and list processing.
- (iv) **LOGO (a version of LISP)**: Developed in the 1960s to help children learn about computers.
- (v) **PILOT (Programmed Instruction Learning, Or Testing)**: Used in writing instructional software.

1.6.3 Input/Output Devices

The computer system is a dumb and a useless machine if it is not capable of communicating with the outside world. It is very important for a computer system to have the ability to communicate with the outside world, i.e., receive and send data and information.

Computers have an input output subsystem, referred to as I/O subsystem, which provides an efficient mode of communication between the central system and the outside world. Programs and data must be entered into the computer memory for processing, and results obtained from computations must be displayed or recorded for the user's benefit. This can be explained with a very common scenario where the average marks of a student need to be calculated based on the marks obtained in various subjects. The marks would typically be available in the form of a document containing the student's name, roll number and marks scored in each subject. This data must first be stored in the computer's memory after converting it into machine-readable form. The data will then be processed (average marks calculated) and sent from the memory to the output unit, which will present the data in a form that can be read by users.

The I/O devices that provide a means of communication between the computer and the outside world are known as peripheral devices. This is because they surround the CPU and the memory of a computer system. While input devices are used to enter data from the outside world into the primary storage, output devices are used to provide the processed results from primary storage to users.

Input Devices

Input devices are used to transfer user data and instructions to the computer. The most commonly used input devices can be classified into the following categories:

- Keyboard devices (general and special purpose, key-to-tape, key-to-disk, key-to-diskette).
- Point-and-draw devices (mouse, trackball, joystick, light pen, touch screen).
- Scanning devices (optical mark recognition, magnetic ink character recognition, optical barcode reader, digitizer, electronic-card reader).
- Voice recognition devices.
- Vision-input devices (Webcam, video camera).

Keyboard

Keyboard devices allow input into the computer system by pressing a set of keys mounted on a board, connected to the computer system. Keyboard devices are typically classified as general-purpose keyboards and special-purpose keyboards.

General-Purpose Keyboard

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

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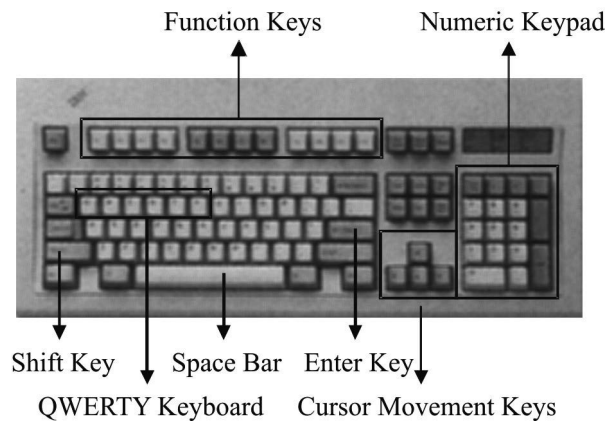


Fig. 1.11 QWERTY Keyboard Layout

The most popular keyboard used today is the 101 key with a traditional QWERTY layout, with an alphanumeric keypad, 12 function keys, a variety of special function keys, numeric keypad, and dedicated cursor control keys. It is so called because the arrangement of its alphanumeric keys in the upper-left row (as shown in the Figure 1.11).

- **Alphanumeric Keypad:** This contains keys for the English alphabets, 0 to 9 numbers, special characters like *, +, -, /, [,], etc.
- **12 Function Keys:** These are keys labelled F1, F2 ... F12 and are a set of user-programmable function keys. The actual function assigned to a function key differs from one software package to another. These keys are also called *soft keys* since their functionality can be defined by the software.
- **Special Function Keys:** Special functions are assigned to each of these keys. The enter key, for example, is used to send the keyed-in data into the memory. Other special keys include:
 - *Shift* used to enter capital letters or special characters defined above the number keys.
 - *Spacebar* used to enter a space at the cursor location.
 - *Ctrl* used in conjunction with other keys to provide added functionality on the keyboard.
 - *Alt* like Ctrl, used to expand the functionality of the keyboard.
 - *Tab* used to move the cursor to the next tab position defined.
 - *Backspace* used to move the cursor a position to the left and also delete the character in that position.
 - *Caps Lock* used to toggle between the capital letter lock feature – when ‘on’, it locks the keypad for capital letters input.
 - *Num Lock* used to toggle the number lock feature – when ‘on’, it inputs numbers when you press the numbers on the numeric keypad.
 - *Insert* used to toggle between the insert and overwrite mode during data entry – when ‘on’, entered text is inserted at the cursor location.
 - *Delete* used to delete the character at the cursor location.

- *Home* used to move the cursor to the beginning of the work area which could be the line, screen or document depending on the software being used.
 - *End* used to move the cursor to the end of the work area.
 - *Page Up* used to display the previous page of the document being currently viewed on screen.
 - *Page Down* used to view the next page of the document being currently viewed on screen.
 - *Escape* usually used to negate the current command.
 - *Print Screen* used to print what is being currently displayed on the screen.
- **Numeric Keypad:** This consists of keys with numbers (0 to 9) and mathematical operators (+ – * /) defined on them. It is usually located on the right side of the keyboard and supports quick entry of numerical data.
 - **Cursor Control Keys:** They are defined by the arrow keys used to move the cursor in the direction indicated by the arrow (top, down, left, right).

Another popular key arrangement, called *Dvorak system*, was designed for easy learning and use. It was designed with the most common consonants in one part and all the vowels on the other part of the middle row of the keyboard. This key arrangement made the users use alternate keystrokes back and forth between both the hands. This keyboard was never been commonly used.

Special-Purpose Keyboard

These are standalone data entry systems used for computers deployed for specific applications. These typically have special-purpose keyboards to enable faster data entry. A very typical example of such keyboards can be seen at the Automated Teller Machines (ATMs) where the keyboard is required for limited functionality (support for some financial transactions) by the customers. Point Of Sale (POS) terminals at fast food joints and air/railway reservation counters are some other examples of special-purpose keyboards. These keyboards are specifically designed for special types of applications only.

Light Pen

The light pen is a small input device used to select and display objects on a screen. It functions with a light sensor and has a lens on the tip of a pen shaped device. The light receptor is activated by pointing the light pen towards the display screen and it then locates the position of the pen with the help of a scanning beam application to directly draw on screen. Figure 1.12 shows the function of light pen on the screen which points to the screen to detect the bright and dim effect for signalling pulse for video clip.

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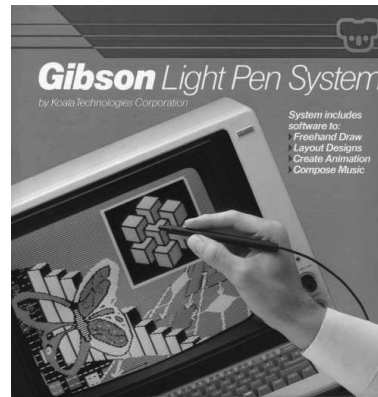


Fig. 1.12 Light Pen

Mouse

A mouse is a small input device used to move the cursor on a computer screen to give instructions to the computer and to run programs and applications. It can be used to select menu commands, move icons, size windows, start programs, close windows, etc. Initially, the mouse was a widely used input device for the Apple computer and was a regular device of the Apple Macintosh. Nowadays, the mouse is the most important device in the functioning of a Graphical User Interface (GUI) of almost all computer systems. Figure 1.13 shows the frequently used input device, i.e., mouse.

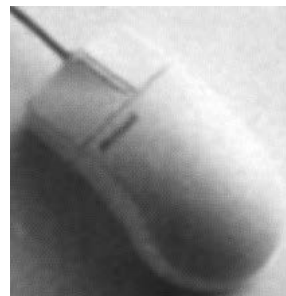


Fig. 1.13 Mouse

You can click a mouse button, i.e., press and release the left mouse button, to select an item. You can right click, i.e., press and release the right mouse button to display a list of commands. You can double click, i.e., quickly press the left mouse button twice without any time gap between the press of the buttons, to open a program or a document. You can also drag and drop, i.e., place the cursor over an item on the screen and then press and hold down the left mouse button. Holding down the button, move the cursor to where you want to place the item and then release the button.

Mechanical Mouse: As shown in Figure 1.14(a), in a mechanical mouse, there is a ball that protrudes under the housing. This ball is rolled across a flat surface. The ball movement turns a perpendicular pair of shafts inside the housing. The shafts drive encodes the distance travelled by using an encoder that consists of a clear plastic wheel with radial lines printed on it. This type of mouse uses LED

and phototransistor to sense the ball movement and generate pulse corresponding to mouse movement.

Let us study how this translation exactly takes place. The basic principle behind the working of a mouse is there is an LED shines that through plastic wheel fall onto a phototransistor, and as mouse moves there is a variation in the light reaching the phototransistor is observed. This variation depends on the number of line it passes on the radial wheel and leads to generation of pulses. This pulse count will be in proportion to distance moved. The pulse generated can either be counted in the mouse itself or it can be sent to the computer for counting. Usually a pair of phototransistors is used so that it can be determined in which direction the shaft is rotating. Thus according to the distance the mouse covers on the flat surface, the corresponding cursor position moves on the screen.

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Optical Mouse: In an optical mouse, as shown in Figure 1.14(b), we use a pair of LEDs. These LEDs shine on a special reflective pad which is printed with a grid of lines having two different colors; generally blue lines run horizontally and black lines run vertically. Two phototransistors are used to sense the reflected light. They determine direction in which mouse is moved across the pad. Each phototransistor is sensitive to one color and is elongated in the particular direction. Like in mechanical mouse, the distance covered is measured by the count of the pulse that is resulted from the reflections of the dots. These pulses are either sent to the computer for counting or the pulses are counted in mouse only and the count result is sent to the computer.

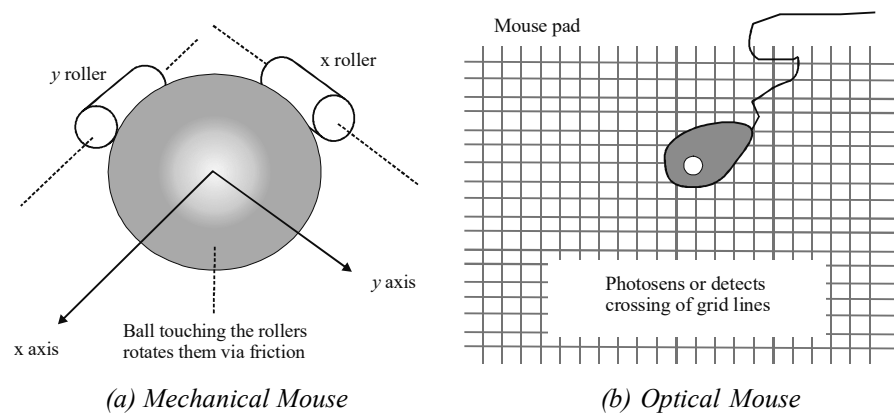


Fig. 1.14 Mechanical Mouse and Optical Mouse

The mouse is one of the devices designed solely for the computer industry. It can send data at the rate of 20 bytes per second. The information is sent to processor in serial manner, same as in the keyboard.

Working of the trackball is similar to a mechanical mouse. The only difference is that in trackball, the ball used is typically larger, and the user rolls it with his or her fingers or hands. The objective of trackball is again the cursor movement.

Joystick

The joystick is a vertical stick that moves the graphic cursor in the direction the stick is moved. It consists of a spherical ball, which moves within a socket and has

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a stick mounted on it. The user moves the ball with the help of the stick that can be moved left or right, forward or backward, to move and position the cursor in the desired location. Joysticks typically have a button on top that is used to select the option pointed by the cursor.

Video games, training simulators and control panels of robots are some common uses of a joystick.

Trackball

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

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

Web Camera

A Web camera is a video capturing device attached to the computer system, mostly using a USB port used for video conferencing, video security, as a control input device and also in gaming.

Optical Input Devices

Scanning devices are input devices used for direct data entry from the source document into the computer system. With the help of the scanner you can capture your images and documents and convert it into digital formats for easy storage on your computer. The scanner comprises of two major components, the first component lights up the page in order to capture the optical image and the second component converts that captured image into a digital format for viewing and storing it on your computer system.

Optical Scanners

There are two types of scanners, contact and laser. Both illuminate the image first to calculate the reflected light and determine the value of the captured image. Hand-held contact scanners make contact as they are brushed over the printed matter to be read. Laser-based scanners are more versatile and can read data passed near the scanning area.

Hand-held scanners are used where the information to be scanned or the volume of documents to be scanned is very low. They are much cheaper as compared to the flat-bed scanners. Capturing information using scanners reduces the possibility of human error typically seen during large data entry. The reduction in human intervention improves the accuracy of data and provides for timeliness of the information processed.

Source data automation is the recent development for data input technologies. Source data automation does not require any manual data entry; rather it captures the data as a derivative of the routine business activity.

Optical Mark Recognition (OMR)

The OMR devices can scan marks from a computer readable paper. Such devices are used by universities and institutes to mark test sheets where the candidate selects and marks the correct answer from multiple choices given on a special sheet of paper. These marksheets are not required to be evaluated manually as they are fed in the OMR and the data is then transferred to the computer system for further evaluation.

The actual technique used by an OMR device once again involves focussing a light on the page being scanned, thereby detecting the reflected light pattern for the marks. Pencil marks made by the user reflect the light determining which responses are marked.

Magnetic Ink Character Recognition (MICR)

Magnetic Ink Character Recognition or MICR is like an optical mark recognition device and is used only in the banking industry. MICR devices scan cheque numbers directly from the cheque leaflets and then automatically feed them in the computer systems for further use, doing the job quickly, accurately and efficiently.

Banks using MICR technology print cheque books on special types of paper. The necessary details of the bank (like the bank's identification code, relevant account number and cheque number) are pre-printed on the cheques using an ink that contains iron oxide particles that can be magnetized.

MICR readers are used to read and sort cheques and deposits. An MICR reader-sorter reads the data on the cheques and sorts the cheques for distribution to other banks and customers or for further processing.

Optical Bar Code Reader (OBR)

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

The laser beam is moved across the pattern of bars in a bar code. These bars reflect the beam in different ways. The reflected beam is then sensed by a light sensitive detector, which then converts the light patterns into electrical pulses, thereby transmitting them to logic circuits for further conversion to alphanumeric value. Bar code devices are available as hand-held devices.

Output Devices

The CRT consist of an electron gun with an electron beam controlled with electromagnetic fields and a phosphate-coated glass display screen structured into a grid of small dots known as *pixels*. The image is created with the electron beam produced by the electron gun, which is thrown on the phosphor coat displayed by the electromagnetic field. A CRT terminals or TV is readily recognizable by its bulky form. LCD monitors and plasma television sets, or flat panel displays, use newer digital technologies. The CRT monitor creates a picture out of many rows or lines of tiny colored dots. These are technically not the same thing as pixels, but

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the terms are often used interchangeably. The more lines of dots per inch produce high and clear the resolution. Therefore, 1024×768 resolution will be sharper than 800×600 resolution because the former uses more lines creating a denser, more detailed picture. Higher resolutions are important for displaying the subtle detail of graphics. For text, resolution is not as critical. Inside a CRT, monitor is a picture tube that narrows at the rear into a bottleneck. In the bottleneck is a negative charged filament or cathode enclosed in a vacuum. When electricity is supplied, the filament heats up and a stream or ray of electrons pours off the element into the vacuum. The negatively charged electrons are attracted to positively charged anodes which focus the particles into three narrow beams, accelerating them to strike the phosphor-coated screen. Phosphor will glow when exposed to any kind of radiation, absorbing ultraviolet light and emitting visible light of fluorescent color. Phosphors that emit red, green and blue light are used in a color monitor, arranged as stripes made up of dots of color. The three beams are used to excite the three colors in combinations needed to create the various hues that form the picture

Non-CRT Terminals

Non-CRT displays include LED, LCD and plasma displays, which are frequently used in microprocessor based industrial controls, instruments etc., where a small amount of data is perpetually exchanged. CRT screen display is used if long amount of data are to be displayed. CRT screen display is used if large amount of data are to be displayed. In portable battery powered instruments, usually LCD displays are used because it consumes low power. For example, in LCD, a liquid crystalline material is used, whereas in LED displays, display and keyboard interfacing chip Intel 8279 is used, which is a programmable keyboard and display device. The non-CRT displays drives the alphanumeric displays or indicator lights. The types of non-CRT terminals are as follows:

Light-Emitting Diode (LED) Display

The three frequently types of LED displays are known as 7-segment displays, 18-segment displays and 5×7 dot matrix display. These types of display are easily available in the market. The 7-segment display is very simple amongst others. It helps in displaying only digits and hexadecimal alphabets. Since 7-segment displays being simple and hence they are widely used. Various types of drivers and decoders are used in 7-segment displays and are available in Integrated Circuit (IC) form. The displays are interfaced to microprocessors and activated through drivers and decoders. The role of port is very important because all types of LED displays with buffers can also be directly connected to the processors with it. These codes are stored in the memory. For example, the 24-inch LED cinema display is designed precisely for the new MacBook Pro, MacBook Air and new Mac desktops. And, with a built-in iSight camera, speakers and MagSafe charger, it does not just expand the screen. LED screens are specifically designed for indoor or outdoor use. There are two main factors that differentiate an indoor screen from an outdoor screen. The first is weather durability. Outdoor screens are designed to function properly in extreme weather conditions, while indoor screens are not built to the same environmental standards. Outdoor led screens use LEDs that are designed to be bright enough for outdoor environment. Figure

1.15 illustrates that distance and character size will be recognized and understood the content of an electronic sign.

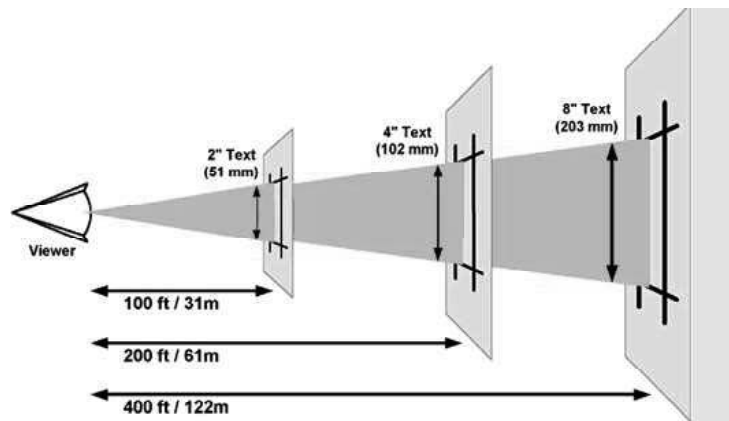


Fig. 1.15 Viewing Distance of LED Display

Figure 1.15 shows how viewing distance is one of the most important factors needed to determine the correct size of most indoor LED screen. A general rule is specified that 1 inch of text is viewable up to 50 feet away or 25mm of text is viewable upto 15m away. LEDs emit light allowing the content to be visible further away than the same content on standard reflective surfaces. Other factors, such as content size, traffic, distractions, weather, lighting conditions, etc. will affect the time required. Each square meter of the LED display can contain from 1,024 pixels (32×32 pixels) upto 9,216 pixels (96×96 pixels) depending on the models. The number of pixels can vary on the same surface because of pixel pitch. The pixel pitch of an LED display defines the distance between the pixels, expressed in millimeters. This is a defining factor of a LED screen's viewing distance. The closer the pixels are the closer the minimum distance but higher the screen cost per area. The further away the minimum viewing distance is and the lower the screen cost per area. Therefore, the pitch determines the image definition and cost of the display. Low pixel pitch equals higher definition and cost, whereas high pixel pitch equals lower definition and cost.

LCD and Plasma Display

Liquid Crystal Display (LCD) was first introduced in the 1970s in digital clocks and watches, and is now widely being used in computer display units. The Cathode Ray Tube (CRT) was replaced with the LCD making it slimmer and more compact. But the image quality and the image color capability got comparatively poorer.

The main advantage of LCD is its low energy consumption. It finds its most common usage in portable devices where size and energy consumption are of main importance.

In plasma type of displays, ionized gas is used. This gas is filled between two glass plates. It starts to work when current is passed through one horizontal and one vertical wire to cause the gas to flow at the intersection of the wires. If problem occurred in LCD, the plasma displays can overcome the problem. Plasma display is brighter than LCD. It can be seen from a wide angle, i.e., 160 degrees. Gas plasma display screen can easily be made larger than 40 inches diagonal.

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Simplified circuits are used in plasma screen. Cathode ray tubes produce vibrant images and they are bulky. In order to increase the screen width in a CRT set, you also have to increase the length of the tube to give the scanning electron gun room to reach all parts of the screen. Consequently, any big-screen CRT television weighs a ton and takes up a sizable chunk of a room. Therefore, a new alternative has popped up on store shelves, i.e., the plasma flat panel display. These displays have wide screens, comparable to the largest CRT sets, but they are only about 6 inches (15 cm) thick. The plasma displays are based on the information in a video signal and it lights up thousands of tiny dots (called pixels) with a high-energy beam of electrons. In most systems, there are three pixel colors Red, Green and Blue (RGB), which are evenly distributed on the screen. By combining these colors in different proportions, the television can produce the entire color spectrum. The basic idea of a plasma display is to illuminate tiny colored fluorescent lights to form an image. Each pixel is made up of three fluorescent lights with RGB combination. It is like a CRT television, the plasma display varies the intensities of the different lights to produce a full range of colors. The central element in a fluorescent light is plasma, a gas made up of free-flowing ions (electrically charged atoms) and electrons (negatively charged particles). In plasma display, an electrical current running through it in which, negatively charged particles rush toward the positively charged area of the plasma and positively charged particles are rushing toward the negatively charged area. A gas is mainly made up of uncharged particles. That is, the individual gas atoms include equal number of protons and electrons. Protons are positively charged particles in the atom's nucleus. The negatively charged electrons perfectly balance the positively charged protons, so the atom has a net charge of zero. If you introduce many free electrons into the gas by establishing an electrical voltage across it, the situation changes very quickly. The free electrons collide with the atoms, knocking loose other electrons. With a missing electron, an atom loses its balance. It has a net positive charge, making it an ion. The xenon and neon gas in a plasma display is contained in hundreds of thousands of tiny cells positioned between two plates of glass. Long electrodes are also sandwiched between the glass plates, on both sides of the cells. The address electrodes sit behind the cells, along the rear glass plate. The transparent display electrodes, surrounded by an insulating dielectric material and covered by a magnesium oxide protective layer, are mounted above the cell and along the front glass plate.

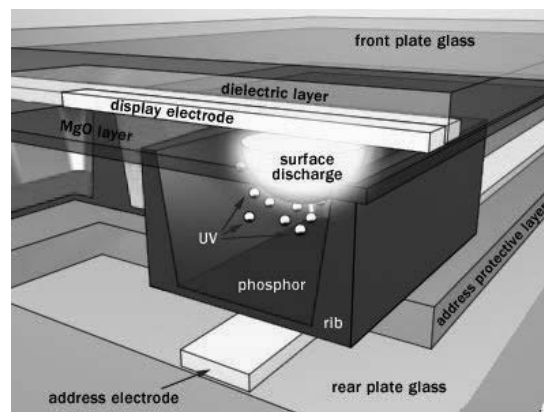


Fig. 1.16 Surface Discharge on Base Screen

Figure 1.16 shows how set of electrodes extend across the entire screen. The display electrodes are arranged in horizontal rows along the screen and the address electrodes are arranged in vertical columns. As you can see in the Figure 1.17, the vertical and horizontal electrodes form a basic grid.

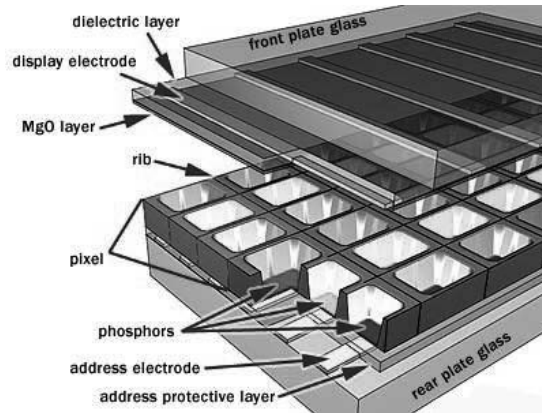


Fig. 1.17 Setting of Vertical and Horizontal Electrodes in Plasma Display

To ionize the gas in a particular cell, the plasma display's computer charges the electrodes that intersect at that cell. It does this thousands of times in a small fraction of a second, charging each cell in turn. The intersecting electrodes are charged with a voltage difference between them, the electric current flows between the cells. And, the current creates a rapid flow of charged particles, which stimulates the gas atoms to release ultraviolet photons. The released ultraviolet photons interact with phosphor material coated on the inside wall of the cell. Phosphors are substances that give off light when they are exposed to other light. If ultraviolet photon hits a phosphor atom in the cell, one of the phosphor's electrons jumps to a higher energy level and the atom heats up. When the electron falls back to its normal level, it releases energy in the form of a visible light photon.

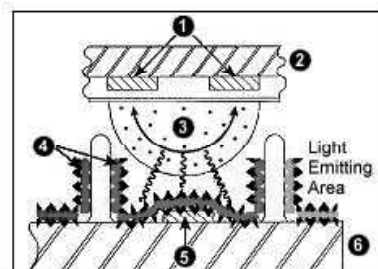


Fig. 1.18 (1) Display Electrode, (2) Glass Substrate (Front), (3) Discharge Region, (4) Phosphor, (5) Address Electrode and (6) Glass Substrate (Rear)

Figure 1.18 shows the phosphors in a plasma display give off colored light when they are heated. Every pixel is made up of three separate subpixel cells, each with different colored phosphors. One subpixel has a red light phosphor, one subpixel has a green light phosphor and one subpixel has a blue light phosphor. These colors blend together to create the overall color of the pixel. By varying the pulses of current flowing through the different cells, the control system can increase or decrease the intensity of each subpixel color to create hundreds of different combinations of red, green and blue. In this way, the control system can produce

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colors across the entire spectrum. The main advantage of plasma display technology is that you can produce a very wide screen using extremely thin materials. And because each pixel is lit individually, the image is very bright and looks good from almost every angle. The image quality is not quite up to the standards of the best cathode ray tube sets, but it certainly meets most people's expectations.

Thin Film Transistor (TFT)

A thin film transistor is comprised of a semiconductor layer. It insulates a gate layer and a gate electrode. The role of semiconductor layer is to add polysilicon layer whose electron mobility is 100 times higher than that of an amorphous silicon layer. This type of transistor is used as switching devices in flat display panels, such as Organic Light Emitting Diodes (OLEDs) or LCDs. A LCD is one of the most widely used flat panel displays since it is lightweight and occupies less space than conventional CRT displays. The applications for liquid crystal displays are extensive, such as mobile phones, digital cameras, video cameras, notebooks and monitors. LCD together with other flat panel type display has become one of the most researched types of displays. Plasma displays and electro-luminance displays are the flat panel type display. The thin film transistor array substrate includes gate lines and data lines, a thin film transistor formed as a switching device at every crossing of the gate lines and the data lines, a pixel electrode connected to the thin film transistor substantially defining a liquid crystal cell and an alignment film applied to the substrate. A thin film transistor is usually fabricated as MOSFET including an electrically insulating substrate, such as a glass substrate and a thin semiconductor layer formed on the substrate and acting as an active region. A TFT LCD display is composed of a thin film transistor array substrate, a color filter array substrate and a liquid crystal layer, wherein the thin film crystal transistor array substrate is composed of many thin film transistors arranged in an array and pixel electrodes corresponding to each thin film transistor to form pixel structures. When a thin film transistor is used in an active matrix type liquid crystal display device, for instance, the thin film transistor is designed to be driven by a driver integrated circuit as a switching device for switching pixels.

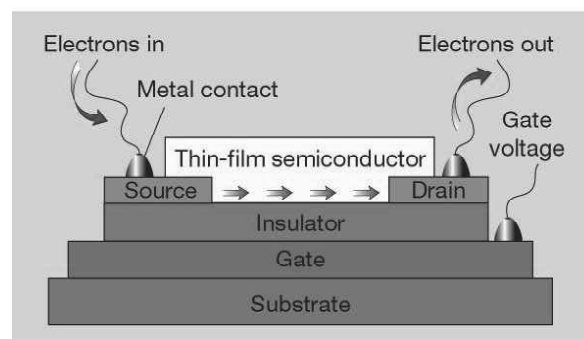


Fig. 1.19 Thin Film Transistor

Figure 1.19 shows the cross section of TFT in which a voltage applied at the gate controls the flow of electrons (resistance) from the source to the drain and a positive gate voltage attracts electrons to the bottom surface of the semiconductor layer and creates a conduction channel. If voltage difference is applied between the two connector wires, electrons enter at one end, i.e., the source and exit at the

other, i.e., the drain. It results in a current along with the channel. A chemical-deposition method is used in TFT to produce the uniform films.

Printers

Printers are used for creating paper output. There is a huge range of commercially available printers today (estimated to be 1500 different types). These printers can be classified into categories based on:

- Printing technology.
- Printing speed.
- Printing quality.

Printing Technology: Printers can be classified as impact or non-impact printers, based on the technology they use for producing output. Impact printers work on the mechanism similar to a manual typewriter where the printer head strikes on the paper and leaves the impression through an inked ribbon. Dot matrix printers and character printers fall under this category. Non-impact printers use chemicals, inks, toners, heat or electric signals to print on the paper and they do not physically touch the paper while printing.

Printing Speed: This refers to the number of characters printed in a unit of time. Based on speed, these may be classified as character printer (prints one character at a time), line printers (prints one line at a time) and page printers (print the entire page at a time). Printer speeds are, therefore, measured in terms of characters-per-second for a character printer, lines-per-minute for a line printer and pages-per-minute or ppm for a page printer.

Printing Quality: It is determined by the resolution of printing and is characterized by the number of dots that can be printed per linear inch, horizontally or vertically. It is measured in terms of dots-per-inch or DPI. Printers can be classified as Near-Letter-Quality (NLQ), Letter-Quality (LQ), Near-Typeset-Quality (NTQ) and Typeset-Quality (TQ), based on their printing quality. NLQ printers have resolutions of about 300 DPI, LQ of about 600 DPI, NTQ of about 1200 DPI and TQ of about 2000 DPI. NLQ and LQ printers are used for ordinary printing in day-to-day activities, while NTQ and TQ printers are used to produce top-quality printing, typically required in the publishing industry.

Types of Printers

Following are the different types of printers.

Dot Matrix

Dot matrix printers are the most widely used impact printers in personal computing. These printers use a print head consisting of a series of small metal pins that strike on a paper through an inked ribbon, leaving an impression on the paper through the ink transferred. Characters thus produced are in a matrix format. The shape of each character, i.e., the dot pattern, is obtained from information held electronically. Figure 1.20(a) and 1.20(b) shows characters formed using dots and dot matrix printer respectively.

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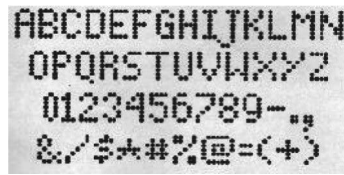


Fig. 1.20(a) Characters Formed using Dots



Fig. 1.20(b) Dot Matrix Printer

The speed, versatility and ruggedness, combined with low cost, tend to make such printers particularly attractive in the personal computer market. Typical printing speeds in case of dot matrix printers range between 40 - 1000 Characters Per Second (CPS). In spite of all these features in dot matrix printer technology, the low print quality gives it a major disadvantage.

Inkjet

Inkjet printers are based on the use of a series of nozzles for propelling droplets of printing ink directly on almost any size of paper. They, therefore, fall under the category of non-impact printers. The print head of an inkjet printer consists of a number of tiny nozzles that can be selectively heated up in a few microseconds by an IC register. When this happens, the ink near it vaporizes and is ejected through the nozzle to make a dot on the paper placed in front of the print head. The character is printed by selectively heating the appropriate set of nozzles as the print head moves horizontally.

Characters are formed as a result of electrically charged or heated ink being sprayed in fine jets onto the paper. Individual nozzles in the printing head produce high resolution, up to 400 dots per inch or 400 Dots Per Inch (DPI) dot matrix characters.

Inkjet printers use color cartridges which combine magenta, yellow and cyan inks to create color tones. A black cartridge is also used for crisp monochrome output. This method of printing can generate up to 200 (CPS) and allows for good quality, cheap color printing.

Laser

Laser printers work on the same printing technology as photocopiers, using static electricity and heat to print with a high quality powder substance known as *toner*.

Laser printers are capable of converting computer output into print, page by page. Since characters are formed by very tiny ink particles, they can produce very high quality images (text and graphics). They generally offer a wide variety of character fonts and are silent and fast in use. Laser printers are faster in printing speed than other printers discussed above. Laser printers can print from 10 pages to 100 pages per minute, depending upon the make/model. Laser is high quality, high speed, high volume and non-impact technology that works on almost any kind of paper. Even though this technology is more expensive than inkjet printers, it is preferred because of its unmatched features, such as high quality, high speed printing and noiseless and easy-to-use operations.

Laser Printers use a laser beam and dry powdered ink to produce a fine dot matrix pattern. This method of printing can generate about 4 pages of A4 paper per minute.

The standard of print is very good and laser printers can also produce very good quality printed graphic images too.

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Character Printer

The character printers are impact printers. In a character printer, characters are printed one after the other with the help of a matrix of dots, so it is also known as *serial printer*. Only one character can be printed at a time and hence they are called *slow printers*. They need less memory as only one character is to be stored for printing. They are capable of printing at the rate of 30 to 300 CPS. The only advantage of character printer is that it is a low cost printer and is basically used with personal computers. The disadvantage of this printer is that it has low speed and makes lot of noise while printing. Dot matrix printer, thermal dot matrix printer, daisy wheel-printer and inkjet printer are the examples of character printers.

Daisy-Wheel Printer

Daisy-wheel printer comes in the category of output device and quite similar to typewriters. It is in the shape of flat and circular printers in which printing elements contain all text, special characters and number characters. The printed characters are spin rapidly and hold the position of printing hammer that is to be stricken the character against ribbon and paper. It was invented in 1969 by David S. Lee at Diablo Data Systems (DDS). This printer uses interchangeable preformed type elements having 96 glyphs that are able to generate a good quality of output on the paper. This printer is used in electronic typewriters to take printouts for documents which are prepared in the word processors or notepads from the year of 1972. This printer contains a print head that looks like the wheel of bicycle hence known as *letter quality printer* too. This printer radiates the crown of spokes which is ended in tiny and formed characters if the paper is inserted into this printer for printing. At the end of each spoke, carved alphabets appear as print outs. Due to advancement of printing technology, this type of printer is not being used in the big organization. The desired character spins around the print hammer in which alphabets and figures are banged into the ribbon that has to be appeared onto the inserted paper. This printer prints the desired alphabets, documents and special characters etc. at the speed of 10 to 75 characters per second. This printer employs either a metal or a plastic print wheel having especially the mounted type of long flexible fingers or petals. A single print hammer is used to impress the characters on the paper.

Note: Glyph is considered as elements of writing. It got its name due to wheel around the printer appeared as a set of print characters to make a typing impression on paper.

Line Printers

Another type of impact printer somewhat similar to the daisy-wheel is the line printer. However, instead of a print wheel, line printers have a mechanism that allows multiple characters to be simultaneously printed on the same line. The

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mechanism may use a large spinning print drum or a looped print chain. As the drum or chain are rotated over the paper's surface, electromechanical hammers behind the paper push the paper along with a ribbon onto the surface of the drum or chain, marking the paper with the shape of the character on the drum or chain. Because of the nature of the print mechanism, line printers are much faster than dot-matrix or daisy-wheel printers; however, they tend to be quite loud, have limited multi-font capability, and often produce lower print quality than more recent printing technologies. Because line printers are used for their speed, they use special tractor-fed paper with pre-punched holes along each side. This arrangement makes continuous unattended high-speed printing possible, with stops only required when a box of paper runs out.

Page Printer

The page printers are high speed non-impact printers. The printing speed is very high and the output is a page at a time. The techniques used to design such printers are called electro-photographic techniques because it was based on paper copier or Xerox technology. The page printers are capable of producing fast output of pages similar to a Xerox machine. The example of page printer is laser printers which print an entire page at once. Laser printers are designed on technology that includes laser beam and electro-photographic for producing approximately 18,000 lines per minute. Page printers require more memory as compared to character or line printers because they store each page in memory before printing it. Example of page printer is as follows:

Thermal Printer

Characters are formed by heated elements being placed in contact with special heat sensitive paper forming darkened dots when the elements reach a critical temperature.

Thermal printer paper tends to darken over time due to exposure to sunlight and heat. The standard of print produced is poor. Thermal printers are widely used in battery powered equipment such as portable calculators.

Check Your Progress

5. What are the three important parts of a computer system?
6. Which component of the computer is responsible for controlling different computer operations?
7. What does computer hardware refer?
8. State about the computer software.
9. What are the categories of software on functional basis?
10. What is business software?
11. Write the full form of COTS.
12. What are peripheral devices?
13. What is the purpose of using input devices?

14. What are scanning devices?
15. Where is a hand-held scanner used?
16. How a picture is created in a CRT monitor?
17. How does a dot-matrix printer operate?

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1.7 COMPUTER ORGANIZATION

One of the important jobs of computers is storing and managing data in a retrievable form as and when required. These days the basic constituents that make up a computer system are: one or more processors (CPUs), several device controllers and the memory. All these components are connected through a common bus that provides access to shared memory. Each device controller acts as an interface between a particular I/O device and the operating system. Thus, a device controller plays an important role in operating a particular device. For example, the disk controller helps in operating disks, USB controller in operating mouse, keyboard, and printer, graphics adapter in operating monitor, sound card in operating audio devices, and so on. In order to access the shared memory, the memory controller is also provided that synchronizes the access to the memory. The interconnection of various components via a common bus is shown in Figure 1.21.

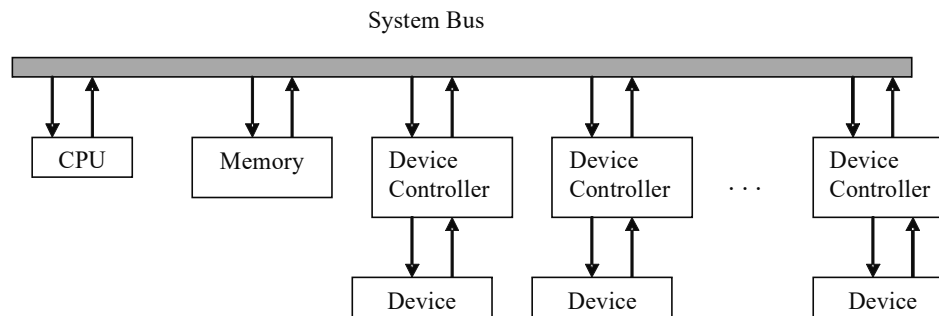


Fig. 1.21 Bus Interconnection

Computer System Operation

When the system originally is turned on, it runs a well defined set of initial programs known as **bootstrap program**. The bootstrap program is typically stored in Read-Only Memory (ROM) or electrically Erasable programmable ROM (EEPROM). During the booting process, all the aspects of the system checking like CPU registers, device controllers and memory contents are initialized, and then the operating system is loaded into the memory. Once the operating system is loaded, the first process such as “init” is executed, and operating system then waits for some special sequence of events to occur.

The event notification is done with the help of an **interrupt** that is fired either by the hardware or the software. When the hardware needs to trigger an interrupt, it can do so by sending a signal to the CPU via the system bus. When the

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software needs to trigger an interrupt, it can do so with the help of **system call** (or **monitor call**).

Whenever an interrupt is fired, the CPU suspends the current task for the time being, and jumps to a predefined location in the kernel's address space, which contains the starting address of the service routine for the interrupt (known as **interrupt handler**). It then executes the interrupt handler, and once the execution is completed, the CPU resumes the task that it was previously doing.

To quickly handle the interrupts, a table of pointers to interrupt routines is used. The table contains the addresses of the interrupt handlers for the various devices, and is generally stored in the low memory (say first 100 locations or so). The interrupt routine can be called indirectly with the help of this table. This array of addresses is known as **interrupt vector**. The interrupt vector is further indexed by a unique device number, given with the interrupt request, to provide the address of the interrupt handler for the interrupting device.

Storage Structure

Whenever a program needs to be executed, it must be first loaded into the main memory (called **Random-Access Memory** or commonly known by the acronym **RAM**) where it is stored. RAM is the only storage area that can be directly accessed by the CPU. RAM consists of an array of memory words, where each word has its unique address. The two instructions, namely, load and store are used to interact with the RAM memory.

- The load instruction is used to move a word from the main memory to the CPU register.
- The store instruction is used to move the content of the CPU register to the main memory.

We know that a program is basically a set of instructions that a computer can read to direct an intended task. The execution of the program instructions takes place in the CPU registers, which are primarily used as temporary storage areas, and have restricted storage margin. Usually, an instruction-execution cycle consists of the following steps.

1. Whenever the CPU needs to execute an instruction, it first fetches it from the main memory, and stores it in **Instruction Register (IR)**.
2. Once the instruction has been loaded into the IR, the control unit examines and decodes the fetched instruction.
3. After decoding the instruction, the operands (if required) are fetched from the main memory and stored in one of the internal registers.
4. The instruction is executed on the operands, and the result is stored back to the main memory.

Ideally all the programs and data should be stored in the main memory permanently for fast execution and better system performance because RAM is the only storage area that allows direct accessibility of the stored data by the CPU,. But, practically it is not possible because RAM is exorbitantly proceed and offers limited storage

capacity. Secondly, it is volatile in nature, that is, the information is vanished the moment the power is switched off.

Therefore, to meet the requirements of sufficient data storage, we need some storage area that can hold large amount of data permanently. Such a type of storage is called **secondary storage**. Secondary storage is non-volatile in nature, that is, the data are retained even when the power is switched off or if the system crashes. However, data on the secondary storage devices are not directly accessed by the CPU as they are used to store the data that are not being concurrently processed. Therefore, it needs to be transferred to the main memory so that the CPU can access it. **Magnetic disk** (generally called disk) is the most widespread form of secondary storage means for computer. It offers intense storage capacity for enormous amount of data and easy accessibility. It is used to hold on-line data for a long term.

In addition to RAM and magnetic disk, some other form of storage devices also exist, which include cache memory, flash memory, optical discs, and magnetic tapes. The basic function of all the storage devices is to store the data in an easy and retrievable form. However, they differ in terms of their speed, cost, storage capacity, and volatility. On the basis of their characteristics, such as cost per unit of data and speed with which data can be accessed, they can be arranged in a hierarchical manner as shown in Figure 1.22.

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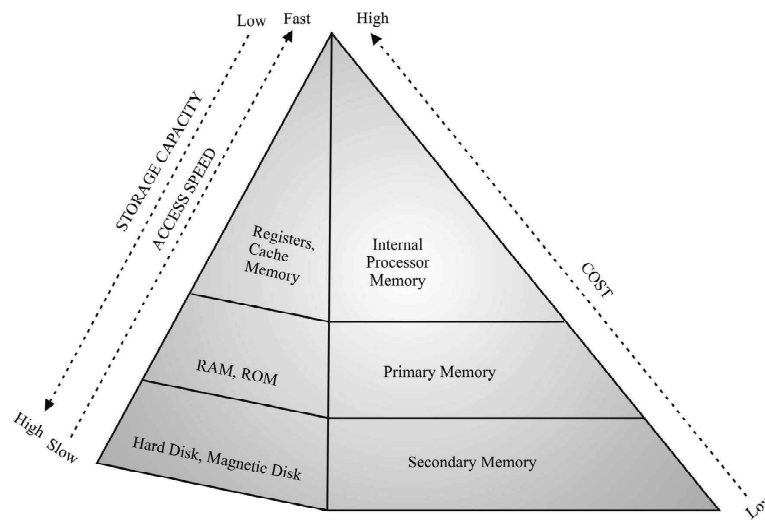


Fig. 1.22 Memory Hierarchy

I/O Structure

Handling I/O devices and getting all these parts work together is a major problem, and that is what an operating system does.. The operating system, therefore, provides an effective link between the components and also clearly outlines how each component should function with the help of codes. One reason for this is the varying nature of I/O devices. The operating system must issue commands to the devices, catch interrupts, handle errors, and provide an interface between the devices and the rest of the system.

NOTES

As already mentioned, a computer system consists of one or more processors and multiple device controllers that are connected through a common bus. Each device controller controls a specific type of device, and depending on the device controller one or more devices may be attached to it. For example, a **Small Computer-System Interface (SCSI)** controller may have seven or more devices attached to it. To perform its job, device controller maintains some local buffer storage and a set of special-purpose registers. The operating systems usually have a **device driver** for each device controller. The device driver acts as an interface to the device to the rest of the system. This interface should be uniform, that is, it should be same for all the devices to the extent possible.

To start an I/O operation, the device driver loads the appropriate registers within the device controller, which in turn examines the contents of registers to determine the action to be taken. Suppose, the action is to read the data from the keyboard, the controller starts transferring data from the device to its local buffer. Upon completion of data transfer, the controller informs the device driver (by generating an interrupt) that the transfer has been completed. The device driver then returns the control along with the data or pointer to the data to the operating system. This form of I/O is interrupt-driven I/O, and this scheme amounts to colossal wastage of CPU's time because CPU requests data from the device controller one byte at a time. This is one of the major drawbacks of this scheme as it is not feasible to transfer a large amount of data with this scheme.

To solve this problem, another scheme, that is, **Direct Memory Access (DMA)** is commonly used. This scheme, after setting up the registers to inform the controller to know what to transfer and where,, reduces the overhead burden of CPU and relieves the CPU to perform other tasks. The device controller can now complete its job, that is, transfer a complete block of data between its local buffer and memory without CPU intervention. Once the block of data has been transferred, an interrupt is generated to inform the device driver that the operation has been successfully executed.

1.7.1 Bus Structures

A shared communication path consisting of one or more connection lines is known as a bus and the transfer of data through this bus is known as bus transfer.

When data is read from or stored in memory, it is referred to as memory transfer.

The functional components of a computer must be connected in order to make a system operational. The CPU communicates with the other components via a bus. A bus is a set of wires that acts as a shared—but common—data path to connect multiple subsystems within the computer system. It consists of multiple lines, allowing the parallel movement of bits. Buses are low cost but very versatile and help connect devices with each other as well as the system. At any given point in time, only one device (be it a register, the ALU, memory or some other component) may use the bus. However, this sharing often results in a

communications bottleneck. The speed of the bus is affected by its length as well as by the number of devices sharing it.

- **Data Bus:** It is used for the transmission of data. Data lines and the number of bits in a word are similar.
- **Address Bus:** It carries the address of the main memory location from where data can be accessed.
- **Control Bus:** It is used to indicate the direction of data transfer and to coordinate the timing of events during the transfer.

NOTES

A digital computer consists of many processor registers and the transfer of information from one register to another is often required. Hence, paths must be provided so that such transfer operations can take place. Figure 1.23 shows the transfer among three registers R1, R2 and R3 through six data paths.

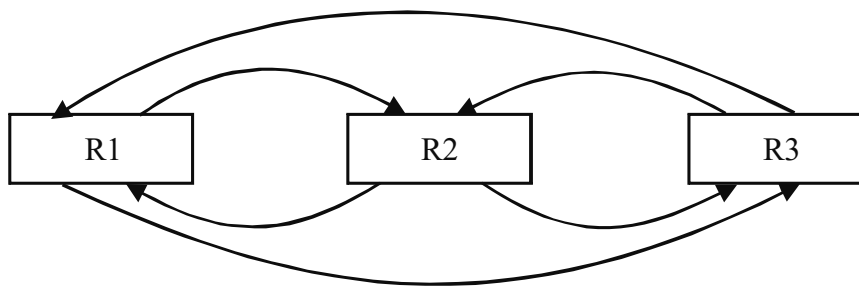


Fig. 1.23 Transfer among Three Registers

If different lines are used involving each register, the number of wires will increase considerably. Hence, a pair of common lines, one line for each bit of the register, is used for the transfer. This set of common lines through which binary data is transferred, one at a time, among registers is known as a *bus*. A common bus system can be constructed with the help of multiplexers and decoders. The multiplexer selects the source register whose binary information is then placed on the bus and the decoder selects one destination register to transfer the information to, from the bus. The construction of a bus system for four registers is shown in Figure 1.24. Two multiplexers have been used, one for the low-order significant bit and one for the high-order significant bit. If the register is of n bits, n multiplexers are required to produce n bus lines. These n lines in the bus are connected to n inputs of all the registers.

S_1 and S_0 are selection lines connected to selection inputs of all n multiplexers. The selection lines choose n bits of one register and transfers these to the common bus n lines. When S_1 and $S_0 = 00$, the 0 data inputs of all n multiplexers are selected and cause the n bits from register A to transfer to the n -line common bus, since the output of this register is connected to 0 data inputs of each multiplexer. Similarly, when S_1 and $S_0 = 01$, the content of register B is transferred into the n -line common bus and so on. The register that is selected for the four possible binary values is shown in Table 1.2.

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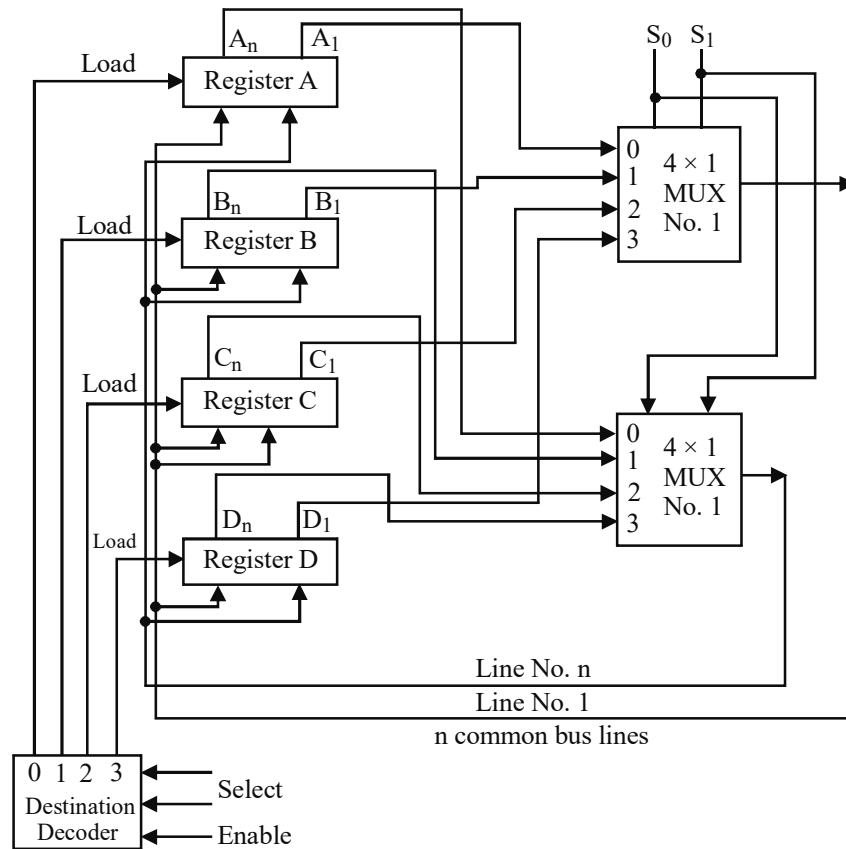


Fig. 1.24 Bus System for Four Registers

Table 1.2 Function Table for Bus as per Figure 1.24

S_1	S_0	Register Selected
0	0	A
0	1	B
1	0	C
1	1	D

The shifting of data from a bus to one of the targeted registers is done with the help of the load control of that register. The load control of the particular register is activated by the outputs of the decoder when enabled. If the decoder is not enabled, no information from the bus will be transferred to the register although the multiplexers place the information of the source register onto the bus.

In general, for registers of n bits, n multiplexers are needed to construct a bus of n lines. The size of a multiplexer depends on the number of registers in the system. If there are K registers, the multiplexer's size will be $K \times 1$ since it multiplexes K data lines. To take an example, a general bus of 16 registers of 16 bits each needs 16 multiplexers of size 16×1 . Four selection lines are required. Also, the size of the destination decoder will be 4×16 .

Consider the statement

$$C \leftarrow B$$

The control function that enables this transfer must select register *B* as the source and register *C* as the destination registers. The content of register *B* is located on the bus and the content of the bus is then transferred to register *C* by starting its load control input.

Bus Organization

A bidirectional bus for carrying data between two units is called a data bus.

A unidirectional bus used to carry memory addresses is called memory bus.

The manner in which different buses are connected to form a common bus so that the CPU, memory and I/O devices can use the common bus, when required, is called bus organization.

A basic computer consists of a memory unit, a control unit and registers. There must be a path that can be used to transfer information between the memory and the registers or among registers. Using a common bus is the most efficient way of transferring information from source to destination in a system with multiple registers. Figure 1.25 shows the connection of eight registers and a 4096×16 memory unit of a common bus system. The eight registers are the Address Register (AR), Program Counter (PC), Data Register (DR), Accumulator (AC), Instruction Register (IR), Temporary Register (TR), Input Register (INPR) and Output Register (OUTR). Here, a 16-bit common bus has been used.

The outputs of seven registers and memory are linked to the common bus. The definite output chosen for the bus lines at any time is finalized by the binary value of the selected lines S_2 , S_1 and S_0 as shown in Table 1.3. The numbers along each output line shows the decimal equivalent of the required binary selection. When $S_2S_1S_0 = 011$, the 16-bit outputs of DR are placed on the bus lines.

The lines from the common bus are linked to the input of each register and the data inputs of the memory. The specific register whose LD (load) input is allowed gets the information from the bus. The memory gets the information from the bus when 'a write input' is allowed.

The memory puts its results on to the bus when the 'read input' is on and $S_2S_1S_0 = 111$.

The registers DR, AC, IR and TR are of 16- bits. Two registers, PC and AR, have 12 bits since they store addresses.

When the contents of AR and PC are placed on the bus, the four most significant bits are set to 0. When AR and PC receive data from the common bus, only the 12 least significant bits are transferred to the register.

The input registers INPR and OUTR have 8 bits; hence, they communicate only with the 8 least significant bits in the bus. INPR is connected to the bus for providing information. However, OUTR is connected to the bus only for receiving information from the bus. INPR receives a character from the I/O device, which is transferred to AC; and OUTR receives a character from AC and delivers it to an output device. No transfer takes place from OUTR to any of the other registers.

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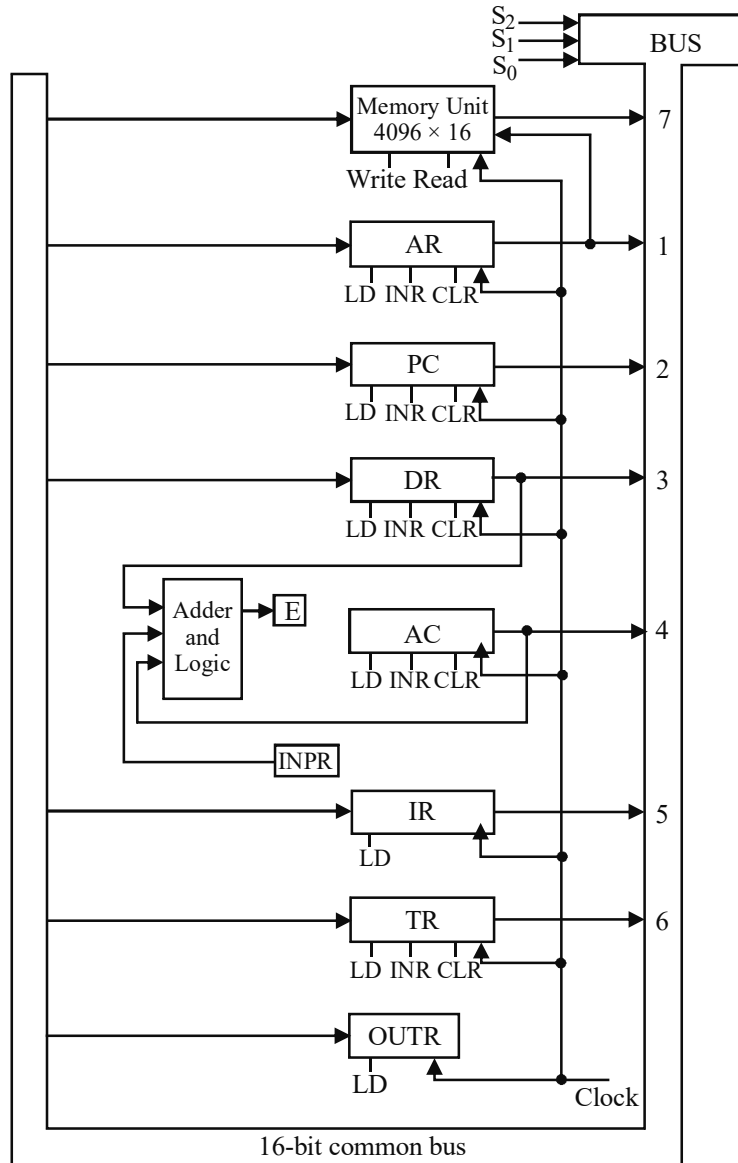


Fig. 1.25 Common Bus Organization

Table 1.3 Function Table

S_2	S_1	S_0	Register
0	0	1	AR
0	1	0	PC
0	1	1	DR
1	0	0	AC
1	0	1	IR
1	1	0	TR
1	1	1	Memory

NOTES

The 16-bit common bus receives information from six registers and the memory unit. In addition, the 16-bit common bus is linked to the inputs of six registers and the memory unit. Five registers have three control signals—LD (load), INR (increment) and CLR (clear). Two registers have only LD (load) control signal connected to the common bus. AR is also connected to the memory address. Thus, AR always specifies the memory address. During a memory write operation, the content of any register can be specified for the memory data and similarly during a memory read operation, any register except AC can receive data from the memory. The 16-bit AC receives inputs from the adder and logic circuit, which receives input from three registers. These three registers are 16-bit AC, 16-bit data register DR and 8-bit inputs, which come from input register INPR. The inputs from DR and AC are used for arithmetic and logic micro-operations. Table 1.3 shows the binary value of selection line $S_2S_1S_0$ that selects one of the registers.

For example, in order to transfer the contents of PC to AR (Address Register), the computer requires the following instructions:

- Set the selection variables $S_2S_1S_0 = 010$
- Transfer the contents of PC to the bus
- Enable LD input of AR
- Transfer contents of bus into AR

Multiple Bus Organization

A two-bus structure used to connect the registers and the ALU of a processor is shown in Figure 1.26. All general-purpose registers are connected to both buses *A* and *B* to form a two-bus organization. The two operands required by the ALU are routed in one clock cycle; hence, the execution of instruction becomes faster since the ALU does not wait for the second operand, as is the case with single bus organization. Information passed on to the bus may be from general-purpose registers or special-purpose registers. In addition, the special-purpose registers are divided into two groups—one group at the left of the ALU connected to bus *A* and the other group is at the right of the ALU connected to bus *B*. The data from two special-purpose registers belonging to the same group cannot be transferred to the ALU at the same time.

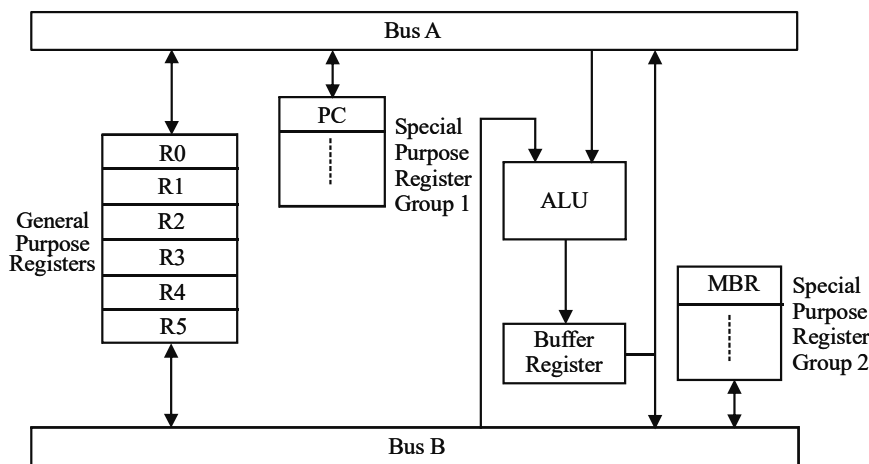


Fig. 1.26 Two-Bus Organization of the Data Path

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The output of the ALU may be routed to either general-purpose registers or special-purpose registers. The ALU does not have any input buffer register and hence, both buses will be busy in carrying the operands during the binary operations. Therefore, the output of ALU is first stored in the output register. Transfer of the required operands and loading of the ALU output buffer register take place in one clock cycle. The content of the ALU output register is routed to the destination with the help of either bus *A* or bus *B* in the second clock cycle.

The performance of a two-bus organization can be further improved by adding a third bus *C* at the output of ALU. The three-bus structure is shown in Figure 1.27. The addition of a third bus allows the system to perform operation, such as $R3 \leftarrow R1 + R2$ in one clock cycle as there are three separate buses in the system.

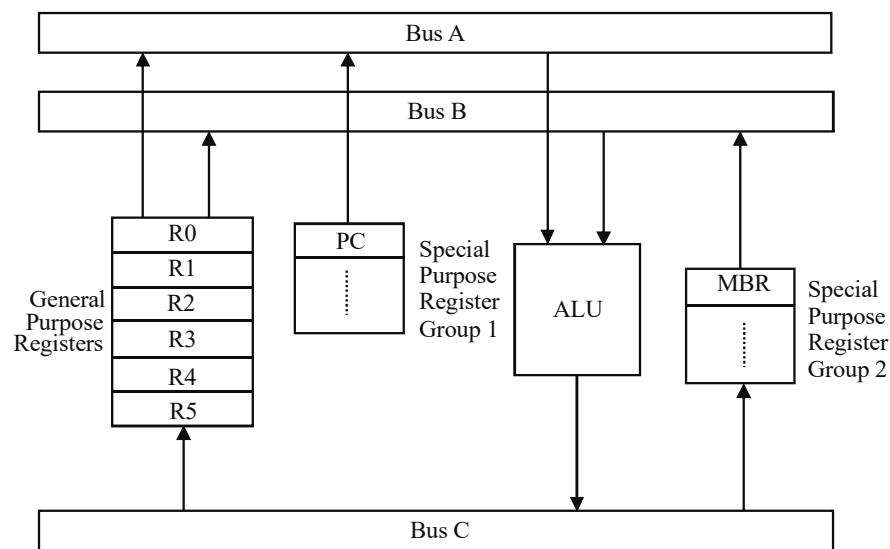


Fig. 1.27 Three-Bus Organization of the Data Path

1.7.2 Memory Location and Address

A digital computer system requires the facility for storing digital information. The information may be instructions, data to be processed, intermediate and final results, and so on. The digital system that provides this storage facility is known as the memory.

A memory address is an identifiable name for a memory location where a computer program or a hardware device stores information. This information or data can be retrieved when needed.

Computers nowadays are *byte-addressable*. Each address identifies a single byte of storage; when the information is very big, it is kept in multiple bytes and is stored in a sequence of consecutive addresses. Some microprocessors are *word-addressable*. Here, the addressable storage unit is bigger than a byte.

An *absolute address* (also called *explicit address* or *specific address*) specifies an address in memory in a unique way. However, the *relative address* is not different and specifies an address that is only relative to some other location (the *base address*).

In both the ROM and RAM, every memory area holds a generic binary number of some sorts. Its type, interpretation, usage and meaning is dependent on the context of the instructions. It retrieves and works on it. Each such coded item has a special physical location which is described by another special binary number—the address of that single word. A pointer is an address safely kept as data in some other memory location.

Information stored in memory can not only be interpreted as data, such as text data, binary or numeric data, but can even be *instructions* to themselves in a uniform manner.

The instructions in a storage address are read contextually as command words to the computer's main processing unit. Data is then brought back by such instructions and put in an internal and isolated memory structure known storage register. Here, the later instruction may use it along with data retrieved from other internal memory locations (or *internal addresses*). Registers are the memory addresses within the the CPU known as the Arithmetic and Logic Unit (ALU). They respond to binary instructions (machine code) fetched into instruction registers selecting combinatorial logic and determining which data registers should be added, subtracted, circulated (shifted), and so on, at the low machine language level of binary manipulation of data.

Usually, the size of a word depends on the computer. It signifies the number of bits that a CPU may process at a time. It is put together in multiples of 4 and 8 bits (*nibbles* and *bytes*). Therefore, with development in technologies, larger sizes (4-64) became available.

Sometimes, while referring to the *word size* of a computer system, one also describes the size of the address space of that computer, for example, a computer that is said to be '32-bit' usually allows 32-bit memory addresses. This is rational and useful as it permits one address to be efficiently stored in one word.

However, this is not always so. Often, computers have memory addresses that are larger or smaller than their word size; the 16-bit Intel 8086 supports 20-bit addressing, allowing it to access 1 MiB rather than 64 KiBs of memory. Pentium processors since the start of Physical Address Extensions (PAE), support 36-bit physical addresses, while they generally have only a 32-bit word.

With adequate Operating System (OS) support, a modern byte-addressable 64-bit computer has the capacity of addressing 2^{64} bytes (or 16 exbibytes).

An *address space* clarifies a range of discrete addresses. Every address may resemble a physical or network host, virtual memory register, peripheral device, a disk sector or any other rational or physical entity.

Comparable to locating a street in a town, a memory address indicates a physical area in the computer memory. And as an address points to where you live, the memory address points to the area where data is kept safely. Similar to a person's address, the *address space* would be an area of locations, such as a neighbourhood, town/city, state or country. Although numerically the same, two addresses might refer to different locations if they belong to different address spaces.

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In order to be able to move a word in and out of the memory, a distinct address has to be assigned to each word. This address will be utilized to check the memory location in which a given word is to be stored. This is called a memory write operation. Similarly, the address will be used to determine the memory location from which a word is to be retrieved. This is called a memory read operation. Thus, there are two basic memory operations—memory write and memory read operations. Both these operations are performed by the CPU.

The following three basic steps are necessary for the CPU to perform a write operation into a specified memory location:

- The word to be stored in the memory location is first loaded by the CPU into a specified register called Memory Data Register (MDR).
- The address of the location in which the word is to be stored is loaded by the CPU into a specified register called Memory Address Register (MAR).
- A signal, called write, is issued by the CPU indicating that the word stored in the MDR is to be stored in the memory location whose address is loaded in the MAR.

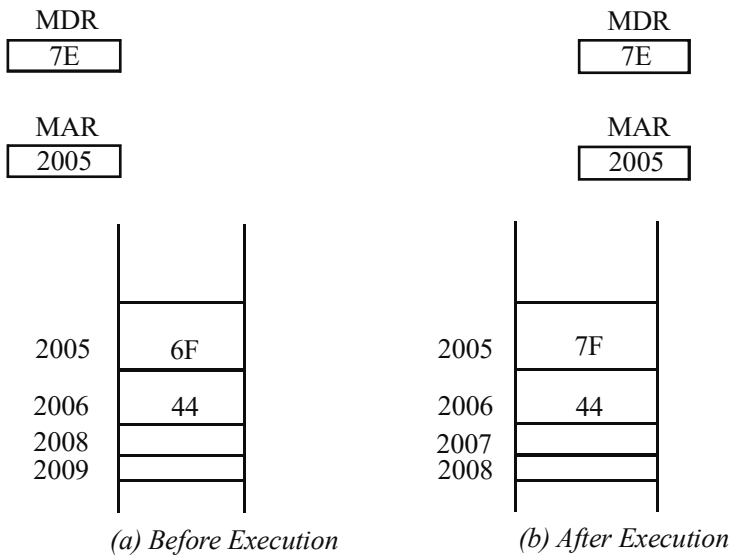


Fig. 1.28 Memory Write Operation

Figure 1.28 illustrates the operation of writing the word given by 7E (in hex) into the memory location whose address is 2005. Figure 1.28(a) shows the status of the registers and memory locations involved in the write operation before the execution of the operation. Figure 1.28(b) shows the status after the execution of the operation. MDR and MAR are the registers used exclusively by the CPU and are not accessible to the programmer.

Similarly, the following three basic steps are needed in order to perform a memory read operation:

- The address of the location from which the word is to be read is loaded into the MAR.

- A signal, called read, is issued by the CPU, indicating that the word whose address is in the MAR is to be read into the MDR.
- After some time, corresponding to the memory delay in reading the specified word, the required word will be loaded by the memory into the MDR ready for use by the CPU.

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Figure 1.29 illustrates the operation of reading the word stored in the memory location whose address is 2010. Figure 1.29(a) shows the status of the registers and memory locations involved in the read operation before the execution of the operation. Figure 1.29(b) shows the status after the read operation.

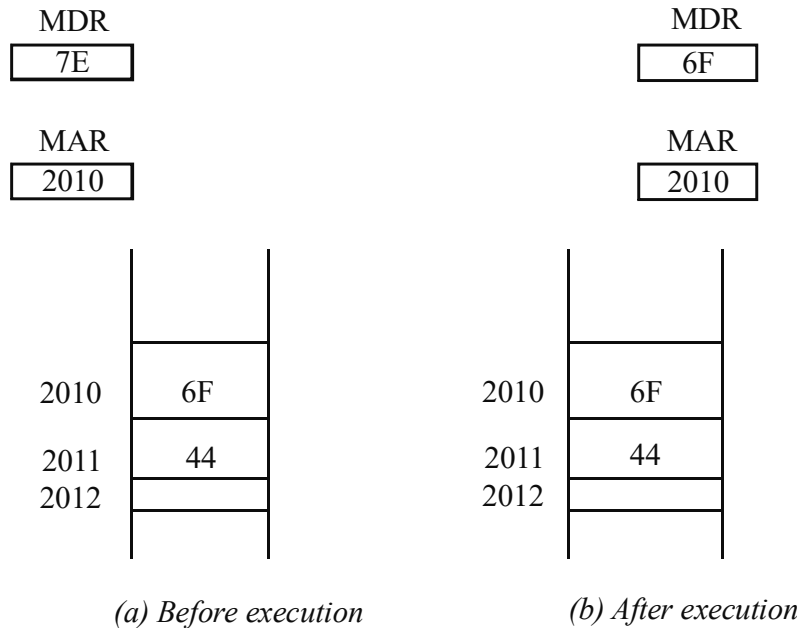


Fig. 1.29 Memory Read Operation

1.8 CENTRAL PROCESSING UNIT

Execution of programs is the main function of the computer. The program to be executed is a set of instructions that is stored in the computer's memory. Tasks are completed when the instructions of the program are executed by the Central Processing Unit (CPU). Also, all the major calculations and comparisons are carried out inside the CPU. Additionally, the CPU is responsible for activating and controlling the operations of various units of the computer system. It activates the peripherals to perform input or output.

The component of the computer that performs data processing operations in bulk is known as the CPU.

It consists of three main parts, as shown in Figure 1.30:

- Register Set
- Arithmetic and Logic Unit (ALU)
- Control Unit (CU)

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A register set is used to store intermediate results obtained during the execution of instructions. The ALU performs the arithmetic and logic micro-operations required for executing these instructions. The control unit instructs the ALU to perform the desired operation and supervises the transfer of information among different registers.

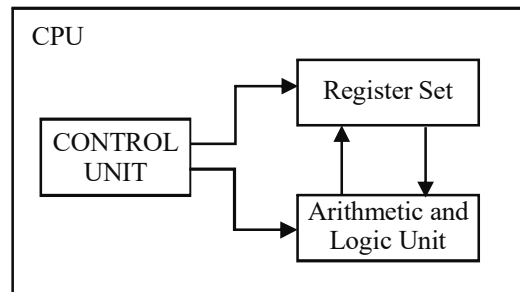


Fig. 1.30 Central Processing Unit

Control Unit

The control unit is necessary if the CPU is to function efficiently and information/data is to be transferred between the CPU and other devices. It does not perform the actual processing of the data, but manages and coordinates the entire computer system, including the input and, output devices. It retrieves and interprets the instructions from the program stored in the main memory, and issues signals that cause the other units of the system to execute them.

It does this through some special purpose registers and a decoder. The special purpose register called the **Instruction register** holds the current instruction to be executed, and the **Program control register** holds the next instruction to be executed. The decoder interprets the meaning of each instruction supported by the CPU. Each instruction is also accompanied by a **Microcode**, i.e., the basic directions to tell the CPU how to execute the instruction.

Arithmetic Logic Unit

The Arithmetic Logic Unit or ALU provides arithmetic and logic operations. This means that when the control unit encounters an instruction that involves an arithmetic operation (add, subtract, multiply, divide) or a logic operation (equal to, less than, greater than), it passes control to the ALU. The ALU has the necessary circuitry to carry out these arithmetic and logic operations.

As an example, a comparison of two numbers (a logical operation) may require the control unit to load the two numbers in the requisite registers and then pass on the execution of the 'compare' function to the ALU.

Figure 1.31 represents the basic structure of a CPU.

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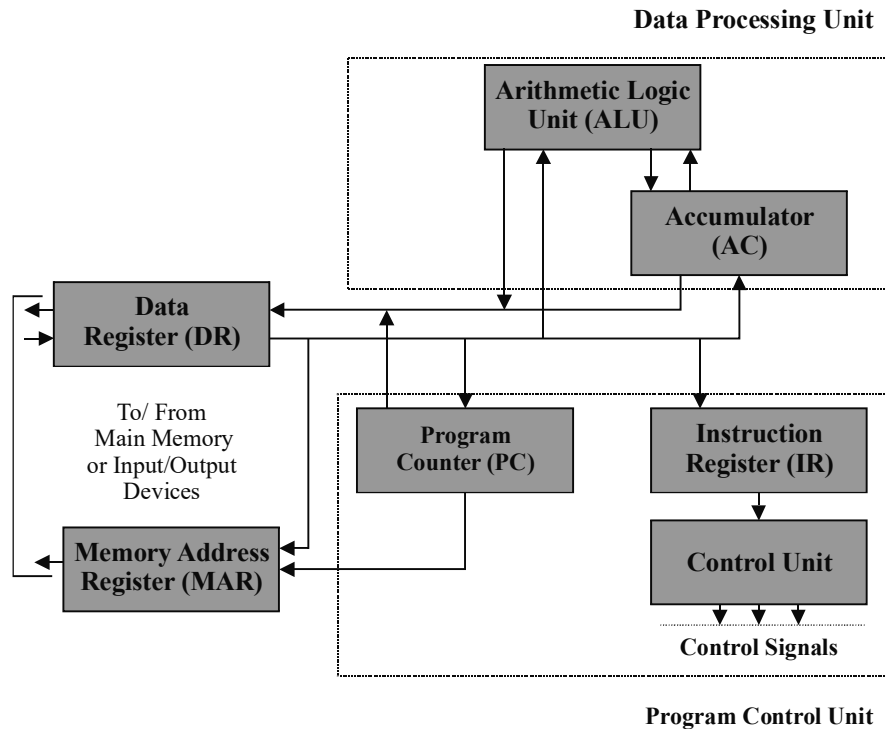


Fig. 1.31 Basic Structure of a CPU

Instruction Set

The primary function of the processing unit in the computer is to interpret the instructions given in a program and carry out the instructions. Processors are designed to interpret a specified number of instruction codes. Each instruction code is a string of binary digits. All processors have input/output instructions, arithmetic instructions, logic instructions, branch instructions and instructions to manipulate characters. The number and type of instructions differ from processor to processor. The list of specific instructions supported by the CPU is termed as its **Instruction set**.

An instruction in the computer should specify the following:

- The task or operation to be carried out by the processor. This is termed as the **opcode**.
- The address(s) in memory of the operand(s) on which the data processing is to be performed.
- The address in the memory that may store the results of the data processing operation performed by the instruction.
- The address in the memory for the next instruction, to be fetched and executed.

The next instruction which is executed is normally the next instruction following the current instruction in the memory. Therefore, no explicit reference to the next instruction is provided.

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Instruction Representation

An instruction is divided into a number of fields and is represented as a sequence of bits. Each of the fields constitutes an element of the instruction. A layout of an instruction is termed as the **instruction format** (Refer Figure 1.32).

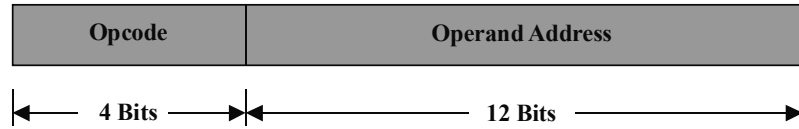


Fig. 1.32 A Sample Instruction Format

In most instruction sets, many instruction formats are used. An instruction is first read into an Instruction Register (IR), then it is decoded by the CPU which extracts the required operands on the basis of references made on the instruction fields, and processes it. Since the binary representation of the instruction is difficult to comprehend, it is seldom used for representation. Instead, a symbolic representation is used (Refer Figure 1.33).

Instruction	Interpretation	Number of Addresses
ADD A,B,C	Operation $A = B + C$ is executed	3
ADD A,B	$A = A + B$. In this case the original content of operand location is lost	2
ADD A	$AC = AC + A$. Here A is added to the accumulator	1

Fig. 1.33 Examples of Typical Instructions

Typically, CPUs manufactured by different manufacturers have different instruction sets. This is why machine language programs developed for a particular CPU do not run on a computer with a different CPU (having a different instruction set).

Registers

The primary task that the CPU performs is the execution of instructions. It executes every instruction by means of a number of small operations known as micro-operations. Thus, it can be seen that:

- The CPU needs an extremely large main memory
- The speed of the CPU must be as fast as possible

To understand further, let us define two relevant terms:

Memory Cycle Time: Time taken by the CPU to access the memory.

Cycle Time of the CPU: The time that the CPU takes for executing the shortest well-defined micro-operation.

It has been observed that the time taken by the CPU to access the memory is about 1–10 times higher than the time that the CPU takes for executing the shortest well-defined micro-operation. Therefore, CPU registers serve as temporary storage areas within the CPU. CPU registers are termed as fast memory and can be accessed almost instantaneously.

Further, the number of bits a register can store at a time is called the length of the register. Most CPUs sold today have 32-bit or 64-bit registers. The size of the register is also called the word size and indicates the amount of data that a CPU can process at a time. Thus, the bigger the word size, the faster the computer can process data.

The different types of CPU registers are as follows:

Accumulator (AC): An accumulator register is required for carrying out operations on data. This register holds the data on which addition, subtraction, shift and logical operations are to be carried out. The result of an arithmetic and logical operation is automatically stored in the accumulator. Thus, it is used for storing results and for performing operations (arithmetic as well as logical) on its contents.

Program Counter (PC): A program counter deals with the order of execution of instructions that are in queue for execution. Thus, it acts as a pointer to the memory location that contains the next instruction to be executed.

Program Counter (PC) contains the address of an instruction to be fetched. It has 12 bits as it also holds a memory address, i.e., the address of the next instruction. Programs are usually sequential in nature. The program counter is updated by the CPU after each instruction is fetched, pointing to the next instruction to be executed. But a branch or skip instruction will modify the contents of the PC to some other value.

Temporary Register (TR): This register is used for holding temporary data generated during processing.

Instruction Register: This register is used for storing instructions.

The instruction fetched from memory is stored in Instruction Register (IR) where the opcode and operand are analysed (operand can be data itself or it can be the address of memory location which store data) and accordingly, control signals are generated by the control unit for the execution of instructions.

Data Register (DR): This register is used to hold data (operand) read from memory.

It acts as buffer storage between the main memory and the CPU. It also stores the operand for the instructions, such as $ADD\ DR\ or\ AC \rightarrow AC+DR$. In other words, contents of AC and DR are added by ALU and the results are stored in the accumulator. Thus, data register can also store one of the input operands.

Address Register (AR): This register is used to hold the address of a memory word.

It is used to provide address of memory location from where data is to be retrieved or to which data is to be stored. Memory Address Register (MAR) has 12-bits as it stores the memory address which is of 12-bit in size.

AR and DR play an important role in the transfer of data between CPU and the memory, i.e., they act as a buffer when the processor wishes to copy information from a register to primary storage, or read information from primary storage to a register. In the computer systems that use a common bus system, AR is directly connected to address bus, while DR is connected to data bus. DR is used for interchanging the data among several other registers

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Input Register (INPR): The input register holds/receives data from an input device.

Output Register (OUTR): It holds data that needs to be sent to output devices.

