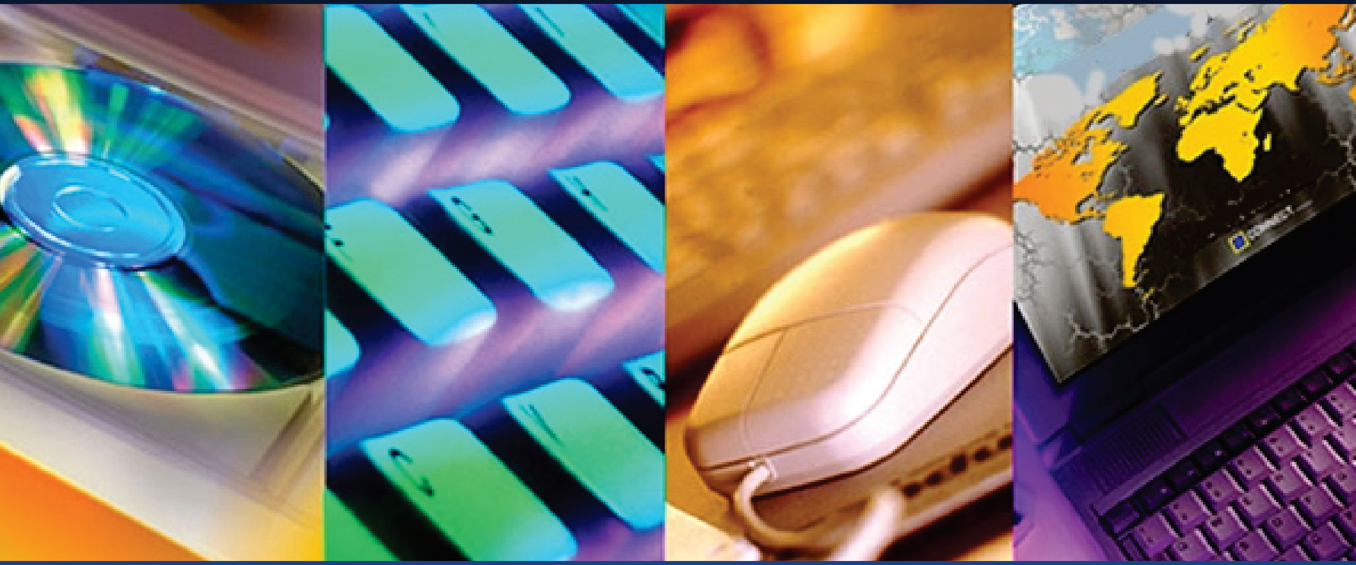
Application of Information and Communication Technologies

Level: B.A./A.D.E./B.Ed./B.S

Course Code: 3003 Unit: 1-9



Department of Computer Science
ALLAMA IQBAL OPEN UNIVERSITY

Application of Information and Communication Technologies

Course Code: 3003 **Unit: 1-9**

Level: Bachelor

Department of Computer Science

ALLAMA IQBAL OPEN UNIVERSITY, ISLAMABAD

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Preface

It is a universally acknowledged fact that Information and Communication Technology (ICT) has brought a revolution in all the fields of life. The world is covering the distance with its double steps to achieve the destination in every school of thought to facilitate the learners. The world becomes a global village. So, it has been realized by keeping up all the thoughts in mind that ICT education has a great application in all the scientific approaches.

Pakistan is a developing country where educational-reforms are under process at different levels. The educational institute such as Allama Iqbal Open University (AIOU) has a major role in its efforts to provide better education in every nook & corner of the country. AIOU is providing education from basic to higher levels. Realizing the importance of technology, AIOU is introducing ICT education at Matric, Intermediate, B.A., and many other levels. This will help our students to perform better in job as IT is now a common skill required.

As a whole, ICT education will provide an opportunity to the students to acquire knowledge of the latest technology in order to complete the challenges of present era. The students/learners may easily be able to identify the importance of ICT in society and determine how ICT can be used as an aid to computer teaching as well as learning.

Kindly write to the authors if any improvements are identified.

Prof. Dr. Nazir Ahmed Sangi
Vice Chancellor

Introduction:

The innovation in science and technology is transforming the world into digital era. As a result the knowledge based societies are evolving and disseminating information everywhere. The digital era is providing us an opportunity to capture and process information. In this phenomenon the role of Information and Communication Technology (ICT) is vital. ICT is playing an important role by serving individuals, businesses and organizations to manipulate information. It is utmost need of the society that the individuals should posses' technological literacy. The need to increase access and bring down the cost of education, the Department of Computer Science initiated introducing basic IT level course at bachelor level.

This book has been developed to provide basic knowledge of ICT for bachelor level students. It can also be used as a reference book on ICT course at other levels. The book provides basic concepts of important topics in ICT. The book is divided into 09 units.

Unit 1 begins with an introduction to ICT. It explains role of ICT and ICT application in society.

Unit 2 introduces overview and organizations of computers. It explains different generations of computers and also highlights classification of computers.

Unit 3 explains different types of input devices. It also explains the basic use and working of important input devices.

Unit 4 describes different types of output devices. It also explains the basic use and working of important output devices.

Unit 5 introduces the concept of software. It explains types of softwares including system software and application software. It also teaches basic steps of installing and uninstalling software.

Unit 6 covers basic concept of an operating system and highlights the services provided by an operating system. It also covers basics of commonly used operating systems.

Unit 7 explains the important concepts of data communications and computer networks.

Unit 8 covers the basic concept of multimedia. It describes different multimedia components and various multimedia applications.

Unit 9 describes different types of programming languages and generations of programming languages. It also explains the concept of compiler, interpreter and linker.

We do hope that the book will go a long way in helping the students to learn the basic knowledge of ICT.

We are thankful to the faculty members; who contributed in writing and reviewing

of the book including Dr. Mohammad Daud Khattak, Mr. Tahir Ayub, Mr. Qasim Khan and Mr. Chaudhary Muhammad Shahbaz Anjum. We are also thankful to the Course Editor for timely completion of the assigned task of editing & Print Production Unit for timely printing of the book.

We are also thankful to Prof. Dr. Nazir Ahmed Sangi, Vice Chancellor, AIOU for his guidance and support, which has been a continuous inspiration for us.

Moiz Uddin Ahmed
Assistant Professor
Department of Computer Science

COURSE CONTENTS

Unit 1

INTRODUCTION TO INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)

Written By: Chaudhary Muhammad Shahbaz Anjum
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

INTRODUCTION TO ICT

1.1. Introduction

This unit covers basic concepts of ICT (Information and Communication Technology). It mainly covers with ICT introduction/definition and its application examples which may help the readers to understand the importance and role of ICT in the society. This unit also describes, how ICT can be used as an aid to computer teaching and learning.

1.2. Objectives:

After reading this unit, the learners may be able to:

- Understand the basic concepts of ICT
- Explore the role of ICT in society
- Identify importance of ICT in society
- Explain and exemplify applications of ICT
- Determine how ICT can be used as an aid to computer teaching as well as learning.

1.3. ICT Introduction

ICT is an abbreviation of a term "Information and Communication Technology". It generally refers to use of new or modern technologies to aid in analysis, storage, processing as well as communication of information. The world is growing rapidly through an explosion of Information Technology.

In order to fully understand the concepts of ICT, first of all it is important to know the meaning of three important terms “Information”, “Communication” and “Technology” individually; which are described below:

1.3.1. Information

Information is generally referred to data which can be recorded, organized and interpreted within a context in order to convey meaning.

For example “NADRA” (National Database & Registration Authority) is an organization which collects data from people. This data is basically organized or compiled with the help of computers for generating computerized National Identity Cards.

1.3.2. Communication

Communication is basically the transfer of ideas and messages among people through different systems, devices or media such as computer, internet, cell phone, telephone, television or radio etc.

A figure named as “Communication Model” (Figure 1) shows the above basic concept in a clear way:

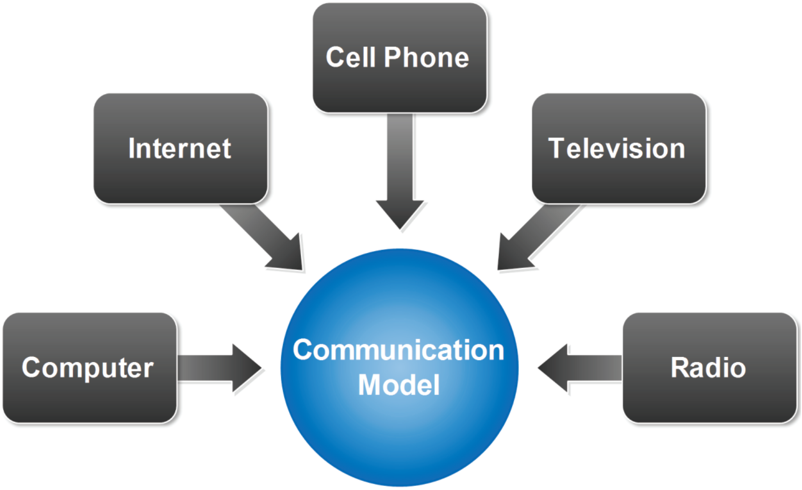

Figure 1: "Communication Model"

1.3.3. Technology

Technology is generally defined as making, modification, adaptation and usage of tools, techniques, systems or machines for the purpose of solving problems or achieving goals in less time period.

After having a brief concept of all these terms individually, ICT can be easily defined as "Any system, product or machine which can receive, store or transmit data/information electronically in digital form". Personal computers, digital television or internet can be considered the best examples of ICT. It basically revolves around those systems or devices which can easily record and interpret information electronically within a context in order to convey meaning. Its basic purpose is to transfer ideas and messages among people for solving their problems in short time period.

After defining the term Information and Communication Technology, it will be good to briefly describe basic concept of ICT.

1.4. Basic Concept of ICT

The ICT is just like an umbrella comprising of different communication devices or applications such as radio, television, satellite systems, internet, cellular phones or computer etc.

Information and communication technologies are rapidly evolving nowadays. New products as well as services are developed and launched constantly in the market. This highly effects the definition, meaning and description of ICT concept as its boundaries are continuously being modified or redefined.

Therefore, it can be said that the ICT sector is basically considered to include:

- The manufacturing as well as assembling of various ICT-equipment.
- A variety of numerous service activities ranging from telecommunication to software-development.

A figure named as "ICT: A combination of different Communication Devices" (Figure 2) shows the above basic concept in a clear way:

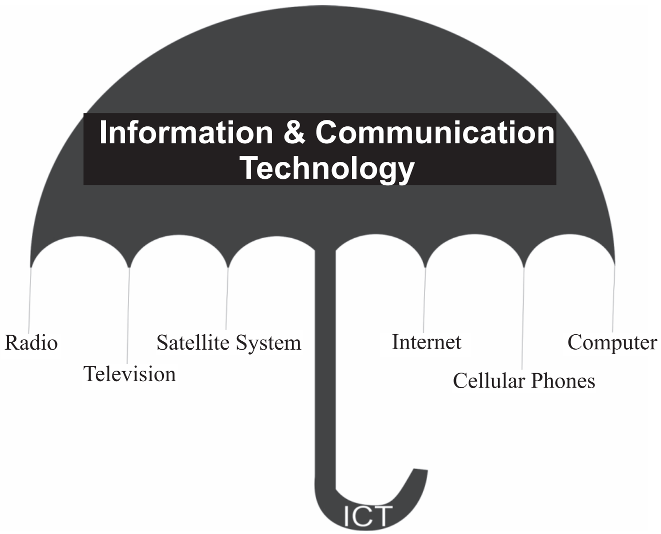

Figure 2: "ICT: A Combination of different Communication Devices"

In past decades, it has been seen that ICT has provided a wide range of new and essential communication capabilities to society. No doubt, latest information and communication technologies have already created a global village by which people can easily communicate and share their ideas with each other.

ICT basically refers to those technologies which provide access to the information by means of telecommunications. It is very similar to IT (Information Technology) but it focuses mainly on different communication technologies. Internet and cell phones are the best examples of communication technologies and also the best communication mediums today.

Basically the internet provides a lot of facilities to the users through various ways such as Email, Social-networking-websites (e.g. Face-book, Twitter or LinkedIn etc.) or numerous search engines like Google/Google Scholar. With this significant information and communication technology, the people can communicate with each other and share their views easily. Overall, it can be said that this technology connects people with each other.

Similarly, the cell phones are widely famous among the people of all ages and have become an important need of everyone. With the help of this interactive information and communication technology, the people can communicate with each other at any time easily through call. Instant messaging (a very safe way of communication) is also another important feature of this technology which makes the life of people easier.

A figure named "ICT & Communication Technologies" (Figure 3) shows this concept easily:

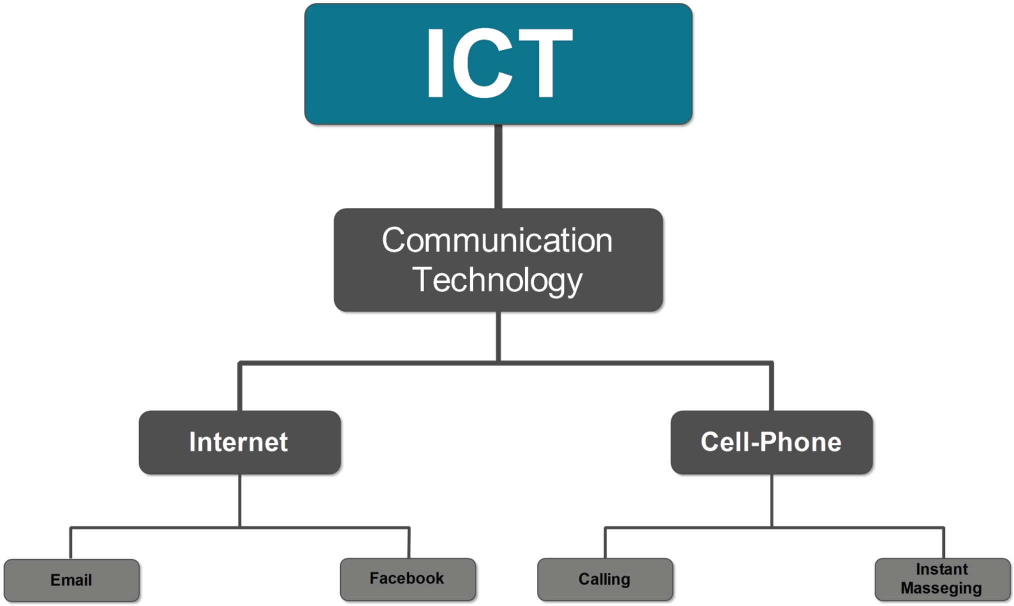

Figure 3: "ICT & Communication Technologies"

The information and communication technologies involve innovations in computing (both hardware and software) as well as telecommunications. The telecommunication is an essential and basic infrastructure which is very necessary for economic as well as social development or rapid growth of a country.

1.5. Role of ICT in Society

No doubt ICT plays an important role in every walk of life or society through use of various devices such as computer, internet, and cell phones. These ICT devices are most convenient and cheaper means of communication across the globe.

One can say that the ICT has turned a significant change in todays' society. The importance and positive influences of information and communication technologies can be easily seen in various fields such as education, business, training, health, environment, employment or government (public administration) etc.

A figure named as "Importance of ICT" (Figure 4) shows its importance in various areas:

Figure 4: "Importance of ICT"

In all these and many more areas, the ICT has brought a significant change, and is therefore growing rapidly.

The role of ICT in society is further explained with the help of various ICT applications.

1.6. ICT Applications

The ICT applications enable people to communicate with each other in real time all over the world. The detail of some of the most important examples of ICT application is described below:

1.6.1. Computer and Internet

Computer is a most significant and major application of ICT which has gained an immense importance in our society. It is one of the basic needs of today's generation. While using computer, it can be easily observed that the people are highly involved in it. They use their minds in order to achieve the target whether the goal belongs to play video games or using any type of software or to solve any educational related problem.

A figure named as "Computer and its Accessories" (Figure 5) shows the various components of a computer:

Figure 5: "Computer and its Accessories"

With the help of computer and internet, people can communicate with each other through various ways. This improves their interaction with the whole world. In this way, they face different experiences which can be beneficial for them.

The computer and internet provide many important benefits to its users such as they can play games, listen music, watch videos, solve many problems related to their education as well as communicate with each other through email facility/social networking websites etc.

Computer in conjunction with internet is a well known social ICT application which enables people to communicate easily through different communication mediums such as face-book (a widely used social networking website) and electronic-mail (generally called email).

The internet has become basic need of everyone in the society. Following are few common advantages:

- ☞ Online sale and purchase
- ☞ Source of entertainment (movies/music)
- ☞ Software's and document's downloading
- ☞ Document's sharing with each other through internet
- ☞ Searching through various search engines like Google or Yahoo etc.
- ☞ People's communication through email, Skype or social networking websites (Face-Book, Linked-In or Twitter) etc.

1.6.2. Cell Phone

Cell phone is another well known ICT device which allows users to communicate with each other. It provides many facilities to the users such as calling, instant messaging, listening music, watching videos, playing games, using internet, maintaining phonebook and many more.

Out of these basic features like calling, messaging, maintaining phonebook, and playing games are available in almost all cell phones. However, additional multimedia like voice, video, and graphics are also included in many cell phones which make this application more attractive, valuable, efficient and interactive. The cell phone has become so popular among the people of all ages, especially the young generation is looking fully dependent on it.

A figure named as "Simple-Phone & Multimedia-Phone" (Figure 6) is shown below:

Figure 6: "Simple-Phone & Multimedia-Phone"

Some of the basic features of cell-phones are explained below in detail :

1) Calling: It is most important feature of this ICT application. With the help of this feature, people can connect with each other.
2) Messaging: Another important feature is instant-messaging. By using this feature, users can send messages to each other.
3) Music/Videos: Listening music and watching videos have become a hobby of young generation. The young generation seems to be very happy in listening different kinds of music and watching different kinds of videos depending on their moods. For them, it is simply a way of entertainment.
4) Games: Many different kinds of computer games are available for the

users in the cell phones. Playing games is one of the most interesting activities of the children or young generation. They play games with great passion. This excitement can be seen easily while their interaction with this ICT application. This is a way of enjoyment and excitement for them.

5) Internet: Using internet on cell phones is also becoming popular. Now modern cell phones have contained this important feature. With the help of this facility, the users can easily send instant emails and get responses too.

1.7. ICT in Teaching and Learning

No doubt, information and communication technologies have put a lot of positive effects in educational areas where teaching and learning are most important aspects. The use of ICT is very necessary for sustainable growth of young generation. With the help of ICT, many problems can be solved easily and one can work more efficiently. ICT inside the educational areas has developed enormously. Now ICT has become an important part of our society, therefore it is necessary that the people should be educated in "how to use it".

Overall, ICT enables teachers as well as learners to:

- Teach well
- Learn well
- Present well

- Work efficiently
- Share ideas easily
- Solve different problems easily
- Gain precise knowledge
- Achieve goals in less time period

Now the use of ICT is also increasing in educational areas. This theme gives young generation many ways of learning as well as generating new ideas. This facility in classroom can prove to be very helpful for teachers to teach and for the learners to learn.

At school or college level, the young generation is in their growing age. So, at that time if they use this facility then their minds can become faster and they can grow with the new technologies. So the computer can be used as a resource to sharp their minds. While solving any problem (either related to education) through computers, they can think deeply. There are a lot of excellent things which are usually done during this interaction. The teachers should also give special importance to engage learners in the design of new applications and technologies.

To achieve this target, it is very necessary to give importance to those ways which are very appropriate for the assessment of the interactive touchy systems for the learners. Deep observational and experimental research is needed, and more conceptual ideas are required for the achievement of this goal.

To enhance the learning abilities of the young generation, the teachers play an important, energetic and active role by using ICT. Initially, the computer related education provides a platform to examine the association among different areas of learning (formal learning and informal learning).

For the learners, education related to the computer should be given at school level. Because interacting with the computer is the easiest way of learning. In this way, their vision can broad and they can think, act and describe their feelings in a better way. It may also prove to be very helpful for their participation in the field of development of new systems and technologies.

So it can be said that the ICT can be used as an aid to computer teaching as well as learning. In a classroom, the interaction of teachers as well as learners with ICT can create that environment of learning, where they face many effective experiences which are useful for the enhancement of their thinking and learning abilities.

1.8. Self-Assessment Questions

Q.No.1. Write down the advantages and disadvantages of "Information and Communication Technology".

Q.No.2. Explain the role of ICT in teaching as well as learning.

Q.No.3. Explore the importance of ICT in different fields like education, business and training. Explain it in detail with the help of examples?

Q.No.4. Write a note on the following:

- Electronic Mail (email)
- Social Networking Websites

Q.No.5. Explain the differences between "ICT" and "Telecommunication".

Q.No.6. Why internet and cell phones are being considered the best examples of ICT? Explain and exemplify it in detail.

Q.No.7. Understand what Information and Communication Technology (ICT) is and give examples of its practical applications in society.

Q.No.8. Internet is a well known example of ICT. How it enables people to communicate easily through different communication mediums?

1.9. Self-Assessment Activities

1. Create an email account and explain how to use and access it?

2. How software(s) and documents can be downloaded through internet?

3. How we can share documents with each other through internet?

4. How people can communicate through social networking websites. Consider an example of face-book and give answer of this question in detail.

5. How the internet will be used in mobile-phone.

Unit 2

OVERVIEW AND ORGANIZATION OF COMPUTER

Written By: Tahir Ayub
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

OVERVIEW AND ORGANIZATION OF COMPUTER

2.1. Introduction:

History and the development of computer help the students to keenly observe the evaluation of the computer. This unit describes different parts of computer and their working and coordination among each other. It includes different components of the computer like Bus, Port, Microprocessor, Main Memory.

2.2. Objectives:

After completing this unit, the students will be able to:

- Describe history and development of computer.
- Distinguish different generations of the computer.
- Classify different types of computers.
- Have knowledge about applications and different parts of the computer.

2.3. History and Development of Computer:

The word 'history' means the activities or the events that have been passed away. The history of computer describes the advancements and growth of computer technology. It is divided into different eras and has its roots starting from pre-history era.

2.4. Pre-History Era 4th Century B.C. to 1930s

2.4.1. Abacus Machine

The abacus is a mechanical device which can perform basic arithmetic problems like addition etc. This was the first machine invented in 4th century B.C.

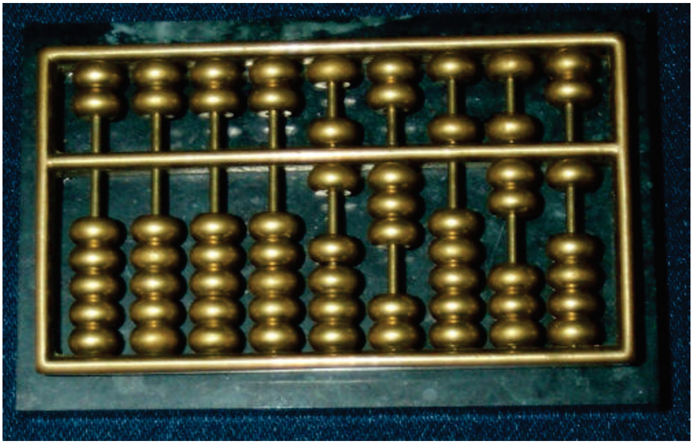

Figure-1: Abacus Machine

2.4.2. Napier's Bones

John Napier a Scottish theologian and mathematician invented logs in 1614 which was able to perform multiplication and division.

Figure-2: John Napier's Bones

2.4.3. Wilhelm Schickard,

Wilhelm Schickard, built a mechanical calculator in 1623 which was able to perform the process of multiplication. This device supported 6-digit capacity.

Figure-3: Wilhelm Schickard Mechanical Calculator

2.4.4. Blaise Pascal

Blaise Pascal, a French mathematician, built a mechanical calculator in 1642 which could add and subtract two numbers directly and multiply and divide by repetition. This device supported 8-digit capacity.

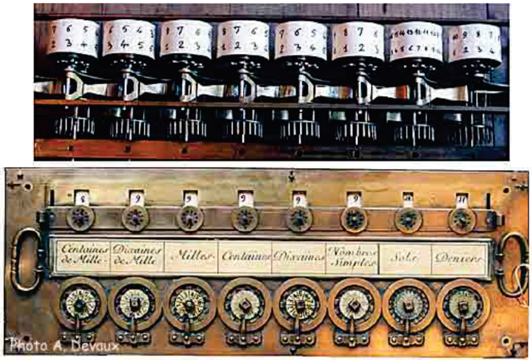

Figure-4: Blaise Pascal Mechanical

2.4.5. Charles Babbage

Charles Babbage, designed a "Difference Engine" in 1820, which could perform mathematical and statistical tables. In 1842, Charles Babbage invented another device with the name of "Analytical Engine", a mechanical computer that was able to perform basic mathematical problem at an average speed of 60 additions per minute.