1.9 GENERAL REGISTER ORGANIZATION

A bus organization for seven CPU registers is shown in Figure 1.34. The output of each register is connected to two multiplexers (MUX) to form the two buses *A* and *B*. The selection lines in each multiplexer select one register or input data for the particular bus. Buses *A* and *B* form the inputs to a common ALU. The operation selected in the ALU determines the arithmetic or logic micro-operations to be performed. The result of the micro-operation is available for the output data and also goes into the inputs of these seven registers. The decoder selects the register that receives the information from the output bus. The decoder activates one of the register load inputs, thus providing a transfer path between the output data bus and the inputs of the selected destination register.

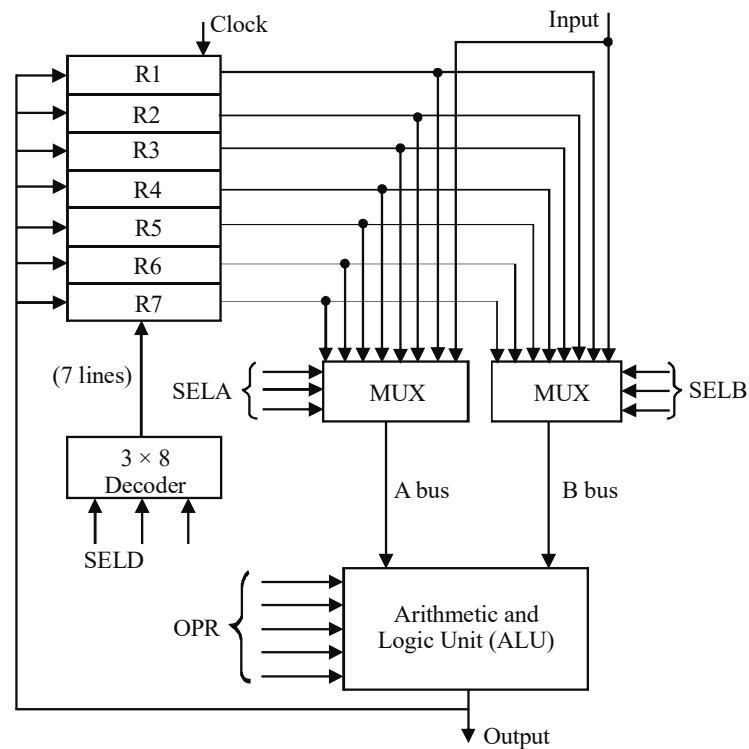


Fig. 1.34 General Register Organization

Let the operation be

$$R1 \leftarrow R2 + R3$$

To perform this operation, the control must provide the following:

- SELA: Place the contents of *R2* into bus *A*
- SELB: Place the contents of *R3* into bus *B*

- ALU operation selector OPR: Provide the arithmetic addition $A + B$
- SELD: Transfer the contents of the output bus $R1$

At the beginning of a clock cycle, the four control selection variables generated by $R2$ and $R3$ must be available in the control unit. Two source registers propagate through the multiplexers and the ALU to the output bus and the input of the destination register during the clock cycle interval. At the next clock transition, information from the output bus is transferred to the destination register $R1$.

NOTES

Register Transfer

A digital system is a sequential logic system in which flip-flops and gates are constructed. The register transfer logic methods focus on how adders, decoders and registers use expressions and statements which resembles the statements used in programming language. High level language C supports register transfer technique for executing applications. It encompasses all types of registers, such as shift registers, counters and memory units. Here, a counter is incremented by one and the memory unit is considered as a collection of storage registers.

In register transfer operations, the straight forward register transfers the data from register to another register temporarily. For example, the data is transferred from register $R3$ to register $R1$. It is shown symbolically as follows:

$$R1 \leftarrow R3$$

The left arrow (\leftarrow) is used to show that data from the right is going to move to the left side register. In the digital system, registers are attached to each other which makes it possible that more than one register can be transferred simultaneously. More registers are separated by comma but they are kept on the same line. It is done in the following way:

$$R1 \leftarrow R3, R2 \leftarrow R5$$

The above statement shows that the contents of register $R3$ are transferred to register $R1$ and the contents of register $R5$ are transferred to register $R2$ at the same time.

Sometimes, register transfer operation depends on certain conditions. For example, register $R1 \leftarrow R3$ takes place only if Boolean variable $k = 1$ is satisfied. In a programming language, it is coded as follows:

$$\text{if } (k=1) \text{ then } R1 \leftarrow R3$$

Inter-register microoperations do not change the information content if the binary data and information moves from one register to another register. The characteristics of microoperations are as follows:

- Arithmetic microoperations perform arithmetic or number operations; logic performs AND, OR, XOR operation; and shift microoperations perform shift register.
- The register is designated by capital letters and sometimes followed by numerals, such as $R1$, $R2$, IR , etc. The flip-flops of an n -bit register are numbered from 1 to n (or from 0 to $n-1$) starting either from the left or from the right.

Simple digital system contains the combinational and sequential circuits. They are characterized as follows:

- The type of registers they contain.
- The operations they perform.

NOTES

Typically, register transfer focuses on the operations of data which are passed into different registers. These operations are called microoperations. The main functions which take place in the register are as follows: Shift, Load, Clear and Increment.

During one clock pulse, the information which is operated and stored in different registers is performed under elementary operation. Table 1.4 shows the transfer functions that are used in transferring registers:

Table 1.4 Transfer Functions that are used in Transferring Registers

Function Name	Purpose	Prototype
__gpr_to_d64	Transfer from general purpose register to floating point register	_Decimal64 __gpr_to_d64 (long long);
__gprs_to_d128	Transfer from general purpose register to floating point register. Transfers a value from a pair of general purpose registers (64-bit mode) or four general purpose registers (32-bit mode).	_Decimal128 __gprs_to_d128 (unsigned long long*upper, unsigned long long*lower);
__d64_to_gpr	Transfer from floating point register to general purpose register. Transfers a value from a floating point register to a general purpose register (64-bit mode) or a general purpose register pair (32-bit mode).	long long __d64_to_gpr (_Decimal64);
__d128_to_gprs	Transfer from floating point register to general purpose register. Transfers a value from a pair of floating point registers to a pair of general purpose registers (64-bit mode) or four general purpose registers (32-bit mode).	void __d128_to_gprs (_Decimal128, unsigned long long*upper, unsigned long long*lower);

In Figure 1.35, $f(R,R)$ function has two parameters which denotes different functions as follows:

f: shift, load, clear, increment, add, subtract, complement, AND, OR, XOR.

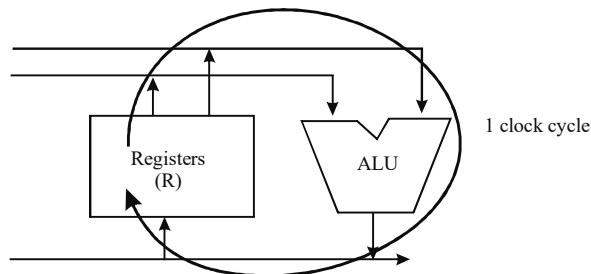


Fig. 1.35 One Clock Cycle of $R \leftarrow f(R, R)$

NOTES

Organization of a Digital System

Digital systems contain the set of registers and their functions in the internal organization of the computer. The main function is that they control signals to initiate the sequence of microoperations to perform the functions. It maintains the way of register transfer on any digital system and therefore it is called register transfer level. The characteristics are as follows:

- It depends on system registers.
- Information/data is transferred on different registers.

Designation of Resistors

Designation of resistors is interrelated with the register transfer facility. It enhances the transferring rate of data which is stored in registers. The characteristics of designation of resistors are as follows:

- Registers are represented by capital letters, such as A, R13, IR.
- The variable names indicate the functions which are used as follows:
 - o MAR indicates Memory Address Register.
 - o PC indicates Program Counter.
 - o IR indicates Instruction Register.

Contents of registers are viewed and designated in various ways. Basically, a register is viewed as a single entity and processes the bits of data it contains.

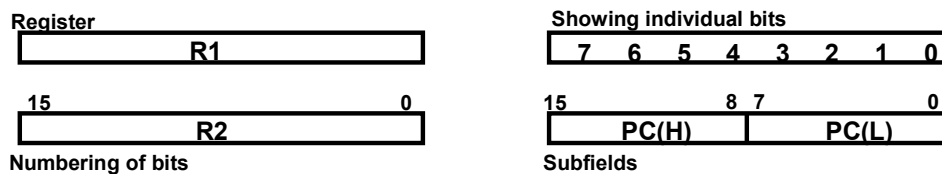


Fig. 1.36 Block Diagram of a Register

In Figure 1.36, $R2 \leftarrow R1$ depicts that the contents of register R2 are copied and loaded into register R1. It transfers simultaneously from the source register R1 to the destination register R2 during one clock pulse. This is called non-destructive method. In this method, the contents of register R1 are not altered during the operation of copying or loading to register R2. It performs step by step. It first copies the contents of one register and then transfers to another register. Let us take another example. A statement is written as follows:

$$R3 \leftarrow R5$$

It implies that the data lines move from the source register R5 to the destination register R3. It loads parallel in the destination register R3. The control lines are used to perform the operation.

Control Functions of Register Transfer

The control functions of register transfer are as follows:

- If a certain condition is true, microoperation is activated as per requirement.
- In register transfer, control function is similar as ‘if’ statement in a programming language.

- Control functions use control signal to perform microoperations. If the control signal comes as 1, the operation takes place.

The statement is represented as follows:

$$P: R2 \leftarrow R1$$

The above statement tells that if $P=1$, then load the contents of register R1 into register R2. This statement is written in programming language as follows:

if ($P=1$) then ($R2 \leftarrow R1$)

Implementation of Controlled Transfer

The control transfer passes the functions via control circuit. It is represented as follows:

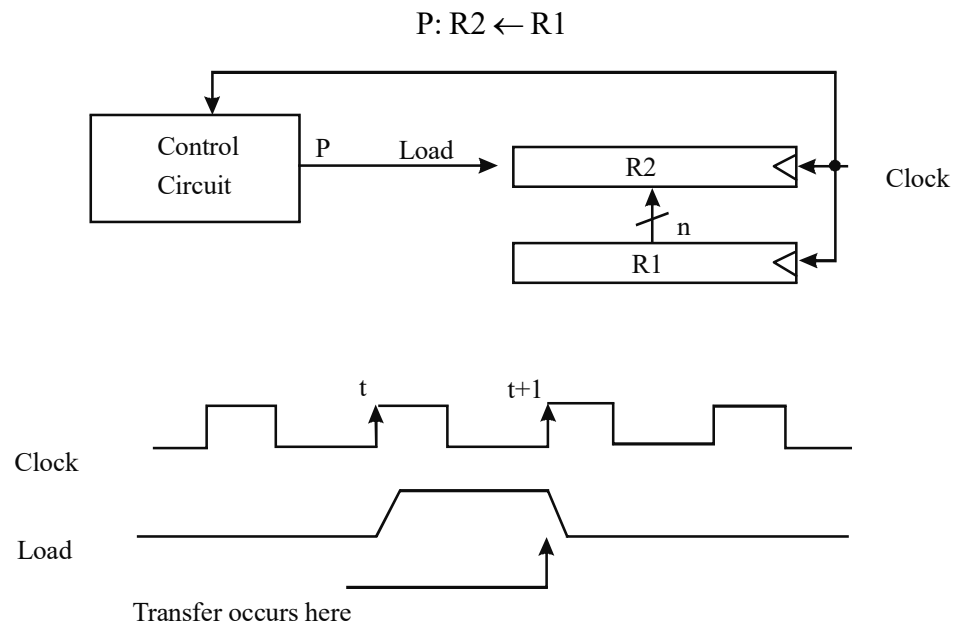


Fig. 1.37 Block and Timing Diagram

Figure 1.37 shows that the same clock controls the circuits that generate the control function. It is incremented by one such as t , $t+1$ and so on and then reaches to the destination register. The transfer occurs in Load process. Registers are assumed to use positive edge triggered flip flops.

There are four types of connections or links between components, such as bus, control, Boolean and miscellaneous. The bus is a general purpose data and control connection passing synchronized information between components. Control connections are used to link the control components and also to invoke activity in other components. Boolean connections are special purpose signals aiding the execution flow by connecting conditions with decision making control components. Finally, there exist miscellaneous connections to connect these register transfer components with external devices.

Table 1.5 Working Registers

Name	Function	Bits	States
W	<u>W</u> -Register	32	–
X	<u>X</u> -Register	32	–
Y	<u>Y</u> -Register	32	–
A	<u>A</u> ddress Register	12	4096
C	<u>C</u> ommand Instruction Register	6	64
PSN	<u>P</u> rogram <u>S</u> tep <u>N</u> umber	8	256
ID	<u>I</u> nformation <u>D</u> ecoder	10	1024
OSP	<u>O</u> utput <u>S</u> tart <u>P</u> oint (Index Register)	5	32

NOTES

Table 1.5 shows the working registers and their functions.

Following are the properties of register transfer:

- Information transfer from one register to another (transfer of the content of register R1 into register R2). The content of the source register R1 does not change after the transfer.
- The transfer occurs only under a predetermined control condition. The transfer operation is executed by the hardware only if P=1.
- A comma is used to separate two or more operations (executed at the same time) 21, 12.

Control Word

The group of binary bits assigned to perform a specified operation is known as control word.

There are 14 binary selection inputs in the units, and their combined value specifies a control word. It consists of four fields as shown in Figure 1.38.



Fig. 1.38 Control Word

Three fields contain three bits each; one field has five bits. The three bits of SELA select a source register for input A of the ALU. The three bits of SELB select a register for input B of the ALU. The three bits of SELD select a destination register using the decoder and its seven load outputs. The five bits of OPR select one of the operations in the ALU.

The 14-bit control word, when applied to the selection inputs, specifies particular micro-operations. The encoding of register selection fields is specified in Table 1.6.

Table 1.6 Encoding of Register Selection Fields

Binary Code	SELA	SELB	SELD
000	input	input	none
001	R1	R1	R1
010	R2	R2	R2
011	R3	R3	R3
100	R4	R4	R4
101	R5	R5	R5
110	R6	R6	R6
111	R7	R7	R7

NOTES

When the 3-bit binary code for SELA or SELB is 000, the respective multiplexer selects the external input data as shown in Figure 1.38, and when the 3-bit binary code for SELD = 000, no destination register is selected and the content of the output bus is for the external output.

The OPR field has five bits. The encoding for the 5-bit OPR field is specified in Table 1.7.

Table 1.7 Encoding of ALU Operation

OPR	Operation	Symbol
00000	Transfer A	TSFA
00001	Increment A	INCA
00010	Addition	ADD
00101	Subtract	SUB
00110	Decrement A	DECA
01000	AND A and B	AND
01010	OR A and B	OR
01100	XOR A and B	XOR
01110	Complement A	COMA
10000	Shift Right A	SHRA
11000	Shift Left A	SHLA

Let the micro-operation given by the statement be

$$R1 \leftarrow R4 \wedge R5$$

This statement specifies R4 for input A of the ALU, R5 for input B of the ALU, and R1 as the destination register. The micro-operation to be performed is the AND operation between R4 and R5.

SELA	SELB	SELD	OPR
R1	R4	R5	AND
001	100	101	01000

Thus, the control word is 001 100 101 01000

Fetching a Word from Memory

To fetch a word of data from memory, the processor gives the address of the memory location in which data is stored on the address bus and activates the read

operation. At this stage, the processor loads the required address in Memory Address Register (MAR) whose output is connected to the address lines of the memory bus.

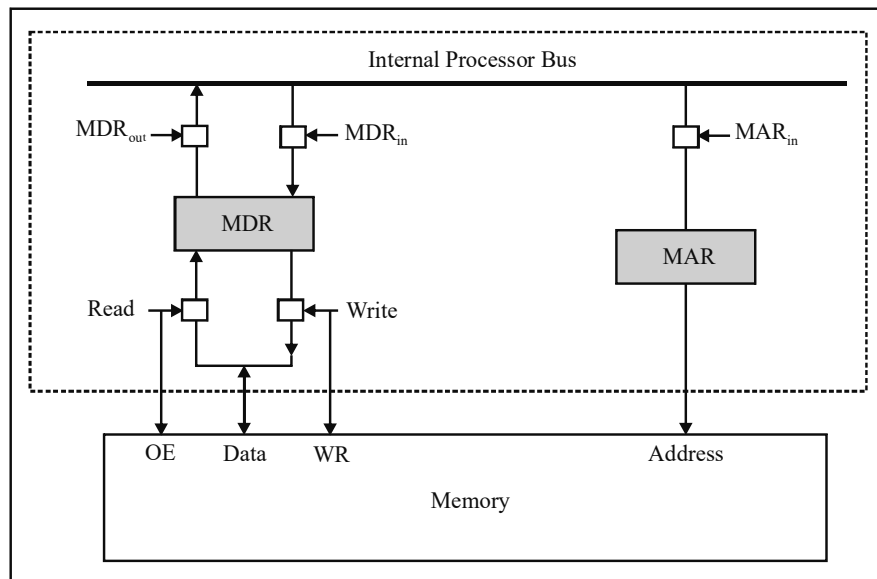


Fig. 1.39 Process to Fetch a Word from Memory

At the same time, processor sends the read signal of memory control bus to indicate the read operation. When requested data is received from the memory it is stored into the Memory Data Register (MDR) from where it can be transferred to other processor registers. MDR is the register of the computer's control unit which contains the data to be stored in the computer storage (RAM) or the data after fetching from the computer storage. Figure 1.39 shows the interface between processor and memory through MAR and MDR registers. The MDR register has four signals in which MDR_{in} and MDR_{out} control the connection to the internal processor data bus and signals Read and Write control the connection to the memory data bus. The MAR register has one control signal. The signal MAR_{in} controls the connection to the internal processor address bus. Control signals Read and Write from the processor control the operations read and write respectively. Let us assume that the address of the memory word to be read is in the register R₂ and we have to transfer data word from that location to the register R₃. This operation can be indicated by instruction MOVE R₃, R₂. The actions needed to execute this instruction are as follows:

- MAR ← [R₂]
- Activate the control signal to perform the Read operation. If memory is slow then wait for Memory Function Complete (MFC).
- Load MDR from the memory bus.
- [R₃] ← MDR

NOTES

NOTES

Let us see the various control signals which are necessary to activate for performing the given actions at each step:

- $R2_{out}$, MAR_{in} , Read
- WMFC
- MDR_{out} , R_3_{in}

Storing a Word in Memory

The five string data transfer instructions are LODS, STOS, MOVS, INS and OUTS. Each string instruction allows data transfers that are either a single byte, word or doubleword (or if repeated, a block of bytes, words or doublewords). Before the string instructions are presented, the operation of the D flag bit (direction), DI and SI must be understood as they apply to the string instructions.

The Direction Flag

The direction flag (D) (located in the flag register) selects the auto increment ($D = 0$) or the auto decrement ($D = 1$) operation for the DI and SI registers during string operations. The direction flag is used only with the string instructions. The CLD instruction clears the D flag ($D = 0$) and the STD instruction sets it ($D = 1$). Therefore, the CLD instruction selects the auto increment mode ($D = 0$) and STD selects the auto decrement mode ($D = 1$).

Whenever a string instruction transfers a byte, the contents of DI and/or SI increment or decrement by 1. If a word is transferred, the contents of DI and/or SI increment or decrement by 2. Doubleword transfers cause DI and/or SI to increment or decrement by 4. Only the actual registers used by the string instruction increment or decrement. For example, the STOSB instruction uses the DI register to address a memory location. When STOSB executes, only DI increments or decrements without affecting SI. The same is true of the LODSB instruction which uses the SI register to address memory data. LODSB only increments/decrements SI without affecting DI.

DI and SI

During the execution of a string instruction, memory accesses occur through either or both of the DI and SI registers. The DI offset address accesses data in the extra segment for all string instructions that use it. The SI offset address accesses data, by default, in the data segment. The segment assignment of SI may be changed with a segment override prefix. The DI segment assignment is always in the extra segment when a string instruction executes. This assignment cannot be changed. The reason that one pointer addresses data in the extra segment and the other in the data segment is that the MOVS instruction can move 64 Kbytes of data from one segment of memory to another.

LODS

The LODS instruction loads AL, AX or EAX with data stored at the data segment offset address indexed by the SI register. (Note that only the 80386 and above use EAX). After loading AL with a byte, AX with a word or EAX with a doubleword, the contents of SI increment, if $D = 0$ or decrement, if $D = 1$. A 1 is added to or subtracted from SI for a byte sized LODS, a 2 is added

or subtracted for a word-sized LODS and a 4 is added or subtracted for a doubleword sized LODS.

Table 1.8 lists the permissible forms of the LODS instruction. The LODSB (loads a byte) instruction causes a byte to be loaded into AL, the LODSW (loads a word) instruction causes a word to be loaded into AX and the LODSD (loads a doubleword) instruction causes a doubleword to be loaded into EAX. Although rare, as an alternative to LODSB, LODSW and LODSD, the LODS instruction may be followed by a byte, word or doubleword sized operand to select a byte, word or doubleword transfer. Operands are often defined as bytes with DB, as words with DW, and as doublewords with DD. The DB pseudo operation defines byte(s), the DW pseudo operation defines word(s) and the DD pseudo operations define doubleword(s).

NOTES

Table 1.8 Forms of the LODS Instruction

Assembly Language	Operation
LODSB	AL = DS:[SI]; SI = SI ± 1
LODSW	AX = DS:[SI]; SI = SI ± 2
LODSD	EAX = DS:[SI]; SI = SI ± 4
LODS LIST	AL = DS:[SI]; SI = SI ± 1 (if LIST is a byte)
LODS DATA1	AX = DS:[SI]; SI = SI ± 2 (if DATA1 is a word)
LODS FROG	EAX = DS:[SI]; SI = SI ± 4 (if FROG is a doubleword)

Note: The segment can be overridden with a segment override prefix as in LODS ES:DATA4.

Figure 1.40 shows the effect of executing the LODSW instruction if the D flag = 0, SI=1000H and DS = 1000H. Here, a 16-bit number stored at memory locations 11000H and 11001H moves into AX. Because D = 0 and this is a word transfer, the contents of SI increment by 2 after AX loads with memory data.

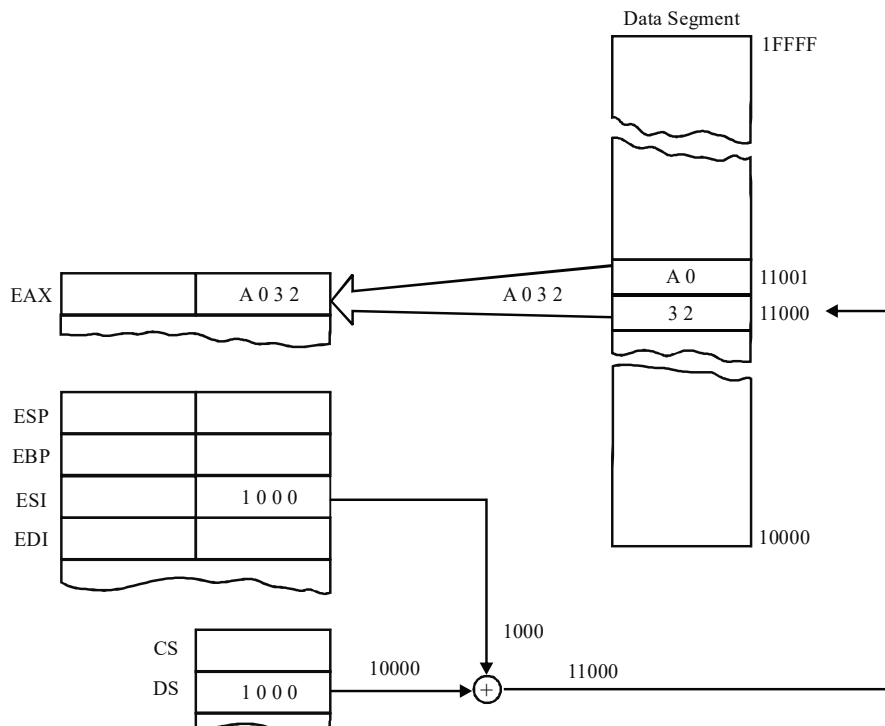


Fig. 1.40 Operation of LODSW Instruction

The operation of the LODSW instruction is executed if DS = 1000H, D = 0, 11000H = 32 and 11001H = A0. This instruction is shown after AX is loaded from memory, but before SI increments by 2.

NOTES

STOS

The STOS instruction stores AL, AX or EAX at the extra segment memory location addressed by the DI register. (Note that only the 80386–Pentium 4 use EAX and doublewords). Table 1.9 lists all forms of the STOS instruction. As with LODS, an STOS instruction may be appended with a B, W or D for byte, word or doubleword transfers respectively. The STOSB (stores a byte) instruction stores the byte in AL at the extra segment memory location addressed by DI. The STOSW (stores a word) instruction stores AX in the extra segment memory location addressed by DI. A doubleword is stored in the extra segment location addressed by DI with the STOSD (stores a doubleword) instruction. After the byte (AL), word (AX) or doubleword (EAX) is stored, the contents of DI increments or decrements.

Table 1.9 Forms of STOS Instruction

<i>Assembly Language</i>	<i>Operation</i>
STOSB	ES:[DI] = AL; DI = DI ± 1
STOSW	ES:[DI] = AX; DI = DI ± 2
STOSD	ES:[DI] = EAX; DI = DI ± 4
STOS LIST	ES:[DI] = AL; DI = DI ± 1 (if list is a byte)
STOS DATA3	ES:[DI] = AX; DI = DI ± 2 (if DATA3 is a word)
STOS DATA4	ES:[DI] = EAX; DI = DI ± 4 (if DATA4 is a doubleword)

STOS with a REP: The repeat prefix (REP) is added to any string data transfer instruction except the LODS instruction. It does not make any sense to perform a repeated LODS operation. The REP prefix causes CX to decrement by 1 each time the string instruction executes. After CX decrements, the string instruction repeats. If CX reaches a value of 0, the instruction terminates and the program continues with the next sequential instruction. Thus, if CX is loaded with a 100 and a REP STOSB instruction executes, the microprocessor automatically repeats the STOSB instruction 100 times. Because the DI register is automatically incremented or decremented after each datum is stored, this instruction stores the contents of AL in a block of memory instead of a single byte of memory. The operands in a program can be modified by using arithmetic or logic operators such as multiplication (*). Other operators appear in Table 1.10.

Table 1.10 Common Operand Operators

<i>Operator</i>	<i>Example</i>	<i>Comment</i>
+	MOV AL, 6+3	Copies 9 into AL
–	MOV AL, 8–2	Copies 6 into AL
*	MOV AL, 4*3	Copies 12 into AL
/	MOV AX, 12/5	Copies 2 into AX (remainder is lost)
MOD	MOV AX, 12 MOD 7	Copies 5 into AX (quotient is lost)
AND	MOV AX, 12 AND 4	Copies 4 into AX (1100 AND 0100 = 0100)
OR	MOV AX, 12 OR 1	Copies 13 into AX (1100 OR 0001 = 1101)
NOT	MOV AL, NOT 1	Copies 254 into AL (0000 0001 NOT equals 1111 1110 or 254)

MOVS

One of the more useful string data transfer instructions is MOVS because it transfers data from one memory location to another. This is the only memory to memory transfer allowed in the 8086 Pentium 4 microprocessors. The MOVS instruction transfers a byte, word or doubleword from the data segment location addressed by source operand SI to the extra segment location addressed by destination operand DI. As with the other string instructions, the pointers then increment or decrement, as dictated by the direction flag. Table 1.11 lists all the permissible forms of the MOVS instruction. Note that only the Source Operand (SI), located in the data segment, may be overridden so that another segment may be used. The DI must always be located in the extra segment.

NOTES

Table 1.11 Forms of the MOVS Instruction

Assembly Language	Operation
MOVSB	ES:[DI] = DS:[SI]; DI = DI ± 1; SI = SI ± 1 (byte transferred)
MOVSW	ES:[DI] = DS:[SI]; DI = DI ± 2; SI = SI ± 2 (word transferred)
MOVSD	ES:[DI] = DS:[SI]; DI = DI ± 4; SI = SI ± 4 (doubleword transferred)
MOVS BYTE1, BYTE2	ES:[DI] = DS:[SI]; DI = DI ± 1; SI = SI ± 1 (if BYTE1 and BYTE2 are bytes)
MOVSW WORD1, WORD2	ES:[DI] = DS:[SI]; DI = DI ± 2; SI = SI ± 2 (if WORD1 and WORD2 are words)
MOVSD DWORD1, DWORD2	ES:[DI] = DS:[SI]; DI = DI ± 4; SI = SI ± 4 (if DWORD1 and DWORD2 are doublewords)

INS

The INS (INput String) instruction (not available on the 8086/8088 microprocessors) transfers a byte, word or doubleword of data from an I/O device into the extra segment memory location addressed by the DI register. The I/O address is contained in the DX register. This instruction is useful for inputting a block of data from an external I/O device directly into the memory. One application transfers data from a disk drive to memory. Disk drives are often considered and interfaced as I/O devices in a computer system.

Table 1.12 Forms of the INS Instruction

Assembly Language	Operation
INSB	ES:[DI] = [DX]; DI = DI ± 1 (byte transferred)
INSW	ES:[DI] = [DX]; DI = DI ± 2 (word transferred)
INSDB	ES:[DI] = [DX]; DI = DI ± 4 (doubleword transferred)
INS LIST	ES:[DI] = [DX]; DI = DI ± 1 (if LIST is a byte)
INS DATA4	ES:[DI] = [DX]; DI = DI ± 2 (if DATA4 is a word)
INS DATA5	ES:[DI] = [DX]; DI = DI ± 4 (if DATA5 is a doubleword)

Note: [DX] indicates that DX contains the I/O device address. These instructions are not available on the 8086/8088 microprocessors.

As with the prior string instructions, there are two basic forms of the INS. The INSB instruction inputs data from an 8-bit I/O device and stores it in the byte-sized memory location indexed by SI. The INSW instruction inputs 16-bit I/O data and stores it in a word-sized memory location. The INSD instruction inputs a

doubleword. These instructions can be repeated using the REP prefix. This allows an entire block of input data to be stored in the memory from an I/O device. Table 1.12 lists the various forms of the INS instruction.

NOTES

OUTS

The OUTS (OUTput String) instruction (not available on the 8086/8088 microprocessors) transfers a byte, word or doubleword of data from the data segment memory location address by SI to an I/O device. The I/O device is addressed by the DX register as it was with the INS instruction. Table 1.13 summarizes the variations available for the OUTS instruction.

Table 1.13 Forms of the OUTS Instruction

Assembly Language	Operation
OUTSB	[DX] = DS:[SI]; SI = SI ± 1 (byte transferred)
OUTSW	[DX] = DS:[SI]; SI = SI ± 2 (word transferred)
OUTSD	[DX] = DS:[SI]; SI = SI ± 4 (doubleword transferred)
OUTS DATA7	[DX] = DS:[SI]; SI = SI ± 1 (if DATA7 is a byte)
OUTS DATA8	[DX] = DS:[SI]; SI = SI ± 2 (if DATA8 is a word)
OUTS DATA9	[DX] = DS:[SI]; SI = SI ± 4 (if DATA9 is a doubleword)

Note: [DX] indicates that DX contains the I/O device address. These instruction are not available on the 8086/8088 microprocessors.

Check Your Progress

18. What is a bootstrap program?
19. What do you mean by bus transfer?
20. What do you understand by memory transfer?
21. What is a data bus?
22. What is the use of control bus?
23. What is Memory Address Register (MAR)?
24. What is the use of absolute address?

1.10 ANSWERS TO ‘CHECK YOUR PROGRESS’

1. In 1842, Babbage came up with his new idea of the Analytical Engine, which was intended to be completely automatic. This machine was capable of performing basic arithmetic functions.
2. Arithmetic Logic Units (ALUs) are not only capable of performing the basic four arithmetic operations, i.e., addition, subtraction, multiplication and division but can also perform logic comparison operations, such as equal to, lesser than or greater than, etc.
3. The function of the control unit is to ensure that the right operation is done on the right data at the right time. The control unit receives instructions and commands from the programs in the primary memory, processes them and ensures that the commands are executed in the desired order by all the other units of the computer system.

4. Tablet PC is a mobile computer that looks like a notebook or a small writing slate but uses a stylus pen or your fingertip to write on the touch screen. It saves whatever you scribble on the screen with the pen.
5. A computer primarily constitutes three integral components, viz. input device, Central Processing Unit (CPU) and output device.
6. The control unit is responsible for the control of various computer operations, which involves accepting instructions, interpreting and processing of this information in the correct parts of the computer.
7. Computer hardware refers to the physical components that make up a computer system. They are the building blocks of personal computers.
8. A computer cannot operate without any instructions and is based on a logical sequence of instructions in order to perform a function. These instructions are known as a 'computer program', and constitute the computer software.
9. The categories of software on the basis of function are:
 - (i) System software
 - (ii) Programming software
 - (iii) Application software
10. Business software is a kind of software is functional in the domain of management and finance. The basic aspect of a business system comprises payroll, inventory, accounting and software that permit users to access relevant data from the database. These activities are usually performed with the help of specialized business software that facilitates efficient framework in the business operation and in management decisions.
11. The full form of COTS is Commercial Off-The Shelf.
12. The I/O devices that provide a means of communication between the computer and the outside world are known as peripheral devices.
13. Input devices are used to transfer user data and instructions to the computer.
14. Scanning devices are input devices used for direct data entry from the source document into the computer system.
15. Hand-held scanners are used where the information to be scanned or the volume of documents to be scanned is very low.
16. The CRT monitor creates a picture out of many rows or lines of tiny colored dots.
17. Dot matrix printers use a print head consisting of a series of small metal pins that strike on a paper through an inked ribbon, leaving an impression on the paper through the ink transferred.
18. When the system originally is turned on, it runs a well-defined set of initial programs known as bootstrap program. The bootstrap program is typically stored in Read Only Memory (ROM) or Electrically Erasable Programmable ROM (EEPROM).
19. A shared communication path consisting of one or more connection lines is known as a bus and the transfer of data through this bus is known as bus transfer.

NOTES

NOTES

20. When data is read from or stored in memory, it is referred to as memory transfer.
21. A bidirectional bus for carrying data between two units is called a data bus.
22. Control bus is used to indicate the direction of data transfer and to coordinate the timing of events during the transfer.
23. The address of the location in which the word is to be stored is loaded by the CPU into a specified register called Memory Address Register (MAR).
24. An absolute address specifies an address in memory in a unique way.

1.11 SUMMARY

- The first mechanical adding machine was invented by Blaise Pascal in 1642. Later, in 1671, Baron Gottfried Wilhelm von Leibniz of Germany invented the first calculator.
- Herman Hollerith came up with the concept of punched cards, which were extensively used as an input medium in mechanical adding machines.
- The Electronic Numerical Integrator And Computer (ENIAC) was the first electronic computer developed for military requirements and was used for many years to solve ballistic problems.
- The Universal Automatic Computer (UNIVAC) was the first digital computer to be installed in the Census Bureau in 1951 and was used continuously for 10 years.
- A computer is a programmable machine designed to automatically process a sequence of various arithmetic or logical operations. The interface between the computer and the human operator is known as the user interface.
- Peripheral devices allow information to be entered from an external source and allow the results of operations to be sent out.
- A Central Processing Unit or CPU executes a series of instructions to read, manipulate and store the data.
- The control unit, Arithmetic Logic Unit or ALU, memory registers and basic Input/Output or I/O devices are collectively known as a Central Processing Unit or CPU.
- Computers can be classified on the basis of their size, processing speed and cost. The various types of computers are personal computers, workstations, notebook/laptop computers, tablet PC, PDA, mainframe computers and supercomputers.
- Analog computers are generally used in industrial process controls and to measure physical quantities, such as pressure, temperature, etc. An analog computer does not operate on binary digits to compute.
- A digital computer stores data in the form of digits (numbers) and processes. It is in the discrete form from one state to the next.
- Hybrid computers are the combination of digital and analog computers. A hybrid computer uses the best features of digital and analog computers. It helps the user to process both continuous and discrete data.

- A mainframe system consists of several computers, such as a host computer that carries out most of the computations and has direct control over all other computers.
- Computers have undergone great transformation over the past decade; however, the basic logical structure remains the same.
- Programs and data are required to be present in a computer system before any operation can be performed.
- The input unit is responsible for transferring data and instructions from the external environment into the computer system.
- The central processing unit is known as the brain of the computer. It includes the control unit, the ALU and the primary memory.
- The primary storage also temporarily stores any intermediate result generated by the ALU.
- Computers understand process data and return the output in a binary form. The basic function of the output unit is to convert these results into a human-readable form before providing the output through various output devices, such as terminals and printers.
- The storage capacity of the primary memory of the computer is limited. Often, it is necessary to store large amounts of data. So, additional memory, called secondary storage or auxiliary memory is used in most computer systems.
- Secondary storage is storage other than the primary storage. These are peripheral devices connected to and controlled by the computer to allow permanent storage of data and programs
- Computers are very fast. They can process millions of instructions every second. The speed is related to the amount of data it processes and the time it takes to complete the processing task.
- The main PCB (Printed Circuit Board) is sometimes alternatively known as a logical board or a main board of a Personal Computer.
- The primary function of the computer is executing programs. The programs or the set of instructions are stored in the computer's main memory and are executed by the CPU.
- Computer hardware refers to the physical components that make up a computer system. They are the building blocks of personal computers. These are typically installed into a computer case, or attached to it by a cable or through a port.
- The sequences of instructions are based on algorithms that provide the computer with instructions on how to perform a function.
- Keyboard devices are typically classified as general-purpose keyboards and special-purpose keyboards.
- The most familiar means of entering information into a computer is through a typewriter-like keyboard that allows a person to enter alphanumeric information directly.

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- The most popular keyboard used today is the 101 key with a traditional QWERTY layout, with an alphanumeric keypad, 12 function keys, a variety of special function keys, numeric keypad, and dedicated cursor control keys. It is so called because the arrangement of its alphanumeric keys in the upper-left row.
- The trackball is a pointing device that is much like an inverted mouse. It consists of a ball inset in a small external box or adjacent to, and in the same unit, as the keyboard of some portable computers.
- A LCD is one of the most widely used flat panel displays since it is lightweight and occupies less space than conventional CRT displays.
- Characters are formed by heated elements being placed in contact with special heat sensitive paper forming darkened dots when the elements reach a critical temperature.
- When the system originally is turned on, it runs a well-defined set of initial programs known as bootstrap program. The bootstrap program is typically stored in Read Only Memory (ROM) or Electrically Erasable Programmable ROM (EEPROM).
- A shared communication path consisting of one or more connection lines is known as a bus and the transfer of data through this bus is known as bus transfer.
- When data is read from or stored in memory, it is referred to as memory transfer.
- A bidirectional bus for carrying data between two units is called a data bus.
- Control bus is used to indicate the direction of data transfer and to coordinate the timing of events during the transfer.
- The address of the location in which the word is to be stored is loaded by the CPU into a specified register called Memory Address Register (MAR).
- An absolute address specifies an address in memory in a unique way.
- The program to be executed is a set of instructions that is stored in the computer's memory. Tasks are completed when the instructions of the program are executed by the Central Processing Unit (CPU).
- The control unit is necessary if the CPU is to function efficiently and information/data is to be transferred between the CPU and other devices. It does not perform the actual processing of the data, but manages and coordinates the entire computer system, including the input and, output devices.
- The Arithmetic Logic Unit or ALU provides arithmetic and logic operations. This means that when the control unit encounters an instruction that involves an arithmetic operation (add, subtract, multiply, divide) or a logic operation (equal to, less than, greater than), it passes control to the ALU.
- A digital system is a sequential logic system in which flip-flops and gates are constructed. The register transfer logic methods focus on how adders, decoders and registers use expressions and statements which resembles the statements used in programming language.

1.12 KEY TERMS

- **Personal Digital Assistant:** A small palm sized hand-held computer that has a small colour touch screen with audio and video features.
- **Inputting:** The process in which the user puts in a set of commands to process data into the computer system.
- **Storing:** The process of recording data and information so that it can be retrieved for use whenever required.
- **Processing:** This process implies performing arithmetic or logical operations on data to convert them into useful information.
- **Arithmetic Operations:** These include addition, subtraction, multiplication and division, and logical operations include comparisons such as equal to, less than and greater than, etc.
- **Outputting:** This is the process of providing results to the user. These can be in the form of visual display and/or printed reports.
- **Controlling:** This refers to directing the sequence and the manner in which all the previous functions are carried out.
- **Input Devices:** These are the devices used for entering information in the computer.
- **Output Devices:** These are the devices used for getting out information from the computer.
- **Joystick:** It is a vertical stick that moves the graphic cursor in the direction the stick is moved.
- **Scanning Devices:** These are input devices used for direct data entry from the source document into the computer system.
- **Bus Structures:** A shared communication path consisting of one or more connections lines.
- **CPU:** The unit considered as the brain of a computer and responsible for the major task of data processing operations in the computer system.
- **ALU:** The unit that does the arithmetic and logic operations needed for executing instructions.

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1.13 SELF-ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Write one drawback of ENIAC.
2. What do you understand by computer generation?
3. What are supercomputers?
4. Define the term notebook and laptop computers.
5. What is a computer?

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6. How the memory is classified?
7. What is computer software and why is it required?
8. Name the types of computer software.
9. What is the database management software?
10. Why does an organization use computers?
11. What is a general-purpose keyboard?
12. How does a mouse work?
13. What is the purpose of CRT terminals?
14. What is the advantage of an LCD display over other displays?
15. Where are impact printers mostly beneficial?
16. What do you mean by interrupt vector?
17. What is an address bus?
18. What is a program counter?
19. What do you mean by instruction set?

Long-Answer Questions

1. Discuss the development of computers with suitable examples.
2. Explain the salient features of fourth- and fifth- generation computers.
3. What do you understand by personal computers? How would you differentiate a personal computer from a workstation?
4. Describe the basic tasks that can be performed by a computer system.
5. Why is memory required in the computer? Explain.
6. Describe any three computer software and their uses.
7. Describe the advantages of word processing application.
8. Describe the various basic types of input and output devices.
9. Discuss the various special function keys of a keyboard.
10. Explain the significance and applications of scanning devices.
11. Explain the functioning of an optical bar code reader.
12. Describe the working of a plasma display.
13. Explain the various types of printing devices.
14. How is a laser printer different from an inkjet printer? Explain.
15. Explain the general register organization giving appropriate examples.

1.14 FURTHER READING

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UNIT 2 OPERATING SYSTEMS

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2.0 INTRODUCTION

In this unit, you will learn about the basic concepts of operating system. An Operating System (OS) is software that manages computer hardware resources and provides common services for computer programs. The operating system is an essential component of the system software in a computer system. Application programs usually require an operating system to function. The various types of operating system are also being discussed in this unit. You will also learn about the basic concepts of MS Windows and the various commands of DOS.

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2.1 OBJECTIVES

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

- Understand the basic concept of operating system
- Describe the functions of an operating system
- Discuss the various types of operating systems
- Explain the various DOS commands
- Discuss the components of MS Windows

2.2 OPERATING SYSTEM BASICS

An operating system is a set of instructions stored on a storage device, such as hard disk, Compact Disk Read Only Memory (CD-ROM) or floppy disk. When you switch on a computer, a set of power-on routine activities is performed. These power-on routine activities verify the devices attached to the Central Processing Unit (CPU), such as keyboard, hard disk, floppy disk, CD-ROM and printers for their proper functioning. The instructions for these power-on routine activities are stored in the Read Only Memory (ROM). ROM is permanent in nature and stores the data even when the power is switched off. However, ROM stores only a few kilobytes of instructions due to its limited size. As a result, the power on routine activities are stored permanently in the hard disk as operating system and are transformed from the hard disk into the Random Access Memory (RAM) on booting the computer.

RAM also called main memory, which is volatile in nature and as a result, the programs and instructions are temporarily stored in it and are lost on power failure. Secondary memory, such as hard disk is non-volatile and thus retains information even in case of power failure. For example, you are working in Microsoft Word and not saving your content in the main memory, the content will be erased from the main memory if the computer is switched off. When the contents are saved in a file, they are transferred into secondary memory.

An operating system is loaded into the computer memory in the following two ways:

- Loaded from Boot ROM.
- Loaded from the hard disk when the computer is switched on.

2.2.1 Services of an Operating System

An operating system acts as a platform for developing the application programs. The major services provided by an operating system are as follows:

- It acts as an extended machine.
- It acts as a resource manager.
- It acts as a constant application program interface.

An operating system acts as an extended machine by translating your

commands into machine language instructions. The CPU executes these machine language instructions and the operating system retranslates the output back into a user understandable language.

An operating system acts as a resource manager by controlling and allocating various hardware and software resources to different users in an optimal and efficient mode. The task of resource management becomes essential in multiuser operating systems where different users compete for the same resources. An operating system manages the resources in the following two ways:

- Time multiplexing
- Space multiplexing

Time multiplexing defines the sharing of resources based on fixed time slices. For example, the operating system allocates a resource, such as CPU to program A for a fixed time slice. When the time slice is over, the CPU is allocated to another program B. If program A needs more CPU attention, then the CPU is again allocated to program A after the time slice allocated to program B is over.

Space multiplexing defines the concurrent sharing of resources among different programs. Sharing of a hard disk and main memory are examples of space multiplexing.

An operating system acts as a constant application program interface that allows you to develop an application on a computer and execute it on another computer. It does not produce any dissimilarity if the configuration of the two computers is different, as the application remains the same. For example, the Windows 98 operating system provides such kind of flexibility. It can hold different disk drives, printers and peripherals produced by different vendors. There are some other functions of an operating system which are as follows:

- It controls the device drivers attached to the computer.
- It acts as a command interpreter.
- It decides the priority of various jobs.
- It performs the allocation and reallocation of memory.
- It performs the Input/Output (I/O) operations.
- It provides security by ensuring controlled access to resources.
- It controls the local and remote files placed on a computer.
- It monitors various jobs running on a computer for their security.
- It allows different processes to communicate with each other through message passing techniques.
- It performs system accounting that monitors the use of system resources.

2.3 FUNCTIONS OF OPERATING SYSTEM

An operating system manages files, resources and CPU utilization that a user needs to perform various tasks. An operating system performs the following

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functions:

- **Process Management:** It is a process that helps in managing processes. A process is a set of sequential steps for performing a task. In other words, for an operating system, a process is an instance of a program. Process management is necessary for proper execution of any program.
- **Memory Management:** It is a process which manages storage system of a computer. The organization and management of a computer storage system is important for an operating system. An operating system allocates memory to the various processes.
- **Resource Management:** The I/O subsystem is required to monitor and manage wide variety of I/O devices. These I/O devices vary with respect to their functionality, data rate, speed and software support.

2.3.1 Process Management

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

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

2.3.2 Memory Management

A computer uses two types of storage, main memory and secondary memory. The main memory stores temporarily the instructions to be executed by the computer. The CPU of a computer retrieves instructions from main memory for execution. On the other hand, secondary memory is constituted by various secondary storage devices, such as magnetic disks and magnetic tapes which store information permanently in the form of files.

Main memory, RAM, is the temporary read/write memory of a computer but faster than the secondary storage device. Main memory is a set of locations defined by sequentially numbered addresses for storing programs for execution and each location contains a binary number. You can access each byte of RAM directly without reading the previous bytes sequentially. Each byte in a RAM has an address. The addresses are usually sequential hexadecimal numbers. Mostly, the addresses of RAM start from 00000.

2.3.3 Memory Management Strategies

To improve utilization of the CPU and the speed of the computer's response to its users, the system keeps several processes in memory, that is, several processes share memory. Due to the sharing of memory, there is need of memory management. There are various strategies that are used to manage memory. All these strategies allocate memory to the processes using either of following two approaches.

- Contiguous memory allocation
- Noncontiguous memory allocation

Contiguous Memory Allocation

In contiguous memory allocation, each process is allocated a single contiguous part of the memory. The memory management scheme that is based on this approach is memory partitioning.

Noncontiguous Memory Allocation

In noncontiguous allocation approach, parts of a single process can occupy noncontiguous physical addresses.

Paging

In paging, the physical memory is divided into fixed sized blocks called **page frames** and logical memory is also divided into fixed size blocks called **pages** which are of same size as that of page frames. When a process is to be executed, its pages can be loaded into any unallocated frames (not necessarily contiguous) from the disk.

2.3.4 Resource Management

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

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

2.4 CLASSIFICATION OF OPERATING SYSTEM

All operating systems consist of similar components and perform almost similar functions, but the methods and procedures for performing these functions are different. Operating systems are classified into following different categories based on their distinguishing features:

- Single user operating systems
- Multiuser operating systems

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- Batch processing or job scheduling operating systems
- Multiprogramming operating systems
- Multitasking operating systems
- Parallel operating systems
- Distributed operating systems
- Real time operating systems

2.4.1 Single User Operating Systems

It allows a single user to access a computer at a time. These computers have single processor and execute single program. The resources, such as CPU and I/O devices are constantly available to the user in a single user operating system for operating the system. As a result, the CPU sits idle for most of the time and is not utilized to its maximum. A single user operating system is divided into two categories:

- Single user, single tasking operating system
- Single user, multitasking operating system

The single user, single tasking operating system allows a single user to execute one program at a time. MS DOS and Palm OS for Palm handheld computers are examples of single user, single tasking operating system.

Single user, multitasking operating system allows a single user to operate multiple programs at the same time. For example, you can perform calculations in Excel sheet, print a Word document and download a file from the Internet concurrently. Mac OS, Windows 95, Windows 98, Windows NT Workstation and Windows 2000 Professional operating systems for desktop and laptop computers are the examples of single user, multitasking operating system.

A single user operating system executes an application program of a user through hardware interaction and gives the result back to the user.

2.4.2 Multiuser Operating Systems

It allows various users to access the different resources of a computer simultaneously. The access is provided using a network that consists of various personal computers attached to a mainframe computer. These computers send and receive information to a multiuser mainframe computer. Therefore, the mainframe computer acts as a server and the other personal computers act as clients for that server. UNIX, Virtual Memory System or VMS, Multiple Virtual Storage or MVS, Windows 2000 and Novell NetWare are the examples of multiuser operating systems.

The advantage of using multiuser operating system is that it facilitates the sharing of data and information among different users. Hardware resources, such as printers and modems are also shared using the multiuser operating system.

The limitation of using a multiuser operating system is the expensive hardware required for mainframe computer. Another limitation is that it reduces the performance of the computer as multiple users work on it.

2.4.3 Batch Processing or Job Scheduling Operating Systems

The batch processing operating system places the user's jobs on an input queue and these jobs are stored as a batch. The batch monitor executes these batches at a

definite interval of time. The batch monitor accepts the commands for initializing, processing and terminating a batch. These jobs are executed through interaction with the hardware and the operating system and gives the output back to different users. The batch processing operating system automatically executes the next job in the batch and reduces user intervention during the processing of jobs.

2.4.4 Multiprogramming

Multiprogramming allows multiple users to execute multiple programs using a single CPU. The multiprogramming operating system executes different processes concurrently using a time multiplexed CPU by implementing the concept of CPU slicing between them. CPU time slicing enables operating systems to execute multiple jobs concurrently. The CPU switching between the programs is so fast that the response time for users is fractions of seconds. The operating system uses an interactive computer system that provides shared access to different resources. The operating system stores multiple jobs in main memory and CPU immediately switches to the next job in sequence, when the previous executing process comes in wait stage. The previous executing process comes in wait stage due to an interrupt or requirement of I/O operations. Therefore, a multiprogramming operating system increases the utilization of CPU by reducing its idle time. UNIX, Windows 95, Windows NT, OS/2 and Amiga are examples of multiprogramming operating systems.

2.4.5 Multitasking Operating Systems

Multitasking operating systems support the concept of multitasking. Multitasking is the ability of a system to handle number of tasks or jobs simultaneously. A multitasking operating system is also called time sharing system with the multiprogramming feature. A time sharing system contains multiple user terminals that are connected to the same system to work simultaneously. The multiprogramming feature of the time sharing system allows multiple programs to reside in main memory and various scheduling algorithms are used to allocate CPU time to the processes. The time interval during which a user process gets the CPU allocation is known as time slice, time slot or quantum. The CPU executes a process until the allotted time slice expires.

2.4.6 Parallel Operating Systems

It consists of multiple processors sharing the clock, bus, memory and peripheral devices. Parallel operating systems are also known as multiprocessor or tightly coupled operating systems. Multiprocessor systems are divided into following categories:

- Symmetric multiprocessing
- Asymmetric multiprocessing

In symmetric multiprocessing, each processor runs a shared copy of operating system. The processors can communicate with each other and execute these copies concurrently. Thus, in a symmetric system all the processors share an equal amount of load. Encore's version of UNIX for the Multimax computer is an example of symmetric multiprocessing system. In this system, various processors execute copies of UNIX operating system, thereby executing m processes if there are m processors.

2.4.7 Distributed Operating Systems

In this type of operating system, user requests are processed independently at more than one location, but with shared and controlled access to some common facilities. A

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system which consists of multiple parts located at or embedded in geographically dispersed physical locations is called a distributed system. In other words, in a distributed system the workload is spread between two or more computers linked together by a communication network.

Different computers communicate with each other using communication links, such as telephone lines and buses. Heterogeneous computers include computers with different configurations, such as workstations, microcomputers, minicomputers and mainframe computers. These computers are referred to as nodes. The processors in distributed operating system do not share clock, memory and peripheral devices. Each processor has its own resources. Distributed operating systems are also known as loosely coupled systems. Amoeba is an example of distributed operating system which is a collection of workstations in a transparent distributed system. Amoeba is being widely used in the field of academia, industry and government for the last five years. It runs on the Scalable Processor ARChitecture or SPARC, Sun 3/50 and Sun 3/60 operating systems.

The design of distributed operating systems is based on following two models:

- Client-Server model
- Peer-to-Peer model

2.4.8 Real Time Operating Systems

It defines the completion of job within the rigid time constraints otherwise the job loses its meaning. The human brain works on the principle of real time operating system. Real time operating systems are used in medical imaging systems, airline reservation systems, home appliances controller systems and nuclear weapon systems. Examples of real time operating systems are VxWorks and QNX. Real time operating systems are divided into following two categories:

- Hard real time systems
- Soft real time systems

2.4.9 Timesharing

A multiprogrammed batch system does not permit real time interaction between users and computer as the user commands needed for executing jobs are prepared as scripts of Job Control Language (JCL) and submitted to the batch system. As users are not permitted to submit the job script input and observe or take output directly, it took many days to debug and correct the mistakes in program development. The solution to the above problem was the introduction of *Interactive Time Shared Multiprogramming* techniques. This enabled many users to interact with the computer system simultaneously, each one using a separate terminal keyboard and monitor connected to the system.

2.5 SOFTWARE

The hardware alone cannot perform any particular calculation or manipulation without being instructed exactly what to do and how to do it. These set of instructions are as important, if not more, than the hardware, and are called software. The software acts as an interface between the user and the computer. Software or a program can

be defined as a complete set of instructions written by the programmer which enables the computer to obtain the solution to a problem (with or without the data). Software is a general term that is used to describe any single program or a group of programs. The software used by a computer may be classified into application software, system software and utility software.

(a) System Software

They consists of all the programs, languages and documentation supplied by the manufacturer with the computer. These programs allow the user to communicate with the computer and write or develop his own programs. This software makes the machine easier to use and makes an efficient use of the resources of the hardware possible. System software are programs held permanently on a machine, which relieve the programmer from mundane tasks and improve resource utilization. MS DOS or Microsoft Disk Operating System was one of the most widely used system software for IBM compatible microcomputers. Windows and its various versions are popular examples of system software today. System software are installed permanently on a computer system used for daily routine work.

(b) Application Software

These are software programs installed by users to perform tasks according to their specific requirements, such as an accounting system used in a business organization or a designing program used by engineers. They also include all the programs, languages and other utility programs. These programs enable the user to communicate with the computer and develop other customized packages. They also enable maximum and efficient usage of the computer hardware and other available resources.

Check Your Progress

1. What does single user operating system executes?
2. What is the function of batch processing operating system?
3. What is distributed system?
4. Write an example of a hard real time system.

2.6 INTRODUCTION TO DOS

Microsoft Disk Operating System (MS DOS) is a single user, single tasking operating system. DOS has a command line, text based/non graphical user interface commonly referred as Character based User Interface (CUI). When the computer is switched on, a small program checks all internal devices, electronic memory and peripherals. Once this process is completed, MS DOS is loaded.

- **DOS Prompt:** The DOS prompt, known as the command prompt, looks like C:\> or D:\> where 'C', 'D' represent the hard drives of the computer system. All commands are typed at the DOS prompt. **Enter** key is pressed to view the output of the typed command. If the command is correctly typed, desired output would be displayed, otherwise an error message (Bad Command or Filename/Invalid Parameter) is displayed on the screen.

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NOTES**Limitations of MS DOS**

Following are the limitations of MS DOS:

- It has a text based user interface where the commands have to be typed for each operation that the user wants to perform. The user is expected to remember the commands as well as their syntax.
- It is a single user, single task operating system and the working is limited to one megabyte of memory. 640 KB of the memory is used for the application program.
- It does not allow using long file names. The user is restricted to eight character file names with three character extensions.

All DOS commands are case insensitive (i.e., there is no difference whether you type COPY, copy or coPY). The same is true for the attributes, parameters and filenames. To view the complete description of each command type HELP followed by the command name, e.g., HELP COPY. Alternatively help can also be displayed using <command>/? (COPY/?).

2.6.1 DOS Architecture

Monolithic architecture consists of a single layer that performs all the functions of the operating system. The concept of information hiding is absent altogether in the monolithic architecture, therefore you are able to observe and call the procedures of different users. MS DOS and Novell NetWare operating systems are examples of monolithic architecture.

In monolithic architecture, the operating system provides services to the users in the form of system calls. These system calls provide functions, such as positioning of procedural parameters on the stack and executing trap instruction. This instruction transfers the control to the operating system by swapping the control from user mode to kernel mode.

The operating system checks the parameters and calls the service procedure which in turn calls the utilities. Utilities return the control back to the user program in user mode. The flow of arrows shows the transfer of user program from the user mode to the kernel mode through system calls. Limitations of an operating system, using monolithic architecture are as follows:

- Difficult to modify as the whole operating system has to be redesigned.
- Failure of a single program crashes the entire system.

Layered architecture categorizes the operating system into different layers which communicates using standard function calls. Each new layer is built on the top of an older layer.

The higher level layers call the set of functions and data structures of lower layers. The various layers of an operating system are as follows:

- Hardware Layer
- Kernel
- Service Layer
- Applications/Shell

2.6.2 Internal and External DOS Commands

Simple DOS Commands

Table 2.1 summarizes the list of simple DOS commands.

Table 2.1 List of Simple DOS Commands

Command	Syntax	Explanation	Example	Notes
COMMAND	COMMAND	Starts a new Window for the DOS command interpreter.	C:\>COMMAND	Starts a new Window for the DOS command interpreter.
EXIT	EXIT	Quits the <u>COMMAND.COM</u> program (command interpreter).	C:\>EXIT	Quits the command interpreter.
CLS	CLS	Clears the screen display completely leaving only the DOS prompt.	C:\>CLS	Clears the screen and displays C: Prompt at the top of the screen.
DATE	DATE	Displays the system's current date and prompts to enter the new date.	C:\>DATE	Current date is Fri 20-01-2012 Enter new date <mm-dd-yy>:
TIME	TIME	Displays the current time and prompts the user to enter the new time.	C:\>TIME	Current time is 12:55:25. Enter new time <hh-mm-ss>
VER	VER	Displays the windows version.	C:\>VER	Displays the Windows version installed on your computer.
HELP	HELP <Command Name> or Command Name/?	Provides complete, information about queried MS DOS commands.	C:\>DATE/?	Complete information about the DATE command is displayed.
DOSKEY	DOSKEY	Edits lines of command, recalls commands of MS DOS and creates macros.	C:\>DOSKEY	Once the Doskey is installed then Up and Down arrow keys can be used in the subsequent commands to recall the previous commands.
PROMPT	PROMPT [Text]	Changes the MS DOS command prompt to the specified text. If the command is typed without any parameters then the default prompt	D:\>PROMPT	Changes the prompt to the default setting.
PRINT	PRINT <Filename>	Prints a text file while other MS DOS commands are being used.	C:\>DATA> PRINT TEMP.TXT	Prints 'TEMP.TXT' stored in the 'DATA' folder of the C: drive.
LABEL	LABEL	Makes, changes or deletes the label of volume of a disk.	C:\>LABEL	Displays the current volume label and volume serial number. Also prompts to enter a new label.
MEM	MEM	Displays the amount of and free and used memory in your system.	C:\>MEM	Displays the total amount of memory, amount of used and free memory in the system.
MORE	MORE <Filename>	Displays output on the screen at a time for the text files. Useful in cases where the content of text file does not fit in a single screen.	C:\>DATA> MORE TEMP.TXT	Breaks the contents of 'TEMP.TXT' in multiple screens. Subsequent screens can be viewed by pressing the 'Enter' key.
ECHO	ECHO	Displays messages, or turns on or off the echoing command.	C:\>ECHO	Displays the current echo setting. ('OFF' or 'ON')
EDIT	EDIT	Starts MS DOS editor, which produces and changes ASCII files.	C:\>EDIT	Opens the MS DOS Editor.
SET	SET	Displays, sets or removes MS DOS environment variables.	C:\>SET	Displays the settings for the current environment variables.
CHKDSK	CHKDSK <Drive-Name>	Checks a disk and gives the information like how many bytes have been used and how many are free and if any bad sectors are there on the disk.	C:\>CHKDSK A:	Checks A: drive and gives information about the disk.
SCANDISK	SCANDISK <Drive-Name>	Finds errors from a drive and fixes any problem it encounters.	C:\>SCANDISK A:	Scans the A: drive and repairs the disk if any problem is there, like damaged area or virus, etc.
DISKCOPY	DISKCOPY	Copies the content of one floppy disk to another.	C:\>DISKCOPY A:	Copies the entire content of one floppy to another.
FORMAT	FORMAT <Drive-Name>	Formats the specified drive.	C:\>Format A:	Floppy inserted in the A: drive will be formatted. Any information in the floppy A: will be erased.

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2.7 INTRODUCTION TO WINDOWS OPERATING SYSTEM

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Windows XP is a line of proprietary operating systems which was developed by Microsoft and is meant to be used for general purpose computers, such as home computers and business desktops, notebook computers and various other types of media centres. Windows XP succeeds Windows 2000 and Windows ME, and is the first consumer oriented operating system produced by Microsoft to be built on the Windows NT kernel and architecture. The most popular operating systems versions are Windows XP Home Edition which is primarily meant for home users and Windows XP Professional, which possesses additional features, such as support for Windows Server domains and dual processors, and is meant for professionals and other experts. Windows XP Media Center Edition has additional multimedia features. Windows XP has an edge over the earlier versions of Microsoft Windows because of enhanced efficiency and better stability.

Windows XP helps you to access and manage your files on the PC using a Graphical User Interface or GUI. All Programs and files stored on the PC are represented as pictures that are called icons. These icons are stored on the desktop.

2.7.1 Components of Windows XP

The Windows XP user interface consists of various components and concepts that help make Windows XP user friendly and intuitive. We will discuss these components and their uses in Windows XP in this unit. Some important ideas that we will discuss are:

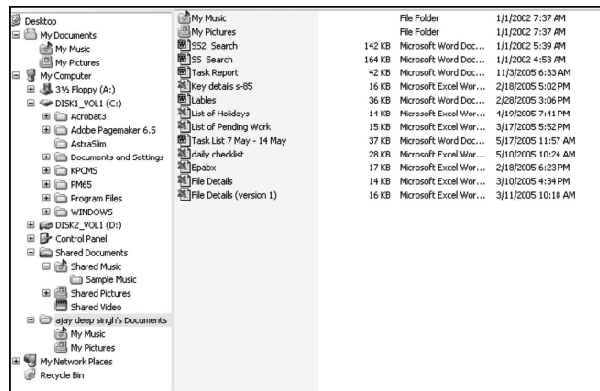
- *Desktop*
- *Windows*
- *Start Menu*
- *Applications*
- *Taskbar*
- *Folders*
- *Icons*
- *Files*
- *Recycle Bin*
- *Control Panel*

2.7.2 Windows Explorer — Managing Files and Folders

Windows is responsible for maintaining all your files and subfolders on your disk. You are aware by now that you store information in individual files. Groups of files on a common subject can be kept in a specially earmarked place called a Folder. Similarly in your computer, you have a storage area called the hard disk drive. Again, theoretically, you can dump all your files into one place. However, this would pose certain problems. Each time you want to access a particular file, it would take you a considerable amount of time. Neither it is feasible to open each and every file in

your system to check whether it pertains to the subject nor could the naming of a file can describe its content. Therefore, obtaining a particular file could be a difficult if all your files reside in one place without any file management. Fortunately, there is a simple way out. You can divide your total hard disk space into a number of smaller units called folders and subfolders. Now, you can store all the files pertaining to a particular topic without bothering too much about individual file names. However, it is still preferable that the file names make some sense with their contents.

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Basically, all the files are maintained on your hard disk in the form of an inverted tree like structure. At the top is the root folder under which there are subfolders and sub-subfolders. Each of these folders or subfolders may contain one or many files.

The number of files in a folder or subfolder is limited only by your hard disk capacity. Another advantage of storing files in separate folders is that if you inadvertently delete a folder, not all your work is lost. Also, individual folders can be copied (either within the same hard disk or to another hard disk or to an external device), moved and deleted far more easily.

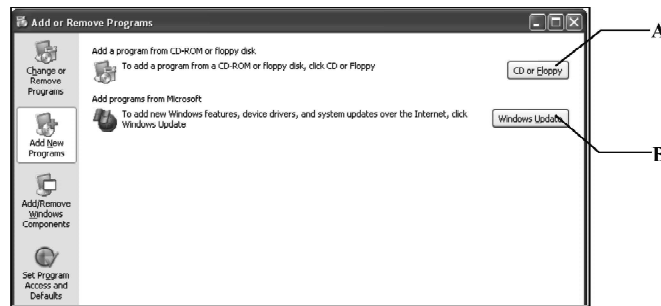
Windows Explorer allows you to do various file and disk management tasks like copy, rename, move and delete file(s), create folder(s), and subfolder(s) and format floppies. Windows Explorer is the quickest way to get a complete view of the contents of your computer. Through it you can quickly get to see where each file is located.

2.7.3 The Control Panel

The main feature of the Control Panel is adding or removing programs (adding all programs and changing Windows components). To view this control, following steps are taken:



- ① Click on the **Start** menu and go to **Control Panel**.
- ② Select the **Add or Remove Programs** option by double clicking on it.

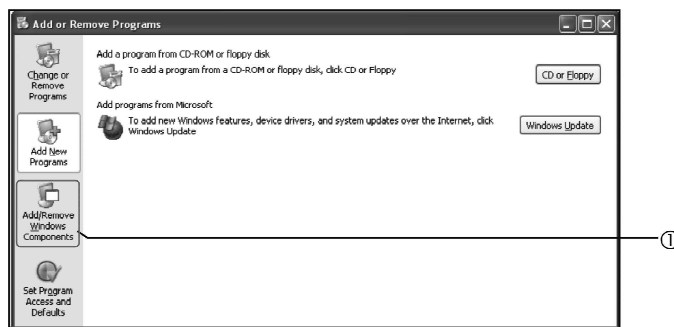


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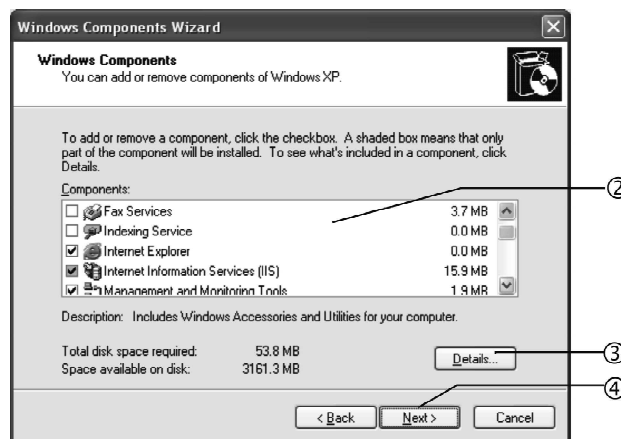
Adding or Removing Windows Components

For installing and/or uninstalling specific components or subcomponents of Windows, click on the **Add/Remove Windows Components** button.

- ① Click once the **Add/Remove Windows Components** button.



- ② Select the required component by clicking once on the check box.
- ③ Click on the **Details** button. It provides you details of the selected component. You can add or remove individual subcomponents contained in the selected component group.
- ④ Click on the **Next** button to install the component.



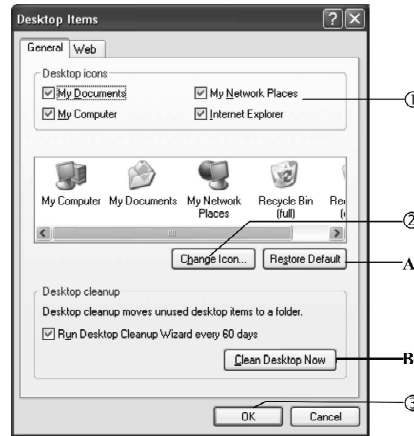
2.7.4 Customizing the Desktop

The following steps can be performed to customize the desktop:

- ① Select the icons you want to display on the Desktop.
- ② Click here in case you want to change the picture of the selected Desktop icons.

- A** Click here to restore the default settings.
- B** Click here to clean the Desktop.
- ③ Click on **OK** once to apply the changes.

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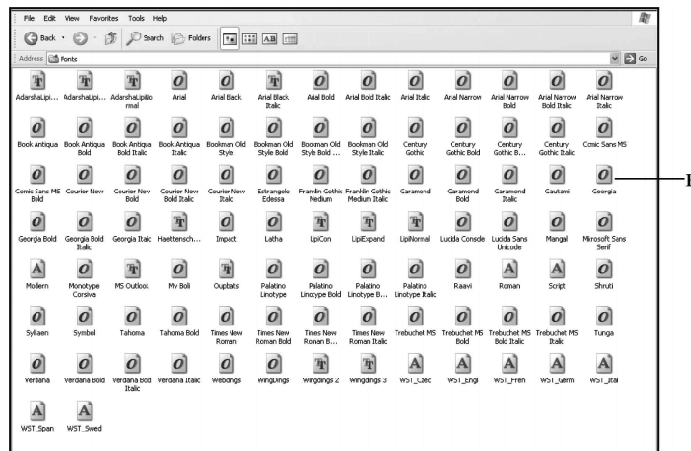
Fonts

Fonts are like having different handwritings available on your computer. They are typefaces that you can use to pep up your work and also for changing the appearance of characters on the screen and as well as on the printed paper. Fonts help you to express your message more clearly and emphatically. Windows comes bundled with a large number of fonts which are automatically installed depending upon your monitor and printer type during the Windows setup installation. You can install additional fonts from other software also, as and when required.



To work with fonts, do the following:

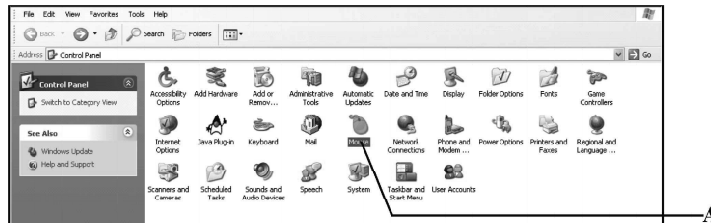
- A** Choose **Fonts** option from the **Control Panel**.
- B** A list of all the available fonts would be displayed. To look at a sample of a font, double click the icon for the desired font.



Mouse

A mouse is a small handheld device through which you can quickly and easily navigate different parts of the screen. You can customize various aspects of the mouse to make it work the way you prefer. You can control the mouse pointer speed, shape, button configuration, double click speed, etc. You can even swap the functioning of left and right buttons. If you frequently lose track of where your mouse pointer is, you can choose to have a mouse trail effect which will make the mouse pointer more visible. To change any of the above mentioned mouse settings, do the following:

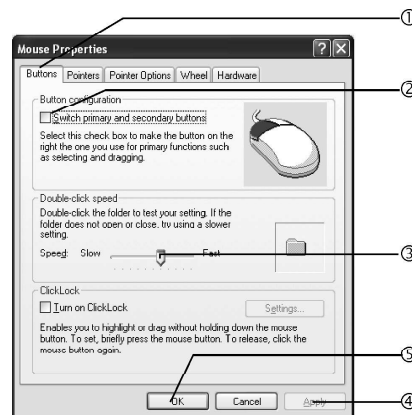
A Choose **Mouse** option from the **Control Panel**.



Button Configuration

To customize button configuration follow the steps given below:

- ① Click on the **Buttons** tab.
- ② Click on the check box under the **Button configuration** option to convert functioning of your left mouse button into right button and vice versa.
- ③ Drag this button to increase or decrease the clicking speed of the mouse.
- ④ Click on the **Apply** button to apply the changes that you have made.
- ⑤ Click on the **OK** button to continue.



Pointer Configuration

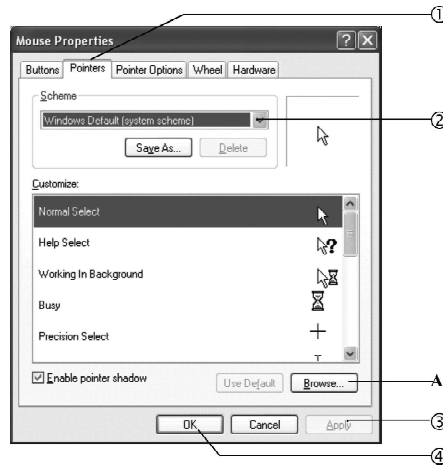
To customize pointer configuration follow the given steps:

- ① Click on **Pointers** tab.
- ② Click on the pull down list to choose the scheme that you want to apply.
- A** You can choose a scheme from another location by clicking on the **Browse** button.
- ③ Click on **Apply** button to apply the chosen scheme.

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- ④ Click on the **OK** button to continue.

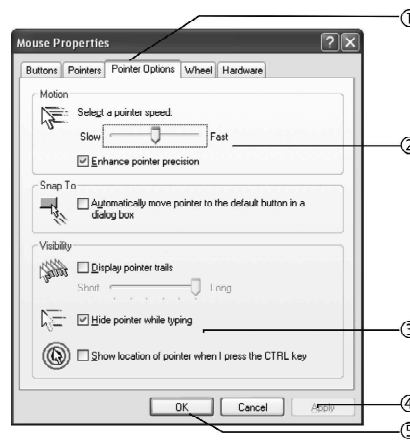
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Motion Configuration

You can also customize the motion configuration of the mouse. To do so follow the given steps:

- ① Click on the **Pointer Options** tab.
- ② Click on this button to increase or decrease the pointer speed.
- ③ You can also click on the **Hide pointer while typing** option to hide the pointer while you are typing.
- ④ Click on the **Apply** button to apply the changes that you have made.
- ⑤ Click on the **OK** button to continue.

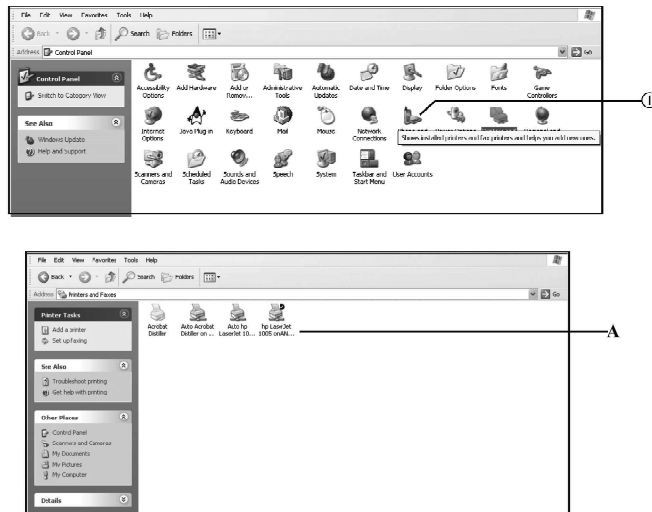


Printers and Faxes

Use this option to install new printers. You would need the Windows XP CD or the Printer Installation CD to run this option. Windows XP installation CD includes many printer drivers from various well known printer manufacturers. However, if your printer or its exact model is not listed in the driver's list provided by Windows XP you need not worry, you simply need to insert the CD or floppy which must have come along with the printer and complete the printer installation procedure.

- ① Choose the **Printers and Faxes** option from the **Control Panel** to see the printers installed.

A You will get a list of the printers installed on your machine.

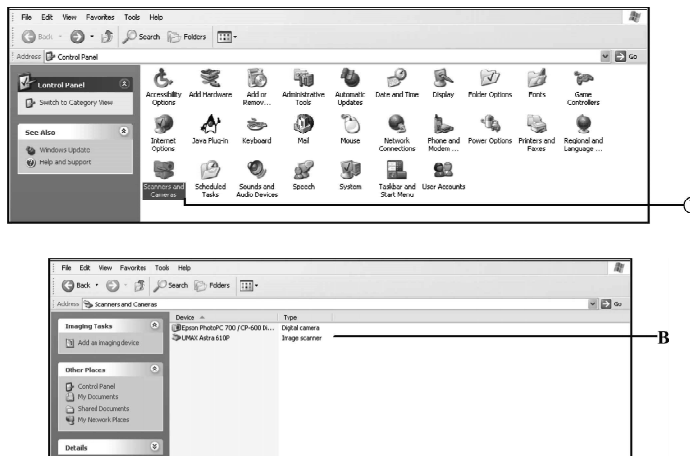


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Scanners and Cameras

① Choose the **Scanners and Cameras** option from the **Control Panel** to see the imaging devices installed.

B You will get a list of the scanners and cameras installed on your machine.



Taskbar and Start Menu Settings

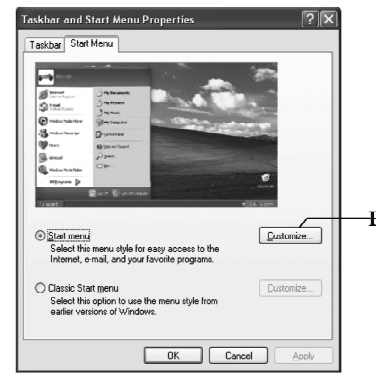
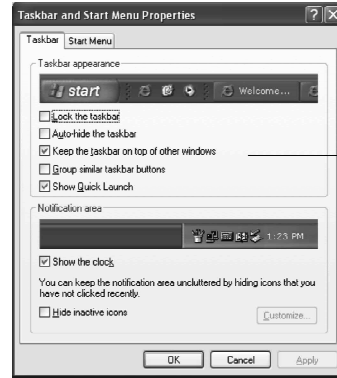
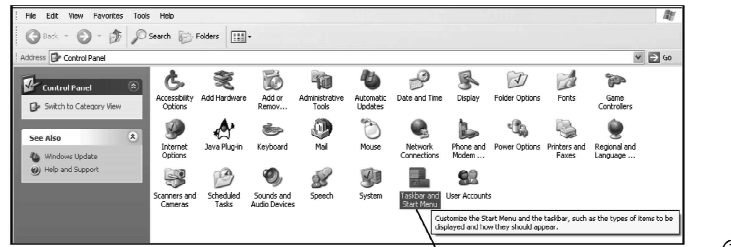
You can customize your Taskbar and Start Menu, such as the types of items to be displayed and how they should appear.

① Click on the **Taskbar and Start Menu** icon from the **Control Panel**.

A You can change your **Taskbar** settings here.

B You can also change your **Start Menu** settings here.

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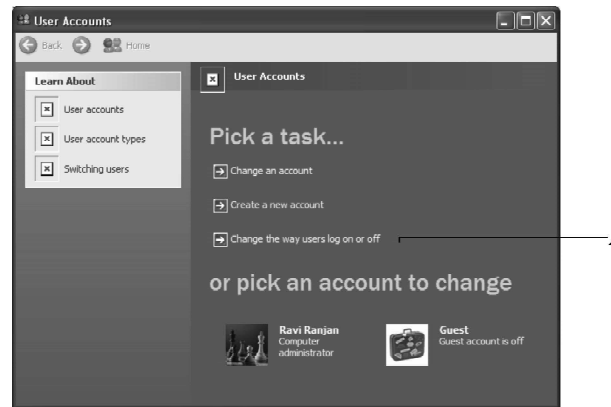
User Accounts

Change User Account settings and passwords for people who share a computer.

- ① Click on the **User Accounts** icon from the **Control Panel**.

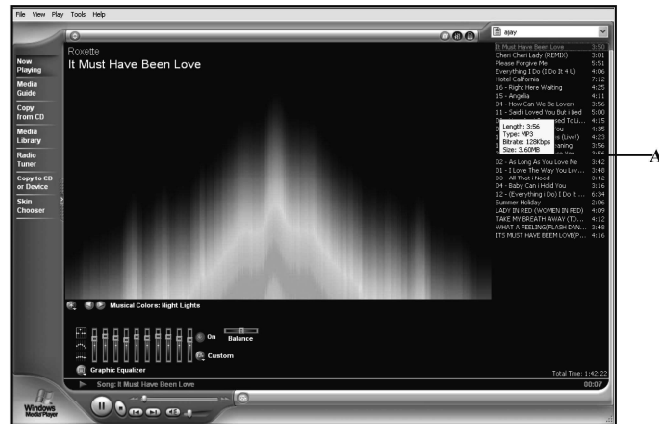


A You can change your settings from this screen.



2.8.5 Accessories

Microsoft Windows OS contains many accessories, such as media player, calculator, games, paint, Notepad, etc. You can access these accessories by clicking on **Start** menu and choosing **Accessories** in **All Programs**.



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Media Player

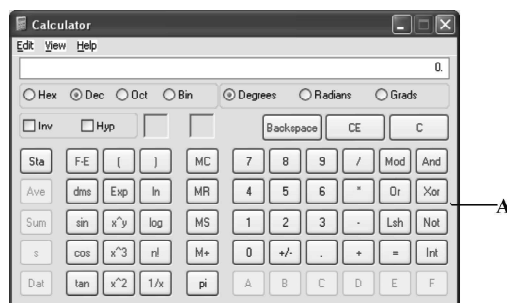
The Media Player turns your computer into a complete music system with a music and video player. Using this option, you can not only play music formats like Moving Picture Expert Group (MPEG) or MP3 but also standard audio/video Compact Disk or CDs/Digital Versatile/Video Disc or DVDs, that you play on your normal music CD/ Versatile Compact Disc or VCD/DVD player. Once again, this option will run only if your computer has multimedia hardware like the DVD/CD ROM drive, sound card and speakers.

- Go to the **Start** menu, click on **All Programs** and then choose **Accessories**. From the list that pops up, choose **Entertainment**. Now select the **Windows Media Player** option.

A You will get this dialog box through which you can play your music.

Calculator

Windows XP provides you with a full fledged calculator through which you can perform various calculations. You have the option of using the scientific (cos, sin, tan, log, square root, cube root functions, etc.) or the standard calculator having basic mathematical functions. You can use either the keyboard or the mouse to enter numbers and operators into the calculator. In case you need the result of your calculations somewhere in your document, you can use the copy command provided along with the calculator to copy the result at the desired place.



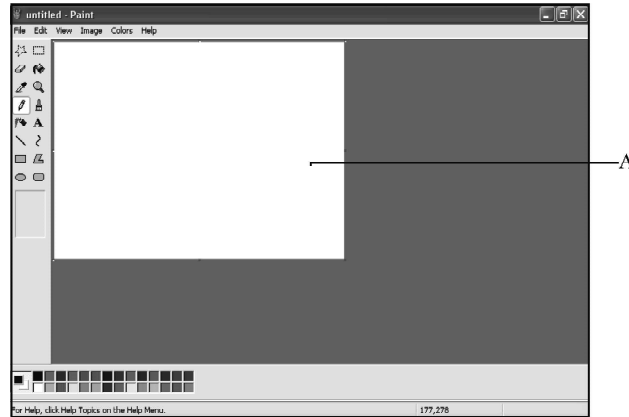
- Go to the Start menu. From **All Programs**, choose **Accessories** and then select **Calculator**.

A You can use the calculation shown above as a normal or a scientific calculator.

Paint

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If you have artistic inclinations, you can use the **Paint** program to draw pictures and maps on your computer. You can create or ‘assemble’ pictures by drawing straight or curved lines, using shapes like squares, circles and polygons or by simply free hand drawing. You can fill different colors and can even erase any portion of your masterpiece that you are not satisfied with. You can use Paint to create wallpapers for your Windows desktop or create logos for your company or any free hand drawing that you wish to insert in Word or Excel.



① From the **Start** menu, go to **All Programs**. From the list that displays, choose **Accessories** and then select **Paint** from the given options.

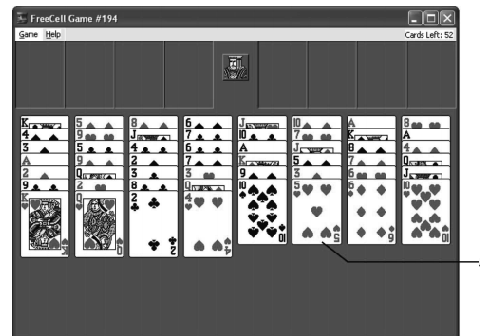
A The **Paint** window appears as shown in the given figure. You can use Paint to create, edit and view pictures. You can also paste a picture into another document you have created or use it as your desktop background.

Games

Windows XP also provides some standard games like FreeCell, Spider Solitaire, Minesweeper, Hearts and Pinball.

① You can play any of these games by choosing the **Games** option from the **All Programs** menu.

A The screenshot shows the game FreeCell.



The object of this game is to use all the cards in the deck to build up the four suite stacks from Ace to King. In case you need any help or instructions on how to play a game, click once on the Help option from the game’s menu bar and you will find all the information that you need.

Check Your Progress

5. What do you mean by Microsoft Disk Operating System (MS DOS)?
6. Write one limitation of MS DOS.
7. Define the term icon.
8. What is the main feature of control panel?

NOTES**2.8 ANSWERS TO ‘CHECK YOUR PROGRESS’**

1. A single user operating system executes an application program of a user through hardware interaction and gives the result back to the user.
2. The batch processing operating system automatically executes the next job in the batch and reduces user intervention during the processing of jobs.
3. A system which consists of multiple parts located at or embedded in geographically dispersed physical locations is called a distributed system.
4. An example of a hard real time system is a flight controller system. If the end user fails to respond an action within the allotted time, it could lead to an unstable aircraft, which could cause a crash.
5. Microsoft Disk Operating System (MS DOS) is a single user, single tasking operating system.
6. One limitation of MS DOS is that it has a text based user interface where the commands have to be typed for each operation that the user wants to perform. The user is expected to remember the commands as well as their syntax.
7. All Programs and files stored on the PC are represented as pictures that are called icons. These icons are stored on the desktop.
8. The main feature of the Control Panel is adding or removing programs (adding all programs and changing Windows components).

2.9 SUMMARY

- An operating system is a set of instructions stored on a storage device, such as hard disk, Compact Disk Read Only Memory (CD-ROM) or floppy disk.
- An operating system acts as a constant application program interface that allows you to develop an application on a computer and execute it on another computer. It does not produce any dissimilarity if the configuration of the two computers is different, as the application remains the same.
- Memory management is a process which manages storage system of a computer. The organization and management of a computer storage system is important for an operating system. An operating system allocates memory to the various processes.

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- A computer uses two types of storage, main memory and secondary memory. The main memory stores temporarily the instructions to be executed by the computer. The CPU of a computer retrieves instructions from main memory for execution.
- The batch processing operating system places the user's jobs on an input queue and these jobs are stored as a batch. The batch monitor executes these batches at a definite interval of time.
- In distributed operating system, user requests are processed independently at more than one location, but with shared and controlled access to some common facilities. A system which consists of multiple parts located at or embedded in geographically dispersed physical locations is called a distributed system.
- The software acts as an interface between the user and the computer. Software or a program can be defined as a complete set of instructions written by the programmer which enables the computer to obtain the solution to a problem (with or without the data). Software is a general term that is used to describe any single program or a group of programs. The software used by a computer may be classified into application software, system software and utility software.
- Microsoft Disk Operating System (MS DOS) is a single user, single tasking operating system. DOS has a command line, text based/non graphical user interface commonly referred as Character based User Interface (CUI).
- Windows XP is a line of proprietary operating systems which was developed by Microsoft and is meant to be used for general purpose computers, such as home computers and business desktops, notebook computers and various other types of media centers.
- Windows is responsible for maintaining all your files and subfolders on your disk. You are aware by now that you store information in individual files. Groups of files on a common subject can be kept in a specially earmarked place called a Folder
- UNIX is a multi-user and multi-tasking operating system. It was developed in the early 1970s at the AT&T Bell Laboratories. There are several versions of UNIX which developed from time to time between 1970 and 2000.
- In UNIX, the command interpreter is not integrated with the operating system; instead it exists as a separate program. The UNIX operating system provides security for the UNIX users by giving each user his/her own login name and password to work on the UNIX computer.

2.10 KEY TERMS

- **Process Management:** It is a process that helps in managing processes. A process is a set of sequential steps for performing a task.

- **Parallel Operating Systems:** It consists of multiple processors sharing the clock, bus, memory and peripheral devices.
- **Microsoft Disk Operating System (MS DOS):** It is a single user, single tasking operating system.
- **UNIX :** It is a multi-user and multi-tasking operating system.

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2.11 SELF-ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is an operating system?
2. Write two functions of an operating system.
3. What is contiguous memory allocation?
4. List two categories of parallel operating systems.
5. Name two models of distributed operating systems.
6. What do you mean by real time operating systems?
7. What do you mean by DOS prompt?
8. What is the function of control panel?

Long-Answer Questions

1. Write a detailed note on the functions of operating system.
2. What are the services provided by the operating system? Explain with the help of examples.
3. Write a detailed note on memory management.
4. Explain the two categories of multiprocessor system.
5. What are various categories of real time operating systems? Explain.
6. Explain the various types of software.
7. Explain the architecture of DOS along with its commands.

2.12 FURTHER READING

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Basavaraj, B. and H.N. Shivashankar. *Basic Electronics*. New Delhi: Vikas Publishing House Pvt. Ltd, 2004.

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UNIT 3 TEXT PROCESSING AND SPREADSHEET SOFTWARE SYSTEMS

NOTES

Structure

- 3.0 Introduction
- 3.1 Objectives
- 3.2 Text Processing Software : MS Word
 - 3.2.1 Microsoft Office 2007: An Introduction
- 3.3 Microsoft Word 2007
 - 3.3.1 Formatting Document
 - 3.3.2 Working with Documents
 - 3.3.3 Advanced Document Formatting
- 3.4 Tables in Microsoft word
- 3.5 Macros
- 3.6 Linking and Embedding Object
- 3.7 Microsoft Excel 2007
- 3.8 Creating and Editing Worksheet
 - 3.8.1 Selection in a Worksheet
 - 3.8.2 Formulas and Functions
- 3.9 Charts
 - 3.9.1 Changing Chart Types
- 3.10 Creating and using Macros
- 3.11 Printing Worksheets
- 3.12 Establishing Worksheet Links
- 3.13 Answers to ‘Check Your Progress’
- 3.14 Summary
- 3.15 Key Terms
- 3.16 Self-Assessment Questions and Exercises
- 3.17 Further Reading

3.0 INTRODUCTION

Almost every computer user has a need for some kind of document preparation system. In the PC world, word processing is the norm, it involves editing and manipulating text and producing printed copies of the text, complete with figures, tables, and other garnishes. Multimedia files, such as digital imagery and video, have become increasingly popular in today’s business world, but the written word remains as important as ever. Word processing software is used to manipulate a text document, such as a resume or a report. You typically enter text by typing, and the software provides tools for copying, deleting and various types of formatting.

Microsoft Word is a word processing software developed by Microsoft. Word for Windows is available stand-alone or as part of the Microsoft Office suite. Word contains rudimentary desktop publishing capabilities and is the most widely used word processing program on the market. Word files are commonly used as the format for sending text documents via e-mail because almost every

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user with a computer can read a Word document by using the Word application,

Spreadsheet software is a software application capable of organizing, storing and analyzing data in tabular form. The application can provide digital simulation of paper accounting worksheets with these capabilities, spreadsheet software has replaced many paper-based systems, especially in the business world. Spreadsheet software has replaced many paper-based systems, especially in the business world. Originally developed as an aid for accounting and bookkeeping tasks, spreadsheets are now widely used in other contexts where tabular lists can be used, modified and collaborated.

Microsoft Excel is a spreadsheet developed by Microsoft for Windows, mac-OS, Android and i-OS. It features calculation, graphing tools, pivot tables, and a macro programming language called Visual Basic for Applications (VBA). It has been a very widely applied spreadsheet for these platforms, especially since version 5 in 1993, and it has replaced Lotus 1-2-3 as the industry standard for spreadsheets. Excel forms part of the Microsoft Office suite of software.

3.1 OBJECTIVES

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

- Explain the process of creating and editing documents in MS Word 2007
- Discuss the significance of formatting documents
- Use tools, such as AutoCorrect, spell checking, etc.
- Discuss the significance of table
- Discuss the process of creating and running the macros
- Understand linking and embedding object
- Understand the significance of Microsoft Excel 2007
- Explain selection process in a worksheet
- Work with formulae
- Edit a worksheet
- Create charts in MS Excel 2007
- Create and execute macro
- Print worksheets data in MS Excel 2007

3.2 TEXT PROCESSING SOFTWARE : MS WORD

The basic elements of an office are people, machines, paper, records, documents, files and procedures. It involves various activities, such as inflow, storage, shifting, collation, reformatting and dissemination of information. Thus, an office is basically a centre for information processing where the following activities are performed:

- Receiving information
- Recording and saving information
- Structuring the information

- Processing the information
- Providing access to information

The term ‘office automation’ refers to the tools and methods used to perform various office activities. Office automation provides elements which simplify, improve and automate the activities of a company or a group of people. It includes the following activities:

- Exchanging the information.
- Managing the administrative documents.
- Managing numerical data.
- Scheduling and planning management works.

In an office, the following software programs are required to fulfil its needs:

- Word processing
- Spreadsheet package
- Presentation package
- Database
- Scheduler

The significant part of office automation is LAN (Local Area Network) which permits users to share data across the office network. It includes all the office functions, such as dictation, typing, filing, copying, fax, Telex, records management, telephone operations, and so on. Office automation includes the various computer hardware and software used in electronically creating, collecting, storing and manipulating office information. The basic activities of office automation are storage of raw data, electronically transferring the data and managing business information.

3.2.1 Microsoft Office 2007: An Introduction

Microsoft Office 2007 is the latest version of MS Office that runs on Windows XP SP2 and above. It is packed with many features. It has components such as Excel (Spreadsheet), Word (Word processor), OneNote and PowerPoint (for making presentations). Microsoft gives these four programs in Home and Student Edition. In the initial stage of its development as beta cycle, it was known as Office 12. It was released on Nov 30, 2006 for volume license customers and was made available to retail customer in the year 2007 on January 30. This was released vis-à-vis Windows Vista (Operating System).

New Features at a Glance: There are number of features that Office 2007 contains. It is much improved in comparison to its earlier versions. New GUI (Graphical User Interface) has been introduced that is known as Fluent User Interface. This has replaced menus and toolbars and has tabbed tool bars and is known as Ribbon. These menus and tool bars that were continuing in earlier versions of Office were dropped. Office 2007 runs on Windows XP SP 2 or above, Windows Server 2003 SP 1 or above, Windows Vista/7. It is the last version Office suite on Windows XP Professional 64-bit Edition. This has also incorporated Office SharePoint Server 2007 which is thought as a major revision for the server platform using Office applications. This provides support for ‘Excel Services’ having C/S (Client/Server) architecture that supports Excel workbooks, shared in real

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time mode between many computers.

User Interface: New UI (User Interface) in Office 2007 is now known officially as *Fluent User Interface*. This interface got implemented in Excel, Word, Access and PowerPoint that form the core Office applications. In the item inspector these are used for creating or editing individual items in MS Outlook.

Office Button: The Office button in 2007 is situated at the top-left corner of the window and it has replaced File menu. This provides access to functions common found common in all Office applications such as opening a file, printing file, saving as well as sharing a file. This is also used for closing applications. A color schemes can also be chosen by users for the interface.

Ribbon: Ribbon is a panel that houses a fixed arrangement of few icons and command buttons. This creates organizations for commands that form a set of tabs that group every relevant command. This can not be customized. Every application contains a different set of tabs that tells about its functions.

Contextual Tabs: There are certain tabs that show appearance only after making selection of certain objects. These tabs are known as *Contextual Tabs*. Such tabs focus on functions specific to the selected objects only. If you select a picture then *Pictures* tab is shown and this gives all options to work with pictures.

Mini Toolbar: This is a new inclusion in Office 2007. It appears automatically as a context menu when you select a text. This design provides easy access to formatting commands that are used repeatedly without making use of right button of the mouse as is done in older versions.

Super Tool Tips: Super tool tips are also known as screen tips. This is capable of housing formatted text as well as images. These show detailed descriptions about most buttons and their functions.

Quick Access Toolbar: This tool bar is inside the title bar and is a repository of functions that are most commonly used. This toolbar can be customized. Any command can be included to this toolbar and this also includes commands that are not available in Ribbon and macro.

3.3 MICROSOFT WORD 2007

Microsoft Office Word 2007 enables you to create formal documents by providing a broad set of tools for crafting and formatting your documents in a new interface. Rich productive review, remarking content with comments and comparison capabilities help you to manage feedback from colleagues. Significant sources of business information stay connected by advanced and improved data integration.

Working in Compatibility Mode

When you open Word 97-2003 document in Microsoft Office Word 2007, Compatibility Mode is turned on and you see Compatibility Mode in the title bar of the document window. In Compatibility Mode, you can open, edit and save Word 97-2003 documents but you will not be able to use any of the new Office MS Word 2007 features.

Compatibility Checker

The Compatibility Checker lists elements in your document that are not supported or will work differently in Word 97-2003 format. In the Compatibility Checker, you can review a summary of elements that behave differently in previous versions of Word and then either click **Continue** to save the document in Word 97-2003 format or click **Cancel**. Some of these features will be permanently changed and will not be converted to Microsoft MS Office Word 2007 elements if you convert the document to Office Word 2007 format.

- **Citations and Bibliographies:** Citations and bibliographies will be converted to static text.
- **Content Controls:** Content controls will be converted to static content.
- **Embedded Objects:** An embedded object in this document was created in Microsoft Office Excel 2007. You will not be able to edit the object in earlier versions of Word.
- **Equations:** Equations will be converted to images. You will not be able to edit the equations until the document is converted to a new file format.
- **SmartArt Graphics:** SmartArt graphics will be converted into a single object that cannot be edited in previous versions of Word.
- **Tabs:** Alignment tabs will be converted to traditional tabs.
- **Text Boxes:** Some text box positioning will change.
- **Tracked Moves:** Tracked moves will be converted.

Creating and Editing Document in Microsoft Word 2007

The **Start** button in the lower-left corner of your screen gives you access to all the programs on your PC and also to MS Word 2007. To start Microsoft Word 2007, click on the **Start** button and select **All Programs**. To open this window, you will need to perform the following steps:

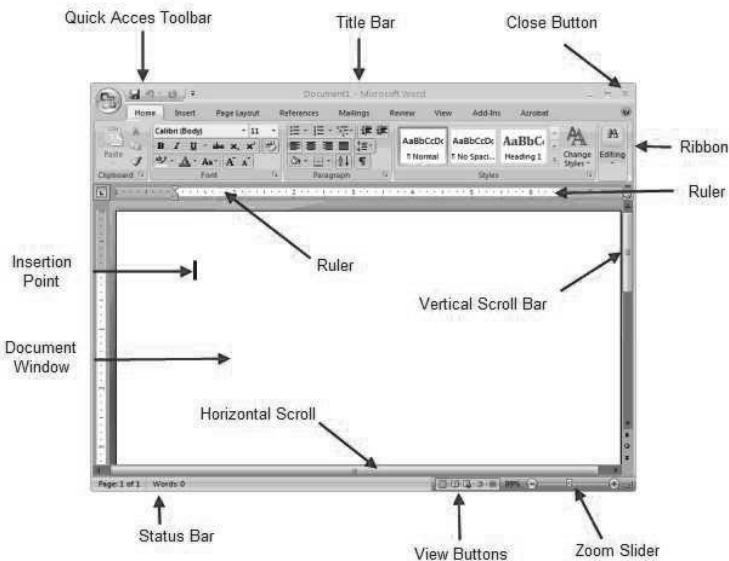


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- Click on the **Start** button and select **Microsoft Office** from **Programs**.
- Select **Microsoft Office Word 2007**.

The user interface of Microsoft Word 2007 is shown in the screen below.

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Menus

When you explore Microsoft Word 2007, you will notice the new look of the menu bar. Three new features help you to work with MS Word 2007, namely the Microsoft Office Button, the Quick Access Toolbar and the Ribbon which contain various functions.

The Microsoft Office Button

The Microsoft Office button is located in the upper-left corner of the MS Word 2007 window. A menu appears when you click on this button. This menu helps in creating a new document or file, opening an existing document or file, saving a document or file, printing a document or file, sending the document or file via fax or e-mail, etc.



The Quick Access Toolbar

The Quick Access Toolbar is right next to the Microsoft Office button. This toolbar helps you to access the frequently used commands. The default commands which appear on this toolbar are **Save**, **Undo** and **Redo**. These commands help you to **Save** a document or file, **Undo** an action and **Redo** an action.

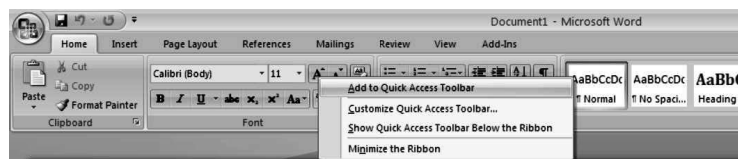


You can customize this toolbar as per your requirements by clicking on the expansion button as shown below.



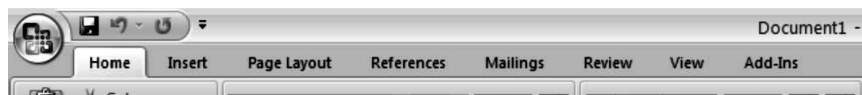
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More items can be added to the quick access toolbar by right clicking on the item which you want to add in the Office Button or the Ribbon and then clicking on **Add to Quick Access Toolbar** as shown below:




The Ribbon

The Ribbon is positioned at the top of the screen of the Word window. It includes seven tabs, namely **Home**, **Insert**, **Page Layout**, **References**, **Mailings**, **Review**, **View** and **Add-Ins** as shown in screen below. Each tab contains various new and advanced features of Word.

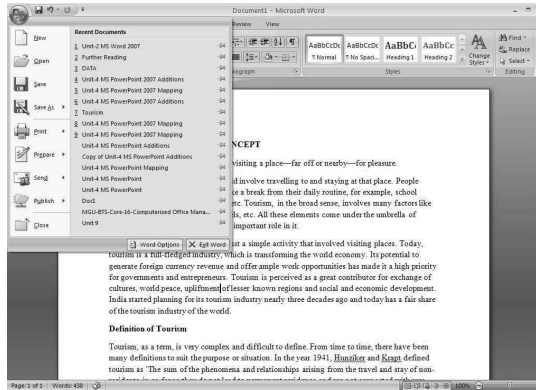


Each tab specifically contains certain tools as follows:


- **Home:** Clipboard, Font, Paragraph, Styles and Editing
- **Insert:** Pages, Tables, Illustrations, Links, Header & Footer, Text and Symbols
- **Page Layout:** Themes, Page Setup, Page Background, Paragraph and Arrange
- **References:** Table of Contents, Footnotes, Citations & Bibliography, Captions, Index and Table of Authorities
- **Mailings:** Create, Start Mail Merge, Write & Insert Fields, Preview Results and Finish
- **Review:** Proofing, Comments, Tracking, Changes, Compare and Protect
- **View:** Document Views, Show/Hide, Zoom, Window and Macros
- **Add-Ins:** PDF Transformer or any new Add-In program

- Click on the **Microsoft Office Button**  and click on the **Save** option.
- The alternate option is to press **CTRL+S**.
- Another option is to click on the **File** icon in the Quick Access Toolbar and click on the **Save**.

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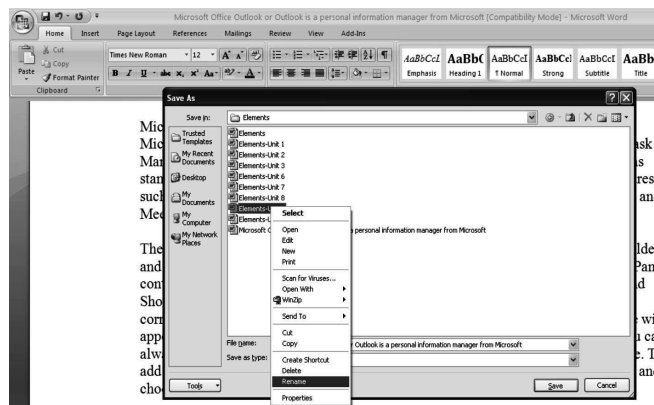
Saving a Document using Save As

To save a document using the Save As option, click on the **Microsoft Office Button**  and click on **Save As**. The Save As option helps you to save a document as a Word Documents, Word Template, Word 97-2003 Document (earlier versions), Other Formats, etc.




Renaming a Document

To rename an existing document, you need to perform the following steps:

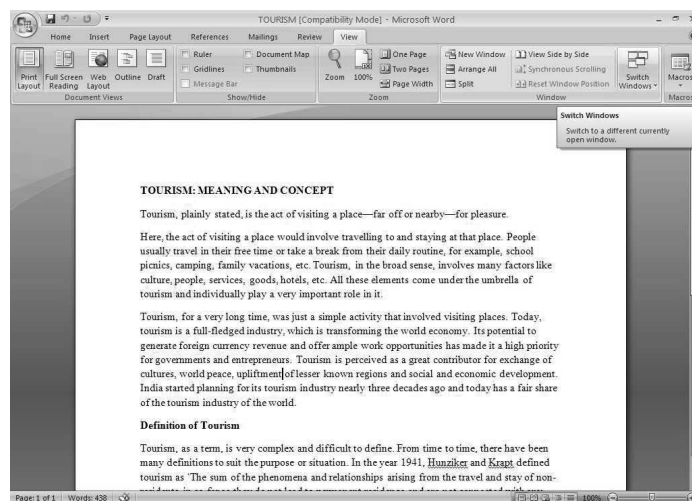


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- Click on the **Office Button**  and locate the document you want to rename.
- Click on the **Save As** option and then right click on the document name with the mouse and select **Rename** from the shortcut menu.
- Type the new name for the document and press the **ENTER** key.

Working on Multiple Documents

Multiple documents can be simultaneously opened when you need to type or edit multiple documents at once. All the documents as opened will be listed in the View tab of the Ribbon when you will click on Switch Windows. The current document has a checkmark beside the file name. You can select a different document as opened by simply clicking on the tab.



Opening an Existing Document

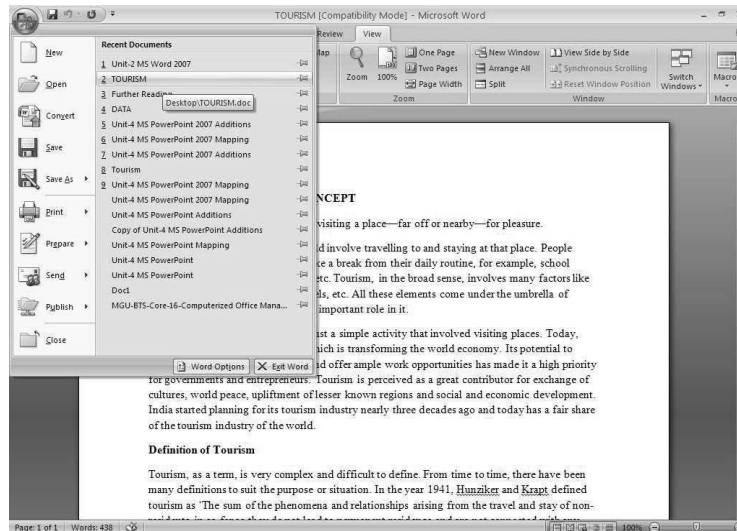
To open an existing document, the following steps need to be performed:

- Click on the **Microsoft Office Button**  and then click on **Open**.
- The alternate option is to press **CTRL+O** on the keyboard.



- For recently used document, you can click on the **Microsoft Office Button** and then click on the name of the document in the **Recent Documents** window.

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Closing a Document

To close a document, the following steps need to be performed:

- Click on the **Office Button**.
- Click on **Close**.

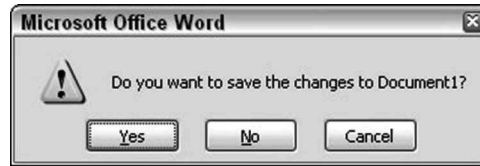


Quitting from MS Word 2007

When you work with Word processing, you can either quit or minimize the Word document. If do not expect to return to it anytime soon, you may just want to quit the program. If you want to stop work on one document to work on another, you can close the document and then open another. You can use the Minimize button to hide Word while you are off doing other things. Following steps are required to perform quit from Word:

- Choose **Exit Word** from the **Office Button** menu.
- Save any files when Word prompts you to do so.
- Click **Yes** to save your file. You may be asked to give the file a name, if you have not yet done so.
- Click **Cancel** to quit **Exit Word** command and return to Word.

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If you select quit, Word closes its Window. Then, you can return to Windows or some other program.

Text Editing

The process of editing a document involves the following steps:

Typing and Inserting Text

To enter text, just type the text in the Word window. The text will appear at the location of the blinking cursor. You can move the cursor using the arrow keys on the keyboard or by positioning the mouse and clicking the left button. The keyboard shortcuts used for this purpose are as follows:

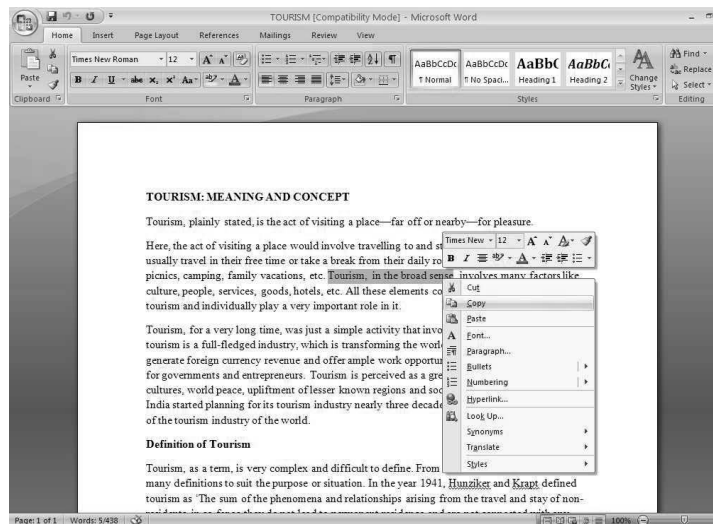
<i>Move Action</i>	<i>Keystroke</i>
Beginning of the line	HOME
End of the line	END
Top of the document	CTRL+HOME
End of the document	CTRL+END

To change the current attributes of the text as typed, it needs to be highlighted first. Select the text by dragging the mouse over the text to be modified while holding down the left mouse button. An alternate way is to hold down the **SHIFT** key on the keyboard and use the arrow buttons to highlight the text. Following are the shortcuts that are used to select a specific portion of the text:

<i>Selection</i>	<i>Technique</i>
Whole word	Double click within the word.
Whole paragraph	Triple click within the paragraph.
Several words or lines	Drag the mouse over the words or hold down the SHIFT key while using the arrow keys.
Entire document	Choose Editing → Select → Select All from the Ribbon or simply press CTRL+A .

Moving and Copying Text

Moving and copying data are common commands used in many computer programs. These commands allow us to take information from one document or location and place them in another without retyping everything. When you move data, you are actually taking it from the location in which it is currently placed and relocating it to another area in the document. When you copy data, the original data remains intact and in addition a copy of that data is placed in another area in the document as shown in the following screen:



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In MS Word 2007, the commands you need to carry out any move or copy operation are located on the Home tab within the Clipboard. Following are the keyboard shortcuts that are also helpful when moving through the text of a document:

<i>Move Action</i>	<i>Keystroke</i>
Beginning of the line	HOME
End of the line	END
Top of the document	CTRL+HOME
End of the document	CTRL+END

Using Drag and Drop Technique

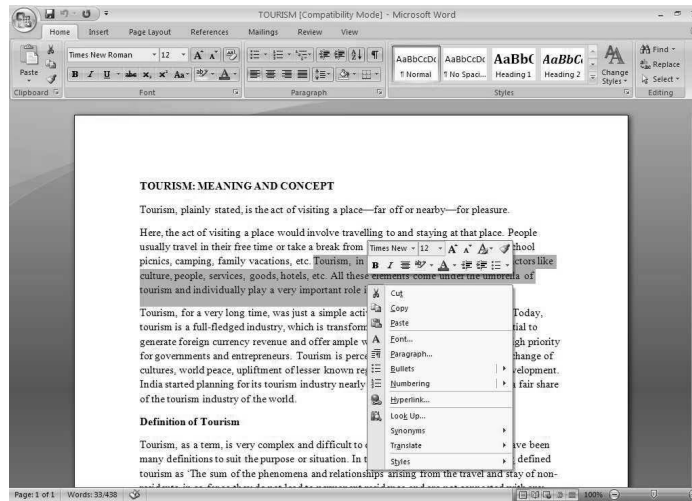
Text can be inserted in a document at any point using any of the following methods:

- **Type Text:** Put your cursor where you want to add/insert the text and begin typing.
- **Copy and Paste Text:** Highlight the text you wish to copy and right click to view options. Now click on **Copy** option. Put your cursor where you want the text to be inserted in the document and right click to view options. Select **Paste** to paste the copied text.
- **Cut and Paste Text:** Highlight the text you wish to cut and right click to view options. Now click on **Cut** option. Put your cursor where you want the text to be inserted in the document and right click to view the options. Select **Paste** to paste the cut text.
- **Drag Text:** Highlight the text you wish to move. Click on it and drag it to the place where you want the text to be inserted in the document.

Using Cut, Copy and Paste Options

To work with Cut, Copy and Paste operations in MS Word 2007, you need to first select the text which you want to copy and paste as shown in the following screen. Press right mouse button to get the shortcut key.

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Copy the selected text. Select Paste option and place the mouse pointer where you want to paste the selected material. Click on Paste option. The copied and cut text will be stored in Clipboard application as shown in the following screen.

For cut operation, you need to select the text. Click on Cut option in shortcut key. Place the mouse pointer where you want to paste the cut text. Click on Paste option in shortcut key.



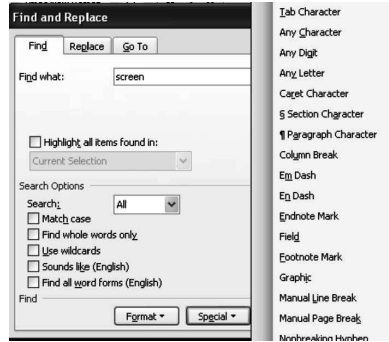
Finding and Replacing Text

The Find and Replace option can be accessed either by selecting **CTRL+F** or **CTRL+H** menu by pressing key combinations for Find and Replace. After choosing the Find or Replace option, you will get the following screen:



The special drop-down list drops a variety of options as follows:

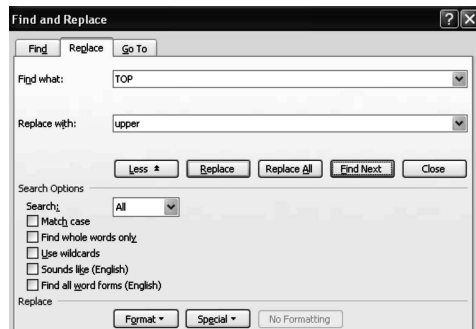
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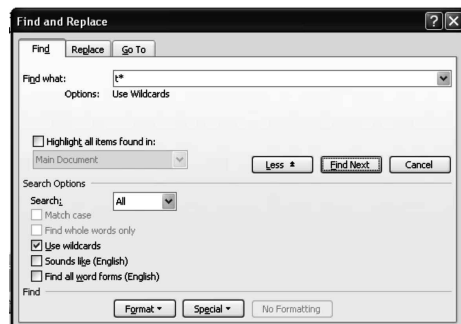
The match case provides you to find and replace the word as uppercase or lowercase. For example, if you check on **Match case** box and type the word in capital as **‘TOP’**, a dialog box appears with a message **‘The search item was not found’**.



If you remove the check box, the found word is replaced by defined word as follows:



You can also search the items by using wild card (*) as shown in screen below:



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Insert/Delete Text

In Microsoft Word 2007, you can create documents by typing them, for example, if you want to create a report, you open Microsoft Word 2007 and then start to type. You do not have to do anything when your text reaches the end of a line and you want to move to a new line, Microsoft Word 2007 automatically moves your text to a new line. If you want to start a new paragraph press ENTER key. Microsoft Word 2007 creates a blank line to indicate the start of a new paragraph. To capitalize, hold down the SHIFT key while typing the letter you want to capitalize. If you make a mistake, you can delete what you typed and then type your correction. You can use the **Backspace** key to delete. Each time you press the Backspace key, Microsoft Word 2007 deletes the character that precedes the insertion point. The insertion point is the point at which your mouse pointer is located. You can also delete text by using the **Delete [DEL]** key. First, you select the text you want to delete and then you press the **Delete** key. Let us take an example, type the following sentence:

I am learning to use Microsoft Word 2007

Delete the word Microsoft and 2007 from the given sentence. Place the cursor using either the arrow keys or the mouse at the end of the word Microsoft. Press the Backspace key until the word 'Microsoft' is deleted. Similarly delete '2007' from the sentence. The sentence will be as follows:

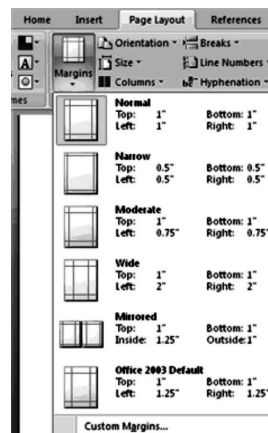
I am learning to use Word

Insert a word 'Processor' at the end of sentence. Place the cursor after the word 'Word'. Start typing the word 'Processor' and save the changes. Similarly insert a word 'how' in between 'learning' and 'to' in the given sentence. The sentence will be as follows:

I am learning how to use Word Processor

3.3.1 Formatting Document

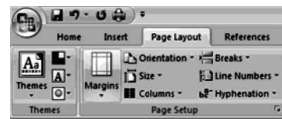
Document formatting represents all the types of formatting parts which are applied to a selected document for making suitable presentation. The page margins can be modified through the following steps:



- Click the **Page Layout** tab on the Ribbon.
- On the **Page Setup** group, click **Margins**.
- Click an **Normal** or **Office 2003 Default**.
- Or you can also click **Custom Margins** and complete the dialog box.

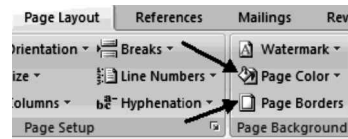
Following steps are required to change the **Orientation**, **Size** of the page or **Columns**:

- Click the **Page Layout** tab on the Ribbon.
- On the **Page Setup** Group, Click the **Orientation**, **Size** or **Columns** drop-down menus.
- Click the appropriate choice.

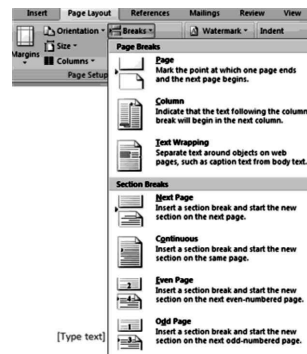


Apply a Page Border and Color

To apply a page border or color, following steps are required:



- Click the **Page Layout** tab on the Ribbon.
- On the **Page Background** Group, click the **Page Color** or **Page Borders** drop-down menus.



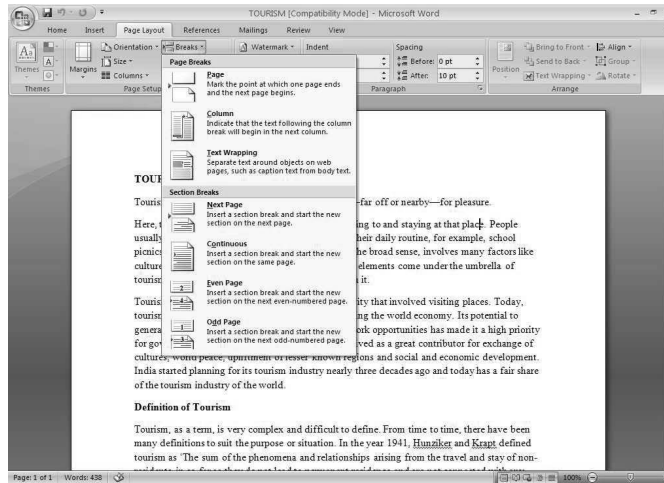
Create or Insert a Page Break

To insert a page break, following steps are required:

- Click the **Page Layout** tab on the Ribbon.
- On the **Page Setup** Group, click the **Breaks**, drop-down menu.
- Click **Page Break**.

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Insert a Cover Page

To insert a cover page, following steps are required:

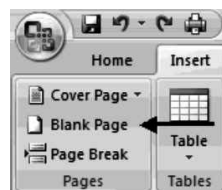
- Click the **Insert** tab on the Ribbon.
- Click the **Cover Page** button on the **Pages** group.
- Choose a style for the cover page.



Insert a Blank Page

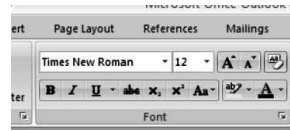
To insert a blank page, following steps are required:

- Click the **Insert** tab on the Ribbon.
- Click the **Blank Page** button on the **Pages** group.



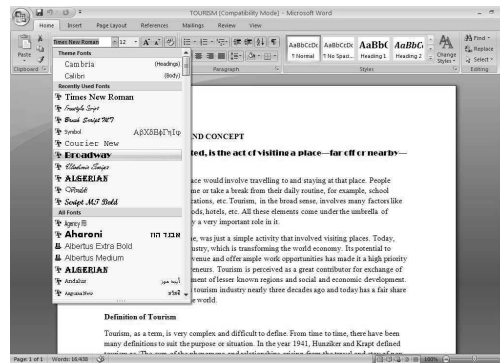
Font Formatting

You can find **Font** toolbar on **Home** tab on the Ribbon.

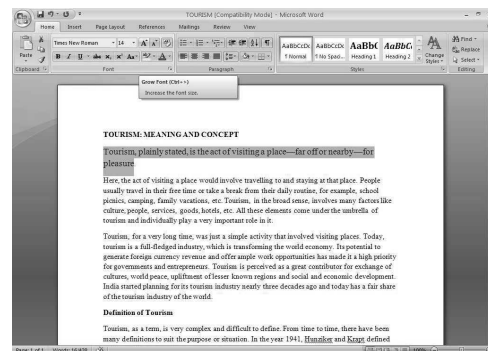


To change the font typeface, Click on the **arrow** next to the font name and select a font.

You can preview how the new font will look by highlighting the text and then hovering over the new font typeface.



To change the font size, click on the **arrow** next to the font size and select the proper size or click on the **increase** or **decrease** font size buttons.



Font Styles and Effects

Font styles are predefined formatting options which are used to emphasize specific text. They include bold, italics and underline. Following are the steps that need to be followed in order to add these effects:

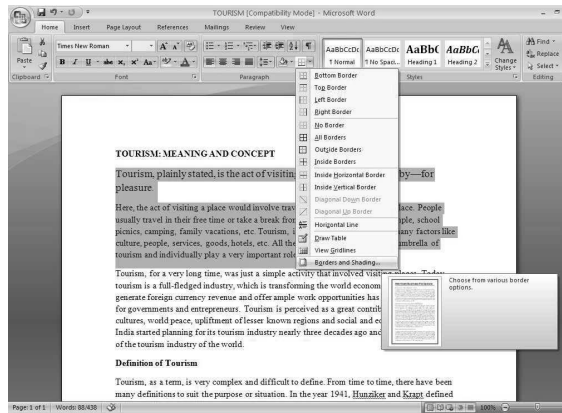
- Select the text and click on **Font Styles** as included in the **Font** group of the Ribbon.
- The alternate way is to select the text and right click on it to display the font tools.

Border and Shading

You can add borders, shade paragraphs and even the entire pages. To create a border around a single paragraph or paragraphs, you need to do the following:

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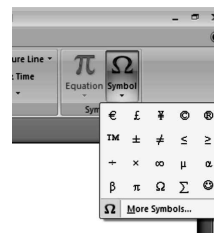


- Select the area of text where you want the border or that which you want to shade.
- Click on the **Borders** button in the **Paragraph** group on the **Home** tab.
- Select the **Borders and Shading** option.
- Select the options as per your choice and requirement.

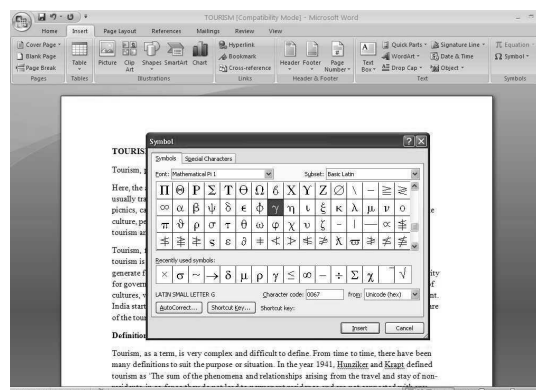
Inserting Symbols

Microsoft Word 2007 permits you to insert special characters, symbols, pictures, illustrations, etc. Special characters are punctuation, spacing or typographical characters that are generally not available on the standard keyboard. Following are the steps for inserting symbols and special characters:

- Move your cursor in the document where you want the symbol.
- Click on the **Insert** tab in the Ribbon.
- Click on the **Symbol** button in the symbols group.
- Select the symbol as required.




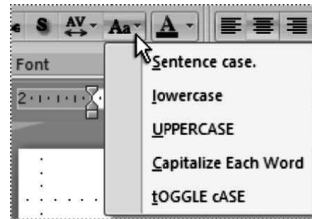
If you want more symbols then click on **More Symbols** to display the following dialog box for a list of various symbols in various fonts.



Changing Case

In Microsoft Word 2007, you can change the capitalization of words, sentences or paragraphs by doing the following:

- Select the text that you want to change the case of.
- On the **Home** tab, in the **Font** group, click **Change Case**  (as shown in the screenshot) and then click the capitalization option that you want.

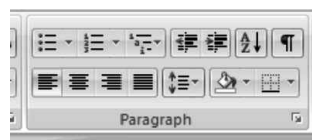


- To capitalize the first letter of a sentence and leave all other letters as lowercase, click **Sentence case**.
- To exclude capital letters from your text, click **lowercase**.
- To capitalize all of the letters, click **UPPERCASE**.
- To capitalize the first letter of each word and leave the other letters lowercase, click **Capitalize Each Word**.
- To shift between two case views, for example, to shift between **Capitalize Each Word** and the opposite, **cAPITALIZE eACH wORD**, click **tOGGLE cASE**.

Text Alignment

Paragraph alignment helps in organizing the text according to the way you want it to appear. To change the alignment, follow the given steps:

- Click on the **Home** tab.
- Select the appropriate button for alignment in the **Paragraph** group.
 - **Align Text Left:** The text is aligned with the left margin.
 - **Center:** The text is centered within the margins.
 - **Align Text Right:** The text is aligned with the right margin.
 - **Justify:** It aligns the text to both the left and right margins.



Insertion of Current Date and Time in a MS Word 2007 Document

In Microsoft Word 2007, use the following shortcut keys to enter the current system date and time as shown in the screenshot, for example [ALT+SHIFT+D] key combination is used to insert the current date and [ALT+SHIFT+T] key combination is used to insert the current time.

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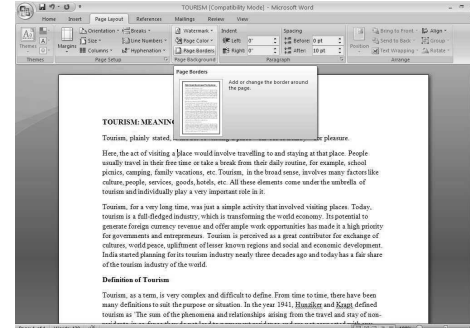
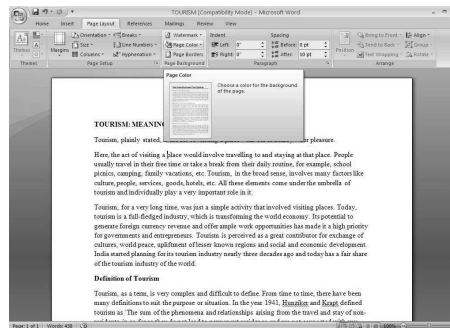
Microsoft Word 2007 is a paid commercial word processor designed released in 1983 under the name Multi-Tool Word for X_{en}ix systems. later written for several other platforms including IBM PCs running Macintosh (1984), the AT&T Unix PC (1985), Atari ST (1986), Microsoft Windows (1989). It is a component of the Microsoft Office standalone product and included in Microsoft Works Suite. The current Word 2010 for 2007 Windows and 2011 for Mac.

Current Date: 4/15/2011 Time: A10:58 AM

Writing Header and Footer Content

To apply a page border or color, follow the given steps:

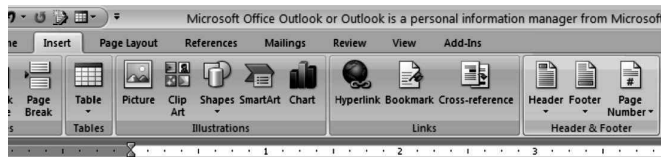
- Click on the **Page Layout** tab in the Ribbon.
- In the Page Background group, click on **Page Color** or **Page Borders** to generate the drop-down menus.



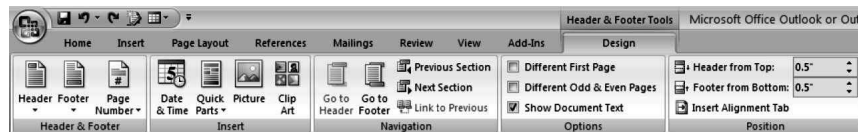
Inserting Common Header and Footer Information

To insert Header and Footer information, such as page numbers, date or title, first decide whether you want the information to be in the header, i.e., at the top of the page or in the Footer, i.e., at the bottom of the page and then follow the given steps:

- Click on the **Insert** tab in the Ribbon.
- Click on **Header & Footer**.
- Select a style.

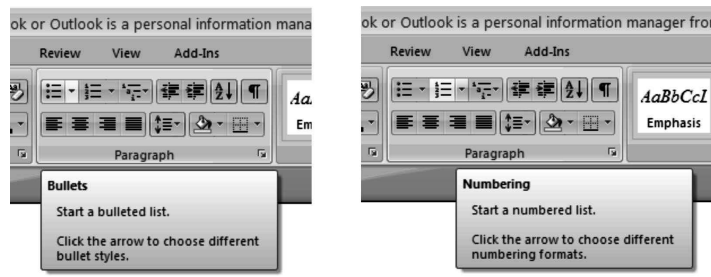


- The **Header & Footer Tools** tab will be displayed in the Ribbon.
- Select or type the information that you want to have in the header or footer, such as date, time, page numbers, etc.



Bullets and Numbering

Bulleted lists are represented using bullet points, numbered lists are represented using numbers and outline lists combine together the numbers and letters depending on the association of the list.



NOTES

Following are the required steps for adding a list to existing text:

- Select the text for which you wish to make a list.
- From the **Paragraph** group on the **Home** tab, click on the **Bullets** or **Numbering** or **Multilevel List** button as per requirement.

To **create** a new list following steps are required:

- Move your cursor where you want the list to appear in the document.
- Click the **Bullets** or **Numbering** button.
- Start typing.
- Bullets or Numbers will automatically appear when you will press the ENTER key and go to a new line.

Nested Lists

A nested list is the list which has several levels of indented text. To create a nested list, do the following steps:

- Create your list following the directions as given above.
- Click on the **Increase** or **Decrease Indent** button.

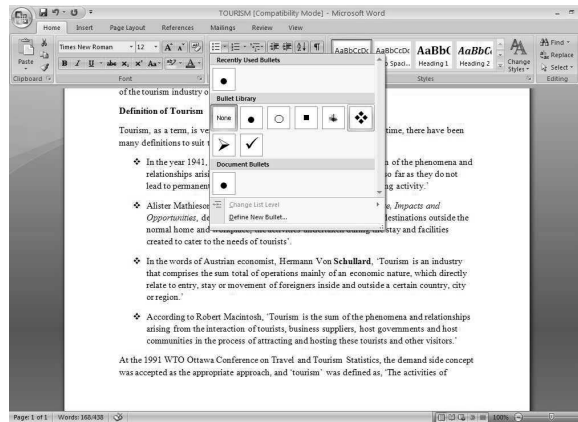


Formatting Lists

The bullet image and the numbering format can be modified using the **Bullets** or **Numbering** dialog box. Following are the steps for formatting a bulleted or a numbered list:

- Select the entire list to change all the bullets or numbers, or just place the cursor on one line within the list to change a single bullet.
- Right click.
- Click on the arrow next to the bulleted or numbered list and choose the bullet or numbering style as required.

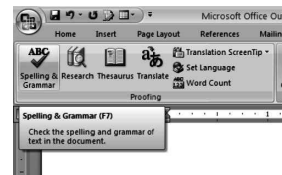
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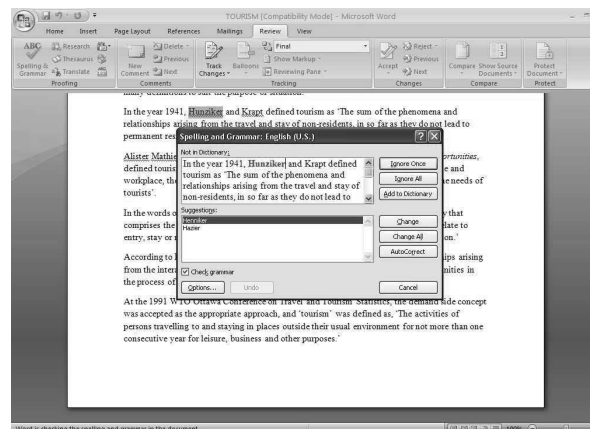
Spelling and Grammar Tool

To check the spelling and grammar of a document, follow the given steps:

- Move the cursor to the beginning of the document or to the beginning of the section that you want to check.



- Click on the **Review** tab in the Ribbon.
- Click on the **Spelling & Grammar** option in the Proofing group.
- Any error as encountered will be displayed in a dialog box which would permit you to select a more proper spelling or phrasing as shown below.



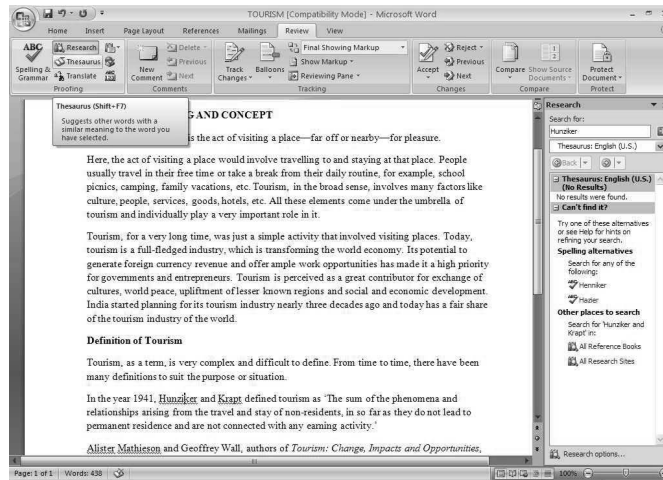
If you wish to check the spelling of an individual word, you can right click on any word that has been underlined by Word and select a proper substitution.

Thesaurus

Thesaurus allows you to view synonyms. To use the thesaurus, follows the given steps:

- Click on the **Review** tab of the Ribbon.
- Click on the **Thesaurus** button on the Proofing group.

- The thesaurus tool appears on the right side of the screen and you can view the word options.



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3.3.2 Working with Documents

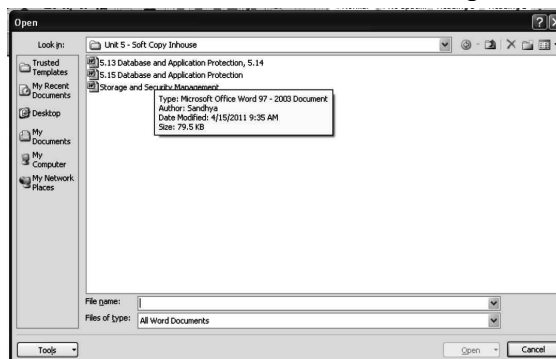
You can perform the following actions on the documents:

Opening Word Application

To open a MS Word 2007 application, you need to select the **File → Open** menu as shown in the following screen and then select the file which you want to open.



After selecting the file, the content of document file is opened on the screen.




NOTES

Explanation of Different Parts of Word Window and Views in MS 2007 Word

Following are the various ways available in 'Document Views' tab in which a document can be viewed in Word:

- **Print Layout:** This is a view of the document as it would appear when printed. It includes all tables, text, graphics and images as present in the document.
- **Full Screen Reading:** This refers to a full length view of a document. It is of utility when you want to view two pages at a time.
- **Web Layout:** This is a view of the document as it would appear in a web browser.
- **Outline:** This is an outline of the document in the form of bullets.
- **Draft:** This view does not display pictures or layouts. It displays only the text.

To view a document in various forms, click on any of the document view shortcuts at the bottom of the screen  or alternatively,

- Click on the **View Tab** in the Ribbon.
- Click on the appropriate document view.



Document Printing

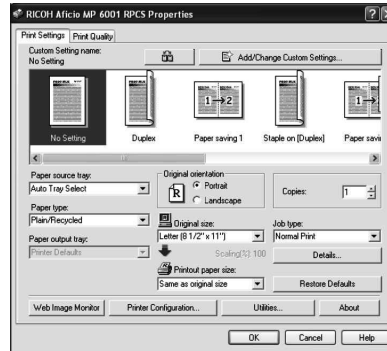
Microsoft Word 2007 is considered as standardized software for creating text documents. In MS Word 2007, you can quickly print a document and can avoid the Print dialog box which saves your time. To use the Preview and Print functions in Microsoft Word 2007, follow the given steps.

- Open the document to preview, if you are not currently working on it.
- Click on '**Microsoft Office Button**' in the top-left corner of your screen. You will find numerous features here that used to be on the '**File**' menu in Microsoft Word 2007.
- Highlight '**Print**' and then select '**Print Preview**'. You will see the document on the screen.

Using the Print Function

In Microsoft Office Button, three buttons, such as **Print**, **Quick Print** and **Print Preview** appear on the screen to perform the printing of the document.

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Print Preview

When working on MS Word 2007 documents for the MS Office 2007 which is used to edit them while in Print Preview instead of going back into the document. Print Preview is used to see how the document will look like when it is printed to paper. You can get into Print Preview mode by clicking the Print Preview icon on the Quick Access Toolbar or clicking on the **Office Start Menu** → **Print** → **Print Preview**.



You can also select the Print Preview option in MS Word 2007 from Office Button as shown in the following screenshot:



After clicking on Print Preview option from Print menu, you can see the previewed page and can modify the required changes.

3.3.3 Advanced Document Formatting

Styles are predefined text formats that are available in MS Word 2007 that can be applied on text by performing following steps to utilize **Quick Styles**:

- Select the text you wish to format.
- Click the dialog box next to the **Styles** Group on the **Home** tab.
- Click the style you wish to apply.



The use of Styles in MS Word 2007 will allow you to quickly format a document with a consistent and professional look. Styles can be saved for further use in many documents.

Apply Styles

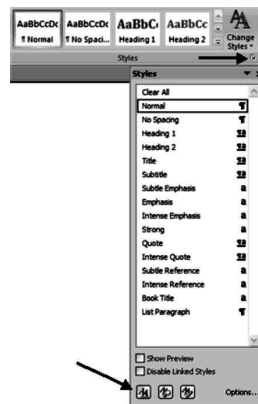
There are many styles that are already provided in Word and ready for you to use. To view the available styles, click the **Styles** dialog box on the Styles group in the **Home** tab. To apply a style:



- Select the text.
- Click the **Styles** tab.
- Click the Style you want to choose.

Creating New Styles

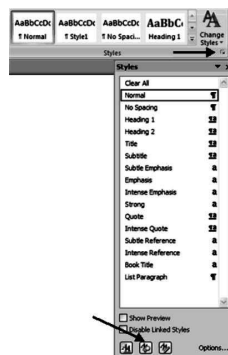
You can create styles for formatting that you use regularly. There are two ways to do this which are known as **New Styles** or **New Quick Styles**.



Style Inspector

Following steps are required to determine the style of a particular section of a document:

- Insert cursor anywhere in the text that you want to explain the style.
- Click the **Styles** drop-down Menu.
- Click the **Style Inspector** button.



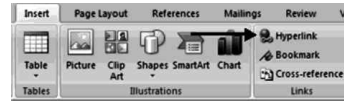
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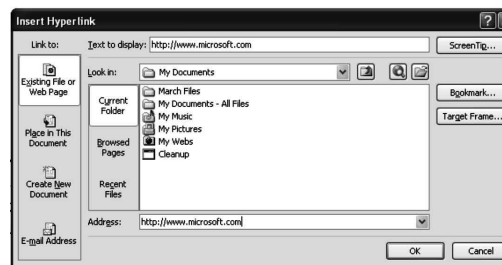
Create Links

Creating links in a MS Word 2007 document allows you to put in a Uniform Resource Locator (URL) that readers can click on to visit a Web page. To insert a link, following steps can be performed :

- Click the **Hyperlink** button on the **Links** group of the **Insert** Tab.
- Type in the text in the '**Text to Display**' box and the Web address in the '**Address**' box.



Once you click on **Hyperlink** tool, following screen will appear.



Indentation

Indentation helps you to set the text within a paragraph at different margins. The various options for the purpose of indenting text are as follows:

- **First Line:** Controls the left boundary for the first line of a paragraph.
- **Hanging:** Controls the left boundary for every line in a paragraph except the first one.
- **Left:** Controls the left boundary for every line in a paragraph.
- **Right:** Controls the right boundary for every line in a paragraph.








Following are the steps that need to be performed for indenting paragraphs

- Click on the **Indent** buttons to control the indent, i.e., to decrease or to increase the size of the indent.

- Open paragraph dialog box by right clicking the selected text.
- Click on the **Indents and Spacing** Tab.
- Select the indent as required.

Using Tab

Tab stops are frequently used to create easy-to-format documents. You can use the ruler to set manual tab stops at the left side, middle and right side of your document. If the horizontal ruler that runs along the top of the document is not visible then to view it click on the **View Ruler** button at the top of the vertical scroll bar. You can quickly set tabs by clicking on the tab selector at the left end of the ruler until it displays the type of tab that you require and then clicking the ruler at the location you require. If you want your tab stops at specific positions that you cannot get by clicking the ruler or if you want to insert a specific character before the tab, then you can use the **Tabs** dialog box. Following are the various Tab tools used for Tab setting and their functions.

<i>Tools Used For Tab Setting</i>	<i>Function</i>
	A Left Tab stop sets the start position of text that will then run to the right as you type.
	A Center Tab stop sets the position of the middle of the text. The text centers on this position as you type.
	A Right Tab stop sets the right end of the text. As you type, the text moves to the left.
	A Decimal Tab stop aligns numbers around a decimal point. Independent of the number of digits, the decimal point will be in the same position. You can align numbers around a decimal character only and you cannot use the decimal tab to align numbers around a different character, such as a hyphen or an ampersand symbol.
	A Bar Tab stop does not position text. It inserts a vertical bar at the tab position.

Check Your Progress

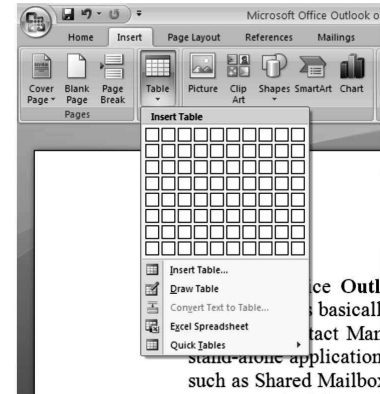
1. List some software that is generally required in an office.
2. What is a ribbon?
3. What is the function of a title bar?
4. What do you mean by document formatting?
5. What is the use of thesaurus?

3.4 TABLES IN MICROSOFT WORD

Tables organize data into rows and columns. They are used for the purpose of displaying data in a tabular format.

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Create a Table

In Microsoft Word 2007, you can create Tables by following the given steps:

- Point the cursor at the location where you want the new table.
- Click on the **Insert** tab of the Ribbon.
- Click on the **Table** button in the **Tables** group.
- Click on any of the following four ways to add table to your document:
 - o Create the table by highlighting the grid of the table.
 - o Click on **Insert Table** and enter the number of rows and columns.
 - o Click on **Draw Table** and manually create your table with as many numbers of row and column, and format.
 - o Click on **Quick Tables** and select any predefined table.

Inserting a Table

MS Word 2007 allows you to insert a table by selecting from a pre-formatted collection of tables provided by Office Word or by mentioning the exact number of rows and columns that you need. You can also insert a table into another table to create a complex table.

1. Using Table Templates

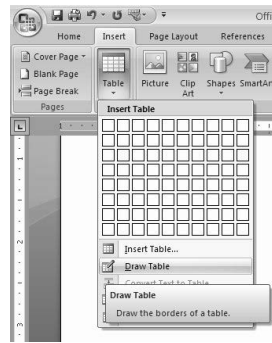
Table templates can also be used to insert a table in your document, which are pre-formatted tables. Table templates include sample styles of data insertion to help you visualize the look of the table.

1. Click where you want to insert a table.
2. On the **Insert** tab, in the **Tables** group, click **Table**, point to **Quick Tables** and then click the template that you want.
3. Replace the data in the template with the data that you want.

2. Using the Table Menu

Another way to add tables into a Word document is by highlighting the table grid, i.e., number of rows and columns. But this option has a limit to the number of rows and columns that can be added, which means the maximum limit is 10×8 table. Therefore this option can only be used for simple and small tables. Follow the steps given below to insert a table through table menu:

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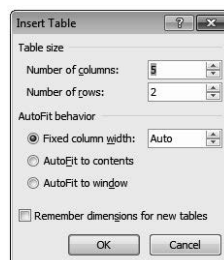


1. Click where you want to insert a table.
2. On the **Insert** tab, in the **Tables** group, click **Table**, and then under **Insert Table**, drag to select the number of rows and columns that you want.

Following is the screenshot showing a highlighting table of a 4×4 matrix:

You can also use the **Insert Table** command to choose the table dimensions and format before you insert the table into a document.

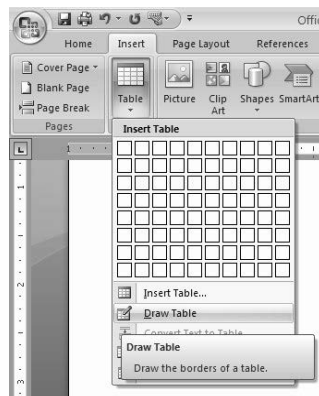
1. Click where you want to insert a table.
2. On the **Insert** tab, in the **Tables** group, click **Table**, and then click **Insert Table**.
3. Under **Table size**, enter the number of columns and rows.
4. Under **AutoFit behavior**, choose options to adjust the table size.



Create a Table Manually

In Microsoft Office Word 2007, you can manually create a table by following two ways:

- By drawing the rows and columns that you want.
- By converting text to a table.



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1. Drawing a Table

MS Word 2007 allows you to draw a complex table, for example, one which needs to contain cells of different lengths or a varying number of columns or rows per cell.

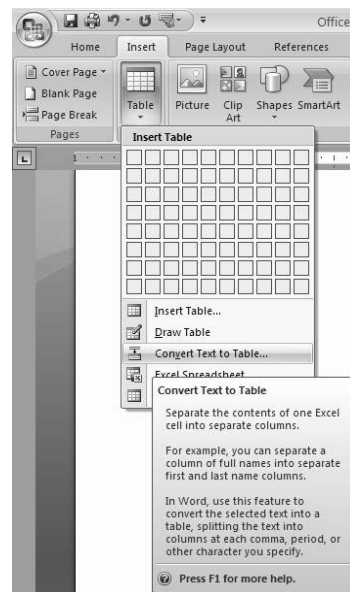
- Click where you want to create the table.
- On the **Insert** tab, in the **Tables** group, click **Table** and then click **Draw Table**.

After clicking the Draw Table option, the pointer will change into a drawing pencil.

- To define the outer table boundaries, draw a rectangle. Then draw the column lines and row lines inside the rectangle.
- To insert text in the table, click in a cell and start typing.

2. Converting Text to a Table

Word 2007 allows you to convert text into a table. Add separator characters, such as commas or tabs, to specify where you want to divide the text into column and use paragraph marks to specify where you want to divide the text into row. Follow the steps given below to convert text to a table:



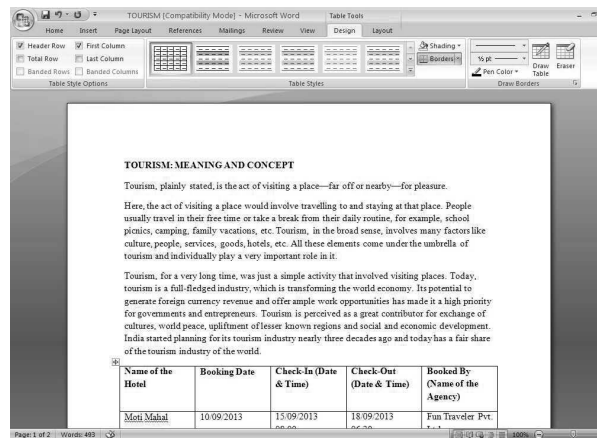
- Select the text you want to convert into table.
- On the **Insert** tab, in the **Tables** group, click **Table** and then click **Convert Text to Table**.
- In the **Convert Text to Table** dialog box, under **Separate text at**, click the option for the separator character that you used in the text.

Select any other options that you want.

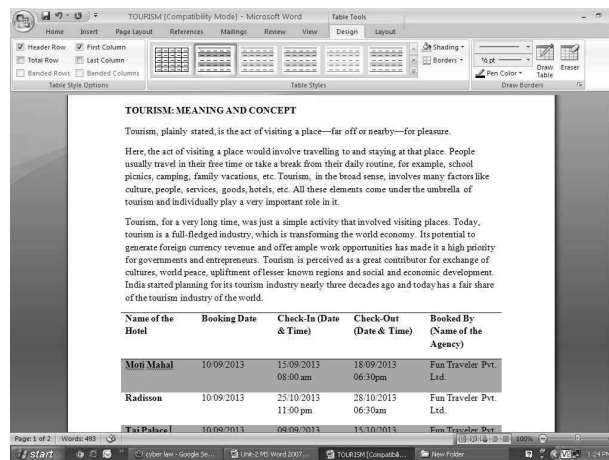
Selection within Table

Selection within tables is prime operation of Word table because it provides you to select and perform the desired options, such as finding total marks of a specific student or merge the headings, etc.

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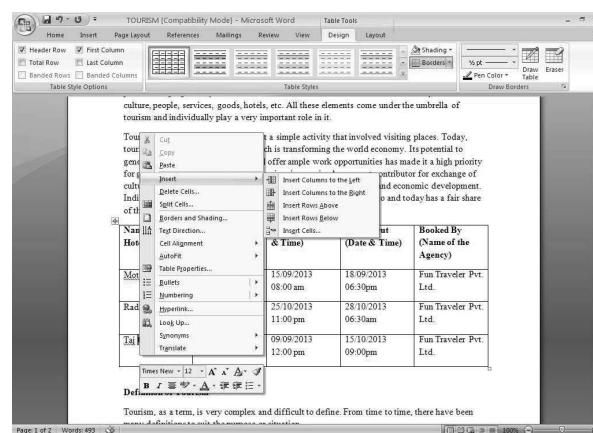


You can also set the various formatting options for selected table as shown in the screen.



Insert/Delete Row(s)/Column(s) into Table

To insert rows and columns, you need to select shortcut key in which you are provided with options, such as **Insert Columns to the Left**, **Insert Columns to the Right**, **Insert Rows Above** and **Insert Rows Below** as shown in the following screen.

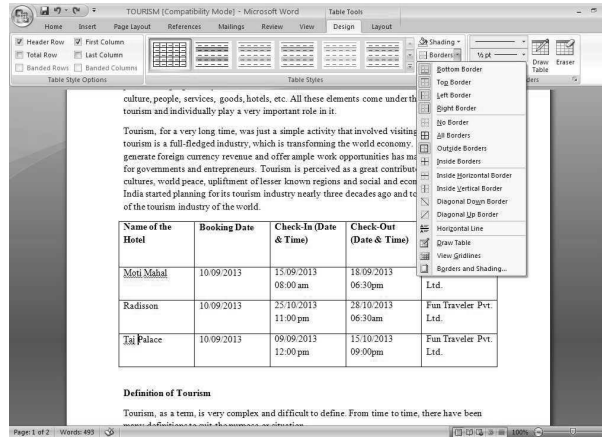


After selecting the option, for example **Insert Columns to the Right**, you will get extra column in which you can fill the data.

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Applying Borders and Shading in the Table

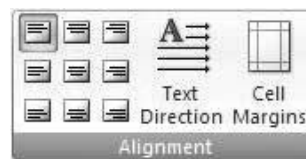
Borders and shading facilitate you to highlight information in a table. Thus it enhances the appearance of the text in a table. Word automatically applies a 1/2 point border and a white background, i.e., no shading to all tables and table cells. Though, to emphasize definite portions of your table, you can add, remove or modify table borders or you can add shading to certain cells, rows or columns in your table. In MS Word 2007, the Ribbon provides quick access to the table borders and shading features. You can add borders to a table or individual table cell.



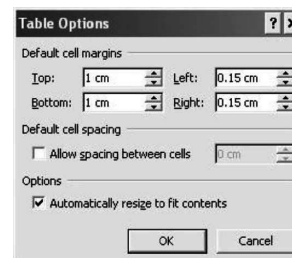
Formatting Data within Table Cells

The Ribbon provides options for changing both the vertical and horizontal alignment with cells.

- Select the cells you want to format.
- Click the **Layout** tab under **Table Tools** on the Ribbon.
- Click on the required button from the **Alignment** group.



The cell margins allow you to change the gap between the cell contents and the border of the cell.



- Select the cells you want to format or the entire table.
- Click the **Layout** tab on the Ribbon.

- Click the **Cell Margins** button in the **Alignment group**.
- The **Table Options** dialog box appears. Adjust the required margin settings.

Adjust the measurement in the **Allow spacing between cells** box to change the spacing between the cells as opposed to within the cell between the content and its borders. Click OK. Your settings become the default settings for all future tables.

Table Autoformatting

By selecting certain formatting options, the 2007 Microsoft Office system programs can automatically format certain kinds of text as you type, such as replacing a typed hyphen (-) with a dash (–). Use the **AutoFormat As You Type** options to control the automatic formatting that you want. The specific AutoFormat As You Type options that are available depend on the program that you are using. The AutoFormat feature, which was a part of Microsoft Office 2003, is not included in the 2007 Microsoft Office system. There are two ways to use the capabilities of the AutoFormat feature:

- You can use other features in Microsoft Office Word and Microsoft Office Outlook. The **AutoFormat As You Type** Tab includes the most useful capabilities of the **AutoFormat** feature.
- In Word, you can add the **AutoFormat** command to the **Quick Access Toolbar**.

Tabular Data Sorting

To sort the data in a table that is based on the contents of a column that includes more than one word, you must first use characters to separate the data including data in the header row. For example, if the cells in a column contain both last and first names, you can use commas to separate the names.

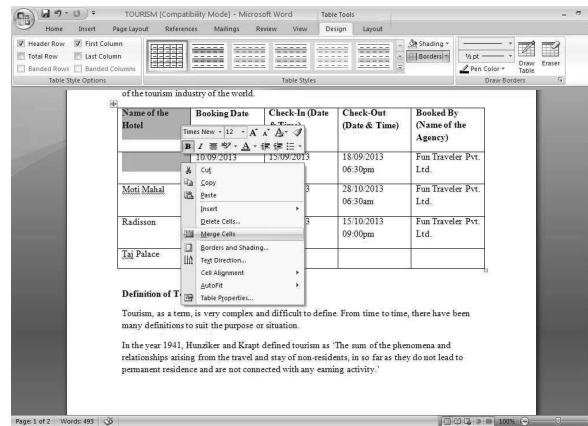
- Select the column that you want to sort.
- Under **Table Tools**, on the **Layout tab**, in the **Data** group, click **Sort**.
- Under **My list has**, click **Header row** or **No header row**.
- Click **Options...**
- Under **Separate fields at**, click the type of character that separates the words or fields that you want to sort and then click **OK**.
- Under **Sort by**, in the **Using list**, select which word or field you want to sort by.
- In the first **Then by** list, enter the column that contains the data that you want to sort by and then in the **Using list**, select which word or field you want to sort by.
- If you want to sort by an additional column, repeat this step in the second **Then by** list.
- Click **OK**.

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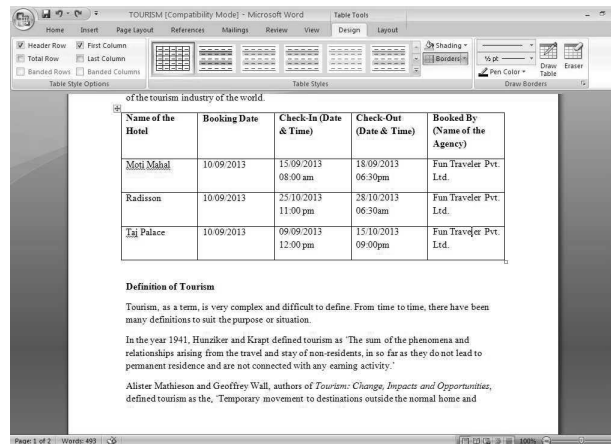
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Merge/Split Cells

Merging columns and rows are used to prepare the common headings as shown in the following screen.

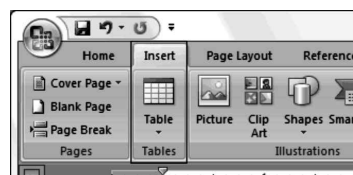


Select the columns and also select Merge Cells option. You will get the following resulted screen in which border of table is not displayed.



Convert Text to Table and Vice Versa

Insert separator characters to convert the text to table or vice versa. These separator characters you choose to indicate where you want text to separate when you convert a table to text or where you want new rows or columns to begin when you convert text to a table, such as commas or tabs to indicate where you want to divide the text into columns. Use paragraph marks to indicate where you want to begin a new row. For example, in a list with two words on a line, insert a comma or a tab after the first word to create a two column table.



- Select the text that you want to convert.
- On the **Insert** tab, in the **Tables** group, click **Table** and then click **Convert Text to Table**.

- In the **Convert Text to Table** dialog box, under **Separate text at**, click the option for the separator character that is in your text:
- In the **Number of columns** box, check the number of columns.

If you do not see the number of columns that you expect, you may be missing a separator character in one or more lines of text.

Convert a Table to Text

Following steps are required to convert a table to text.

- Select the rows or table that you want to convert to paragraphs.
- Under **Table Tools**, on the **Layout** Tab, in the **Data** group, click **Convert to Text**.
- Under **Separate text at**, click the option for that you want to use in place of the column boundaries.

Rows are separated with paragraph marks.

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3.5 MACROS

In Microsoft Office Word 2007, you can automate frequently used tasks by creating macros. A macro is a series of commands and instructions that you group together as a single command to accomplish a task automatically. Macros are used for the following reasons:

- To speed up routine editing and formatting.
- To combine multiple commands, for example to insert a table with a specific size and borders and with a specific number of rows and columns.
- To make an option in a dialog box more accessible.
- To automate a complex series of tasks.