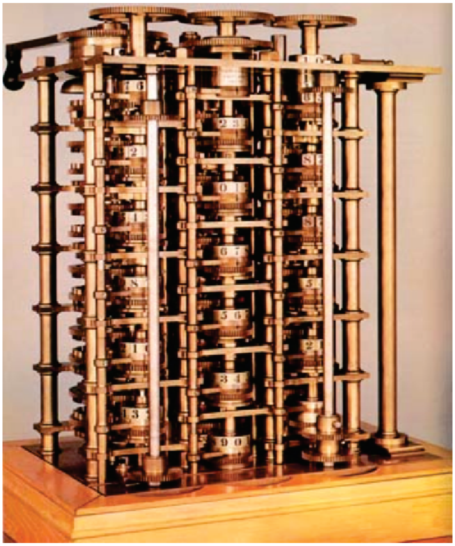

Figure-5: Charles Babbage Difference Engine

2.5. Generations of Computer

With the passage of time, several changes were made in computer technology to meet the challenges of the age. These changes or modifications were classified into different periods and later on these periods were also named as "Generations" of the Computer.

2.5.1. First Generation of Computer (1951 – 1958)

- The first generation computers used vacuum tubes technology. Vacuum tubes were like fragile glass tubes, which consumed more electricity due to more glowing time. First generation computers also used punched card and magnetic tape as an input device. Magnetic tapes were able to access large data but they process it sequentially.
- The sequential processing called Batch processing technique where data was processed in the form of bundles or batches.
- First generation computer relied on machine language, which consisted of binary instructions of 0 or 1 codes. Later the Assembly language was introduced which used special names instead of codes called mnemonics.

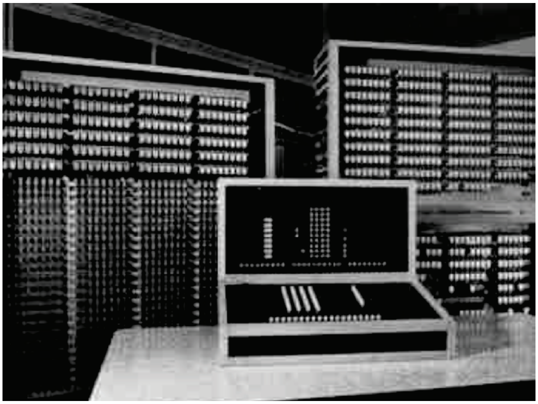

Figure-6: First Generation Computer.

2.5.1.1. Limitations

- Vacuum tubes generated much heat and covered a lot of space.
- Punched cards technology consumed large number of cards even for

small programs.

- Magnetic tapes were unable to retrieve large amount of data quickly, being a sequential medium.

2.5.2. Second Generation of Computer, 1959 – 1964

- In 2nd generation of computers, Transistors replaced vacuum tubes. Transistor is an electronic component, which is used for amplification and switching of electric signals.
- Punched cards were used as an input device to feed the computer programs (instructions).
- Magnetic tapes were also used as an input/output storage.
- Some high level languages like FORTRAN, COBOL and BASIC were also used. Due to close resemblances with English language, these languages are called high level languages.

Figure-7: Second Generation Computer.

2.5.2.1. Advantages

- Transistors were much more reliable and have greater computational speed.
- Transistors required no warm-up time and consumed less electricity.

2.5.3. Third Generation (1965 – 1970):

- In 3rd generation of computers, Integrated Circuit(IC) replaced transistors. Integrated circuit was consisted of thousands of transistors fabricated in a single silicon chip.
- ICs were smaller in size and had better performance than transistors.
- Keyboard and monitors were used as input and output devices.
- PASCAL was used as a high level language.

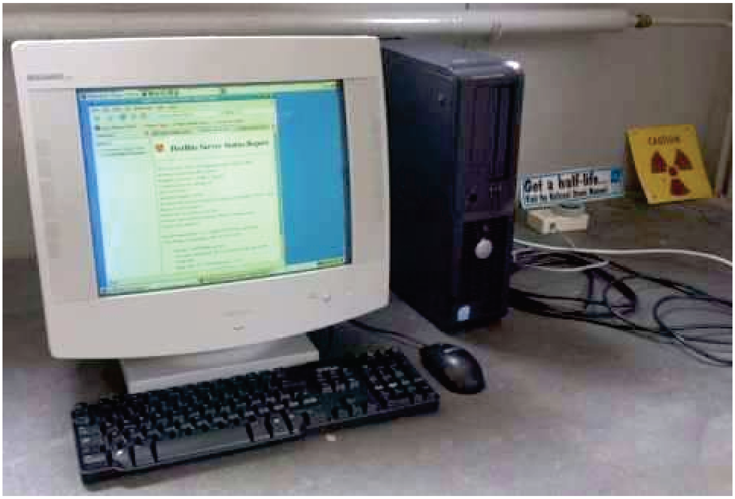

Figure-8: Third Generation Computer.

2.5.3.1. Advantages:

- Integrated circuits were more reliable.
- Silicon chips were cheap because of their small size and they also consumed less electricity.

2.5.4. Fourth Generation (1980)

- Fourth generation of computer was based on two technologies, Large Scale Integration (LSI) and Very Large Scale integration (VLSI). In LSI technology, about 30,000 electronic components were fabricated in a single chip, while in VLSI technology about one million electronic components were fabricated in a single chip.
- Keyboard and monitors were used as primary input /output devices
- Magnetic tape was also used as an input/output storage devices.

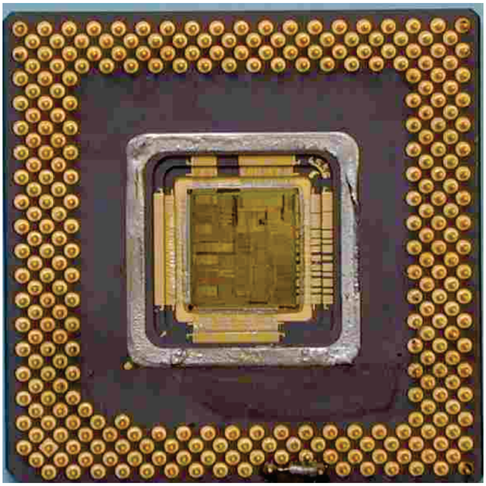

Figure-9: 4th Generation Technology.

2.5.5. Fifth Generation (late 1990's)

- In Fifth generation computers Voice recognition was used as an additional special feature. Voice recognition is also called speech recognition. It is the ability of a device to receive and interpret dictation.
- Optical fiber technology was introduced for communication. Optical fiber is normally made of glass, through which light can be transmitted.
- Artificial Intelligence technology was also introduced. Artificial Intelligence acts like a human being, for example Robot Artificial Intelligence made the computers to have thinking power and reasoning.

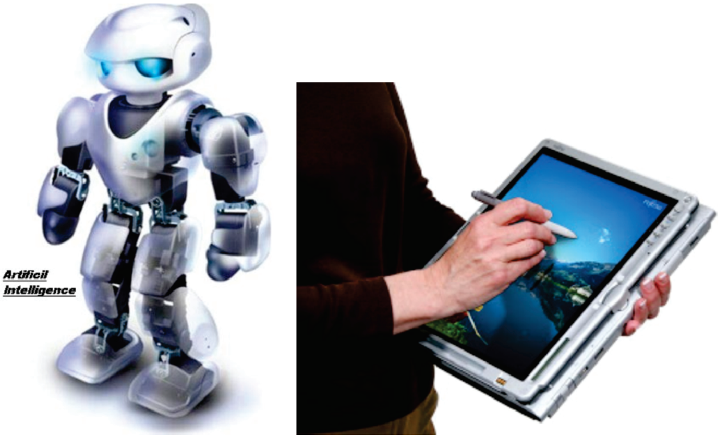

Figure-10: 5th generation computer.

2.6. Classification of Computer

Classification of computer fall into two broad categories

- Size (Physical Appearance)
- Purpose.(Objectives)

2.6.1. Size

Size deals with the physical appearance. According to size computers are further classified into following sub classes.

2.6.1.1. Microcomputer

A Microcomputer is derived from the word micro which means smaller in size. It is also called a personal computer, because it is mostly used in the homes for general purpose tasks like to make drawings, budget, listening music etc. Micro computer uses microprocessor as its central processing unit.

Figure-11: A Microcomputer.

2.6.1.2. Laptop Computer

Laptop computers are also called notebook computers. This type of computer is portable and compact in size. Laptops are popular because they are easy to carry anywhere for example in traveling etc. It can also be used with the help of its internal battery.

All components like keyboard, mouse, etc of the laptop are placed in one unit. Laptops are usually expensive as compare to Microcomputers.

Figure-12: A Laptop Computer.

2.6.1.3. Minicomputer

A minicomputer usually falls between a microcomputer and a mainframe. A minicomputer supports hundreds of users simultaneously.

Examples: Pec Master, Toshiba DS1 and AS400

Figure-13: A Minicomputer.

2.6.1.4. Mainframe

Mainframes were in cupboard size computers than PC/mini computers /laptop computers. These were expensive and their processing speed was extremely high. Mainframe computers were used to store, manage, and process large amounts of data that need to be reliable, secure, and centralized. The main feature of mainframe computer was capable of supporting thousands, of users simultaneously. A mainframe computer had the capability to execute many programs run at the same time.

Examples: IBM – 360, NEC Mainframe

Figure-14: A Mainframe Computer.

2.6.1.5. Handheld Computer

Handheld computers are very much smaller in size, which can be easily carried out in hands. These computers use small keyboards and screens. Mostly handheld computers are mainly designed to facilitate personal information manager functions, such as a calendar and address book. Handheld computers are also called PDAs, palmtops and pocket computers. Examples: CS40 ,CK70,CK71 etc.

Figure-15: A Handheld Computer.

2.6.1.6. Palmtop

These are the computer which can be easily carried out in hands or palm and that is why these are called palmtop computers. Palmtops are specifically designed for special functions like phonebooks and calendars. Palmtops use a special device called a pen as an input device.

Examples: Nokia 9500, Nokia E90 etc

Figure-16: A Palmtop Computer.

2.6.1.7. PDA (Personal Digital Assistant)

PDA stands for Personal Digital Assistant. PDA is a type of palmtop computer or handheld device which contains features of the computing, telephone/fax, and networking. A PDA can also perform function of a cellular phone, fax sender, and personal organizer. PDAs also use pen based device as an Input rather than keyboard.

Examples: Nokia 770, Nokia N800 etc.

Figure-17: A Personal Digital Assistant.

2.7. Purpose

According to purpose computers are divided into following sub classes.

2.7.1 Digital Computer

2.7.2 Analog Computer

2.7.3 Hybrid Computer

2.7.1. Digital Computer:

Digital computer processes information in the form of characters and digits. It displays output in the form of characters, digits, charts & graphics. Digital computers are also called personal or general purpose as daily life problems such as making home budget, playing games, listening music etc can be solved.

Figure-18: A Digital Computer.

2.7.2. Analog Computer

Analog computers are specifically used for special purpose applications such as wheel balancing, measuring temperature, velocity etc. These type of computers deal with continuous type of data rather than digits.

These computers display their output in the form of electrical waves rather than digits. Therefore these computers are mostly used in the scientific laboratories.

2.7.3. Hybrid Computer

Hybrid computers have the capability to process both the digital data as well as analog data. The hybrid computers are especially helpful in the science laboratory where both analog and digital data is required for processing.

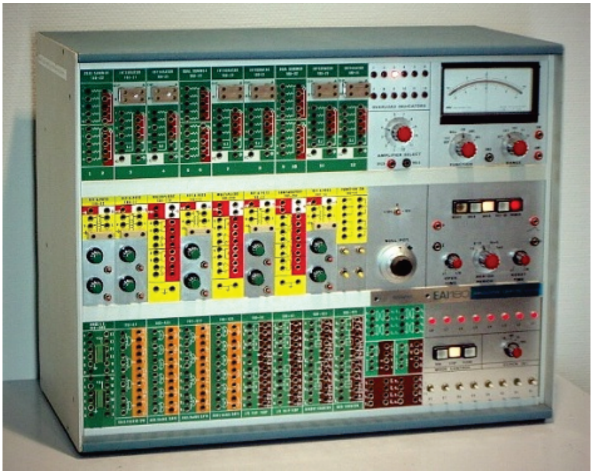

Figure-19: A Hybrid Computer.

2.8. Applications of Computer:

Due to the remarkable progress of the computer technology, it is useful almost in every aspect of life. Some of the important fields are as under:

2.8.1 Education
2.8.2 Business
2.8.3 Banking
2.8.4 Defense
2.8.5 Entertainment

2.8.1. Education

Computer technology is playing a very vital role in education sector; College students get their study notes, tutorials and even text books and solution manuals with the help of internet technology. It also enhances the student's learning and help to improve the quality of education. One of the great revolutions in education is the e-learning.

Figure-20: Computer in Education.

2.8.2. Business

Computer technology is playing a very important role in productivity and competitiveness of Businesses. Sales and Marketing departments are very important in any business sector and internet has become a very vital tool for the sale and marketing. A customer can now easily buy and purchase products and the payments can be made just by using smart cards, internet banking, and electronic deposit or even can pay his bills online.

Figure-21: Computer in Business

2.8.3. Banking

Banking sector is also getting great benefit from using computer technology. Internet banking is an example of modern banking where a customer can easily check balance while sitting at his home, and can transfer funds without any queuing or physical fatigue. In fact computer technology has enormously saved the user time.

ATM (any time money) is another example of modern banking sector. A user can now draw money through ATMs anywhere and anytime that is round the clock.

Figure-22: Computer in Banking Sector

2.8.4. Defence:

The computer technology has productive application in defense. Computer technology is used in Intercontinental Ballistic Missiles, Rocket etc that uses GPS(Global Position System) to help the missile to hit the specified target.

Computer technology is used to track incoming missiles and also help the weapons systems to locate incoming target.

Computer technology is also used in tanks and aeroplanes and ships to target the specified targets of the opponent.

More important the computer technology has the capability to design and test new systems.

Figure-23: Computer in Defense

2.8.5. Entertainment:

Computer technology has also provided enormously high opportunities for entertainment and pleasure. In restaurants, the computer technology has now changed the trend to order the food items. Instead; a person sitting on the computer directly enters your required food items and their respective cost and finally gives you a computerized receipt. For example "Savour Foods" restaurant, where a man sitting on his computer gets your order and enter into the computer and then hand over a printed receipt to the customer. The customer then shows his receipt and collects his items.

In movies, computer technology has brought a great revolution in movies or cinema sector by introducing 3-D technology, which enhances the quality of graphics.

2.8.6. Sports

In sports, computer technology is used for record keeping. Computer is used to collect and analyze the statistics and displays the updated score. Computer also helps to sell tickets, create training programs and even suggests diets for athletes.

2.9. Important Terms:

2.9.1. Buses:

Buses are the electrical paths through which data is transferred from one location to another location within a computer system.

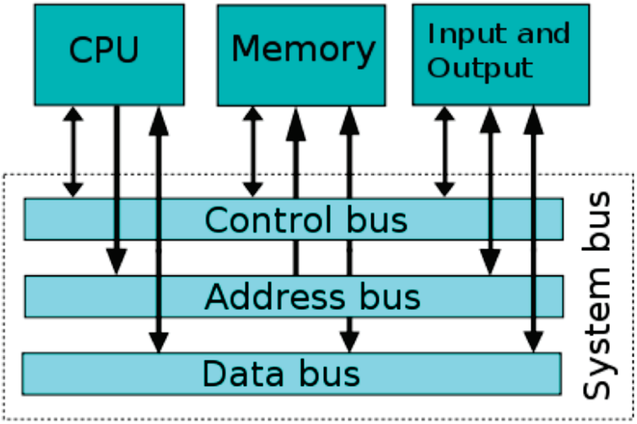

Figure-24: Computer Buses

There are number of different computer buses, which are as follows:

2.9.1.1. Data Bus:

Data bus uses the combination of wires, to transfer the data. Data bus is bi-directional.

2.9.1.2. Address Bus.

An Address bus is also called memory bus. It carries the memory addresses, which are required by the microprocessor for reading and writing the data. An Address bus works only in one direction.

2.9.1.3. Control Bus:

Control bus is also called Command bus. It carries all kind of travelling within the computer. This bus works in both directions.

There are two important terminologies which are used to define the operations of computer buses. This includes the followings

- **Width:**

  The size of the bus is also called its width. Width means; how much data can be transferred at one time.
- **Clock speed:**

  Every bus has its own speed, which is called a clock speed. It is measured in Mega Hertz (MHz)

  For example: If a bus is of 8 bits, it means that it can transfer 8 bit of data at one time.
- **Computer Ports:**

  Computer ports are basically an interface or a link through which data or information is communicated. There are three types of ports:

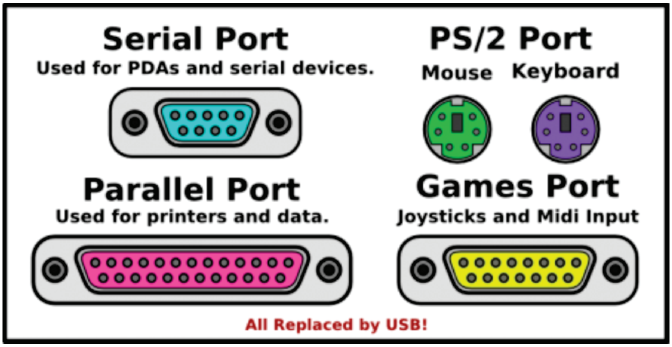

Figure-25: Computer Ports

- **Serial Port**
- **Parallel Port**
- **USB Port**

- **Serial Port:**

Serial port is also called male port. Normally serial port uses 9 to 24 pins which are used for keyboard and mouse. Serial port transfers data one bit at a time; that is why it is slow in processing. Serial ports are also known as communication ports or RS232C ports. Serial ports are used to connect devices like mouse and modem.

- **Parallel Port**

Parallel port is also known as female port. It consists of 25 pins. This port is normally used for connection of printers and scanners etc. Parallel port is capable to transfer 8 bits of data at one time but parallel to each other. Therefore Parallel port is faster than serial port.

- **USB (Universal Serial Bus)**

Universal Serial Bus does not use the concept of Pins like serial or parallel port. USB is easy to use and portable; that is why every device is now converted to USB port like printer, scanner, digital camera etc.

2.9.2. Microprocessor

Microprocessor is also called brain of computer. Microprocessor is normally in the form of a silicon chip containing millions of transistors fabricated on it and is called CPU (Central Processing Unit). Intel and Motorola are well known brand of microprocessors. Microprocessor consists of the following different components

2.9.2.1. ALU (Arithmetic & Logical Unit)

The Arithmetic & Logical Unit is an important part of a CPU which has the capability to do arithmetic and logical operations. Arithmetic operations are simple mathematical operations.

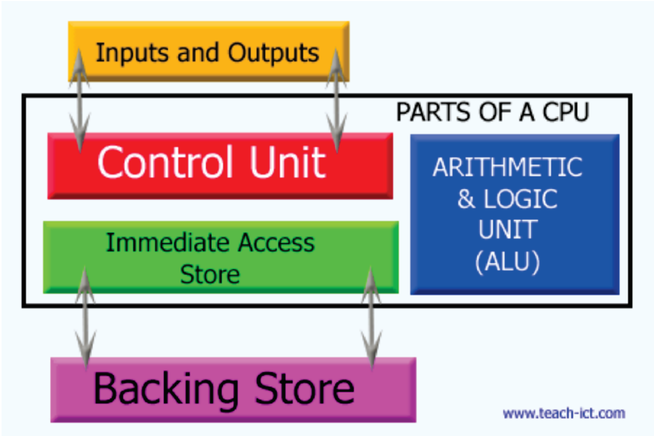

Figure-26: CPU Parts

For Example:

$2+5=7$

$6-5=1$

Logical operations are different because these operations are based on some conditions or criteria

For Example:

IF A>B

print A

else

Print B

In this example if the value of A is greater than B then computer will print A otherwise print value of B

2.9.2.2. Control Unit:

Control unit supervises all the components of the computer. First of all control unit selects the input /output device and then it flows the data between the I/O devices and the memory device.

Control unit brings instructions from memory unit and then executes them in an appropriate order.

2.9.3. Memory:

Memory is the place where the data or programs are stored temporarily, which are needed during the data processing.

Memory is further divided into two types

2.9.3.1. Primary Memory

Primary memory is also called main memory of the computer. Primary memory keeps several storage locations, which are called locations or cells and the data or programs are stored in these memory locations. Primary memory is called volatile, because when a computer system is shutdown all the data existing in memory is erased. Normally a computer memory is measured in term of bytes. Byte is the combination of 8 bits. Bit is a single binary digit in the binary codes that is 0 or 1.

Primary memory is further divided into the following categories

- **Dynamic Random Access Memory(DRAM)**
- **Static Random Access Memory(SRAM)**

- **DRAM**

DRAM stands for D*ynamic Random Access Memory.* DRAM is a kind of main memory which is cheaper & dynamic in the sense that it is refreshed after every few milliseconds. It is refreshed after sometime while static RAM is not refreshed & this memory is expensive. DRAM is slower than SRAM memory, because DRAM memory has to be refreshed many times. The capacity of DRAM's data reading is 60 nano seconds.

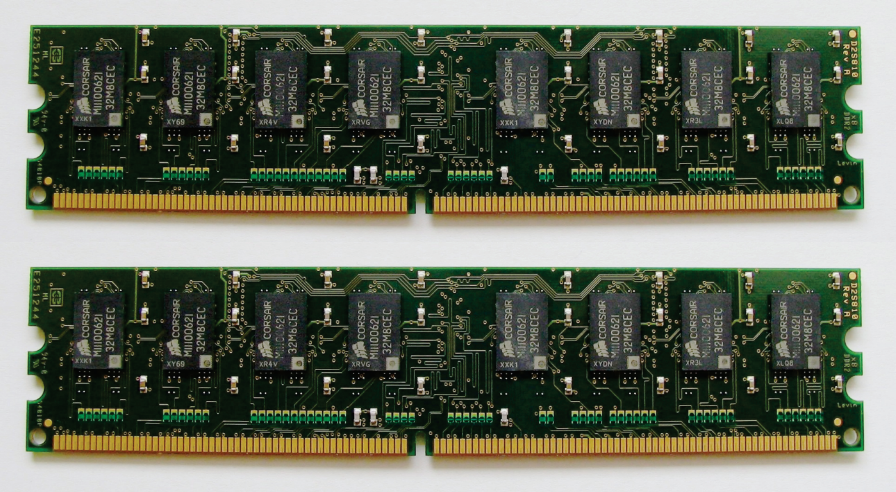

Figure-27: DRAM

- **SRAM**

SRAM stands for Static RAM. It does not need refreshing. Static RAM is generally used for cache memory, which can be accessed more quickly than DRAM. SRAM is faster than DRAM because it is not refreshed as DRAM.

Figure-28: SRAM

2.9.3.2. Secondary Memory:

Secondary memory is also called secondary storage or auxiliary storage. These devices are used to store large amount of data permanently. These are called non volatile memory, because after shutting off the computer, the data is not erased. These are further divided into the following categories.

Types of Storage Media

- **Hard Disks**
- **Optical Disks**
- **Magnetic Tape**

- **Hard Disks**

A **hard disk** is part of a computer system, which is also called a hard drive or **fixed** drive. Hard disk is primarily used to store large amount of data and also provides a very quick access to retrieve the data or programs. Hard disk is available in different sizes. Like 320 GB (Giga byte) & 400 GB etc.

Figure- 29: Hard Disk

- **Optical Disk**

An **optical disk** is used as an electronic data storage medium, which can be written and read using a low-powered laser beam.

Optical disks are available in the following Formats:

- **Compact Disk (CD)**
- **Digital Versatile Disk (DVD)**

- **Compact Disk(CD):**

A **compact disk** is non volatile storage medium, which is used for recording, storing, and playing back audio, video, and computer data.

Compact disks are available in the following types:

- **CD-R**
- **CD-RW**

- **CD-R**

CD-R - is a compact disk on which data can be written only once and therefore CD-R is called read-only memory. Data cannot be erased from CD-R.

Figure-30: CD-R

- **CD-RW**

CD-RW (CD-Re-writeable) is used to write the data more than one time and can also erase the previous contents of data. CD-RW are little bit expensive than CD-R.

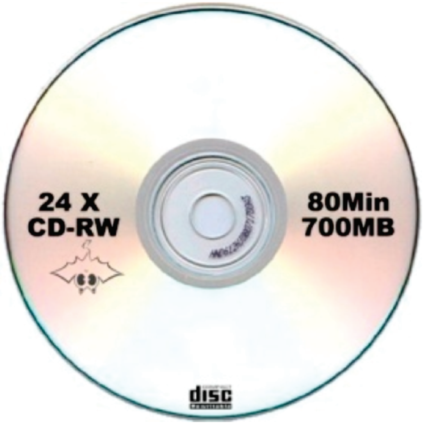

Figure-31: CD-RW

- **DVD:**

DVD (Digital Versatile Disk) has the capability to store large amount of data, movies etc than CD. DVDs are rapidly replacing CDs just because of their higher capacity and performance

Figure- 32: DVD-ROM

DVDs are further classified into the followings.

- **DVD-R (Recordable)**

DVD-R is used to record the data only one time. It can't be recorded or rewritten again due to the nature of DVD-R.

Figure-33: DVD-R

- **DVD-RW(Rewriteable)**

DVD-RW is used to record the data multiple times. However previous data can also be erased from it.

Figure-34: DVD-RW

2.9.4. Motherboard of Computer system:

The circuit board of the computer is called a mother board of the computer. It is called motherboard because it contains the key elements or components due to which a computer can't work properly. The key elements mounted on motherboard include microprocessor, computer memory, serial & parallel ports and expansion slots etc.

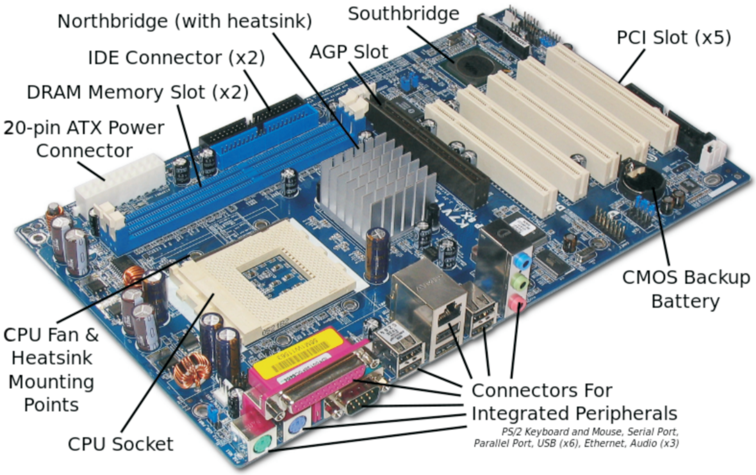

Figure-35: Mother Board

2.9.5. SELF ASSESMENT QUESTIONS

Q.No.1. What is computer? Describe basic five operations performed by the computer.

Q.No.2:

a) Write full form of the followings.

i. ALU ii. CU iii. CPU

b) Define Volatile & Non Volatile Memory? Explain with proper examples.

Q.No.3:

a) What is the importance of Port in Computer System? Name any four Computer ports.

b) Can Computer buses play an important role in communication of data? How?

Q.No.4. In what respect Digital computer is better than Hybrid computer?

Q.No.5. Discuss the classification of computer with examples.

Q.No.6. Explain some important computer applications.

Q.No.7. What is the difference between memory and the hard disk?

Q.No.8. Clarify the difference between History and generation of computer.

Q.No.9. Explain briefly first four computer generations with proper examples.

Q.No.10. Define and explain the followings with proper examples.
i. Microprocessor ii. Secondary storage devices iii. Input devices.

2.9.6. SELF ASSESMENT ACTIVITIES:

1 Describe important applications of computers in education and practically show them to your teacher.

2 Explore the different computer buses on the motherboard and practically show their results to your teacher.

3 Observe the working of different input devices.

4 Describe motherboard of the computer and show the result.

Unit 3

INPUT DEVICES

Written By: Tahir Ayub
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

INPUT DEVICES

3.1. Introduction:

Input devices are used to feed data into a computer. Keyboard and mouse are most popular input devices. This unit is focused on different input devices and their uses.

3.2. Objectives:

After completing the unit the student would be in position to:

- Describe the purpose of Input devices.
- Distinguish between different Input devices
- Have knowledge about advance Input devices like speech recognition systems and image scanning.

3.3. INPUT DEVICES

The Input devices are used to enter the data and instructions into the computer. Following are most widely used Input devices.

3.3.1. Keyboard Device:

Keyboard is a standard input device as readily available for us to feed the data. A keyboard is similar to a conventional type writer with about 101 keys as shown below.

Figure 1: Keyboard with Labels

A keyboard is divided into three major parts.

- **a)** Function Keys
- **b)** Numeric Keys
- **c)** Alphabetic Keys

3.3.1.1. Function Keys:

Function keys are 12 in numbers labeled as F1 to F12. Function keys are programmable keys to perform a specific stored function. For example: F1 key is used for help option.

Figure-2: Function Keys

3.3.1.2. Numeric Keys

Numeric keypad is very important for entering numeric data. Numeric keypad is switched "ON" and switch "Off" by pressing "Num lock" key. Numeric keypad can also be used for "Arrow keys" and page up & down tasks as mentioned on the keys.

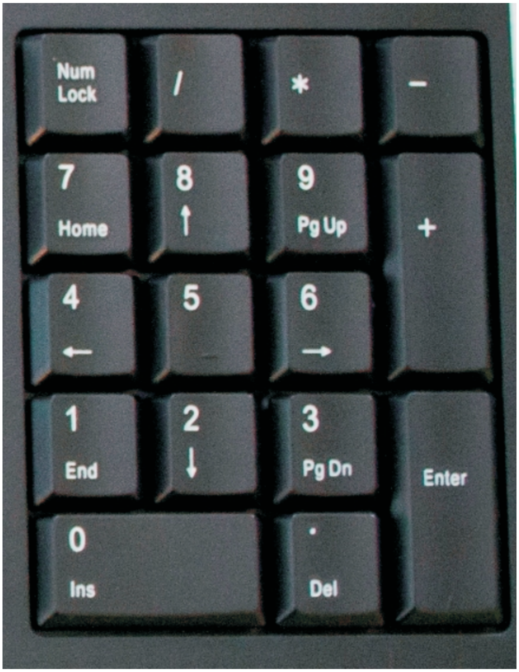

Figure-3: Numeric Keypad

3.3.1.3. Alphabetic Keys

Alphabetic keys are used to type the character data. It is used for normal typing work.

Figure-4: Alphabetic KeyPad

3.3.2. Point and Draw Devices:

Point and draw device is an input device which helps to rapidly point and select an icon to display on the screen. Some of the most popular point and draw devices are described below

3.3.2.1. Trackball

Trackball works just like a mouse; trackball contains only one ball instead of different buttons like left or right etc. Trackball uses this ball to move the cursor position from one location to the other. Trackball neither uses any such pad nor covers much space.

Figure-5: Trackball an Input device Trackball

3.3.2.2. Joy Stick

Joy stick is a pointing device. Joy stick is mostly used by the children to play their games. Joy stick is also used as a control stick in the aeroplanes to control the movements. It consists of a handle, which can be used to move the cursor position left, right, up and down. Joy stick can also be attached with a television set. It uses USB or serial port for connection. Joy stick is faster than keyboard.

Figure-6: Joy Stick

3.3.2.3. Mouse

Mouse is a pointing device. User can move cursor very rapidly on the screen with the help of mouse. Mouse controls the movements of the cursor positions. There is variety of mouse available in the market. For example: Wheel mouse, laser mouse, wireless mouse etc.

- **Wheel mouse:**

  Wheel mouse contains left, right buttons, and a wheel button at the middle. Wheel button is used to scroll the pages up and down very rapidly.

Figure-7: Wheel Mouse

- **Laser Mouse:**

  Laser mouse uses the laser beam for its movement. Laser mouse does not need any mouse pad. Laser mouse is automatically activated as it gets attached with the computer.

Figure-8: Laser Mouse

3.3.2.4. Light Pen

Light pen is a pointing device, which is used for making drawings. Light pen rapidly moves on the screen just like ordinary pen but it works with electricity. Light pen does not need any alphabetic keys.

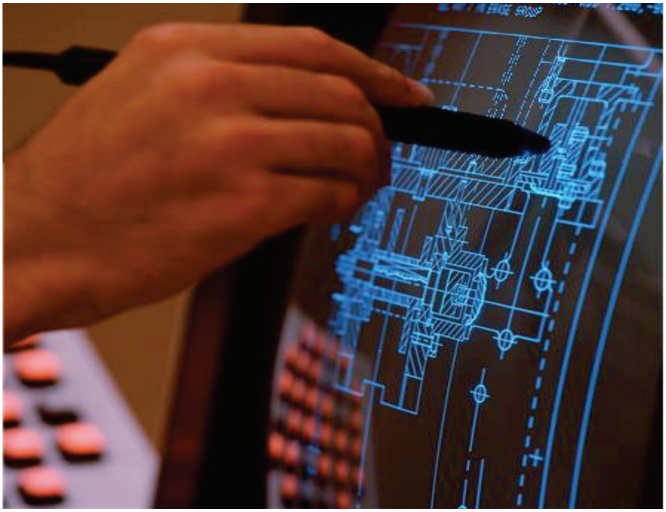

Figure-9: Light Pen

3.3.3. Touch Screen

Touch screen is an input device. Touch screen is capable to touch the data directly by using fingers within the display area. Touch screen is very simple and easy to use. Currently it is also used in the mobile phones.

Figure-10: Touch Screen

3.3.4. Digitizer

Digitizer is an input device. Digitizer is used to convert the maps, pictures and drawings into a digital form for storing in the computer system. A Digitizer consists of a digitizing tablet and a stylus (pen). Digitizing tablet is a flat surface on which stylus or a pen is moved to draw shapes, pictures or maps etc.

Figure-11: Digitizer

3.3.5. Speech Recognition Device

Speech Recognition is an input device. Speech Recognition allows a person to input data to the computer through speaking or voice. Speech Recognition device converts the human voice into text. This device is especially helpful for the disable persons.

Speech recognition has the capability to first recognize words with the help of software or a device then convert into text or device readable format.

Figure-12: Speech

3.3.5.1. Types of Speech Recognition system

- **Single Word Speech Recognition System**

  These systems recognize only single word like “Hello', “Yes”, “No”, at one time.

- **Continuous Type of Words Speech Recognition System**

  This type of Speech Recognition System recognizes more than one word or a complete sentence. For example “hello how are you”.

3.3.5.2. Uses of Speech Recognition System

- Speech Recognition Systems are especially helpful for the disable persons, who cannot write.
- It helps those persons who feel comforts to speak rather than to write.
- It facilitates a user in a situation where he/she is unable to edit & review a long text. It also helps the users, who are quite busy and don't want to type the data due to shortage of time.

3.3.6. Data Scanning Devices

3.3.6.1. Image Scanner

Image scanner is an input device. Image scanner translates the documents into an electronic format and stores them into the computer. Important documents can be preserved in an electronic form by using image scanner for later use. These documents can also be printed.

Figure-13: Image Scanner

Image scanner is further classified into the following

- **Flatbed Scanner**

  Flatbed Scanner is like a photocopier machine having a glass sheet. Flatbed scanner is also called desktop scanners. In a flatbed scanner, the paper is placed on a glass sheet, and a light source is moved horizontally from one line to other line. The process is repeated until all the lines are completed.

Figure-14: Flatbed Scanner

- **<u>Hand-Held Scanners</u>**

A handheld scanner is an input device. Hand-held scanner works much like a flatbed scanner but it works manually by the user itself. For scanning the documents or products, the scanner is dragged slowly with its light on. Hand-held scanners are mostly used in the shops to scan the price of the products.

Figure-15: Handheld Scanner

3.3.6.2. OCR (Optical Character Recognition)

Optical Character Recognition is also called Optical Character Reader. Optical Character Reader uses software called "OCR software". The scanner first creates an image of the document and then OCR software converts that image into ASCII text. Computer interprets the ASCII text as letters, numbers and special characters.

OCR is also called as ICR (Intelligent Character Recognition), which is used to scan images and text.

Figure-16: Optical Character Recognition

3.3.6.3. OMR (Optical Mark Reader)

Optical Mark Reader has the capability to recognize the pre-mentioned marks either of a pen or a pencil. Optical Mark Reader is specifically helpful for making objective type questions. The students mark the answer sheet by filling/darkening a circle, oval shape or square. This printed answer sheet is fed into the computer and the grading is done by using Optical Mark Reader.

Figure-17: Optical Mark Reader

3.3.6.4. BCR (Bar Code Reader)

Barcode reader is an input device. It is normally used in the shops, glossary stores. This device contains the photo electric cells that read bar codes consisting of lines having different thickness. Barcode reader helps shopkeepers to analyze the price of an item immediately.

Figure-18: Bar Code Reader

3.3.6.5. MICR (Magnetic Ink Character Recognition)

Magnetic Ink Character Recognition (MICR) is an input device. MICR is used to read the magnetically encoded characters. MICR is a system that provides a full alphanumeric recognition of printed or handwritten characters by simply scanning the form. A user scans the data through a scanner, which is recognized by an engine of the OCR system. The MICR converts the images into machine-readable characters.

3.3.6.6. Electronic Card Reader

Electronic Card Reader is an input device which is used to scan e-cards / smart cards like visa card, bank credit cards etc. An electronic card reader reads the memory card of the ATM debit card or visa card etc. The memory card is in the form of a black strip, which is wiped through an electronic device called an Electronic card Reader machine.

Figure-19: Electrical Card

3.3.6.7. Vision Input System

Vision Input System is one of the latest input devices that recognize the vision, image, which appears in the range of its lens. These are especially used to design industrial Robots.

Figure-20: Vision Input System

3.4. Self Assessment Questions

Q.No.1. What is the purpose of scanner? Also describe BCR & MICR with suitable examples.

Q.No.2. Define the following:
i. Function keys ii. Numeric keys iii. Alphabetic keys

Q.No.3. What is the importance of point and draw devices. Name any two points & draw devices.

Q.No.4. In what respect trackball is different from joy-stick. Give examples.

Q.No.5. Discuss the purpose of speech recognition device?

Q.No.6. Explain some types of image scanner.

Q.No.7. What is the difference between handheld scanner and flatbed scanner?

Q.No.8. Clarify the difference between OCR and OMR.

Q.No.9. Explain briefly vision input systems.

3.5. Self Assessment Activities:

1. Draw any map using point & draw devices and show the results to your teacher.

2. Create a text by using speech recognition device and practically show the required output to the teacher.

3. Observe the working of voice reproduction devices. Also consult with your teacher.

4. Scan some documents and pictures show the results to the teacher

Unit 4

OUTPUT DEVICES

Written By: Tahir Ayub
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

OUTPUT DEVICES

4.1. Introduction:

The computer output devices are also important peripherals of a computer system. There are different types of output devices such as monitor, printers, and plotter . In this unit we will study about different output devices.

4.2. Objectives:

After completing the unit, the student would be able to:

- Distinguish between different output devices.
- Explain various types of output devices including printers, monitors.
- Explain special function terminals.
- Have knowledge about working of different output devices.

4.3. Output Device

4.3.1. Monitor:

Monitor is a standard output device which provides visual output from a computer. It is the first device, which is readily available for a user to view or to display the output. Monitors are of different types with different resolutions, sizes, and characteristics.

Figure-1: Monitor

4.3.1.1. Types of Monitors:

Following are the different types of monitors

1. **CRT (Cathode Ray Tube) Monitor**
2. **LCD (Liquid Crystal Diode) Monitor**
3. **LED (Light Emitted Diode) Monitor**

1. CRT Monitor

Cathode Ray Tube (CRT) technology is an embed vacuum tube technology, which is evolutionary in the field of monitors. These monitors are low cost, reliable and available in colors etc. However they consume much electricity and heavy in weight.

Figure-2: Cathode Ray Tube

2. LCD Monitor

Liquid Crystal Display (LCD) monitors uses Liquid crystals, which were first discovered in 1888 by an Austrian botanist Friedrich Reinitzer. These types of monitors are very slim and light weight. The LCDs are rapidly replacing CRT monitors. LCD monitors are used in notebooks, small computers, pagers, phones and other devices.

Figure-3: LCD Monitor

3. LED Monitor

LED (Light Emitting Diode) is an enhanced version of LCD with the fluorescent lamps having LED backlight. It uses semiconductor diode instead of filament. Semiconductor diode is an electronic component which is used to develop liquid crystal display in LED. LED is normally used in many devices such as cell phones, computers, monitors, flash lights and movement sensors etc.

Figure-4: LED Monitor

4.3.2. Graphic Adapters

A video adapter is a device that performs graphics processing. It is also called graphics card, display adapter, video card etc. It describes the resolution, refresh rate and number of colors to be displayed on the monitor. Currently the graphics circuits are built into the chipset.

Figure-5: Graphic Adapter

4.3.2.1. Size:

The monitor size refers to the distance in inches from one corner to other of the viewable area. A CRT monitor size actually measures the distance of the entire front of the CRT monitor.

The size of monitor screen is measured in inches, just like televisions its commonly used sizes are 14", 15", 17", 19", and 21" screens etc.

4.3.2.2. Resolution

Resolution defines number of horizontal and vertical pixels on the monitor.

The pixels are the smallest component of a digital image and are combined to form a comprehensive picture.

More pixels make better picture quality. Monitor resolution is measured in width by height like 640 x 480 resolution means that the width of the screen is 640 pixels and 480 is its height.

4.3.3. Printer:

Printer is an output device. Normally a user displays its output on the screen but sometimes a user also needs to take the output in the form of a paper, which is possible with the help of a printer. Generally a printer may be black & white but color printers are also available. Printers are further categorized as:

4.3.3.1. Dot Matrix Printer:

Dot Matrix printers are the character printers, which print one character at a time. It uses a ribbon cartridge to print characters on the paper. The speed of printing of dot matrix printer ranges from 30 to 550 characters per second (cps). It is also available in different sizes.

Figure-6: Dot Matrix Printer

1. **Characteristics:**

- Dot matrix is low cost printer and consumes less energy

2. **Limitations:**

- Dot matrix printers create noise during printing process.
- They print the text with low resolution
- The font facility is limited and graphics quality is also not high.

4.3.3.2. Inkjet Printer

Inkjet printers are the character printers used to print all kinds of images. Inkjet printer print one character at a time and uses ink bottles in different color combinations. Inkjet printer uses four ink cartridges. Graphic quality or text quality depends on the strength of the ink cartridges. Inkjet printer can be attached with the help of USB cable, serial, parallel and SCSI etc.

Figure-7: Ink Jet printer

Figure-8: Inkjet cartridges

1. **Characteristics:**

- Inkjet printers consume less energy
- The printing quality is high.

2. **Limitations:**

- Inkjet printers are expensive because refilling bottles make a high cost.

4.3.3.3. Drum Printer:

Drum printers are line printers that are used to print an entire line at a time. It uses cylindrical drum as printing mechanism. Whenever a user wants to print a character, a desired character is rotated around to the hammer line. The hammer hits the paper & pushes it into the ribbon to print the character.

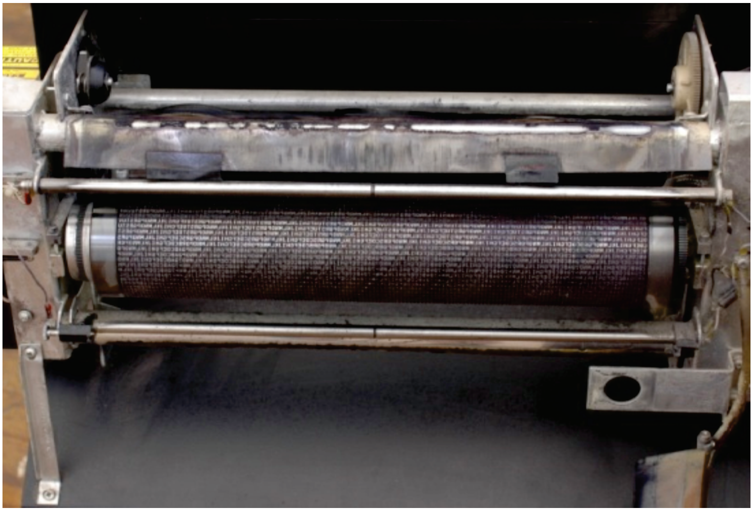

Figure-9: Drum Printer

1. **Characteristics :**

- Drum Printer is energy efficient
- They consume less ink

2. **Limitations:**

- The printing speed of drum printer is slow.
- The printing quality is low and they also produce noise during the printing.
- They cover a lot of space.

4.3.3.4. Chain or Band Printers:

Chain or Band printers are also line printers that print one line at a time. Chain or Band Printer consists of a metallic chain/band and uses chain as its printing mechanism. A chain moves horizontally around a set of hammers. When a desired character appears in front of the selected printing position, the hammer hits the paper into the ribbon to print the character.

Figure-10: Chain or Band Printer

1. **Characteristics:**

- Chain or band printers are low cost

2. **Limitations**

- They consume much electricity and cover a lot of space
- They also produce noise during the printing.

4.3.3.5. Laser Printer:

Laser printers are called page printers that print one page at a time. The Laser printer uses tonners to print the desired characters. They are also capable to print the high quality graphics images with resolution ranges from 600 to 1200dpi.

To print a desired character a laser beam sends information from the computer to a rotating mirror and as a result the image is produced on the drum

Figure-11: Laser printer

1. **Characteristics:**

- Laser printers are speedier and noiseless
- The printing quality is high.
- They can print on both sides of a paper

2. **Limitations:**

- Laser printers are expensive

4.3.4. Plotters:

Plotters are used to print architectural, engineering and mechanical etc. drawings on large sheets with high printing quality. Pen Plotter is most commonly used plotter, which consists of six or eight color pen cartridges that move across the entire paper of the drawing. They are capable of printing complex technical drawings.

Figure-12: Pen Plotter

Nowadays, these plotters are replaced by large capacity inkjet printers and LED toner based printers. These are plotters but behave as raster plotters rather than pen plotter. Raster is a digital computer image which is the combination of small pixels.

Examples of raster image devices include inkjet, laser printers, video screens, dot matrix, , and scanners.

4.3.5. Special Function Terminal (ATMs, POS)

4.3.5.1. ATMs:

ATM (Automatic Teller Machine) is used as unattended device or a machine, which is used in the banks for withdrawal of money without the need of any bank employee. ATM provides a very easy and secure way for the money transactions. NCR is the one of the major distributor of ATMs machines in banking sector all around the world.

These sorts of machines use real time operating system. ATM monitors are specifically used for the money transactions with the following key features.

Figure-13: ATM Machine

1. **Characteristics**

- ATM provides instant cash withdrawal facility.
- They are used to inquire quick balance.
- It is easy to operate.
- The PIN number can be changed any time.

4.3.5.2. POS Terminal:

POS (Point of Scale) terminal is an input/output device, which is used in place of cash registers on the shops. Currently the POS terminals have replaced the manual system of registering the record of sale and purchase. POS terminal immediately updates the sale & purchase records in the computer and also provides a printed receipt of the record.

The POS system has the capability to record and track customer orders. They can also process credit and debit cards which are connected to their respective debit/credit card server systems over the network.

An important example is the hotel environment, where all the prices of necessary food items are stored in a program called database. The information about menu items is displayed on the point of sale terminal for information of customers. These type of terminals can also be used in the factories' sales shop to enter the record of sale & purchase items.

Figure-14: Point-of-Sale Terminal

4.3.6. Multimedia Projector

Multimedia projector is an output device, which is used to display information from the computer on to a large screen. This device is specifically helpful in delivering lectures and presentations.

There are further two prominent types of multimedia projector.

4.3.6.1. LCD Projector (Liquid Crystal Display) Multimedia Projector

LCD Projector is also called digital multimedia projector. LCD multimedia projector can adjust the brightness and contrast and produce sharp images.

Some popular LCD multimedia projectors are View Sonic PJ862, Sony etc.

Figure-15: LCD Multimedia Projector

4.3.6.2. DLP (Digital Light Processing) Projector:

DLP projectors are also called digital multimedia projectors. DLP projectors are lighter in weight and smaller in size. These projectors produce best quality video images. They are portable in size and lighter in weight. They have the capability to connect easily to other digital devices like DVD player, CD player etc.

Figure-16: DLP Multimedia Projector.

4.3.7. Voice Response Systems

Voice Response Systems enable computers to talk with a user. Voice Response Systems keeps an audio response device that helps to produce audio output. In this way these systems provide an easy communication way to both a user and a computer.

Voice response systems are of two types:

4.3.7.1. Voice Reproduction System

Voice Reproduction System uses a database of pre-recorded responses like words, phrases, or sentences which are spoken by human beings or even musical sounds generated through musical instruments. It produces the output by selecting the particular words, phrases etc from the database.

The analog recordings of the pre-recorded sound are converted into digital data and then this data is stored on a hard disk or any other secondary storage like CDROM, DVD etc. Whenever a user wants to produce an audio output, the system selects the required sound from the set of pre-recorded sounds stored in the computer. The selected sound is then converted back into analog form to a speaker to produce the audio output.

- **Applications of Voice Reproduction System**

  The most familiar example of using Voice Reproduction System is special ATM machine which uses voice reproduction system to provide systematic or step by step guidance to customers. It helps the customers to make a financial transaction.