You can use the macro recorder to record a sequence of actions, or you can create a macro from scratch by entering Visual Basic for Applications or VBA. A macro language version of Microsoft Visual Basic that is used to program Microsoft Windows based applications and is included with several Microsoft programs. Visual Basic Editor supports an environment in which you write new and edit existing Visual Basic for Applications code and procedures. The Visual Basic Editor contains a complete debugging toolset for finding syntax, runtime and logic problems in your code.

- On the **Developer** tab, in the **Code** group, click **Record Macro**. Following steps are required to change the keyboard shortcut for a macro:
- **Begin Recording:** To begin recording the macro without assigning it to a button on the Quick Access Toolbar or to a shortcut key, click OK.
- **Create a Button:** To assign the macro to a button on the Quick Access Toolbar, do the following:
 - o Click on **Button**.

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- o Under **Customize Quick Access Toolbar**, select the document or all documents for which you want to add the macro to the Quick Access Toolbar.
- o Under **Choose commands from** dialog box, click the macro that you are recording and then click **Add**.
- o To customize the button, click **Modify**.
- o Under **Symbol**, click the symbol that you want to use for your button.
- o In the **Display name** box, type the macro name that you want to display.
- o Click OK twice to begin recording the macro.

Note: To make your macro available in all documents, be sure to click **Normal.dotm**.


The symbol that you choose is displayed in the Quick Access Toolbar. The name that you type is displayed when you point to the symbol.

- **Assign a Keyboard Shortcut:** To assign the macro to a keyboard shortcut, do the following:
 - o Click **Keyboard**.
 - o In the **Commands** box, click the macro that you are recording.
 - o In the **Press new shortcut key** box, type the key sequence that you want and then click **Assign**.
 - o Click **Close** to begin recording the macro.
- 2. Perform the actions that you want to include in the macro.
- 3. To stop recording your actions, click **Stop Recording** in the **Code** group.

Note: When you record a macro, you can use the mouse to click commands and options but not to select text. You must use the keyboard to select text.

Change the Keyboard Shortcut for a Macro

Following steps are required to change the keyboard shortcut for a macro:

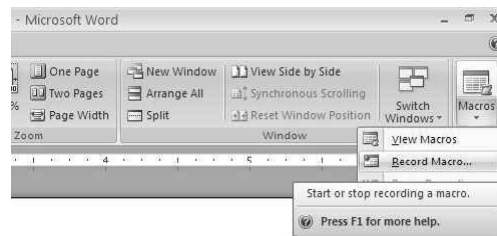
- Click the **Microsoft Office Button**  and then click **Word Options**.
- Click **Customize**.
- Next to **Keyboard shortcuts**, click **Customize**.
- In the **Categories** list, click **Macros**.
- In the **Macros** list, click the macro that you want to change.
- In the **Press new shortcut key** box, type the key combination that you want to choose.
- Check the **Current keys** box to make sure that you are not assigning a key combination that you already use to perform a different task.
- In the **Save changes in** list, click the option that matches where you want to run your macro.
- Click **Close**.

Note: To make your macro available in all the documents, you need to click **Normal.dotm**.

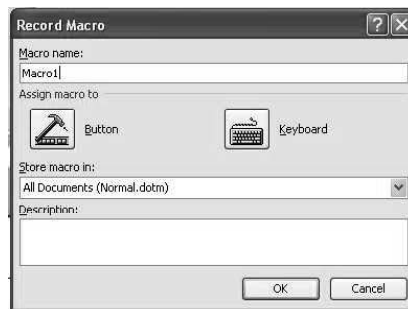
To Create and Record a Macro

To create a macro, following steps are required:

- Select **View** option in menu bar.



- Select '**Record Macro...**' option to record a macro and do the required operation as you want to save in recording macro. Type a name for '**Macro name:**' bar, for example **Macro1** as shown in the screen below.



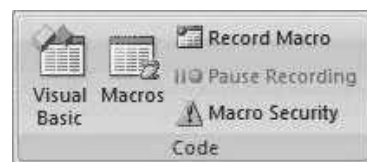
- Select the macro name and click on **Run** button as shown in the screen below. The performed tasks are to be run for selected macro.



To Run a Macro

Following steps are required to run a macro:

- On the **Developer** tab, in the **Code** group, click **Macros**.
- In the list under **Macro name**, click on the macro name that you want to run.
- Click **Run**.



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3.6 LINKING AND EMBEDDING OBJECT

You can insert objects into a Microsoft Word document when you want to include information from files created in other Microsoft Office programs or in any program that supports linked objects. An object refers to a table, chart, graphic, equation, or other form of information. Objects created in one application, for example spreadsheets, and linked or embedded in another application are Object Linking and Embedding or OLE objects. Linked object refers to an object that is created in a source file and inserted into a destination file while maintaining a connection between the two files. The linked object in the destination file can be updated when the source file is updated and embedded objects. Once embedded, the object becomes part of the destination file. Changes you make to the embedded object are displayed in the destination file.

Difference between Linked Objects and Embedded Objects

The main differences between linked objects and embedded objects are where the data is stored and how you update the data after you place it in the destination file.

- **Linked Objects:** When an object is linked, information is updated only if the source file is modified. Linked data is stored in the source file. The destination file stores only the location of the source file, and it displays a representation of the linked data. Use linked objects if file size is a consideration. Linking is also useful when you want to include information that is maintained independently, such as data collected by a different department, and when you need to keep that information up-to-date in a Word document. When you link to an Excel object, you can use the text and number formatting from Excel, or you can apply the formats supplied by Word. If you use the Word formats, you can preserve formatting features when the data is updated. For example, you can change table layout, font size and font color without losing those changes once the object in the source file is updated.
- **Embedded Objects:** When you embed an object, information in the destination file does not change if you modify the source file. Embedded objects become part of the destination file and once inserted are no longer part of the source file. Because the information is totally contained in one Word document, embedding is useful when you want to distribute an online version of your document to people who do not have access to independently maintained worksheets.

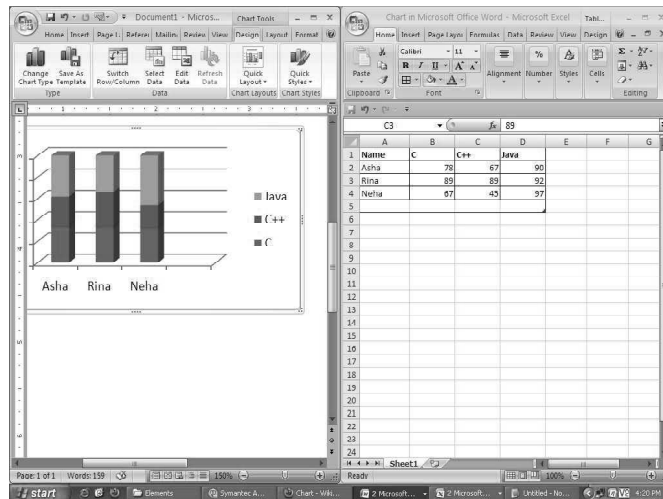
Edit Linked Object

Following steps are required to edit the linked object:

- On the **Edit** menu, click **Links**.
- In the **Links** dialog box, in the list of objects, click the linked object and then click **Open Source**. The linked object, an object that is created in a source file and inserted into a destination file, while maintaining a connection between the two files. The linked object in the destination file can be updated when the source file is updated.

- Make the changes you want to the linked object.
- In the source program, click **Exit** on the **File** menu and **Save** the file. The source program is used to create a linked object or embedded object. To edit the object, you must have the source program installed on your computer.

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In the above representation, you can see how the OLE object is embedded in Microsoft Word with the help of Excel source data. If you change source data the embedded object (in the form of chart) is also changed.

Note: You can preserve formatting changes you make to a Microsoft Excel linked object in your document by selecting the **Preserve formatting after update** check box in the Links dialog box.

Introducing Graphics in Word Document

In MS Word 2007, you can modify objects and including graphics in many ways to add sparkle to even the most mundane document. You can add drop caps, group two or more objects into one object and change the layering of overlapping objects. You can also position graphics anywhere on a page, change text wraps around an object and modify how objects are aligned relative to each other and to the page. You can enhance graphic objects with gradient color fills, textures, shadows and 3-D effects, and by adding a watermark and page border.

MS Word 2007 allows you to insert illustrations and pictures into a document. To insert illustrations follow the steps given below:

- Place your cursor in the document where you want the illustration/picture.
- Click the **Insert** Tab on the Ribbon.



- Click the **Clip Art** Button.
- The dialog box will open on the screen and you can search for **Clip Art**.
- Choose the illustration you wish to include.

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To insert a picture following steps are required:

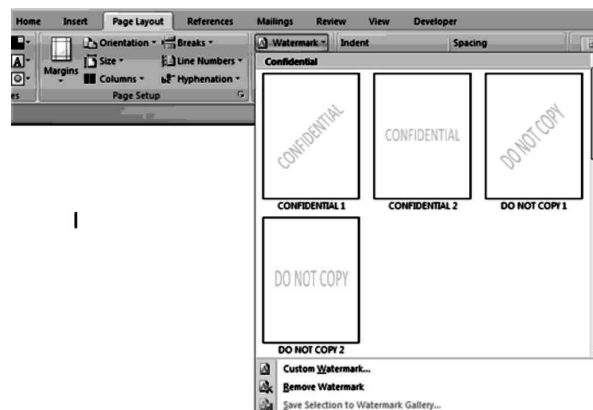
- Place your cursor in the document where you want the illustration/picture.
- Click the **Insert** tab on the Ribbon.
- Click the **Picture** button.
- Browse the picture you wish to include.
- Click the **Picture**.
- Click **Insert**.



Watermark

Watermark is a translucent image that appears behind the primary text in a document. To insert a watermark, following steps are required:

- Click the **Page Layout** tab in the Ribbon.
- Click the **Watermark** button in the **Page Background** Group.
- Click the **Watermark** you want for the document or click **Custom Watermark** and create your own watermark.
- To remove a watermark, follow the steps given above but click **Remove Watermark**.



Insert AutoShapes and Smart Art

MS Word 2007 also permits you to insert SmartArt and AutoShapes into the document, at the desired location. Following are the steps for the insertion of illustrations into a document:

SmartArt is a collection of graphics that you can utilize to organize information in your document. It includes timelines, processes or work flow. The following steps need to be performed in order to insert SmartArt into the document:

Move your cursor in the document where you want the illustration/picture to appear.

- Click on the **Insert** tab in the Ribbon.
- Click on the **SmartArt** button.
- Click on the **SmartArt** that you wish to include in your document.
- Click on the arrow on the left side of the graphic to insert text or type the text in the graphic.

Formatting Graphic Objects using Drawing Toolbar

Following steps are required to format graphic objects using **Drawing Toolbar**:

- Click on the **Insert menu** found in the top right portion of the screen.
- Select **Picture** from the drop-down menu.
- Choose the **AutoShapes** option.

Once you have completed these steps, the **Drawing Toolbar** will stay located under your drop-down menus.



Once you insert an object into the screen, you can format objects as shown in the screen below.



Check Your Progress

6. What do you understand by Web layout view?
7. What is the use of indentation?
8. Why borders and shading are used in documents?
9. List two uses of macros.

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3.7 MICROSOFT EXCEL 2007

Microsoft Excel 2007 is the newest version of spreadsheet software in the Microsoft 2007 Office Suite. This spreadsheet application is specifically developed by Microsoft for Microsoft Windows and Mac OS X. Technically speaking, MS Excel 2007 files are referred as spreadsheets. This is a generic term, which sometimes means a workbook (file) and sometimes means a worksheet (a page within the file). Data files created with MS Excel 2007 are called workbooks. MS Excel 2007 files by default contain three blank worksheets. This gives you the flexibility to store related data in different locations within the same file. More worksheets can be added and unwanted worksheets can be deleted as per the user requirement. Thus, MS Excel 2007 is a powerful and most extensively used tool as spreadsheet application which allows you to store, organize and analyse numerical, graphic and text data. Spreadsheets allow information to be organized in rows and tables, and can be analysed using various mathematical, trigonometric, text, logical, date and time functions. The number of rows is now 1,048,576 (2^{20}) and columns is 16,384 (2^{14}). Microsoft Excel 2007 has the basic features of all spreadsheets, using a grid of cells arranged in numbered rows and letter named columns to organize data manipulations. Further with Microsoft Excel 2007 you can analyse, manage and share information quickly and easily to formulate more knowledgeable decisions. With the new user interface, rich data visualization and PivotTable views, professional looking charts can be created easily.

The advanced features in Microsoft Excel 2007 include Office themes, more styles, rich conditional formatting, easy formula writing, Sort & Filter, data validation, worksheet and workbook protection, Goal Seek, Scenario, PivotTable and PivotChart. Goal Seek and Scenario are part of What-If Analysis tools. MS Excel 2007 supports charts, graphs or histograms generated from specified groups of cells. The generated graphic component can either be embedded within the current sheet or added as a separate object. OLE or Object Linking and Embedding allow a Windows application to format or calculate data. This may acquire the form of 'embedding' where an application uses another to handle the task, for example a MS PowerPoint presentation can be embedded in an MS Excel 2007 spreadsheet or vice versa.

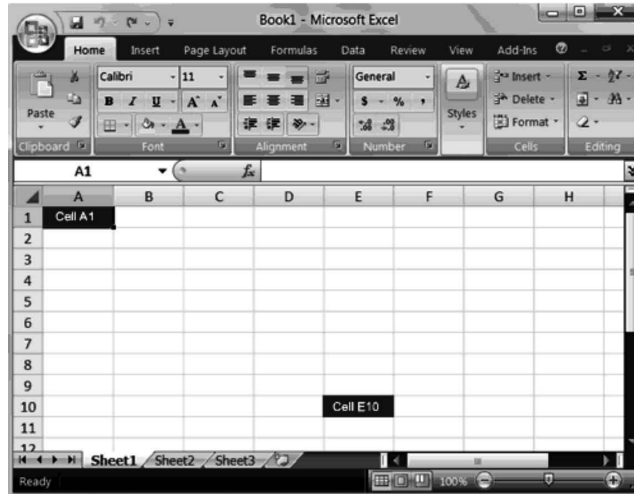
You can create a spreadsheet using various formatting and editing features given in the Ribbon panel. Thus, you can perform calculations using the functions given in MS Excel 2007 and can sort and filter data as per your requirement. You can create graphs in the worksheet, insert illustrations, Clip Art, SmartArt, Shapes and pictures to enhance your worksheet. You can freeze and unfreeze rows and columns and can also hide and unhide any worksheet.

Worksheet, Workbook and Workspace

A Microsoft Excel 2007 file in which you can enter and store related data is known as a workbook. A workbook is also identified as a spreadsheet that is a group of cells on a single sheet where you in fact keep and operate data. Every

worksheet consists of columns and rows. The columns are lettered A to Z and then continue with AA, AB, AC, and so on. The rows are numbered from 1 to 1,048,576. The number of rows and columns that you can hold in your worksheet is restricted by computer memory and your system resource.

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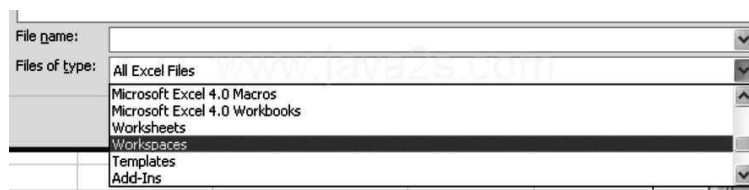


Cell address is the combination of a column letter and a row number. For example, if a cell is located in the upper left corner of the worksheet, which is A1, this means that it is located in column A and row 1. Similarly, cell E10 is situated in column E on row 10. The data can be entered into the cells present on the worksheet. N-number of worksheets can be present in a workbook. To work with workspace you have to perform the following steps:

- Click the Office button. Click **Open**.

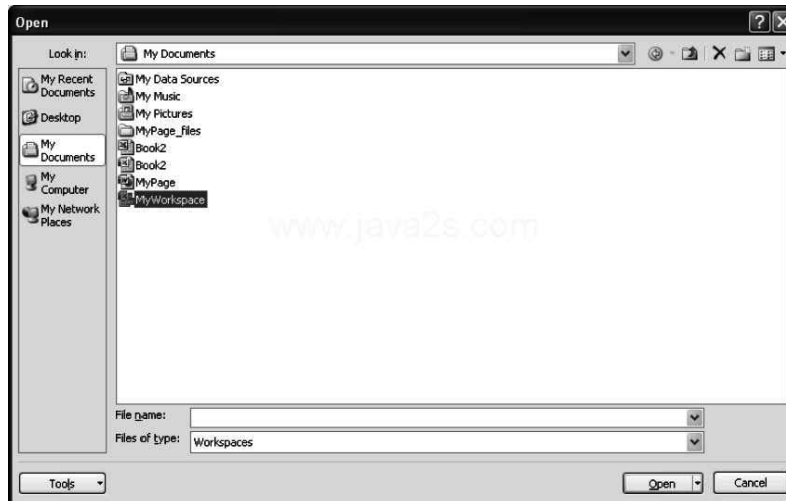


- Click the **Files of type:** list arrow. Click **Workspace**.



- Select the workspace file. Click **Open**.

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Getting Started

As soon as you start MS Excel 2007, you will see that its features are similar to the previous versions. You will also see that there are many additional features which help you to work with special effects. Three new features that are included in MS Excel 2007 are the Microsoft Office Button, the Quick Access Toolbar and the Ribbon.

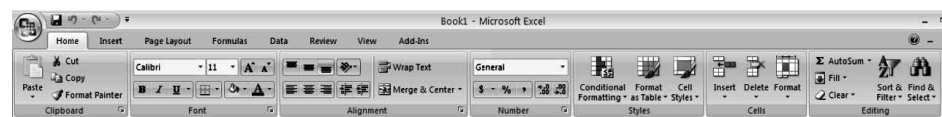
Microsoft Office Button

The **Microsoft Office Button** performs various functions that were found in the File menu of older versions of MS Excel 2007. This button permits you to create a new workbook, open an existing workbook, save a workbook using Save and Save As, Print, Send or Close a workbook.



Ribbon

The **Ribbon** is the panel at the top portion of the spreadsheet. It includes seven tabs namely, **Home**, **Insert**, **Page Layout**, **Formulas**, **Data**, **Review** and **View**. **Add-ins** is another option which is automatically displayed on the Ribbon when you add any new application to the program. Each tab is a collection of features designed to perform specific functions that you require while creating or editing MS Excel 2007 spreadsheets.



The frequently used features are displayed on the Ribbon. To view additional features of each group, click on the arrow at the bottom right corner of each group.

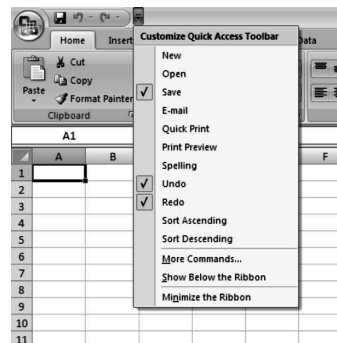


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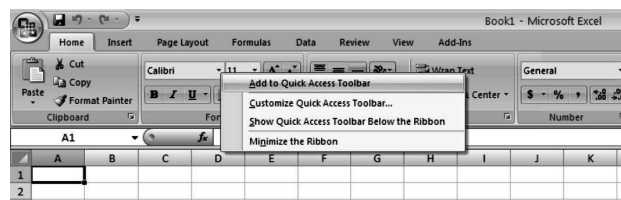
- **Home:** Clipboard, Fonts, Alignment, Number, Styles, Cells, Editing.
- **Insert:** Tables, Illustrations, Charts, Links, Text.
- **Page Layouts:** Themes, Page Setup, Scale to Fit, Sheet Options, Arrange.
- **Formulas:** Function Library, Defined Names, Formula Auditing, Calculation.
- **Data:** Get External Data, Connections, Sort & Filter, Data Tools, Outline.
- **Review:** Proofing, Comments, Changes.
- **View:** Workbook Views, Show/Hide, Zoom, Window, Macros.

Quick Access Toolbar

The **Quick Access Toolbar** can be customized as per the user need and contains commands that you use most frequently. You can place the Quick Access Toolbar above or below the Ribbon. To change the location of the Quick Access Toolbar, click on the arrow at the end of the toolbar and click **Show Below** the Ribbon.



You can also add more items to the Quick Access toolbar. To do this, right click on any item in the Office Button or the Ribbon and then click on Add to Quick Access Toolbar. A shortcut will be added there.



Mini Toolbar

Mini Toolbar is a new feature in Microsoft Office 2007. This is a floating toolbar and is displayed when you select text or right click any text. It displays the common formatting tools, such as Bold, Italic, Fonts, Font Size and Font Color.



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MS Excel 2007 Options

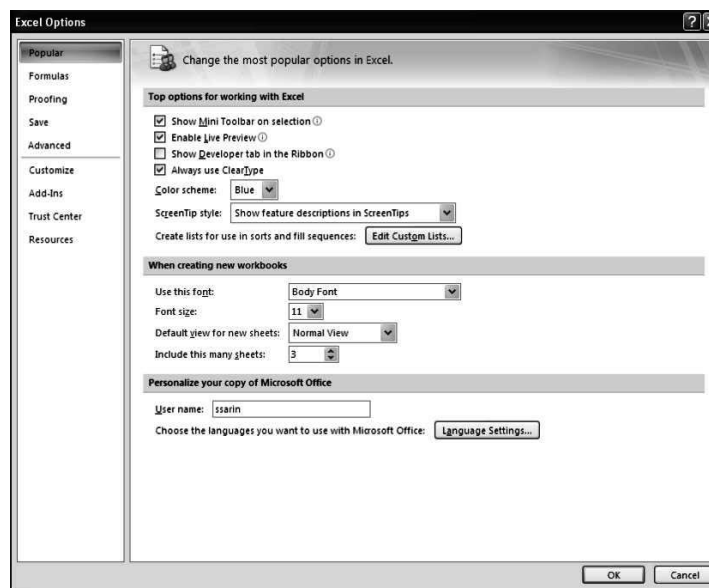
MS Excel 2007 provides a wide range of customizable options that help you to create an MS Excel 2007 workbook of required specifications. To access these customizable options, follow the given steps:

- Click on the Office Button.
- Click on MS Excel 2007 Options which you will get from Quick Access Toolbar.



Popular

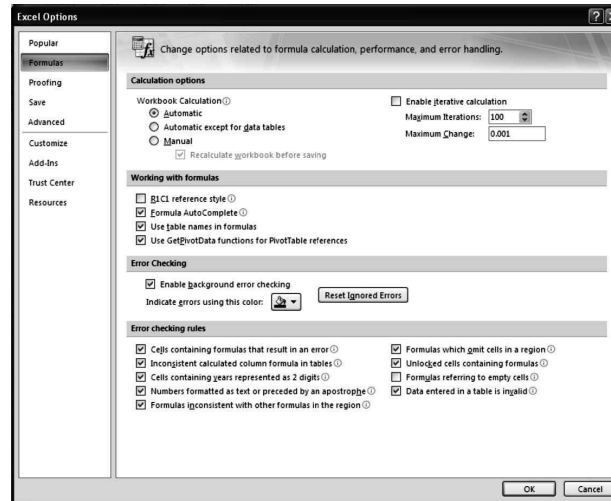
The **Popular** features helps you to personalize your work environment using the Mini Toolbar, Color schemes, default options when creating new workbooks and creating lists for sort and fill sequences. It also helps you to access the Live Preview feature to preview how a feature affects the document as you hover over different choices. The choices provide new font size, table style or cell style which can be applied on a workbook as per requirement.



Formulas

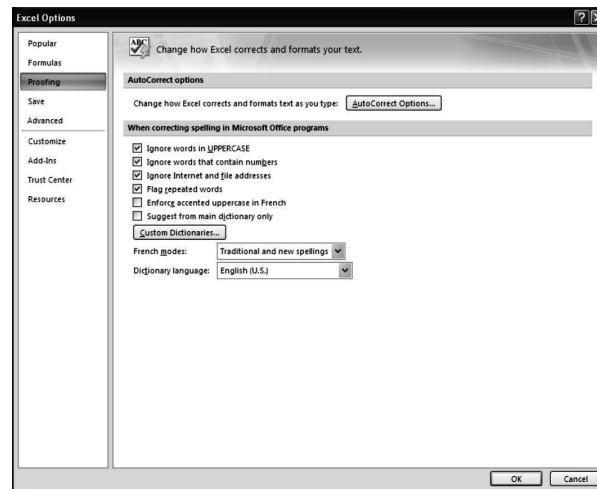
The **Formulas** feature permits you to modify the calculation options, to work with formulas, error checking and error checking rules. Working with formulas provide four check boxes which are R1C1 reference style, Formula AutoComplete, Use table names in formulas and Use GetPivotData functions for PivotTable references as shown in the given screen.

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Proofing

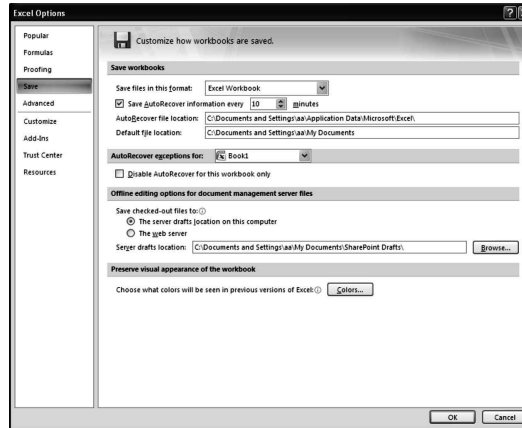
The **Proofing** feature permits you to personalize the options for correcting words and formats of your text. You will get AutoCorrect option in Proofing feature. You can customize auto correction settings so that it will ignore certain words or errors in a document via the **Custom Dictionaries...**



Save

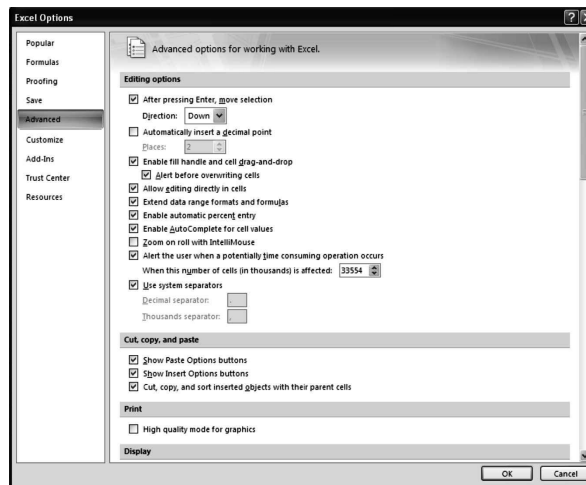
The **Save** feature permits you to personalize your workbook when saved. You can also specify how often you want auto save to run and where to save the workbooks.

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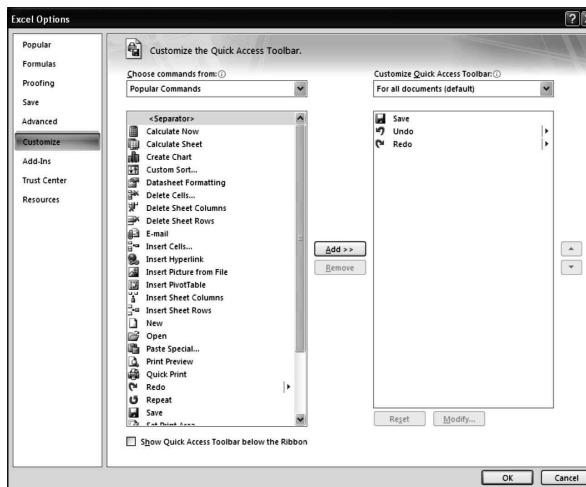
Advanced

The **Advanced** feature permits you to specify the options for editing, copying, pasting, printing as well as displaying formulas, calculations and other general settings.



Customize

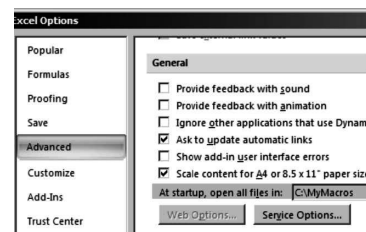
Customize permits you to add specific features to the Quick Access Toolbar. It adds the tools which you frequently use.



Opening MS Excel 2007 Application

To open MS Excel 2007 application, following steps are required:

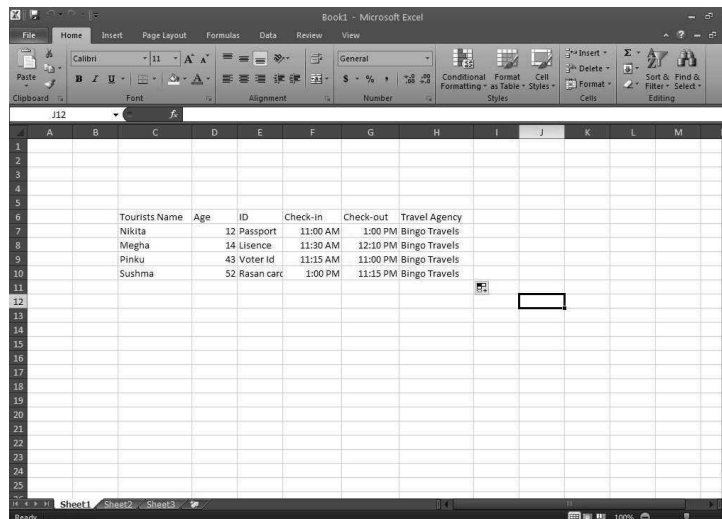
- Click the Office Button, then press right to select **Customize Quick Access Toolbar** which provides MS Excel 2007 Options tab.
- Click the Advanced category and scroll down up to the General section.
- In the box for '**At startup, open all files in**', you might see the name of a folder and its path. Clear the folder information from that box or go to that folder and remove the unwanted files. Click **OK** to close the MS Excel 2007 Options dialog box.



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Entering Information in a Worksheet

To enter information in a worksheet, you need to open an empty workbook and enter the data as shown in the screen, below:



Moving Around Worksheet and Workbook

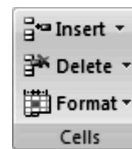
The arrow keys give you the option to move around your worksheet. With the help of down arrow key you can move downward one cell at a time. Similarly, the up arrow key can be used to move upward one cell at a time. You can even move across the page to the right, one cell at a time by using the Tab key. By holding hold the SHIFT key and then pressing the Tab key, you can move to the left, one cell at a time. You even have the right and left arrow keys available by which you can also move right and left respectively, one cell at a time. The Page Up (Pg Up) and Page Down (Pg Dn) keys move up and down one page at a time. By pressing down the CTRL key and simultaneously pressing the Home key, you can move to the beginning of the worksheet.

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It is convenient to either move or copy the whole worksheet. The term worksheet refers to the main document that you use in MS Excel 2007 to store and work with data. There might be a chance that calculations or charts that are based on worksheet data might turn out to be inaccurate if you shift the worksheet. You can move or copy worksheet by inserting between sheets that are referred by a 3-D reference. This reference refers to a range that spans two or more worksheets in a workbook. Data on that worksheet might be unexpectedly included in the calculation. Select the worksheets that you want to move or copy as shown in the screen below.



To move to the next or previous sheet tab, you can also press CTRL + Pg Up or CTRL + Pg Dn. On the **Home** tab, in the **Cells** group, click **Format** and then under **Organize Sheets**, click **Move or Copy Sheet**.



You can also right click a selected sheet tab and then click **Move or Copy**. In the **Move or Copy** dialog box, in the **Before sheet** list, do one of the following:

- Click the sheet before which you want to insert the moved or copied sheets.
- Click **move to end** to insert the moved or copied sheets after the last sheet in the workbook and before the **Insert Worksheet** tab.



To copy the sheets instead of moving them, in the **Move or Copy** dialog box, select the **Create a copy** check box.

Saving a Workbook

To save a workbook, you have two options, **Save** and **Save As**. To save a document, follow the given steps:

- Click on the **Microsoft Office Button**.
- Click on **Save**.



You can also use the **Save As** feature to save the workbook with a different name or to save it as earlier versions of MS Excel 2007. The older versions of MS Excel 2007 cannot be opened in an MS Excel 2007 worksheet unless you save it as an MS Excel 97-2003 Format. To use the **Save As** feature, follow the given steps:

- Click on the **Microsoft Office** button.
- Click on **Save As**.
- Give a name for the workbook.
- In the **Save as Type** box, select **Excel 97-2003** workbook.

Closing a Workbook File

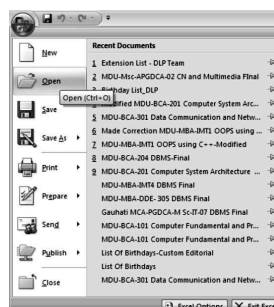
To close a workbook file, you need to press CTRL+F4 key combination. You can close all open workbooks without closing MS Excel 2007. For this, you need to open file menu and select Close All option.



Opening an Existing Workbook File

To open an existing workbook, follow the given steps:

- Click on the **Microsoft Office** button.
- Click on **Open**.
- Browse to the workbook.
- Click on the title of the workbook.
- Click on **Open**.



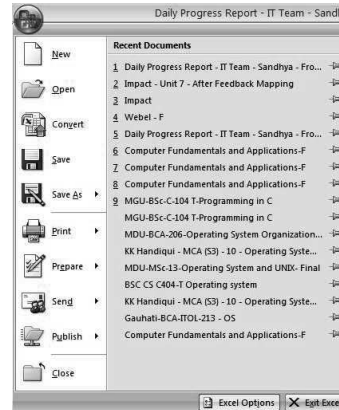
Quitting From MS Excel 2007

To quit from MS Excel 2007, click on **Microsoft Office Button** and then select **Exit MS Excel 2007** button.

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You will quit from MS Excel 2007.

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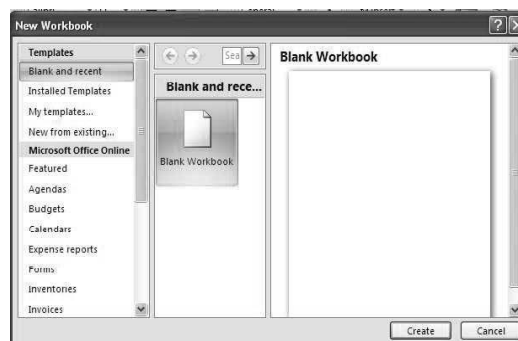
Check Your Progress

10. What is a spreadsheet?
11. What does advanced feature permit in MS Excel 2007?
12. How will you edit a worksheet in Microsoft Excel 2007?
13. What does a cell address identifies in MS Excel 2007?

3.8 CREATING AND EDITING WORKSHEET

You can create a new worksheet and can edit any existing worksheet as per your requirements. To create a worksheet, follow the given steps:

- Click on the **Office Button** and select **New** option. It will open the **New Workbook** dialog box as shown below. From the **Templates** group select **'Blank and recent'** option.
- Now click on **'Blank Workbook'** and select **Create** button. A new blank spreadsheet will be displayed on the screen. Give a name to this worksheet and save the file with **' .xlsx '** file name extension.



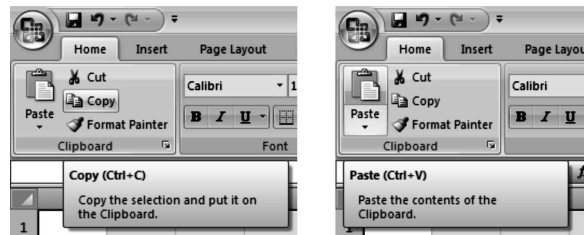
You can edit a worksheet if any incorrect information has been entered into a cell. To do so, click on the cell and enter the correct information. Typing replaces whatever is in the cell. Editing a spreadsheet includes copy, cut, paste, move, changing column width/row height, cell alignment and formatting, font and number formatting, inserting and deleting cell(s)/row(s)/column(s), insert/copy/move/

rename/delete a worksheet.

Copy and Paste

To copy and paste data, follow the given steps:

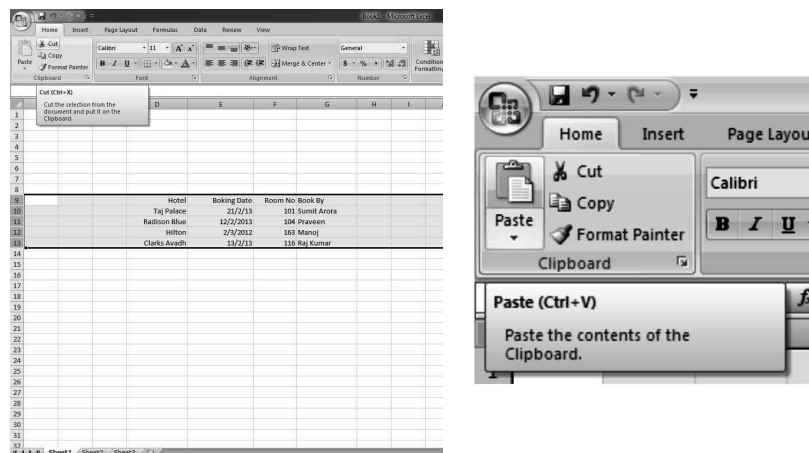
- Select the cell(s) that you want to copy.
- On the **Clipboard** group of the **Home** tab, click on **Copy**.
- Select the cell(s) where you want to copy the data.
- On the **Clipboard** group of the **Home** tab, click on **Paste**.



Cut and Paste

To cut and paste data, follow the given steps:

- Select the cell(s) that you want to copy.
- On the **Clipboard** group of the **Home** tab, click on **Cut**.
- Select the cell(s) where you want to copy the data.
- On the **Clipboard** group of the **Home** tab, click on **Paste**.



Undo and Redo

To undo or redo the most recent actions, click on **Undo** or **Redo** on the **Quick Access Toolbar**.



Changing Column Width/Row Height

In MS Excel 2007, you have the option to modify any column width or row height in your worksheets so that the readability and look of the data can be changed. For example, if your worksheet contains large numbers, you can enlarge the columns to make the worksheet less cluttered. It is much more advisable to expand the

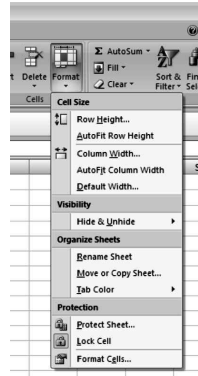
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width of the columns that contain cells with truncated text entries or numbers that MS Excel 2007 shows as #####.

To change the width of a column or the height of a row, follow the given steps:

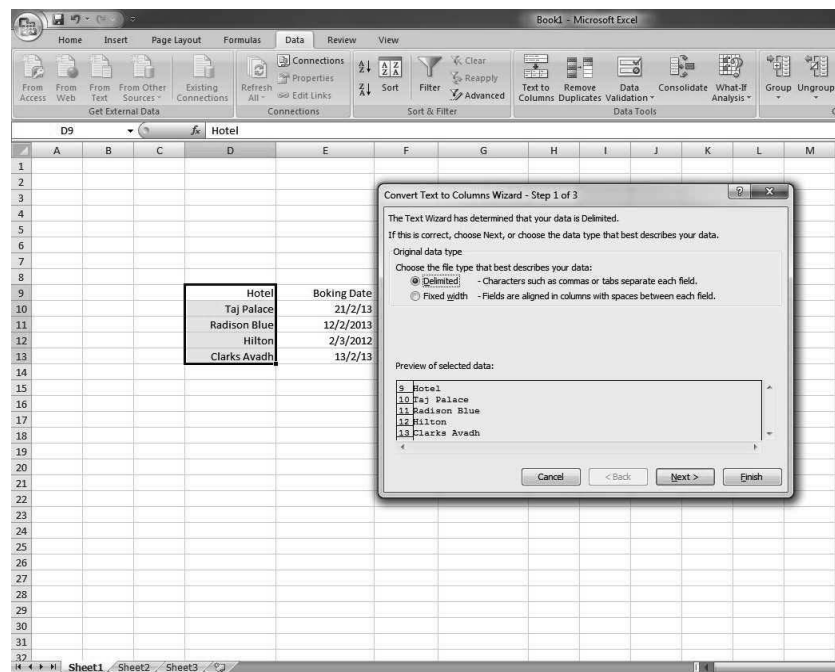
- Click on the **Format** button on the **Cells** group of the **Home** tab.
- Manually adjust the height and width by clicking on **Row Height** or **Column Width**.
- To use **AutoFit**, click on **AutoFit Row Height** or **AutoFit Column Width**.



Cell Formatting—Font, Alignment and Number

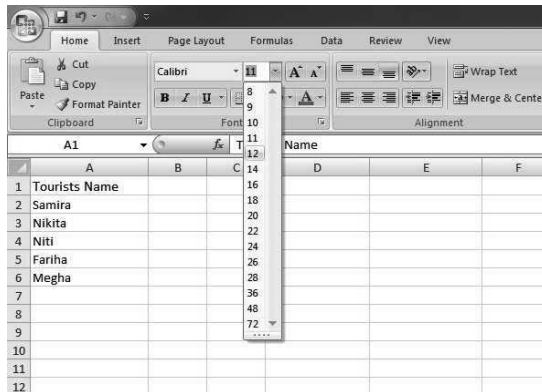
Convert Text to Columns: Sometimes, you may have to split data of one cell and place them in two or more cells. You can do this by utilizing the Convert Text to Columns Wizard.

- Highlight the column in which you wish to split the data.
- Click on the **Text to Columns** button on the **Data** tab.
- Click on **Delimited** radio button if you have a comma or tab separating the data or click fixed widths to set the data separation at a specific size.



Modify Fonts: Modifying fonts in MS Excel 2007 helps you to emphasize titles and headings. To modify a font, follow the given steps:

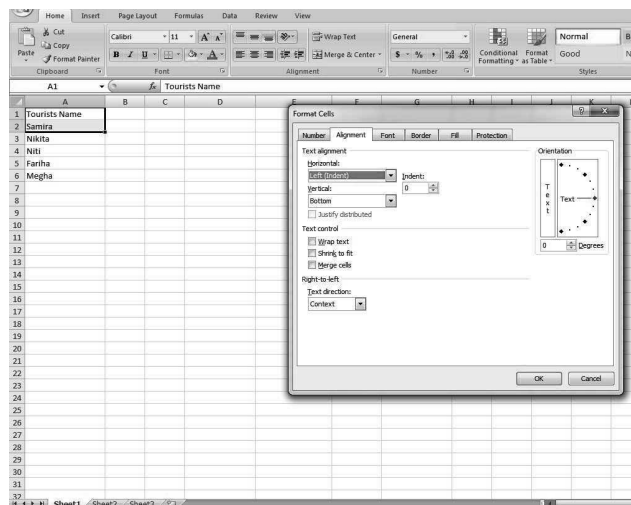
- Select the cell or cells where you want to apply the font.
- On the **Font** group on the **Home** tab, select the font type, size, bold, italics, underline or color.



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Format Cells Dialog Box: In MS Excel 2007, you can apply specific formatting to any cell. To apply formatting to a cell or group of cells, follow the given steps:

- Select the cell or cells to change the formatting.
- Click on the **Dialog Box** arrow on the **Alignment** group of the **Home** tab.



There are various tabs on this dialog box that permit you to modify the properties of the cell or cells.

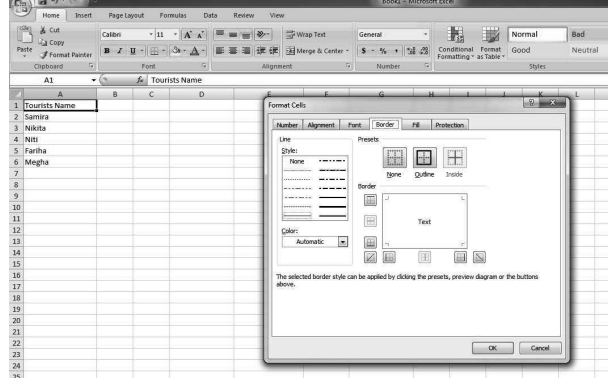
- **Number:** Allows the display of different number types and decimal places.
- **Alignment:** Allows the horizontal and vertical alignment of text, wrap text, shrink text, merge cells and the direction of the text.
- **Font:** Allows control of font, font style, size, color and additional features.
- **Border:** Changes border styles and colors.
- **Fill:** Fill colors and styles.
- **Protection:** Locking cells and hiding formulas.

NOTES

Adding Borders and Colors to Cells

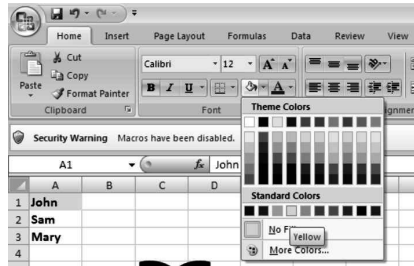
Borders and colors can be added to cells manually or using the styles. To add borders manually, follow the given steps:

- Click on the **Borders** drop-down menu on the **Font** group of the **Home** tab.
- Select the suitable border.



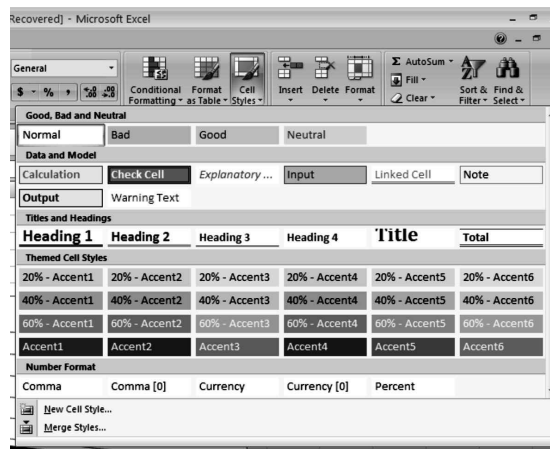
To apply colors manually, follow the given steps:

- Click on the **Fill** drop-down menu on the **Font** group of the **Home** tab.
- Select the proper color.



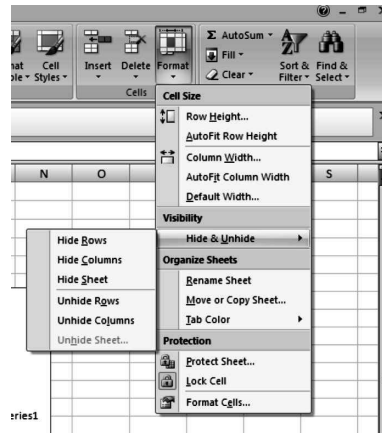
For applying borders and colors using styles, follow the given steps:

- Click on **Cell Styles** on the **Home** tab.
- Select a style or click on **New Cell Style**.



Hide or Unhide Rows or Columns: To hide or unhide rows or columns, follow the given steps:

- Select the row or column you want to hide or unhide.
- Click on the **Format** button on the **Cells** group of the **Home** tab.
- Click on **Hide & Unhide**.



NOTES

Inserting and Deleting Cell(s)/Row(s), Column(s)

Inserting Cells, Rows and Columns

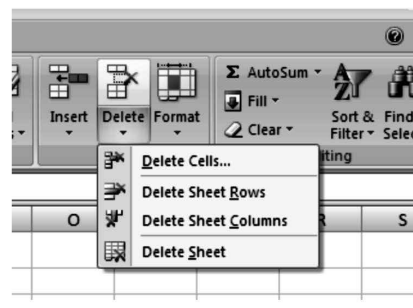
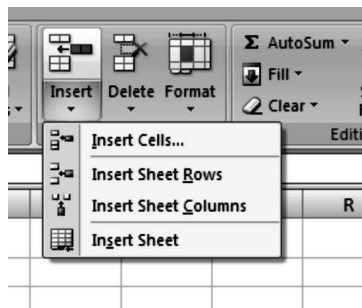
To insert cells, rows and columns in MS Excel 2007, follow the given steps:

- Place the cursor in the row below where you want the new row or in the column to the left of where you want to have the new column.
- Click on the **Insert** button on the **Cells** group of the **Home** tab.
- Click on the proper option **Cell, Row or Column**.

Delete Cells, Rows and Columns

To delete cells, rows and columns, follow the given steps:

- Place the cursor in the cell, row or column that you want to delete.
- Click on the **Delete** button on the **Cells** group of the **Home** tab.
- Click on the appropriate option **Cell, Row or Column**.



NOTES

Insert/Copy/Move/Rename/Delete Worksheet

To insert a new worksheet, do any one of the following steps:

- To quickly insert a new worksheet at the end of the existing worksheets, click the **Insert Worksheet** tab at the bottom of the screen.



- To insert a new worksheet in front of an existing worksheet, select that worksheet and then, on the **Home** tab, in the **Cells** group, click **Insert** and then click **Insert Sheet**.



You can also right click the tab of an existing worksheet and then click **Insert**. On the **General** tab, click **Worksheet**, and then click **OK**.

Insert Multiple Worksheets at the Same Time

Hold down SHIFT and then select the same number of existing sheet tabs of the worksheets that you want to insert in the open workbook. For example, if you want to add three new worksheets, select three sheet tabs of existing worksheets. On the **Home** tab, in the **Cells** group, click **Insert**, and then click **Insert Sheet**.

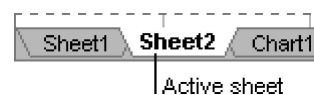
You can also right click the selected spreadsheet tabs and then click **Insert**. On the **General** tab, click **Worksheet** and then click **OK**.

To move to the next or previous sheet tab, press CTRL+Pg Up or CTRL+Pg Dn. On the **Home** tab, in the **Cells** group, click **Format** and then under **Organize Sheets**, click **Move or Copy Sheet**.

You can also right click a selected sheet tab and then click **Move or Copy**. In the **Move or Copy** dialog box, in the **Before sheet** list, do one of the following:

- Click the sheet before which you want to insert the moved or copied sheets.
- Click **move to end** to insert the moved or copied sheets after the last sheet in the workbook and before the **Insert Worksheet** tab.

To copy the sheets instead of moving them in the **Move or Copy** dialog box, select the **Create a copy** check box. When you create a copy of the worksheet, the worksheet is duplicated in the workbook and the sheet name indicates that it is a copy, for example the first copy that you make of Sheet1 is named Sheet1 (2).



To rename the active sheet, one of the following steps can be performed:

- On the **Format** menu, point to **Sheet** and then click **Rename**.

- On the **Sheet tab** bar, right click the tab you want to rename and then click **Rename**.

Type the new name over the current name.

To delete a worksheet, follow the given steps:

- Open the workbook.
- Click on the **Delete** button on the **Cells** group of the **Home** tab.
- Click on **Delete Sheet**.

3.8.1 Selection in a Worksheet

To select contiguous columns in the worksheet, do the following task:

- Click to select the first column heading in the desired range and then drag the pointer to the last column in the desired range. Release the mouse button to select the columns.
- You can also click to select the first column heading in the desired range. Scroll the worksheet using the scroll bars at the bottom of the worksheet as needed to display the last column in the desired range.
- Hold down the SHIFT key and click on the last column heading.

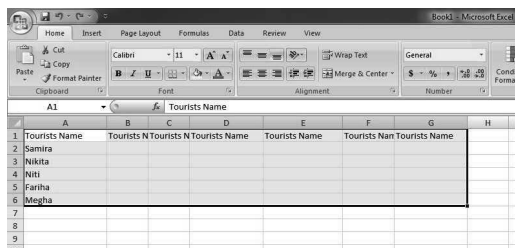
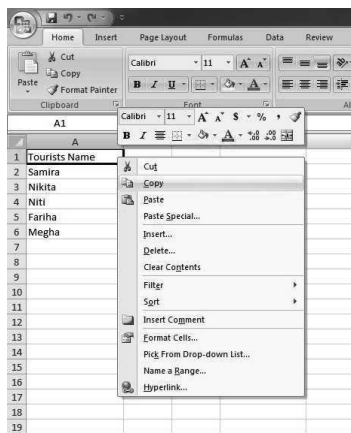
To select the entire worksheet, you need to select the first column heading and then drag the pointer across all remaining column headings in the worksheet.

- Click to select the first column heading, scroll the worksheet until the last column is visible.
- Press the SHIFT key and click on the last column heading.

Cell Selection

To select a cell or data to be copied or cut, follow the given steps:

- Click on the **cell**.
- Click and drag the cursor to select many cells in a range.



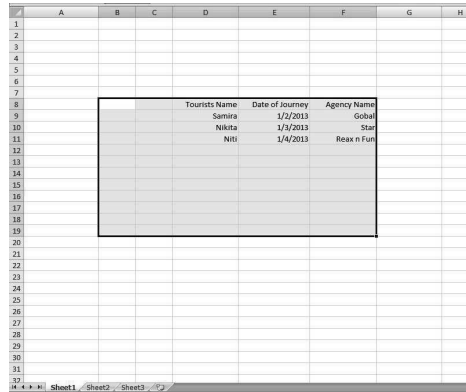
Selecting Data Range

Once you have entered your data in Microsoft Office MS Excel 2007, you should be aware of how to select cells in a worksheet. The cell cursor is made up of black border that surrounds the active cell and is called the current cell in a worksheet. In MS Excel 2007, following steps are required to select multiple cells in a worksheet:

NOTES

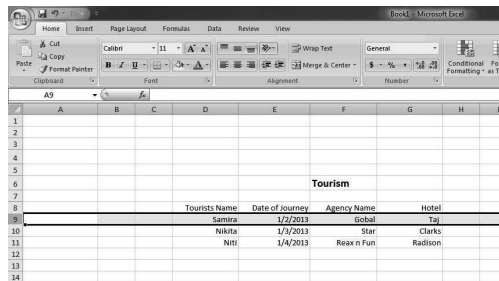
NOTES

- To select a single entire column, click a column heading, i.e., the letter or letters that indicate the column. To select multiple columns, drag across multiple column headings.
- To select a single entire row, click the row number. To select multiple rows, drag across multiple row numbers.
- To select sequential cells, click the first cell, hold down the SHIFT key and click the last cell you want. Optionally, click and drag the mouse over a group of cells to select a sequential area.
- To select non-sequential cells, click the first cell, hold down the CTRL key and click each additional cell or row or column you want to select.



Row(s)/Column(s) Selection

To select a row or column, click on the **row** or **column header**.



Entire Worksheet Selection

To select the entire worksheet, click the small box located to the left of column A and above row 1. You can select all cells in a worksheet by pressing CTRL+A key combination

3.8.2 Formulas and Functions

Formulas, also called functions, are a powerful feature of MS Excel 2007. Formulas available in MS Excel 2007 are grouped into the following categories:

- **Financial:** Formulas for calculating depreciation, interest, return on an investment, loan, payment and mortgage.
- **Logical:** The logical operators of **And**, **True**, **False**, **If**, **Not** and **Or**.
- **Text:** Formulas for combining text from various cells with the concatenate formula, converting text to upper case, lower case or proper case and trimming extra spaces from text.

- **Date & Time:** Formulas for calculating the number of days between two dates, the current date and day of the week for a given date.
- **Lookup & Reference:** Formulas for horizontal or vertical lookup, a hyperlink or getting data from a Pivot Table.
- **Math & Trig:** Formulas for calculating trigonometric functions, logs, random numbers, Roman numerals, rounding and truncating.
- **Statistical:** Formulas for calculating averages, frequency, percentile, quartile and standard deviation.
- **Engineering:** Formulas for Bessel functions and conversions between numbering systems, such as octal to binary.
- **Cube:** Formulas for working with three dimensional sets.
- **Information:** Includes formulas which return a true or a false response in determining if a cell is blank or if the content of the cell is a number or text.

NOTES

Cell Address

In MS Excel 2007 spreadsheet, the purpose of the cell address is to identify the position of the cell. The cell address is formed by the combination of column letter and row number of a cell, such as C4 or D8. Therefore, the column letter followed by the row number can identify a cell number. Active cell can also be known as current cell. The active cell is covered with a black border and data can be entered only in the active cell. In MS Excel 2007, the cell location of cell or group of cells is indicated by a cell reference. A cell reference consists of a column letter and row number that intersects at the cell's location. The cell reference of any active cell is displayed by the Name Box. Cell references are used in formulas, functions, charts and other MS Excel 2007 commands.

Operators: Arithmetic, Logical, Relational, String and Reference

Operators specify the type of calculation that you want to perform on the elements of a formula. There is a default order in which calculations occur, but you can change this order by using parentheses. There are four different types of calculation operators which are named as arithmetic, comparison, text concatenation and reference. To perform basic mathematical operations, such as addition, subtraction or multiplication and to combine numbers and to produce numeric results, use the arithmetic operators summarized as follows:

<i>Arithmetic Operator</i>	<i>Example</i>
+ (plus sign)	Addition (3+3)
- (minus sign)	Subtraction (3-1)Negation (-1)
* (asterisk)	Multiplication (3*3)
/ (forward slash)	Division (3/3)
% (percent sign)	Percent (20%)
^ (caret)	Exponentiation (3^2)

You can compare two values using the following operators. When two values are compared by using these operators, the result is a logical value either TRUE or FALSE as follows:

NOTES

<i>Relational Operator</i>	<i>Example</i>
= (equal sign)	Equal to (A1=B1)
> (greater than sign)	Greater than (A1>B1)
< (less than sign)	Less than (A1<B1)
>= (greater than or equal to sign)	Greater than or equal to (A1>=B1)
<= (less than or equal to sign)	Less than or equal to (A1<=B1)
<> (not equal to sign)	Not equal to (A1<>B1)

Use the string operator ampersand (&) to join or concatenate, one or more text strings to produce a single piece of text. The features of string operator is summarized as follows:

<i>String Operator</i>	<i>Example</i>
& (ampersand)	It concatenates two values to produce one continuous text value, such as 'Information' & 'Technology' produces the result as Information Technology.

Reference operators are used to combine ranges of cells for calculations. The following operators are the features of reference:

<i>Reference Operator</i>	<i>Example</i>
: (colon)	Range operator which produces one reference to all the cells between two references including the two references (B5:B15).
, (comma)	Union operator which combines multiple references into one reference (SUM(B5:B15,D5:D15)).
(space)	Intersection operator which produces one reference to cells common to the two references (B7:D7 C6:C8).

Operator Precedence

In Microsoft MS Excel 2007, you can combine several operators in a single formula to perform the operations in the order shown in the following table. If a formula contains operators with the same precedence, for example, if a formula contains both a multiplication and division operator then MS Excel 2007 evaluates the operators from left to right.

Operator	Description
: (colon)	Reference operators
(single space)	
, (comma)	
-	Negation (as in -1)
%	Percent
^	Exponentiation
* and /	Multiplication and Division
+ and -	Addition and Subtraction
&	Connects two strings of text (concatenation)
=	Comparison
<>	
<=	
>=	
<>	

Use of Parentheses

To change the order of evaluation, enclose in parentheses the part of the formula to be calculated first. For example, the following formula produces 11 because MS Excel 2007 calculates multiplication before addition. The formula multiplies 2 by 3 and then adds 5 to the result.

`=5+2*3`

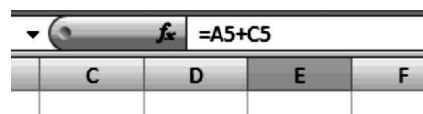
On the contrary, you can use parentheses to change the syntax as `=(5+2)*3`. Now the order of evaluation is changed and MS Excel 2007 will first add 5 and 2 and then multiplies the result by 3 to produce 21. In the example below, the cell addresses are used instead of numbers. The parentheses around the first part of the formula force MS Excel 2007 to calculate `B4+25` first and then divide the result by the sum of the values in cells D5, E5 and F5.

`=(B4+25)/SUM(D5:F5)`

Writing Simple Formulas

A formula is referred as an equation which performs operations on a worksheet data. In MS Excel 2007, the use of formulas is to basically perform mathematical operations, namely, addition, subtraction and multiplication. They also have the ability to compare the worksheet values, taking out the average of a student's test result, join text, etc. Formulas can refer to other cells on the same worksheet, cells on other worksheets in the same workbook or cells on worksheets in other workbooks. The MS Excel 2007 can automatically recalculate the answer in case you change the data in your spreadsheet, without even re-entering or changing the formula.

A basic formula format starts with an equals sign (=) which is followed by one or more operands, which are separated by one or more operators. Operands can be values, text, cell references, ranges, defined names or function names. The various symbols that represent the arithmetic and comparison operations are known as operands.



To enter a formula, follows the given steps:

- Place the cursor in the cell where the formula will appear, i.e., E5.
- Enter an = sign. All MS Excel 2007 formulas start with the equal sign.
- Enter the expression that will produce the result you want. This can consist of operands, values, variables, and symbols which represent mathematical procedures, such as + or – to add and subtract respectively, for example `A5+C5`.
- When the formula is complete press ENTER key. The result of the formula will be calculated and displayed in the cell E5.
- You can see the formula in the Formula bar at the top of the screen by placing the cell pointer on the cell E5.

NOTES

If there is an error in a formula, an error message is displayed which will begin with a # sign.

MS Excel 2007 Formula Error Messages

NOTES

Sometimes the formulas are not written correctly. It happens unknowingly while writing formulas. The following are some common error messages:

Error	Meaning
#####	The contents of the cell cannot be displayed correctly as the cell column is too narrow.
#REF!	Indicates that a cell reference is invalid. This message is displayed when you delete cells which involved a formula.
#NAME?	MS Excel 2007 cannot recognize text contained within a formula.

Copying Formula

One of the big advantages of a spreadsheet is to copy a formula or a text as often as you need. It is easier and faster to copy a formula than to rewrite it every time you need it. When you copy a formula by copying and pasting it you must be aware of cell references, whether they are absolute or relative. When you move a formula, the cell references within the formula do not change no matter what type of cell reference that you use. When you copy a formula, the cell references may change based on the type of cell reference that you use.

Select the cell that contains the formula that you want to copy. On the **Home** tab, in the **Clipboard** group, click **Copy**. Do one of the following steps:

- To paste the formula and any formatting, on the Home tab, in the Clipboard group, click **Paste**.
- To paste the formula only, on the **Home** tab, in the **Clipboard** group, click **Paste**, click **Paste Special** and then click **Formulas**.

You can paste only the formula results. On the **Home** tab, in the **Clipboard** group, click **Paste**, click **Paste Special** and then click **Values**. Verify that the cell references in the formula produce the result that you want. If necessary, switch the type of reference by doing the following:

- Select the cell that contains the formula.
- In the formula bar, you can enter or edit values or formulas in cells. It displays the constant value or formula stored in the active cell, select the reference that you want to change.
- Press F4 to switch between the combinations.

Cell Referencing

As already discussed, each box on the MS Excel 2007 screen is a cell and each cell can be located in a spreadsheet by means of its reference termed as cell reference. Cell on other worksheets in the same workbook and to other workbook can also be referred by cell references. References to cells in other workbooks are called links or external references. When cell references are used in formulas, MS Excel 2007 will calculate the answer using the data located in the referenced

cells. If that data should later change, MS Excel 2007 will automatically recalculate the formula and update the answer.

Calling the cells by just their column and row labels, such as 'A1' is called **relative referencing**. When a formula contains relative referencing you copy it from one cell to another, MS Excel 2007 will not create an exact copy of the formula. It will only change the cell addresses relative to the row and column to which it is moved. For example, for a simple addition the formula in cell D1 = (A1+B1) will be copied to cell D2 as = (A2+B2). It will reflect the new row. This is called **absolute referencing** and is accomplished by placing dollar signs '\$' within the cell addresses in the formula. Now, the formula in cell D1 will look like = (\$A\$1+\$B\$1). **Mixed referencing** can also be used when only the row and column is to be fixed. For example, in the formula = (A\$1+\$B2) the row of cell A1 is fixed and the column of cell B2 is fixed.

NOTES

Relative Referencing, Absolute Referencing and Mixed Referencing

A reference is a connection to something, that is to say when you type in the formula =SUM (A1;B1) you refer to the sum of the content of A1 and the content of B1. The various types of references are discussed below:

Relative Reference: Reference to rows and columns changes when we copy the formula in another cell. The formula adapts to its environment because references relate to the distance between the formula and the cells that form the formula. This is the option MS Excel 2007 offers by default. Consider the following example:

	A	B
1	15	20
2	= A1 + 2	30
3		

If we copy cell A2 in B3, because you can move one column to the right and one row down, the formula will change to: =B2+2. What varies is the reference to the cell A1 because you have copied the formula in a cell that is in the column to the right, the name of the column will change from A to B and because we have gone one row down, 1 will become 2, the result will be =B2+2. This maintains the formula that adds two to the content of the cell above.

Absolute Reference: References to rows and columns do not change when you copy the formula to another cell, the formula's reference to cells are fixed.

	A	B
1	15	20
2	= \$A\$1 + 2	30
3		

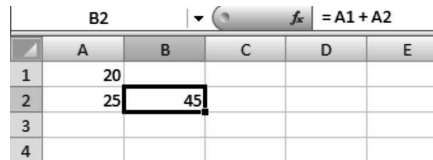
If you copy now the cell A2 in B3 even though you have copied it one column to the right and one row down, the formula will not change. The sign \$ before the column and the row indicates that. So, B3 will show = \$A\$1+2.

NOTES

An important difference in MS Excel 2007 spreadsheets is between absolute cell references and relative cell references. Open the MS Excel 2007 Spreadsheet as follows:

In cell B2, you need the following formula:

= A1 + A2

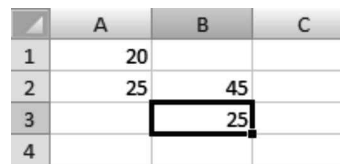


The screenshot shows a spreadsheet with columns A through E and rows 1 through 4. Cell A1 contains the value 20, and cell A2 contains the value 25. Cell B2 is selected and contains the value 45. The formula bar at the top shows the formula =A1+A2.

	A	B	C	D	E
1	20				
2	25	45			
3					
4					

- Click inside cell B2 to highlight it.
- Click on cell B2 with your right mouse button, and select Copy from the menu that appears.
- Now click into cell B3.
- Again, right click the cell to get the menu. But this time click Paste option.

Your spreadsheet should now look in the following way:



The screenshot shows the same spreadsheet as before, but now cell B3 is selected and contains the value 25. Cell B2 still contains 45. The formula bar at the top shows the formula =A1+A2.

	A	B	C
1	20		
2	25	45	
3		25	
4			

With cell B3 still highlighted, look at the formula bar at the top of MS Excel 2007. You should see this formula:

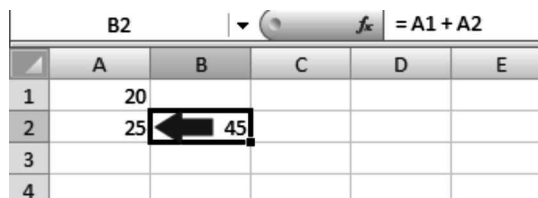
= A2 + A3

Click into B2 and the formula as follows:

= A1 + A2

The problem is due to cell referencing. When you clicked Copy from the menu, MS Excel 2007 does not only copy the formula. It took a look at where the cells were in the formula, relative to the B2 cell and copied this as well. From B2, the first cell reference (A1) is up one row, and left 1 column (the arrow in screen).

The second cell reference (A2) is one column to the left of cell B2.



The screenshot shows the spreadsheet with cell B2 selected. The formula bar at the top shows the formula =A1+A2. A black arrow points from cell B2 to cell A1, indicating the relative reference.

	A	B	C	D	E
1	20				
2	25	45			
3					
4					

When you clicked into cell B3 and selected Paste from the menu, MS Excel 2007 was not only pasting the formula, it was pasting this 'up 1, left 1'. Start working at cell B3. The first cell reference appears as shown in the screen:

	A	B	C	D	E
1	20				
2	25	45			
3					
4					

Formula bar: B2 | fx | = A1 + A2

The second cell reference appears as shown in the screen.

	A	B	C
1	20		
2	25	45	
3		25	
4			

Thus, the first arrow is pointing to cell A2 and the second arrow is point to cell A3. This is what has been copied. MS Excel 2007 used the following formula to perform this:

$$= A2 + A3$$

But, it will be appeared as follows:

$$= A1 + A2$$

If you want the correct answer in cell B3, then you have stop MS Excel 2007 from using this relative cell referencing that it is currently doing.

Absolute cell referencing is placing a dollar symbol (\$) before each letter and number. Click inside of cell B2 on your spreadsheet and change the formula as follows:

$$= \$A\$1 + \$A\$2$$

Now copy and paste it over to cell B3 again. You will get the correct answer by doing so.

	A	B	C	D	E
1	20				
2	25	45			
3		45			
4					

Formula bar: B3 | fx | = \$A\$1 + \$A\$2

MS Excel 2007 will use absolute formula in its calculation.

- If you need to copy and paste formulas use absolute cell references.
- Absolute referencing means typing a dollar symbol before the numbers and letters of each cell reference. You can mix absolute and relative cell references also.

Mixed Reference: This is a combination of both references. You may have relative references for the rows and absolute for the columns or vice versa. Consider the example given below:

	A	B
1	15	20
2	= \$A1 + 2	30
3		

NOTES

NOTES

If you copy the cell A2 in B3, the sign \$ before the column will mean that the formula will not change although you move to the right. But not having the sign before the row when you copy the formula one row down it will change to 2 instead of 1 and the result will be =A2+2. See the example given below:

	A	B
1	15	20
2	=A\$1 + 2	30
3		

Using Functions in Formulas

A function computes the values provided and shows you the desired results, for example, a simple function **SUM()** automatically adds up all the values provided either in a range or as individual values. Some functions can even check values and take actions based on what they find. For example, by using **IF()** function, you can check whether the current value in a particular cell is greater or less than 100 and based upon the answer it gets, you can ask the function to multiply or divide this value by a different amount. Some functions can convert numbers or text to another measure or format, for example, the function **LOWER()** converts the text entry in another cell into lower case.

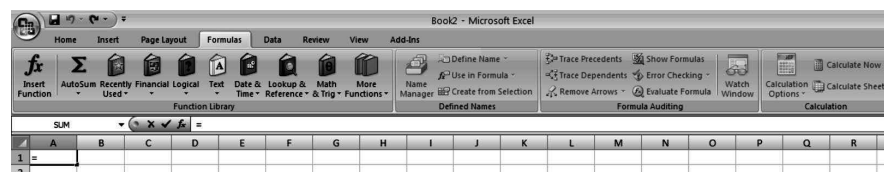
Typically, a function consists of two parts—function name and arguments. Arguments (or values) may in some cases be mandatory and in some cases optional. Even within a function, one of the arguments may be mandatory and another optional.

A function is a built-in formula in MS Excel 2007. A function has a name and arguments (the mathematical function) in parentheses. The following is a list of common functions used in MS Excel 2007.

- **Sum()**: Adds all cells in the argument.
- **Average()**: Calculates the average of the cells in the argument.
- **Min()**: Finds the minimum value.
- **Max()**: Finds the maximum value.
- **Count()**: Finds the number of cells that contain a numerical value within a range of the argument.

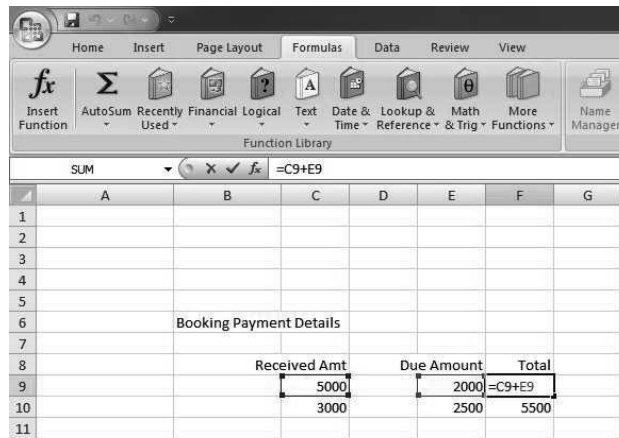
To calculate a function, follow the given steps:

- Click the **cell** where you want to apply the function.
- Click the **Insert Function** button from Formulas tab.
- Choose the function.
- Click **OK**.



- Write the address of first cell in the range that you want to calculate in the Number 1 text box.
- Write the address of last cell in the range that you want to calculate in the Number 2 text box.

- Click **OK**.



NOTES

Mathematical Functions

In MS Excel's 2007 mathematical functions can be used to perform common mathematical operations, such as addition (SUM() function), multiplication (product function) and rounding numbers (ROUND() function). Other mathematical functions are discussed as follows:

SQRT()

In MS Excel 2007, the **SQRT()** function returns the square root of a given number. The syntax for the **SQRT()** function is as follows:

=SQRT(Number)

In the above statement, number is a positive number that you wish to return the square root for. If a negative number is entered in the number parameter, the SQRT() function will return the #NUM! error.

ROUND()

The ROUND() function in MS Excel 2007 can be used when rounding integers and decimal numbers to make them easier to work within your spreadsheets. The syntax for the ROUND() function is as follows:

=ROUND(Number, Num_digits)

SUM()

The SUM() function in MS Excel 2007 provides a quick way to add numbers together in an MS Excel 2007. The syntax for the SUM() function is as follows:

=SUM(Number1, Number2, ..., Number255)

Up to 255 numbers can be entered into the function.

FACT()

In MS Excel 2007, the FACT() function returns the factorial of a given number. The syntax for the FACT() function is as follows:

=FACT(Number)

In the above statement, number is a numeric value.

NOTES

INT()

The INT() function is used to round a number downwards towards the next lowest number. INT() is similar to the ROUNDDOWN() function except that it always rounds a number down to the nearest whole number completely removing the decimal portion. The ROUNDDOWN() function will round a number down to a desired number of decimal places. The syntax for the INT function is as follows:

=INT (Number)

In the above statement, Number is the value to be rounded.

MOD()

The MOD() function can be used to divide numbers in MS Excel 2007. Unlike regular division, however, the MOD() function only gives you the remainder as an answer. The syntax for the MOD() function is as follows:

=MOD() (Number, Divisor)

PI()

In MS Excel 2007, the PI() function returns the mathematical constant which is equal to 3.14159265358979. The syntax for the PI() function is as follows:

=PI()

POWER()

Although you can use the caret (^) operator to build a formula that raises a number to any power, the POWER() function() accomplishes the same thing. For example, to build a formula that raises 5.9 to the third power, i.e., cubes the number you can use the exponentiation operator as follows:

=5.9^3

You can have MS Excel 2007 perform the same calculation with the POWER() function by entering this formula:

=POWER(5.9,3)

In either case, MS Excel 2007 returns the same result as 205.379.

PRODUCT()

The PRODUCT() function provides a quick way to multiple numbers in a MS Excel 2007. The advantage of using this function becomes apparent if you have several numbers to multiply together. It is easier than building a long formula. The syntax for the PRODUCT() function is as follows:

=PRODUCT(Number1, Number2, ... Number255)

In the above statement, up to 255 numbers can be entered into the function.

Date Functions

There are a number of date functions available in MS Excel 2007. Depending on your needs, you can use a date function in MS Excel 2007 to return the current date, the current time or the day of the week. Like all functions in MS Excel 2007, entering date functions is very straightforward. Just type in the function in the cell where you want the date or time to appear. The various date functions are discussed below:

NOW()

The NOW() function, one of MS Excel 2007's date and time functions, is used to add the current time and date to a spreadsheet. The syntax for the NOW() function is as follows:

= NOW ()

The NOW() function takes no arguments.

DATE()

The DATE() function, one of MS Excel 2007's date and time functions has several uses for adding dates to a spreadsheet. It can be used to combine date elements from different locations. It can also be used to convert dates to the computer's serial date. It can be used to ensure that imported dates are formatted correctly in a spreadsheet, such as a date or a number instead of text. The syntax for the DATE() function is as follows:

= DATE(Year, Month, Day)

TODAY()

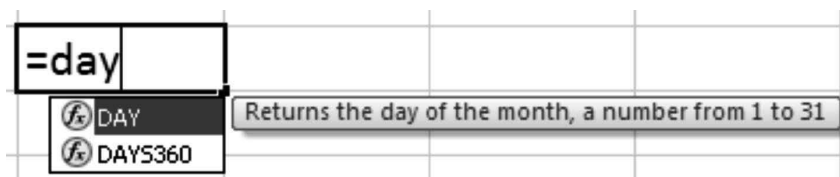
The TODAY() function, one of the MS Excel 2007's date and time functions, is used to add today's date to a spreadsheet. The syntax for the TODAY() function is as follows:

=TODAY()

The TODAY() function takes no arguments.

DAY()

The DAY() function returns the day of the month.



MONTH()

The function MONTH() takes one argument as MONTH(start_date) where start_date is the date for which you are trying to find the month. For example,

=MONTH(DATE(2011,3,12))

Above statement will return the value 3.

YEAR()

In MS Excel 2007, the YEAR() function returns a four digit year (a number from 1900 to 9999) given a date value. The syntax for the YEAR() function is as follows:

YEAR(Date_value)

In the above statement, date_value is a valid date.

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Logical Functions—IF(), AND(), OR(), NOT()

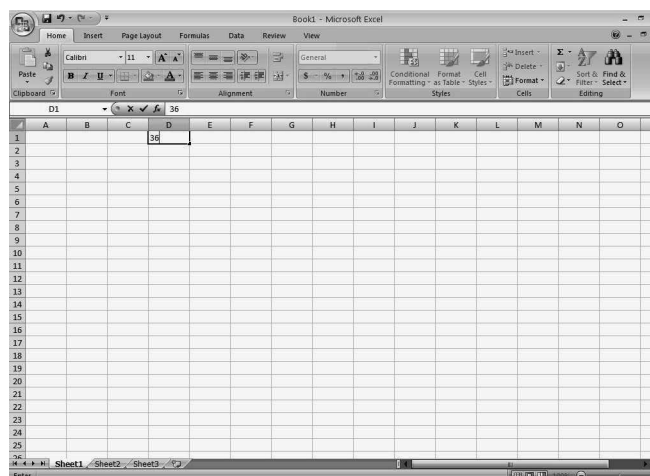
MS Excel 2007 uses seven logical functions, such as AND(), FALSE(), IF(), IFERROR(), NOT(), OR() and TRUE() which appear on the Logical command button's drop-down menu on the Formulas tab of the Ribbon. All the logical functions return either the logical TRUE or logical FALSE when their functions are evaluated. Here are the names of the logical functions along with their argument syntax:

- AND(logical1,logical2,...) tests whether the logical arguments are TRUE or FALSE. If they are all TRUE, the AND function returns TRUE to the cell. If any are FALSE, the AND function returns FALSE.
- IF(logical_test,value_if_true,value_if_false) tests whether the logical_test expression is TRUE or FALSE. If TRUE, the IF function returns the value_if_true argument. If FALSE, the IF function returns the value_if_false argument.
- IFERROR(value,value_if_error) tests whether the value expression is an error. IFERROR returns value_if_error if the expression is an error or value of the expression if it is not an error.
- NOT(logical) tests whether the logical argument is TRUE or FALSE. If TRUE, the NOT function returns FALSE. If FALSE, the NOT function returns TRUE.
- OR(logical1,logical2,...) tests whether the logical arguments are TRUE or FALSE. If any are TRUE, the OR function returns TRUE. If all are FALSE, the OR function returns FALSE.
- FALSE() takes no argument and simply enters logical FALSE in its cell.
- TRUE() takes no argument and simply enters logical TRUE in its cell.

IF() Function

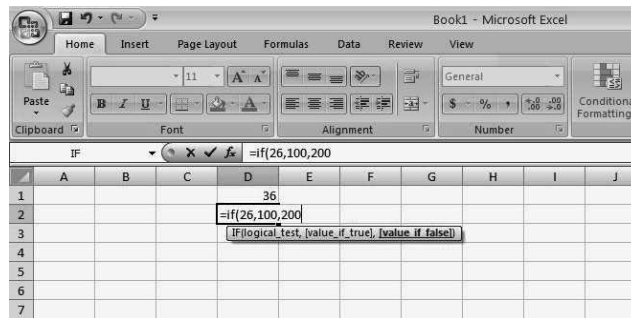
The IF() function is used to test whether a certain condition is TRUE or FALSE. Following steps help to get the result of IF() function:

- Enter 36 into cell D1.

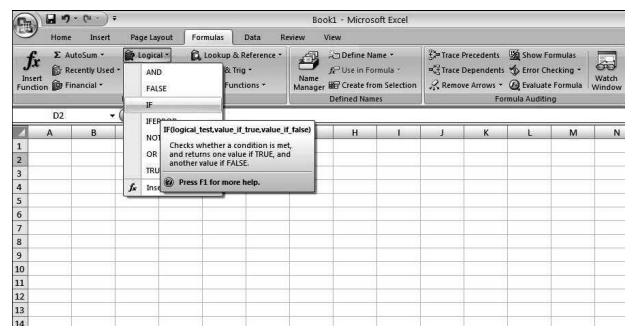


- Select D2 cell and type the statement as '=IF(26,100,200)'.

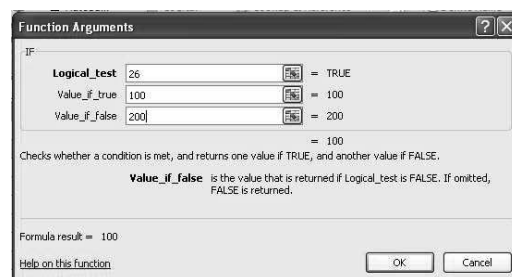
NOTES



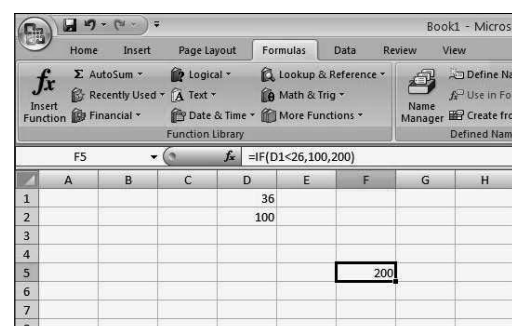
- After pressing ENTER key, value 100 will appear on D2 because 26 is less than 36 therefore 'value_if_true' condition will be executed.
- Changing the IF() function's results. Click on cell F5 which is the location of the result. Click on the Formulas tab. Choose **Logical** from the Ribbon to open the drop-down list as shown in screen. Click on IF in the list to bring up the function's dialog box.



- On the Logical_test line in the dialog box, type 26. On the Value_if_true line of the dialog box, type 100. On the Value_if_false line of the dialog box, type 200.



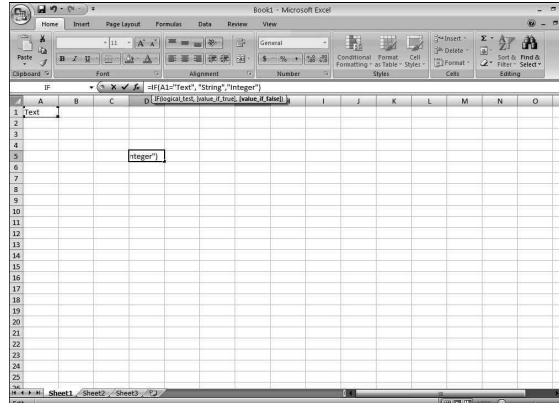
- If you click on cell F5, the complete function '= IF(D1<26,100,200)' appears in the formula bar as shown below:



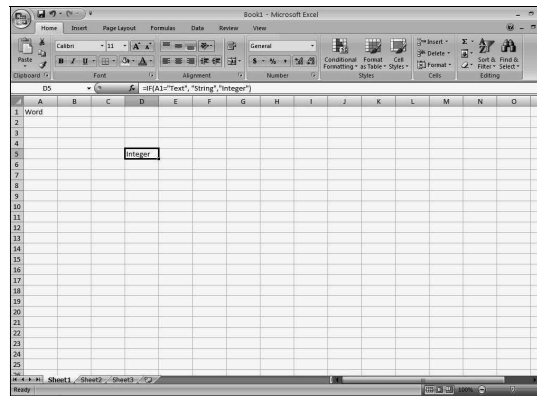
NOTES

Let us take another example to explain the concept of IF() function.

Type a word “Text” in A1 cell. Keep cursor on cell D5. Type the formula =IF(A1=”Text”, “String”, “Integer”) in cell D5. Press ENTER key. Word ‘String’ will appear in resulted cell D5.



- If you change the word ‘Word’ instead of ‘Text’ then the value of resulted cell will contain ‘Integer’ as shown in screen.



Nested IF() Function

A nested IF() function is worked when a second IF() function is placed inside the first in order to test additional conditions. It is possible to nest multiple IF() functions within one MS Excel 2007 formula. You can nest up to seven IF() functions to create a complex IF() statement. The syntax for the nested IF() function is as follows:

IF(condition1, value_if_true1, IF(condition2, value_if_true2, value_if_false2))

Above statement displays how to nest two IF() functions in which ‘condition1’ or ‘condition2’ is the value that you want to test, ‘value_if_true’ is the value that is returned if condition evaluates to **True** and ‘value_if_false’ returns if condition evaluates to **False**. Consider an example where using the nested IF() function the following grades will be displayed:

- A-If the student scores 80 or above.
- B-If the student scores 60 to 79.
- C-If the student scores 45 to 59.

- D-If the student scores 30 to 44.
- FAIL-If the student scores below 30.

Use the following nested IF() function to compute and display the result:

=IF(B2>=80, "A", IF(B2>=60, "B", IF(B2>=45, "C", IF(B2 >=30, "D", "Fail"))))

In the above statement, if the answer to the first question is False then control will go to next IF statement. If it is True then it will display Grade 'A' as shown in result of 'Student Examination Grade' spreadsheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M
1		Received Amt	Due Amount	Total									
2	Hotels	98	68	78									
3	Taj	99	56	89									
4	Clark Avadh	54	54	51									
5	Radison												
6													
7													
8													
9													
10													
11													

The approach of nesting IF() function increases the flexibility of the function by a number of possible results. For example, the deductions from an employee's income will follow the approach 'the higher the income, the higher the deduction rate'.

Text Functions

Following are the text functions in MS Excel 2007.

LOWER()

In MS Excel 2007, the LOWER() function converts all letters in the specified string to lowercase.

If there are characters in the string that are not letters, they are unaffected by this function. The syntax for the LOWER() function is as follows:

=LOWER(Text)

In the above statement, text is the string to convert to lowercase.

UPPER()

In MS Excel 2007, the UPPER() function allows you to convert text to all uppercase. The syntax for the UPPER function is as follows:

=UPPER(Text)

In the above statement, text is the string that you wish to convert to uppercase.

PROPER()

In MS Excel 2007, the PROPER() function sets the first character in each word to uppercase and the rest to lowercase. The syntax for the PROPER() function is as follows:

=PROPER(Text)

In the above statement, text is the string argument whose first character in each word will be converted to uppercase and all remaining characters converted to lowercase.

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LEN()

In MS Excel 2007, the LEN() function returns the length of the specified string. The syntax for the LEN() function is as follows:

=LEN(Text)

In the above statement, text is the string to return the length for.

LEFT()

In MS Excel 2007, the LEFT() function allows you to extract a substring from a string, starting from the left most character. The syntax for the LEFT() function is as follows:

=LEFT(Text, number_of_characters)

In the above statement, text is the string that you wish to extract from and the number_of_characters indicates the number of characters that you wish to extract starting from the left most character.

RIGHT()

In MS Excel 2007, the RIGHT() function extracts a substring from a string starting from the right most character. The syntax for the RIGHT() function is as follows:

=RIGHT(Text, number_of_characters)

In the above statement, text is the string that you wish to extract from and number_of_characters indicates the number of characters that you wish to extract starting from the right most character.

MID()

In MS Excel 2007, the MID() function extracts a substring from a string (starting at any position). The syntax for the MID() function is as follows:

=MID(Text, start_position, number_of_characters)

In the above statement, text is the string that you wish to extract from and start_position indicates the position in the string that you will begin extracting from. The first position in the string is 1 and number_of_characters indicates the number of characters that you wish to extract.

REPT()

In MS Excel 2007, the REPT() function returns a repeated text value a specified number of times. The syntax for the REPT() function is as follows:

=REPT(Text, Number)

In the above statement, text is the text value to repeat and number is the number of times to repeat the text value.

TRIM()

In MS Excel 2007, the TRIM() function returns a text value with the leading and trailing spaces removed. The syntax for the TRIM() function is as follows:

=TRIM(Text)

In the above statement, text is the text value to remove the leading and trailing spaces from.

Financial Functions (PMT(), PV(), FV(), RATE(), IPMT(), NPER())

Here is the list of financial functions.

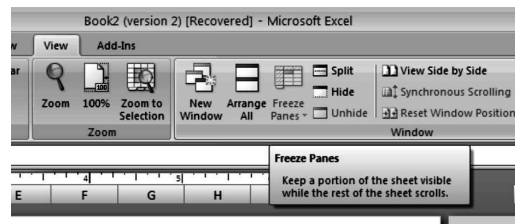
Function	Description
FV	This function returns the future value of an investment.
IPMT	This function returns the interest payment for an investment for a given period.
NPER	This function returns the number of periods for an investment.
PMT	This function returns the periodic payment for an annuity.
PV	This function returns the present value of an investment.
RATE	This function returns the interest rate per period of an annuity.

NOTES

Freeze Panes

A particular portion of a worksheet can be selected to stay static while you are working on other parts of the sheet. This is done using the **Freeze Rows and Columns Function**. To **Freeze** a row or column, follow the given steps:

- Click on the **Freeze Panes** button on the **View** tab.
- Either select the section to be frozen or click on the defaults of top row or left column.
- To unfreeze, click on the **Freeze Panes** button.
- Click on **Unfreeze**.



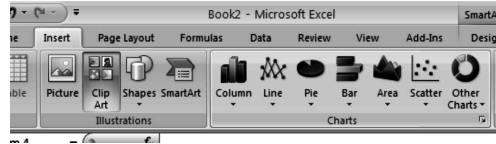
Check Your Progress

14. Write the keyboard shortcuts used to move up and down one screen in MS Excel 2007?
15. What is a cell cursor?
16. Define the term cell address.
17. What does MS Excel 2007 function compute?
18. What does FACT() function return?
19. What does LEN() function return?

3.9 CHARTS

Charts help you to present the information of the worksheet in a graphic format. MS Excel 2007 provides various types of charts which includes **Column, Line, Pie, Bar, Area, Scatter** and **Other charts**. To view the charts click on the **Insert tab** on the Ribbon.

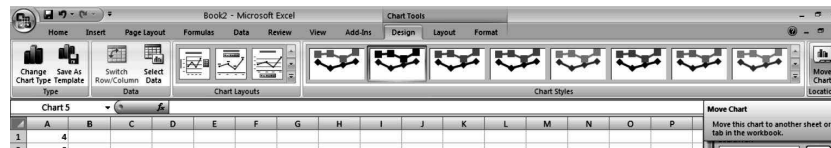
NOTES



Creating a Chart: To create a chart, follow the given steps:

- Select the cells that contain the data you would like to use in the chart.
- Click on the **Insert** tab on the Ribbon.
- Click on the **Charts**, choose the type of chart you want to create.

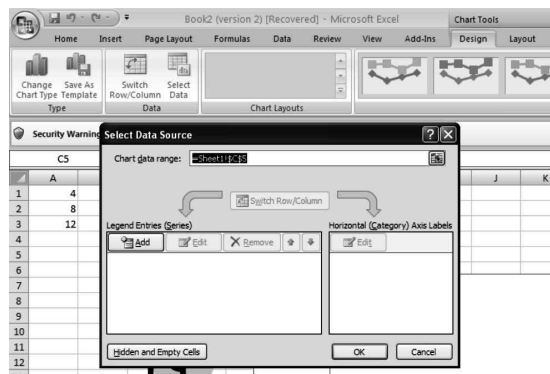
Moving a Chart: You can modify and move a created chart. To move the chart, follow the given steps:



- Click on the chart and drag it to the location, you want the chart to insert in the same worksheet.
- Click on the **Move Chart** button on the **Design** tab.
- Select the desired location in the same or another worksheet.

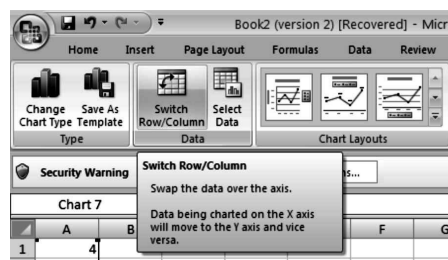
To change the data included in the chart, follow the given steps:

- Click on the chart.
- Click on the **Select Data** button on the **Design** tab.



To reverse the data displayed in the rows and columns, follow the given steps:

- Click on the chart.
- Click on the **Switch Row/Column** button on the **Design** tab.



To modify the labels and titles, follow the given steps:

- Click on the chart.
- On the **Layout** tab, click on the **Chart Title** or the **Data Labels** button.
- Modify the title and Press ENTER key.

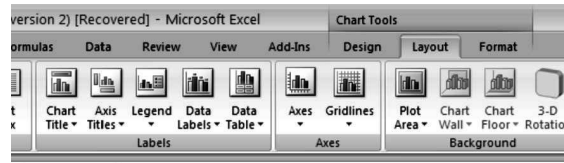
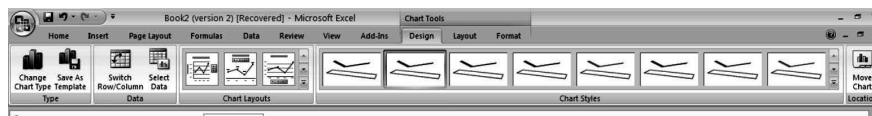
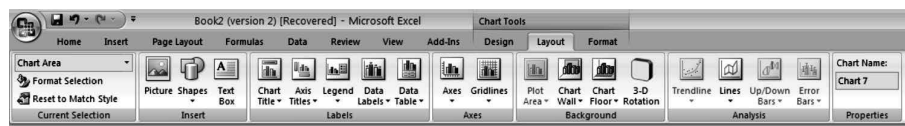


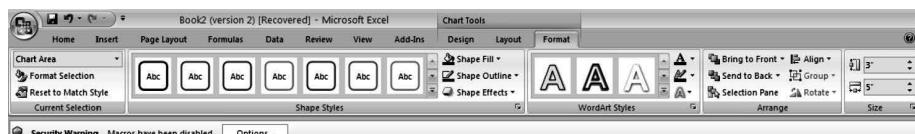
Chart Tools: The Chart Tools appear on the Ribbon when you click on the chart. The tools are located on three different tabs that are Design, Layout and Format. Within the **Design** tab you can control the chart type data, layout, styles and location.



The **Layout** tab controls inserting pictures, shapes and text boxes, labels, axes, background and analysis.

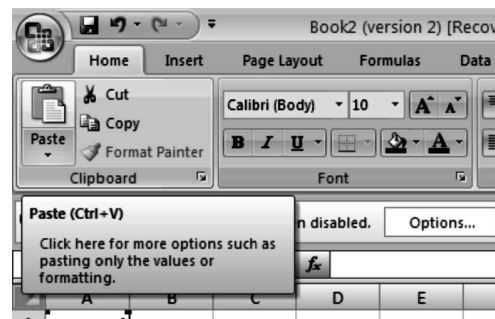


Within the **Format** tab you can modify shape styles, word styles, chart arrangement and alignment, and size of the chart.



Copy a Chart to Word

- Select the chart.
- Click on **Copy** on the **Home** tab.
- Go to the **Word** document where you want the chart to be located.
- Click on **Paste** on the **Home** tab.



NOTES

Creating an Embedded Chart

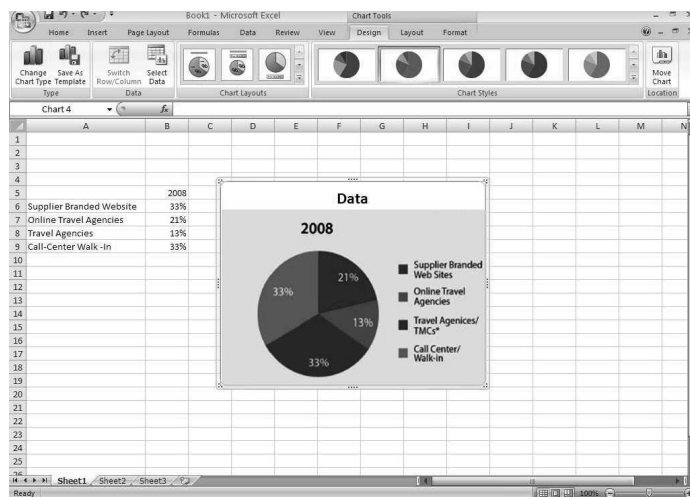
An embedded chart is referred as a chart that appears right within the worksheet so that when you save or print the worksheet, you save or print the chart along with it. By default, the chart is placed on the worksheet as an embedded chart. You can also choose to create a chart in its own chart sheet in the workbook at the time you create it. Embed a chart on worksheet when you want to print the chart along with its supporting worksheet data. Place a chart on its own sheet when you intend to print the charts of the worksheet data separately. The steps for creating an embedded chart are exactly same as for creating a simple chart.

Creating Chart Sheet

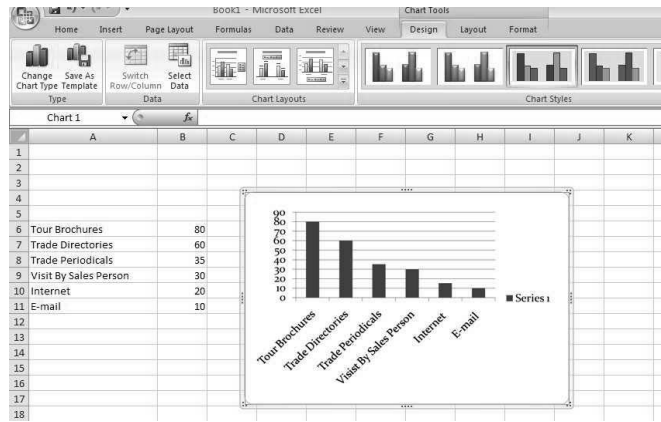
By default, when you create a chart, MS Excel 2007 embeds the chart in the active worksheet. You can move a chart to another worksheet or to a chart sheet. A chart sheet is a sheet dedicated to a particular chart. By default, MS Excel 2007 names each chart sheet sequentially starting with Chart1. You can change the name of the **chart sheet** as per your choice.

Formatting Chart: Title, Gridlines, Legends and Resizing

To add chart, you need to type suitable title for the prepared chart. Suitable title is provided to the prepared chart when it is inserted in the worksheet. Subject names can be displayed on your chart by selecting the tab marked as **Data Labels**. Chart's appearance can be viewed by seeing the previews of the changes you make when you check or uncheck the property boxes.



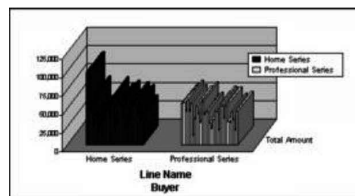
Data can be displayed in horizontal and vertical chart gridlines to make it easier to read and understand. Gridlines extend from any horizontal and vertical axes across the plot area. In a 2-D chart, the area is bounded by the axes including all data series. In a 3-D chart, the area is bounded by the axes, including the data series, category names, tick mark labels and axis titles of the chart. Depth gridlines can also be displayed in 3-D charts. Note that gridlines cannot be displayed for those kind of chart types that do not have any axes, such as pie charts and doughnut charts.



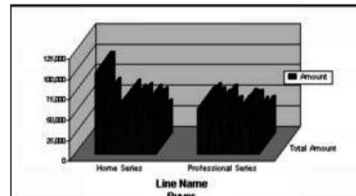
NOTES

You can choose the axis along which you want to distinguish your data by setting the chart legend on that axis. This is a significant way to view values on the selected axis without rearranging the values in the Outliner. A chart legend can be set on the X-, Y- or Z-axis. You can also reposition or resize a legend to take advantage of either the horizontal or vertical space within the chart area.

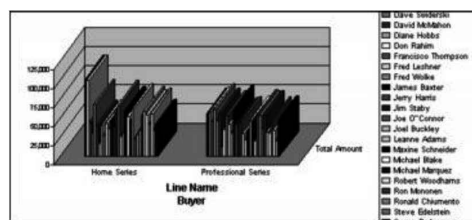
The following three examples show how the legend are placed on different axes to alter the appearance and data shown by the same chart. In the first example, the legend has been set on the X (categories) Axis. In the second example, the legend has been set on the Y (facts) Axis. In the third example, the legend has been set on the Z (clusters) Axis:



Legend on X-Axis



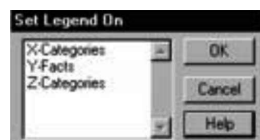
Legend on Y-Axis



Legend on Z-Axis

To set the axis used for a chart legend from the **Format** menu, follow the given steps:

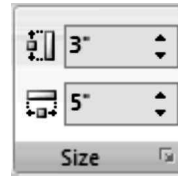
- Choose **Format** → **Set Legend On**.
- The **Set Legend On** dialog box appears.
- Select the axis on which you want to set the legend and click **OK**.



To resize a chart, do one of the following:

- To change the size manually, click the chart and then drag the sizing handles to the size that you want.

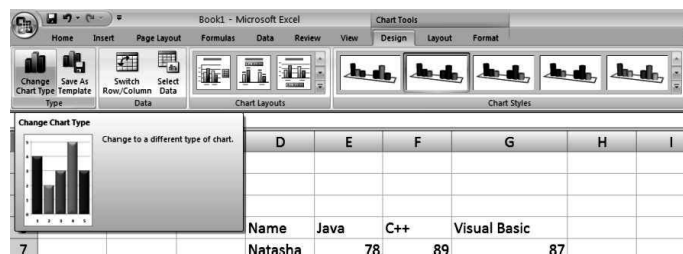
- To use specific height and width measurements, on the **Format** tab, in the **Size** group, enter the size in the **Shape Height** and **Shape Width** box.



NOTES

3.9.1 Changing Chart Types

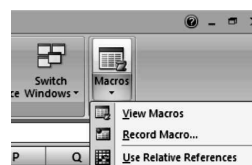
Any change you can make to a chart that is embedded in a worksheet, you can also make to a chart sheet. For example, you can change the chart type from a column chart to a bar chart and for this following steps are required:



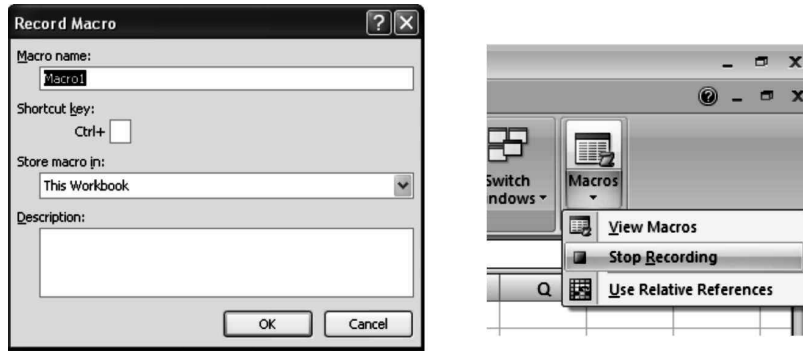
- Start Microsoft Excel 2007 and open a workbook from your documents that contains a chart or you can create a chart from data in an existing workbook.
- Right click on top of the chart that you want to change to a different type of chart and click '**Change Chart Type**'. The '**Change Chart Type**' dialog box will open in the middle of the screen.
- Click the type of chart you would like to change to on the left side of the '**Change Chart Type**' dialog box.
- Select the specific chart you would like to change your existing chart to by clicking it in the right portion of the '**Change Chart Type**' dialog box. The chart you have chosen will be highlighted.
- Click the '**OK**' button to close the '**Change Chart Type**' dialog box and to change the selected chart type to the new chart type that you have specified.

3.10 CREATING AND USING MACROS

Macros are advanced features which speed up editing or formatting in an MS Excel 2007 worksheet. They record the sequences of menu selections selected by you so that a series of actions can be successfully performed in one step.



NOTES



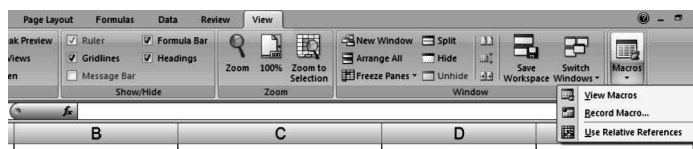
Recording a Macro: To record a Macro, follows the given steps:

- Click on the **View** tab on the Ribbon.
- Click on **Macros**.
- Click on **Record Macro...**
- Enter a name for Macro (without spaces).
- Enter a **Shortcut Key**.
- Enter a **Description** and click OK.
- Record the **Macro**.
- Click on **Macros**.
- Click on **Stop Recording** to stop macro recording.

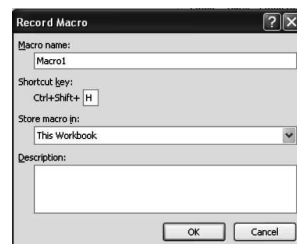
Assigning a Keyboard Shortcut to a Macro

Macro in MS Excel 2007 is used to record each command and action that is required to perform task. The created and recorded macro can further be used to carry out the similar task in a worksheet. You can run the specified Macro for performing desired action. The simplest way to create a Macro in MS Excel 2007 is to use the Macro recorder. The required steps are as follows:

- Open the workbook where you want to use the Macro.
- Click on **View** → **Record Macro** and then select **Record New Macro** from the menu.



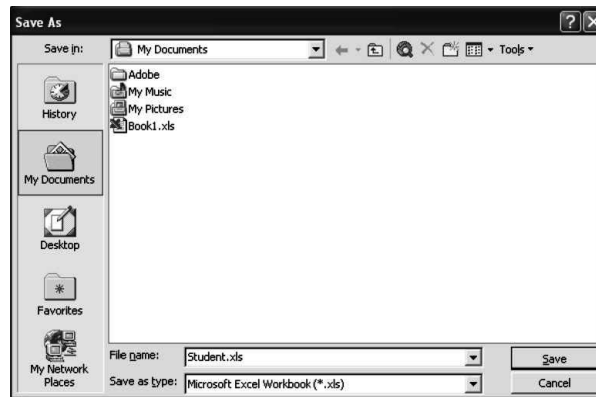
You will now see the **Record Macro** dialog box as shown below:



After setting the shortcut key for creating Macro as CTRL+SHIFT+H and Macro name as **Macro1**, the given screen will appear which shows the recording Macro button. This button records all the activities which will be issued by user.

NOTES

Type the valuable data in the worksheet. Save the file name as 'Student.xls'.



Running Macro

To run a Macro from the Keyboard shortcut, simply press the keys that you have assigned to run the Macro.

- Click on **Macros**.
- Click on **View Macros**.
- Select the **Macro** and click on **Run**.



Check Your Progress

20. How does modifying fonts in MS Excel 2007 help?
21. Write the function of Layout tab.

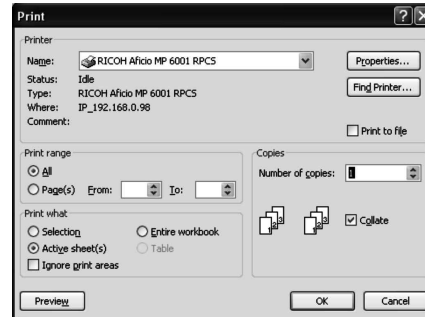
3.11 PRINTING WORKSHEETS

You can choose the spreadsheet you want to print. To print a worksheet, do the following steps:

- Click **Print** on the **File** menu.
- Under **Print what**, select **Entire** workbook radio button.

You will get the **Print** tab where you can set the 'Print range', 'Print what', 'Number of copies:' options as shown in the screen .

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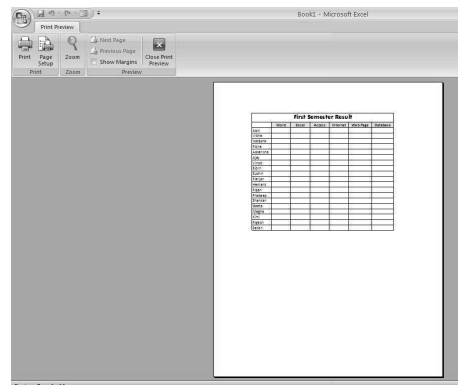


Previewing Worksheet

To preview worksheet, go to the **Office** button in which **Print** option is given. To view the spreadsheet in Print Preview, follow the given steps:

- Click on the **Office button** on the Ribbon.
- Select the arrow to the right of **Print**.
- Choose **Print Preview**.

The spreadsheet appears on screen as it will be printed. You can proceed to print the document from here or you can change options and settings to make the printed output look different. When you select **Print Preview** option the worksheet page will look as shown in the screen below:



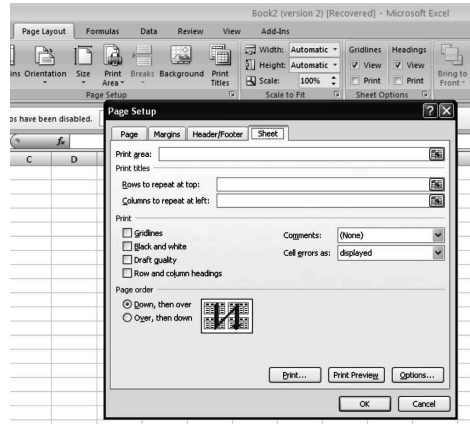
Page Setup Margin, Paper Size and Orientation Setting

Set Print Titles

The Print Titles function permits you to repeat the column and row headings at the beginning of each new page to make reading a multiple page sheet easy to read when printed. To print titles, follow the given steps:

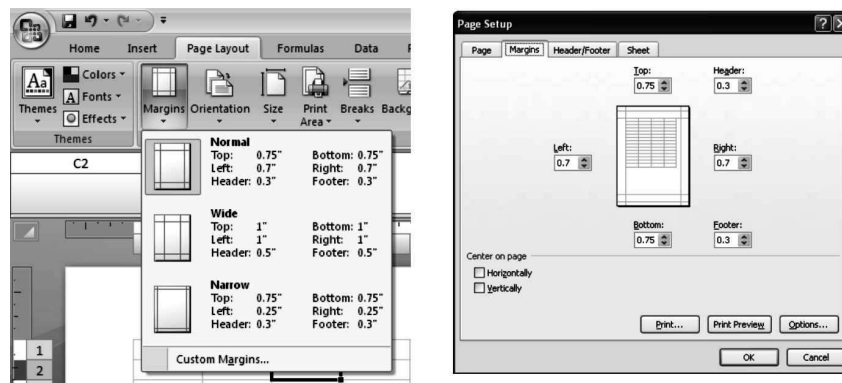
- Click on the **Page Layout** tab on the Ribbon.
- Click on the **Print Titles** button.
- In the **Print Titles** section, click on the box to select the rows/columns to be repeated.
- Select the row or column.
- Click on the **Select Row/Column Button**.
- Click on OK.

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Set Page Margins

To set the page margins, follow the given steps:

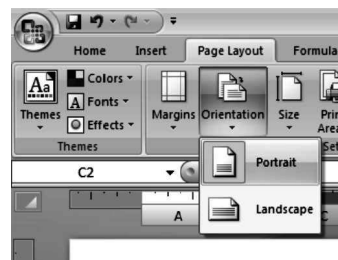


- Click on the **Margins** button on the **Page Layout** tab.
- Select any one of the given options.
- Click on **Custom Margins**.
- Complete the boxes to set margins.
- Click on OK.

Changing Page Orientation

To change the page orientation from portrait to landscape, follow the given steps:

- Click on the **Orientation** button on the **Page Layout** tab.
- Select **Portrait** or **Landscape**.



Printing an Area of a Worksheet

A print area can be defined for specific sections on the worksheet that are printed frequently. A print area can be defined as one or more selected range of cells that

are selected for printing so that the entire worksheet does not need to be printed. Therefore, when print command is executed after selected a print area, only the selected cells are printed. If required, cells can be added to enlarge the print area. For printing the entire worksheet, the print area is simply needed to be cleared.

To set a print area, follow the given steps:

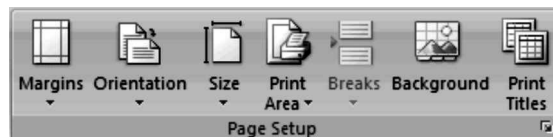
- On the worksheet, select the cells that you want to define as the print area.
- On the **Page Layout** tab, in the **Page Setup** group, click **Print Area** and then click **Set Print Area**.

The print area that you set is saved when you save the workbook. You can add cells to an existing print area by performing the following steps:

- On the worksheet, select the cells that you want to add to the existing print area.
- On the **Page Layout** tab, in the **Page Setup** group, click **Print Area** and then click **Add to Print Area**.


A print area can be cleared by performing the following steps:

- Click anywhere on the worksheet for which you want to clear the print area.
- On the **Page Layout** tab, in the **Page Setup** group, click **Clear Print Area**.



Printing Worksheet with/without Gridlines

To make a printed worksheet or workbook easier to read, you can print the worksheet or workbook with gridlines displayed around the cells.

- Select the worksheet or worksheets that you want to print.
- When multiple worksheets are selected, **Group** menu appears in the title bar at the top of the worksheet. To cancel a selection of multiple worksheets in a workbook, click any unselected worksheet. If no unselected sheet is visible, right click the tab of a selected sheet and then click **Ungroup Sheets** on the shortcut menu.
- On the **Page Layout** tab, in the **Sheet Options** group, select the **Print** check box under **Gridlines**.
- Click **Microsoft Office Button**  and then click **Print**. You can also press CTRL+P which are assigned as keyboard shortcut. Worksheets print faster if you print without gridlines.

Adding Standard/Customized Header and Footer in Worksheet

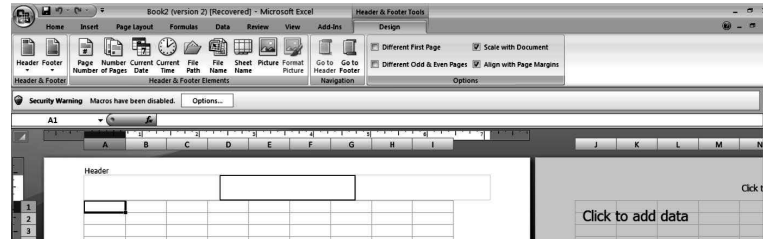
To create a header or footer in a worksheet, follow the given steps:

- Click on the **Header & Footer** button on the **Insert** tab.
- It will display the **Header & Footer Design Tools** tab.

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- To switch between the Header and Footer, click on the **Go to Header** or **Go to Footer** button.
- To insert text, enter the text in the header or footer.
- To enter preprogrammed data, such as page numbers, date, time, file name or sheet name, click on the respective button.
- To change the location of data, click on the desired cell.



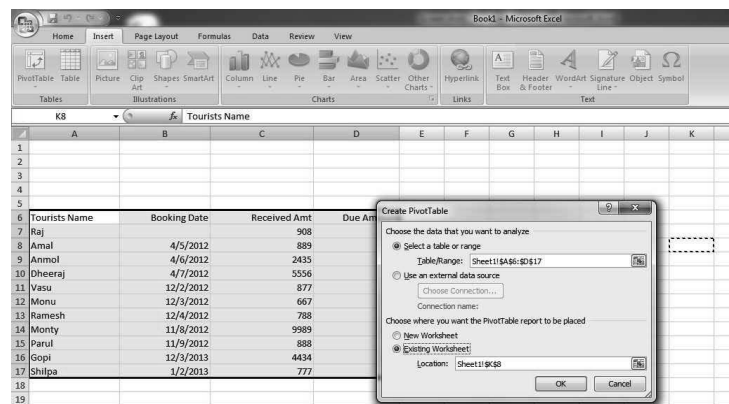
PivotTable and PivotChart

The PivotTables are interactive tables that allow the user to group and summarize large amounts of data in a concise, tabular format for easier reporting and analysis. A PivotChart is the graphical representation of PivotTables. When you create a PivotTable or PivotChart report and can use several different types of source data. The source data refers to the list or table that is used to create a PivotTable or PivotChart report. Source data can be taken from an MS Excel 2007 list or range, an external database or another PivotTable report. A PivotTable report is used to summarize, analyse, explore and present summary data. This report is visualized in the summary data in a PivotTable report and to easily see comparisons, patterns and trends. Both a PivotTable report and a PivotChart report enable you to make informed decisions about critical data in your enterprise.

Creating a PivotTable

To create a PivotTable, following steps are required:

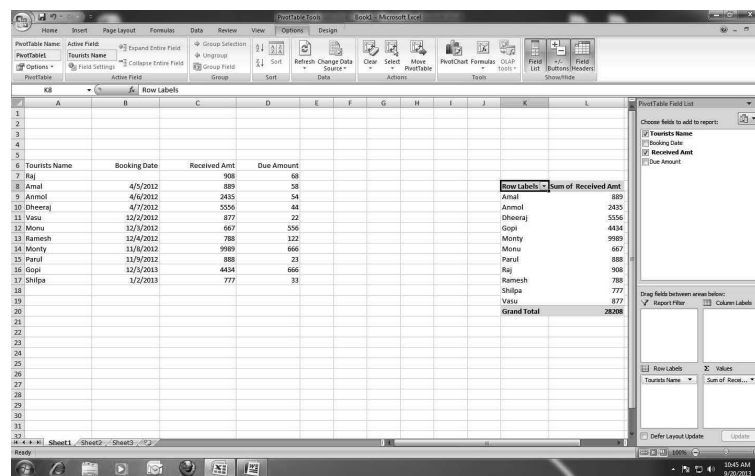
- Prepare a suitable data on which you want to create a PivotTable and select the range in **Table/Range:** bar as shown in the screen below.




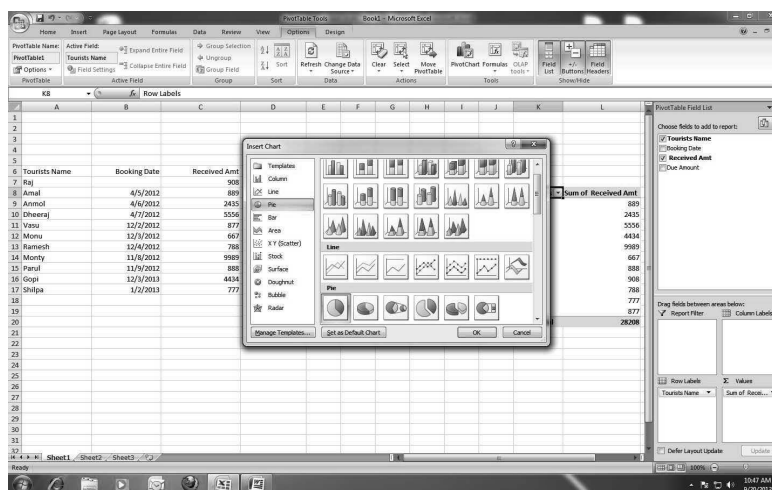
- After clicking on OK button, **'PivotTable Field List'** appears where you can choose the selected fields on which you want to prepare the PivotChart.

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- Once you select the desired fields, the **PivotTable** is prepared as shown in screen.

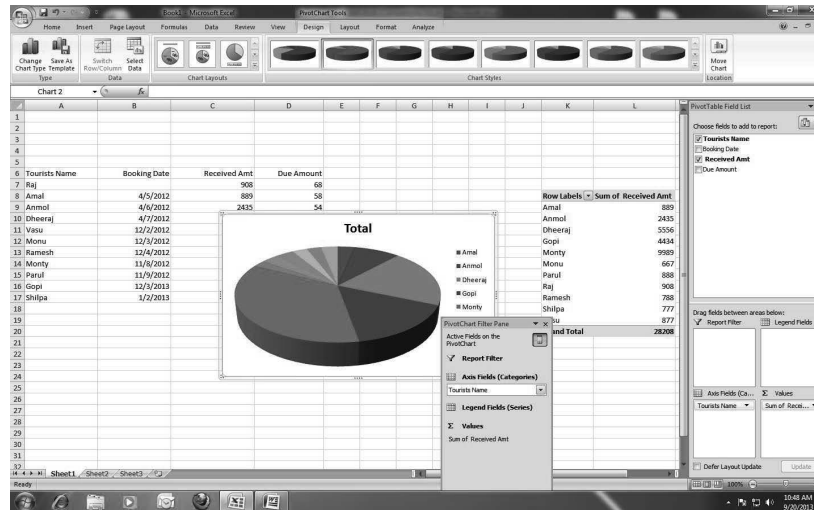


- You can create a **PivotChart** using  tool. This tool will provide 'Insert Chart' option where you can create a suitable chart to depict the selected data.



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- Once you select the chart, for example ‘Pie’ chart then the result appears as follows:



3.12 ESTABLISHING WORKSHEET LINKS

To summarize and report results from separate worksheets, you can consolidate data from each separate worksheet into a master worksheet. The worksheets can be in the same workbook as the master worksheet or in other workbooks. When you consolidate data, you are assembling data so that you can more easily update and aggregate it on a regular or ad hoc basis. For example, if you have a worksheet of expense figures for each of your regional offices, you might use a consolidation to roll up these figures into a corporate expense worksheet. This master worksheet might contain sales totals and averages, current inventory levels, and highest selling products for the entire enterprise. To consolidate data, use the **Consolidate** command in the **Data Tools** group on the **Data** tab. After you have consolidated data from multiple worksheets, you can change the in which the data is consolidated. For example, to add worksheets from new regional offices, delete worksheets from departments that no longer exist or change formulas with 3-D references. The term ‘3-D reference’ is a range that spans two or more worksheets in a workbook. You change a consolidation by changing the formulas or by editing the formulas, such as changing the function or expression. Regarding cell references, you can do one of the following:

To Change a Consolidation made by Position or Category

You can change the consolidation only if you have not previously selected the ‘**Create links to source data**’ check box in the **Consolidate** dialog box. If the check box is selected, click **Close** and then recreate the consolidation. Click the upper left cell in the consolidated data.

- On the **Data** tab, in the **Data Tools** group, click on **Consolidate**.
- The new source range must have either data in the same positions if you previously consolidated by position or column labels that match those in the other ranges in the consolidation if you previously consolidated by category.

- If the worksheet is in another workbook, click **Browse** to locate the file and then click OK to close the Browse dialog box. The file path is entered in the **Reference** box followed by an exclamation point.
- Type the name for the range and then click **Add**.
- Adjust the size or shape of a source range.
- Under **All references**, click the source range that you want to change.
- In the **Reference** box, edit the selected reference.
- Click on **Add**.

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To Delete a Source Range from the Consolidation

- Under **All references**, click the source range that you want to delete.
- Click on **Delete**.

To Make the Consolidation Update Automatically

Select the check box if the worksheet is in another workbook. Once you select this check box, you will not be able to change which cells and ranges are included in the consolidation.

- Select the **Create links to source data** check box.
- To update the consolidation with the changes, click OK.

If the data to consolidate is in different cells on different worksheets, you need to add, change or delete the cell references to other worksheets. For example, to add a reference to cell G3 in a Facilities worksheet that you have inserted in the following Marketing worksheet, you must edit the formula as shown in the screen. The MS Excel 2007 sheet appears before as follows:

	A	B	C	D	E
1					
2		=SUM(Sales!B4, HR!F5, Marketing!B9)			
3					

Sales HR Marketing Consolidation

Once the multiple worksheets, such as 'Sales', 'HR', 'Marketing' and 'Facilities' are consolidated, the result appears as follows:

	A	B	C	D	E	F
1						
2		=SUM(Sales!B4, HR!F5, Marketing!B9, Facilities!G3)				
3						

Sales HR Marketing Facilities Consolidation

To add another worksheet to the consolidation, move the sheet into the range that your formula refers to. For example, to add a reference to cell B3 in the Facilities worksheet, move the Facilities worksheet between the 'Sales' and 'HR' sheets as shown in the screen.

	A	B	C	D	E
2					
3		=SUM(Sales:Marketing!B3)			
4					

Sales HR Marketing Consolidation

Facilities

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Because, the formula contains a 3-D reference to a range of worksheet names, **'Sales:Marketing!B3'** as shown in the screen, all worksheets in the range are included in the new calculation.

During a consolidation, MS Excel 2007 enables you to link the data in the source areas specified in the **'All references'** list box of the **'Consolidate'** dialog box to the destination area in the new worksheet. Thus any change that you make to the values in the destination area of the consolidation worksheet is applied to all references. To create links between the source worksheets and destination worksheet, just select the **'Create Links to Source Data'** check box to the **'Consolidate'** dialog box prior to performing the consolidation. When you perform a consolidation with linking, MS Excel 2007 creates the links between the source areas and the destination area by outlining the destination area. Each outline level created in the destination area holds rows or columns that contain the linking formulas to the consolidated data.

Check Your Progress

22. Why a PivotTable report is used?
23. What is '3-D reference' in consolidating data?

3.13 ANSWERS TO 'CHECK YOUR PROGRESS'

1. In an office, the following software programs are required to fulfill its needs:
 - (i) Word processing
 - (ii) Spreadsheet package
 - (iii) Presentation package
 - (iv) Database
 - (iv) Scheduler
2. Ribbon is a panel that houses a fixed arrangement of few icons and command buttons. This creates organizations for commands that form a set of tabs that group every relevant command.
3. The function of a title bar is to display the title of the current document which is in use.
4. Document formatting represents all the types of formatting parts which are applied to a selected document for making suitable presentation.
5. Thesaurus allows you to view synonyms.
6. Web Layout view is a view of the document as it would appear in a web browser.
7. Indention helps you to set the text within a paragraph at different margins.
8. Borders and shading are used to highlight information in a table. Thus it enhances the appearance of the text in a table.

9. Macros are used for the following reasons:
 - (i) To speed up routine editing and formatting.
 - (ii) To combine multiple commands, for example to insert a table with a specific size and borders and with a specific number of rows and columns.
10. A spreadsheet is an electronic document which saves various types of data in columns and rows.
11. The advanced feature permits you to specify the options for editing, copying, pasting, printing as well as displaying formulas, calculations and other general settings.
12. You can edit a worksheet if any incorrect information has been entered into a cell. To do so, click on the cell and enter the correct information. Typing replaces whatever is in the cell. Editing a spreadsheet includes copy, cut, paste, move, changing column width/row height, cell alignment and formatting, font and number formatting, inserting and deleting cell(s)/row(s)/column(s), insert/copy/move/rename/delete a worksheet.
13. In MS Excel 2007 spreadsheet, a cell address identifies the location of the cell.
14. In MS Excel 2007, to move up or down one screen the keyboard shortcuts used are Pg Up and Pg Dn keys.
15. The cell cursor is a black border that surrounds the active cell sometimes called the current cell in a worksheet.
16. The cell address is a combination of column letter and row number of a cell, such as C4 or D8.
17. A function computes the values provided and shows you the desired results; e.g., a simple function SUM() automatically adds up all the values provided either in a range or as individual values.
18. In MS Excel 2007, the FACT() function returns the factorial of a number.
19. In MS Excel 2007, the LEN() function returns the length of the specified string.
20. Modifying fonts in MS Excel 2007 helps you to emphasize titles and headings.
21. The Layout tab controls inserting pictures, shapes and text boxes, labels, axes, background and analysis.
22. A PivotTable report is used to summarize, analyse, explore and present summary data.
23. The term '3-D reference' is a range that spans two or more worksheets in a workbook while consolidating data.

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3.14 SUMMARY

- Office automation includes the various computer hardware and software used in electronically creating, collecting, and storing and manipulating office information.
- The basic activities of office automation are storage of raw data, electronically transferring the data and electronically managing business information.
- When you explore Microsoft Word 2007, you will notice the new look of the menu bar. Three new features help you to work with Word 2007, namely the Microsoft Office Button, the Quick Access Toolbar and the Ribbon which contain various functions.
- The Ribbon is positioned at the top of the screen of the Word window. It includes seven tabs, namely Home, Insert, Page Layout, References, Mailings, Review, View and Add-Ins.
- Document formatting represents all the types of formatting parts which are applied to a selected document for making suitable presentation.
- Bulleted lists are represented using bullet points, numbered lists are represented using numbers and outline lists combine together the numbers and letters depending on the association of the list.
- Microsoft Word 2007 is a product of Microsoft Office 2007 or 2007 Microsoft Office System. It is the latest version of Windows of the Microsoft Office System. It introduced the 'Ribbon User Interface' instead of the old menu and toolbar which is a work oriented Graphical User Interface (GUI).
- Web Layout view enables you to see your document as it would appear in a browser, such as Internet Explorer.
- The Reading Layout view formats your screen so that you can read the document more comfortably.
- Align Right option is used to align the text with the right margin.
- In Microsoft Office Button, there are three buttons in Print option, which are Print, Quick Print and Print Preview, which appear on the computer screen to perform the printing of the document. In the 'Preview mode', you can change margin setup, page size and orientation, print options and can also opt for many other printing features.
- Styles are the predefined text formats that are available in MS Word 2007 to apply on text content.
- Indention is used to set the text content within a page or within a paragraph at different margins.
- Tab is classified into left, center, right, decimal and bar tab.
- Content can be inserted from one document to another document by using hyperlinks. A hyperlink can point an entire document or Web page or to some specific section within your document. A hyperlink contains an anchor which stores the destination location which the hyperlink can use to follow

the destination document. The source document is the document that contains hyperlinks.

- Tables organize data into rows and columns. They are used for the purpose of displaying data in a tabular format. Selection within tables is prime operation of Word table because it provides you to select and perform the desired options, such as finding total marks of a specific student or merge the headings, etc.
- MS Word 2007 provides Borders and Shading options that facilitate you to enhance the appearance of the text information in a table.
- Microsoft Office Word generates a copy of the main document for item or record in your data file.
- Queries can contain operators, quotation marks, wildcard characters and parentheses to help focus your search, i.e., defined in the database.
- In Microsoft Office Word 2007, you can automate frequently used tasks by creating macros. A macro is a series of commands and instructions that you group together as a single command to accomplish a task automatically.
- The linked object in the destination file can be updated when the source file is updated and embedded objects. Once embedded, the object becomes part of the destination file. Changes you make to the embedded object are displayed in the destination file.
- In MS Excel 2007, the columns are lettered A to Z and then continuing with AA, AB, AC, and so on, and the rows are numbered from 1 to 1,048,576.
- MS Excel 2007 provides a wide range of customizable options that help you to create an MS Excel 2007 workbook of required specifications.
- The Proofing feature permits you to personalize the options for correcting words and formats of your text.
- If you hold down the CTRL key and then press the Home key, you move to the beginning of the worksheet.
- If there is an error in a formula, an error message is displayed which will begin with a # sign.
- The ROUND() function in MS Excel 2007 can be used when rounding integers and decimal numbers to make them easier to work within your spreadsheets.
- In MS Excel 2007, you can change any column width or row height in your worksheets to improve the readability and appearance of data.
- Within the Format tab you can modify shape styles, word styles and size of the chart.
- In a 3-D chart, the area is bounded by the axes, including the data series, category names, tick mark labels and axis titles of the chart.
- To run a Macro from the keyboard shortcut, simply press the keys that you have assigned to run the Macro.

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- The PivotTable report is an interactive, cross tabulated MS Excel 2007 report that summarizes and analyses data, such as database records from various sources including ones that are external to MS Excel 2007.
- The PivotTable make easy to arrange and summarize complicated data based on details. When you create a PivotTable or PivotChart report, you can use any of several different types of source data. The source data refers to the list or table that is used to create a PivotTable or PivotChart report.
- To summarize and report results from separate worksheets, you can consolidate data from each separate worksheet into a master worksheet.

3.15 KEY TERMS

- **Draft View:** A view used for the purpose of editing a document quickly.
- **Paragraph Alignment:** This option helps in organizing the text according to the way you want it to appear.
- **Justify:** An option which aligns the text to both the left and right margins.
- **Data Source:** A file that contains the information to be merged into a document.
- **Cell Address:** The combination of a column coordinate and a row coordinate.
- **Operators:** Symbols used to represent the various arithmetic and comparison operations you can perform on the operands.
- **NOW():** This function is used to add the current time and date to a spreadsheet.
- **LOWER():** This function converts all letters in the specified string to lowercase.
- **Level Buttons:** Buttons that represents a level of organization in a worksheet and clicking a level button hides all levels of detail below that of the button you clicked.
- **Print Area:** Area refers to one or more ranges of cells that you designate to print when you do not want to print the entire worksheet.

3.16 SELF-ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. Why is LAN considered as significant part of office automation?
2. What is word processing?
3. What does Microsoft Office button menu provides?
4. How a blank page is inserted in a document?
5. Which button is selected if you want to check the margin, paper size and orientation to print the Word document?

6. How is a nested list created?
7. How new styles are created?
8. What is the significance of OLE DB?
9. Why 'Print' option is selected in mail merge operation?
10. Why macro is used?
11. How to edit a linked object?
12. What is Microsoft Excel 2007?
13. Write the steps to select data range.
14. Which string operator is used to concatenate the two text values?
15. Write the syntax of MOD() function.
16. Write the steps to cut and paste the formula.
17. How any chart type is changed in MS Excel 2007?
18. What are macros?
19. Why previewing worksheet is a required step before taking the printout?
20. How a PivotTable is created?
21. Why is PivotTable report used?
22. What happens when you consolidate data?

Long-Answer Questions

1. Explain the various activities associated with text processing software
2. Explain briefly the concept of 'getting started' and also name the various ways in which a document can be viewed in MS Word 2007.
3. Explain the process to create and edit document with the help of examples.
4. Explain the steps required in formatting a document.
5. Explain the steps required in creating a custom dictionary with the help of examples.
6. Explain the features of spelling and grammar tool with the help of examples.
7. Write the steps required to use a Print function in Microsoft Word 2007.
8. Write all the steps required to insert symbols in Word document.
9. Describe the styles with reference to advanced document formatting.
10. Explain all the operations that can be performed in MS Word table.
11. Explain the significance of macro with the help of examples.
12. What is the difference between linked objects and embedded objects?
13. Describe the difference between worksheet, workbook and workspace with the help of suitable examples.
14. Explain the features of Microsoft Office button in MS Excel 2007.
15. Describe the concept of selection in a worksheet.
16. What are the categories of formulas in MS Excel 2007? Explain.
17. Explain the syntax of text functions: LOWER(), UPPER(), PROPER(), LEN(), LEFT(), RIGHT(), MID(), REPT() and TRIM().

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18. Explain briefly the concept of editing worksheet.
19. What are the steps required in creating chart and embedded chart, moving chart and formatting chart?
20. How a keyboard shortcut is assigned in creating and executing a macro? Explain briefly.

3.17 FURTHER READING

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- Blattner, Patrick, Ken Cook, Laurie Ulrich and Timothy Dyck. *Special Edition Using Microsoft Excel 2000*. New Delhi: Prentice-Hall of India, 1999.
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UNIT 4 PRESENTATION GRAPHICS

SOFTWARE: MS POWERPOINT

*Presentation Graphics
Software: MS PowerPoint*

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Structure

- 4.0 Introduction
- 4.1 Objectives
- 4.2 Utility of PowerPoint Presentation
- 4.3 Getting Started with Microsoft PowerPoint
- 4.4 Creating, Manipulating and Enhancing Slides
 - 4.4.1 Creating Slides
 - 4.4.2 Manipulating Slides
 - 4.4.3 Enhancing Slides
- 4.5 Slide Formatting
 - 4.5.1 Formatting Text in a Slide: Font, Alignment and Line Spacing
 - 4.5.2 Changing Slide Background Color
 - 4.5.3 Applying Themes
- 4.6 Different Views in PowerPoint
 - 4.6.1 Normal View
 - 4.6.2 Outline View
 - 4.6.3 Slide View
 - 4.6.4 Slide Sorter View
 - 4.6.5 Notes Page View
- 4.7 Animations and Sounds
 - 4.7.1 Slide Transition
 - 4.7.2 Automation of Slide Presentation
 - 4.7.3 Inserting Animated Pictures
 - 4.7.4 Inserting Recorded and In-built Sound Effects
- 4.8 Utility of Master Slide
 - 4.8.1 Inserting Date/Time/Slide Number into Master Slide
 - 4.8.2 Inserting Common Objects to All Slides
 - 4.8.3 Applying Common Title/Text Format to All Slides
- 4.9 Some Advanced Features of PowerPoint Presentation
 - 4.9.1 Hide/Unhide in Slide Show
 - 4.9.2 Customizing Slide Show
 - 4.9.3 Applying Rehearse Timings for Slide Show
 - 4.9.4 Saving Presentation
 - 4.9.5 Printing Presentation
- 4.10 Answers to 'Check Your Progress'
- 4.11 Summary
- 4.12 Key Terms
- 4.13 Self-Assessment Questions and Exercises
- 4.14 Further Reading

4.0 INTRODUCTION

In this unit, you will learn about the basics of Microsoft PowerPoint 2007. PowerPoint presentations in Office 2007 are a way of attracting audience towards your views and arguments. This software package provides various options for creating learning

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guidelines, corporate training session and marketing strategy. You will also learn to create a variety of slides using different layouts, such as slide master layout, chart slide layout, subtitle slide layout, table slide layout, picture slide layout, etc. You can perform various operations, such as opening PowerPoint application, creating presentation, adding objects to slides, inserting graphics, such as chart, organizational chart, photo album, etc., to the PowerPoint slides. The presentations in PowerPoint 2007 can be saved both with a .ppt or the .pptx extension. Slide formatting allows you to format the master slide for the AutoLayout area. You can change the font type and size in PowerPoint 2007 slides. To apply a design template to all slides you can select a suitable template. A design template is a file which contains the styles in a presentation including the type and size of the bullets and fonts, background design and fill color scheme. The view option in PowerPoint slide enables the presentation to be viewed in different ways, such as normal view, notes view, handout view, printout view, screen view, etc. You can adjust the line spacing in Paragraph tab where options are given as Single, 1.5 lines, Double, Exactly and Multiple. Animation is considered as the most interesting and effective feature of PowerPoint presentation. You can change the slide transition effect from the animations tab. You can set the transition speed, transition sound and can animate the slide transitions. You can also set up text boxes, objects, images, etc. Finally, you will learn the concept of slide master which is one of several master slides and is used in PowerPoint to make global changes to all your slides at one time. Slide Show view is the view used for presenting the presentation to an audience. Slide Show view can be accessed from the View tab of the Ribbon or by pressing the F5 key on the keyboard. PowerPoint can show your presentation on your computer's own monitor, a projector or an external monitor, such as a giant screen Plasma or LCD display.

4.1 OBJECTIVES

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

- Understand the utility of PowerPoint presentation
- Explain the significance of Ribbon and Quick Access Toolbar in PowerPoint
- Discuss the different views available in PowerPoint
- Create presentation using texts, objects, graphics, Clip Arts, tables, charts, photo albums, organizational charts, etc.
- Understand the concept of slide formatting
- Apply design templates
- Change slide background color
- Apply themes
- Animate PowerPoint presentation
- Describe the significance of master slide
- Discuss the advanced features of PowerPoint presentation
- Save and print presentation

4.2 UTILITY OF POWERPOINT PRESENTATION

PowerPoint presentations in Office 2007 are a way of attracting audience towards your views and arguments. It is one of the most helping factors behind success of every meeting. There are various uses of PowerPoint presentations, some of them are integrated. The prime utility of PowerPoint presentations in modern days are learning, corporate training sessions, business and marketing meetings and sales gatherings. They are as follows:

Learning Solutions

Microsoft PowerPoint 2007 thus allows for creation of professional, effective and creative business presentations that can be used for corporate or sales presentations and trainings. Each page in the presentation, termed as a slide in PowerPoint can be customized according to business requirements. PowerPoint contains several easy-to-use features, such as design templates, the capability to insert graphics and charts, and various printing options that allow the user to create a business presentation. Companies can develop their specific design theme containing their logo and design template to give a uniform look to all their presentations.

Corporate Training Session

Companies often utilize PowerPoint to create a visual simplified platform to conduct the training session for their employees. PowerPoint 2007 is considered as an essential element of every corporate training session. Hence PowerPoint is frequently used to develop training materials, such as orientations, computer system lessons, customer service trainings and specific concept trainings. Top executives and managers (marketing and sales) utilize this powerful tool to train their juniors or associates to bestow them better, interactive and more proficient training. The PowerPoint slides highlight key points on each slide by accommodating titles, bulleted text, photos and graphics making the presentation easy to read and understandable.

Marketing Strategy

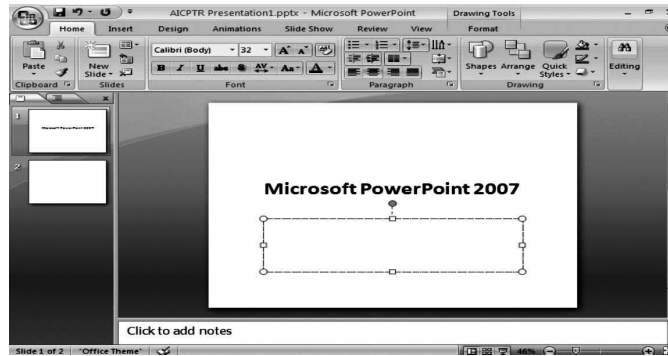
Powerful tools and options present in Microsoft PowerPoint makes it easier for people in marketing, advertising and sales to make presentations for motivation of their subordinates. Inclusion of different types of charts, images, Clip Arts and other graphical structures makes PowerPoint 2007 presentation eye catchy. Animation and sound effects add extra emphasis on these presentations making them more interactive.

4.3 GETTING STARTED WITH MICROSOFT POWERPOINT

PowerPoint helps in using charts, diagrams, pictures and animations for the purpose of creating effective presentation slides. The main feature that separates PowerPoint 2007 from PowerPoint 2003 is that in PowerPoint 2007 file is saved with a .ppt and .pptx extension. When the PowerPoint slides are saved as .pptx, Windows 2003 is unable to open the file.

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Microsoft Office Button

The Microsoft Office Button performs all the functions of the 'File' menu of the older versions of PowerPoint. It helps you to create a new presentation, open an existing presentation, save a presentation, save a presentation with a new name using the 'Save As' option, print a presentation, send a presentation and close a presentation.



Ribbon

Ribbon refers to the strip of buttons that resides on top of the main Window. The standard Ribbon includes the **Home** tab, the **Insert** tab, the **Design** tab, the **Animation** tab, the **Slide Show** tab, the **Review** tab and the **View** tab.

Design

The **Design** option is accessed on the Ribbon. This option facilitates the choice of colors, background styles, fonts, page setup, slide orientation, etc.



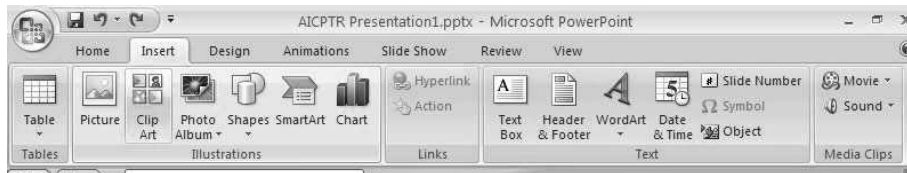
Home

The Home option is the most commonly used option which by users. It helps in creating new slides. The 'slides' option provides you to insert new slides. You can adjust the layout of slides, reset and set default slides. The paragraphs can be aligned and specified in form of bulleted or numbered lists. The drawing and editing tools help in editing the text and figures.



Insert

The insert option is available for the purpose of adding tables, illustrations, links, text and media clips. WordArt, header, footer, text, movie and sound can also be inserted in the slides. The tables can be inserted or imported from MS Excel. Illustrations can be in form of Clip Art files, photo albums, pictures, Smart Art, shapes and charts. You can insert a link using the hyperlink tool to navigate the corresponding presentations. The 'insert text box' option provides the orientation and location of the words along with the insertion of date, time, symbols, slide numbers and embedded objects.



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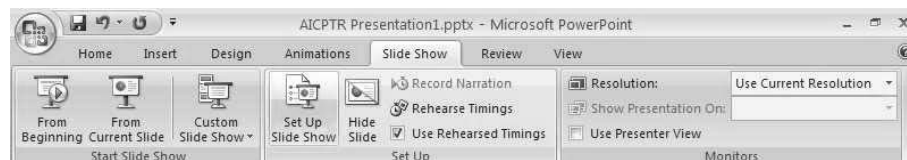
Animation

The animation option contains preview, custom animation and various transition settings that can be applied to the specified or all slides in the presentation. The slide show transition can be set at mouse clicks or 'automatically-after -seconds' options. You can preview the slide show to view the proper effect and the mode of presentations. Various objects, such as images, text and embedded objects can be added on the slides. The various transitions available for slide shows are wipes, fades and dissolve, random, strips and bars, push and cover, etc.



Slide Show

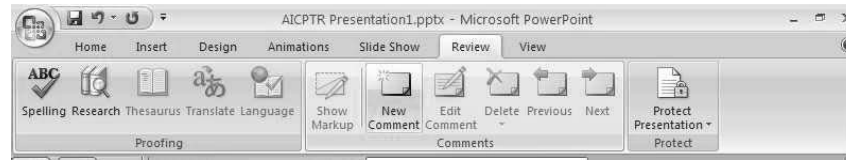
The slide show option helps in setting up the start slide show (either from the starting or from-and-to specific slide numbers) and to record narration. It also has the option to monitor the screen resolution by providing separate views of the slide show.



Review

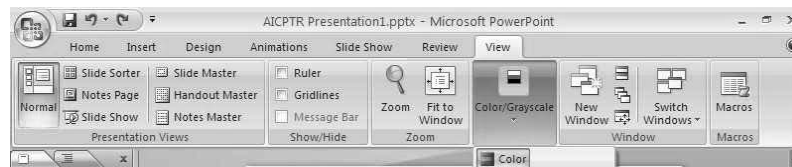
The content of the slides can be reviewed and modified by using the spell check, research, adding comments, etc. This makes the presentation flawless. Proofing provides the facility of text proofing by scanning the online research references, finding synonyms and converting the text to other languages in totality. This option provides the comment facility that enables the addition or modification of a comment for a particular slide or the content of a slide. The protect option restricts usage by unauthorized users. This option is helpful for slide show share with a network drive if you collaborate with other users.

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View

The view option enables the presentation to be viewed in different ways, such as normal view, notes view, handout view, printout view and screen view, show/hide grid lines, rulers and tools, zoom in and zoom out facility and also includes the color/grayscale view whether the slides should appear in color or black and white. The window tab arranges the windows of the current working slides and macros includes complex tasks that get activated after clicking on the slides.



The format tab includes drawing tools and picture tools. The picture tool is a context sensitive tab that appears on the Ribbon and allows the user to work with inserted images, photos, Clip Art and pictures. It sets the brightness of images, crops the picture, etc.

Navigation

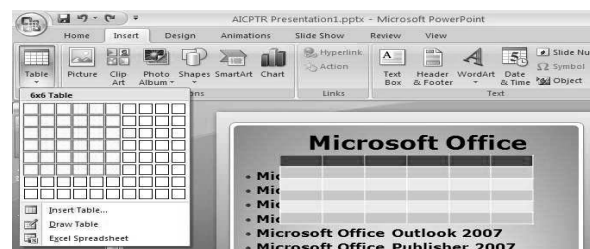
Navigation through the slides can be accomplished using the Slide Navigation menu on the left side of the screen. An outline of slides appear on the left side that have been entered in the presentation. You need to click the outline tab to access the outline of the presentation.

Mini Toolbar

A new feature in Office 2007 is the Mini Toolbar. This is a floating toolbar that is displayed when you select text or right click on the text. It displays the common formatting tools, such as bold, italics, fonts, font size and font color.

Table

This option includes adding borders, rows and columns, formatting of individual cell, etc., to a table. It helps in deciding the number of rows and columns that would appear on the screen. The merge option combines the cells into a larger one and the alignment option sets the alignment of the cell so that the text may fit better.



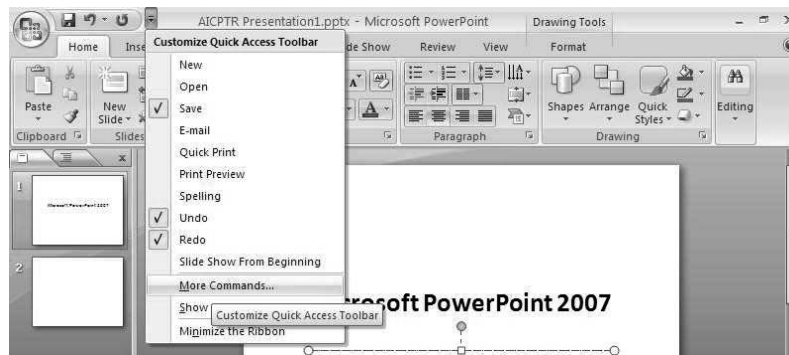
Quick Access Toolbar

The quick access toolbar holds the commands which are issued by the user again and again. The quick access toolbar can be easily customized using the command button available on the Ribbon. This tool is displayed on the top most left corner of the screen.

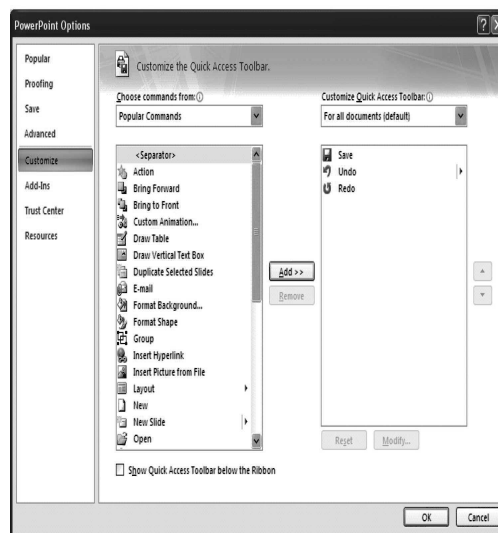
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The drop-down list is customized on the quick access toolbar by selecting the **Customize Quick Access Toolbar** → **More Commands** → **Customize**.



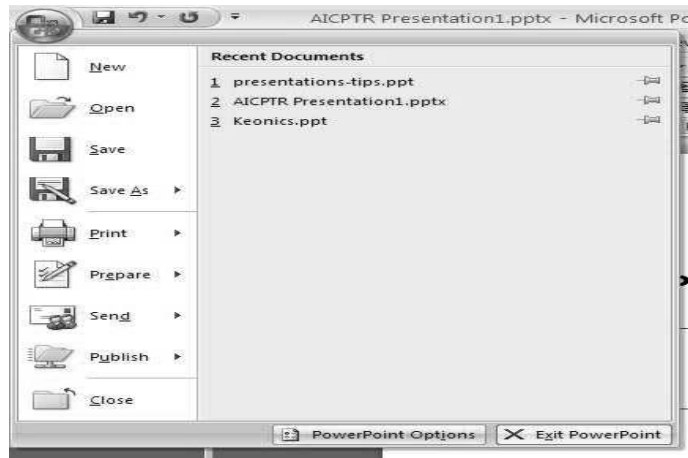
You can add or remove the commands from the list. Once you make changes and save them, the quick access toolbar gets updated. This toolbar is also known as a customizable toolbar. You can add or delete the toolbar from the menu.



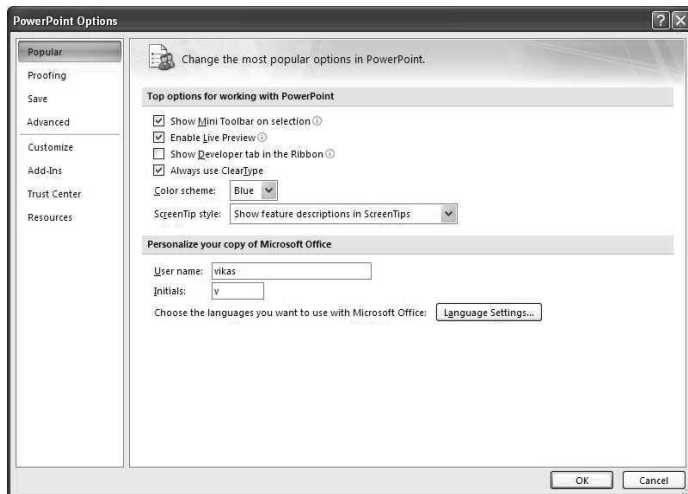
Customize

Microsoft PowerPoint 2007 facilitates customizable options. For this, click on the **File** menu. It generates the option called '**PowerPoint Options**' as follows:

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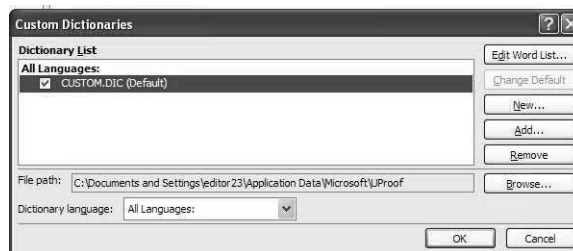


By clicking on the **PowerPoint Options** leads to the **Customize** option.



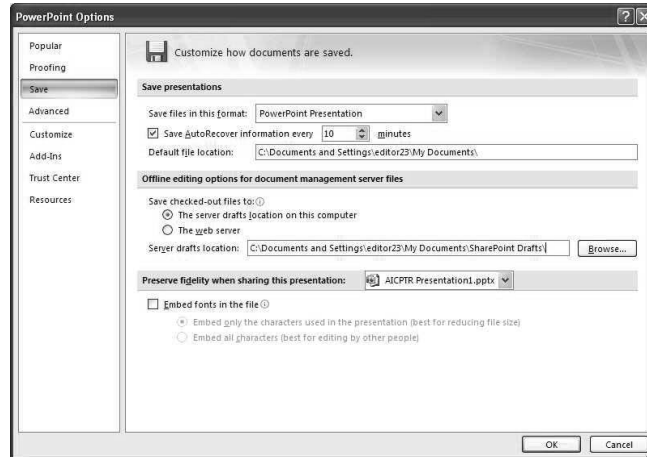
The **Popular** option helps you to initialize the work environment, color schemes and user name along with initials and accessing the Live Preview feature which is useful for applying designs and changes.

The **Proofing** option provides auto correction settings and also helps in finding errors through custom dictionaries.

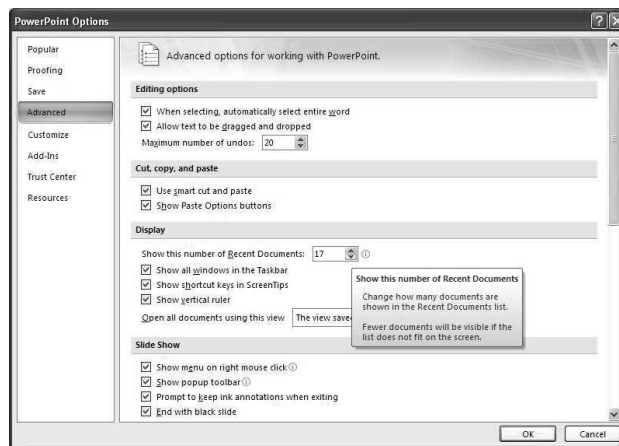


The save option allows you to personalize the process of saving the workbook.

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The **Advance** feature option provides the options to edit, copy, paste, print, display slide show and for general settings.



The **Customize** option allows you to add or delete the toolbars in the quick access toolbar. This option is very useful from the point of view of setting the toolbars as per the user requirement.

4.4 CREATING, MANIPULATING AND ENHANCING SLIDES

In Microsoft PowerPoint 2007 you can create, manipulate and enhance slides. The presentation can be created by blank presentation, templates, from existing presentations and word outline. The presentation slides can be manipulated by office themes, duplicate selected slides or reuse slides. Microsoft PowerPoint 2007 provides various tools to enhance slides. These all features are discussed as follows:

4.4.1 Creating Slides

The presentations can be created as follows:

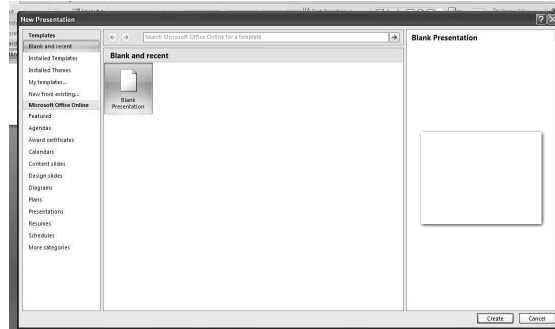
New Presentation

You can create a new presentation from a blank slide, a template, existing presentations or a Word outline. To create a new presentation from a blank slide, the following

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steps need to be performed:

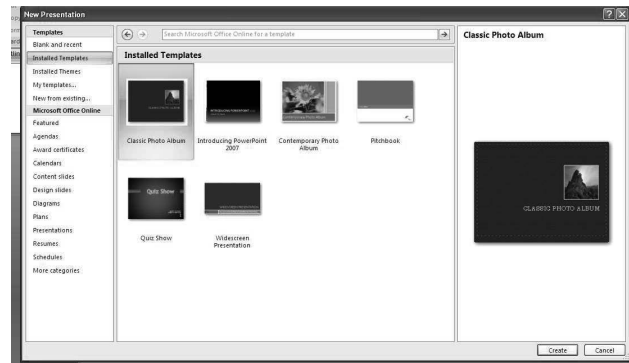
- Click on the **Microsoft Office Button**.
- Click on **New**.
- Click on **Blank Presentation**.



To Create a New Presentation from a Template

To create a new presentation from a template, the following steps must be performed:

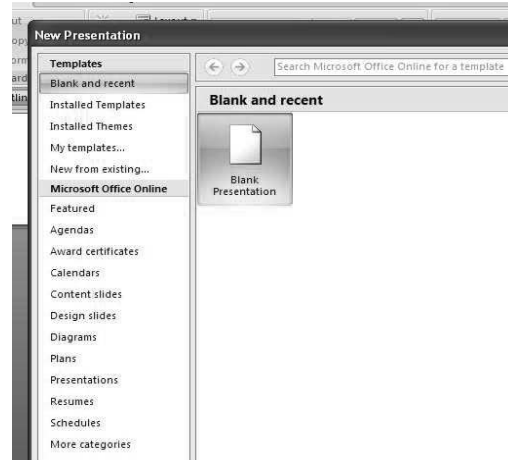
- Click on the **Microsoft Office Button**.
- Click on **New**.
- Click on **Installed Templates** or **Browse through Microsoft Office Online Templates**.
- Click on the template you want.



To Create a New Presentation from an Existing Presentation

To create a new presentation from an existing presentation, the following steps need to be performed:

- Click on the **Microsoft Office Button**.
- Click on **New**.
- Click on **New from Existing**.
- Browse and click to open the presentation.

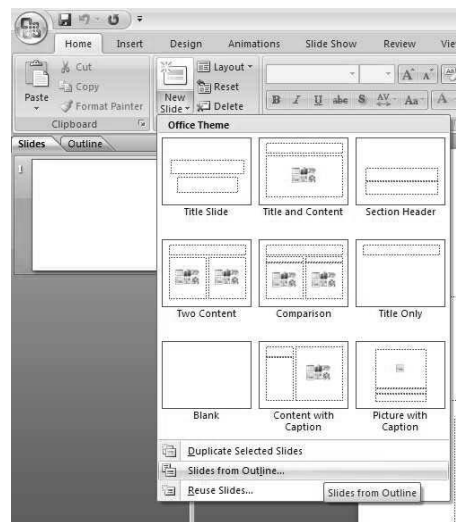


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To Create a New Presentation from a Word Outline

To create a new presentation from a Word outline, the following steps need to be performed:

- Click on the slide where you would like the outline to begin.
- Click on **New Slide** on the **Home** tab.
- Click on **Slides from Outline**.
- Browse and click on the Word document that contains the outline.

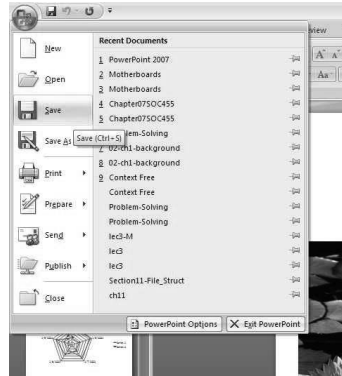


Saving a Presentation

You can save a presentation using the **Save** or the **Save As** command. To save a document with Save command follow these steps:

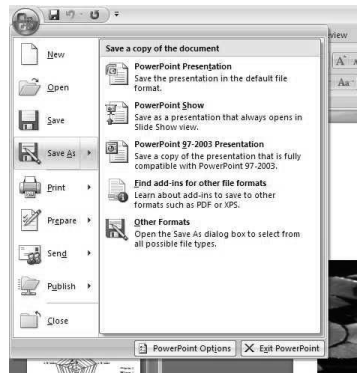
- Click on the **Microsoft Office Button**.
- Click on **Save**.

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You can also use the **Save As** command to save a presentation with a different name or to save it as an earlier version of PowerPoint. The older versions of PowerPoint will not open the PowerPoint 2007 presentation unless you save it in the PowerPoint 97-2003 format. To use the **Save As** command, follow these steps:

- Click on the **Microsoft Office Button**.
- Click on **Save As**.
- In the **Save as** box, choose **PowerPoint 97-2003 Presentation**.
- Type the name for the presentation.