  Another application is the Automatic Answering Machines which are mostly used in telephone enquiries like schedule of trains and airplanes etc.

  One more important example is interactive video games in which various exiting and interesting sounds are produced while playing a video game from a database of pre-recorded sounds.

  The Mobile phone talking alarm clock is also an example of voice reproduction system. For example, after every hour mobile phone clock speaks the time from the database of pre-recorded voice messages.

  Another interesting application is the children talking toys in which various exciting sounds are produced.

Figure-17: Voice Reproduction System

4.3.7.2. Speech Synthesizer

A speech synthesizer helps to convert the text information into spoken words or sentences. A speech synthesizer program is helpful for the disable persons who cannot easily read.

Whenever a user feeds the data in the form of text information, the sequences of words are combined into phonemes. The phonemes are amplified, and passed on to a speaker.

Figure-18: Speech Synthesizer

- **Applications of Speech Synthesizer**

  Speech Synthesizer is especially helpful for the blind persons who cannot read. In special education sector study material or a book is scanned using a scanner, and then it is converted into text using OCR software. It is finally presented to the blind persons using a speech synthesizer. In this way it becomes very easy for the blind person to get the updated knowledge or information.

  It is helpful for the people who cannot speak, with either vocal problem or they cannot communicate effectively. For example, a person having disability problem can simply type the information and the speech synthesizer converts his information into spoken words for him.

  Speech Synthesizer is also helpful for the interpretation or translation into other languages, Speech Synthesizer program converts an entered text into spoken words in any selected language.

4.4. Self Assessment Questions

Q.No.1. What is the difference between LCD and LED monitors? Explain with examples.

Q.No.2. Explain graphic adopter card.

Q.No.3. Explain the difference between Dot Matrix Printer and Inkjet Printer Explain with examples?

Q.No.4. In what respect printer is different from plotter.

Q.No.5. Discuss the functions of Point of Sale Terminal and ATM machine.

Q.No.6. In what respect speech synthesizer is helpful for a user? Explain with the help of a scenario.

Q.No.7. Is DLP multimedia projector is better than LCD multimedia projector? Please discuss.

Q.No.8. Explain the function of ATM machine and also briefly describe POS terminals. Discuss with proper examples.

Q.No.9. Clearly differentiates between Drum Printer and Chain Printer? Discuss with proper examples.

Q.No.10. Write note on any two of the following:

i. Drum Printer ii. Voice Reproduction Systems

iii. LED monitors. Iv. Monitor Resolution

4.5. Self Assessment Activities:

1. Try to find out the size and resolution of your monitor and also at least three monitors of your friend.

2. Explore the functions of Overhead Multimedia Projectors.

3. Try to convert the written text into spoken words in any language of your choice using speech synthesizer.

Unit 5

COMPUTER SOFTWARE

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Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

COMPUTER SOFTWARE

5.1 Introduction:

Computer software comprises different computer programs, or instructions that enable users to perform different tasks on a computer system. It is not only important for the users but also the whole computer system, depends upon the services provided by the software. Due to the importance of computer software this unit has been developed. It covers the basics of computer software and its important types.

5.2 Objectives:

After completing this unit students would be able to:

- Understand the basics of computer software.
- Distinguish between application software and system software
- Have a knowledge about important system and application software
- Learn about software installation and un-installation

5.3 Computer Software:

A computer cannot do anything at its own rather than it must be provided some sequence-wise instructions and relevant data to perform its functions. This sequence of instructions is called a computer program which is commonly referred to as computer software.

Software is a generic term used for collection of data and instructions given to the computers to perform specific tasks. It also refers to set of programs, procedures and associated documents designed for the working of computers. The software is logical part of the computer that user can not touch but use to make computer operate.

Computer software controls the operation of hardware or some other software by implementing the instructions given to it in an ordered way.

5.4 Types of Computer Software:

There are two main categories of Computer Software:

5.4.1 System Software:

System Software is the collection of computer programs that controls the operation of computer and its devices. It provides an interface between computer hardware and application software. It is backbone of a computer system which provides a platform for its operation.

System software helps computer users to make use of application software and perform the programmed activities. System software monitors the use of various hardware components such as CPU, memory and other peripheral devices. They also communicate with the peripheral devices to support user activities.

5.4.1.1 Types of System Software

There are different kinds of system software:

1. Operating System

An operating system is a collection of programs that coordinates the internal working of a computer system. It provides us an interface to communicate with the computer. It also manages all computer components and operations and isolates the hardware from the user. A computer cannot perform any job without operating system.

Operating system permits the computer to supervise the operations and manage the data to produce the results. It is the first software that must be installed on every computer.

2. Utility Programs

A utility program allows a user to perform an explicit task. It is normally used to resolve system maintenance activities and provide assistance in these activities. There are different types of utilities available for example: formatting of hard disk, system backup, antivirus and file compressor.

3. Device Drivers

A device driver is a system program that is used to turn on and manage a device such as monitor, keyboard attached to computer. Device drivers are built in programs, provided by manufactures of devices. The devices cannot work properly without driver's utility programs. A driver typically communicates with the device to control its operations. For example device drivers for printer, mouse and keyboard are required to regulate their operations during working of computer system.

5.4.2 Application Software:

Application software is a set of computer programs used to perform user specific jobs. They allow the users to develop programs for their personal/organizational use. An application program facilitate user to manipulate text, numbers, graphics, or a combination of these elements. Therefore there are varieties of application programs available in market depending on the activity for which it is designed.

5.4.2.1 Categories of Application Software:

There are thousands of application software available in market. It is not possible to categorize all application software; however some commonly known application software includes the following:

- Word Processing software
- Spreadsheet Software
- Database Software
- Graphics and Multimedia Software
- Personal Assistance Software
- Communication Software

- **Word Processing Software:**

Word Processor is an application program used for creating, editing, storing, and printing personal and official documents.

Word Processor became popular in 1970s and 1980 when the electric typewriter was merged with a dedicated processor (like a computer processor) for the editing of text. Since then different companies are developing Word Processor with new and enhanced features.

i. Standard Features of Word Processor:

Word Processors have several text manipulating features. The standard features include:

- **Text Editing:**

  Text editing includes entering the text, cut/copy and paste the text, making insetions and deletions etc.

- **Word Wrap :**

  The cursor automatically moves to next line when the line is completed with the text.

- **Status Line:**

  Status line provides all the information about the current document.

- **Search and Replace :**

  Search and Replace allows the user to search for a particular word or expression and replace it with some other word or expression.

- **Headers , Footers , and Page Numbers:**

  It allows users to insert tailored headers and footers that the word processor will put at the top and bottom of every page. Similarly page numbers can also be inserted at top or bottom of the pages.

- **Spell Checker :**

  Spell checker allows the user to check the spelling of words. It spotlights any word that it does find in its dictionary.

- **Table:**

  Word Processor allows inserting tables comprising of rows and columns.

- **Save and Print:**

  Once a document has been created, edited and formatted, it can be saved and printed.

Some well known Word Processor includes the following:

i. Micrsoft Word
ii. Word Perfect
iii. Word Star
iv. In Page (used for urdu typing)

The screenshots are shown from figures 5.1 to 5.4

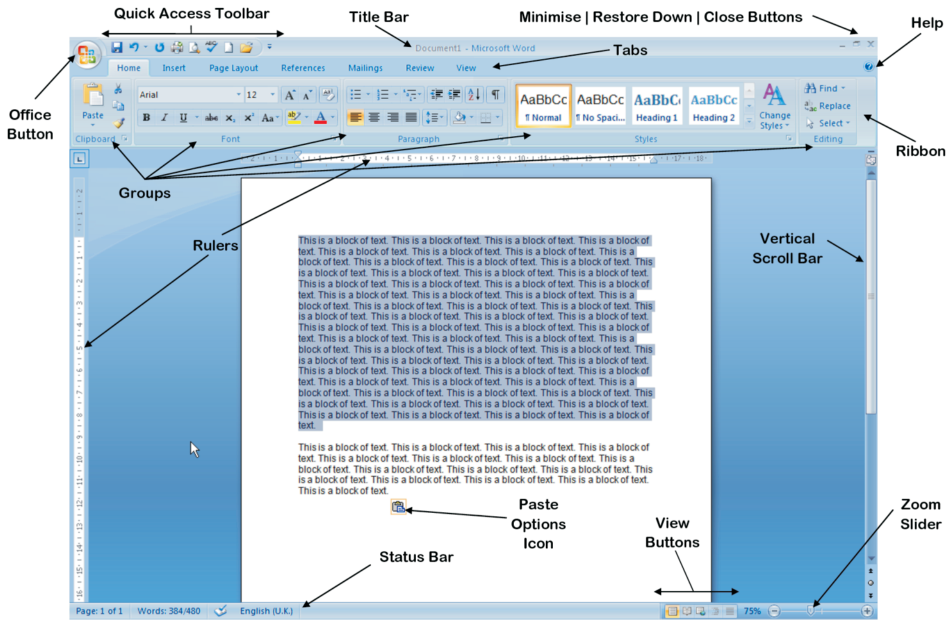


Figure-5.1: MS Word

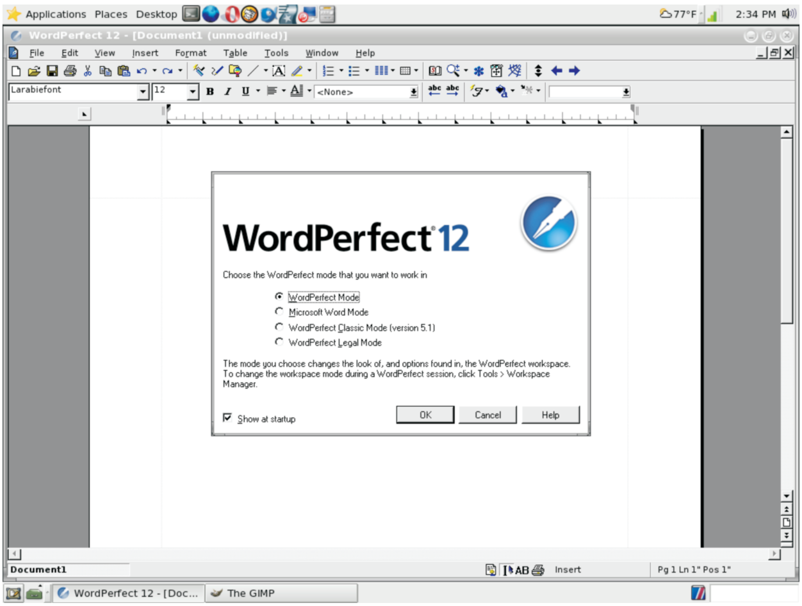


Figure-5.2: Word Perfect

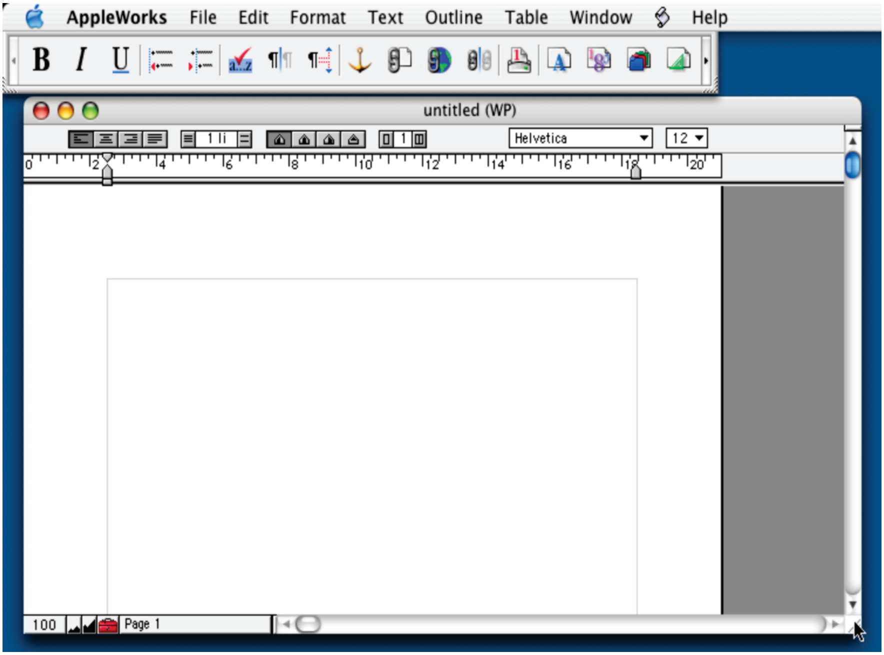


Figure-5.3: Apple Word

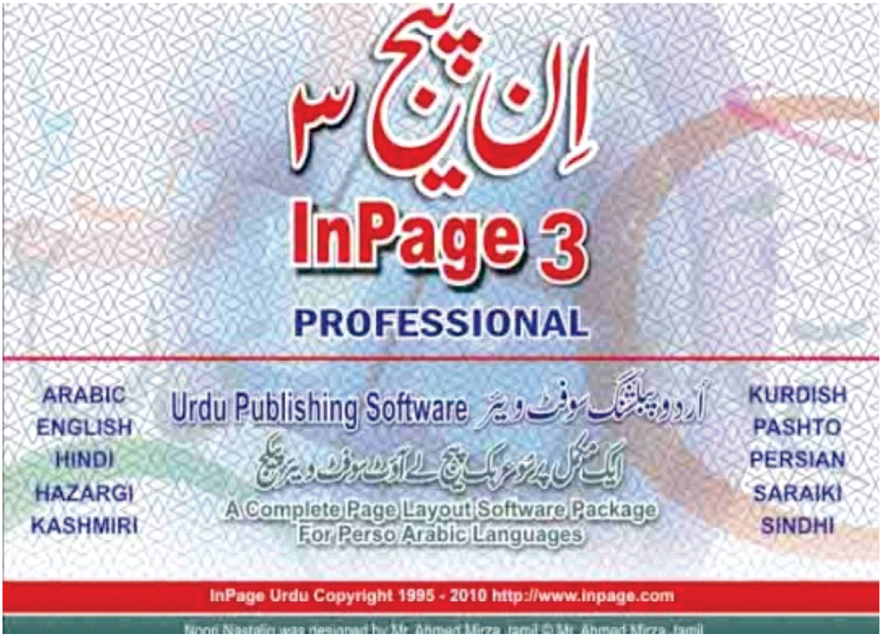


Figure-5.4: In page

- **Spreadsheet:**

Spreadsheet is a data manipulation tool used for organization and analysis of information in tabular form. It is a kind of computerized ledger that accepts data values in rows and columns and allows user to perform caluculations.

It is an application program that replicates a physical spreadsheet by entering, displaying, and calculating data available in rows and columns.

i. Standard Features of Spreadsheet:

- **Rows and Columns:**

A spreadsheet is a table consisting of columns and rows as shown in the following figure.

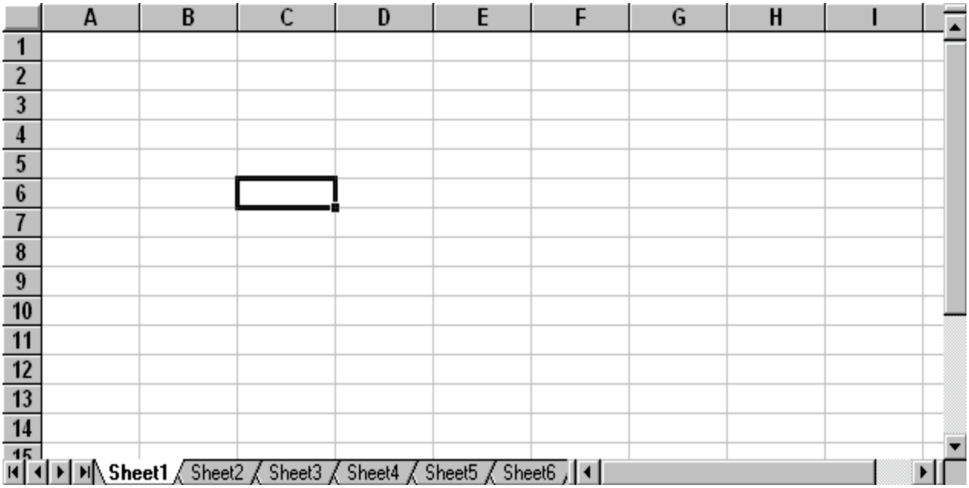


Figure-5.5: Spreadsheet

The rows are labeled by numbers and the columns by letters as shown in the figure 5.5.

- **Cell:**

The intersection of a row and a column is called a cell. A cell is uniquely identified by its column and row designators, e.g. A2, B10, J13. The data is entered into cells for further manipulation. in the figure 5.6 the cell A1 is highlighted.

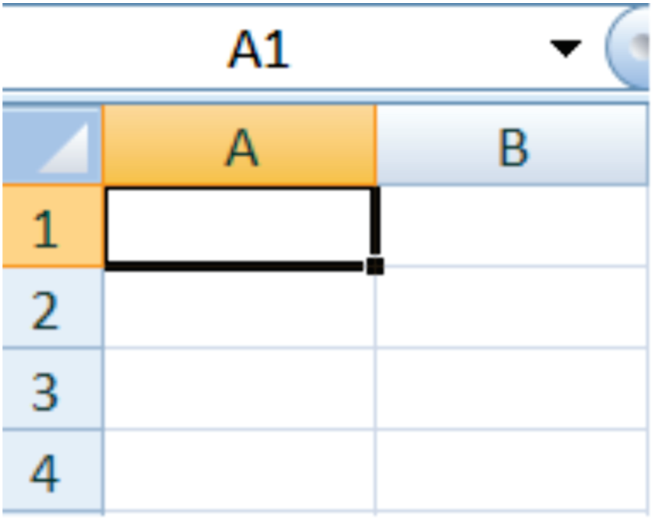


Figure-5.6: Cell

- **Formula:**

Formula is a relationship between values of cells. It is used to apply mathematical equation among data items of a cell. For example, D2=B1+C1 would calculate and display the sum of cells B1 and C1 into cell D1.

- **Functions :**

Functions are built-in formulas for certain problems that have already been created and stored in the program. They are used as shortcuts when applying mathematical equations and give ease and flexibility to the users to handle complex calculations. Some examples are COUNT, SUM, MAX, and MIN.

- **Graphs and Charts:**

Data and information in spreadsheets can be analyzed in a graphic form. Spreadsheets allow the users to display numerical data as a graph or chart.

Some well known spreadsheet includes the following:

- Microsoft Excel
- Lotus 123
- Quarter Pro

The screen shots are shown from figures 5.7 to 5.9

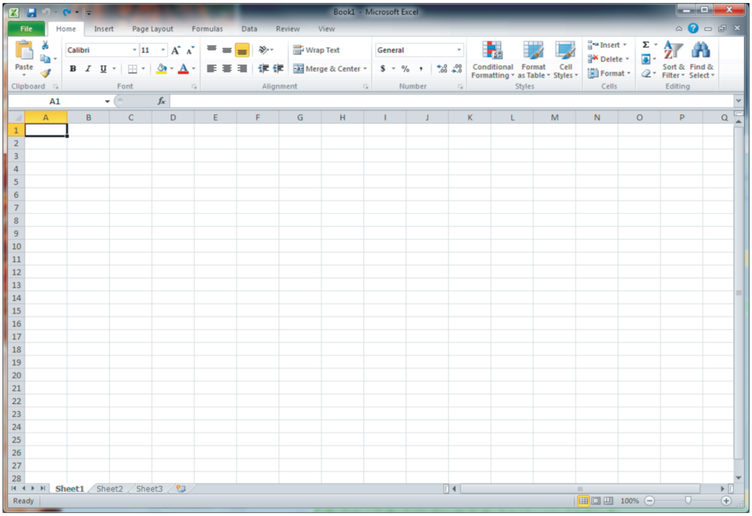


Figure-5.7: Microsoft Excel

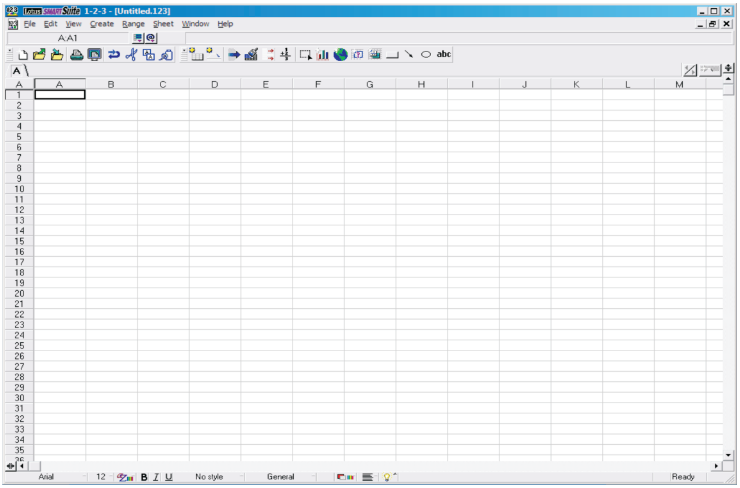


Figure-5.8: Lotus 123

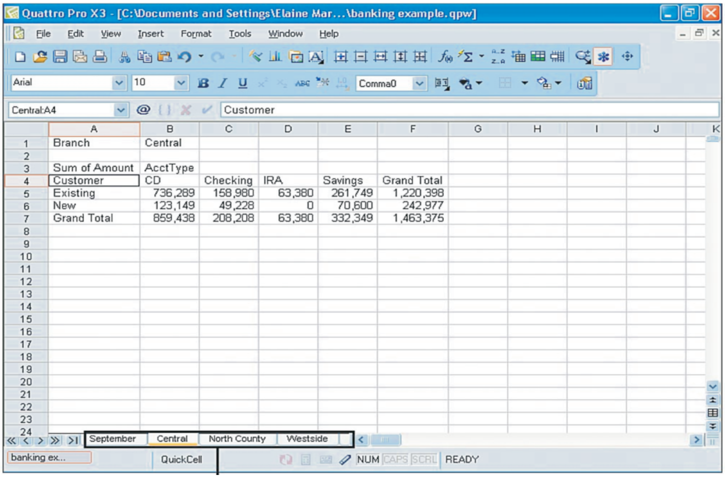


Figure-5.9: Quarter Pro

- **Database Software:**

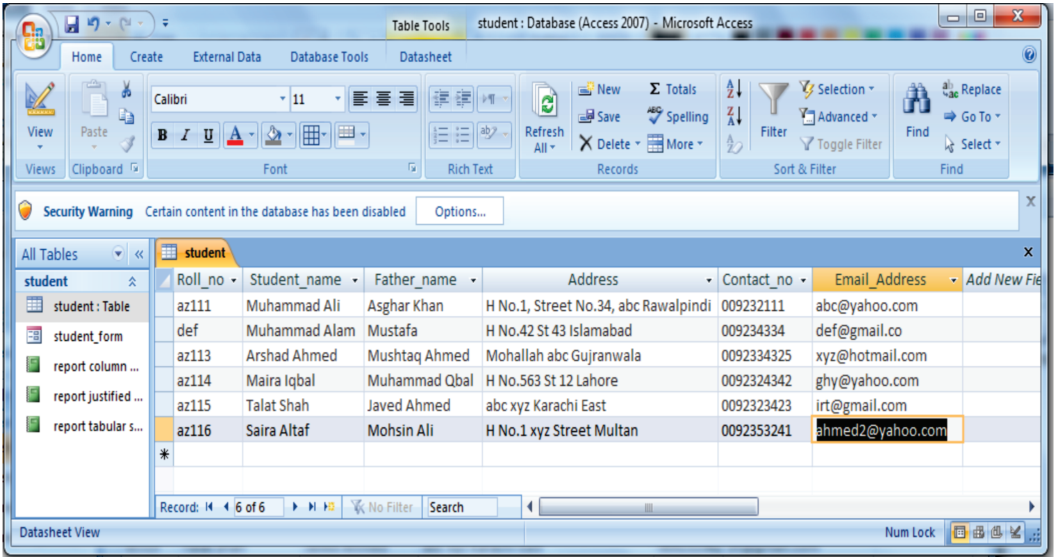
Database is a collection of related data that allows the users to retrieve, edit and update the data. Database management system (DBMS) is an Application Software that allows users to develop, access, and administer a database. Data in a database can be added, updated, deleted and searched using a DBMS.

A DBMS is like a traditional filing system which stores individual groups and pieces of information. Like filing system's cabinet, drawers and folders, a DBMS consists of separate components of information.