4.4.2 Manipulating Slides

Adding Slides

There are various options available to add new slides to the presentation, such as Office Themes, Duplicate Selected Slide or Reuse Slides.

To create a new slide from Office Themes, the steps that need to be performed are as follows:

- Select the slide that is just **BEFORE** where you have to insert the new slide.
- Click on the **Home** tab and then on the **New Slide** Button.
- Click on the slide format of your choice.

To create a duplicate slide of a particular slide in the presentation, following are the steps that need to be performed:

- Select the slide which you want to duplicate.
- Click on the **Home** tab and then click on the **New Slide** Button.
- Click on **Duplicate Selected Slides**.

To insert a slide from another presentation, the steps that need to be performed are as follows:

- Select the slide that is just BEFORE where you have to insert the new slide
- Click on the **New Slide** Button on the **Home** Tab.
- Click on **Reuse Slides**.
- Click on **Browse**.
- Click on **Browse File**.
- Find the slide and click on the specific slide to import.

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4.4.3 Enhancing Slides

Microsoft PowerPoint offers tool to enhance slides by creating informative, interesting and dynamic presentation. You can create high-impact presentation by adding tables, charts, etc. Adding visual components to your slides can enhance your presentation. Clip Art images, Word Art, Internet images or scanned images can be added to your PowerPoint slides. You can also add visual components by using Smart Art, Charts, Photo Album, etc.

Entering Text

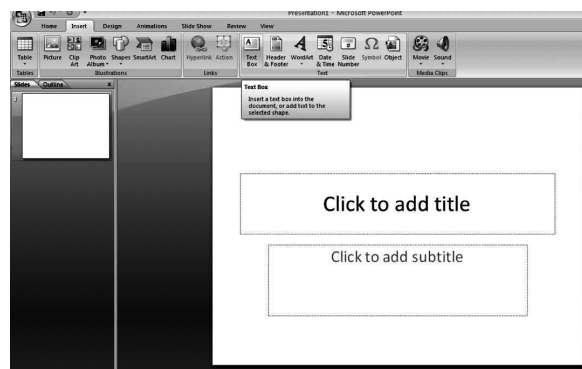
Following are the steps that must be performed to enter text in a slide:

- Select the **slide** where the text needs to be added.
- Click on the **Text Box** to add text.



Following are the steps that must be performed to add a text box:

- Select the **slide** in which you want to insert the text box.
- Click on the **Insert** Tab, then click on **Text Box**.
- Click on the slide and drag the cursor to enlarge the text box.
- Type the text in the text box.

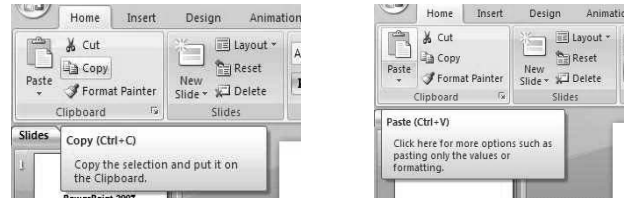


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Copy and Paste

Following are the steps for copying and pasting any object or text in a slide:

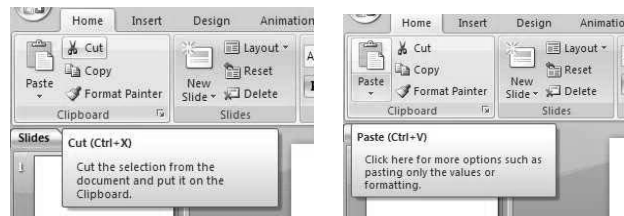
- Select the object or text that you want to copy.
- On the **Clipboard Group** of the **Home Tab**, click on **Copy**.
- Select the location where you want to copy the object or text.
- On the **Clipboard Group** of the **Home Tab**, click on **Paste**.



Cut and Paste

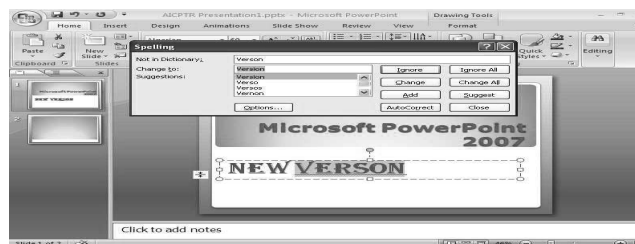
Following are the steps to cut and paste any text or object in a slide:

- Select the text or object that you want to copy.
- On the **Clipboard Group** of the **Home Tab**, click on **Cut**.
- Select the location where you want to copy the text or object.
- On the **Clipboard Group** of the **Home Tab**, click on **Paste**.



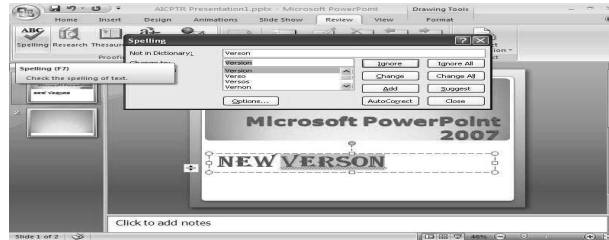
Spell Check

The spell check option is useful if a text based PowerPoint presentation is to be prepared. It underlines every wrong spelling by a red wavy line.

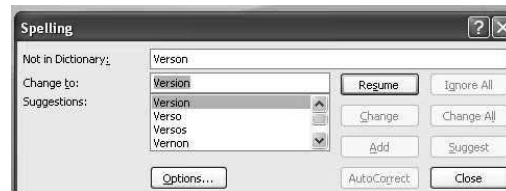


The spell check option can be used by pressing the right mouse button. It generates a shortcut menu. You can correct the spelling by either using the **Review** option or by pressing the function key [F7].

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The spelling dialog box provides a variety of buttons—Ignore, Change, Options, AutoCorrect, etc., to the users. If you do not wish to make any changes in the spelling, click on the **Ignore** button.

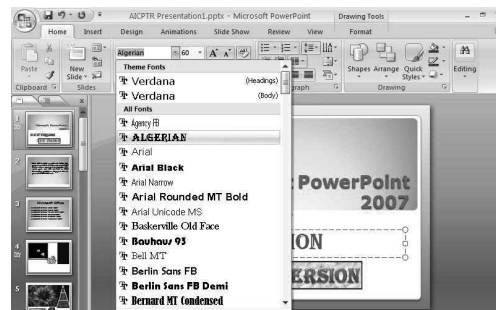


Once the spellings have been changed as required, it provides a dialog box which says, ‘**The spelling check is complete.**’

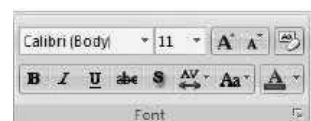


Change Font Typeface and Size

The font typeface and size can be changed by selecting the specific tool in the Home Tab of the Ribbon.



For this, you first select the text which needs to be changed to the desired font size, color and style.

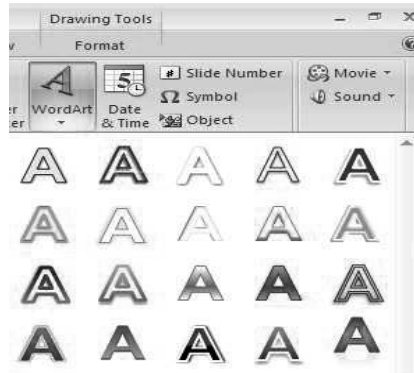


WordArt

WordArt is a gallery of text styles that you can add to your 2007 Microsoft Office system documents to create decorative effects, such as shadowed or mirrored (reflected) text. In Microsoft Office PowerPoint 2007, you can also convert existing text into WordArt. You can use WordArt to add special text effects to your document.

For example, you can stretch a title, skew text, make text fit a preset shape or apply a gradient fill. On the **Insert** Tab, in the **Text** group, click **WordArt** and then click the WordArt style that you want to add in your presentation.

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You can use any of the styles of WordArt by choosing any one option from the list to get the desired effect.

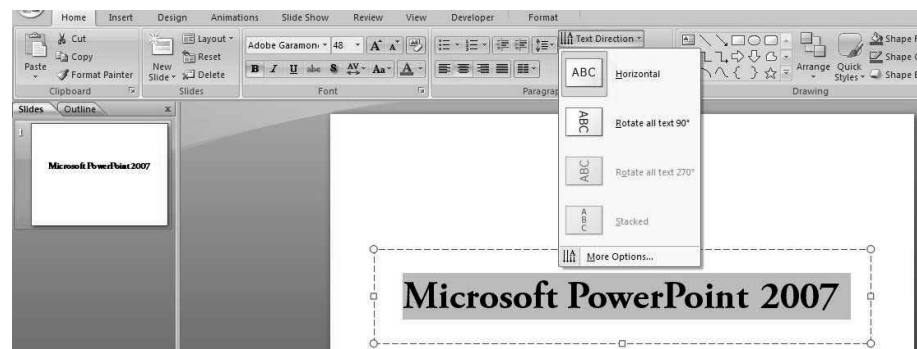
Paragraph Alignment

This option provides the various alignment options to change the indent setting of text as Align Left (it aligns text to the left margin [CTRL+L]), Center (it centers text [CTRL+E]), Align Right (it aligns text to the right margin [CTRL+R]) and Justify (it justifies the text on left and right margins).

To see the effect, select the paragraph for which you have to set the indent. The paragraph is indented when you click on the indent button to control the indent style.

Text Direction

The text direction option is used to change the direction of the text. The options available are **Horizontal**, **Rotate all text 90°**, **Rotate all text 270°**, **Stacked** and **More Options**.





Resize a Text Box

You can resize a text box by clicking on the **Text Box Tool**. You can resize the text box by dragging the handles that appear around the typed text.

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Nested Lists

A nested list also known as a sublist that represents a list in another list. It has two tools—Increase List Level (increases the indent level) and Decrease List Level (decreases the indent level). For this, the tools ‘ ’ are used. The resultant effect of Increase List Level would be as follows:



Formatting Texts

This option allows the text to be formatted by using **Font option in the Home Tab**. It helps you to make changes in the font size, style type and effects.

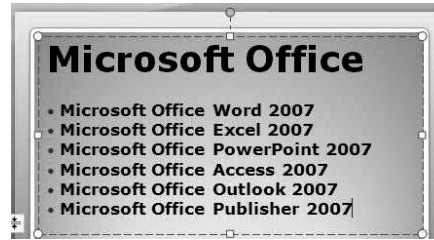
To change text attributes, open a presentation, select the text on a slide by dragging the cursor over it. Right click on your selection and select Format Text Effects as shown below.



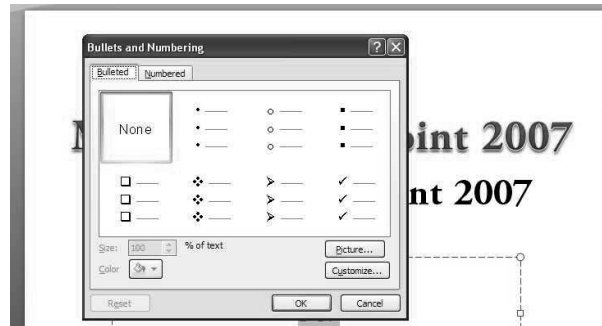
Formatting Lists (Bulleted and Numbered)

Bulleted and numbered lists are useful for the purpose of highlighting the important elements or key features of the specified heading. This can be done with the help of Bullets and Numbering tool. For example, if you want to show the MS Office 2007 group/package in form of a numbered or bulleted list, you can add bullets as follows:

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The dialog box for the Bullets and Numbering option appears as follows:



Table

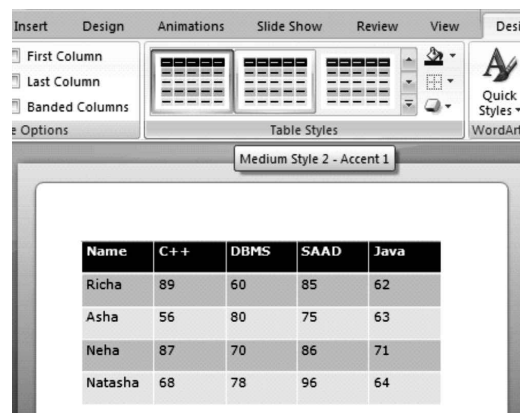
Tables can be inserted along with text to show the statistical data on the slide. You can insert a table by clicking on **Insert**→**Table** option.

Enter Data

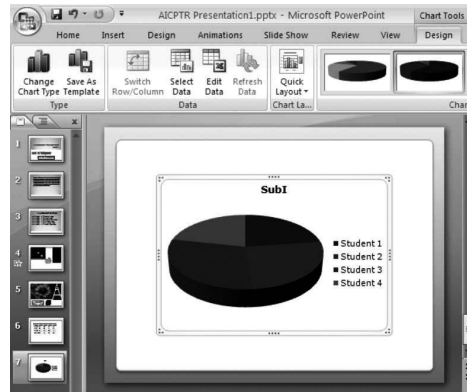
The data is entered in a tabular format. For example, if marks obtained by students in a specific course module have to be displayed on the slide, you can add them as shown in the screen.

Format Table

The table that has to be appeared on the slide can be formatted by using the **Design** menu. You can also format the border and shading of the table as per your requirement.



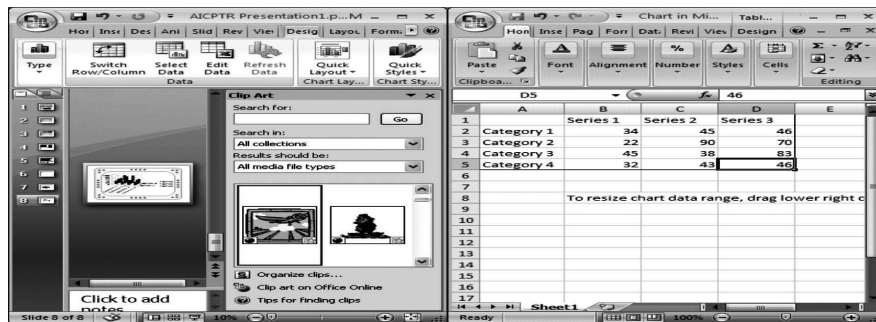
Tables can be embedded from other applications too, such as Microsoft Excel 2007 and Microsoft Word 2007. For this, you have to first open Microsoft Excel 2007 and prepare a table. Then click on PowerPoint 2007 to add the required chart/table.



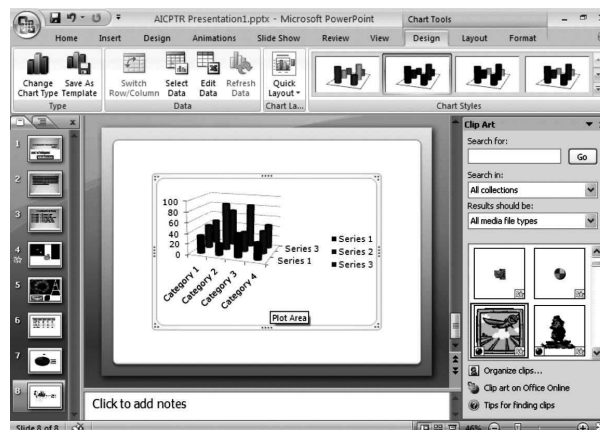
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Chart

Microsoft Excel 2007 charts and tables can also be embedded to Microsoft PowerPoint 2007. For this, you need to select **Insert**→**Chart** option.



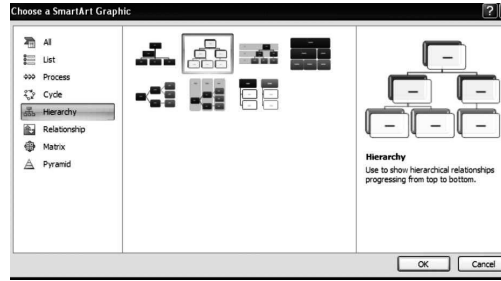
After copying and pasting the chart on slide, you can get the desired chart from Microsoft Excel 2007.



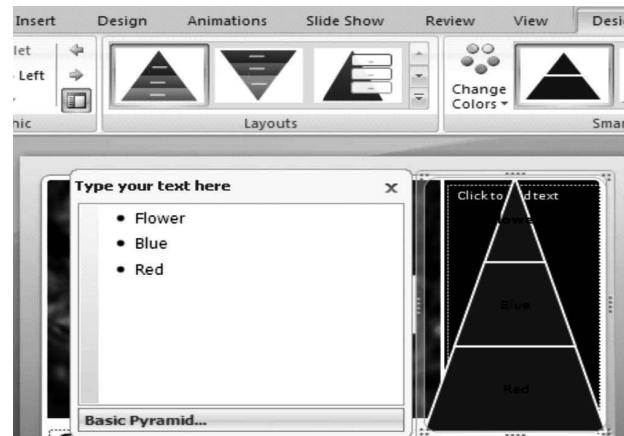
Adding Organizational Chart using SmartArt

Information can be communicated visually by using the **SmartArt** option. It provides graphics, ranging from graphical list and process diagrams to more complex graphics. For example, Venn diagrams and organization charts. The options available for the purpose are List, **Process**, Cycle, **Hierarchy**, Relationship, Matrix and Pyramids. The **SmartArt** picture is added by clicking on **Insert**→**SmartArt** option.

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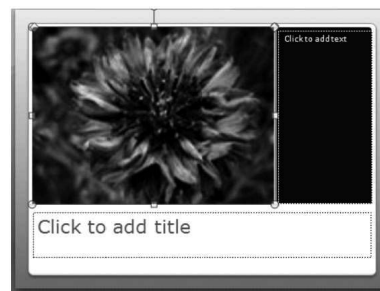


If you select the Pyramid option, it generates various options as shown in screen.



Graphics

You can add a picture to your PowerPoint slide by selecting **Insert**→**Picture** option.

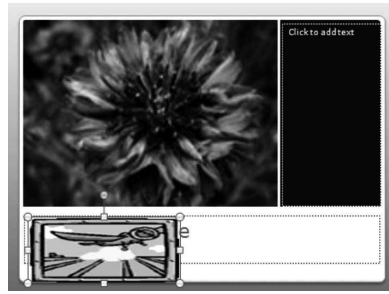


Once you get a picture on your slide, you can move the picture around the slide by dragging it with your mouse. You can also resize the photo by dragging the corner handles and rotating using the little circles located at each corner.

Adding Clip Art

The Clip Art picture option helps in adding Clip Art to the slide. For this, select **Insert**→**Clip Art** tool.

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Adding Photo Album

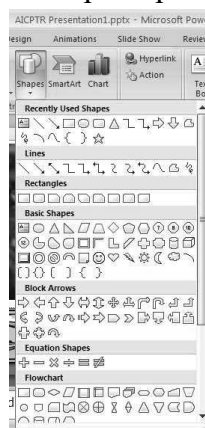
To create a photo album, click on 'Insert' menu and click on '**Photo Album**' and then select 'New Photo Album'. A pop up Window then opens, select the photos that you want to insert in the album. After adding the photos, you can rotate them or even change their brightness/contrast. You can even add your own Photo Album and can create it in form of a presentation.



Adding Shapes

The **Adding Shapes** option is available to the user by clicking on the **Shapes** tool which generates a drop-down list.

You can add various types of shapes as per the text or presentation requirement.



Layering Art Objects

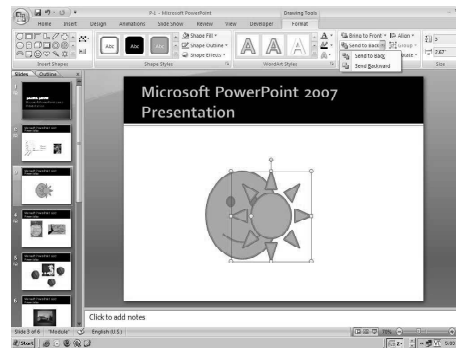
PowerPoint 2007 gives you the option of layering your images by controlling their order and how they appear on the slide. As you add objects to your slides, you may find that one object overlaps another or causes another object to disappear completely.

NOTES

For instance, you may add a Clip Art graphic to your slide and can draw a rectangle around the graphic. However, when you draw the rectangle, you find that the graphic has disappeared from the screen. PowerPoint layers objects in a stack that is, the first object drawn or inserted is on the bottom of the stack, and the next object appears on top of the previous object, and so on. You can order the images on the slide so they appear behind the text or above it. PowerPoint's formatting tool allows you to organize the image objects on the slide by keeping track of the image's hierarchy.

Changing the Layering Order of Objects

- Select the graphical object that you wish to move.
- Click the **Format** Tab.
- To send an object backward or to the back of the stack, click the **Send to Back** arrow on the **Arrange** group and choose either **Send to Back** or **Send Backward**.
- To bring an object forward or to the front of the stack, click the **Bring to Front** arrow on the **Arrange** group and choose either **Bring to Front** or **Bring Forward**.



Check Your Progress

1. Name the prime utility of PowerPoint presentation.
2. Write the main feature of PowerPoint which separates PowerPoint 2007 from PowerPoint 2003.
3. What is the need of Insert option in the Ribbon?
4. What is the use of bulleted and numbered lists?
5. What is layering of objects?

4.5 SLIDE FORMATTING

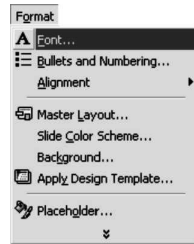
The slide master controls the formatting for all slides with the specified layout. Changes made to the slide master will affect all slides with that layout. Slide masters are special slides that allow you to format basic information and apply it to every slide in a presentation. Masters let you format the title, background, color, date, time and slide number. By using the slide masters, you can add consistency to a presentation, making it easier to follow and understand. Entering a title or other text

is easy in PowerPoint. Simply click in the appropriate text box and type your text. Click a slide in the Slides tab where you want to change some text formatting.



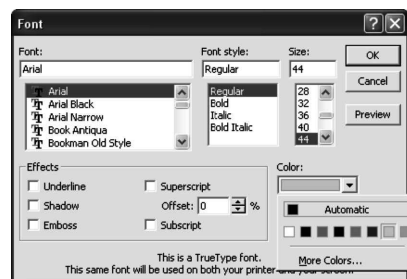
NOTES

To format the Master Title you started on the previous page, highlight the text that says '**Click to edit Master title style**'.



Once you have highlighted all the text (the parts in black in the image above), click **Format** from the menu bar at the top of PowerPoint. From the **Format** menu, select **Font...** where you can right click the highlighted text and select Font from the context menu that appears.

You should now see the **Font** dialog box appear. Select Arial for the font and 44 for the size. Click the color drop-down list and select the color as per your choice.



Click **OK**. Your Master title should now look like as shown in screen.

Format the AutoLayout area

With the Master title set up, you can format the **AutoLayout** area (the one with the bullets in it). You only need one slide with bullets in our presentation, so it makes sense to delete these and just add some text instead. So, click inside the **AutoLayout** area and select all the text.

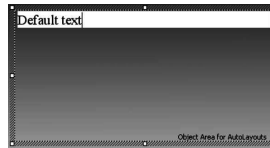


With the text highlighted, locate the bullet tool on the PowerPoint toolbar at the top. When you deactivate the bullets, your **AutoLayout** area look as shown in screen.

NOTES



Press the delete key on your keyboard to get rid of this text and type out a word or two of default text in its place.



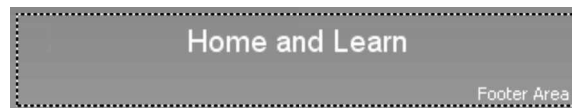
Format the text like you did for the Master title. Choose **Arial** for the font and keep the size 16. Leave it on black for the color.

Format the Footer

You can also enter defaults in the Footer area. Click on the word <footer>, as shown in the screen.



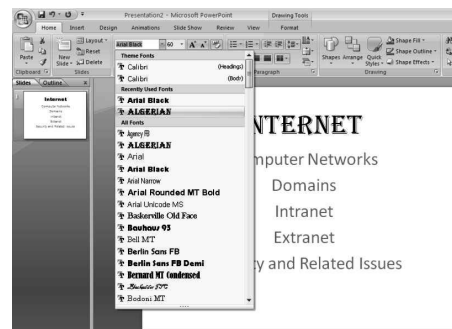
Then type the text you want to appear on every slide. Or just leave it, if you want this area blank. Leave the Date Area and Number Area as they are. Screen below displays the footer.



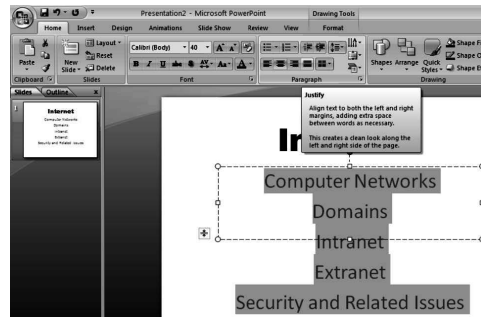
If Arial for the font is chosen as size is 12 and the color is white then screen above appears.

4.5.1 Formatting Text in a Slide: Font, Alignment and Line Spacing

To change the font in PowerPoint 2007, you need to select the slide on which you have to format the text. Select the text that you want to format. Select the font type as shown in the screen.

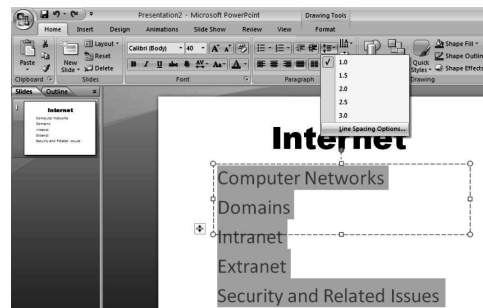


You can align the selected text as shown in the screen.

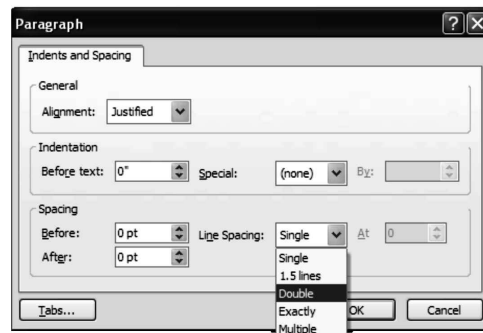


NOTES

The line spacing is set with the tool as shown in the following screen.



You can adjust the line spacing in **Paragraph** Tab where options are given as **Single**, **1.5 lines**, **Double**, **Exactly** and **Multiple** as shown in the screen.

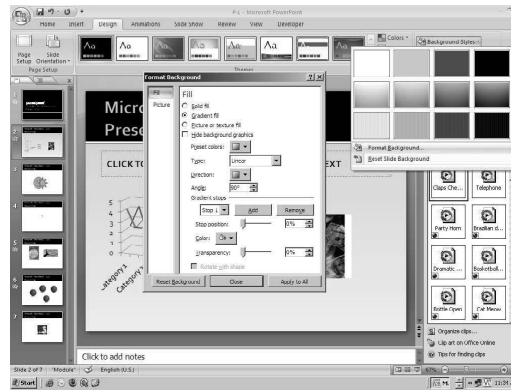


4.5.2 Changing Slide Background Color

The background is the area that covers the whole slide in PowerPoint 2007. It is referred to as background because it stays in the back and it is positioned behind anything else in the slide. If you assign or change a presentation's design, a nicely formatted background is applied to the slides. You can change and design a slide's background anytime or change the presentation's design manually if none of the designs suits your particular needs. To design a particular slides background, you should be in the Slides tab of the Normal view.

- Click **Background Styles**, and then select **Format Background**, from the **Design Tab**, in the Background group. The **Format Background** dialog box will appear.

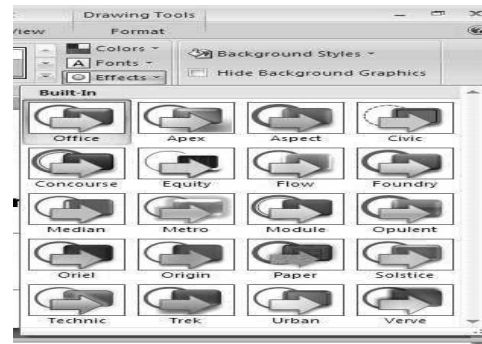
NOTES



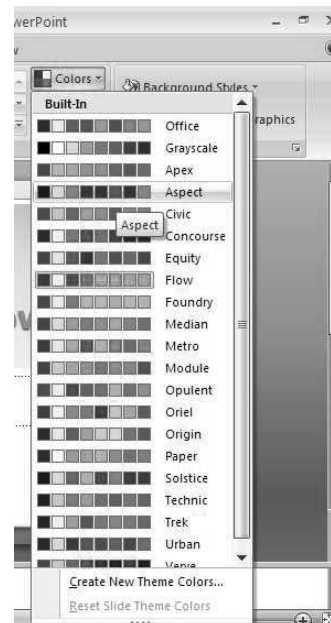
- Select the desired options from the **Fill** section.
- To apply the changes only to the current slide and close the dialog box, click **Close**.
- To apply the changes to all slides, click **Apply to all**.

4.5.3 Applying Themes

This option comprises certain buttons that help in the customization of colors, fonts and effects. For this, you have to select the **Design** option.



If you click on Color drop-down list, you can get the available color scheme and be able to see the preview by hovering the cursor over the color scheme.

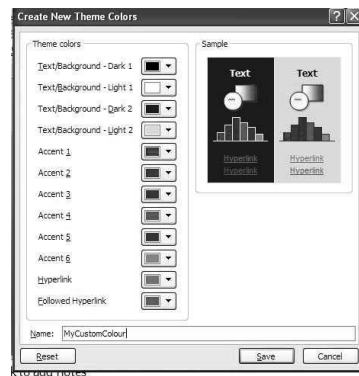


The color schemes as specified are applied to all the slides in the presentation. For example, the 'Aspect' option gives the following effect to the slides.

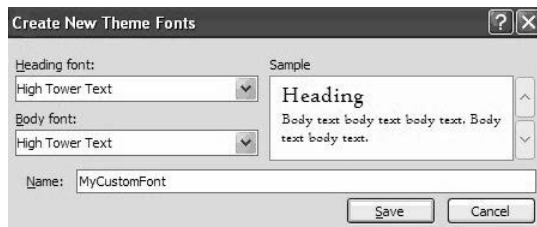
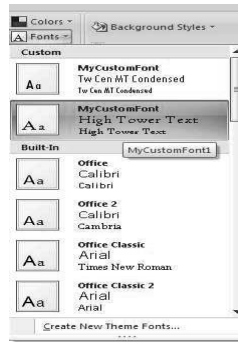


NOTES

The new color theme option is created by selecting the **Create New Theme Colors** option. You can save the color theme as **MyCustomColor** which in turn would affect the current slide color.



The new font theme option is created by selecting the **Create New Theme Font** option. You can save the custom font as **MyCustomFont** which would change the current slide font.

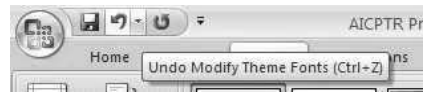


The font can be used for Heading and body text. The theme is saved with a **.thmx** file extension. The custom theme **MyCustomFont** is then available in the theme gallery for further use.

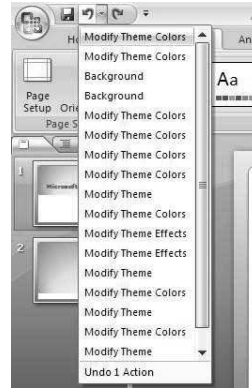
Undo and Redo

The Undo and Redo Buttons are located at the top most left side of the interface.

NOTES



The two ways to use the **Redo** command are by either clicking on the 'Redo Button' or pressing the [CTRL+Y] key combination simultaneously.



The Undo command [CTRL+Z] reverses the last performed or the preceding task, whereas the 'Redo Button' is used for repeating the task. The Undo command is useful if the text or figure is deleted accidentally. For example, 'Modify Theme Colour' can be undone as shown in screen.

4.6 DIFFERENT VIEWS IN POWERPOINT

The view option enables the presentation to be viewed in different ways, such as Normal view, Notes Page view, Handout Master view, Slide Sorter view, Slide show view and Notes Master view, show/hide grid lines, rulers and tools, zoom in and zoom out facility and also includes Color, Grayscale view and Pure Black and White. The Window Tab arranges the Windows of the current working slides and macros includes complex tasks that get activated after clicking on the slides.

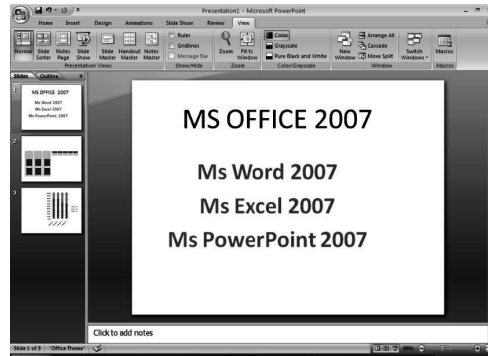


The Format Tab includes drawing tools and picture tools too. The picture tool is a context sensitive tab that appears on the ribbon and allows one to work with inserted images, photos and Clip Art pictures. It sets the brightness of images, crops the picture, etc.

4.6.1 Normal View

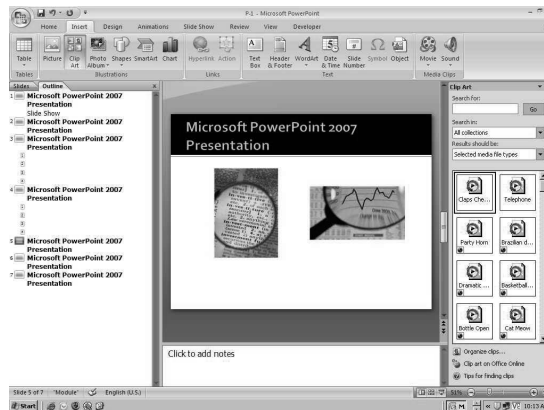
Normal view in Microsoft PowerPoint is the main working Window in the presentation. The slide is shown in full size on the screen. This view is more commonly known as Slide view.

NOTES



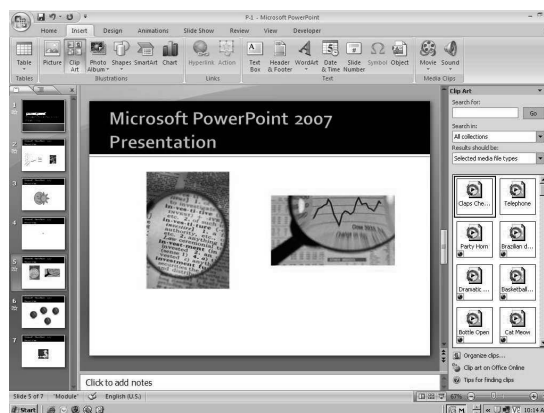
4.6.2 Outline View

Outline view shows all the text of all slides in a list. No graphics are shown in Outline view. This view is useful for editing purposes and can be exported out as a Word document and used as a summary handout.



4.6.3 Slide View

The Slide view does not differ much from the Normal view, except in that the Slide view does not display the presentation outline. The Slide view displays each slide on the screen and is helpful for adding images, formatting text and adding background styles.

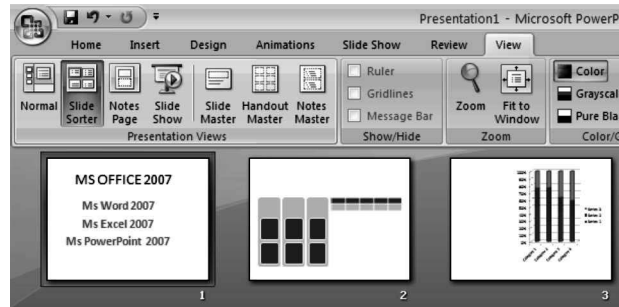


4.6.4 Slide Sorter View

Slide Sorter view in PowerPoint 2007 is a Window that displays thumbnail versions

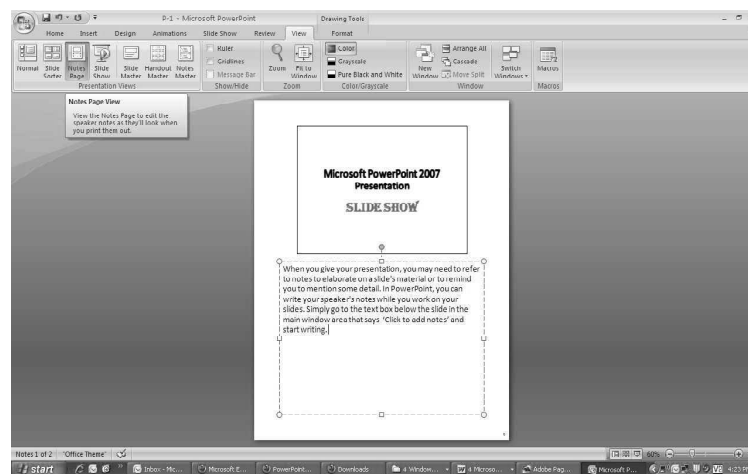
NOTES

of all your slides, arranged in horizontal rows. This view is useful to make global changes to several slides at a time. Rearranging or deleting slides is easy to do in Slide Sorter view. In order to apply the same transition to all of the PowerPoint slides at one time, users switch their presentation to Slide Sorter view. Slide Sorter view shows miniature versions of all the slides in horizontal rows. These miniature versions of the slides are called thumbnails. A thumbnail is the term used to describe a miniature version of a slide or picture. Slides can be easily deleted or rearranged quickly in this view. Effects, such as transitions and sounds can be added to several slides at the same time in Slide Sorter view.



4.6.5 Notes Page View

PowerPoint lets you create speaker notes to help you through your presentation. You can write a complete script for your PowerPoint presentation or just jot down a few key points to refresh your memory. Each slide can be created with its own notes page. The user can print these pages and use as a reference while making the presentation. Notes Page show the added notes at the bottom of the slide as shown in the screenshot. These notes are not visible on the screen during the slide show or presentation. The Notes pane is located just below the Slide pane. You can type notes that you want to apply to the current slide. When you present your presentation, you may need to refer to notes to elaborate on a slide's material or to remind you to point out some detail. In PowerPoint, you can write your speaker's notes while creating your slides. Simply go to the text box below the slide in the main window area that says 'Click to add notes' and start writing. To work with Notes Page, click on the **View** Tab. Under **Presentation Views** select the **Notes Page** Button. Type your notes in the space that appears in the notes area in your slide.



Check Your Progress

6. What is background area in PowerPoint 2007?
7. Write the extension of theme when saved.
8. What is Normal View in context of PowerPoint 2007?

NOTES

4.7 ANIMATIONS AND SOUNDS

The animation option contains preview, custom animation and various transition settings that can be applied to the specified slides. The Slide Show transition can be set at mouse clicks or 'automatically-after-seconds' options. You can preview the slide show to view the proper effect and the mode of presentations. Various objects, such as images, text and embedded objects can be added on the slides. The various transitions available for slide shows are wipes, fades and dissolve, random, strips and bars, push and cover, etc.



4.7.1 Slide Transition

Transition effects add movement to changes between the slides. The slides appear as thumbnail diagrams on the Ribbon's Animations Tab. The Normal view is generated when the mouse is rolled over a thumbnail. PowerPoint 2007 applies the transition effect to the slide when we click on the thumbnail. Clicking on the slide in Normal or Slide Sorter view highlights the thumbnail to which the slide transition effect needs to be applied. To apply the transition effect to multiple slides, hold down the **CTRL** key as you click on several slides and choose an animation. To insert a transition between every slide in a presentation, click **Apply to All** button in the **Animations** Tab. The transition effect comes after clicking on the **Animations** Tab. You can even set the transition speed and transition sound as per requirement.



After setting the slide transition set, click on the **Slide Show** option as follows:



NOTES

The slide speed option can be set as fast, medium or slow.

4.7.2 Automation of Slide Presentation

PowerPoint 2007 presents an effect of slide presentation. You can include wipes, zooms, pans, spins, reveals or hundreds of visually special effects at the time of preparing presentation. Automation of slide presentation leads the concept of self running presentations. It is a great way to communicate information without having someone available to run a Slide Show presentation. For example, you might want to set up a presentation to run unattended in a trade show or convention or send a Compact Disk (CD) with a self running slide show to a client. You can make most controls unavailable so that users cannot make changes to the presentation. A self running presentation restarts when it has finished and also when it has been idle on a manually advanced slide for longer than five minutes. When a self run presentation is designed, the corresponding environment is kept in the mind, such as elements you add to your presentation, how much control you give users and what steps you need to take to prevent misuse. Options you might want to consider when designing a self running presentation include:

- **Automatic or Manual Timings:** You can set up a presentation to run by itself with automatic timings or you can set it so that users can move through it at their own pace by using the mouse to click action buttons for navigation. If you set up a slide show to be browsed at a kiosk, mouse clicks are ignored unless they are on objects with hyperlinks or action buttons.
- **Hyperlinks and Action buttons:** You can use hyperlinks to move through the presentation or to jump to other slides and programs. Action buttons are predefined navigation buttons which can give your presentation the look and familiarity of a Web page with buttons for Home, Help, Back, Next, and so on.
- **Voice Narration:** The recorded narration can be added to play with your presentation.
- **Capture User Input:** You can use the ActiveX controls that come with PowerPoint to create a response slide in your presentation. For example, you can add a text box in which people can enter their names and addresses to receive further information.

You can set timings for your slides manually or you can set them automatically while you rehearse. You can set the exact amount of time each slide is viewed, for example you can have the title slide appear for 10 seconds, the second slide for two minutes, the third for 45 seconds, and so on. You may find it easiest to work with the Slides Tab selected in **Normal** view so you can see miniatures of each slide in your presentation. To set timings automatically while you rehearse, you can use the buttons in the Rehearsal dialog box to pause between slides, restart a slide and advance to the next slide. As you rehearse the presentation, PowerPoint

tracks how long each slide appears and sets the timing accordingly. If you display the same slide more than once, for example in a custom show the last timing will be recorded by the PowerPoint.

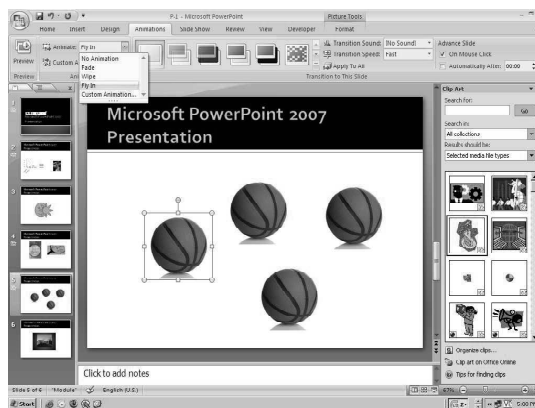
4.7.3 Inserting Animated Pictures

You can use animation to focus on important points, to control the flow of information and to increase viewer interest in your presentation. You can use the built-in animation effects in Microsoft Office PowerPoint 2007 or you can create your own custom effects. You can apply animation effects to individual slides, to the slide master or to custom slide layouts.

Applying a Pre-Built Animation Effect to Text or Objects

For applying animation effects to objects in Office PowerPoint 2007, do the following:

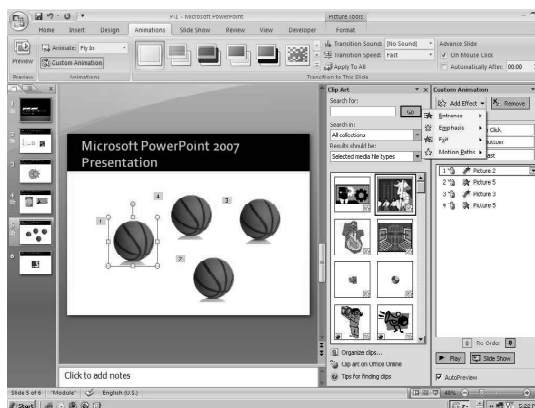
- Select the text or object that you want to animate.
- On the **Animations** Tab, in the **Animations** group, select the animation effect that you want from the **Animate** list.



Applying a Custom Animation Effect to Text or Objects

You create custom animations in the **Custom Animation**. The **Custom Animation** task pane shows important information about an animation effect, including the type of effect, the order of multiple effects in relation to each other and a portion of the text of the effect.

- Select the text or object that you want to animate.
- On the **Animations** Tab, in the **Animations** group, click **Custom Animation**.



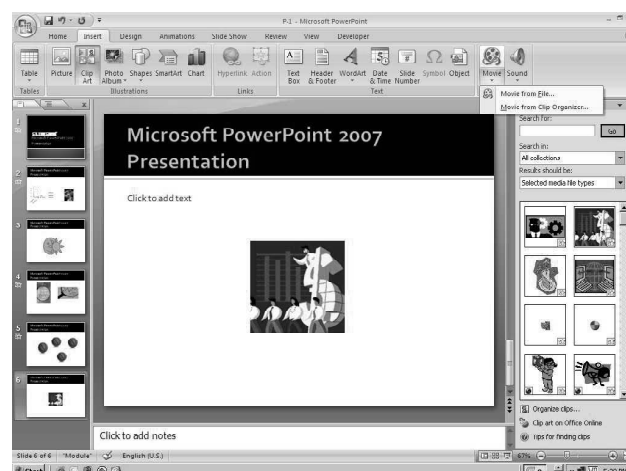
NOTES

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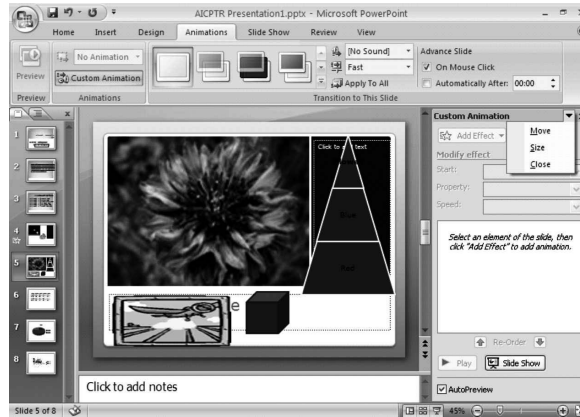
- In the **Custom Animation** task pane, click **Add Effect** and then do one or more of the following:
- To make the text or object enter with an effect, point to **Entrance** and then click an effect.
- To add an effect, such as a spin effect, to text or an object that is already visible on the slide, point to **Emphasis** and then click an effect.
- To add an effect that makes text or an object leave the slide at some point, point to **Exit** and then click an effect.
- To add an effect that makes text or an object move in a specified pattern, point to **Motion Paths** and then click a path.
- To specify how the effect is applied to your text or object, right click the custom animation effect in the **Custom Animation** list and then click **Effect Options** on the shortcut menu.

Inserting GIF Files

- Click on the slide where you want the GIF video file to appear. Click on the **Insert** Tab and then click on the **Movie** option from the **Media Clips** group.
- For inserting image from file, click on the **Movie from File** option and then locate the folder on your computer where the GIF video file is stored. Click on the video file and then click on the **Open** Button.
- For inserting image from clip organizer, Click **Movie from Clip Organizer**, scroll to find the clip that you want in the **Clip Art** task pane and then click it to add it to the slide.
- The video is automatically inserted and a dialog box appears.
- Click on the **Automatically** option if you want the video to play automatically when the slide is shown or click on the **When Clicked** option to have the animation play when you click on it.



You can animate the slide transitions. You can also set up text boxes, objects, images, etc. Custom animation buttons control the effect on mouse clicks.



NOTES

PowerPoint 2007 includes triangles, spirals, bounces, etc. This option also helps in customizing the animation, for example move, size and close.

Animation Preview

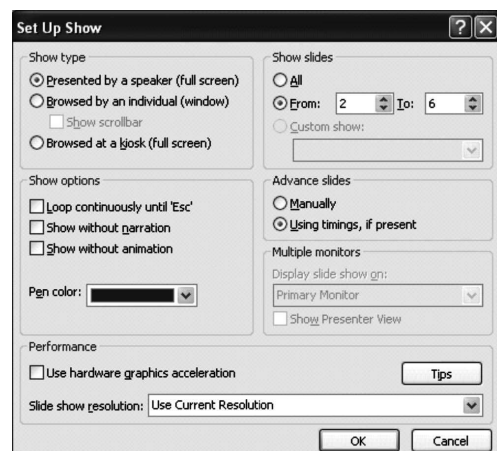
Click on the **Slide Show** menu and then click on the **Custom Animation Button**. To preview animations in the slides, click on the **Play** Button in the custom animation task pane. The slide show can also be viewed with the help of the **Slide Show** tool.

The **Animation Preview** option is a very useful feature in Slide Show.

Slide Show Options

The Slide Show option can be accessed by clicking on the slide show tool. You can set the slide show according to the requirement, that is either for **All** option or the **From: and To:** drop-down list. From the **Set Up Show** dialog box as displayed, under the **Show type** section, choose any of the following show type options:

- **Presented by a speaker:** To run a full screen slide show.
- **Browsed by an individual:** To run a slide show in a window and allow access to some PowerPoint commands.
- **Browsed at a kiosk:** To create a self running, unattended slide show for a booth or kiosk.



Under the **Set-Up Show** options section, check or clear the following check boxes:

- **Loop continuously until 'Esc':** Check to replay the slide show again until you stop it.

NOTES

- **Show without narration:** Select if you do not want the narration to play.
- **Show without animation:** Select if you do not want the animation to play.

Under the **Show slides** section, select any one of the following options:

- **All:** All the slides will show during the slide show.
- **From:** Enter the first and last slide numbers of the range that you want to show.


Under the **Advanced slides** section, select the **Manually** or **Using timings, if present** option, which would you use to advance the slides manually or automatically.

- **Slide Show Resolution:** The drop-down list allows you to select the display resolution that you want.
- Click on the **OK** button.

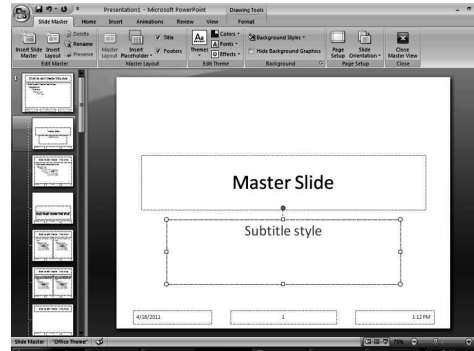
4.7.4 Inserting Recorded and In-built Sound Effects

Incorporating sound clips into PowerPoint is an effective way to capture your audience's attention and communicate information in diverse ways. Sound clips are not restricted to pre-installed sound effects. They may also include music and voice recordings.

To insert recorded and inbuilt sound effects to PowerPoint slide do the following:

- Select the slide to which you wish to add a sound.
- In the **Insert Tab**, under the **Media Clips group**, click the arrow on the Sound button.
- For adding in-built sound, choose **Sound From Clip Organizer...** to bring up the Clip Art task pane for built-in sound effects. Click the sound to insert it or hover your mouse over it first, click on the menu arrow that appears and choose **Insert**.
- For adding recorded sound file, choose **Sound From File...** to bring up the **Insert Sound** dialog box. Find the sound file on your computer using the "**Look in**" drop-down list. Select the file and click **OK**.
- A pop-up box will appear asking you how you would like the sound to start in the presentation. Choose **automatically** if you want the video to play automatically when the slide is shown or click on the **When Clicked** option to have the animation play when you click on it.
- A sound icon  appears on your slide.

NOTES



4.8.2 Inserting Common Objects to All Slides

You can insert the standard objects, text caption, rollover caption, rollover image and highlight box to a master slide. All other standard objects are disabled. You can also insert the text animation, widget, image, animation and Flash Video (FLV)/F4V files. You cannot add audio to a master slide. To add objects to a Master Slide, following steps are required:

- Select the Master Slide in the Master Slide strip.
- Add objects in the same way as you do in the slides in your project.

4.8.3 Applying Common Title/Text Format to All Slides

A PowerPoint Slide Master is an element of the design template that stores information about the template including font styles, placeholder sizes and positions, background design and color scheme information. They also allow you to insert common elements on every slide, such as a common footer, slide number, copyright line, logo or even pictures. If you want all of the slides in your presentation to use similar fonts, formatting, colors and graphics then this is the best way to do this. You can create a new Master instead of editing the existing one if you want to apply the master changes only to selected slides or if you only plan to use it temporarily. You can also create a new Slide Master and then apply it to the Main Slide Master once you are sure of how you want it to look.

Check Your Progress

9. What does animation option contain?
10. What is slide master?
11. What are placeholders?

4.9 SOME ADVANCED FEATURES OF POWERPOINT PRESENTATION

Following are the advanced features of PowerPoint 2007:

- It provides to achieve consistency with Master Slides.
- It supports background, such as the plain white background on all slides is something your clients will insist that you change. You can set backgrounds individually on every slide.

- Office 2007 provides about 25 preset textures to use.
- You can use a bitmap as a background as well as gradient fills.
- PowerPoint 2007 allows you to select the gradient fills interactively.
- It supports animations which are special effects, such as visual and audio that highlight important elements in a slide. Some animation effects that PowerPoint supports are objects flying in from the edge (choose your edge), text appearing letter-by-letter and sound files playing. These animations can be timed to happen sequentially or all at once. They can happen automatically or in response to mouse clicks.
- PowerPoint 2007 allows specific actions to be taken when the mouse is moved over or clicked on a shape. Actions include jumping to a specific slide in the Slide Show, running another slide show, running a separate program, playing a sound, as well as a few others.
- In this world of high tech movies and video games, multimedia in business presentations is almost expected. Multimedia has the power to enhance a presentation, making it more interesting to watch and easier for the viewer to retain what was presented. While you are developing automated presentations, be sure that your program can handle scaling to the wide variety of hardware available for presentations.

NOTES

4.9.1 Hide/Unhide in Slide Show

A good way to hide and unhide slides is in **Slide Sorter** view because an indicator appears below each slide to show whether it is hidden. This way, you can easily determine which slides is part of the main presentation. In the slide thumbnail pane in **Normal** view, hidden slides appear ghosted out. Follow these steps to hide a slide:

- Switch to **Slide Sorter** view.
- Select the slide or slides that you want to hide. Remember, to select more than one slide, hold down the CTRL key as you click the ones that you want.
- Click the **Hide Slide** Button on the **Slide Show** toolbar. A gray box appears around the slide number and a diagonal line crosses through it, indicating that it is hidden.

To unhide a slide, select the slide and click the **Hide Slide** Button again. The slide's number returns to normal. You can also right click a slide and choose **Hide Slide** or **Unhide Slide** to toggle the hidden attribute on and off.

4.9.2 Customizing Slide Show

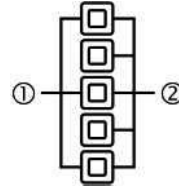
There are two kinds of custom shows known as basic and hyperlinked. A basic custom show is a separate presentation or a presentation that includes some of the slides of the original. A hyperlinked custom show is a quick way to navigate to one or more separate presentations.

Basic Custom Shows

Use a basic custom show to give separate presentations to different groups in your organization. For example, if your presentation contains a total of five slides, you

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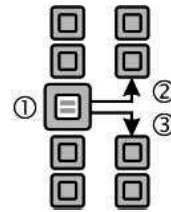
can create a custom show named 'Site 1' that includes just slides 1, 3 and 5. You can create a second custom show named 'Site 2' that includes slides 1, 2, 4 and 5. When you create a custom show from a presentation, you can always run the entire presentation in its original sequential order.



In the above screen 1 represents the slides for Site 1 and 2 represents the slides for Site 2.

Hyperlinked Custom Shows

Use a hyperlinked custom show to organize content in a presentation. For example, if you create a primary custom show about your company's new overall organization, you can then create a custom show for each department within the organization and link to these shows from the primary presentation.



In the shown screen, 1 represents slide with hyperlinks, 2 and 3 represents the custom shows. On the **Slide Show** Tab, in the Start Slide Show group, click the arrow next to **Custom Slide Show** and then click Custom Shows.

- In the **Custom Shows** dialog box, click **New**.
- Under Slides in presentation, click the slides that you want to include in the custom show and then click **Add**.

To select multiple sequential slides, click the first slide and then hold down SHIFT while you click the last slide that you want to select. To select multiple non-sequential slides, hold down CTRL while you click each slide that you want to select. To change the order in which slides appear, under Slides in custom show, click a slide and then click one of the arrows to move the slide up or down in the list. Type a name in the Slide Show name box and then click **OK**. To create additional custom shows with any slides in your presentation, repeat above steps. To preview a custom show, click the name of the show in the **Custom Shows** dialog box and then click **Show**.

4.9.3 Applying Rehearse Timings for Slide Show

The **Rehearse Timing** option provides you the option to make the presentation within a certain time frame. It is also used to present the slides with audio.



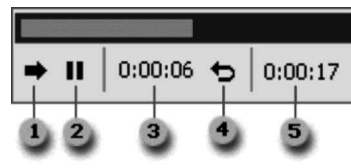
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The Rehearsal tool presents the following options for setting the toolbar:

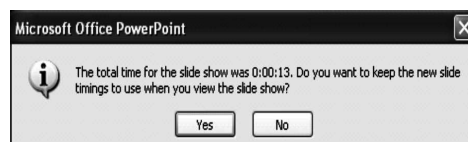
Once the **Rehearsal** toolbar appears, the **Slide Time** box begins to time the presentation.

The Rehearsal toolbar's five labels can be described as follows:

- ❶ Next (advance to next slide)
- ❷ Pause
- ❸ Slide Time
- ❹ Repeat
- ❺ Total time for presentation



After completing the rehearse timing of the slides as set, following dialog box appears. Click on Yes to save the changes.



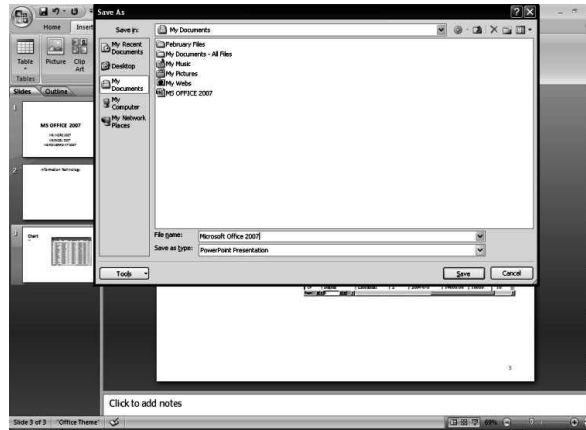
4.9.4 Saving Presentation

By default a presentation is saved with a .pptx file extension name. To save the first time of the presentation, you need to perform the following tasks:

- Choose **File**→**Save As** from File menu. The following dialog box will be appeared. Type the name of the presentation in '**File name:**' bar. You can select the folder name in 'Save in' drop-down list where you want to save the file.

Click the **Save** Button. In case you wish to save the file into another directory, specify the correct path and directory. Once you save the file by a name, you need to click on **Save as** option. The modification and further changes can be saved either by pressing CTRL+S keys together or by choosing **File**→**Save** menu. If you choose **Save as** option again, the following dialog box will appear on the screen.

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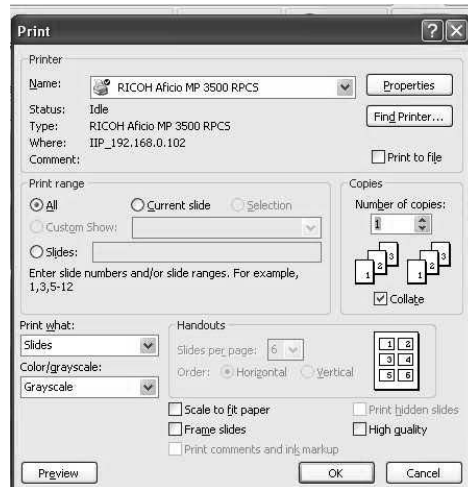
4.9.5 Printing Presentation

Printing a PowerPoint presentation provides three options to the user—Print, Quick Print and Print Preview.

The Print option selects a printer, the number of copies to be printed and the other options for printing, whereas Quick Print sends the presentation direct to the default printer without making changes. The Print Preview option previews and provides options to make changes to the pages before they are printed.



To access the **Print** settings in the **Advanced** Tab dialog box, click on the **Microsoft Office Button** , click on **PowerPoint Options**, click on **Advanced** and then scroll down to **Print**. The Printer Name option can also be accessed through this dialog box. If you click on the **Print** option, you can access a lot of options, for example, All, Current slide or Slides number as per your requirement.



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Check Your Progress

12. What is the characteristic of hyperlinked custom show in Slide Show option?
13. Write one of the features of Rehearse Timing option in PowerPoint 2007.

4.10 ANSWERS TO ‘CHECK YOUR PROGRESS’

1. The prime utility of PowerPoint presentations in modern days are learning, corporate training sessions, business and marketing meetings and sales gatherings.
2. The main feature that separates PowerPoint 2007 from PowerPoint 2003 is that in PowerPoint 2007 file is saved with a .ppt and .pptx extension.
3. The insert option is available for the purpose of adding tables, illustrations, links, text and media clips.
4. Bulleted and numbered lists are useful for the purpose of highlighting the important elements or key features of the specified heading.
5. Layering of objects is controlling the appearance and order of objects on a slide.
6. The background is the area that covers the whole slide in PowerPoint 2007.
7. The theme is saved with a .thmx file extension.
8. Normal View in Microsoft PowerPoint is the main working Window in the presentation.
9. The animation option contains preview, custom animation and various transition settings that can be applied to the specified slides.
10. The slide master is one of several master slides that are used in PowerPoint to make global changes to all your slides at one time.
11. The placeholders are boxes with dotted or hatch marked borders that are

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part of most slide layouts.

12. A hyperlinked custom show is a quick way to navigate to one or more separate presentations.
13. The Rehearse Timing option provides you the option to make the presentation within a certain time frame.

4.11 SUMMARY

- PowerPoint Presentations in Office 2007 are a way of attracting audience towards views and arguments.
- The Microsoft Office Button performs all the functions of the 'File' menu of the older versions of PowerPoint which helps you to create a new presentation, open an existing presentation, save a presentation, save a presentation with a new name using the 'Save As' option, print a presentation, send a presentation and close a presentation.
- Task pane is a Window within an Office program that provides commonly used commands. Its location and small size allow you to use these commands while still working on your files.
- Presentation can be created from a blank slide, a template, existing presentation or a word Outline.
- Spell check underlines every wrong spelling by a red wavy line.
- Charts and tables from Microsoft Excel 2007 can also be embedded to Microsoft PowerPoint 2007 by selecting Insert→Chart option.
- The options that are available for creating Organizational Chart are Process, Cycle, Hierarchy, Relationship, Matrix and Pyramids.
- The background is the area that covers the whole slide. It is referred to as background because it stays in the back and it is positioned behind anything else in the PowerPoint slide.
- Applying a new theme changes the major details of your presentation. Word Art effects are applied to titles in Office PowerPoint 2007. Tables, charts, SmartArt graphics, shapes, and other objects are updated to complement one another.
- The picture tool sets the brightness of images, crops the picture, etc.
- Slide Sorter View shows miniature versions of all the slides in horizontal rows.
- Outline View is useful for editing purposes and slides can be exported as a Word document to use as a summary handout.
- The transition effects are applied to the PowerPoint slide by clicking on the thumbnail of the slide.
- Automation of slide presentations with timings, hyperlinks, voice narration and user input leads the concept of self running presentation.

- The Animation option contains preview, custom animation and various transition settings that can be applied either to all or the specified slides in a presentation.
- Animation scheme adds preset visual effects to text and objects on slides.
- The movie clip is usually in the animated .gif format or the .avi format.
- Video clips will get dull if used over and over again in PowerPoint slide.
- The slide master is one of several master slides that are used in PowerPoint to make global changes to all your slides at one time.
- The Rehearse Timing option provides the option to make the presentation within a certain time frame.

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4.12 KEY TERMS

- **Ribbon:** It refers to the strip of buttons that resides on top of the main Window.
- **Design Option:** This option facilitates the choice of colors, background styles, fonts, page setup, slide orientation, etc.
- **SmartArt:** This option provides graphics, ranging from graphical list and process diagrams to more complex graphics.
- **Picture Tool:** This tool is a context sensitive tab that appears on the ribbon and allows one to work with inserted images, photos and clip art pictures.
- **Slide View:** This view displays each slide on the screen and is helpful for adding images, formatting text and adding background styles.
- **PowerPoint Slide Master:** This type of slide allows you to insert common elements on every slide, such as a common footer, slide number, copyright line, logo or even pictures.
- **Basic Custom Show:** It is a separate presentation that includes some of the slides of the original.

4.13 SELF-ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What are PowerPoint presentations?
2. What is Ribbon in PowerPoint 2007?
3. Write steps to format the footer.
4. Write one use of picture tab.
5. Why transition effects are used?
6. What do you understand by slide view?

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7. How can you preview animations?
8. Name the file extension name in which a presentation is saved.

Long-Answer Questions

1. Describe the utility of PowerPoint presentation with the help of suitable examples.
2. Explain the steps to insert text, graphics, clip art, table, chart, organizational chart and photo album.
3. Describe the concept of formatting the AutoLayout area.
4. Explain various types of views of slide presentation.
5. Explain the concept and option used in automation of slide presentation.
6. Write and explain all the steps required in adding animated pictures in slides.
7. Briefly explain how to insert date, time, slide numbers and common objects into the slides.
8. Write all the steps required to add sound effects in slides.

4.14 FURTHER READING

Tanenbaum, Andrew S. *Computer Networks*. New Jersey: Prentice-Hall PTR, 2002.

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Stallings, William. *Data and Computer Communications*. New Jersey: Prentice-Hall, 1996.

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Basavaraj, B. and H.N. Shivashankar. *Basic Electronics*. New Delhi: Vikas Publishing House Pvt. Ltd, 2004.

Blattner, Patrick, Ken Cook, Laurie Ulrich and Timothy Dyck. *Special Edition Using Microsoft Excel 2000*. New Delhi: Prentice-Hall of India, 1999.

Kinloch, Sherry Willard. *Microsoft Office 2007 Simplified*, 1st edition. London: Visual Editions, 2007.

UNIT 5 INFORMATION TECHNOLOGY AND SOCIETY

NOTES

Structure

- 5.0 Introduction
- 5.1 Objectives
- 5.2 The Internet: Basics
- 5.3 Working of Internet
 - 5.3.1 TCP/IP
 - 5.3.2 Internet Applications
- 5.4 Computer Networks
 - 5.4.1 Components of a Network
 - 5.4.2 MAN and WAN
 - 5.4.3 Modem
- 5.5 Application of Technology in Society
- 5.6 Answers to 'Check Your Progress'
- 5.7 Summary
- 5.8 Key Terms
- 5.9 Self-Assessment Questions and Exercises
- 5.10 Further Reading

5.0 INTRODUCTION

Today, innovations in information technology are having wide-ranging effects across numerous domains of society, and policy makers are acting on issues involving economic productivity, intellectual property rights, privacy protection, and affordability of and access to information. Technology affects the way individuals communicate, learn, and think. It helps society and determines how people interact with each other on a daily basis. Technology plays an important role in society today.

The Internet, IT and computers are having, an enormous effect on everyone. These computers and the Internet have become one of the most important changes to modern society. They bring transformations to human daily life. The Internet has transformed the reality of distances and has made individual self-operating information collection machines that get immediate and easily access to information and communication.

Internet provides effective communication using emailing and instant messaging services to any part of the world. It improves business interactions and transactions, saving on vital time. Banking and shopping online have made life less complicated. One can access the latest news from any part of the world without depending on the TV or newspaper. Education has received a huge boost as uncountable books and journals are available online from libraries across the world. This has made research easier. Students can now opt for online courses using the

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internet. Application for jobs has also become easier as most vacancies are advertised online with online applications becoming the norm. Professionals can now exchange information and materials online, thus enhancing research.

In this unit, you learn about the basic of internet, working of internet, TCP, internet applications, computer networks and application of technology in society.

5.1 OBJECTIVES

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

- Discuss the features of internet
- Understand the working of internet
- Explain the significance of TCP/IP
- Discuss the internet applications
- Define the computer networks
- Describe the components of a network
- Know about the MAN and WAN
- Explain the MODEM
- Analyze the application of technology in Society

5.2 THE INTERNET: BASICS

The Internet is a ‘**Network of Networks**’ that links computer systems around the world. It allows communication across networks, i.e., communication can take place between one network and another. This allows people to have access to information from different Web sites, locations and machines. It virtually makes accessible a sea of information and a nearly worldwide audience at the click of a button.

It was the Sputnik’s launch and the subsequent cold war, space race and the development of ARPANET (Advanced Research Projects Agency Network) in 1950 that led to the establishment of the Internet. However, it actually gained momentum in the 1980s when ARPANET was used by the National Science Foundation to connect the five supercomputers at its regional centres. Thus emerged a high-speed Internet service that enabled access to many universities, networks, bulletin board systems, commercial online services and institutions. The decade closed with the coming into being of the World Wide Web (WWW), which proclaimed the emergence of an independent platform of communication that was further augmented by a relatively easy-to-use and pleasant graphical interface.

Important Features

Some of the facilities that are available on the Internet are:

- **World Wide Web:** The Internet application that is currently drawing maximum attention is the World Wide Web. It has dramatically influenced the online world and continues to grow in popularity.

- **Direct Communication:** Through e-mail (electronic mail), messages can be sent to or received from any part of the world within a few minutes.
- **Round-the-Clock Availability:** Information on the Internet is available to users 24 hours a day.
- **Central Repository of Data:** The Internet is like a huge central warehouse of data that people from all over the world can access.
- **Search Engines:** These are like directories which help get any kind of information from the world over within a few seconds.
- **Advertisement:** A company can advertise its products/services through the Internet.
- **E-Commerce:** The Internet is increasingly being used for conducting monetary transactions. Through the Internet, you can shop and pay through your credit card or ask your bank to transfer your money to a different account, without even leaving your desk.
- **Distance Learning:** Several online distance learning courses are now being offered by Indian and foreign universities on the Internet.
- **BBS and New Services:** The Internet is perhaps the cheapest medium for online help. BBS services are available on the Internet through which you can ask questions and get immediate troubleshooting assistance.
- **Wide Area Networks:** Using the Internet, organizations can collect and compile information from offices spread over large geographical areas.
- **Shareware Software:** The Internet is also a great medium for downloading free software. You can get a truckload of free games, utilities and trial versions of software through the Internet.

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Types of Connections and Internet Protocols

You can use following options for connecting to the Internet.

Direct Connection

Through a direct connection, a machine is directly connected to the Internet backbone and acts as a gateway. Though a direct connection provides complete access to all Internet services, it is very expensive to implement and maintain. Direct connections are suitable only for very large organizations or companies.

Through Internet Service Provider (ISP)

You can also connect to the Internet through the gateways provided by ISPs. The range of Internet services varies depending on the ISPs. Therefore, you should use the Internet services of the ISP that is best suitable for your requirements. You can connect to your ISP using two methods:

Remote Dial-Up Connection

A dial-up connection (Refer Figure 5.1) enables you to connect to your ISP using a modem. A modem converts the computer bits or digital signals to modulated or analogue signals that the phone lines can transmit and vice versa. Dial-up connections use either SLIP (Serial Line Internet Protocol) or PPP (Point-to-Point Protocol) for transferring information over the Internet.

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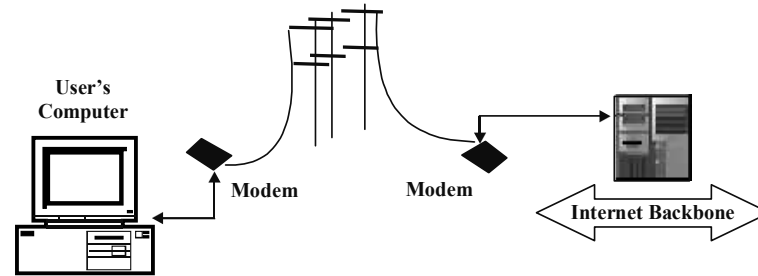


Fig. 5.1 Remote Dial-Up Connection

For dial-up connections, regular telephone lines are used. Therefore, the quality of the connection may not always be very good.

Permanent Dedicated Connection

You can also have a dedicated Internet connection that typically connects you to ISP through a dedicated phone line. A dedicated Internet connection is a permanent telephone connection between two points. Computer networks that are physically separated are often connected using leased or dedicated lines. These lines are preferred because they are always open for communication traffic unlike the regular telephone lines that require a dialling sequence to be activated. Often, this line is an ISDN (Integrated Services Digital Network) line that allows transmission of data, voice, video and graphics at very high speeds. ISDN applications have revolutionized the way businesses communicate. ISDN lines support upward scalability, which means that you can transparently add more lines to get faster speeds, going up to 1.28 Mbps (Million bits per second).

T1 and T3 are the two other types of commonly used dedicated line types for The Internet connections. Dedicated lines are becoming popular because of their faster data transfer rates. Dedicated lines are cost-effective for businesses that use Internet services extensively.

A Web browser, commonly known as a browser, is a computer application that creates requests for HTML pages or Web pages and displays the processed HTML page. Web browsers use HTTP (HyperText Transfer Protocol) to request for information from Web servers. The two most commonly used Web browsers are:

- Mozilla Firefox
- Microsoft Internet Explorer

Other examples of Web browsers include Mosaic, Cello, Lynx and Netscape Navigator.

Having knowledge of the basic features of browsers can be helpful in using them easily.

Toolbar of the Internet Explorer



The toolbar consists of various icons that can be used to execute functions. In fact, most of the options available through the menu bar are also available through the icons on the toolbar. Some commonly used icons are:

Back: The Back button allows you to navigate to the Web page you viewed last.

Forward: The Forward button on the toolbar navigates to the next Web page that was accessed previously. To view a list of the last few Web pages visited, you can click the down arrow button beside the Back and Forward buttons.

Stop: The Stop button can be used to terminate the current Web page request. This is usually used when you type the wrong URL by mistake and want to stop the request for the Web page or if the Web page takes too long to download.

Refresh: The Refresh or the Reload button is used to load the current Web page again. In other words, it refreshes the contents of the current page by fetching a new copy of it.

Search: The Search button allows you to find information on the Web. You can find information by clicking on the Search button on the toolbar. This activates the search text box as shown. You can then type in a word or phrase and click the 'search' button to start the search.

Favorites: The Favorites button is used to record the addresses of frequently visited Web sites. Once a Web site or a Web page is added to the favorites list, it can be revisited by simply clicking on the link in the list. This saves the effort of typing the URL each time the user wishes to visit the same site.

History: The History button is used to view the list of all the Web pages visited in the last few days, hours or minutes. To revisit any one of them, simply click on the address.

Print: The Print button is used to print the contents of the current Web page.

Net Surfing

Net surfing, Internet browsing or exploring a network on the World Wide Web is associated with visiting different Web sites on the Internet. It is typically finding places of interest at the click of a mouse. It is analogous to surfing TV channels with a remote control.

Searching

Searching is one of the most common uses of the Internet. You can search for any topic or information on the Internet. This is possible by using websites that provide a search engine.

Search Engines

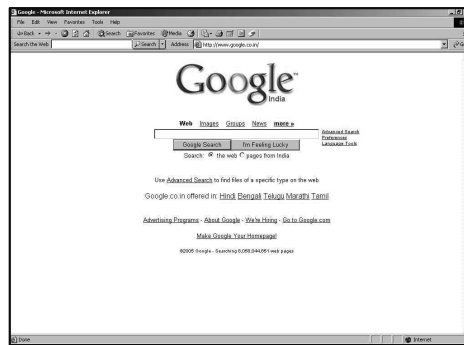
A search engine is a software system that enables users to search for information on the Web using keywords. It is designed to help the Internet users locate the Internet resources, such as Web pages, documents, programs and images using a keyword search mechanism. Search engines typically use databases that contain references to a host of resources. The users interact with a search engine using an interface. There are many search engines available with different appearances and search mechanisms. Some commonly used search engines are: Google, Yahoo, MSN, Altavista, AOL, Ask Jeeves, Lycos, Excite and HotBot.

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Google (<http://www.google.com>)

Yahoo (<http://www.yahoo.com>)



Information is collected by programs; called ‘spiders’ or ‘robots’; following which, the search engine indexes them. ‘Directories’ also provide similar services by maintaining a systematic list of Web sites. Search engines function as card catalogues for the Internet. They try to index and locate the requested information by looking for the keywords specified by the user. They usually maintain indices of Web resources, from which the necessary information is retrieved by querying for the keywords that the user enters.

5.3 WORKING OF INTERNET

TCP/IP

TCP/IP stands for Transmission Control Protocol/Internet Protocol. It was developed with the objective to specify a suite of protocols capable of providing transparent communications interoperability services between computers of all sizes, regardless of the hardware or operating system platforms supporting them. Over the years, TCP/IP has become the most widespread among today’s protocols. One reason for TCP/IP’s popularity is the public availability of its protocols’ specifications. In this sense, TCP/IP can justifiably be considered an open system. Most users rely on TCP/IP for the purpose of file transfers, electronic mail (E-mail), and remote login services.

LAN standards define physical transmission media and the usability of these media. These standards conform to the protocols defined in the physical and data link layers of the OSI reference model as shown in Figure 5.2. Among the protocols defined in the layers above the data link layer, TCP/IP, IPX/SPX and NetBIOS are well known. Of these protocols, TCP/IP is the most popular and is employed for UNIX and the Internet. IPX/SPX is used for Novel’s NetWare. NetBIOS was developed by IBM for small size LANs and is employed in the Windows 95 or Windows NT environment.

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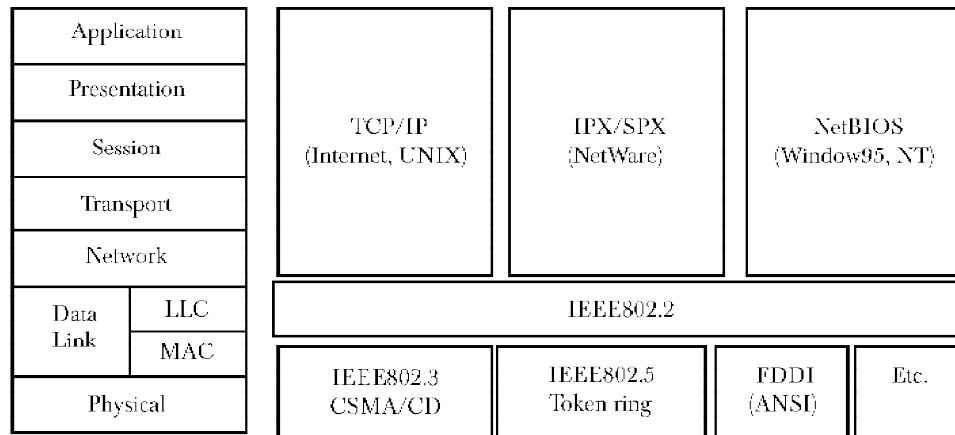


Fig. 5.2 LAN Standards in Physical and Data Link Layers

Network Architectures

Network architecture defines the communications products and services, which ensure that various components work together. In the early days of data communication systems, the majority of communications were between the DTE and the host computer. Therefore, transmission control procedures were alone enough as communication protocols. However, recent computer systems link with other systems to form a network which result in a situation where different protocols serving for different purposes is required. Hence, the network architecture represents a systemization of the various kinds of protocols needed to build a network.

Computer manufacturers have developed different protocols as needed. This means that each type of computer needed to support different protocols. This necessitated large development and maintenance costs. All computer manufacturers, Table 5.1, worked together to standardize and systemize protocols to link their models and reduce the development and maintenance costs thereby. This was how each manufacturer built his own network architecture.

Since the concept of the network architecture was first introduced, connecting computers of the same manufacturer has become easier. However, from a user’s perspective, the ideal form of network architecture is one which enables machines of all manufacturers to connect to each other. Therefore, the need of standardization of network architecture arose.

Table 5.1 Network Architecture by Vendor

Manufacturer	Network Architecture
IBM	System Network Architecture (SNA)
DEC	Digital Network Architecture (DEC)
Borroughs	Borroughs Network Architecture (BNA)
UNIVAC	Distributed Communication Architecture (DCA)
Toshiba	Advanced Network System Architecture (ANSA)
NEC	Distributed Information Processing Architecture (DINA)
Honeywell	Distributed System Environment (DSE)

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The following are ways to achieve connection between different manufacturers:

- **Protocol converters:** These are devices that translate from one native protocol into another, for example, from ASCII to IBM SNA/SDLC
- **Gateways:** These are hardware/software combinations that connect devices running different native protocols. In addition to protocol conversion, gateways provide a gateway connection between incompatible networks. Examples include Ethernet-to-Token Ring gateways, X.25-to-Frame Relay gateways, and T-carrier-to-E-Carrier International Gateway Facilities (IGFs).