Relational database systems are the most common DBMS. Relational database organise data into separate structures, which can be linked via common information to make data storage more efficient. A relational DBMS has the following basic components:

- **Tables:**

A database is comprised one or more tables or relations which is a group of related data items and contains the records for an entity. Tables are made up of records and records are made up of rows and columns holding the actual data items. For example a student table might hold the information in the form of database table:



Roll_no	Student_name	Father_name	Address	Contact_no	Email_Address
az111	Muhammad Ali	Asghar Khan	H No.1, Street No.34, abc Rawalpindi	009232111	abc@yahoo.com
def	Muhammad Alam	Mustafa	H No.42 St 43 Islamabad	009234334	def@gmail.co
az113	Arshad Ahmed	Mushtaq Ahmed	Mohallah abc Gujranwala	0092334325	xyz@hotmail.com
az114	Maira Iqbal	Muhammad Qbal	H No.563 St 12 Lahore	0092324342	ghy@yahoo.com
az115	Talat Shah	Javed Ahmed	abc xyz Karachi East	0092323423	irt@gmail.com
az116	Saira Altaf	Mohsin Ali	H No.1 xyz Street Multan	0092353241	ahmed2@yahoo.com

Figure-5.10: Student Table

- **Forms**

Form is graphical user interface used to communicate with the database. They are used to enter data in the database. A form consists of text boxes, password fields, checkboxes and other input objects. These objects facilitate the user to communicate with the database easily. The user can also access, update and delete data by using forms. The application programmers can develop database forms in different ways. Some databases like MS Access enable the users to create forms the database automatically by using wizards.

Some important advantages of forms are as follows:

i. Forms are easy to operate.
ii. They provide attractive interface for users.
iii. The user can use forms without technical knowledge.

- **Queries**

Query is used to search the data items available in the database tables. It uses standard language like Structured Query Language (SQL) to manipulate the data items in the tables.

- **Report:**

  Report is meaningful information that is extracted from the database. It is generated on the basis of one or more SQL queries. Reports are the output of database applications. They are used to locate and arrange data in a formatted way. The information retrieved through reports is arranged in different ways. A report can present the data in form of tables, records and graphs etc.

  - **Advantages**
    - i. Reports provide efficient result from database.
    - ii. It helps in making important decision.
    - iii. It can be printed and mailed easily

Some well known Database Applications includes the following:

- i. Microsoft Access
- ii. Oracle
- iii. SQL Server

The screen shots are given from figures 5.11 to 5.13.

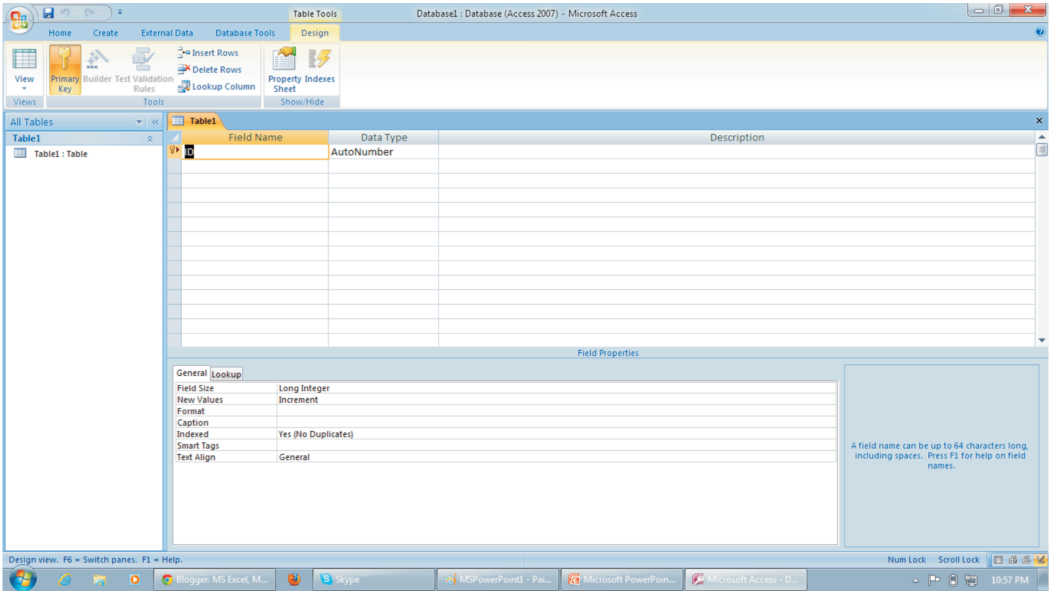


Figure-5.11: MS Access

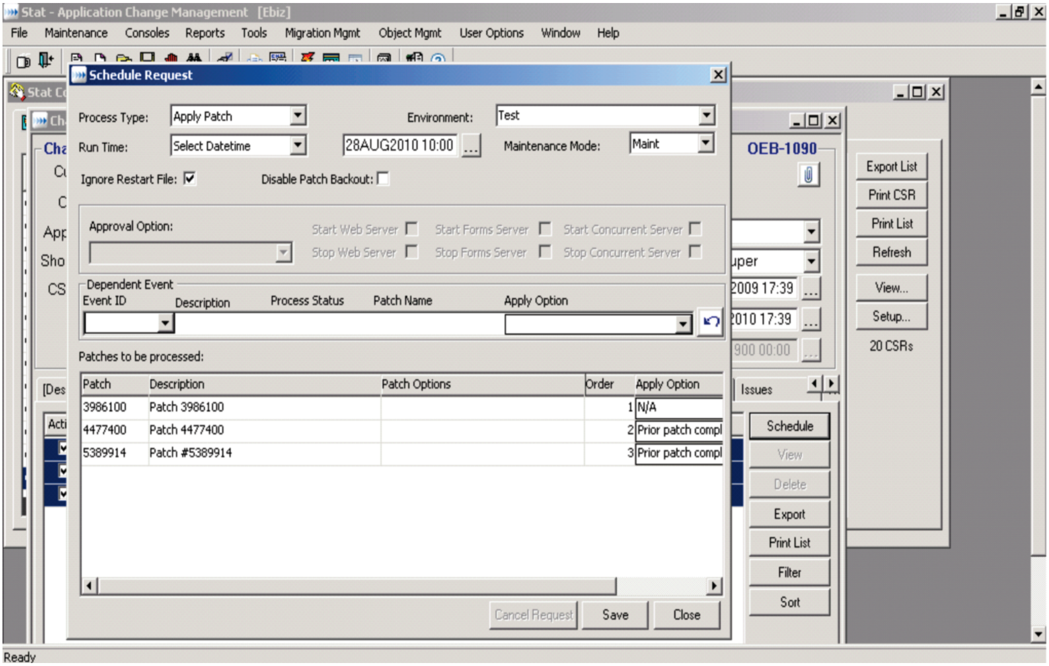


Figure-5.12: Oracle

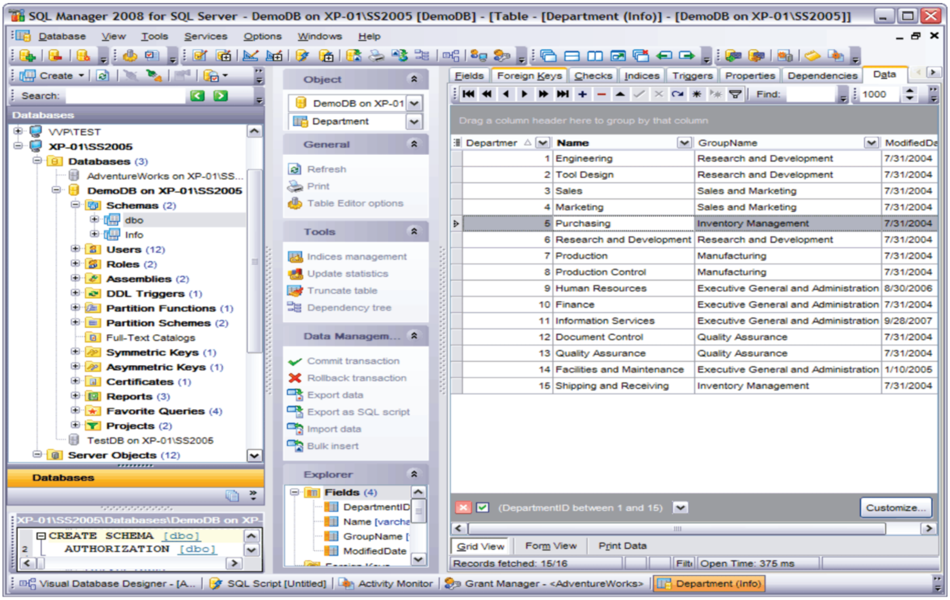


Figure-5.13: SQL Server

- **Graphics Software:**

Graphics packages are application programs that allow users to create, edit, display and print graphic images. They enable a user to manipulate visual images on a computer.

  - **Category Based Features of Graphics Software:**

i. Sketch Design :

The sketch design feature allows users to create design objects of different shapes and sizes. These include lines, circles, rectangles etc. Users need not to worry about the exact shapes of objects as the package adjusts the dimensions of the shape according to the base of a design. Special features allow the users to rotate, flip, move and resize the objects dimensions.

ii. Paint Feature:

The paint feature is used to paint designs of different varieties on the display screens. It is used to create colorful graphics on the screen without using original paints. Most paint features provide the tools in the form of icons. By selecting an icon, user can perform functions associated with the tool.

iii. Photo Editing:

Photo editing feature is used to edit and customize digital photos. It allows users to save images in a wide variety of file formats. Besides this users can retouch images, crop images, change image shape, re-arrange objects in photos and apply filters to the images.

iv. Multimedia Authoring:

Multimedia authoring permits users to merge text, audio/video and graphics /animations in an application. User can bring interactivity by controlling the placement of text and duration of audio and video clips. Animations can also be inserted at the required places of application. E-learning applications can also be developed by using multimedia authoring tools and can be burnt on CD/DVD for students.

v. **Web Page Authoring:**

Web page authoring allows users to create web pages that include images, audio/video, graphics/animations and other special effects. They are used to make the web pages more attractive and interacting.

Some commonly used graphics packages include the following:

i. Adobe Photoshop

ii. Corel Draw

iii. Macromedia Free Hand

The screenshots are given from figures 5.14 to 5.16.

Figure-5.14: Adobe Photoshop

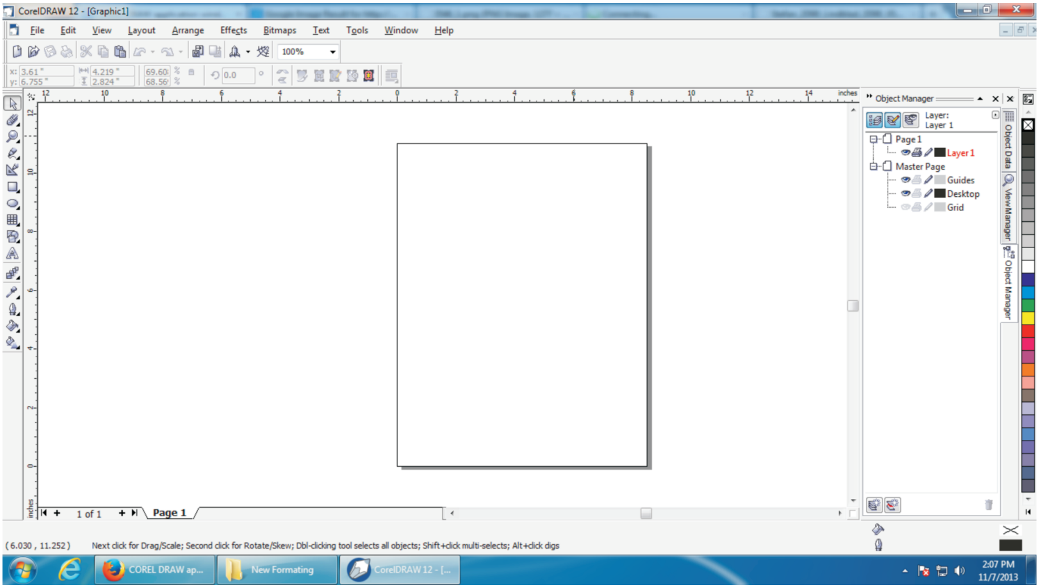


Figure-5.15: Corel Draw

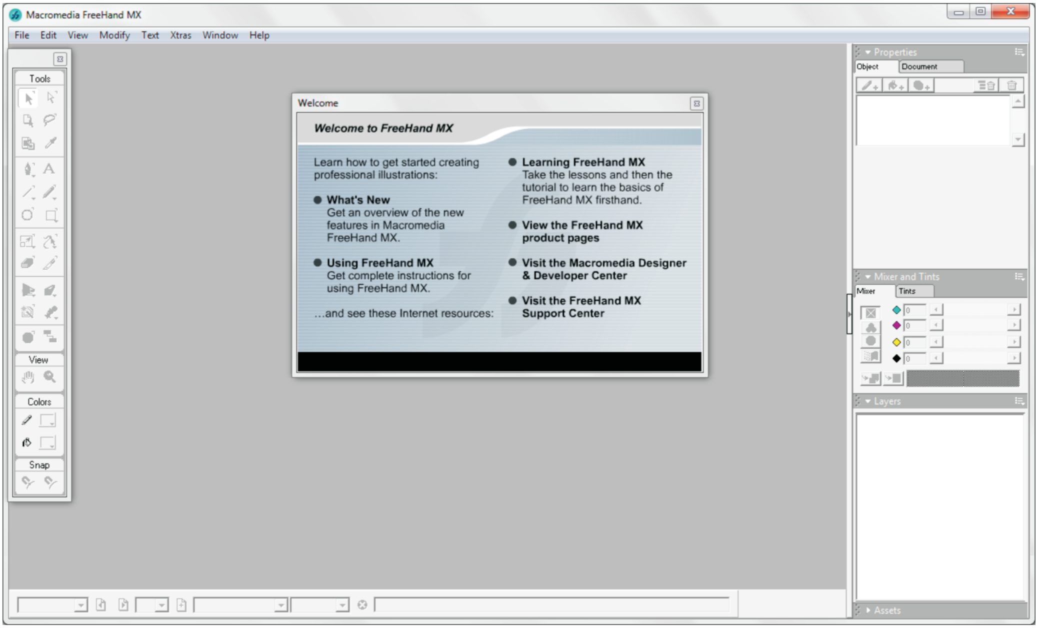


Figure-5.16: Macromedia Free Hand

- **Communication Packages:**

Communication packages are application programs that are used to facilitate communication between two nodes (computers, mobiles etc.). They allow the users to send and receive data over communication system. The data transfer may be between two nodes or between networks of nodes. The features of a communication package include the following:

i. Data upload i.e. send the data from the user node to another node
ii. Data download i.e. receive the data on the user node
iii. User session maintenance i.e. recognize individual user during live communication
iv. Support of file transfer i.e. send and receive files over the network

Application packages for communication include the following:

i. Web browser
ii. FTP (file Transfer protocol)
iii. SMS (Short messaging services)

- **Personal Assistance Packages:**

Personal assistance package allows users to store and retrieve their personal information. They are also used to plan and manage contacts, meetings, finances and other important information. Category based of personal assistance packages includes the following:

- **Calendar:**

Calendar enables users to record appointments and meetings. It alerts the user for the upcoming events and also inform in case of any conflicts when a new event is scheduled. It also allows users to browse the previous events with brief descriptions.

- **To Do List**:

To do list arranges the task to perform by the user. A user can plan and priortize the tasks with intimation targets and deadlines.

- **Address Book:**

Address book maintains the names, addresses, telephone numbers, and other related information about friends, relatives and officals. User can also search the particulars of known persons when required.

- **Personal Finance:**

Personal finance helps users to balance their checkbooks, maintain bill's records and track personal income/expenses and setup the budget.

- **Tax Preparation:**

Tax preparation guide individuals, families or small businesses prepare the taxes. Legal cases preparations assist in preparation of legal documents and provide legal information to the concerned users.

5.5 How Software Works (Installation and Un-installation):

Installation of a computer program is the method of making a program ready for execution and use. The process varies for each program, computer, and the operating system. There is a program called installer which comes with every software. The installer is responsible for doing whatever is needed for their installation. When software is installed on a personal computer; a series of functions are performed before and behind the screen.

Common measures performed during software installations include:

1. Study the features of different software versions and select the appropriate one as per your requirement.
2. Make sure that system requirements are avaialable
3. If software is already installed, it can be upgraded according to the latest version.
4. Install only the licensed copy of the software.

5.5.1 Install a New Software Program:

If you are installing software downloaded from the Internet, you simply download the installer and it starts working. If software is burnt on a CD-ROM, installer will run automatically when the CD is inserted into the CD-Rom.

The exact procedure may vary from one program to other. However; the setup.exe is a file which is provided with the installation package of most of the application software. When the user double clicks the setup.exe, the installer first unzips the files to a location in a temporary directory.

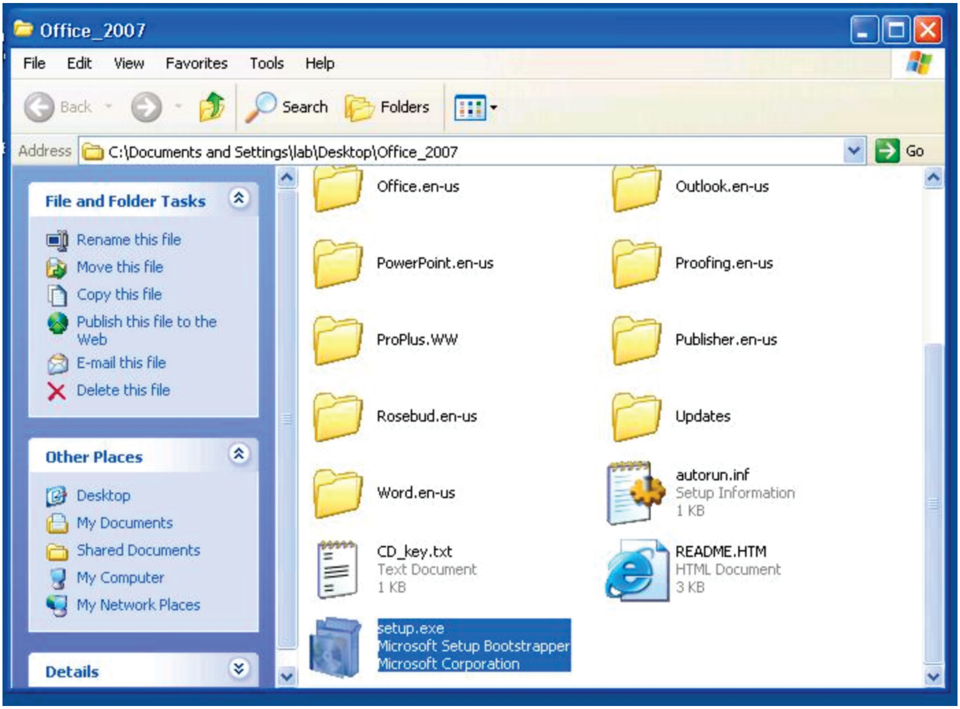


Figure-5.17: setup.exe

Next a license agreement comes up which urges upon the user either to agree or disagree, here user agrees to move forward. Next the installer prompts the user for location of the program. The user gives the appropriate location and the process moves forward.

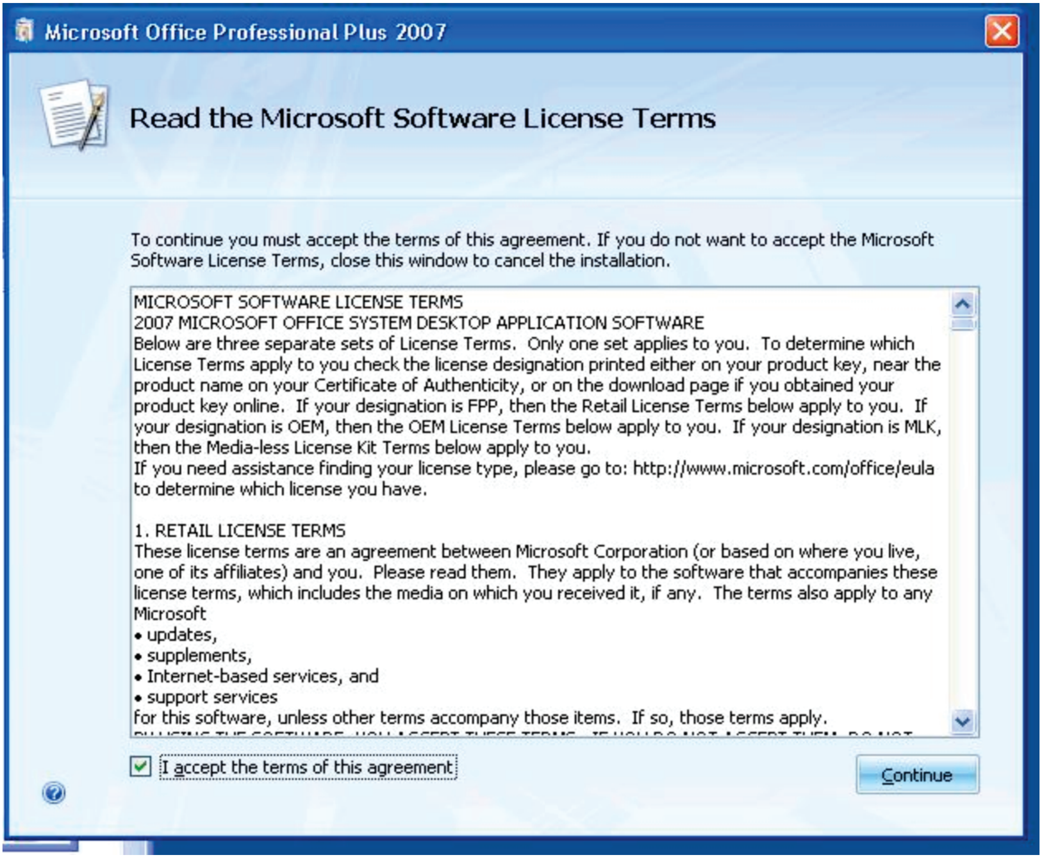


Figure-5.18: License Agreement

Now the installer can copy the relevant program files to the target location in the destination directory provided by the user. An application is generally made up of many individual files. Most of the files are stored in the application's destination directory. The installer continues the installation in the destination file till the completion of process.

Figure-5.19: Installation progress

The Windows Registry is a hierarchical database that stores settings and preferences for software and hardware. It contains configuration information about low-level operating system components and applications running on the platform. The recently installed program also stores settings information in the Registry. The software installer updates the information of system registry by adding information about new program and set default settings for the application. Please do not try to modify the registry at your own without any technical assistance.

Many installers provide shortcuts at the Desktop or Start Menu to invoke the installed program. After completing the installation, it deletes all the files which were created temporarily. Finally, a message is displayed that the program has been installed and the new software is ready to use.

5.5.2 Uninstall a Program:

If a user wants to remove a program, it needs to be uninstalled from the PC. Some programs provide an uninstall link or icon in the application directory, However in Windows XP user can uninstall a program by using Add Or Remove option available in the control panel.

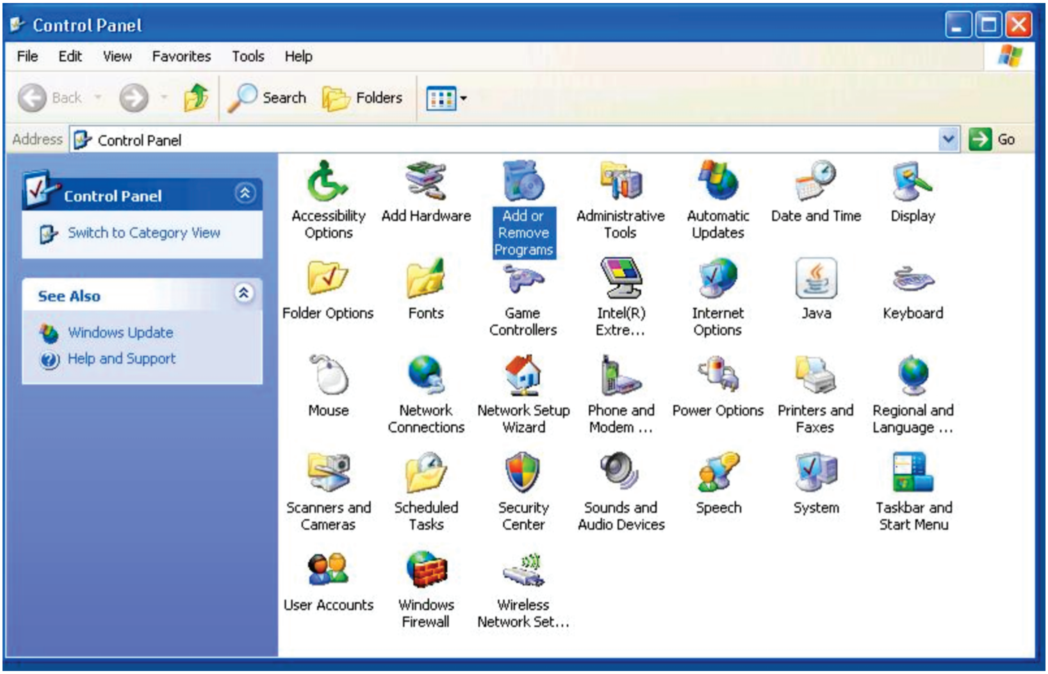


Figure-5.20: Control Panel

The user clicks on the control Panel and selects Add/Remove programs. A panel appears comprising of installed program. The user selects the required program and clicks the remove button. The uninstaller eliminates the program files along with the folder that it created and also removes relevant entries in the system registry.

5.6 Self Assessment Questions:

Q. No.1. What is meant by computer software?

Q. No.2. Differentiate between system software and application software?

Q. No.3. List down key functions performed by system software?

Q. No.4. What is utility program? Why they are used?

Q. No.5. What is meant by word processing? List key features provided by word processors.

Q. No.6. Explain the important features of spreadsheet package.

Q. No.7. Write important steps of installation and un-installation of softwares.

5.7 Self Assessment Activities:

1. Collect information about latest versions of well known application softwares. Compare and contrast features.

2. Prepare a list of device drivers installed in your home/office or any other computer.

3. Explore the basic use of word processor and spreadsheet softwares.

4. Install and uninstall any software of your choice in your home/office or any other computer. (***You may take help from your tutor/internet/any relevant book***)

Unit 6

OPERATING SYSTEM

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CONTENTS

OPERATING SYSTEM

6.1. Introduction

This unit covers the basic concept of an operating system and its functionality. This unit also covers basics of commonly used operating systems. It mainly deals with the "Microsoft Windows Practice".

6.2. Objectives:

After complete study of this unit, you will be in position to:

- Describe the basic concept of an operating system
- Identify the functions of an operating system
- Define system performance measures & process management tools
- Explain some popular operating systems
- Explore Microsoft Windows Practice.

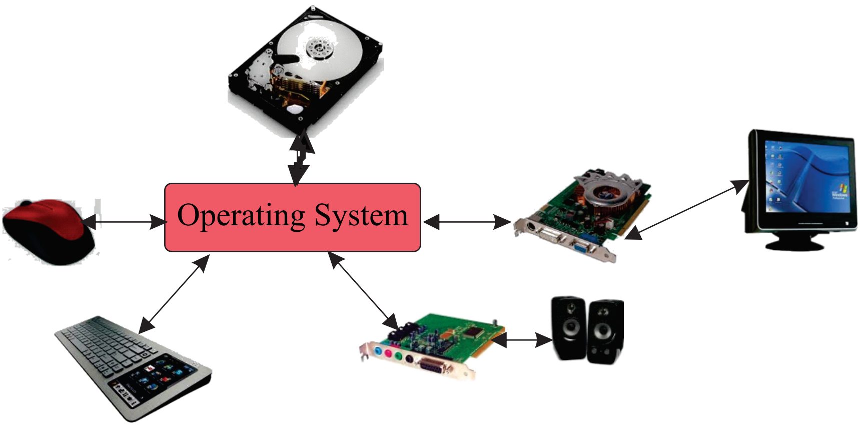
6.3. Introduction

An operating system is the most important and major program that runs on a system (computer). Every computer system must have an operating system in order to run different programs. The operating system is collection of softwares which manage various computer hardware resources. It additionally provides common services to different computer programs.

An operating system performs several tasks such as:

1. Recognize input from a keyboard
2. Send output to a display screen (monitor)
3. Keep track of files as well as directories on a disk
4. Control various peripheral devices like hard drive, printer, video or sound card etc.

A figure named as "Operating System & its Interfaces" shows the above basic concept in a clear way:



Firgure-6.1: "Operating System & its Interfaces"

An operating system generally acts as an “ interaction” between computer user and computer hardware. The most observable feature of an operating-system is its interface. The operating system basically provides an environment where users can execute different programs.

As soon as a user turn-on or boot a computer, the operating system is loaded into memory automatically. The term booting basically refers to the complete process of loading any operating system into a computer's memory. This process is usually done through a program (commonly known as boot-strap loader) which is permanently stored in a computer's electronic circuitry (generally on a ROM-chip).

6.4. Types of Operating System

The operating systems are generally categorized into two major types depending on the basis of numerous features such as Graphical User Interface (GUI) Operating-System and Command Line Operating-System. The description of these both types of operating systems is given below:

6.4.1. Graphical User Interface (GUI) Operating-System

A GUI operating-system basically provides a graphical-user-interface to its users in order to communicate with system/computer. In this interface, the icons, menus or graphical objects are being used for issuing commands. The users of GUI operating systems don't need to memorize different commands while interacting with computer. The examples of GUI operating-system include:

- Windows (The windows (operating system) are very popular among all others which will be described in this unit in detail).
- Linux etc.

The best features of graphical-user-interface may include:

- Easy to learn (As it is described above that the users of GUI don't need to memorize different commands while interacting with computer)
- Simple to use (More User Friendly as compared to command line operating system)
- More interactive
- Efficient (It provides various shortcuts)
- Multi-tasking (It easily enables users to view, control as well as manipulate multiple tasks at a time).

The drawbacks of the graphical-user-interface (GUI) operating-system may include:

- It is not so faster as compared to command line operating-system.
- It doesn't provide a powerful and significant scripting facility as compared to command line operating-system (but it provides various shortcuts).
- It doesn't provide full/complete access to computer-resources (It basically provides very less control to the file system as well as operating system).
- In terms of use, it is slow as compared to command line operating-system.

6.4.2. Command Line Operating-System

A command line operating-system basically provides a command-prompt in order to type different commands.The users use these commands while their interaction with computer.The users of command line operating systems need to memorize different commands for performing various tasks.The examples of command line operating-system include:

- DOS
- Unix etc.

The features of command line operating-system may include:

- It is faster than GUI operating system.
- It provides a powerful and significant scripting facility.
- It provides full/complete access to computer-resources.

There are also some drawbacks of the command line operating-system such as:

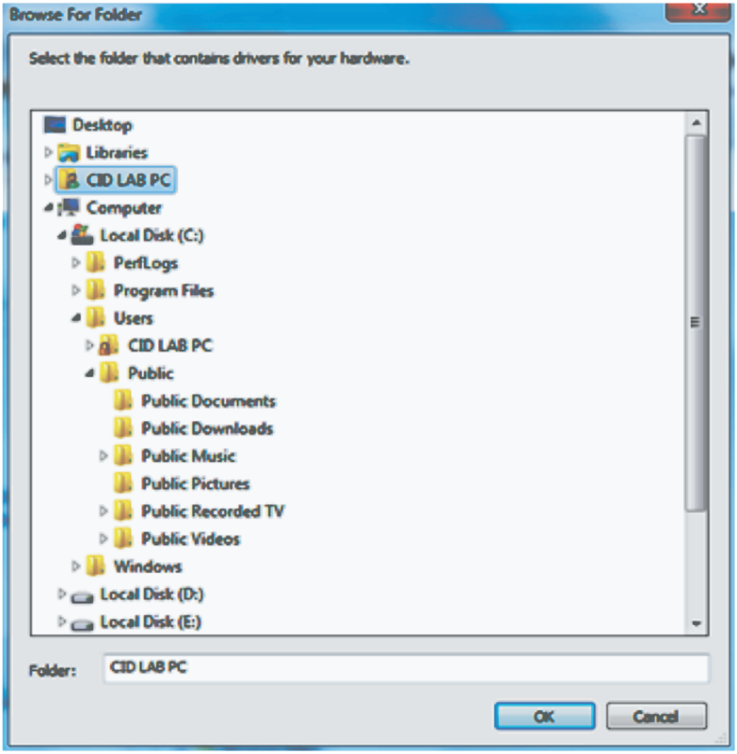
- Not very easy to learn
- Not very simple to use
- Few command line operating-systems provide the facility of multi-tasking (but it is very difficult to implement).

6.5. Functions of an Operating System

Following are the common functions of an operating system:

6.5.1. Manage Resources

One of the major functions of an operating system is to manage the different resources of a computer which include mouse, keyboard, monitor, printer, storage devices or memory etc. The operating system usually creates a file-structure on a hard drive. Once a file is stored, the operating system saves it, names it and also remembers it for future use. The way by which an operating system normally organizes information/data into file(s) is called a file system. The operating systems mostly use "Hierarchical File System" where the files are organized into directories (generally referred as folders) under a tree-structure. The screenshot of a tree structure while using Windows Explorer is shown below:

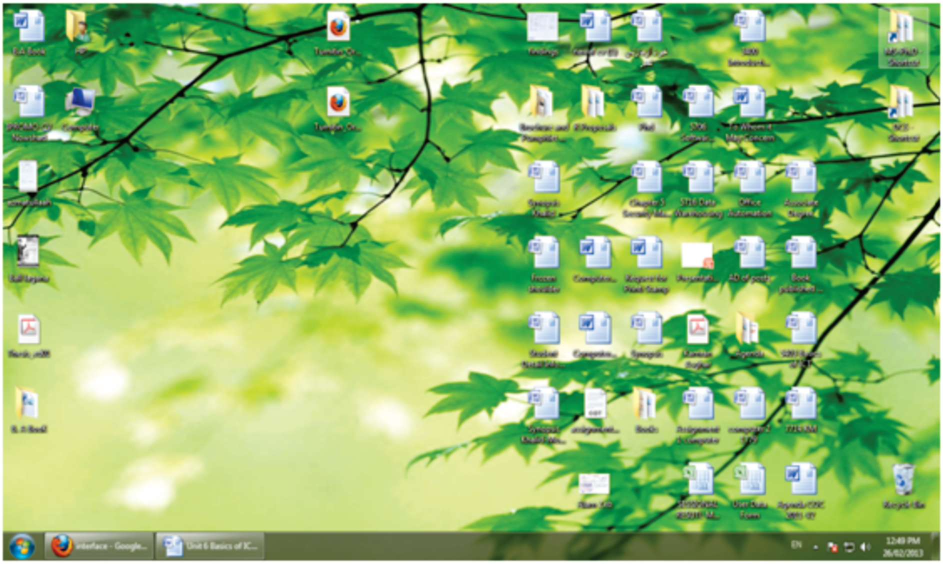


Firgure-6.2: A Screenshot of a Tree Structure

6.5.2. User Interface

The users basically interact with the application programs as well as the computer hardware by user-interface. Today, almost every operating system provides a "Graphical User Interface" (GUI) where the graphic-objects or icons are generally used to represent various features. The GUI is an efficient interface where the users issue different commands with the help of different pointing devices such as mouse in order to point or click on icons, menus, lists as well as buttons on a screen etc.

A screenshot of a Graphical User Interface (GUI) while using Windows 7 is shown below:



Firgure-6.3: A screenshot of a Graphical User Interface (GUI)

6.5.3. Run Applications

Most of the operating systems support "multi-tasking". The term multi-tasking means that an ability to run two or more applications/programs at a time. As soon as a user sends a request for a program, an operating system suddenly locates that application & loads it into a RAM (Random Access Memory).

If more programs are being loaded then the operating-system must allocate various computer resources.

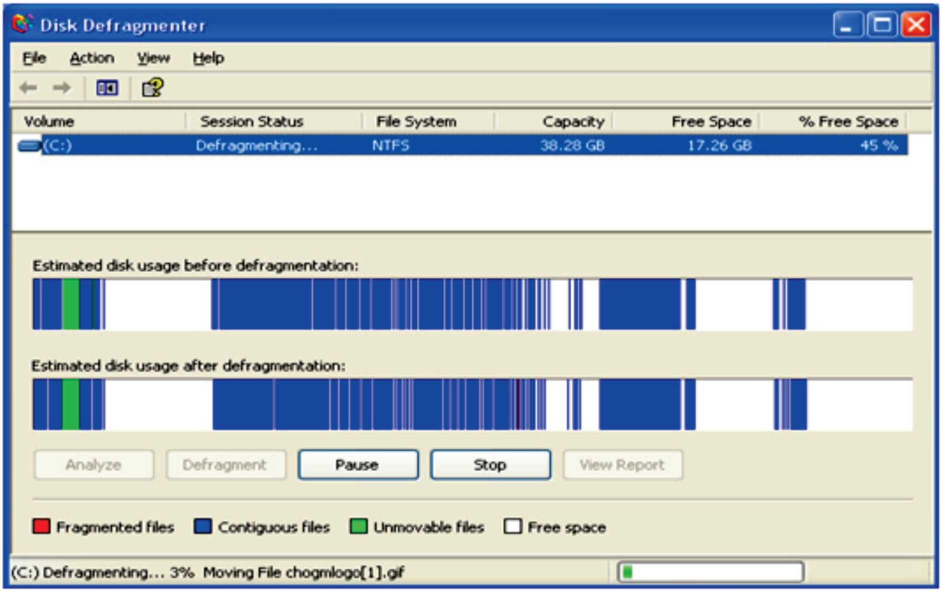
6.5.4. Support for Built-In Utility Programs

An operating system may use utility program for the purpose of repairing and maintenance. The utility programs are special programs which make the use of computer more easy. When unexpected things happen such as hard disk crash, virus attacks or slow operations etc. then function of the utility programs start. Many operating systems like "windows" have built-in utility programs for common purposes. These utility programs are commonly known as "System Tools". In order to find these tools, follow the following steps: Click on Start / Programs / Accessories/System Tools. The main examples of these utility tools may include:

1) Format
2) Scan Disk
3) Disk Cleanup
4) Disk Defragmenter and
5) Anti-Virus etc.

The following image shows a progress of "Disk Defragmenter" which is basically found in:

Programs > Accessories > System Tools.



Firgure-6.4: Disk Defragmention

The utility programs may help in identifying different problems such as locate lost files, repair damaged files and backup data etc.

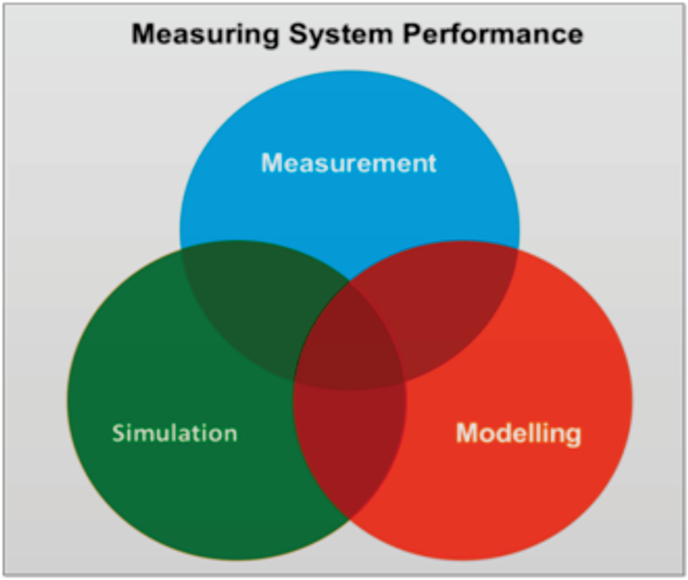
6.5.5. Control Computer Hardware

The operating system lies between the two main things which are defined as Programs and BIOS (Basic Input Output System). The BIOS mainly controls the computer hardware(s). Every program that needs hardware resources in order to run must go through an operating system. Finally it depends on the operating system either it access these hardware resources through BIOS or device drivers.

6.6. System Performance Measures

Measuring operating system's performance is such an important task which sets out the major and fundamental techniques which are used in analyzing as well as understanding its performance.

There are different methods which are being used for describing and measuring the operating system's performance such as measurement, simulation and modelling as shown below:



Firgure-6.5: Measuring System Performance

These methods are described below in detail:

6.6.1. Measurement

Measurement means to carry out some real experiment along with a real IP (Internet Protocol) system which is being operated in real time (with real users). A monitoring feature basically records all necessary and primary data during this experiment. After that the performance values can be easily computed from that recorded data.

6.6.2. Simulation

Mostly a "simplified functional model" of an IP system & its users is generally developed for simulation. Then a computer-program is written which runs that model. This computer-program may run in one of the three different modes which include slow motion, time lapse mode or in real time. Any one of these modes can be used easily (it doesn't create any problem). All necessary and fundamental information during the above simulated run can be simply recorded with the help of a software monitor. After that the performance values can be easily computed from that recorded data.

6.6.3. Modelling

A "very simplified functional model" of an IP system & its users is generally developed for modelling. From this model, another mathematical model is basically derived by using "queuing theory". This mathematical model is then analyzed with the help of so-called state equations (merely numerically). But sometimes the explicit formulae (of interesting performance-terms) may be found. Then the performance values may be computed with the help of those formulae.

Overall, the brief summary is that the simulation and modelling are those methods which use only “models of the system” under test. These two methods basically deliver performance-values of the models. These are estimated values which can't be considered as measured values. So it can be said that simulation and modelling only deliver predictions of performance-values. On the other hand, the measurement is that method where the real IP-system is analyzed, investigated and tested (which can be a considered a suitable approach for measuring system performance).

6.7. Process Management

A program doesn't do anything unless the instructions related to it are executed or carried out by a Central Processing Unit (CPU). The term “process” can be defined in many different ways such as:

- A program in execution-mode (as mentioned above) is called a process.
- A compiler (time-shared user program) can also be referred as a process.
- A word-processing program which is being run through an individual user (on a PC) is also known as a process.

So, it can be said that a process can be considered like a job/time-shared program.

Basically a program (by itself) is not a “process”. A program is usually a passive entity; say for example a file's contents which are stored on a disk, while a process is generally referred as an active entity. In a system, a process is basically a unit of work. Such system contains a broad collection of processes. Some of these processes are referred as operating system processes (those that execute system-code) and some of these processes are referred as user processes (those that execute user-code).

All these processes may potentially execute concurrently by means of multiplexing the CPU. For example, the operating-system may be responsible for those activities (which are listed below) in connection with process-management:

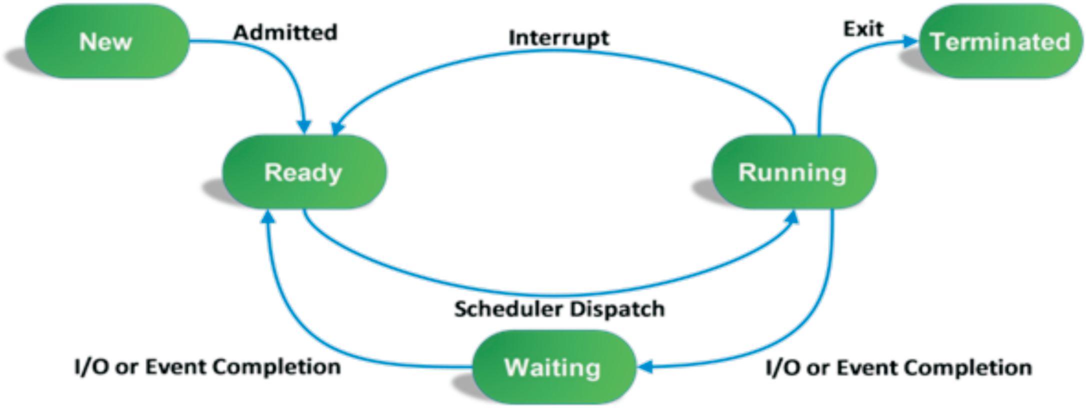
- Create & delete both users as well as system processes.
- Suspending & resuming processes.
- Provide mechanisms for the process synchronization.
- Provide mechanisms for the process communication.
- Provide mechanisms for the deadlock handling.

As a process carries-out/executes, it changes its state. The state of any process can be easily defined in part through current activity (action) of that process. Every process can be existed in anyone of the following mentioned states such as:

- **New:** A process is being produced / created.
- **Ready:** The process is now waiting to be allotted or assigned to some processor.
- **Running:** The instructions are being carried-out / executed.
- **Waiting:** The process is basically waiting for some result / event to occur (like an I/O completion / reception of a sign (signal)).

- **Terminated:** The process has completely finished execution.

The following figure "Process States" shows the relationship of all the above states of a process clearly:



Firgure-6.6: Process States

6.8. Commonly Used Operating Systems

The computer operating systems usually categorize by their different characteristics such as technology, working state, ownership, licensing as well as usage etc. There are number of operating systems which have become very famous at the time of their releases such as DOS (Disk Operating System), Windows 95, Windows NT (New Technology), UNIX, Linux, Macintosh Operating System, Windows 98, Windows 2000 Professional, Windows Me, Windows XP, Windows Vista and Windows 7, etc.

The use of these operating systems depends upon user's choice. Different users may use different types of computers with different operating systems. Main characteristics of commonly used operating systems may include:

1) System Reliability (It includes different functions such as windows error reporting, automated system recovery and improved system restore etc.)

2) Faster Start-Up

3) User Friendly Interface

4) Hardware support improvements (This support can be related to USB, Firewall, Windows image acquisition or Media transfer protocol etc.)

5) Remote Desktop Features (Those features which can allow users to connect with a system across a network and access their different applications like files or printers etc.)

6) Various improvements to "System Administration Tools" like Windows installer, Windows task manager, Disk defragmenter or Windows script host etc.)

7) Network Features (such as Windows firewall and Internet connection sharing)

8) Important Security Features (such as Encrypting file system improvement, Credential manager, Software restriction policies etc.)

The Windows XP, Windows Vista and Windows 7 have emerged as one of the popular operating systems.

A figure named as "Popular Operating Systems" shows the above concept in a clear way:

Figure-6.7: Popular Operating Systems

The above mentioned operating systems are still very popular among the users of all ages which are described below in detail:

6.8.1. Windows XP

Windows XP is a famous and highly compatible operating system. It was produced by "Microsoft". It is one of the most famous versions of Windows. The name XP is mainly abbreviated as "eXPerience". It was released worldwide both in "home" and "professional" versions in 2001. The following image shows the Windows XP interface:

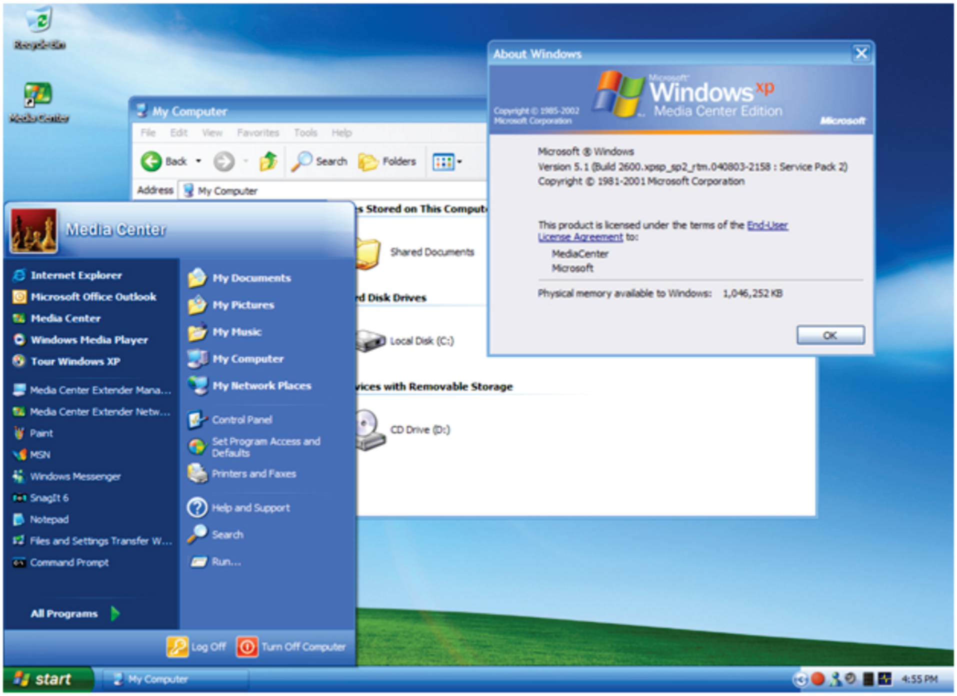


Figure-6.8: Microsoft Windows XP

The Windows XP (a successor to "Windows-2000" and "Windows-Me") was basically a first consumer-oriented operating-system. This operating system is highly used and very well accepted by users. There are a number of characteristics of this popular operating system such as:

a) New Task Based GUI (Graphical User Interface)
b) Updated Start-menu and Taskbar
c) System Reliability
d) Faster Start-Up
e) User Friendly Interface
f) Hardware Support Improvements
g) Remote Desktop Features
h) Various improvements to "System Administration Tools"

i) Network Features

j) Important Security Features.