In addition to the above, Protocol Analyzers are available as diagnostic tools for displaying and analysing communications protocols. Analysers allow technicians, engineers and managers to test the performance of the network to ensure that the systems and the network are functioning according to specifications. LAN managers, for instance, use protocol analysers to perform network maintenance and troubleshooting and to plan network upgrades and expansions.

Example of TCP/IP Operations

TCP/IP Layers and Protocols

TCP/IP defines a suite of communications and applications protocols in layer structure, with each layer handling distinct communication services. TCP/IP defines a four-layer model as shown in Figure 5.3 consisting of Application, host-to-host, Internet, and Network Access layers. This architecture is based on three sets of interdependent processes, namely, application-specific processes, host-specific processes, and network-specific processes.

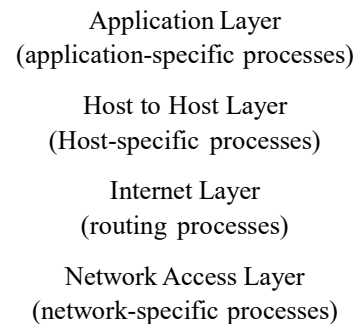


Fig. 5.3 TCP/IP Communication Architecture

The following are examples of concerns that each of these processes should handle:

Application-specific processes: TCP/IP defines the External Data Representation (XDR) protocol to provide an agreement between the data syntax running between the different platforms.

Host-specific processes: It is the responsibility of the host-specific process to establish, maintain, and release a connection on behalf of an application without losing track of other logical connections on multiuser/multitasking operating systems.

Therefore, it ensures that data integrity is maintained without confusing the identity of the communicating applications.

Network-specific processes: These are processes that concerns with the delivery of data to the transmission medium and route data across networks until it reaches its ultimate destination.

The correspondence between the TCP/IP and OSI model is shown in Figure 5.2. From Figure 5.3, the relationship between the two figures may be established. Layer 5, 6 and 7 corresponds to application layer (4th layer) of TCP/IP communication architecture. In a similar manner layer 4 and 3 of OSI can be related with the host-to-host layer and Internet layer of TCP/IP suite, respectively. The physical layer and data link layer of OSI is similar to the network layer of TCP/IP.

5.3.1 TCP/IP

Transfer Control Protocol (TCP) standard is defined in Request for Comment (RFC). Its document number is 793 which is given by Internet Engineering Task Force (IETF). The original specification was written in 1981 and experimented by Advanced Research Projects Agency Network (ARPANET) for guaranteed delivery. It's sliding window protocol facilitates handling for timeouts and retransmission.

Structure of TCP

TCP connects two endpoints by full duplex virtual connection. Each endpoint contains an IP address and a TCP port number. The byte stream is moved in segments. The number of bytes of data sent prior to acknowledgement of the receiver is determined by the window size. TCP includes 'Post-it-Note' process in its header which has two steps:

Step I

When application requests to send data for remote location, TCP arranges the initial segment to set up the socket interface between two systems. No data is sent until and unless TCP gets a message from the receiving system that a socket is placed for receiving data.

Step II

Once the sockets are ready, TCP starts sending data within segments. It then asks TCP to acknowledge the arrived data segments. TCP retransmits the segments if acknowledgement is not received.

TCP Header

TCP header is required for every TCP segment. The header segment is same for the TCP segment. There are six flag bits in the header namely URG, ACK, PSH, RST, SYN and FIN. TCP header consists of eleven fields.

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0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3		
0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
Source Port										Destination Port																					
Sequence Number																															
Acknowledgment Number																															
Data Offset				reserved		ECN			Control Bits				Window																		
Checksum																Urgent Pointer															
Options and padding :::																															
Data :::																															

Fig.5.4 TCP Header

Figure 5.4 shows the eleven fields which are in the TCP header. The **source port** and **destination port** contain 16 bits. The **sequence number** tells the position of the sequence of the segment's first data byte. The **acknowledgement number** tells the value of the next sequence number (Refer Figure 5.5). **Data offset** contains 4 bits and indicates the beginning of data section. **Reserved** contains 6 bits which is reserved for future use.

Explicit Congestion Notification (ECN) contains 3 bits. **Control bits** returns **106 URG** for urgent pointer field, **107 ACK** for acknowledgement number, **108 PSH** for push function, **109 RST** to reset the connection, **110 SYN** to synchronize the sequence numbers and **111 FIN** to close the connection. **Window size** contains 16 bits which contains the maximum size of data that sender receives. **Checksum** contains 16 bits which are used for error detection and does not perform error correction. **Urgent pointer** also contains 16 bits and indicates a number of positive offset from the sequence number of last byte for the urgent data segment. **Options padding** ensures that TCP header ends. Options occupied at the end of the TCP header are included in checksum.

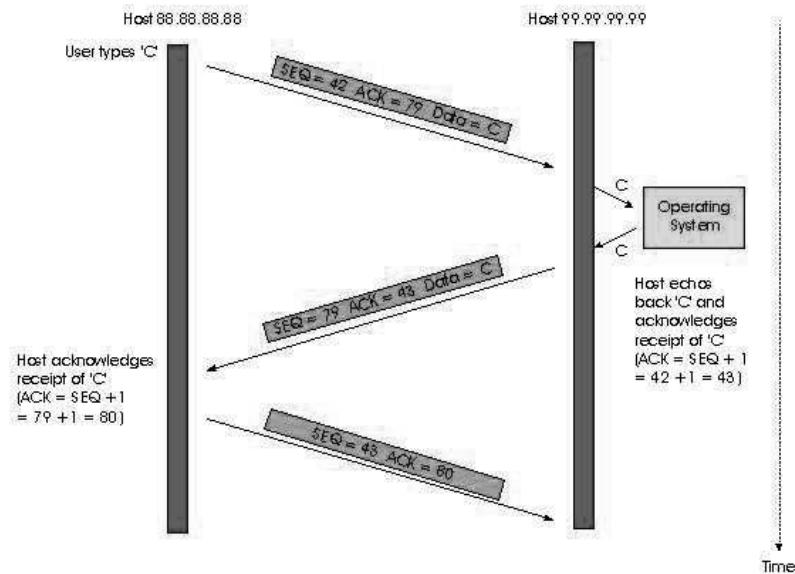


Fig. 5.5 Sequence and Acknowledgement Numbers over TCP

TCP Segment

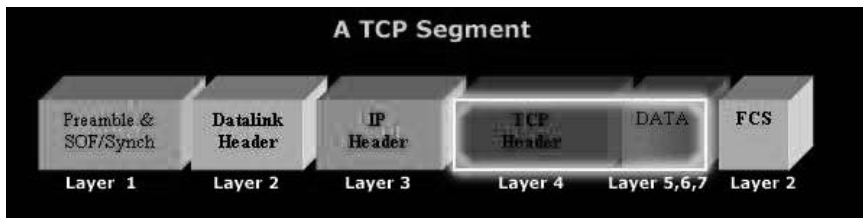


Fig. 5.6 TCP Segment

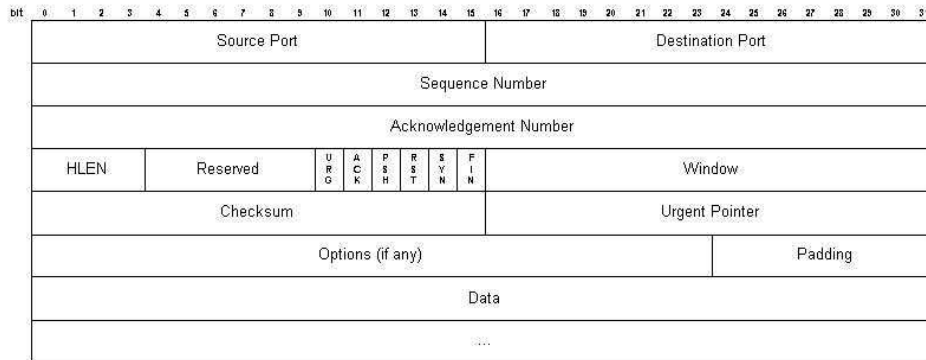


Fig. 5.7 TCP Segment Headers

Figure 5.6 and 5.7 show the TCP header format containing the TCP header and TCP in one packet called a TCP segment. The size of the header without options is 20 bytes.

TCP Switching

TCP switching is a network architecture which creates a circuit for TCP connection. It directly controls the creation/destruction of the circuits. It is optimized to 90 per cent of network traffic. TCP switching is done to increase bandwidth efficiency and robustness because sometimes network connections should change the routing table to recover from its failure.

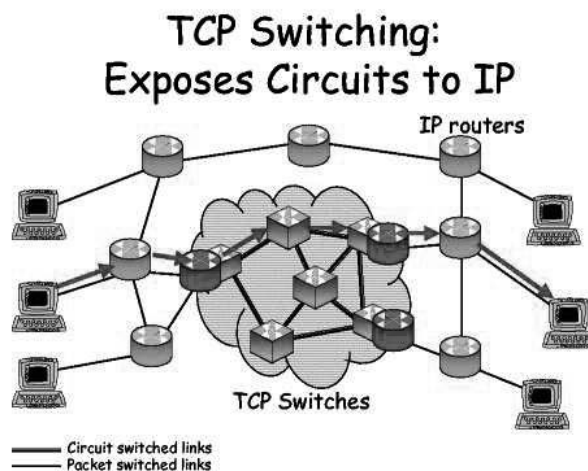


Fig. 5.8 TCP Switching

Figure 4.38 illustrate TCP switching containing established fast and lightweight circuits triggered by application level data flow. In Figure 5.8, TCP switching inside

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the cloud works as packet switching. Circuit switches makes the core of circuit switching cloud. Boundary routers work as a gateway between packet switching and circuit switching.

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TCP Protocol

TCP protocol contains a set of rules and communicates applications securely and independently from the lower level. Data in terms of datagram is concerned with transport layers. The original machine is called clients which request for the connection and the recipient machine is called the server which provides the requested information to the client. Therefore, TCP connection is called a Client–Server connection.

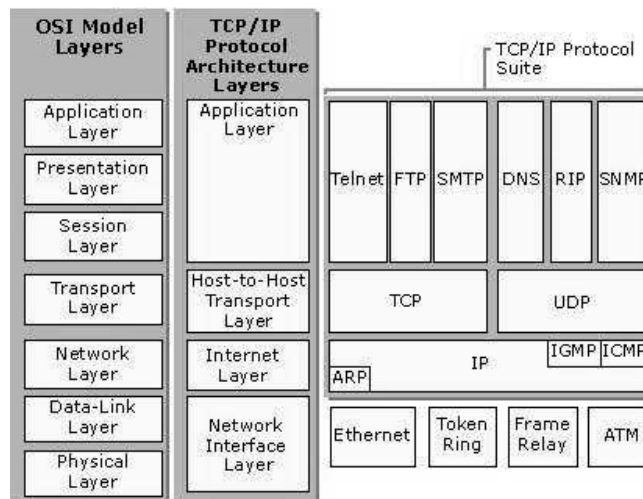


Fig. 5.9 TCP Protocol Layers

Figure 5.9 shows how a TCP protocol works in different layers. It works in four layers with reference to the TCP model. They are as follows:

- **Application layer:** In this layer, TCP provides network services such as http, ftp and telnet.
- **Transport layer:** In this layer, TCP manages transferring data using connection oriented (TCP itself) and connectionless (UDP) transport protocols and also makes connection between networked applications.
- **Internet layers:** TCP addresses data packets and delivers packets over network. It manages fragment packets.
- **Network interface layer:** TCP delivers data via physical links and provides error detection and packet framing.

The main **characteristics of TCP protocol** are as follows:

- TCP enables data flow for monitoring.
- It avoids network saturation.
- It makes data to contain variable length segment which returns to the IP protocol.
- It makes data multiplex where information coming from distinct sources can be circulated.

- It enables successful communication between the client and server .

TCP is layered over the following functionality:

- **Streams:** TCP data is like a file which is organized as a stream of bytes. IT contains an urgent pointer which lets flagged data out.
- **Reliable delivery:** It contains sequence numbers of the transmitted and received data.
- **Network adaptation:** It delays the characteristics of network and maximizes the throughput without overloading the network.
- **Flow control:** TCP protocol manages data buffers and maintains traffic so that the buffer don't overflow.
- **Full duplex operation:** TCP provides full duplex data transfer mechanism. For example, application level data is transferred between two hosts such as process on host A and process on host B in both directions. TCP makes connection in such a way that application level data can flow from A to B and B to A at the same time. TCP connection related to multicasting which is used as point-to-point means of single sender and single receiver.

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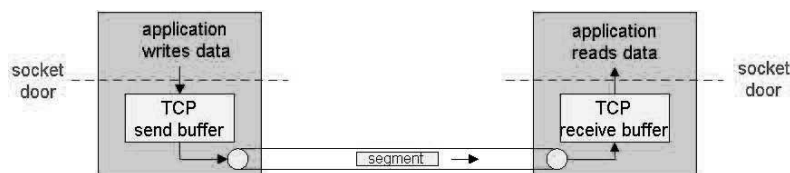


Fig. 5.10 TCP Send Buffer and Receive Buffer

Figure 5.10 shows how segments are passed down to the network layer. When TCP sends data from one end, it is known as send buffer and when it receives a segment which is placed in TCP connections it is known as receive buffer.

TCP—Three-Way Handshake

TCP uses a three-way handshake connection to send and receive data between hosts based on three phases. They are connection establishment, data transfer and connection termination. Telnet (Telecommunication network), FTP (File Transfers), HTTP Hypertext Transfer Protocol (Web request), POP3 (Post Office Protocol), SMTP (Simple Mail Transfer Protocol) for emails, SSH (Secure Shell) uses three way handshake protocol when connection takes place. These days, TCP rides on top of IP which is called TCP/IP (TCP over IP) in which IP facilitates addressing and routing but TCP handles the actual communication between hosts.

The steps that make the three-way handshake connections over TCP

- Step I : Host A sends TCP Synchronize packet to Host B (SYN)
- Step II : Host B receives SYN of A (SYN)
- Step III : Host B sends Synchronize-Acknowledge (SYN-ACK)
- Step IV : Host A receives SYN-ACK (SYN-ACK)
- Step V : Host A sends Acknowledge (ACK)
- Step VI : Host B receives Acknowledge (ACK)
- Step VII : TCP connection is established

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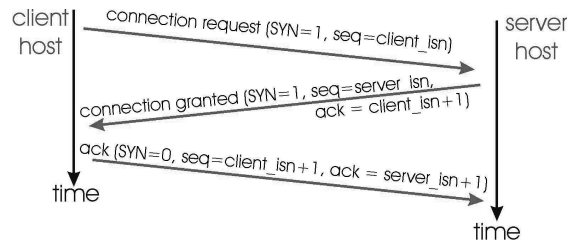


Fig. 5.11 TCP Three-Way Handshake

Figure 5.11 illustrate how the three-way handshake connection is established in which segment is exchanged.

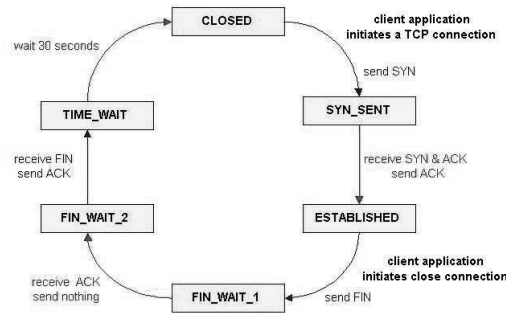


Fig. 5.12 Sequence of TCP Visited by Client TCP

Figure 5.12 shows how the server side TCP connections are established and shut down.

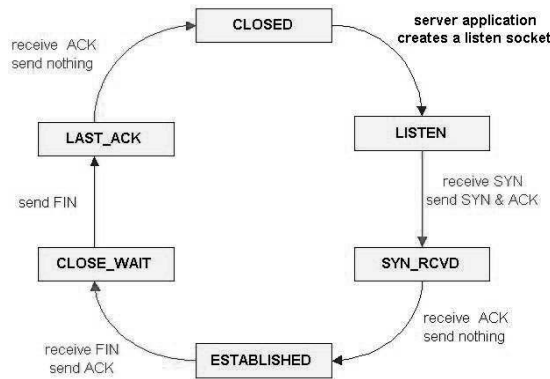


Fig. 5.13 Sequence of TCP Visited by Server-Side TCP

Figure 5.13 shows the TCP congestion control is established in server application which creates a listen sockets.

Security Aspects of TCP

Secure Socket Layer (SSL) provides security services between TCP and applications. These days, SSL comes in a new version as TLS. SSL/TSL provides confidentiality using symmetric encryption and message integrity using MAC (Message Authentication Code) over TCP network setting. This security layer includes protocol mechanism to enable two TCP users to determine the security mechanism and services. TCP security mechanism is arranged in different layers as is shown in Figure 5.14.

HTTP	FTP	SMTP
TCP		
IP/IPSec		

Network Level

HTTP	FTP	SMTP
SSL/TLS		
TCP		
IP		

Transport Level

	S/MIME	PGP	SET
Kerberos	SMTP		HTTP
UDP	TCP		
IP			

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Fig. 5.14 Application Level

Note: TCP has the option of forcing IP NOT to transmit packets but implement it because it can cause security problems where different network technologies are concerned with TCP.

SSL is intended to utilize TCP to provide an end-to-end security services which is secure and reliable since World Wide Web is a client/sever application running over the network and TCP/IP intranets. Therefore, SSI contains a record protocol which provides confidentiality and message integrity.

Confidentiality is the handshake protocol where three- way handshake protocol is used in reference to TCP. A shared secret key is used for conventional encryption of SSL payloads. Message integrity defines a shared secret key which is also the handshake protocol. This forms a message authentication code (MAC). They transmit the fragment of data into manageable blocks. MAC encrypts and a TCP header format is added and the resulting unit is transmitted in a TCP segment.

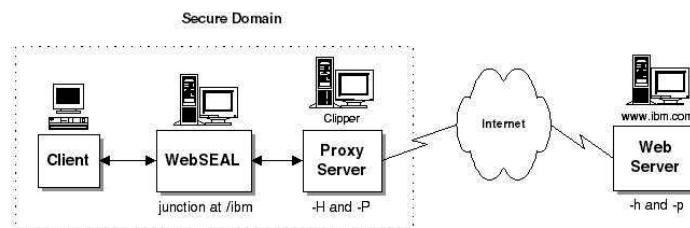


Fig. 5.15 Proxy Server is Used between TCP and SSL

Figure 5.15 shows how proxy server handles requests to standard TCP communication with protected SSL security services. It further protects the lack of authentication of IP packets with TCP.

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Major Features of TCP

The prominent TCP features provide two popular options TCP SACK and TCP Windows scaling. The primary advantage of TCP Window scaling is to control congested data. Network connections consist of the host at both ends and the actual connections, such as telecommunication telephony or satellite worked together. TCP Window then keeps sending speed smoothly where congestion and data loss do not occur. It provides confidential and reliable data delivery over network. It is needed for efficient transfer of data when the bandwidth delay is greater than 64 K, whereas timestamps are used to avail two mechanisms such as Round Trip Time Measurement (RTTM) and Protect against Wrapped Sequences (PAWS). TCP SACK option provides the list of missed packets. For example, if a server checks an acknowledgement with ACK no 101, TCP SACK checks that missed packet is 5201-5202; the result goes with SACK option. **Iptable** firewall then checks it and generates a reject message.

The major features of TCP are as follows:

- TCP is a connection based protocol which first prepares a setup before transferring data.
- It facilitates acknowledgements which performs safe receipt of packets.
- TCP detects duplicate/missing/corrupted packets. It has a good relative throughput on modem and LAN.
- It maintains sequence numbers which reassembles the data packets in which they sent earlier.
- TCP data packets follow the stream from the application side.
- TCP is used for Telnet (Telecommunication Network), FTP (File Transfer Protocol), HTTP (Hypertext Transfer Protocol), and SMTP (Simple Mail Transfer Protocol).
- TCP maintains data order, it means if 5 data packets are sent to destination then data packet 1 is received before data packet 2.
- Routers always take notice of TCP packets. If they are not transmitted in an order and without duplication, TCP buffers and retransmits them.
- It has few socket options which tolerate the built-in control. However, it has no block boundaries and cannot be used in broadcast or multicast transmission. It transfers servers which maintain a separate socket and separate thread for each client.
- It uses four algorithms which provide congestion control, congestion avoidance and slow start, fast retransmit and fast recovery. Losing packets indicates congestion. It checks the availability of bandwidth and changes the delays on the link which solves the loopholes with the help of algorithms.
- TCP issues a **process** for the web browser. In the process, the browser sends data such as URL to a destination host such as the web server. TCP creates an initial segment which connects the sender (browser) and receiver (server). They change the IP address and port numbers to create a socket interface and set up flow control and sequencing methods.

Features of TCP Security

The key features of TCP security includes as follows:

- Only inbound packets are blocked.
- Outbound traffic and response and response of inbound traffic are not affected.
- ICMP (Internet Control Message Protocol) packet flowing is not controlled using TCP security filters.
- TCP latency is introduced as acknowledgements where VPNs (Virtual Private Networks) are built on top of other protocols for performance reasons. There is also significant overhead in each packet to accommodate all the TCP/IP metadata.

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Passive and Active Operation

Active and passive data operations are supported in network data operations.

A passive operation responds to external activity such as request for data on the network. For example, data packets calculate checksum operation with those data which pass through it. This operates passive operation because the data packets are executed only when another network entity gives data. Data is easily accessed through this operation.

An active operation over network is an important device which recognizes its data into efficient structure during congesting period. It actively pushes data into the level of memory hierarchy.

Active and passive operation updates an existing operation such as data packet duplication/corruption and network database through servers and node clients.

Transmission Control Block (TCB)

Data Transmission by TCP and Ethernet

TCP/IP encapsulate upper layers using headers for the purpose of exchanging control and status information about the progress of the communication because its protocols also engage in peer talk by encapsulating data with protocol headers before submitting it to the underlying layer for subsequent delivery to the network. Figure 5.19 represents the data communication using TCP/IP and Ethernet as it is passed down the layers by an application on node X to node Y across the network.

A header is added to the data at each layer before being sent to the receiving node. The same header is removed at the receiving end in the reverse order as shown in Figure 5.16. In Figure 5.17, when a node wishes to transmit a data, the application layer of TCP/IP architecture adds a header as TCP header which is again complemented by IP header and Ethernet header in the lower layers.

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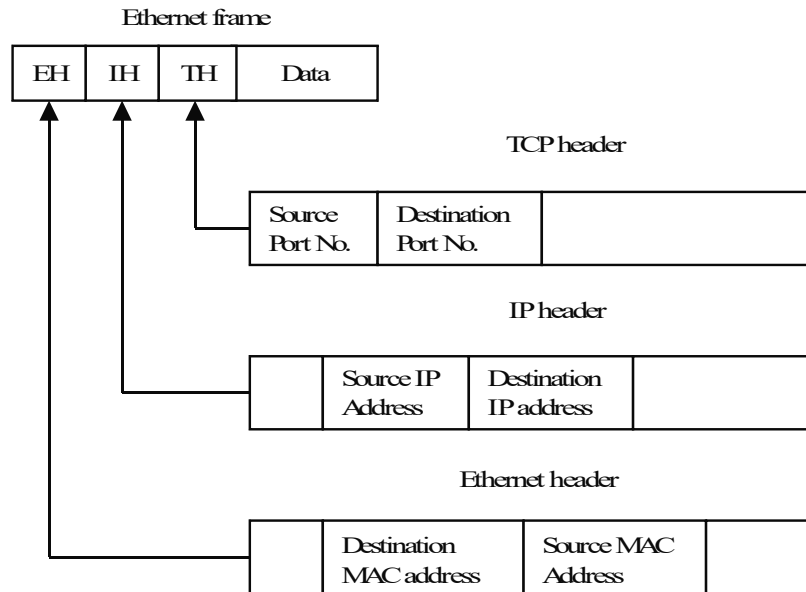


Fig. 5.16 TCP/IP Data Encapsulation

Figure 5.17 shows the configuration of each header. The addresses included in the TCP, IP and Ethernet headers are port numbers, IP addresses, and MAC addresses, respectively.

At the transport layer, the header includes destination and source port numbers. For example, port number 25 identifies a SMTP session, whereas port number 80 HTTP session. Therefore, upon receiving data from the Internet layer, the transport layer fetches its own header for the destination port number to identify the application that it is supposed to deliver the data to. This mechanism helps the transport layer establish connections on behalf of multiple applications without confusing the data exchange process. The protocol data unit thus formed at this layer is normally referred to as a data segment.

At the Internet layer, the header contains information to identify the IP addresses of the ultimate communicating hosts and intervening routers.

At the network access layer, the header includes the MAC addresses of the source and destination devices communicating on the same physical network. A frame check sequence is also included to assist the network access layer in checking the integrity of the received data. The protocol data unit thus formed at this layer is normally referred to as a data frame.

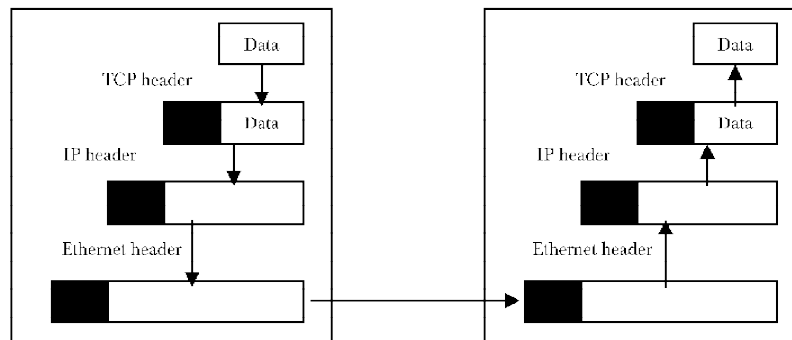


Fig. 5.17 Configuration of TCP, IP and Ethernet Header

Route Discovery Protocol and its Examples

Route Discovery Protocol (RDP) is a standard protocol which is used to inform the router on which they send packets. It also used wiretapping routing protocols such as RIP which is configured as default routes in hosts. It has two portions; one is the server portion which runs on routers and the client portion which runs on hosts.

The RDP Server

The RDP servers run on routers. They are based on multicasting or broadcasting on which the router advertisements are enabled over each interface. Then, the host sends a router solicitation which requests an advertisement. Once the advertisement is sent, all host multicasts are addressed as 224.0.0.1 and an interface is configured as limited broadcast address 255. 255. 255. 255. If the whole process takes place then the net or subnet address is included in the advertisement.

The RDP Client

The RDP client runs on hosts. It only hears those router advertisements which have all host muticast addresses 224.0.0.1 and interfaces on broadcast address. When RDP client receives a router advertisement, the host installs a default route to each of the addresses listed in the advertisement, as can be seen in Figure 5.18.

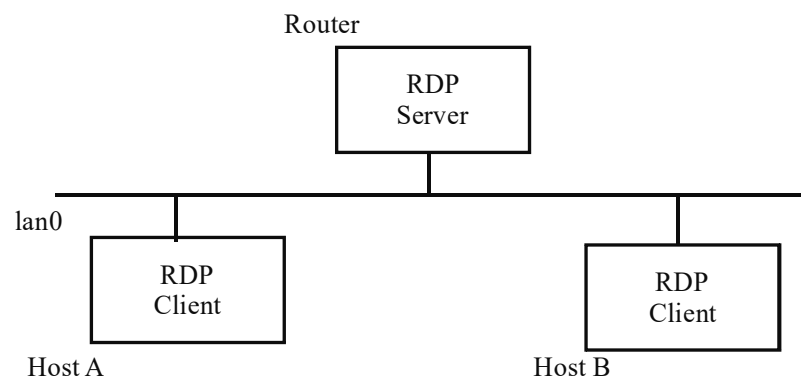


Fig. 5.18 RDP Server and Clients

Application Layer Protocols

TCP/IP Services and Application Protocols

This section presents an overview of the most common protocols used for TCP/IP communication. The discussion focusses on the nature of these applications and the purpose they serve.

The Client/Server Model

TCP/IP applications operate at the application or process layer of the TCP/IP hierarchy as discussed in the preceding sections. TCP/IP protocol splits an application into server and client components. Figure 5.19 illustrates that the server component is a service provider that controls commonly shared resources pertaining to a particular application on the network. The server normally runs on a remote, high-powered computer to which only authorized users have an access. The client component is the service user, by which to this piece of software engages

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with the server. It is done in a sequence of request-response datagrams fulfilling certain user-specified demands or requirements.

The client/server computing model (as illustrated in Figure 5.19) has the following attributes:

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- **Flexible deployment:** This can be easily customized.
- **Low computer cost:** Reduced processing requirement at the client end. In most cases, the client has to deal with lesser details of the application compared to the server. This, in turn, means cheaper hardware on the client machine (less CPU power, memory, disk space, and so on). On the other hand, the server must be powerful enough and well-outfitted to make it respond satisfactorily to the user demands on its services.

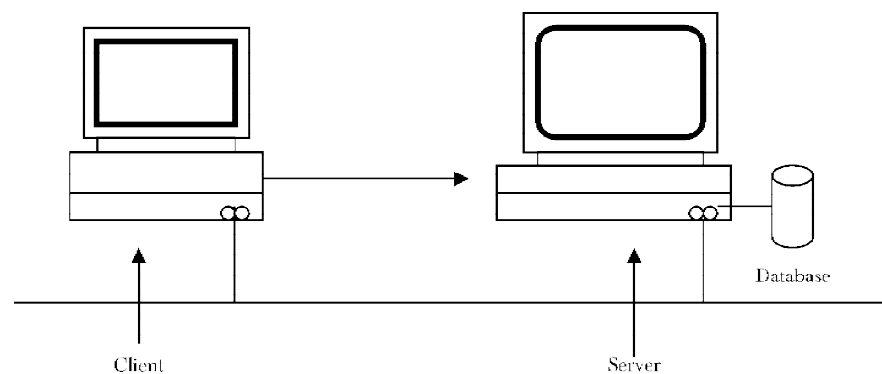


Fig. 5.19 The Client-Server Computing Model

- **Increased network management costs:** Reduced loss of bandwidth from unnecessary data traffic, due to the exchange of data on an as-needed basis. In the case of an Ethernet LAN, this also contributes to reduced collisions and therefore, better networks availability.
- **Lower transmission facility costs.**

Telnet

Telnet is a program that allows a user with remote login capabilities to use the computing resources and services available on the host. Telnet can also be used to connect other ports serving user defined as well as well-known services. The telnet program requires two arguments that is the name of a computer on which the server runs and the protocol port number of the server. Telnet service is unique since it is not platform-specific like other TCP/IP services. A DOS user running Telnet, for example, can connect to a UNIX host or a mainframe computer. The down side of using Telnet, however, is that unless the user is familiar with the operating system running on the remote platform, he or she cannot use the desired resources easily.

File Transfer Protocol (FTP)

File Transfer protocol is among the oldest protocols still used in the internet. FTP is widely available on almost all-computing platforms, including DOS, OS/2, UNIX, and up to the mainframe level. FTP is a file server access protocol that enables a

user to transfer files between two hosts across the network or Internet. This is also established through TCP. Accessing FTP sites over the Internet requires that the user must have the knowledge of the location and the name of the desired files.

Unlike Telnet, FTP does not require any familiarity with the remote operating system. The user is still required, however, to be familiar with the FTP command set built into the protocol itself so that he or she can productively manage the session.

Modern FTP servers known as `ftpd` support two modes, the classic normal mode and more security conscious passive mode or PASV mode.

Trivial File Transfer Protocol (TFTP)

TFTP, like FTP, is also an Internet service intended for the transfer of files between hosts. Unlike FTP, however, TFTP does not rely on TCP for transport services. Instead, TFTP uses UDP to shuttle the requested file to the TFTP client.

Simple Mail Transfer Protocol (SMTP)

The Simple Mail Transfer Protocol is an electronic mail (E-mail) service provider. It is intended for the transfer of E-mail messages across the network. SMTP uses TCP transport for the reliable delivery of mail messages. When there is an outgoing mail, the SMTP client will connect to the SMTP server and sends the mail to the remote server.

Network File System (NFS)

Network file system service enables hosts across the network to share file system resources transparently among themselves. Although it all started on UNIX platforms, NFS can be implemented on any platform, including DOS, NetWare, and Windows NT.

Simple Network Management Protocol (SNMP)

Using the Simple Network Management Protocol, LAN administrators can monitor and tune the performance of TCP/IP (as well as non-TCP/IP) networks. Using SNMP, all kinds of information about network performance can be gathered, including statistics, routing tables, and configuration-related parameters. The information and configuration gathering capabilities of SNMP make it an ideal tool for network troubleshooting and performance tuning.

Domain Name System (DNS)

Due to Internet explosion, it is not practical to keep an exhaustive host file for every host because of the sheer volume of listing as well as addition, deletion and updating of new, old and current hosts. Therefore, DNS is used to provide host-to-IP address mapping of remote hosts to the local hosts and vice versa.

You know that each device connected directly to the network must have an IP address that is uniquely assigned to it. The address takes the form of a dotted decimal notation such as 128.45.6.89 (to be explained later on) to make a machine connected on the network and consequently accept connections as well as request them. The addresses in the form of dotted notations are very difficult to remember for a large number of services residing on the network. DNS enables system

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administrators solve this problem by facilitating a kind of directory that associates IP addresses with names that can be both friendly and meaningful to the user. If you enter `www.hotmail.com`, DNS resolves the name to its associated IP address on behalf of the client.

What does the address `www.hotmail.com` mean? The answer lies in the DNS system. DNS is hierarchical system, which organizes host names in hierarchy of domain names. The name uniqueness problem is also solved as host name to be unique within its domain. Moreover, large domains can also be split into sub-domains. For example, `www.hotmail.com` can be split into `www.rag.hotmail.com` and `www.bbt.hotmail.com`.

5.3.2 Internet Applications

The Internet has made things simpler. It can serve the following purposes :

- **Direct Communication:** You can send messages to family and friends, business associates and acquaintances using the electronic mail facility. Using electronic mail, you can send and receive messages within a few seconds anywhere in the world. Using Internet Relay Chat (IRC), you can communicate online with people over the Internet. You can log into a chat room and converse with others by typing messages that are instantly delivered. With the improvement of network technologies and increase in broadband, not only can you use text messages but also graphics, audio and video for communication with other people.
- **Online Shopping:** Logically, the Internet has removed all barriers of distance and nationality. You can shop for products and services across the world by logging on to a Web portal. You can also pay your bills online using credit and debit cards. You can also transfer money between different accounts with the click of a mouse.
- **Distance Education:** The Internet provides a perfect medium for knowledge sharing and information dissemination. Courses are available on the Internet. You can register and pay online, and complete a course on different interest areas. You can also pursue specialized higher studies now in the comfort of your own office or home.
- **Knowledge Base:** The Internet provides a rich information base that people from across the globe can access. In fact, it is one of the richest information bases that can be accessed at the click of a mouse. Using search engines, you can search for detailed information on any topic of your interest.
- **Banking:** Banks are using information technology to provide online banking facilities to their customers. Using the Internet, you can now view your account details, get drafts made, request for chequebooks and transfer money from one account to another. The use of ATMs has shifted the mundane back-office work to the customer himself. Instead of hiring an army of bank clerks, banks can now use ATMs to considerably reduce time and operational costs.
- **Travel:** Using the Internet, travel agencies can publish their services on the Web along with the latest discounts, packages and availability details, so that customers can compare rates, make online bookings and avail discounts without having to run around multiple offices.

- **Bill Payments:** The government sector has also realized the benefits of IT. Now you can make online payments for public utilities such as water, electricity and phones, using credit cards as the payment medium.

5.4 COMPUTER NETWORKS

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In the mainframe and minicomputer environment, each user is connected to the main system through a dumb terminal that is unable to perform any of its own processing tasks. In this computing environment, processing and memory are centralized. However, this type of computerization has its merits but the major disadvantage is that the system could get easily overloaded as the number of users, and consequently, terminals increase. Second, most of the information is centralized to one group of people, the systems professionals rather than the end-users. This type of centralized processing system differs from the distributed processing system used by LANs. In a distributed processing system, most of the processing is done in the memory of the individual PCs or workstations besides sharing expensive computer resources like software, disk files, printers and plotters, etc.

There may arise a question why PCs cannot be connected together in a point-to-point manner. The point-to-point scheme provides separate communication channels for each pair of computers. When more than two computers need to communicate with one another, the number of connections grow quickly as the number of computers increase. Figure 5.20 illustrates that two computers need only one connection, three computers need three connections and four computers need six connections.

Figure 5.20 illustrates that the total number of connections grow more rapidly than the total number of computers. Mathematically, the number of connections needed for N computers is proportional to the square of N :

$$\text{Point-to-point connections required} = (N^2 - N) / 2$$

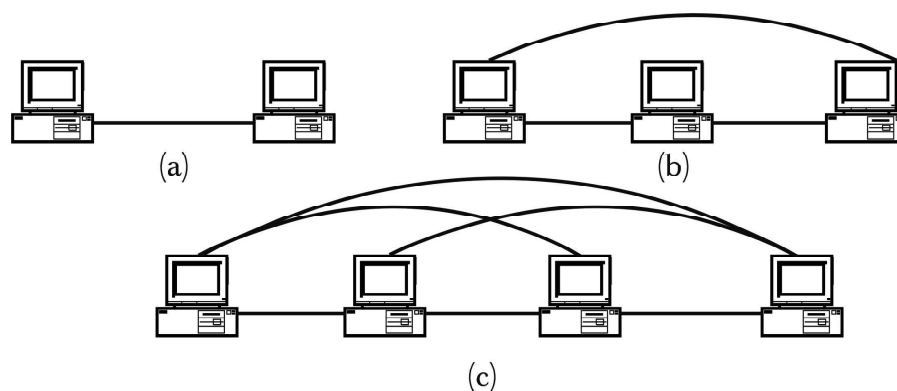


Figure 5.20 (a), (b), (c) Number of Connections for 2, 3, 4 Computers, Respectively

Adding the N th computer requires $N-1$ new connections, which becomes a very expensive option. Moreover, many connections may follow the same physical path. Figure 5.21 shows a point-to-point connection for five computers located at two different locations, say, ground and first floor of a building.

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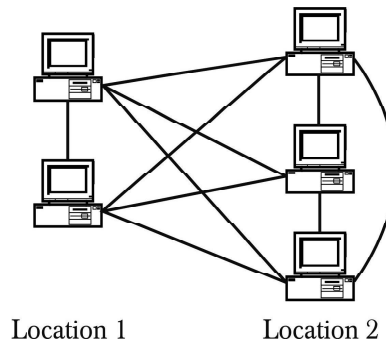


Fig. 5.21 Five PCs at Two Different Locations

As there are five PCs, total ten connections will be required for point-to-point connection. Out of these ten connections, six pass through the same location thereby making point-to-point connection an expensive one. By increasing the PC by one in the above configuration, at location 2 as shown in Figure 5.21, will increase the total number of connections to fifteen. Out of these connections, eight connections will pass through the same area.

LAN: Definition

Networks that are privately owned offer consistent fast paced communication channels which are optimized to connect information processing tools in a restricted geographical area. These are known as Local Area Networks (LANs).

A shared, local (restricted-distance) packet network for computer communication is a form of LAN. A common medium is used by LAN to link peripherals and computers so that the user can share access to databases, files, host computers, peripherals and applications.

LANs in addition to linking the computer equipment available in a particular premises also provides a connection to other networks either through a computer, which is attached to both networks, or through a dedicated device called a gateway. The main users of LANs include business organizations, research and development groups in science and engineering, industry and educational institution. The electronic or paperless office concept is possible with LANs.

LANs offer raw bandwidth of 1 Mbps to 100 Mbps or more, although actual throughput often is much less. LANs are limited to a maximum distance of only a few miles or kilometers, although they may be extended through the use of bridges, routers, and other devices. Data is transmitted in packet format, with packet sizes ranging up to 1500 bytes and more. Mostly, IEEE develops LAN specifications, although ANSI and other standards bodies are also involved.

Advantages of Networks

LANs are used almost exclusively for data communication over relatively short distances such as within an office, office building or campus environment. LANs allow multiple workstations to share access to multiple host computers, other workstations, printers and other peripherals, and connections to other networks. LANs are also being utilized for imaging applications. They are being used for video and voice communication as well, although currently on a very limited basis.

LAN applications include communication between the workstation and host

computers, other workstations and servers. The servers may allow sharing of resources. Resources could be information, data files, e-mail, voice mail, software, hardware (hard disk, printer, fax, etc.) and other networks.

LAN benefits include the fact that a high-speed transmission system can be shared among multiple devices in support of large number of active terminals and a large number of active applications in the form of a multi-user, multi-tasking computer network. LAN-connected workstations realize the benefit of decentralized access to very substantial centralized processors, perhaps in the form of mainframe host computer and storage capabilities (information repositories). Additionally, the current technology allows multiple LANs to be inter-networked through the use of LAN switches, routers, etc.

Disadvantages of LANs include concern for security of files and accounts.

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Broadband versus Baseband

There exist two LAN transmission options, Baseband and Broadband. Baseband LANs, which is the most prevalent by far, is a single-channel system that supports a single transmission at any given time. Broadband LANs, which are most unusual, support multiple transmissions via multiple frequency channels.

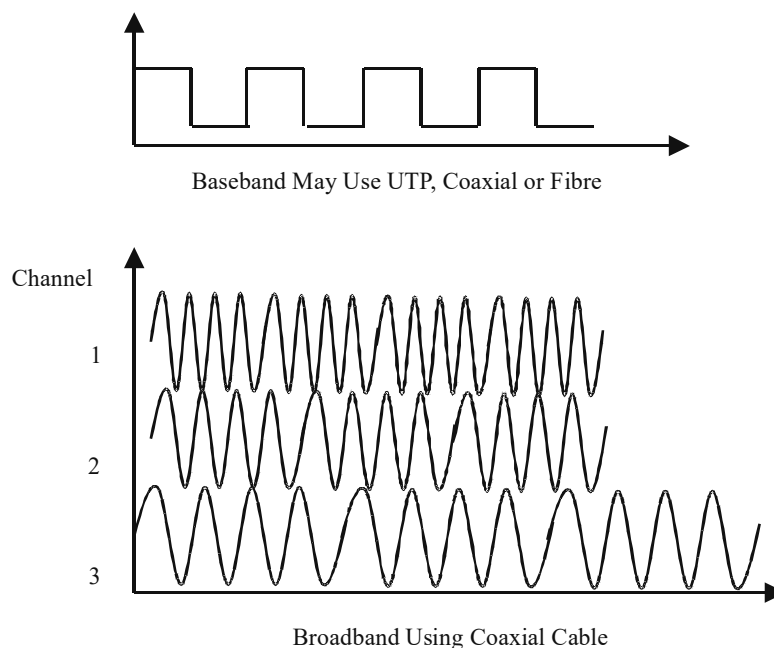


Fig. 5.22 *Broadband versus Baseband*

Broadband LANs

Broadband LANs are multichannel, analogue LANs as shown in Figure 5.22. They are typically based on coaxial cable as the transmission medium, although fibre optic cable is also used. Individual channels offer bandwidth of 1 to 5 Mbps, with 20 to 30 channels typically supported. Aggregate bandwidth is as much as 500 MHz. Its characteristics are:

- Stations connected via RF modems, i.e. radio modems accomplish the digital-to-analogue conversion process, providing the transmitting device access to an analogue channel.

- Digital signal modulated onto RF carrier (analogue).
- Channel allocation based on FDM.
- Head-End for bidirectional transmission.

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Advantages

- Greater bandwidth
- Data, voice and video can be accommodated on broadband channel
- Greater distances

Disadvantages

- High cost, requires modems
- Lack of well-developed standards
- Cable design
- Alignment and maintenance

Some broadband LANs are referred to as 10Broadband36 where 10 stands for 10 Mbps, Broadband for multichannel and 36 for 3600 metres maximum separation between devices.

Baseband LANs

Baseband LAN is a single channel, supporting a single communication at a time as shown in Figure 5.22. They are digital in nature. Total bandwidth of 1 to 100 Mbps is provided over coaxial cable, UTP, STP, or fibre optic cable. Distance limitations depend on the medium employed and the specifics of the LAN protocol. Baseband LAN physical topologies include the ring, bus, tree, and star topologies.

Baseband LANs are by far the most popular and the most highly standardized. Ethernet, Token Passing, Token Ring and FDDI LANs are all baseband. They are intended only for data, as data communication is, after all, the primary reason for the existence of LANs. The characteristics of this system may be summarized as follows:

- No need of modems – low cost installation
- Bidirectional propagation of signal
- Unmodulated digital signal
- Single channel
- Stations connected via T connectors

Advantages

- Simplicity
- Low cost
- Ease of installation and maintenance
- High rates

Disadvantages

- Limited distances
- Data and voice only

Communication Media

1. Bounded Media

Bounded media or wired transmission systems employ physical media which are tangible. Also known as conducted systems, wired media generally employ a metallic or glass conductor which serves to conduct a few types of electromagnetic energy. For example, a copper medium is employed to conduct electrical energy by a twisted pair and coaxial cable system. Fibre optic systems conduct light or optical energy, generally using a glass conductor. The term bounded or guided media refers to the fact that the signal is contained within an enclosed physical path. Finally, bounded media refers to the fact that some form of shield, cladding, and/or insulation is employed to bind the signal within the core medium, thereby improving signal strength over a distance and enhancing the performance of the transmission system in the process. Twisted pair (both unshielded and shielded), coaxial and fibre optic cable systems fall into this category.

Twisted Pair (Copper Conductors)

Figure 5.23 shows a pair of copper wires which are twisted together and wrapped with a plastic coating as a twisted pair and which has a diameter of 0.4-0.8. The error rate of transmission and the electrical noise is reduced by the twisting. Each conductor is separately insulated by some low-smoke and fires retardant substance. Polyethylene, polyvinyl chloride, flouropolymer resin and Teflon(r) are some of the substances that are used for insulation purposes.

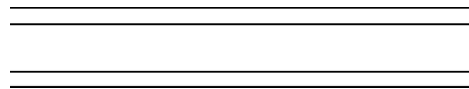


Fig. 5.23 Two Wires Open Lines

Twisting process serves to improve the performance of the medium by containing the electromagnetic field within the pair. Thereby, the radiation of electromagnetic energy is reduced and the strength of the signal within the wire is improved over a distance. This reduction of radiated energy also serves to minimize the impact on adjacent pairs in a multiple cable configuration. This is especially important in high-bandwidth applications as higher frequency signals tend to lose power more rapidly over distance. Additionally, the radiated electromagnetic field tends to be greater at higher frequencies, impacting adjacent pairs to a greater extent. Generally, the more the twists per foot, the better the performance of the wire.

These are popular for telephone network. The energy flow is in guided media. Metallic wires were used almost exclusively in telecommunication networks for the last 80 years, until the development of microwave and satellite radio communications systems. The copper wire has developed into an established technology which is strong and cost effective. In certain applications, copper-covered steel, copper alloy, nickel- and/or gold-plated copper and even aluminum metallic conductors are employed.

The maximum transmission speed is limited in this case. The copper conductor that carries analogue data can be used to carry digital data also in association with modem. Modem is a device that changes analogue signals into digital signals and

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vice versa. In this category, data rate is restricted to approximately 28 kbit/s. The use of better modulation and coding schemes led to the introduction of Integrated Services Digital Network (ISDN) along with an increased data rate of 128 kbit/s. Local Area Networks (LANs) also use twisted pairs. These networks also upgraded to support for high bit rate real time multimedia. In Asymmetric Digital Subscriber Lines (ADSL) technology, there has been a new progress which intended to use two cooper loops at a data rate of 1.544 Mbps. This data rate is developed towards the user direction in the network and data rates upto 600 kbit/s from the user to network.

The twisted pair cable may be defined in two categories based upon the shielding and without shielding.

In Figure 5.24, Unshielded twisted pair (UTP) is shown as a copper medium which has come from telephony which is being utilized more and more for data rates. It is fast becoming a practice for horizontal wiring. It states the link between the end in the communication closet and the outlet which is further restricted to 90 metres. Communication closet is universal to every application working over the media and is independent of the type of media.

Additionally, in the work area, there is a grant for 3 meters and for cross connecting in the closet for a whole of 99 metres, it is 6 metres.

The suggested connectors and media for horizontal wiring are discussed as follows:

- 150 ohms Shielded Twisted Pair (STP) contains 2 pairs (IBM connector or RJ45).
- 100-ohm UTP contains 4 pairs and 8-pin modular connector (ISDN).
- 62.5/125 contains multi-mode fibre.
- 50ohm coax (thin)-IEEE10BASE2, standardBNC connector.

A UTP cable contains 2 to 4200 twisted pairs. Flexibility, cost-effective media and usability of both data communications and voice are the biggest advantages of UTP. On the other hand, the major disadvantage of UTP is the fact that the bandwidth is limited. This limits long distance transmission with low error rates.

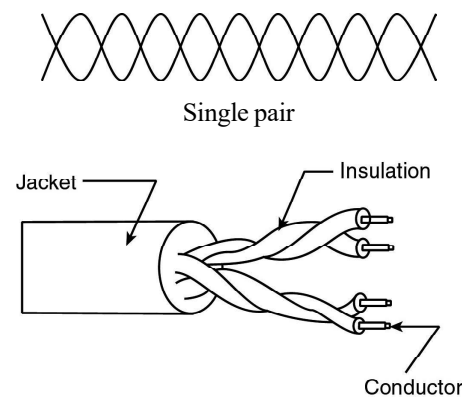


Fig. 5.24 Unshielded Twisted Pair (UTP)

Shielded Copper or STP

Shielded twisted pair (STP) differs from UTP in the metallic shield or screen which surrounds the pairs, which may or may not be twisted. As illustrated in Figure 5.25, the pairs can be individually shielded. A single shield can surround a cable containing multiple pairs or both techniques can be employed in tandem. The shield itself is made of aluminium, steel, or copper. The shield is in the form of a metallic foil or woven meshes and is electrically grounded. Although less effective, the shield sometimes is in the form of nickel and/(or) gold plating of the individual conductors.

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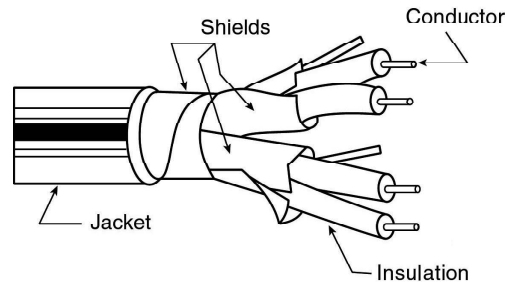


Figure 5.25 *Shielded Twisted Pair (STP) Configuration*

Shielded copper offers the advantage of enhanced performance for reasons of reduced emissions and reduction of electromagnetic interference. Reduction of emissions offers the advantage of maintaining the strength of the signal through the confinement of the electromagnetic field within the conductor. In other words, signal loss is reduced. An additional benefit of this reduction of emissions is that high-frequency signals do not cause interference in adjacent pairs or cables. Immunity from interference is realized through the shielding process, which reflects electromagnetic noise from outside sources, such as electric motors, other cables and wires and radio systems.

Shielded twisted pair, on the other hand, has several disadvantages. First, the raw cost of acquisition is greater as the medium is more expensive to produce. Second, the cost of deployment is greater as the additional weight of the shield makes it more difficult to deploy. Additionally, the electrical grounding of the shield requires more time and effort.

General Properties of Twisted Pair

Gauge: Gauge is a measure of the thickness of the conductor. The thicker the wire, the less the resistance, the stronger the signal over a given distance, and the better the performance of the medium. Thicker wires offer the advantage of greater break strength. The gauge numbers are retrogressive. In other words, the larger the number, the smaller the conductor.

Configuration: In a single pair configuration, the pair of wires is enclosed in a sheath or jacket, made of polyethylene, polyvinyl chloride or Teflon. Usually, multiple pairs are so bundled as to minimize deployment costs associated with connecting multiple devices (e.g., electronic PBX or KTS telephone sets, data terminals, and modems) at a single workstation.

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Bandwidth: The effective capacity of twisted pair cable depends on several factors, including the gauge of the conductor, the length of the circuit and the spacing of the amplifiers (repeaters). One must also recognize that a high-bandwidth (high frequency) application may cause interference with other signals on other pairs in close proximity.

Error performance: Signal quality is always important, especially relative to data transmission. Twisted pair is susceptible to the impacts of outside interference, as the lightly insulated wire act as antennae and, thereby, absorbs such errant signals. Potential sources of Electromagnetic Interference (EMI) include electric motors, radio transmissions and fluorescent light boxes. As transmission frequency increases, the error performance of copper degrades significantly with signal attenuation increasing approximately as the square root of frequency.

Distance: Twisted pair is distance limited. As distance between network element increases, attenuation (signal loss) increases and quality decreases at a given frequency. As bandwidth increases, the carrier frequency increases, attenuation becomes more of a issue, and amplifiers (repeaters) must be spaced more closely.

Security: Twisted pair is inherently an insecure transmission medium. It is relatively simple to place physical taps on UTP. Additionally, the radiated energy is easily intercepted through the use of antennae or inductive coils, without the requirement for placement of a physical tap.

Cost: The acquisition, deployment and rearrangement costs of UTP are very low, at least in inside wire applications. In, high-capacity, long distance applications, such as interoffice trunking, however, the relative cost is very high, due to the requirements for trenching or boring, conduit placement, and splicing of large, multipair cables. Additionally, there are finite limits to the capacity and other performance characteristics of UTP, regardless of the inventiveness of technologists. Hence, the popularity of alternatives such as microwave and fiber-optic cable.

Applications: UTP's low cost including recently developed methods of improving its performance has increased its application in short-haul distribution systems or inside wire applications. Current and continuing applications include the local loop, inside wire and cable and terminal-to-LAN. UTP no longer is deployed in long haul or outside the premises transmission systems.

The additional cost of shielded copper limits its application to inside wire applications. Specifically, it is generally limited to application in high-noise environments. It is also deployed where high frequency signals are transmitted and there is concern about either distance performance or interference with adjacent pairs. Examples include LANs and image transmission.

Coaxial Cable

The core factor that limits a twisted pair cable is due to the skin effect. The flow of the current in the wires is likely to flow only on the wire's outer surface as the frequency of the transmitted signal raises, thus, less of the available cross-section is used. The electrical resistance of the wires is increased for signals of higher frequency which leads to higher attenuation. Further, significant signal power is lost due to the effects of radiation at higher frequencies. Thus, another kind of transmission medium can be used for applications that require higher frequencies. Both these effects are minimized by coaxial cable.

Coaxial cable as shown in Figure 5.26 is a robust shielded copper wire two-conductor cable in which a solid center conductor runs concentrically (coaxial) inside a solid outer circular conductor. This forms an electromagnetic shield around the former that serves to greatly improve signal strength and integrity. The two conductors are separated by insulation. A layer of dielectric (nonconductive) material, such as PVC or Teflon, protects the entire cable.

The coaxial cable comes under the category of a bounded media and is still an effective medium to use in data communication. For better performance, coaxial cable contains shields which make it costly. Cable television uses coaxial cables. LANs functions over coaxial cable to the 10Base5, 10Base2 and 10BaseT specifications. Generally, coaxial cable allows longer distance transmission instead of twisted pair cable at a higher data rate. This is however, costly.

There are two types of coaxial cables.

Baseband: It transmits a single signal at a time at very high speed. The signal on baseband cable must be amplified at a specified distances. It is used for local area networks.

Broadband: It can transmit many simultaneous signals using different frequencies.

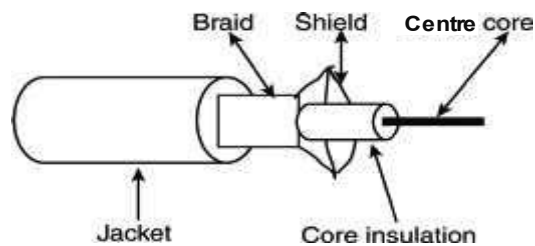


Fig. 5.26 Coaxial Cable Configuration

General Properties of Coaxial Cable

Gauge: The gauge of coaxial cable is thicker than the twisted pair. While this increases the available bandwidth and increases the distance of transmission, it also increases the cost. Traditional coaxial cable is quite thick, heavy and bulky of which Ethernet LAN 10Base5 is an example. Ethernet LAN 10Base2 is of much lesser dimensions but offers less in terms of performance.

Configuration: Coaxial cables comprise of a two-conductor wire which is single, with an outer shield (conductor) made of solid metal and a centre conductor. At times, stranded or braided metal is employed. Twin axial cables contain two such configurations within a single cable sheath. The centre conductor carries the carrier signal and the outer conductor generally is used for electrical grounding. Coaxial cable connectivity can be extended through the use of twisted pair with a BALUN (Balanced/Unbalanced) connector serving to accomplish the interface.

Bandwidth: The effective capacity of coaxial cable depends on several factors, including the gauge of the center conductor, the length of the circuit, and the spacing of amplifiers and other intermediate devices. The available bandwidth over coaxial cable is very significant, hence it is used in high capacity applications, such as data and image transmission.

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Error performance: Coaxial cable performs exceptionally well due to the outer shielding. As a result, it is often used in data applications.

Distance: Coaxial cable is not so limited as UTP, although amplifiers or other intermediate devices must be used to extend high frequency transmissions over distances of any significance.

Security: Coaxial cable is inherently quite secure. It is relatively difficult to place physical taps on coaxial cable. Radiation of energy is also minimal hence interception of it is not easy.

Cost: The acquisition, deployment, and rearrangement costs of coaxial cables are very high, compared with UTP. In high capacity data applications, however, that cost is often outweighed by its positive performance characteristics.

Applications: Coaxial cable's superior performance characteristics make it the favoured medium in many short hauls, bandwidth-intensive data applications. Current and continuing applications include LAN backbone, host-to-host, host-to-peripheral and CATV.

Optical Fibre

We have seen in the previous section that the geometry of coaxial cable significantly reduces the various limiting effects, the maximum signal frequency, and hence the information rate that can be transmitted using a solid conductor, although very high, is limited. This is also the case for twisted lines. Optical fibre is different from the transmission media. The transmitted information is carried through a beam of light which is fluctuating in a glass fibre instead of a wire or an electrical signal. This type of transmission has become strong support for digital network owing to its high capacity and other factors favourable for digital communication.

Fibre optic transmission systems are opto-electric in nature. In other words, a combination of optical and electrical electromagnetic energy is involved. The signal originates as an electrical signal, which is translated into an optical signal, the optical signal subsequently is reconverted into an electrical signal at the receiving end. Figure 5.27 shows a clean, thin glass fibre reflecting light internally as the transmission carries light with encoded data. Fibres can bend without breaking with the help of plastic jacket. Light Emitting Diode (LED) or laser injected light for transmission into the fibre. Receivers that are light sensitive translate light back into data at the other end.

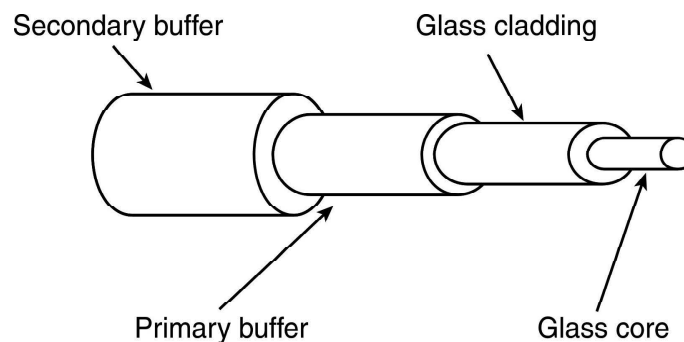


Fig. 5.27 Optical Fibre Cable — General View

The optical fibre consists of a number of substructures as shown in Figure 5.28. In this case, a core made of glass, In this case, the glass core carrying the

light is encircled by a glass cladding which has lower refractive index. Thus, blending the light and confining it to the core. A substrate layer of glass encircled the core thus, adding to the diameter and the power of the fibre. This layer of glass, however, doesn't carry light. The mechanical protections cover the secondary buffer coating and primary buffer coating.

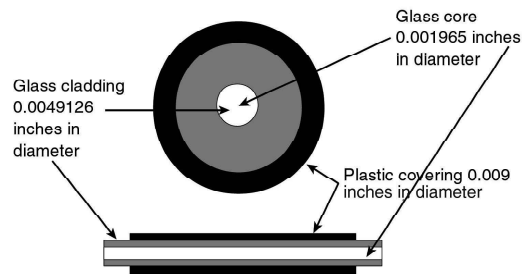


Fig. 5.28 Glass Optical Fibre Cable Side View and Cross-Section

The light pulse travels down the center core of the glass fibre. Surrounding the inner core is a layer of glass cladding, with a slightly different refractive index. The cladding serves to reflect the light waves back into the inner core. Surrounding the cladding is a layer of protective plastic coating that seals the cable and provides mechanical protection. This is shown in Figure 5.28. Typically, multiple fibres are housed in a single sheath, which may be heavily armored.

Light propagates along the optical fibre core in one of the following ways as given below depending on the type and width of core material used.

Multimode fibre: Compared to the wavelength of light, the diameter of the core is relatively large. This is known as multimode fibre. In comparison to the wavelength of light, which is about 1 μm , core diameter ranges from 50 micrometers (μm) to 1,000 μm . It is therefore, called multimode, because light can travel through the fibres in various ray paths. In multimode, light spreads through the fibre in various modes or paths of rays.

Multimode fibre is less expensive to produce and inferior in performance because of the larger diameter of the inner core. When the light rays travel down the fibre, they spread out due to a phenomenon known as modal dispersion. Although reflected back into the inner core by the cladding, they travel different distances and, therefore, arrive at different times. The received signal thus has a wider pulse width than the input signal with a corresponding decrease in the speed of transmission. As a result, multimode fibre is relegated to applications involving relatively short distances and lower speeds of transmission, for example, LANs and campus environments.

Two types of multimode fibres exist. The old and simple sort is the 'step index' fibre. Here, the refraction index, which is the capability of an object to bend light, is similar across the fibre core.

Step Index Multimode Fibre

Step index multimode fibre is shown in Figure 5.29. With various means of propagation or ray paths, diverse rays traverse various distances, and varied periods

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of time for the fibre length to transit are taken. Therefore, in a fibre, if a small pulse of light is infused, the different rays that emanate from the short pulse will come at the other side of the fibre at various times, and the input pulse will be of a shorter period of time than the output pulse. This is known as ‘Modal Dispersion’ (pulse spreading) which restricts the amount of pulses per second that transmits down the fibre and is recognized as separate pulses at the different end. Therefore, a bandwidth or bit rate of a multimode fibre is limited. When a bandwidth is around 20 to 30 MHz over one kilometer of a fibre, stated as ‘MHz - km’, there is no effort to compensate for modal dispersion in case of step index fibres.

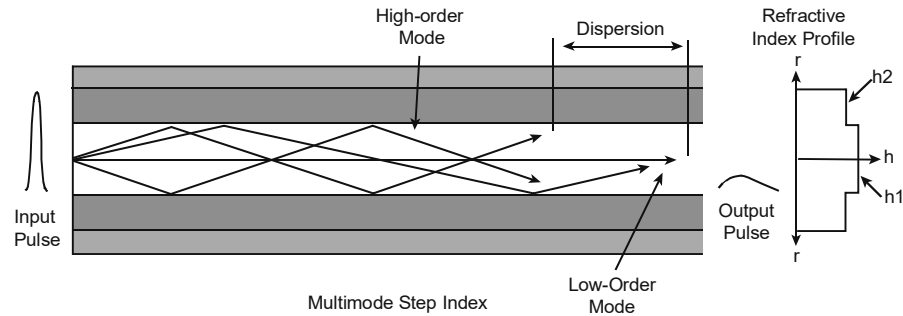


Fig. 5.29 Step Index Multimode Fibre

Graded index multimode fibre: The refraction index across the core is altered slowly from the highest at the centre to the lowest near the edges; therefore, it is termed as the graded index. This proves the fact that light passes through rapidly in a low-index-of-refraction material than a high-index material. In the graded index fibre, a short pulse of light is launched which spreads during its transit of the fibre. Therefore, dispersion can be reduced using a core material that has a variable refractive index. In such multimode graded index fibre light is refracted by an increasing amount as it moves away from the core as shown in Figure 5.30. This results in the narrowing of the pulse width of the received signal in comparison with stepped index fibre. This enables a corresponding increase in the transmission speed. Therefore, they are capable of supporting a much higher bandwidth or bit rate. Usually, bandwidths of graded index fibres are between 100 MHz-km to well over 1 GHz-km. The bandwidth is dependant on two things. One on the extent a specific index profile of the fibre reduces modal dispersion, and second on the light's wavelength introduced into the fibre.

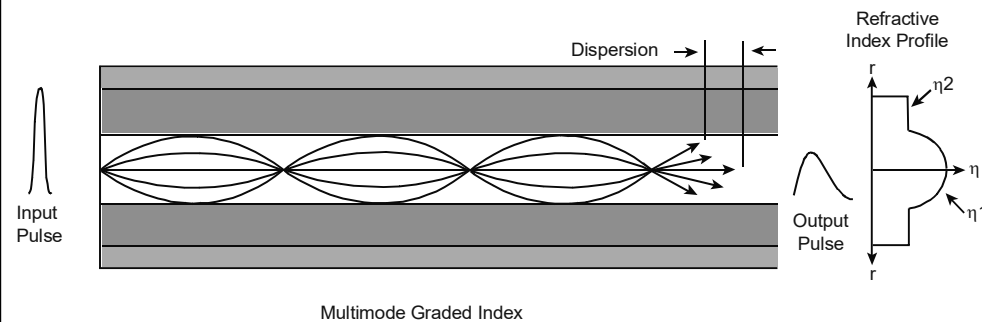


Fig. 5.30 Light Propagation in Graded Index Multimode Fibre

Monomode/singlemode fibre: This has a thinner inner core. The core diameter which is approximately $9\ \mu\text{m}$ is much nearer in size to the light's wavelength which is spread by around $1.3\ \mu\text{m}$. The transmission of light is thus, limited to one ray or mode of light which propagates down the fibre core as shown in Figure 5.31. Hence, effects of multimode or a multiple-mode are reduced. However, the mechanism of one pulse-spreading continues. 'Chromatic Dispersion' is a phenomenon where many wavelengths of light move at various speeds. This causes small pulses of light, like in the case of multimode fibres, to spread as they travel.

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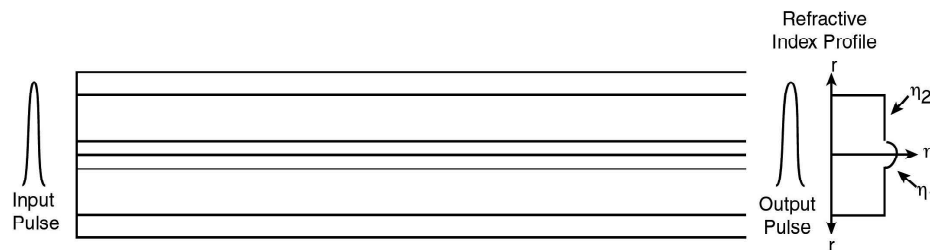


Fig. 5.31 Light Propagation in Single Mode Step Index Fibre

At higher transmission rates, single mode fibre is a better performer in case of long distances, than multimode fibre. All the light that is emitted is propagated along a single path, because of the core diameter which is reduced. The input signal is of a comparable width to the received signal. Though it proves to be more expensive, monomode fibre has its advantages especially in applications with high bandwidth.

Single-mode fibres have broad bandwidth, cost-effective and low reduction of strength of any existing optical fibre. They are commonly used in cable television applications and long-distance telephony.

The advantages of optical fibres are as follows:

- Weight is light and the size is small
- Immunity to crosstalk and electromagnetic interference
- Bandwidth is large
- No problems of short circuit or electrical ground loop
- It is safe in combustible areas (no arcing)
- It is immune to lightning and electrical discharges
- Long cables run between repeaters
- High strength and flexibility
- Potential high temperature operation
- It is safe and secure against signal leakage and interference
- When cut or damaged, there is no electrical hazard

General Properties of Optical Fibre Cable

Configuration: Fibre optic systems consist of light sources, cables and light detectors, as depicted in Figure 5.32. In a simple configuration, one of each is used. In a more complex configuration over longer distances, many such sets of elements are employed. Much as is the case in other transmission systems, long haul optical communications involve a number of regenerative repeaters. In a fibre optic system,

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repeaters are opto-electric devices. On the incoming side of the repeater, a light detector receives the optical signal, converts it into an electrical signal, boosts it, converts it into an optical signal, and places it onto a fibre, and so on. There may be many such optical repeaters in a long haul transmission system, although typically far fewer than would be required using other transmission media.

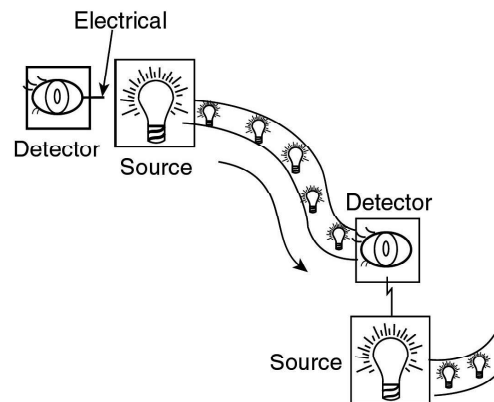


Fig. 5.32 Fibre Optic System

Bandwidth: Fibre offers by far the greatest bandwidth of any transmission system, often in excess of 2 Gbps in long haul carrier networks. Systems with 40 Gbps have been tested successfully on numerous occasions. The theoretical capacity of fibre is in the terabit (Tbps) range, with current monomode fibre capacity being expandable to that level.

Error performance: Fibre being a dielectric (a nonconductor of direct electric current), it is not susceptible to Electromagnetic Interference/Radio Frequency Interference (EMI/RFI). This also does not emit EMI/RFI. The light signal will suffer from attenuation, although lesser than other media. Scattering of the optical signal, bending in the fibre cable, translation of light energy to heat, and splices in the cable system can cause such optical attenuation.

Distance: Monomode fibre optic systems routinely are capable of transmitting signals over distances in excess of 325 km. Therefore, relatively few optical repeaters are required in a long-haul system. This will reduce costs, and eliminating points of potential failure.

Security: Fibre is intrinsically secure, as it is virtually impossible to place a physical tap without detection because no light is radiated outside the cable. Therefore, interception of signal is almost impossible. Additionally, the fibre system supports such a high volume of traffic that it is difficult to intercept and distinguish a single transmission from the tens of thousands of other transmissions that might ride the same cable system. The digital nature of most fibres, coupled with encryption techniques frequently used to protect transmission from interception, make fibres highly secure.

Cost: While the acquisition, deployment, and rearrangement costs of fibre are relatively high, the immense bandwidth can outweigh that cost in bandwidth-intensive applications. At Gbps speeds, a single set of fibres can carry huge volumes of digital transmissions over longer distances than alternative systems, thereby lowering the transport cost per bit and cost per conversation to fractions of a penny per minute.

Applications: Applications for fibre optic transmission systems are bandwidth intensive. Such applications include backbone carrier networks, international submarine cables, backbone LANs (FDDI), interoffice trunking, computer-to-computer distribution networks (CATV and Information Superhighway) and fibre to the desktop (Computer Aided Design).

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Bounded Media Comparison Chart (Table 5.2)

Table 5.2 Bounded Media Comparison Chart

Media	Advantages	Disadvantages
Twisted pair cable	Inexpensive, well established, easy to add nodes	Sensitive to noise, short distances, limited bandwidth, security hazard because of easy interception
Coaxial cable	High bandwidth, long distances, noise immunity	Physical dimensions, security is better in comparison to twisted pair cable
Optical fibre cable	Very high bandwidth, noise immunity, long distances, high security, small size	Connections, cost

2. Unbounded Media

Wireless transmission systems do not make use of a physical conductor, or guide, to bind the signal. In this case, data are transmitted using electromagnetic waves. Therefore, they are also known as unguided or unbounded systems. Energy travels through the air rather than copper or glass. Hence, the term ‘Radiated’ often is applied to wireless transmission. Finally, such systems employ electromagnetic energy in the form of radio or light waves that are transmitted and received across space, and are referred to as airwave systems. The transmission systems addressed under this category include microwave, satellite and infrared. There are different techniques to convert the data suitable for this mode of communication. Theoretically, radio waves travel through a building and through walls just like in the case of a radio, cellular phone and TV. They commute longer distances through satellite communication and use wireless communication to travel shorter distances. This technology can be used to deliver time applications like multimedia material. However; it has to be carefully treated since radio links are vulnerable to interference, fading and random delays. Non-real time usage of this technology performs as good as the present Ethernet LANs.

5.4.1 Components of a Network

In general, a computer network is composed of one or more servers, workstations, network interface cards, active and passive hub, routers, bridges, gateways, modem, software components like network operating systems, and other application software. The following components are widely used for the construction of networks.

Server

It is the most powerful computer of the network. In a local area network, usually a powerful microcomputer or a super microcomputer with the power of a minicomputer is used as a server. There are two types of servers normally employed in a local area network. They are *dedicated* servers and *non-dedicated* servers.

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In a dedicated server, the server computer performs functions and services of the whole network. It helps to efficiently run user applications and increases the overall system cost. Users cannot run their applications directly in a dedicated server. It provides e-mail service, sharing of multiple hard disks, and sharing of other resources and faster response time. For larger networks with heavy load, dedicated servers are usually employed.

In a non-dedicated server, apart from the role of a network controller, a server also acts as an individual workstation. The server is equipped with large memory. Network operations demand only a portion of server memory. The remaining portion of the memory may be used for the user applications. Under light load conditions, it is advisable to use a non-dedicated server. Some servers can operate on both modes, according to the requirement of the user.

File Server

The primary goal of a computer network is to share data among several users. They also make their attached disk drives, printers, modems, and unique communication links available to the various client stations. Providing one computer with one or more hard disks facilitates this. All client stations share these hard disks. Clients can make their requests to access any of the shared facility to the server. The file server is a powerful computer, which runs special software. It provides the files and other shared resources to different users in the network. It provides facilities like user authentication, security to various user programs, and data. It can be accessed through network operating system (NOS). Typical configurations of a server are Pentium 4 machine with 128 MB or higher capacity RAM, 40 GB or higher capacity hard disk, to serve upto 10 nodes or workstations.

All activities of a file server can be monitored and controlled from the monitor called console. The network administrators are given special privileges. They are given supervisory passwords. They perform the network administration operation for the entire network. Any user of the network needs to get a new network service, they have to contact the network administrator and make a request for the specific service they need. The file server has a large memory, which is used for caching directories, and files and hashing directories. Novell Netware and Windows NT are the two network operating systems that run on a server machine.

Workstation

Another important component of a network is the workstation or a client. A workstation is an individual computer with capabilities to communicate with other machines. It must be equipped with the hardware and software necessary to connect to a LAN. Usually a Network Interface Card (NIC) or an Ethernet card or an Arcnet card is used for this purpose. Part of the network operating system is also available in the workstation. A workstation can communicate with other workstations or to the server. The hardware requirement for a workstation depends on the application and the size of the network. In a typical LAN of a university computer center, a Pentium III system with 64 MB RAM and 4 to 8 GB hard disk capacity, with necessary network interface card can be used for a typical workstation. In general, the memory and hard disk capacity of a workstation is much less than that of the server.

Network Interface Unit

Every computer on the network needs one add on card called Network Interface Card (NIC) or Ethernet Adapter or Network Interface Adapter. The role of NIC is to move the serial signals on the network cables, or media into parallel data stream inside the PC. In some cases, two or more such NICs are used in the server to split the load. These interface units also have the important jobs of controlling access to the media. This includes activities known as carrier sense (listen before transmit), sequential station number, and token passing, which are discussed in the later chapters. The above activities are known as Media Access Control.

Transmission Media

The data signal travels through this medium. There are two general categories. They are bounded (guided) and unbounded (unguided) medium. Twisted pair, coaxial cable, and fibre optic cables are all bounded media. The data signals travel within the boundaries of the transmission media. On the other hand, microwave and satellite transmissions, both travel through the air, which has no boundaries, hence called un-bounded transmission.

Hub

The network hub is a centralized distribution point for all data transmission in a network. Hub may also be referred to as a concentrator Data packet from a NIC arrives at the hub. The hub receives and rebroadcasts them to other computers connected to it. In general, the hub network is a passive device. It does not know the destination of a received data packet. Hence, it is required to send copies to all the hub connections. Hubs can be classified into the following three categories.

- Stackable and non-stackable hubs
- Active and passive hubs
- Intelligent and non-intelligent hubs

Stackable hubs are hubs that can be stacked or interconnected to make a single hub appearance. They are useful for vendors to make hubs of size suitable to customer requirement. Non-stackable hubs cannot be interconnected. They are always provided only a fixed number of connections.

The hubs that connect to the network backbone are known as active hubs. The hubs, which connect only to active hubs, are known as passive hubs.

Intelligent hubs contain a special firmware that can be accessed by remote workstations. The firmware is known as Simple Network Management Protocol (SNMP). Network performance and network status data are read from SNMP.

Repeater

A repeater is a communication device that connects between two segments of the network cable. It retimes, regenerates, strengthens the digital data, and sends them on their way again. Repeaters are often used to extend the cable length to enlarge LANs. Wide area network contain many repeaters. Ethernet also frequently uses repeaters to extend the length of the bus.

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Bridge

A bridge interconnects two networks using same technology (such as Ethernet or Arcnet). Bridge is more sophisticated than a repeater. A modern bridge reads the destination address of the received packet and determines whether the address is on the same segment of the network cables of the originating station. If the destination is on the other side of the bridge, the bridge transmits the packet into the traffic on that cable segment. Local bridges are used to connect two segments of a same LAN. Remote bridges are used to link local LAN cables to thin long distance cables to link two physically separated networks. Network administrators often use bridges to split the big networks into number of small networks. Bridges are easy to install. They provide an easy way to perform network management functions.

Router

A router transfers data between networks. It is also possible for a router to transfer data between different compatible network technologies such as Ethernet and IBM token ring. Since Internet consists of thousands of different network technologies, routers are an integral part of the Internet. A router has the address on the network. A bridge does not have an address. Hence, a router can act as an intermediate destination. In other words, a computer can send a data packet to the router of another network. The router will transfer the packet to the other network. On the other hand, the bridge must examine all the packets to determine which packets to transmit between networks. As such, computers never send packets directly to a bridge. A router examines a packet only if it contains the router's address.

A router also can act as a bridge. Such a router is known as a *brouter*. The brouter receives the packet and examines whether it supports the protocol used by the packet. If not, it simply drops the packet. The packet is bridged using the physical address information.

Gateway

Two dissimilar networks can be connected by means of a gateway. For example, a mainframe can be connected and accessible to a PC network by means of a gateway. Unlike routers, a gateway converts the format of the data sent between two networks. A router adds only addressing information to the data packet. Routers never change the content of the message. A gateway has to identify the protocols used in the networks, and recognise the data format and convert the message format into suitable format to be accepted by the other network. Wide area networks often use gateways because there is a large number of dissimilar networks present in a WAN. Gateways provide good connectivity to different kinds of networks on the Internet.

Modem

Another significant network component is modem. The term Modem is the shortened version of the name modulator–demodulator. Modem provides two-way communication facility between a computer network and telephone network.

As Wide Area Network uses the existing telephone network to connect to a distant network, it always uses a modem to dial-up the telephone network. Modem converts the digital data from the computer into useful analogue signals that can be transmitted through a telephone network. Similarly, signals from the telephone channels are converted back into digital data suitable for a computer.

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5.4.2 MAN and WAN

Metropolitan Area Network (MAN)

A Metropolitan Area Network (MAN) covers large geographic areas such as towns, cities or districts. By linking or interconnecting smaller networks within a large geographic area, information is conveniently distributed throughout the network. Local libraries and government agencies often use a MAN to establish a link with private industries and citizens. It may also connect MANs together within a larger area than a LAN. The geographical limit of a MAN may span a city. Figure 5.33 depicts how a MAN may be available within a city.