6.8.2. Windows Vista

The windows vista was also produced by Microsoft. It was released in 2007. This operating system is basically a successor to a very popular operating system "Windows XP". It can be used for personal commuters like home & business desktops, tablet PCs, laptops or media center PCs etc. It is also one of the efficient operating systems. The following image shows the Windows Vista interface:

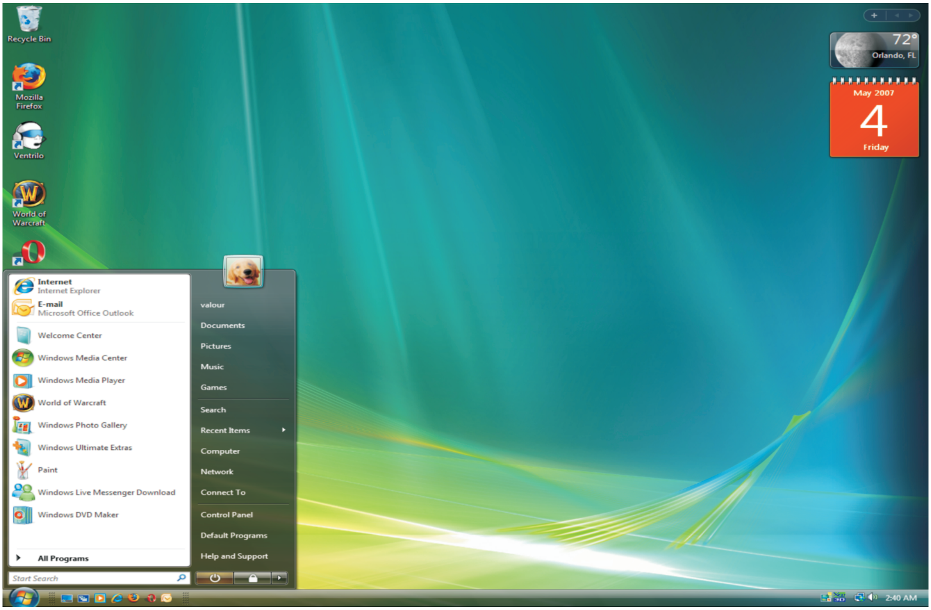


Figure-6.9: Microsoft Windows Vista

As compared to windows XP, it has contained a lot of changes as well as new features such as:

a) Updated Graphical User Interface

b) New Visual Style

c) Updated Search Function

d) Important Multimedia Tools which also include windows DVD maker.

e) A redesigned Networking Feature

f) Audio, Print & Display sub-systems

g) User Friendly Interface

This version of windows included the feature of ".Net Framework" which allows software-developers to write complex applications without "traditional windows APIs (Application Programming Interfaces)". This version was succeeded to improve the security features of windows XP which is considered as one of its best features.

6.8.3. Windows 7

The Windows-7 was also produced by Microsoft. It was released in 2009. This operating system is basically a successor to another popular operating system "Windows Vista". It can also be used for personal computers like home & business desktops, tablet PCs, laptops or media center PCs etc. It is also very famous and highly compatible operating system.

The following image shows the Windows-7 interface:

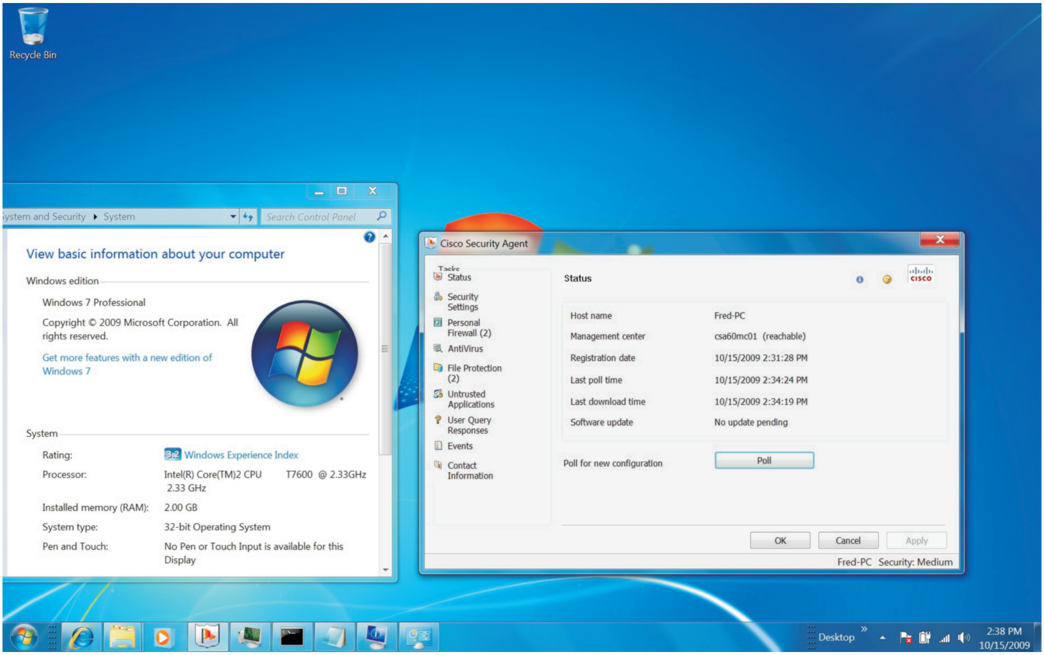


Figure-6.10: Microsoft Windows-7

There are a number of characteristics such as:

i). Updated Graphical User Interface

ii). Multi-touch Support

iii). A redesigned "Windows shell" with a new taskbar

iv). Improved Multimedia Features

v). Faster Start-Up

vi). Hardware Support Improvements

vii). New Version of "Windows Media Center"

viii). Remote Desktop Features

ix). Important Security Features

x). Improved Performance on "Multi-core" Processors

xi). New Visual Style

xii). Networking Features

xiii). User Friendly Interface.

All these features of windows-7 have made this version of windows very popular and significant. Due to these features, it is considered as highly stable and efficient operating system.

After this efficient operating system, the Microsoft has released "Windows 8" (a successor to Windows-7) in 2012. It can also be used for personal computers like home & business desktops, tablet PCs, laptops or media center PCs etc.

The following image shows the Windows-8 interface:

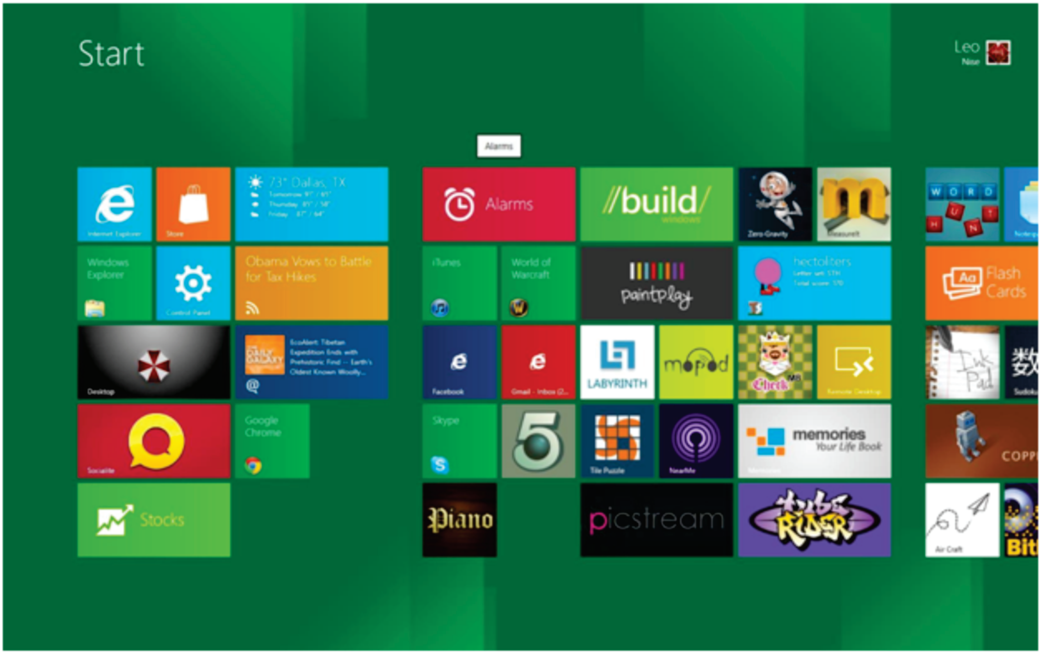


Figure-6.11: Microsoft Windows-8 Startup

Hopefully, it can be believed that this newly released operating system will become very popular among the users of all ages.

6.9. Microsoft Windows Practice

Microsoft windows practice includes different tasks such as how to "start & shutdown a system", "create & open the icons" as well as "open, close & sizing the windows" etc. All the above tasks are briefly explained below:

6.9.1. How to Start a System

In order to start the system, simply follow the following steps:

1. Start the system by powering on "computer" as shown in the following figure as well as its peripheral devices such as monitor, printer or scanner etc.

Figure-6.12: Computer Start-Up Process

1. Then click your "user-account" icon in order to log on simply *without a password*. Or one can also click a "user-account" icon in order to log on *with the password*.
2. Then press enter to "log on".

After that your desktop will be appeared.

6.9.2. How to Shutdown a System

Let us consider an example of Windows-7. In order to shutdown the system, simply follow these steps:

1. Click the Start-Button (which shows on desktop's left-corner (below))
2. Then simply click “Shut down” icon (as shown below in the following figure)

Figure-6.13: Shut-down a System/Computer

After that the system will be safely shutdown (closed).

6.9.3. How to Create/Operate Icons

Let us consider an example of Windows-7. In order to create/operate desktop icons, simply follow the following steps:

1. Write click on desktop, a smarter window will be open with different options. Simply choose an option “Personalize”.

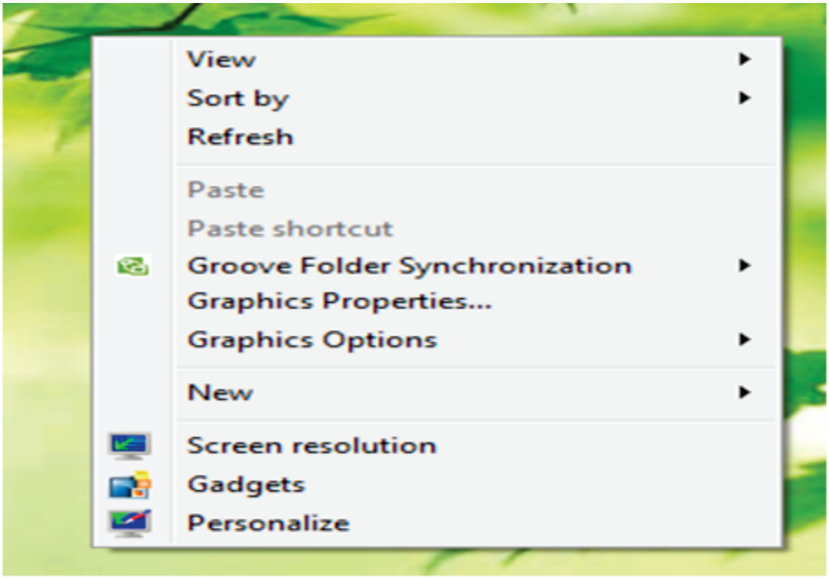


Figure-6.14: Creating Icons

2. After clicking this option, another window will be open where one can see an option "Change desktop icons" on left upper corner. Simply choose this option.

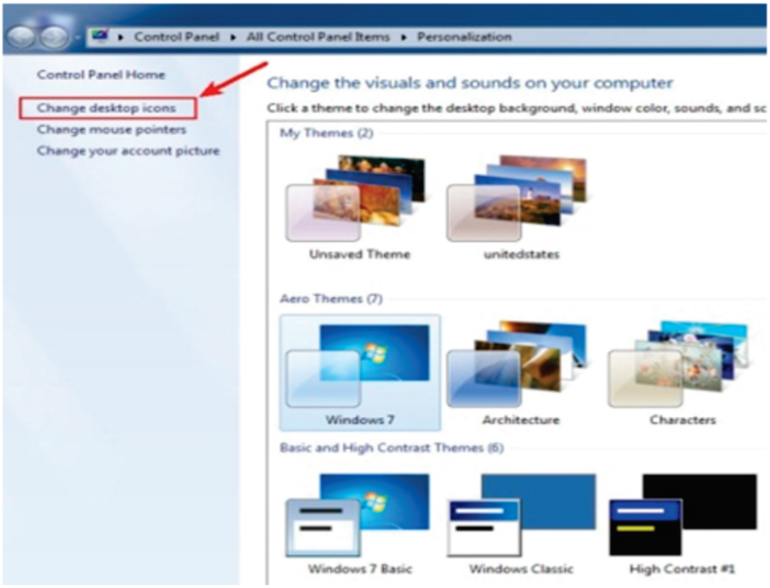


Figure-6.15: Change desktop icons

3. After clicking this option, another smarter window will be open which is named as "Desktop Icon Settings". Here one can see the different icons along with their default images and names such as Computer, Network or Recycle Bin etc.

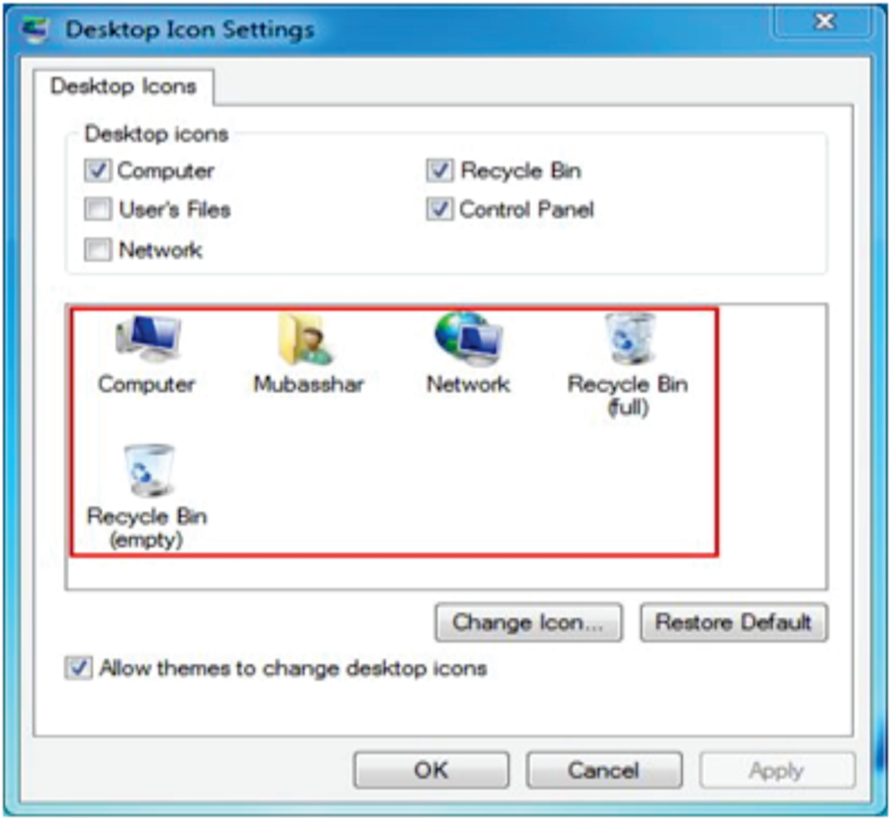


Figure-6.16: Desktop Icon Settings

4. After that select any icon (which a user wants to change), then press "Change Icon…" button. Another smarter window will be open with a lot of images. Select an image of your choice and press "OK" button.

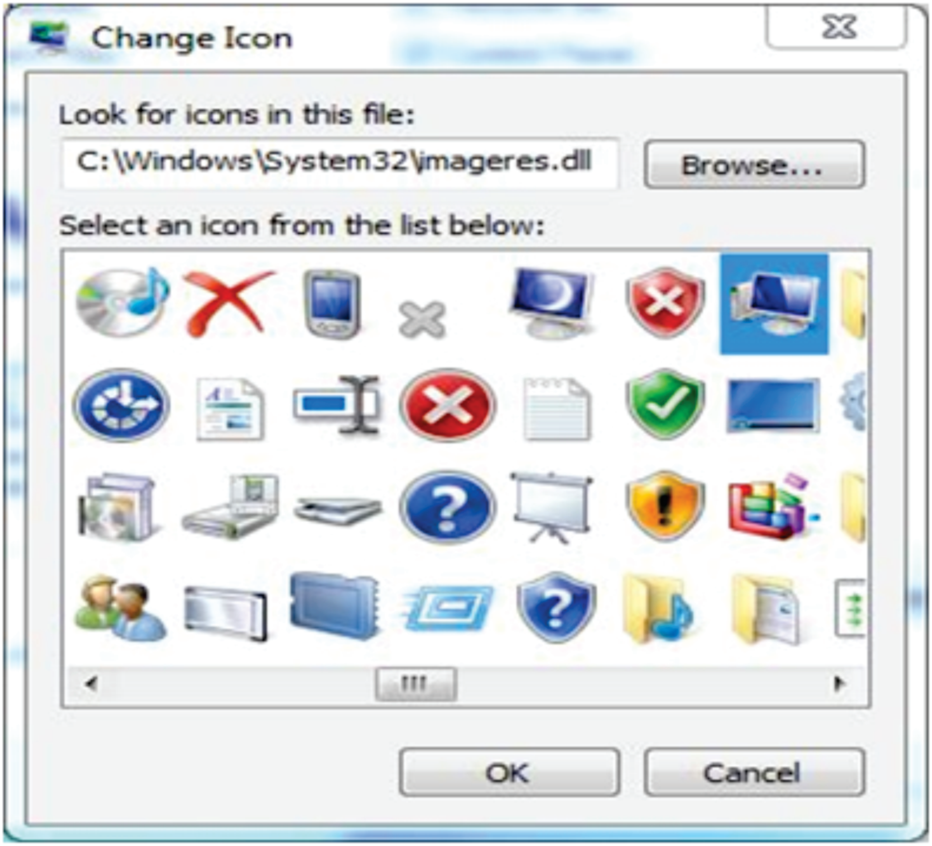


Figure-6.17: Change Icon

5. Then one can see that selected icon with the new image on the same smarter window “Desktop Icon Settings” (which is already appeared according to step 3).

6. If you are satisfied then press “Apply” button and then press “OK” button.

After that process, the selected icon with the new image can be easily seen on the desktop. In this way, the icons can be easily created as well as operated by user's choice.

6.9.4. How to Open the Windows (Operating System)

One computer can have more than one operating systems installed on it but it should be noted that only one operating system can be used at a time.

For example, if Windows XP and Windows-7 have been installed on a computer then only one operating system can be used at a time (it depends upon a user's choice).

In order to open the windows-7, just follow the following steps:

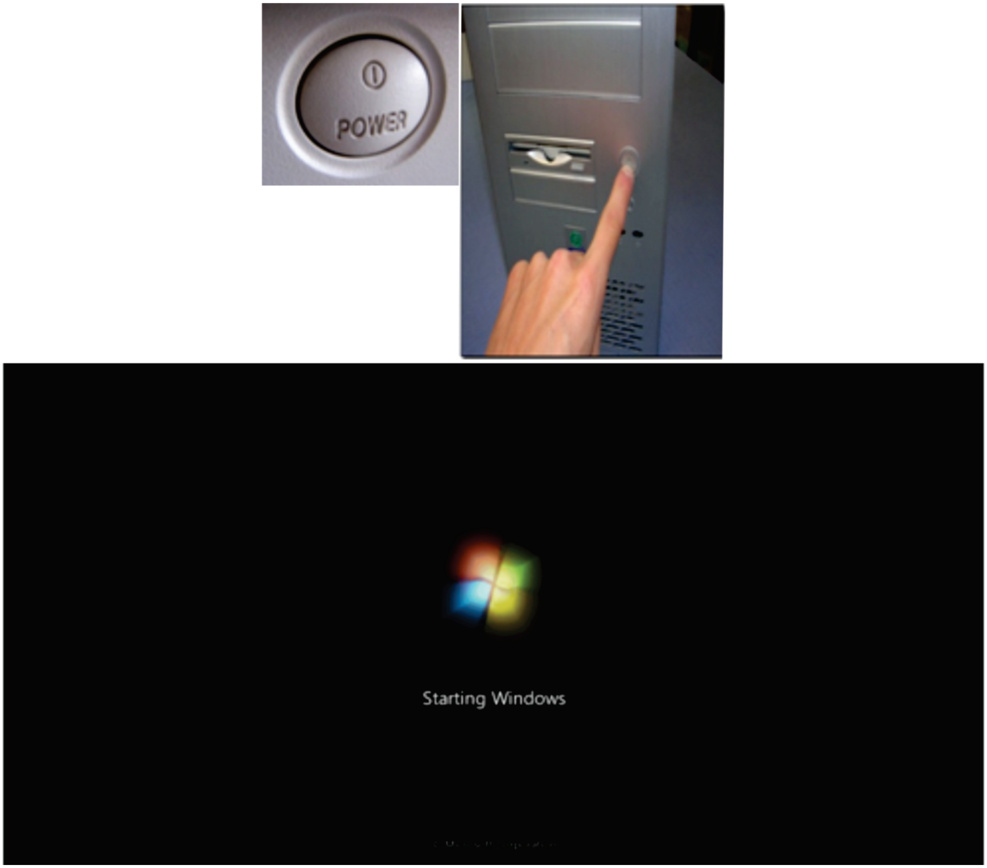


Figure-6.18: Starting Computer

1. Simply power on "computer" (as mentioned above in section "How to start a System").
2. All installed operating systems will be seen clearly. Now it depends upon a user. Just click on any one operating system which you want to use. It will simply start to open. Go to next step simply.
3. Note: if there is only one operating system installed then leave the above step and just go to the next step.
4. Click your "user-account" icon in order to log on. Note: If you have a password then give it and press "Enter", the windows will simply start to open. Otherwise (if you have no password) then simply click the "user-account" icon.

Figure-6.19: User-Account

After this your desktop will be appeared.

6.9.5. How to Close the Windows (Operating System)

Let us consider an example of Windows-7. In order to close the windows, simply follow the following steps:

1. Click the Start-Button (which shows on desktop's below left-corner)
2. Then simply click "Shut-down" icon (as shown below in the following image).

Figure-6.20: Shut-down Operating System

After that the windows will be safely closed.

6.10. Using Elementary Job Commands

It includes different job commands which are explained below:

6.10.1. Create a File

Each file is basically given a file-name (i.e. some common file-name) and extension such as:

- doc: Word Document
- txt: Text File
- xls: Excel Spreadsheet
- htm or html: HTML File
- ppt: Power Point Presentation etc.

As the MS Word is an application package used to create official/personal documents. So let us see the procedure of creating a file in MS-Word:

Note: Microsoft Office should be installed in order to take a start.

1. First of all, click start menu (start button) then a list of different options will be opened. Choose an option "All Programs".

Figure-6.21: Choose an option "All Programs"

2. Then another list of different options will be opened. Choose an option "Microsoft Office".

Figure-6.22: Choose an option “Microsoft Office”

3. By clicking this option “Microsoft Office”, different sub-options will be opened immediately. Then simply click “Microsoft Office Word”, a document will be opened which is basically known as a word file.

Figure-6.23: Click “Microsoft Office Word”

4. Simple write/type something on this file. Then after completion, the file is needed to be saved. Just follow the next step below.

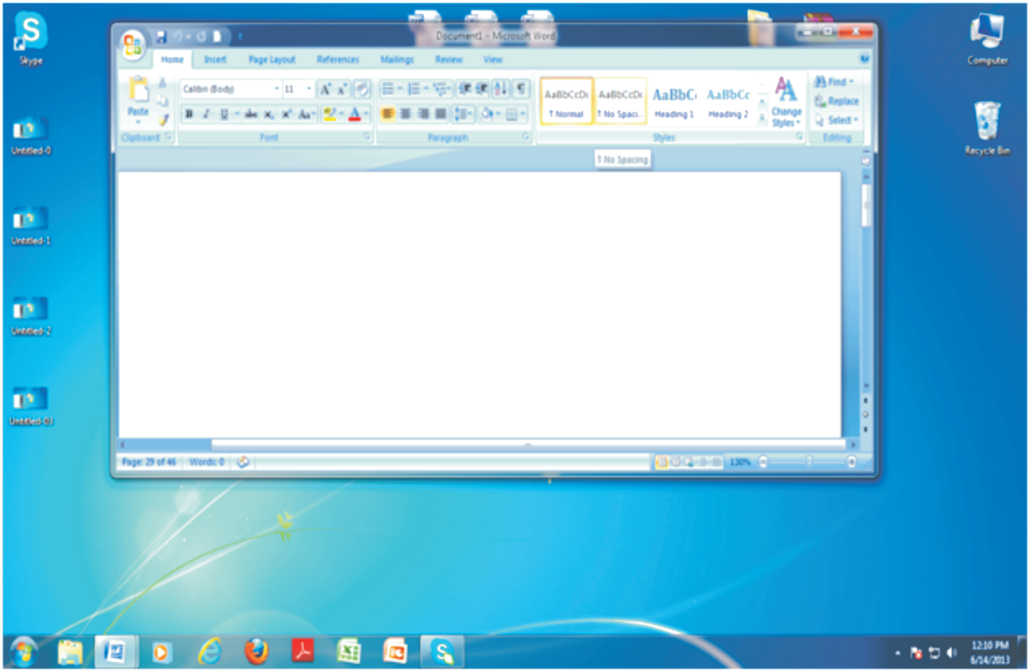


Figure-6.24: A Word File

6.10.2. Save a File

The following is the basic procedure of saving a file in the MS-Word:

1. Just click a button (Office Button) on the upper left corner of the file. Then click an option "Save", by clicking this option, a dialog box will be opened where you will give a path to save this file.