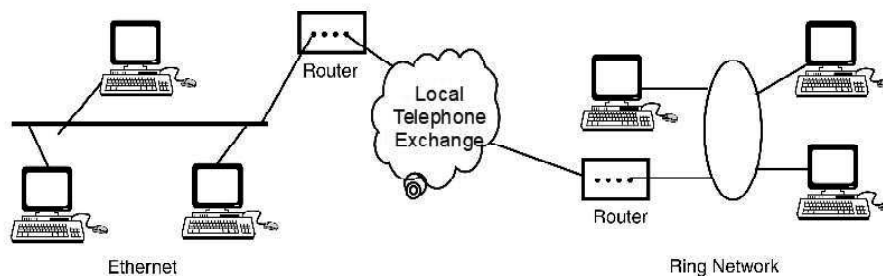


Fig. 5.33 Metropolitan Area Network (MAN)

In MAN, different LANs are connected through a local telephone exchange. Some of the widely used protocols for MAN are RS-232, X.25, Frame Relay, Asynchronous Transfer Mode (ATM), ISDN (Integrated Services Digital Network), OC-3 lines (155 Mbps), ADSL (Asymmetrical Digital Subscriber Line) etc. These protocols are quite different from those used for LANs.

Wide Area Network (WAN)

This technology connects sites that are in diverse locations. Wide Area Networks (WANs) connect larger geographic areas, such as New Delhi, India, or the world. The geographical limit of WAN is unlimited. Dedicated transoceanic cabling or satellite uplinks may be used to connect this type of network. Hence, a WAN may be defined as a data communications network covering a relatively broad geographical area to connect LANs together between different cities with the help of transmission facilities provided by common carriers, such as telephone companies. WAN technologies operate at the lower three layers of the OSI reference model. These are the physical data link and network layers.

Figure 5.34 explains the WAN, which connects many LAN together. It also uses switching technology provided by local exchange and long distance carrier.

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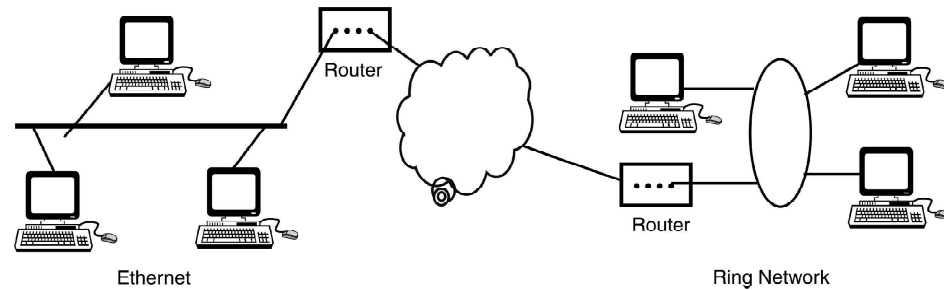


Fig. 5.34 Wide Area Network (WAN)

Packet switching technologies such as Asynchronous Transfer Mode (ATM), Switched Multimegabit Data Service (SMDS), Frame Relay and X.25 are used to implement WAN along with statistical multiplexing to allow devices to use and share these circuits.

The difference between MAN and WAN may be understood only from the services being used by them. WAN uses both the local and long distance carrier while MAN uses only local carrier. Hardware and protocols are same as in case of MAN.

There is a lot of confusion between LAN technology and WAN technology. The answer lies in how data is switched. Switching techniques are described subsequently in this chapter. It is the LAN/(WAN) integration that makes the network work. After all, people and machines not only need to be accessible locally, but from different sites as well.

A network is formed and completed using the following basic components:

- (i) Hardware
- (ii) Applications (useful software).

Each of these actually comprises several layers. An important concept in networking as well as computer designs is the concept of layers. Each layer provides protection to the layer above from the layer below so that one layer can change without affecting the upper layers too much. In some cases, the protection provided is so good that an application may never become aware that it is functioning on different hardware. Seven layers are defined by the OSI reference model.

The role of computer networks in development has many facets. Computers along with the necessary networking infrastructure required have to be connected with either LAN or WAN or Internet or all based on the needs and playing a greater role in e-governance, telemedicine, e-education, e-business, etc. A computer with Internet (internetworking) has become a potent tool for education, productivity and enlightenment. The Internet can improve life at a relatively low cost. The Government of India has set up ERNET in 1986 to provide TCP/IP connections for education and research communities in India. ERNET has established first TCP/IP computer network in India and it offers services like e-mail, surfing Internet, FTP, Telnet, and database access, gopher, Archie, WAIS and WWW. Subsequently, the Government of India has liberalized the policies relating with Internet and its backbone. The liberalized policies initiated by government encouraged many private players like DISHNET, Mantra online, JAIN TV etc.

and other government organizations like NIC, VSNL and MTNL to enter in this field to bring the Internet to common people.

The major network infrastructure available in the country has two types of WAN:

- Terrestrial WAN
- VSAT WAN.

Following are different options for setting up their Intranet, education portal or e-commerce etc.:

- Leased line
- Dialup connection
- VSAT
- RADIO LINK.

The role of Internet can be seen in the area of education, economic productivity, healthcare, democracy and human rights and quality of life etc. There are several more areas where Internet can contribute largely. In the area of education, this can contribute by way of shared databases, organization of conferences, circulation of papers and discussion, collaborative research and writing undertaken, web-based registration, online digital library privileges, other online learning facilities like virtual classrooms and information regarding courses and so forth. Economic productivity may be enhanced as an Internet run over telephone infrastructure at relatively marginal cost, provides more economic advantage. Internet enables global communication with suppliers and customers etc. This can lead to opening global markets to the developing countries. In this manner, Internet has facilitated the opening of e-commerce. Internet is being effectively utilized in health sector. The rapid growth of Internet and related areas like switched leased lines, terrestrial and satellite packet radio and videoconferencing etc, has lead to the development of telemedicine. The Internet is expected to encourage democracy by providing those suffering dictatorship with external information and new ideas. This exposure to information allows people to share ideas and coordinate political activity within their countries. Internet may force transparency in the administration and therefore, may be considered as a catalyst to encourage human rights in a wider sense. The environment is under a lot of pressure everywhere. We have pollution and there are limited resources for energy. The Internet may enable us to substitute communication for transportation and therefore, will reduce pollution and save energy and time both in the larger interest of mankind.

5.4.3 Modem

The square waves or digital signals are composed of wide spectrum and are prone to attenuation in the signal strength and distortion due to different frequency components of the signal. These signal impairment effects are not suitable for baseband (DC) signalling for higher speed and long distances. They are suitable only for slow speeds and over short distances. The data communication also seeks to communicate over large distances. Hence, another technique called AC signalling is employed in which a continuous wave called sine wave is used. A sine wave is

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characterised by frequency, amplitude and phase. Any one of the characteristics of a sine wave is modulated in accordance with the information so that the information can be transmitted over large distances in which sine wave acts as a carrier for information.

A device that accomplishes the above function in which it accepts a series of bits in the form of 0 and 1 as input and produces a modulated carrier as output at the transmitting end and a reverse operation at the receiving end is called a modem. In other words, a modem is an electrical component that can connect another modem over an analogue telephony network. When two modems are connected, they can send each other a two-way stream of digital bits. A computer sends information to another computer located at a remote location using modem. The modem receives digital information from the computer, translates it to an analogue signal using digital-to-analogue converter unit (DAC) and sends the analogue information to the PSTN. On the other side, when receiving data from the network, an analogue-to-digital converter (ADC) unit is being used to retrieve the data. It is important to know that DAC/ADC units are noisy units and are thus limitations on the performance of the modem.

The data communication techniques were developed based on the existing telephone network so that no extra expenditure may be incurred on infrastructure. It was the voice communication that had necessitated the communication between remote computers and computing devices using the existing telephone network for voice communication. Most of the telephone lines were installed for voice communication and therefore, they were able to transmit only analogue information. On the other hand, the computers and related computing devices were based on digital signal in the form of pulses or 0 and 1. Therefore, to use the existing telephone lines or the analogue medium, a device that may convert digital signal into analogue and vice versa was needed. This device is known as the MODEM and stands for Modulator Demodulator. It performs the function of modulating and demodulating a signal.

A modem therefore receives serial binary data as its input. It modulates some of the characteristics of a sine wave like amplitude, frequency or phase generated by it in accordance with the input signal so that the binary signal may be transmitted over large distances. A reverse procedure takes place at the receiving end where the received signal is demodulated to retrieve the binary signal as the output of the modem which can be inputted to the digital device at the receiving end for further processing. In other words, the modem changes the analogue information into digital pulses at the computer or the digital device at the receiving side of the communication link or channel.

Conventionally, modems were devised for communication between a host computer and data terminals. Subsequently, they were also deployed to communicate between remote computers and computing devices. As they were used to communicate between remote digital devices, their data transmission rates were also subjected to increase from 300 bps to 28.8 kbit/s. The modem technologies were also upgraded to involve data compression techniques. However, they increase the additional burden of error detection and error correction to maintain reliability.

Therefore, the modem can be considered as a peripheral device for computers to enable two remote computers to communicate over standard telephone lines. Modems are developed in different shapes and sizes for various types of applications and needs. The word modem stands for modulator/demodulator and performs the conversion of digital signals to analogue signals (modulation) and vice versa (demodulation), as shown in Figure 5.35.

In order to establish interoperability among different types of modems from different manufacturers, standards for modem interface were developed. Modems are deployed to perform various types of functions. Some of them are used in voice and text mail systems, facsimiles, etc., and others are attached or assimilated into mobile phones or laptops making data transmission possible from any location to any other. In future, modems may be utilized for other types of applications. Modem speeds are still around 28/56 kbit/s and further increase in speed will be possible only on digital phone technology, like ISDN and fibre optic lines. Some of the new applications are videophones in which simultaneous communication of voice and data are performed.

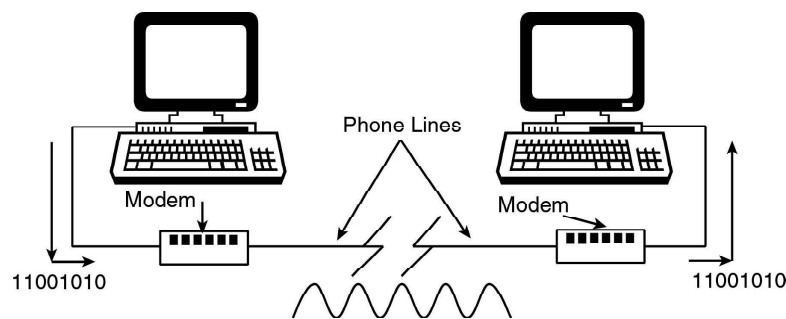


Fig. 5.35 Connecting Two Computers via Modem

Modems continuously generate a carrier signal to send information so that the information may be delivered from one location to another remote location. The information to be transmitted is superimposed on the carrier signal. In this manner, the transmitted information varies or modulates this carrier signal. The terms baud and bps to measure the data rate are very popular with this technology and continually used interchangeably. However, they are not the same at all.

The number of pulses transmitted in a second characterizes the carrier signal in which each pulse is called a baud. The bps stands for bits per second and indicates the number of bits that can be transmitted during one pulse (one baud). Similarly, kbit/s stands for kilo bits per second.

Therefore, $\text{bps} = \text{baud} \times \text{number of bits per baud}$.

The baud and bps often create confusion because early modems were based on 1 bit per baud and used to transmit only 1 bit per baud. In such a case, for example, a 2400 baud modem will also transmit 2400 bps. However, because of the need of higher speeds, modems are designed to have more number of bits per baud.

The difference between baud and bps can be understood from this analogy. Bit rate means the number of bits (0 or 1) transmitted during 1 second of time. The number of changes in signal per unit of time to represent the bits is called the

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modem's data rate. This rate is expressed in terms of baud. A signal unit may have 1 or more than 1 bits. Therefore, baud signifies the number of times per second the line condition can switch from 1 to 0. Baud rate and bit rate, which are expressed in bits per second, are not similar, as number of bits may be transmitted by the modem through the channel in each signal change (some bits can be send as one symbol). The relation between bit rate and baud is that bit rate is equal to baud rate multiplied by the number of bits representing each signal unit. Bit rate is always more than or equal to baud rate because baud rate determines the bandwidth required to transmit the signal. The signal may be in the form of pieces or block that may contain bits. A fewer bandwidth is required to move these signal units with large bits for an efficient system. To understand the relation between bit and baud rate, we consider an analogue of car, passengers and highway with signal units, bits and bandwidth respectively.

A car has a capacity of carrying a maximum of five passengers at a time. Suppose a highway may support only 1000 cars per unit time without congestion. When each car on the highway carries five passengers, it is considered that the highway is capable of providing services without congestion. Thus highways services are treated efficient. Consider another case, when all these 5000 passengers wish to go in separate cars, they require 5000 cars and the highway can only support 1000 cars at a time. The services offered get deteriorated because the highway's capacity is meant only for 1000 cars. It does not bother as to whether these 1000 cars are carrying 1000 passengers or 5000 passengers or more. To support more cars, the highway needs to be widened. Similarly, the number of bauds determines the bandwidth.

Concepts of Modulation

Modulation is the technique that is used to translate low-frequency (base band) signal like audio, music, video and data to a higher frequency. In other words, it may be said that modulation/ demodulation is a non-linear process where two different sinusoids are multiplied.

The modulation process involves a high-frequency sinusoidal carrier f_c . Some characteristics of this signal like amplitude, frequency and phase change in direct proportion to the instantaneous amplitude of the base band signal f_m as shown in Figure 5.36.

Let us assume the two sinusoids (as shown in Figure 5.36) f_m and f_c as base band signal and carrier respectively and are represented as:

$$f_m = A \sin \omega_m t + \phi_1 \quad (5.1)$$

and

$$f_c = B \sin \omega_c t + \phi_2 \quad (5.2)$$

In equation (5.2), we may change either amplitude B or angular frequency ω_c in accordance with equation (5.1) and thus produce either amplitude modulation or frequency modulation or phase modulation, respectively. Angular frequency is defined as twice of the frequency of carrier signal.

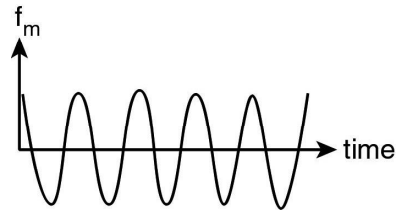


Fig. 5.36 Two Different Sinusoids

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In other words, modulation is used to superimpose a message (voice, image, data, etc.) on to a carrier wave for transmission. The frequencies that comprise the message (base band) is translated to a higher range of frequencies. The frequencies that comprise the message is preserved, that is, every frequency in that message is scaled by a constant value as explained above. Modulation is necessary for data communication because of several reasons. Modulation translates two or more base band signals to different frequencies and thus enables the simultaneous transmission of those signals.

It also reduces the size of the antenna for higher frequencies with greater efficiency. Inter-modulation is a special case in which two (or more) sinusoids affect one another to produce undesired products, that is, unwanted frequencies (noise). This can occur only when both waves share the same nonlinear device. The nonlinearity results in several even or odd harmonics. Harmonics are the multiples of the fundamental frequency, that is, the message frequency.

The modulating index is the ratio of the peak of the modulating signal to the peak of the carrier in case of amplitude modulation. In angular modulation, the modulating index is measured as the ratio between the deviation of frequency of the modulated signal and the frequency of a sinusoidal modulating signal. In phase modulation, the index of modulation is equal to the phase deviation in radians.

Amplitude Modulation

Amplitude Modulation (AM) involves the modulation of the amplitude of the carrier as analogue sine wave, as depicted in Figure 5.36 as f_c . It occurs when a signal to be modulated is applied to a carrier frequency. The carrier frequency may be a radio wave or light wave. The amplitude of carrier frequency changes in accordance with the modulated signal, while the frequency of the carrier does not change and we get a complex wave as shown in Figure 5.37. Basically, it is the sum of three sinusoids of different frequencies. These are $f_c - f_m$, f_c , and $f_c + f_m$. The sinusoid with frequency f_c has the same amplitude as the unmodulated carrier. The other two waves are called as lower and upper side band with frequency $f_c - f_m$, and $f_c + f_m$ respectively and have equal amplitudes, which are proportional to the amplitude of the modulating signal. It is clear from the above that the bandwidth is equal to $2f_m$.

The AM signals resulting from the combination comprises of the carrier frequency and the lower and upper side bands. This is shown in Figure 5.37.

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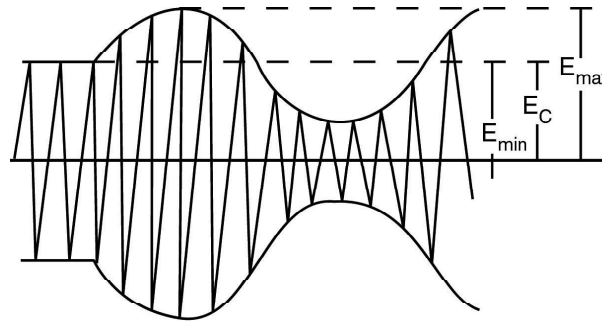


Fig. 5.37 Amplitude Modulation of a Carrier Wave

At a comparatively low level, carrier frequency is either suppressed or transmitted. For demodulation, it needs the carrier frequency to be generated, or derived at the receiving location. This transmission is called Double Side Band-Suppressed Carrier (DSB-SC).

Transmission of a single side band is also possible. To transmit the signal, reduced analogue bandwidth is needed. This proves to be an advantage. Modulation of this type is called Single Side Band-Suppressed Carrier (SSB-SC). It is perfect for frequency division multiplexing (FDM).

One more kind of analogue modulation is called Vestigial Side Band modulation. It is similar to a single side band apart from the carrier frequency which is protected. In addition, one of the side bands is removed by filtering. Vestigial side band transmission is usually found in television broadcasting. Amplitude modulation is rarely used individually as it is highly sensitive to the impacts of attenuation and line noise.

The modulating index is given as:

$$m = \frac{E_{max} - E_c}{E_c} \quad (5.3)$$

From Figure 5.37 and equation (5.3) we may derive the following equation for modulating index m.

$$m = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} \quad (5.4)$$

Angle Modulation

It is described in equation (5.2) as a carrier which is being reproduced as follows:

$$f_c = B \sin \omega_c t + \phi_2$$

In the equation, there is an argument of sin as $\omega_c t + \phi_2$ which can be varied in accordance with equation 1 and thus producing either frequency or phase modulation. In either case, the amplitude of the carrier remains unchanged with incremental change in $\omega_c t + \phi_2$.

Frequency Modulation

Frequency Modulation involves the modulation of the frequency of the analogue sine wave as shown in Figure 5.38. Where the instantaneous frequency of the carrier is deviated in proportion to the deviation of the modulated carrier with

respect to the frequency of the instantaneous amplitude of the modulating signal. It may be said in a simple word that it occurs when the frequency of a carrier is changed based upon the amplitude of input signal.

Unlike AM, the amplitude of the carrier signal is unchanged in FM. This leads to FM modulation becoming further resistant to noise compared to AM and thus, improving the complete signal-to-noise proportion of the communication system. Power output differs from the varying AM power output. The total analogue bandwidth required to transmit FM signal is superior to AM, a limiting constraint for some systems.

The modulating index for FM is given as follows:

$$\beta = f_p / f_m$$

where

β = Modulation index

f_m = frequency of the modulating signal, and

f_p = peak frequency deviation.

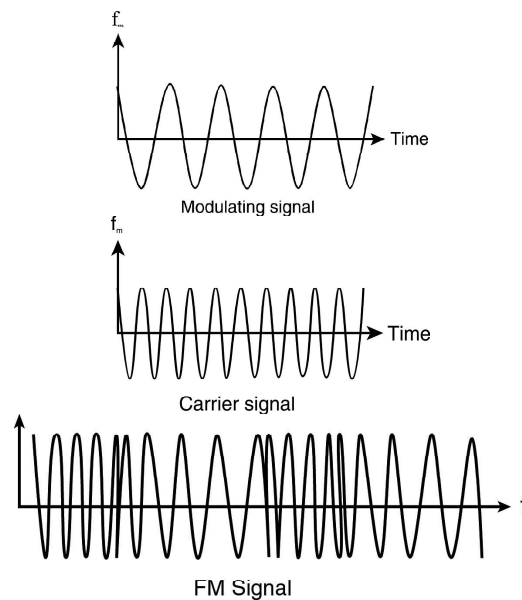


Fig. 5.38 Frequency Modulation

It is understood from Figure 5.38, that amplitude of the modulated signal stays constant, in spite of the frequency and amplitude of the modulating signal. It means that the modulating signal adds no power to the carrier in FM unlike the AM. FM produces an infinite number of side bands spaced by the modulation frequency, f_m unlike AM. Therefore, AM considered a linear process whereas FM as a nonlinear process. It is necessary to transmit all side bands to reproduce a distortion free signal. Ideally, the bandwidth of the modulated signal is infinite in this case. In general, the determination of the frequency content of a FM waveform is complicated (but when it is small, the bandwidth of the FM signal is $2f_m$). On the other hand, when it is large, the bandwidth is determined (empirically) as $2f_m (1 + b)$.

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Phase Modulation

Phase Modulation (PM) is similar to frequency modulation. In FM, the frequency of the carrier wave changes, whereas in PM the phase of the carrier wave changes. In PM the phase of the carrier is made proportional to the instantaneous amplitude of the modulating signal.

Modulating index for PM is given as:

$$\beta = \Delta\phi$$

where

$\Delta\phi$ is the peak phase deviation in radians.

As in the case of angular modulation argument of sinusoidal is varied and therefore, we will have the same resultant signal properties for frequency and phase modulation. A distinction in this case can be made only by direct comparison of the signal with the modulating signal wave, as shown in Figure 5.39.

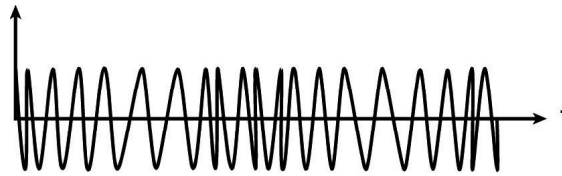


Fig. 5.39 Phase Modulation

Phase modulation and frequency modulation are interchangeable by selecting the frequency response of the modulator. Hence, its output voltage will be proportional to integration and differentiation of the modulating signal, respectively. Bandwidth and power issues are same as that of the frequency modulation.

Check Your Progress

1. What is internet?
3. Define the term network architectures.
3. What do you understand by TCP/IP?
4. Define the term LAN.
5. Write the advantages and disadvantages of broadband LANs.

5.5 APPLICATION OF TECHNOLOGY IN SOCIETY

Information technology (or IT as it is popularly called) has dramatically changed the way of our life. After the discovery of electricity, the computer ranks as one of the most important breakthroughs of the modern era. Like electricity, IT has impacted all facets of life and in fact its usage is so ubiquitous that it is hard for today's generation to even visualize as to how our ancestors lived without computers. From medicine to transportation, from banking to the entertainment

industry there is hardly any industry or sector that does not deploy IT in a fundamental manner to achieve one of the three goals:

- (a) Reducing cost of operations by increasing operational efficiency and staff productivity
- (b) Improving revenues and bottom lines by helping management in informed decision-making and focusing on priority areas
- (c) Improving customer satisfaction by providing better, faster and value-added services

IT has opened up several allied industries and employment opportunities which never existed before. Whether it is Business Process Outsourcing (remote data processing) or Web-enabled services (medical transcription, call centres etc.), IT has opened up new avenues for jobs.

1. Airlines

The air travel industry is one of the biggest users of information technology. There is hardly any aspect of the airline business in which computer systems have not been deployed for increasing revenues, reducing costs and enhancing customer satisfaction.

It is now almost inconceivable to book a ticket or get a seat confirmed across multiple sales counters (airline offices, travel agents, etc.) spread over numerous cities, without using computerized databases and e-networking. Like most other industries, the use of computerized systems in the air travel industry started with the front office and sales desk with back-office operations playing a crucial role in delivering a quality experience to consumers. What typically started as airlines intranet systems have now blossomed into vast web-based online systems which can be accessed by anybody from anywhere in the world.

Some of the interesting areas where IT has been used successfully are:

- **Online ticket reservation through the Internet:** Today, most leading airlines like United Airlines, Delta, British Airways, etc. sell tickets through their websites. You can book the ticket through the Internet, pay online by giving your international credit card details and then collect the ticket (on the day of journey), and boarding pass from e-ticket kiosks at the airport by simply furnishing your booking reference details.
- **Flight and seats availability:** If you wish to travel from New Delhi to New York and do not know what your flight options are, simply log onto the airline site (or better still a travel site like 'msn' which offers information and tickets from many airlines and can therefore give you more options than a single airline's website), specify the cities of travel origin and destination along with preferred journey dates and the database would yield all the possible options. Once you have selected the flights, you could even go a step further (possible in case of a few airlines) and book a specific seat number in that flight along with the choice of meal.

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- **Last minute deals and auctions:** A seat is a perishable commodity. An unsold seat means a revenue opportunity lost forever. Therefore, most airlines, including Indian Airlines (and some specialized ticket auction sites like Razorfinish.com) have now started a facility on their website where potential customers can bid for last minute tickets in online auctions. Cases of people buying a ticket worth \$1000 for as low as \$100 are not uncommon. This is a case of win-win by effective use of IT – the passenger is happy at getting the ticket at a fraction of its normal cost, and the airline is able to recover something from what might otherwise have been an unsold seat.

All these facilities/opportunities would have been impossible without an integrated online computer systems.

2. Telephone Exchanges

The first telephone service invented by Alexander Graham Bell was strictly ‘point-to-point’, i.e., each user had to be physically wired to every other user. There was no ‘telephone exchange’. Needless to say, Bell immediately realized the need for an exchange, and made one. In this first exchange each subscriber had to be wired only up to his local exchange. An operator sitting in the exchange connected him to other subscribers upon request (earlier phones did not have dialing facility) by physically connecting the caller’s wire to the recipient subscriber’s telephone by using a hand-actuated circuit switch. One does not need to stretch one’s imagination to appreciate the fact that operator-controlled exchanges were not only extremely labour intensive but also highly error prone.

Now compare this to the digital, computerized telephone exchanges used today. These are electronic systems that do the switching operation based upon a ‘stored program control’. The rules defined in the software assess which destination the caller is trying to reach, plot the most optimal path, intimate the called party, inform the caller about his call status and then if the called party accepts the call, establish the circuit. The call is monitored during its progress and the circuit disconnected once the call is terminated. Computerized exchanges improved and enhanced call-processing capacity, thereby lowering the cost of operations. They also opened up a dazzling array of IT-enabled services for subscribers that have made modern telephony an indispensable service.

Bharat Sanchar Nigam Limited (BSNL), one of the main providers of telephony services extensively uses a product called Infotel for managing their telephone exchanges. This product provides:–

- **Provision of facilities:** Activation, deactivation and modification of subscriber facilities, such as ISD, STD, call waiting, call transfer, computer-generated bills etc.
- **Fault booking and restoration service:** Maintenance of a database of complaint calls either through an IVRS (Interactive Voice Response System) or a customer service cell. The system automatically creates the complaint docket and generates a range of statistical and exception reports.

- **Line data maintenance:** The system provides online data on cable codes, cable pair numbers, cabinet number, pillar numbers, etc. for all subscriber connections to facilitate and expedite line repair and maintenance.
- **Directory enquiry:** The computerized subscriber database also allows extensive online or voice-based directory enquiry based upon subscriber name, location, telephone number etc.

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3. Mobile Phones

Statistically, major portions of the populations of any developing country still do not possess a telephone. Making a simple call to anybody requires locating the nearest telephone booth, waiting for ones' turn in the queue, and then paying for a short chat on (most often) a disturbed line.

In the developing countries the penetration of landline phones has been low largely due to the hassles of laying cables across long distances. Especially in the case of remote areas, the cost of connecting a few phones to the mainland mass becomes disproportionately high. Maintaining these telephone cables across inhospitable terrain also poses a major challenge to network expansion planners and engineers.

It sometimes pays to be late! Thanks to the advances made in the telecommunications industry in the last two decades, mobile phones provide an excellent cost-effective and efficient alternative to the land phones for developing countries like India.

A cellular phone (as mobile phones are also known) is primarily a radio—a very sophisticated variant of a radio telephone. The genius of a cellular system is the division of the city into small cells (hexagons on a big hexagonal grid). Each cell has a base station that consists of a tower and a small building containing the radio equipment. Wireless communication is possible within and across cells allowing a user complete mobility and making communication much easier and less time-consuming. Through switching devices in landline telephone exchanges, mobile phone users can also access the global landline network, effectively bringing everyone within speaking distance.

The mobile phone industry owes its growth to information technology which is in fact central and pivotal in any mobile system. Technologies like PCS, TDMA, CDMA, GSM are often associated with mobile phones.

PCS (Personal Communications Services) is a wireless phone service somewhat similar to a cellular telephone service but emphasizing on personal service and extended mobility. It is sometimes referred to as digital cellular (although cellular systems can also be digital). Like cellular, PCS is for mobile users and requires a number of antennas to blanket an area of coverage. As a user moves around, the user's phone signal is picked up by the nearest antenna and then forwarded to a base station that connects to the wired network.

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

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CDMA employs analogue-to-digital conversion (ADC) in combination with spread spectrum technology. Audio input is first digitized into binary elements. The frequency of the transmitted signal is then made to vary according to a defined pattern (code), so that it can be intercepted only by a receiver whose frequency response is programmed with the same code, and so it follows the transmitter frequency exactly. There are trillions of possible frequency-sequencing codes; this enhances privacy and makes cloning difficult.

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

Today, mobile phones are proliferating as handsets are getting cheaper and call rates are declining, bringing them within the reach of the common man. They provide an array of functions (some very simple and others very sophisticated). Some of the popular functions which are based upon IT are:

- **SMS (short messaging service):** Small text messages can be exchanged between people who do not believe in long verbal conversations over communication channels. In fact today SMS has gained popularity as a medium for sending and forwarding messages.
- **Address Book:** It is a store of contact information maintained on the mobile handset or the central server. It does away with the usual problem of maintaining an usual address book and allows the phone user to dial numbers without having to bother about carrying a bulky file-o-fax or telephone diary along.
- **Schedules or to-do lists:** You can store a list of important tasks that you wish to accomplish. Most mobile phones software also provide for appointments and reminders associated with these tasks.
- **Send or receive e-mail:** Thanks to WAP technology it is now possible to access your e-mails using your mobile phone. Popular portals like Yahoo and Rediff offer a facility whereby users get automatic alerts on their mobile phones as soon as any new mail arrives. You can also use your mobile phone for chatting using your MSN or ICQ account.
- **Get information updates:** All mobile service providers now provide add-on facilities for their subscribers to receive regular updates on news, entertainment, stock market prices. This is done by integrating web-based databases with the mobile users' database. Service providers also use this capability to advertise for new products, services and schemes.

As you can appreciate, all the above facilities are based upon the usage of electronic databases and intelligent software available on the mobile phone. Due to the global trend of convergence the dividing line between information technology and telecommunications technology is getting increasingly blurred. Today's

computers combine phone, fax, television, VCD/DVD drives, stereo—all in one seamless bundle.

4. Video Games

Games have been one of the most popular uses of computers. In fact, organizations like Attari, Nintendo, and Sony who were developers of video games have been instrumental in the improvements in the multimedia capabilities of desktop computers. Till about a decade ago when personal computers had severe limitations of disk storage, processing speed, and memory size, only very simple uni-dimensional video games were possible. With the development of much faster Pentium series of CPUs with inbuilt multimedia capabilities coupled with improvement in digital storage and acoustics, today's games are limited only by their creators' imagination and not by any technological hindrances. Today's games like Doom, Pokeman, PlayStation, Galaxian, Defender, etc. use very sophisticated graphic and sound techniques to create three dimensional games.

Some of the interesting developments in this area have been:

- Virtual reality
- Improvements in specialized input devices like joysticks
- Special game cards and enhanced graphic capability of CPU
- Web games (Casinos)

5. Special Effects in Movies

Special effects in movies have come a long way since the early 20th century. During the early years of movie making, special effects were limited to time-lapse cinematography where hand-controlled dummies were brought to life by stop motion filming which meant manually moving the animated model a fraction of an inch and taking a snapshot. For example, the 1933 classic *King Kong* involved tedious photography of a life-size dummy model moved laboriously inch-by-inch between takes by a team of assistants.

Similarly, the early animation movies (popularly called cartoon films) involved a team of artists and painters who would painstakingly draw and paint each sketch frame by frame. The photography team would then click shots of these sketches at the rate of twenty four frames a second of film and edit them into a story.

Cut to the 21st century. If another version of *King Kong* were to be made in 2004 (and it has) what you would get is a completely authentic-looking Gorilla (made fiercer by digitally created and enhanced sound effects) walking in a lush green forest (once again created by a clever mix of amazon rainforest pictures and computer techniques commonly known as digital compositing). Not only would the ape look and behave completely naturally but would be able to perform stunts (like 360 degree flips or making 100 metre jumps) that would just not have been possible with any physical model.

Some of the interesting techniques used for creating special effects are:

- **Digital compositing:** Typically done through a process called 'Bluescreen' where the actors perform the scene in a studio in front of a large blue screen. A separate team of computer designers and artists

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create a virtual background (by mixing multiple photographs and computer-generated images). Later the actors' footage is superimposed on the top of the background to create a seamless 'composite picture'.

- **Time slicing:** In this technique a series of cameras are placed around the object of concern. All these cameras shoot pictures at precisely the same time. When these pictures are played together it appears as if there is one camera moving around the object. Coupled with other special tricks (such as slow motion photography as used in the Matrix series) this creates an ethereal effect.
- **Computer-generated imaging (CGI):** CGI techniques are used to create scenes which are either not possible in real life or would be too expensive or dangerous to film. To gather a crowd, for instance of 150,000 people in a colosseum to shoot a *Gladiator* fight sequence would cost an enormous amount of money besides creating nightmarish logistical problems. Doing the same though CGI would not only cost a fraction of the money, but also save precious time.

None of the above developments would have been possible without the fantastic developments in Information Technology.

6. Business

Like banking, the insurance sector has also to contend with a lot of routine paperwork insurance policies, claims filed, survey or investigation reports, payment receipts etc. IT provides a perfect opportunity to reduce costs and processing times.

According to Insurance Journal:

Eighty-eight per cent of insurers think that IT will become more important in driving efficiencies and cost-reductions in future, according to new research released by RebusIS, an insurance technology solutions provider. A further 55 per cent of respondents to the survey argued that IT is currently playing an 'important' role in driving efficiencies and cost-reductions, with 43 per cent contesting that IT is 'essential' to business efficiency.

Typically, insurance companies use computerized databases to keep track of all insurance policies, generating premium due statements, premium received receipts, lodging claims for insurance recovery, etc. Basically all kind of transactions are recorded and processed through computerized systems. This not only enables insurance companies to provide quicker and more efficient service to their clients, it also allows them to minimize their risks and maximize their profits by enabling complex financial, economic and demographic analyses of their customers. Using sophisticated computer programs, an insurance company can determine which customer segments are growing the fastest, which are most profitable, and which are more risky than others.

Although a lot of processes have been automated, things like insurance claims etc. are still filed on paper forms first. The volumes involved are quite intimidating prompting some insurance companies in the US and Europe to outsource the entire data entry process to specialized offshore firms—many of them in India!

This is how the typical process works: an insurance agent or the insured party fills up a paper form somewhere in the US. These forms are collected from multiple locations at one location – let’s say the insurance company’s head office. A team of professionals from the data entry agency (working in the Insurance company’s head office) scans these forms through high-speed scanners, generates image files for all the forms and then at the end of the day, using the Internet, transmits all these images to their data processing facility, let’s say in New Delhi. Due to time difference, by the time this transmission is done at the end of day in the US, it is morning in India. A team of trained data entry operators, using specialized software, views these forms (as images) on one portion of their screen and then types the same data in a database. Once the data has been properly verified and validated the database is then uploaded back to the US within a few hours. This means that the images that were sent from the US the previous night could be available in the US the next morning in the form of a computerized database! Of course, other than the effective use of IT, the time difference between the US and India has helped tremendously to make this ‘zero time lag’ system a great success! This system of outsourcing one of the business functions is called ‘BPO’ or Business Process Outsourcing.

Another more sophisticated alternative to this is OCR—Optical Character Recognition—where the images are run through OCR software that automatically converts these into text. OCR is only feasible where the text quality is very (typically typed or computer printed matter) high. Since OCR operations still produce only 90 to 95 per cent accurate text, human intervention is still required to correct the mistakes made by OCR systems. In course of time, however, technological advancements will bring 100 per cent reliability and further change the face of remote-processing arrangements.

7. Financial Accounting

Financial accounting was one of the first business functions for which software applications were developed. The importance of financial accounting and management for any business cannot be overemphasized, but the scale of transactions, the repetitive and structured nature of the data and the sheer volumes involved in the case of large corporates makes for an ideal case for computerization. Computerizing accounts also takes the drudgery out of bookkeeping, which means that accountants can now concentrate more on analysing information rather than devoting countless hours merely in filling out vouchers and updating registers and ledgers.

Typically this is how a computerized accounting system works—the accounting clerk makes the voucher directly on the computer using a financial accounting software package. The voucher on the screen looks very similar to a regular paper voucher and is in fact much simpler to fill because things like current date and voucher number are generated automatically. The appropriate account names that have to be debited or credited need not be typed but simply selected by the click of a mouse from a list of all ledger accounts. Appropriate checks and validations are also built into the accounting software which reduces the chances

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of errors. Unless, for example, the total of all debit accounts equals to the total of all credit accounts, the software will not allow the voucher to be saved.

Once the basic data has been entered into the computer voucher, the accountant can print out as many copies as required. Unlike a manual accounting system where a the voucher, once prepared, has to be entered into the daybook and then posted in the relevant ledger account, the computer software does this automatically. In fact the moment the voucher is entered and saved it is not only automatically posted to all the relevant daybooks and ledger but also up-to-date trial balance, profit and loss account and balance sheet can be generated instantly showing the downstream effects on each one of them. Since there is no time lag between voucher preparation and posting, the accounting software always shows up-to-date statement and final account.

Depending upon the size of the organization and the complexity of its operation, different software packages are readily available in the market. At the bottom end are popular and inexpensive software such as Tally and EX which are quite sufficient for most small and medium scale-organizations. Tally provides an excellent user-friendly interface through which all accounting transactions can be entered or modified easily and the user can see the effects of each transaction in all financial statements.

At the top end of the market is ERP (Enterprise Resource Planning) software like Oracle Financials, Baan, SAP etc. which cater to the financial accounting and management needs of huge multi-location, multi-currency, multi-operations organizations like Nestlé, Pepsi, Coca Cola, Procter & Gamble etc. Such software is called ERP software, since it provides completely integrated solutions for all functions of a business like financial accounting, inventory, payroll, production planning and control, etc. Despite the fact that ERP solutions typically cost millions of rupees and are relatively much more complex to implement, they provide an excellent platform for ensuring that the company's system and procedure are uniformly followed across multiple locations (or even countries). Such systems also make it very easy to consolidate huge amounts of information from different profit centres and locations. Thus, effective, near real-time management information can be generated to assist apex level decision making.

8. Hotel Management

The hotel industry is an integral part of the tourism industry, which is a vital source of revenue and foreign exchange for a country's economy. A vibrant hotel industry means greater employment generation. However, since this industry relies on easy and quick availability of information, the role of IT in its development and growth cannot be over-stressed. In fact, IT has revolutionized the hotel and tourism industry. This is because of the instant availability of information about tourist spots, hotel infrastructure, room availability, tariff details, online Booking, etc. at the click of a button. IT is playing a critical role in improving performance because of its potential of creating customer relationships and the flow of information between the people and customers.

There are numerous instances of use of IT in hotel industry. Some of these include:

- Today's hotel management software means that the moment a guest expresses interest in staying at the hotel, till the time he checks out, all transactions with him (room charges, food and laundry bills, business centre, health centre, hiring cars etc.) are recorded electronically, making information available at the click of a button.
- Many leading hotels offer online booking facility for tourists and guests. This makes it very easy for the tourist as he has beforehand knowledge of room availability and charges. There are several websites wholly devoted to this. Microsoft's MSN has a traveller's section where one can search for hotel accommodation based on criteria like city, location, budget etc. A tourist, for example, can specify the city and his budget. Based on this information, the search facility throws up a complete list of hotels available. Moreover, the tourist can even specify his preferred location. Once the hotel is identified, booking can be made online using an internationally valid credit card.
- Most of the hotels have computerized their records. It is very easy to know details of room availability at a particular time. The information about the occupant is also available instantly. This computerized system typically integrates all hotel MIS functions into one system. Cendant Corporation has successfully implemented this practice in its chain of hotels. The Barbizon Hotel and Empire Hotel, New York has eliminated logbooks and standardized recordkeeping by the use of customized software. Carlson Hospitality Worldwide has the most efficient and productive reservation system in the US. IMPAC Hotel Group has lobby kiosk touch screen guest-tracking system. Inter-Continental Hotels & Resorts use a global strategic marketing database. All these are examples of use of IT in hotel industry, which have significantly transformed operations and profitability.
- Hotel Information Systems help users to access guest database information and use the information to create attractive one-to-one reservation confirmations, e-mail marketing and sales messages, custom reports and e-mail comment cards to reinforce guest relationships. The Balsams Grand Resort Hotel has a comprehensive guest history program that it has used successfully for productive purposes. Courtyard by Marriott has an Intranet system by which it has replaced manuals and printed material.
- Information technology is being used increasingly by international hotel chains to formulate and align their corporate strategies. Marriott International is a successful example of alignment of information technology with corporate strategy.

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9. Education

Teaching has traditionally been associated with classroom instructions on a blackboard with the instructor dependent almost entirely on his/her oratory and presentation skills for holding the attention of the class. From a student's perspective, he had to keep pace with the instructor's pace, which meant that the slower (though not necessarily less intelligent) student was at a natural disadvantage. Similarly some students were more interested in a more in-depth study than the others. Since access to information was neither easy nor inexpensive, these variables had always posed a major barrier to learning.

Ever since the advent of information technology, the scenario has changed dramatically. Today, the instructor has a repertoire of information technologies. To make the lecture not only more interesting but also more informative, there are advanced electronic teaching tools available. These vary from simple slide presentations to full-blown multimedia presentations which have video clippings, sound effects, animation and graphics to explain even the most abstruse subjects in a simple and easy-to-understand manner. As an example, a medical student does not have to pore over boring textbooks to understand let's say, the human anatomy. Simple computer packages like 'Body Works' are available which explain the same using photographs, images and graphics that make in-depth learning fun rather than a chore. Moreover, learning is not only faster but is retained longer when test is supported by visuals and sound clips. Multimedia has transformed both classroom as well as online (distance) and packaged (CDs, VCDs, DVDs etc.) education, in terms of both content as well as interactivity.

Some of the interesting developments in IT for the education sector can be seen in:

- **Computer-based training (CBT):** In most of the progressive institutes today, classroom sessions are complemented by CBTs. CBT typically comprises user-friendly software in which the course syllabi is broken up into a series of interactive sessions. These sessions involve imparting a slice of knowledge to the student and then quizzing him to reinforce his understanding. Students have the option of going through these sessions at a time most convenient to them and a pace best suited to them. CBTs also provide an excellent medium for the student to learn by exploration and discovery rather than by rote. However, Education software is often positioned as 'enriching' the learning process and not as a potential substitute for traditional teacher-based methods.
- **Internet:** Thanks to the Internet, any and every type of information is available at the click of a mouse. No longer have students to trudge long distances to visit a library and spend valuable time plodding through library catalogues to find the right information. Using a search engine, one can easily access the desired information. Also, knowledge is no longer restricted within the academic fraternity alone. Thanks to our networked world (Intranet / Internet) information dissemination is faster and widespread.

- **Distance learning:** Information technology has also made distance learning a reality. You need not be physically present in a Business School to do a management course from there. By innovative use of information technology, educational institutes have reached out to students who would otherwise never have been able to enroll with them.
- **Computerization of administrative tasks:** Most academic institutes use computerized systems for student enrollment, fee management, examination, administration, etc. Enrollment forms, for instance, are now available on institutional websites, and examination results are usually available on the Internet. Some schools have also started collecting fees through the Internet by using credit cards.

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10. Weather Forecasting

Predicting the condition or state of the atmosphere after a period of time and over a certain region(s) is known as weather forecasting. The professionals involved in the study and prediction of weather are called meteorologists. The state of the atmosphere is governed by various factors, such as temperature, humidity, wind speed etc.

A few decades ago, man depended on the close observation of natural phenomenon and changes in atmosphere such as cloud formation, sky colour, wind speed, temperature, animal and insect behaviour to make weather predictions. Human senses and knowledge used to be the main driving factor behind these early predictions, which were limited to short-term forecasting and had low accuracy levels.

With the development in information technology, weather forecasting has become a science rather than an art. Weather forecasting requires processing and analysing huge amount of data very quickly. This makes it an ideal field for the application of information technology. The volume of data to be processed and the complexity of calculations that must be made in order to forecast weather with a certain degree of accuracy can be gauged by the fact that this task can only be performed by super-computers which work at phenomenally high speeds and can crunch huge amount of data very quickly.

The software and hardware tools provided by IT help in making accurate weather forecasts over longer time intervals. Large amounts of data are collected by weather balloons, satellites, sensors and radar instruments and fed into computers with huge processing power and data storage for quantitative analysis and weather modelling (Refer Figure 5.40). Some examples of software used in this process would be Digital Atmosphere, Forecast Laboratory and RAOB. Accurate assessments of the condition of weather over a period of three to six days can be made using hydrological forecasts and warnings of extreme events can be issued over a lead time of five to ten days.

There is still a huge scope of development in the field of weather forecasting and information technology is driving it by developing better software for computer modelling, building and designing weather monitoring sensors for data collection, analysis and growing channels of weather forecasting services and making systems with huge computing power and storage space available.

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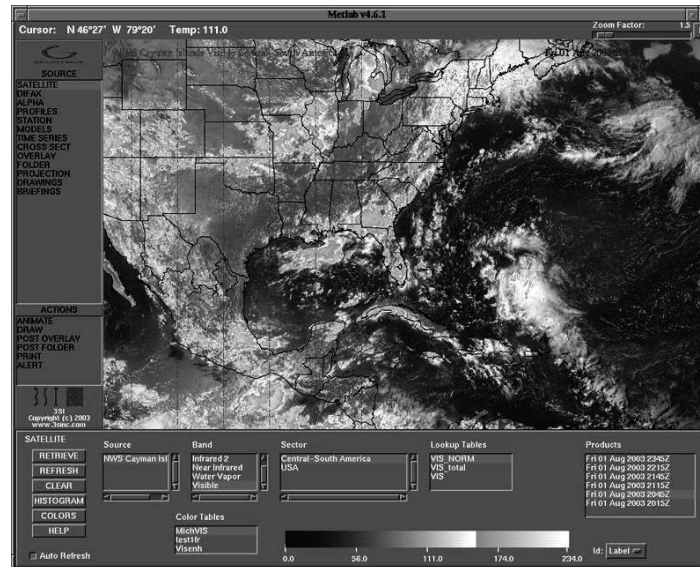


Fig. 5.40 METLAB Classic — Weather Forecasting Software

11. Remote Sensing

The retrieval of data and information regarding an object or phenomena without coming into physical contact with it is known as remote sensing. The devices used for recording such data are known as sensors and depending upon the method of retrieval there can be either recording or real-time sensors. The technique of remote sensing determines if it's active remote sensing or passive remote sensing.

In active remote sensing, artificial radiation is bombarded over a particular region of interest and the reflected rays are detected by the sensors to collect data and relevant information. An example of active remote sensing is the radar technology.

Passive remote sensing only detects natural radiations of an object or the one reflected from its surrounding area. The remote sensors do not emit radiation for measuring values of the object. A remote camera setup to observe wildlife and natural phenomenon is a good example of passive remote sensing (Refer Figure 5.41).

In earlier times, our forefathers used to find high ground or climb treetops to map the surrounding landscapes for information. Later in the year 1858 balloonist G. Tournachon took photographs of Paris from his hot air balloon. Then with the help of IT remote sensors, computer systems and software were developed to precisely monitor and collect geographic or spatially-referenced data. The above-mentioned traditional drawbacks have been successfully overcome with the help of IT.

The various applications of IT in the field of remote sensing are:

- 1. Software:** Embedded software's are used to process data from remote sensors and turn it into relevant information. They also control the functions of a remote sensor by judging the data returned from it. Image enhancement and grouping applications, for example, help in clearing interference from raw images (captured images from camera with minimally-processed data and huge detail) and can be used to transform multiple images into one high resolution continuous image.

2. **Hardware:** IT helps in designing customized hardware components for the purpose of remote sensing. The capabilities of a sensor can be optimized if they are redesigned for each application.
3. **Telecommunication:** Advancements in the communications between the sensor and the base station have helped in increasing the remote distance. Global environmental mapping, for example, would not have been possible without worldwide telecommunication

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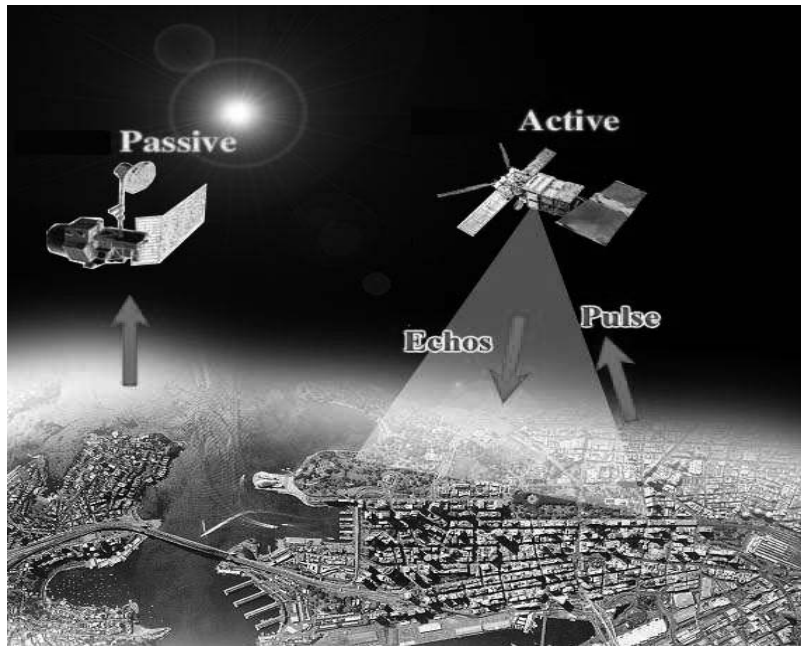


Fig. 5.41 Remote Sensing

12. Planning

Planning in organizations—public and private—concerns both the organizational process of creating and maintaining a plan and the psychological process of thinking about the activities required to create a desired future on some scale. As such, it is a fundamental property of intelligent behaviour. The thought process is essential to the creation and refinement of a plan, or integration of it with other plans, that is, it combines forecasting of developments with the preparation of scenarios of how to react to them.

The term is also used to describe the formal procedures used in such an endeavour, such as the creation of documents, diagrams, or meetings to discuss the important issues to be addressed, the objectives to be met, and the strategy to be followed.

Planning is a crucial aspect of an individual, organization and economy. It is done to attain growth, development and competitive advantage in a firm. Information technology tools have been a growing contributor to planning over the years.

It is a commonly acknowledged fact that with the right knowledge at the right time a firm can become the market leader of its products and services and continue to make profits for further growth. Therefore planning helps an organization in facing and beating competition. Second, the daily operations of an organization

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are becoming increasingly dependent on telecommunication and distributed networking processes.

Information and Communications Technology (ICT) tools greatly assist the planning process since they allow large amount of historical data to be processed and analysed which form the major requirement for the future planning process. Also by using sophisticated scenario analysis tools, Decision Support Systems allow the managers to know the repercussions of making long term or policy decisions such as entering a new market, or introducing a new product, or increasing the prices of goods and services being offered. These packages, by using a combination of complex algorithms, mathematical calculations, statistical analysis, etc. allow the managers to predict the outcome of such policy changes and therefore enable them to plan better.

So whether it a case of a small grocery store deciding what to order (from its suppliers) for the coming week's sales, or a large multinational working in many countries trying to do inventory forecasting for its thousands of stores, IT tools can be used to automate the basic number crunching (data collation and compilation) and make better decisions regarding the future.

13. E-Commerce

E-commerce is the exchange of goods and services involving financial transaction over an electronic medium by utilizing information and communication technologies, such as Electronic Data Interchange (EDI), Electronic Funds Transfer (EFT), Online shopping portal, etc.

An e-commerce system replaces almost all the paperwork in an organization with inexpensive and more efficient electronic exchange of data which is reliable and secure. The general way of doing business in e-commerce and traditional commerce is the same—a buyer and seller indulge in swapping products and/or services for money. Instead of shops and stores, mail order catalogue or telephone, e-commerce is conducted over a network, such as the internet. Information technology tools, such as networking, software development, data mining, data warehousing and enterprise resource planning (ERP) have provided sellers a way to conduct business without the need of building physical infrastructure, printing advertisement pamphlets or recruiting a large number of staff. Additionally, automation of billing and tracking systems has further cut labour costs and time. For distribution of digital content the distribution channels and delivery time have been minimized as they can be readily downloaded after payment through online payment gateways. Due to the World Wide Web sellers aren't restricted to local markets. They can target customers across the world and provide the same quality of service irrespective of distance and country.

E-commerce by a combination of facilitates, such as online payment gateways, customer analysis and report generation, advertisement channels and security-coded access to goods and services, provides a sales and distribution channel which is extremely customer-friendly.

The internet revolution and availability of cheap computers and Internet bandwidth have been the main reason for proliferation of e-commerce as a viable alternative to the 'brick-and-mortar' businesses.

'Brick and Mortar' is a term used since the development of e-commerce to refer to a traditional model of a business that is based at a commercial address made up of brick and mortar. Before the advent of the Internet and e-commerce, a commercial address or shop front was required for any business that wanted to sell goods directly to the public.

A brick and mortar business can offer some things that an e-commerce business cannot. They are:

- **Customer security:** Many people feel more comfortable buying goods or services from a business with a real world presence rather than a virtual business where the customer cannot visit in person should they wish.
- **Increased customer relations:** A business operating at a commercial address with sales staff can offer a more personal experience to the customer, increasing satisfaction and the possibility of repeat business.
- Many businesses simply require a physical location in order to provide services. Such businesses could include healthcare services or a motor vehicle repair shop.

A brick and mortar business also has disadvantages compared to businesses that operate only online.

- **Increased cost:** The costs of setting up and running a brick and mortar business far outweigh those in e-commerce. The basic reason behind this is the cost of operating in a commercial property. Property cost, maintenance charges, tax, insurance and employees are all costs that e-commerce can avoid but a brick and mortar business cannot.
- **Smaller customer base:** A brick and mortar business with no online presence has a customer base limited by geography and local population. An online store has no such limitations.

Therefore many brick and mortar businesses now recognize the potential for business expansion through E-commerce and so simultaneously run online and shop front operations. So it is no longer a case of one against another, both business can harmoniously co-exist and complement each other. So for every example of 'Pure' online stores (like E-Bay.com and Amazon.com; see Figures 5.42 and 5.43) which sell ONLY on the Web, there are many examples of standard businesses using the online business to complement its brick and mortar operation (like HP and Sony).

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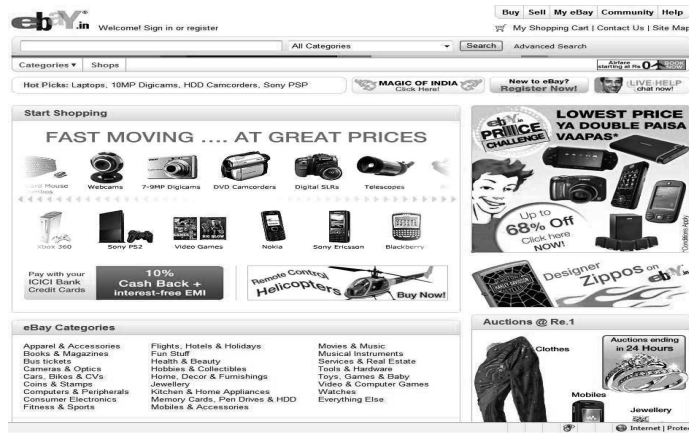


Fig. 5.42 E-Bay.com

Now buyers can visit and compare the prices of different goods and services from multiple vendors across the world and then select and buy goods and services, without having to step outside the comfort of their home or office. E-commerce has given a whole new meaning to the word ‘window-shopping’ by offering goods and services from all over the world right on your window screen.

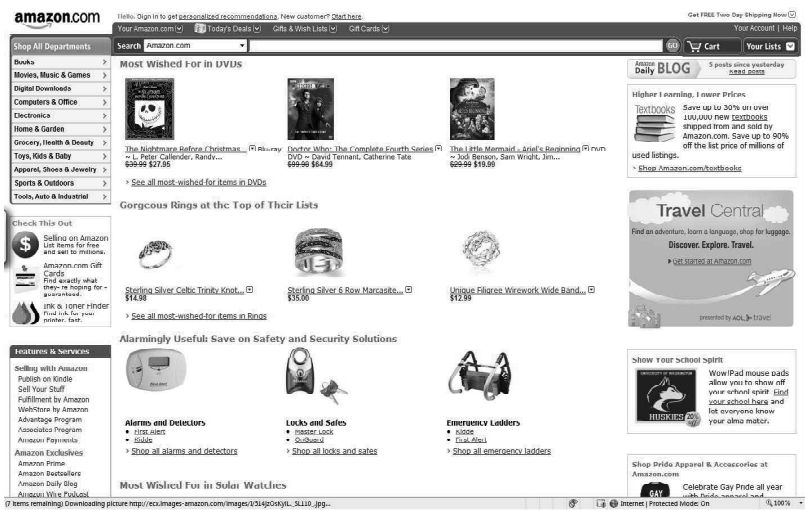


Fig. 5.43 Amazon.com

14. Web Publishing

Traditionally, when we talk about the term publishing then printers, paper, distribution, expensive infrastructure and static content comes to the mind. The drawbacks of these are that they require a huge amount of investment, the productivity is low as several manual and machinery work is involved, the content published cannot be changed easily and the scope of marketing the product is very limited. All these drawbacks have been overcome by the development of web publishing.

Web publishing is the umbrella term for putting content on the World Wide Web and includes all support arrangements required for it. It includes custom web designs for web development, website hosting and e-commerce. Originally, web

publishing simply meant putting selected content on paper into HTML over a website for public access, this is also known as ipaper. This method of publishing is not widely used anymore as professional web publishers now use modern software, such as content management systems for rearranging the structure of a website and making its content dynamically modifiable.

The most important tool of information technology used in the process of web publishing is the World Wide Web. This makes content available twenty-four hours a day, seven days a week, to anybody in the world who is connected to the Internet. The only requirement for publishing and viewing the content online is a computer or a handheld device which has an Internet connection and a web browser. The scope of web publishing in terms of penetration is very high with an estimated 1.5 billion Internet users worldwide, as of 2007. The relative low cost of buying a domain name and hosting a website is another major driver behind the large amount of online data available over websites.

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15. Management Information Systems

Management Information Systems (MIS) consist of people, technology and procedures to collect, process, store and disseminate data and information required by a business organization for planning, controlling, monitoring, decision making and other functions of management (Refer Figure 5.44).

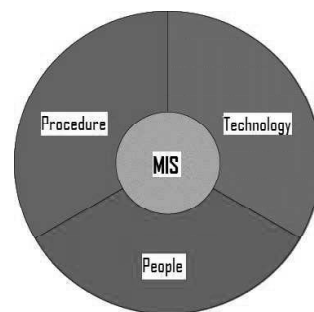


Fig. 5.44 MIS

Some of the most commonly used applications of management information systems are: accounting, financial management, production planning and control, sales and marketing, human resource management, project management, etc.

The two most important components of an MIS system are database management system and software which allows users to work on these databases for performing the various business functions like sales, accounting, etc. The first component is typically covered by a Relational Database Management Systems also called a RDBMS and second by Enterprise Resource Planning also called ERP.

Although MIS systems need not always be based on standard ERP software, since businesses can use custom-built MIS software to serve one or more specific areas of a business, such as inventory control or human resource management. However, the use of standard Commercial Off-the-Shelf (COTS) packages, such as ERP packages are increasing and gaining market share.

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Before the advent of computers and computerized MIS, it was very difficult and cumbersome to manage vast databases of customers, suppliers, shareholder etc. Since these databases could not be maintained and managed properly, the data therein could not be analysed easily. This meant that the managers had to make decisions on either partial data or rely more on 'hunch' or 'gut feel' rather than on facts and figures.

Nowadays large Relational Database Management Systems like Oracle and Ingress along with Enterprise Resource Planning packages (which are sophisticated MIS packages covering the entire gamut of functions of an organization) like Oracle, SAP and Baan, my-SQL help organizations to manage vast databases more efficiently, accurately, quickly and easily compared to past methods of manual data base management. The use of these sophisticated databases and packages has meant that managers can now be better informed and base their decisions on factual analysis rather than guesstimates. While nobody can still deny the role of 'gut-feel' and intuitive decision making, these when complemented by hard facts and figures provide the basis for making better decisions.

The use of the Internet and web-based management information systems have made MIS much more simpler and faster making it possible to get data and information instantly on the click of a mouse from anywhere across the globe.

16. Decision Support Systems

Decision support systems (DSS) is a computerized information system that supports organizational and business decision-making tasks (Refer Figure 5.45). It is basically an interactive computer software developed to enable decision makers to compile information from basic data, documents, knowledge and business models to enhance the ability to make decisions. A DSS may present information graphically and may support or may be complemented by an artificial intelligence (AI) or an expert system.

A decision support application mainly collects and presents the following information

- Inventory of all your present information assets like data warehouses, data marts etc.
- Comparison of your periodic data, e.g. inventory for this month with last months
- Projected data based on assumptions, e.g. projected sales figures based on sales assumptions
- Consequences of different decision alternatives based on past experience in a context that is described

The decision support systems can be classified into the following five types:

- Communication-driven DSS
- Data-driven DSS
- Document-driven DSS
- Knowledge-driven DSS
- Model-driven DSS

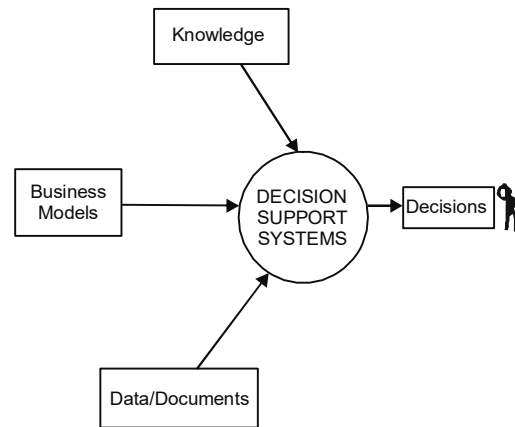


Fig. 5.45 Decision Support Systems

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DSSs have many applications and can be developed for any knowledge domain. They can be used in any field where organization is necessary. Clinical decision support systems for medical diagnosis, bank loan officer verifying the credit of a loan applicant, deciding which area or field to market your product, decision making on the stock market are a few examples where DSS can be applied.

DSSs are extensively used in business and management. For faster decision making, identification of negative business trends and better allocation of business resources, business performance software's like Executive dashboard, MS Data Analyser, MS Excel solver are available.

A DSS has the following advantages:

1. Increases productivity and is time saving
2. Expedites problem solving and enhances effectiveness
3. Improves interpersonal communication
4. Promotes learning or training
5. Increases organizational control
6. Generates new evidence in support of a decision
7. Creates a competitive advantage
8. Encourages exploration and discovery on the part of the decision maker
9. Reveals new approaches to thinking about the problem space

17. Inventory Control

For any manufacturing firm, managing inventory is crucial. High inventory results in money being locked up unnecessarily, thereby reducing liquidity and indirectly profitability (if you offer immediate payment, most suppliers would be willing to offer you better rates). On the other hand, lower inventory of finished goods may lead to lost sales, or lower inventory of raw material may lead to disruption in production line. Optimum stock levels optimize operational efficiency.

Most large manufacturing units typically need hundreds (if not thousands) of raw material components and produce many products. Managing optimal inventory of such a large number of items is a difficult task. It is here that information technology again plays a very useful role. Inventory management software provides facility for specifying (and determining) the maximum, minimum and reorder levels

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for each item, so that appropriate levels of inventory can be maintained keeping in mind lead times and Just-in-time JIT systems (if any) for component suppliers.

Basically this is how a typical computerized inventory system works—a list of all the inventory items is prepared along with the maximum, minimum, reorder and current levels (quantity in hand as on a fixed date) for each item. This list is fed into the inventory software. Thereafter, all incomings (materials purchased or produced) and outgoings (sales or issues to production floor) are recorded through the inventory package. Since the computer knows all the ins and outs for each item, it can track the exact quantity in hand for each. The package also generates reports for all the fresh stocks that need to be procured (based upon the levels specified). A variety of other useful MIS reports like aging analysis, goods movement analysis, slow and fast-moving stock report, valuation report, etc. can also be generated which assists the storekeeper and the accountants.

Some of the more sophisticated inventory packages (or inventory modules of ERP packages like Oracle financials, Baan, SAP etc.) automatically generate purchase orders (as soon as minimum level of any item is reached), provide automatic posting of accounting entries (as soon as any purchase or sale is carried out) and generate analytical reports which show the previous and future trends in inventory consumption.

Some interesting innovations in usage of IT for better inventory management are:

- **Use of barcoding system:** Bar coding is a technique which allows data to be encoded in the form of a series of parallel and adjacent bars and spaces which represent a string of characters (Refer Figure 5.46). A bar code printer encodes any data into these spaces and bars and then a bar code reader is used to decode the bar codes by scanning a light source across the bar code and measuring the intensity of light reflected back by the white spaces. Bar coding provides an excellent and fast method for identifying items, their batch numbers, expiry dates, etc. without having to manually type or read the data.



Fig. 5.46 Barcode

- **Use of Hand Held Terminals (HHTs):** HHTs are simple devices used to communicate with any type of microprocessor-based device. The standard input device is the keyboard (typically more akin to the calculator, rather than the computer keyboard) and a small LCD display for the output. HHTs are compact, simple and rugged devices designed for outdoor applications like collecting information about inventory from large warehouses, recording movement of goods in and out etc.
- **Internet and Intranets:** Many organizations (specially those following 'Just-in-Time' techniques) now have a system whereby the moment

they receive an order or a request for an item (which is not in stock or whose stock is low), the inventory package automatically generates a purchase or supply order electronically and mails it to the preferred supplier – all this without any human intervention!

18. Medical Science

The medical science is a branch of science that treats injuries and prevents and cures diseases by prescribing medicines or boosting the immune system of patients. Information technology has completely transformed the way modern medical systems work from storing information about a patient's history to developing new ways of diagnosing patients and educating students in medicine. IT has become such an integral part of the modern medical system that nowadays it is inconceivable to think how this industry worked without the aid of ICT.

Developments in medicine due to information technology have offered significant benefits to patients and healthcare systems. Research in Hi-Tech medicine, such as genetic research, DNA modification, hospital infrastructure, rapid ambulance services, etc. have been facilitated by IT. Medical scientists can now use computers to check the effectiveness of a drug against a disease by modeling their genetic structure on computer-based software and using high-speed processors to simulate the process.

The storage and rapid access to electronic medical records and its instant transmission over the Internet in large amounts is called teleconsulting where practitioners share patients' data across the world to diagnose patients cooperatively without experiencing their medical history. Videoconferencing between surgeons allows the sharing of expertise so that complicated procedures can be carried out by sharing knowledge in real time. This allows doctors to develop expertise without the need for supervising surgeons to travel. Operations can be performed in areas in which they would not ordinarily be accessible, potentially saving or improving many lives, with the help of IT.

Medical images are sometimes so complicated that they cannot be effectively analysed without using computers. They can not only improve the image quality but also adapt images to fit in accordance to the doctor's wish (Refer Figure 5.47).

Medical Industry



Fig. 5.47 Medical Imaging

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19. Industrial Control

Industrial Control Systems (ICS) are remote systems which continuously monitor local machine operations in an industrial factory. Based on the data/feedback collected, automated or operator-driven commands are given to remote-control devices to change the current state and work of machinery and other devices. They consist of Supervisory Control and Data Acquisition (SCADA), Distributed Control Systems (DCS) and Programmable Logic Controllers (PLC) among other small control systems.

Using machine-automated controls and monitoring systems, organizations can capitalize on higher efficiency, reliability and flexibility. Information technology links ICS to supervisors and corporate offices and provides user-friendly software for real-time monitoring and controlling of machinery. This has helped in reducing cost of manufacturing and greatly increased product quality by ensuring standardization and quality control.

ICSs are used to lab test a product before final deployment into the production line of factory to check on the safety, quality and reliability of the automation and control. Computer-based simulations help in saving time and provide a prototype testing environment for all the aspects of an ICS (Refer Figure 5.48).



Fig. 5.48 Industrial Control Systems

20. Banks

In the 1960s and 1970s the banking industry—as fiercely competitive as ever—was losing the battle of providing good customer services due to impossibly heavy workloads. All major banks already had branches in most major locations and they simply had to recruit more and more staff to cope with the increasing number of customers. The accepted wisdom was that cost was the main basis for competition and so the banks were making strenuous efforts to reduce operational costs, kicking off the process by computerizing customer accounts. Computerization did lead to cost reductions by saving a lot of back office work, but banks still

needed to employ large number of front office staff to deal with customers. To overcome this problem, one of the UK banks adopted a radical solution. Why not get the customers to do the clerical work? This idea—not unlike that behind the airline reservation systems—led to the development of Automatic Teller Machines (ATMs) which allowed customers to take advantage of specific banking services twenty-four hours a day, seven days a week, without entering the bank. ATMs made it easy to deposit and withdraw money, check balances, request statements, etc. and coupled with the added advantage of round the clock availability, they not only reduced staff workloads but also gave customers a new experience of hassle-free banking.

The banking sector has come a long way since then. It is now one of the largest users of information technology. Some of the areas where banks typically use IT are:

- **Back office computerization:** Nowadays, almost all Indian and international banks run on fully integrated and online systems where all back office operations like accounts posting, reconciliation, clearing house operations, etc. are completely automated.
- **Front office computerization:** All banks provide facilities like instant account statement, making fixed deposits, electronic funds transfer, direct debit facility, etc. to their customers. None of these would be possible without the low transaction costs and efficiency offered by computerized systems.
- **Automatic teller machines (ATMs):** These computerized machines enable customers to do their regular bank transactions (depositing and withdrawing money, ascertaining current account balance, etc.) without visiting a bank branch. ATMs considerably reduce costs for banks (employee cost, space cost, etc.) and provide better level of service to customers (by enabling twenty-four hour banking access at numerous locations).
- **Internet banking:** Most banks like HSBC, Standard Chartered, HDFC, ICICI, etc. have extremely user-friendly websites where the typical banking transactions making request for cash and cheque pickup, cash delivery, generating account statements, requests for cheque books and drafts, etc.) can be carried out online without visiting the bank. This innovative use of IT means that effectively, customers have no need to physically visit the bank for most routine banking transactions, which is an enormous convenience.
- **Credit card operations:** In a typical credit card operation, you purchase an article or a service and give your credit card to the vendor/service provider at the time of clearing the bill. The vendor (called 'merchant' in banking language) swipes your credit card on a Point of Sale (POS) machine that instantly dials into the bank database to verify the authenticity and credit worthiness of the card. If both are satisfactory (in other words the transaction is covered by your credit card limit agreed between you and the bank) the POS prints an authentication receipt that authorizes

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the merchant to collect the transaction amount from the bank instead from the customers. Credit cards obviate the necessity of having to carry huge amounts of cash, and an option of spending more than one's current cash status. On the other hand, banks earn money by charging a transaction fee from the merchant and interest on the credit facility. This entire operation is critically dependent on IT and would not have been possible otherwise.

21. Railways

The railways is an important driver for a country's economic growth. An efficient rail network means transportation of goods and people at low cost and in time and thereby facilitating economic growth. However the size and complexity of problems, which the railways face, are also unique. Let us consider, for instance, the Indian Railways, which is one of the largest rail networks in the world. It runs around 11,000 trains everyday, out of which 7000 are passenger trains. It has over 7500 locomotives, 37,000 coaches and over 2 lakh freight wagons. It operates from over 6800 railway stations and employs over 1.5 million people. The sheer scale of their operations poses numerous management and operational problems. Fortunately the key decision makers in railways saw the tremendous potential of IT in solving some of these problems and embarked upon a major computerization initiative. Some of these are:

- **Centralized reservations system:** One of the most successful examples of computerization in the country is the all-India computerised reservation system which means that anybody, even in a small town, can book tickets for any destination.
- **Internet booking: IRCTC** has launched online ticketing facility which can be accessed through the website irctc.co.in. Currently these facilities are available at 758 locations in the country. Computerized reservation-related enquiries about passenger status, train schedule, trains between pairs of stations, etc., are also provided on this site. Anybody with a credit card can book a ticket on any train through this website. The site levies a small service fee and delivers the ticket to the passenger's home through courier within twenty-four hours. Timetables, network maps, freight information, fares and tariff are also available on the Indian Railways home page.
- **Computerized unreserved ticketing:** Nearly 12 million unreserved passengers travel everyday by Indian Railways. To cater to this huge segment, computerized ticketing systems has been recently launched. Unreserved tickets can now be issued even from locations other than the boarding station, reducing long queues at booking offices and stations.
- **Pilot projects:** A pilot project for issuing monthly and quarterly season tickets through Automated Teller Machines (ATMs) has been successfully launched in Mumbai recently. Another pilot project for purchasing tickets (including monthly and quarterly season tickets) through Smart Cards has also been launched.

- **National train enquiry system:** It has been introduced in order to provide upgraded passenger information and enquiries. This system provides train running position in real time—through various output devices, such as terminals in the station enquiries and Interactive Voice Response System (IVRS)—at important railway stations. This project has been implemented at ninety-eight stations so far.
- **Railnet:** Railways have established their own Intranet called ‘Railnet’. It provides networking between the Railway Board, zonal headquarters, divisional headquarters, production units, training centres, etc. to facilitate inter and intra-departmental communication and coordination.

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Check Your Progress

6. What is MAN?
7. What is the main function of a modem?
8. How does IT assist in the use of mobile phones?
9. How can IT help in forecasting the weather?

5.6 ANSWERS TO ‘CHECK YOUR PROGRESS’

1. The Internet is a ‘Network of Networks’ that links computer systems around the world.
3. Network architecture defines the communications products and services, which ensure that various components work together. In the early days of data communication systems, the majority of communications were between the DTE and the host computer.
3. TCP/IP stands for Transmission Control Protocol/Internet Protocol. It was developed with the objective to specify a suite of protocols capable of providing transparent communications interoperability services between computers of all sizes, regardless of the hardware or operating system platforms supporting them.
4. Networks that are privately owned offer consistent fast paced communication channels which are optimized to connect information processing tools in a restricted geographical area. These are known as Local Area Networks (LANs).
5. Advantages: Greater bandwidth, data, voice and video can be accommodated, greater distances.
Disadvantages: High cost, lack of well-developed standards, cable design, alignment and maintenance.
6. A Metropolitan Area Network (MAN) covers large geographic areas such as towns, cities or districts. By linking or interconnecting smaller networks within a large geographic area, information is conveniently distributed throughout the network.

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7. A modem, which is the shortened version of modulator–demodulator, provides a two-way communication facility between a computer network and telephone network. It converts analogue signals to digital signals and vice versa.
8. Some of the popular functions that are based on IT are: SMS, Address book, To-do lists, send or receive e-mails.
9. Large amounts of data are collected by weather balloons, satellites and sensors and fed into computers with huge processing power and data storage for quantitative analysis and weather modelling. This task can only be performed by supercomputers which can crunch a large amount of data very quickly.

5.7 SUMMARY

- The Internet is a ‘Network of Networks’ that links computer systems around the world.
- The Internet application that is currently drawing maximum attention is the World Wide Web. It has dramatically influenced the online world and continues to grow in popularity.
- The Internet provides a perfect medium for knowledge sharing and information dissemination. Courses are available on the Internet.
- Through a direct connection, a computer is directly connected to the Internet backbone and acts as a gateway.
- Net surfing, Internet browsing or exploring a network on the World Wide Web is associated with visiting different Web sites on the internet.
- Searching is one of the most common uses of the Internet. You can search for any topic or information on the Internet. This is possible by using websites that provide a search engine.
- A search engine is a software system that enables users to search for information on the Web using keywords. It is designed to help the Internet users locate the Internet resources, such as Web pages, documents, programs and images using a keyword search mechanism.
- Network architecture defines the communications products and services, which ensure that various components work together. In the early days of data communication systems, the majority of communications were between the DTE and the host computer.
- TCP/IP defines a suite of communications and applications protocols in layer structure, with each layer handling distinct communication services.
- TCP switching is a network architecture which creates a circuit for TCP connection. It directly controls the creation/destruction of the circuits.
- The prominent TCP features provide two popular options TCP SACK and TCP Windows scaling.

- The primary advantage of TCP Window scaling is to control congested data.
- Route Discovery Protocol (RDP) is a standard protocol which is used to inform the router on which they send packets. It also used wiretapping routing protocols such as RIP which is configured as default routes in hosts.
- Networks that are privately owned offer consistent fast paced communication channels which are optimized to connect information processing tools in a restricted geographical area. These are known as Local Area Networks (LANs).
- Shielded twisted pair, on the other hand, has several disadvantages. First, the raw cost of acquisition is greater as the medium is more expensive to produce.
- The core factor that limits a twisted pair cable is due to the skin effect. The flow of the current in the wires is likely to flow only on the wire's outer surface as the frequency of the transmitted signal raises, thus, less of the available cross-section is used.
- A Metropolitan Area Network (MAN) covers large geographic areas such as towns, cities or districts. By linking or interconnecting smaller networks within a large geographic area, information is conveniently distributed throughout the network.
- Wide Area Networks (WANs) connect larger geographic areas, such as New Delhi, India, or the world.
- The geographical limit of WAN is unlimited. Dedicated transoceanic cabling or satellite uplinks may be used to connect this type of network. Hence, a WAN may be defined as a data communications network covering a relatively broad geographical area to connect LANs together between different cities with the help of transmission facilities provided by common carriers, such as telephone companies.
- A modem, which is the shortened version of modulator–demodulator, provides a two-way communication facility between a computer network and telephone network. It converts analogue signals to digital signals and vice versa.
- Phase Modulation (PM) is similar to frequency modulation. In FM, the frequency of the carrier wave changes, whereas in PM the phase of the carrier wave changes.
- Some of the popular functions that are based on IT are: SMS, Address book, To-do lists, send or receive e-mails.
- Digital compositing, time slicing and computer-generated imaging.
- Large amounts of data are collected by weather balloons, satellites and sensors and fed into computers with huge processing power and data storage for quantitative analysis and weather modelling. This task can only be performed by supercomputers which can crunch a large amount of data very quickly.

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5.8 KEY TERMS

- **Internet:** It is a 'Network of Networks' that links computer systems around the world.
- **DNS (Domain Name System):** It is a hierarchical system which organizes host names in hierarchy of domain names.
- **Baseband:** A type of coaxial cable that transmits a single signal at a time at high speeds.
- **Optical Fibre:** A type of transmission media in which information is carried through a beam of light.
- **Hub:** It is a centralized distribution point for all data transmission in a network.
- **Remote Sensing:** It is the process of retrieval of data and information regarding a phenomenon or object without coming into physical contact with it.
- **E-Commerce:** The exchange of goods and services involving financial transactions over an electronic medium by using communication and information technologies.

5.9 SELF-ASSESSMENT QUESTIONS AND EXERCISES

Short-Answer Questions

1. What is a direct connection?
2. What do you understand by FTP?
3. Write the applications of internet.
4. What are the advantages of networks?
5. Differentiate between broadband versus baseband.
6. How LAN, MAN and WAN are different from each other?
7. What is amplitude modulation?
8. What are the various application areas of IT?
9. State the use of IT in financial accounting.

Long-Answer Questions

1. Briefly explain the various purposes served by the internet.
2. Explain the TCP/IP layers and protocols with appropriate diagram.
3. Describe briefly TCP and its features with the help of appropriate examples.
4. Briefly explain the structure of data communication networks with the help of example.
5. What are the different transmission/communication media? Explain.

6. Describe the various components of network.
7. Differentiate between MAN and WAN with the help of diagram.
8. Explain the concepts of modulation giving appropriate example.
9. IT has dramatically changed the way of our life. Explain in detail.

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