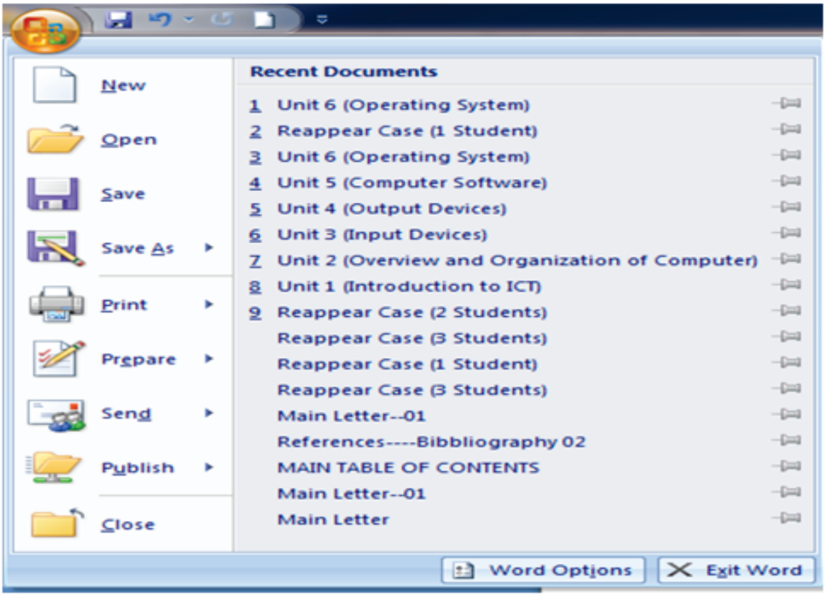


Figure-6.25: Click an Option "Save"

2. Any path can be chosen e.g. desktop. (On the left hand side of this dialog box, a scrolling vertical bar will be seen. One can scroll this bar by choosing any other path for saving this file).

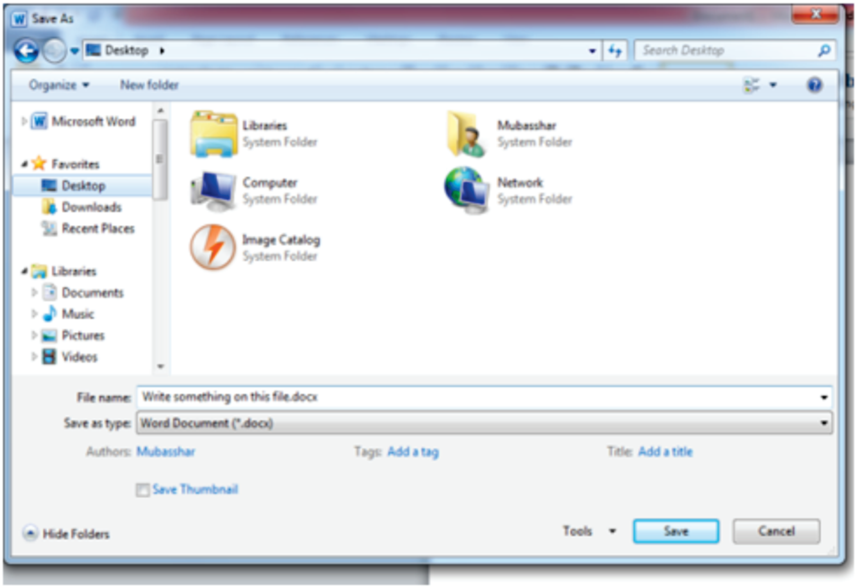


Figure-6.26: How to give a Path

3. Then just give a file name e.g. My Document

4. Press "Save" button (then this word file will automatically be saved on desktop). After that, the user can modify this file at any time. For this purpose, just go to the next step below.

6.10.3. Modify a File

Modify means to do changes in the document. The following is the basic procedure of modifying an MS-Word file:

1. Simply locate the file to be changed where you have saved it. Double click on this file then the file will be opened.

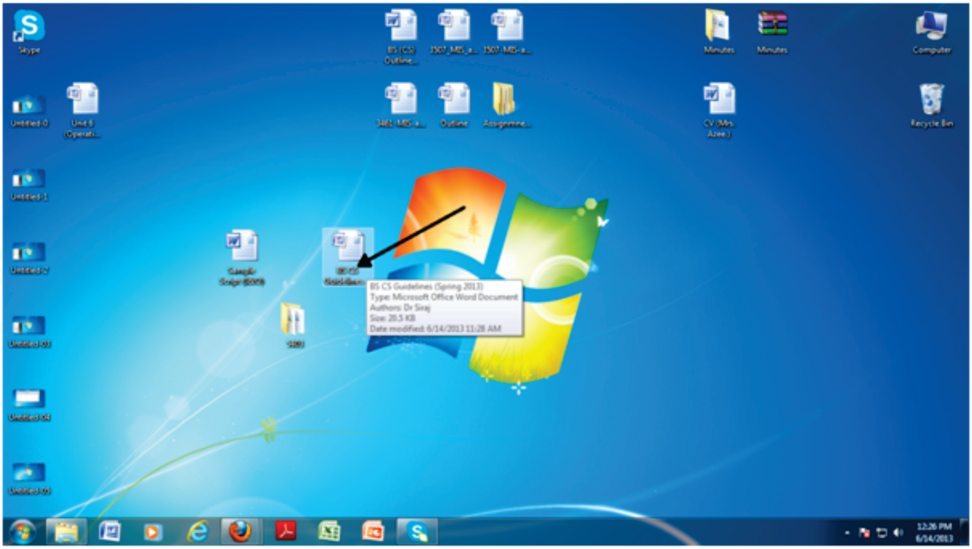


Figure-6.27: Modifying an MS-Word File

2. Then do changes according to your requirements. After that the file again needs to be saved then there are two options to save this file such as:

➢ Just click on the save button (which shows on the upper left

Corner of the file (just along with office button). Then simply close this file. The file will be saved safely.

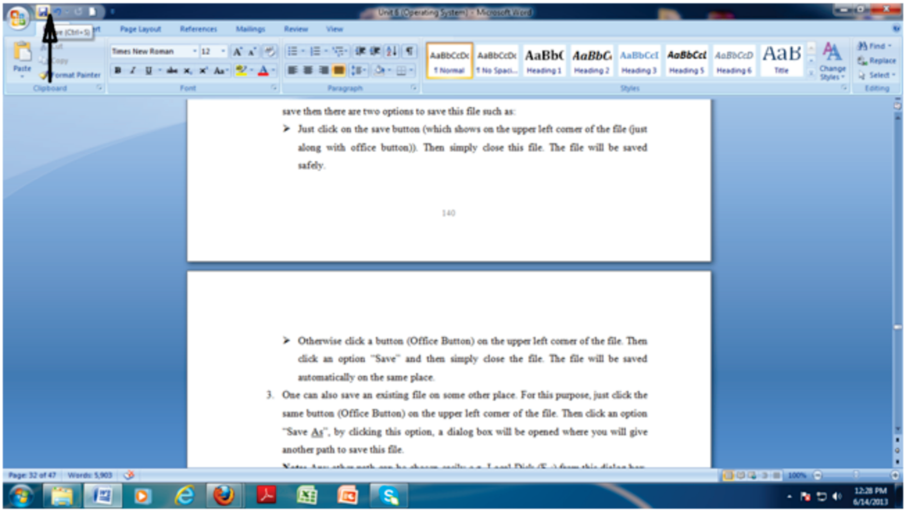


Figure-6.28: Click on the Save Button

➢ Otherwise click a button (Office Button) on the upper left corner of the file. Then click an option "Save" and then simply close the file. The file will be saved automatically on the same place.

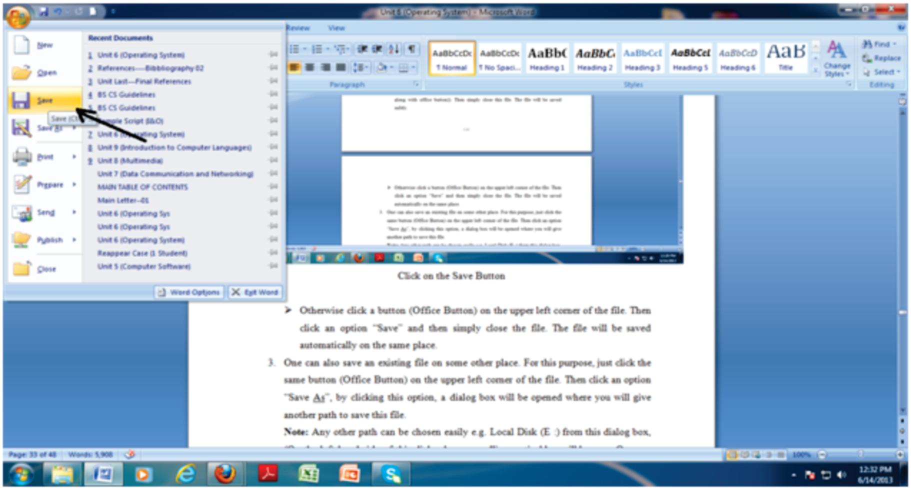


Figure-6.29: Click an option "Save"

3. One can also save an existing file on some other place. For this purpose, just click the same button (Office Button) on the upper left corner of the file. Then click an option "Save As", by clicking this option, a dialog box will be opened where you will give another path to save this file.

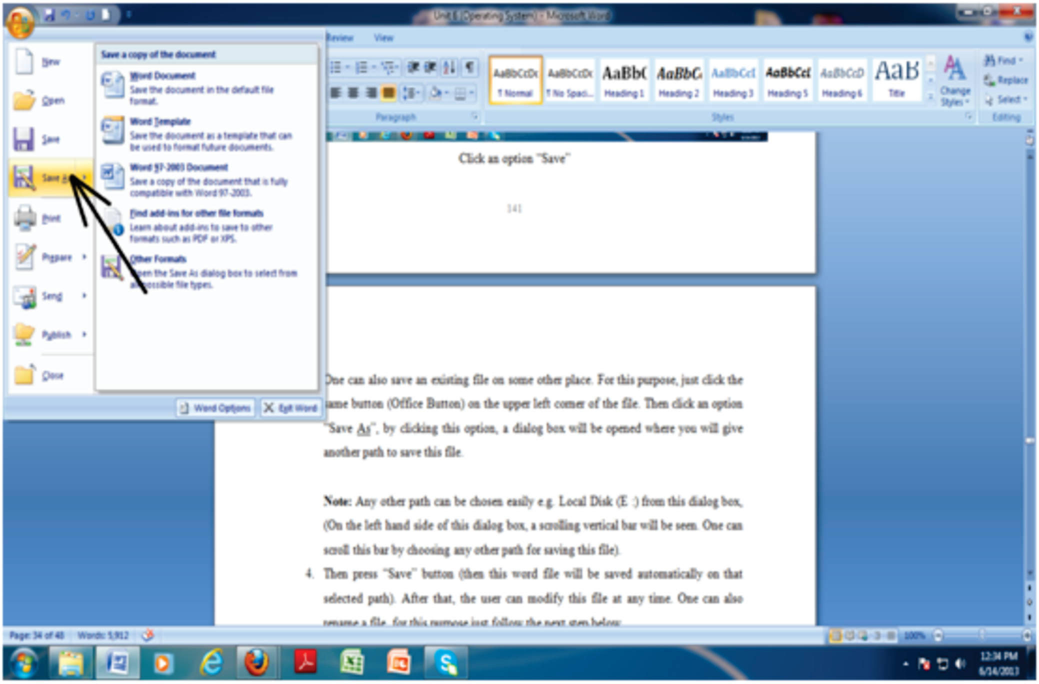


Figure-6.30: Click an option "Save As"

Note: Any other path can be chosen easily e.g. Local Disk (E :) from this dialog box, (On the left hand side of this dialog box, a scrolling vertical bar will be seen. One can scroll this bar by choosing any other path for saving this file).

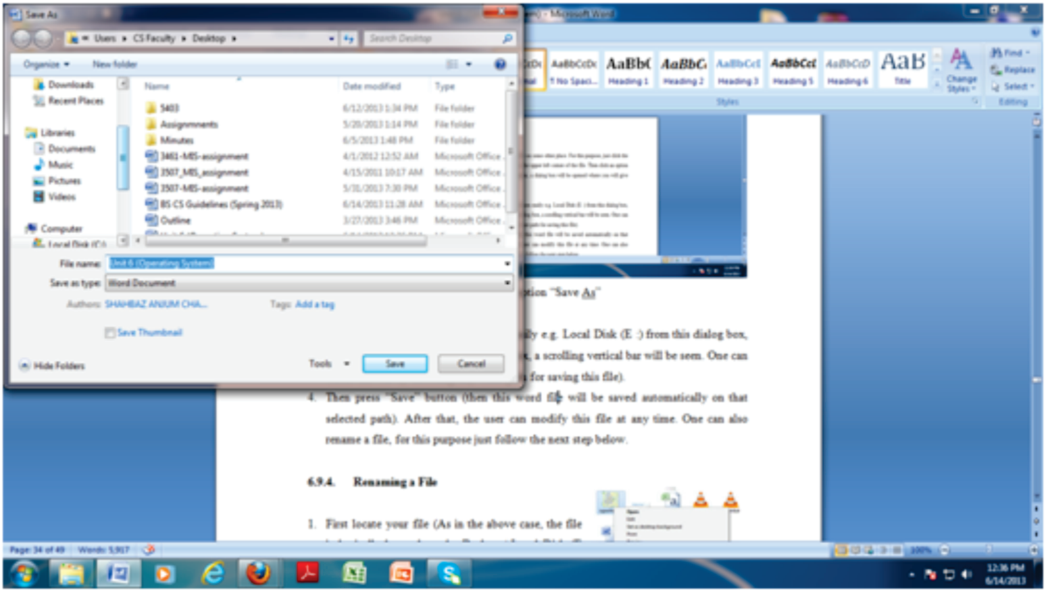


Figure-6.31: Choose a path

4. Then press “Save” button (then this word file will be saved automatically on that selected path). After that, the user can modify this file at any time. One can also rename a file, for this purpose just follow the next step below.

6.10.4. Renaming a File

1. First locate your file (Let us consider, the file is located on the Desktop).
2. Right-click the file.
3. Choose an option “Rename”.
4. The file name will be highlighted in blue then ready to be retyped.

Figure-6.32: Renaming a File

5. Type a new file name and then press Enter.
6. The file is "renamed".

One can also delete a file, for this purpose just follow the next step below.

6.10.5. Delete a File

1. First locate your file (As in the above case, the file is basically located on the Desktop).
2. Right-click the file icon.
3. Choose an option "Delete".

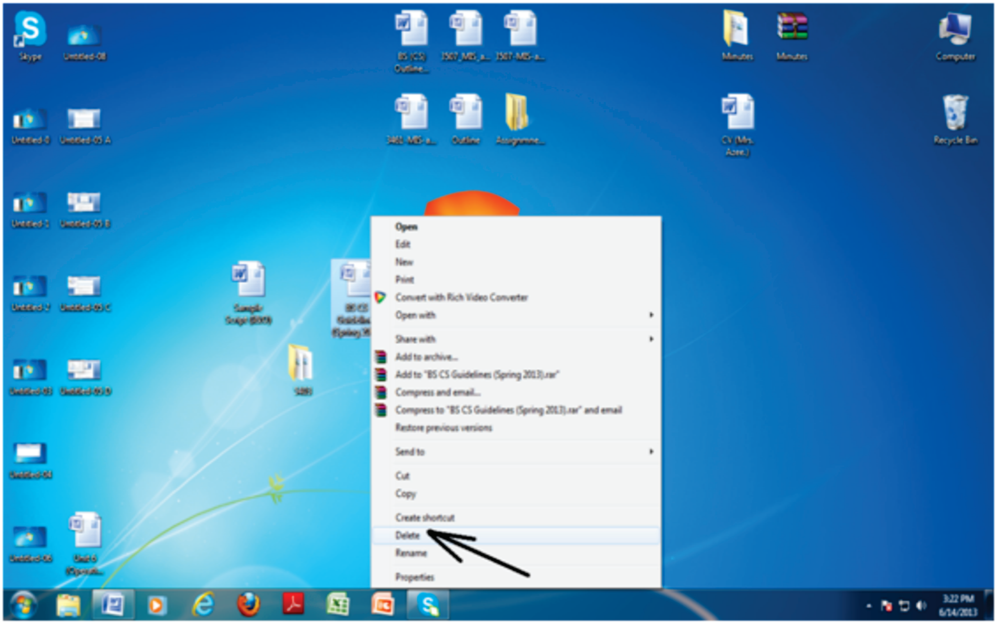


Figure-6.33: Delete a File

4. A "Delete File" dialog box will be appeared in order to ask you "Are you sure you want to move this file to the Recycle Bin?".

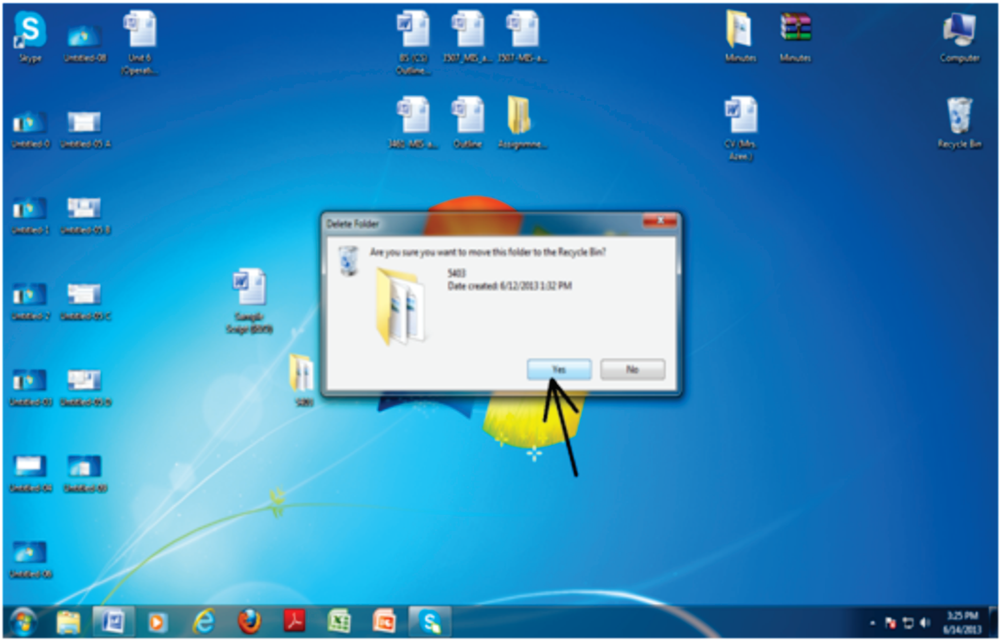


Figure-6.34: A "Delete File" Dialog Box

5. Choose Yes, if you want to delete this file.
6. Then the file will be moved to the Recycle Bin (Till now the file has been deleted from the original path but still existed in Recycle Bin).

Note: If you want to delete this file permanently from a system then go to Recycle Bin and delete the same file. In order to delete the file from Recylcle Bin, just follow the following steps which are similar to the above steps except those changes which are highlighted below:

- Right-click the file icon.
- Choose an option "Delete".
- A "Delete File" dialog box will be appeared in order to ask you "**Are you sure you want to permanently delete this file?**".
- Choose Yes, if you want to **permanently**delete this file.

Then the file will be deleted permanently from the system.

6.10.6. Find a File

In order to find a file in a system, follow the following steps:

1. Double click an icon "Computer" on desktop. A window will be opened.
2. On the upper right corner of this window, an option "Search Computer" is seen.
3. Just click that option then the line will seem to be blinked.

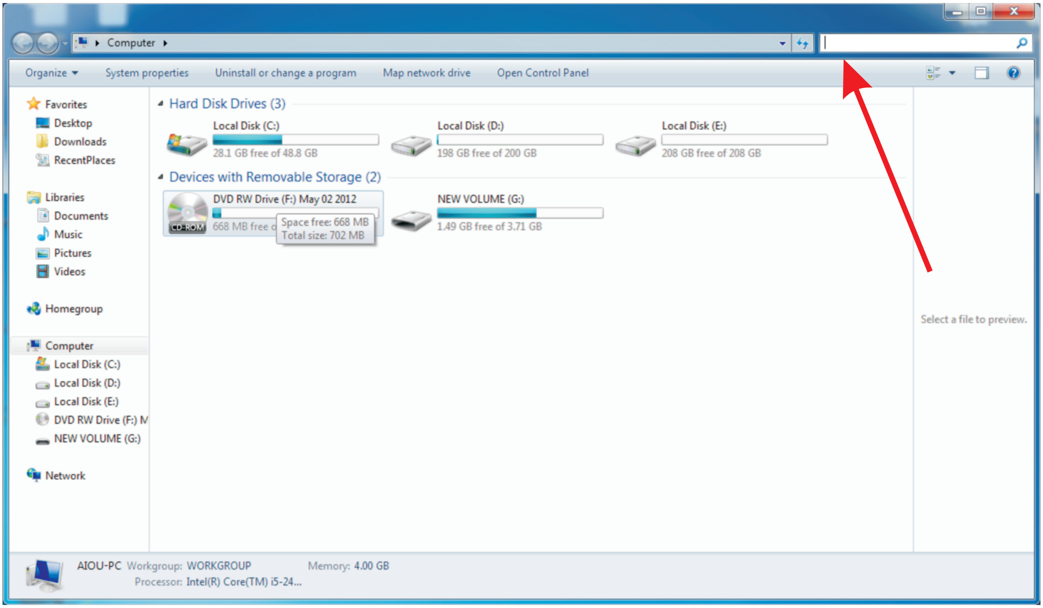


Figure-6.35: Find a File

4. Just write a name of file which you want to search.
5. After that the system will start finding that file. Within a short time-period, different files related to that name will be shown on this window.
6. One can easily find the exact file from there.

6.10.7. Create and Operate a Folder

Create/operate a folder is a very easy task. For this purpose, just follow these following steps:

1. Right click on desktop (or open any hard drive and do right click) wherever you want to make a folder.
2. Then a dialog box will be opened. Choose an option "New".
3. After clicking this option, a new connected dialog box will be

opened. Choose an option "Folder".

4. By clicking this, a folder will be made and highlighted in blue color with the default name "New folder" then ready to be retyped.
5. Type a new folder name and then press Enter.

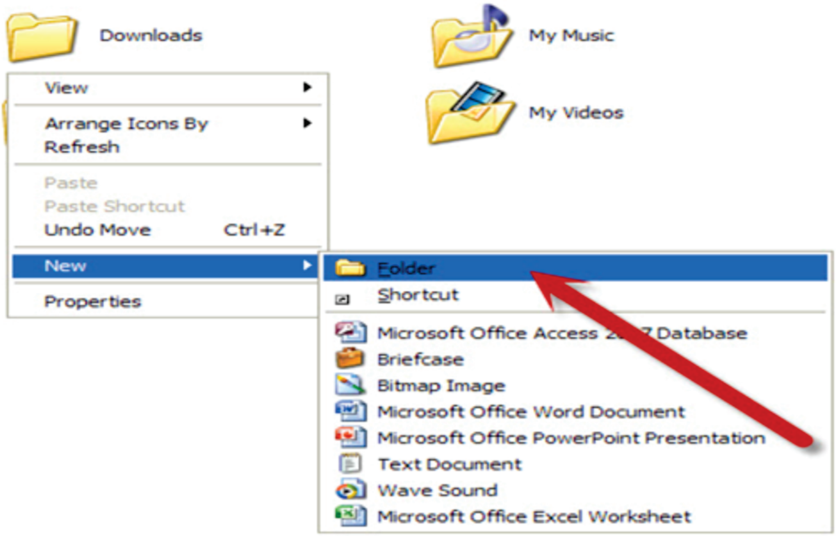


Figure-6.36: Create and Operate a Folder

6. The folder is created and ready to use/operate.

In order to operate a folder generally, just go to that location where folder is created and then double click this folder. It will be opened quickly. One can use this folder according to the requirements. Different files can be easily saved or made inside a folder.

It may be noted that one can creates a new folder within a folder by following the above steps.

6.10.8. Change Setting like Date, Time &Desktop-Colour

In order to change date and time, just follow the following steps below:

1. On the lower right corner of the desktop, the date and time is shown on every system. In order to change the date and time of a system, just click once on this "date and time icon". A dialog box will be opened which shows a complete calendar and a clock.
2. Below this, one can see easily "Change date and time settings…" option. Just click this option, another window will be opened. There is an option "Change date and time", just click this.

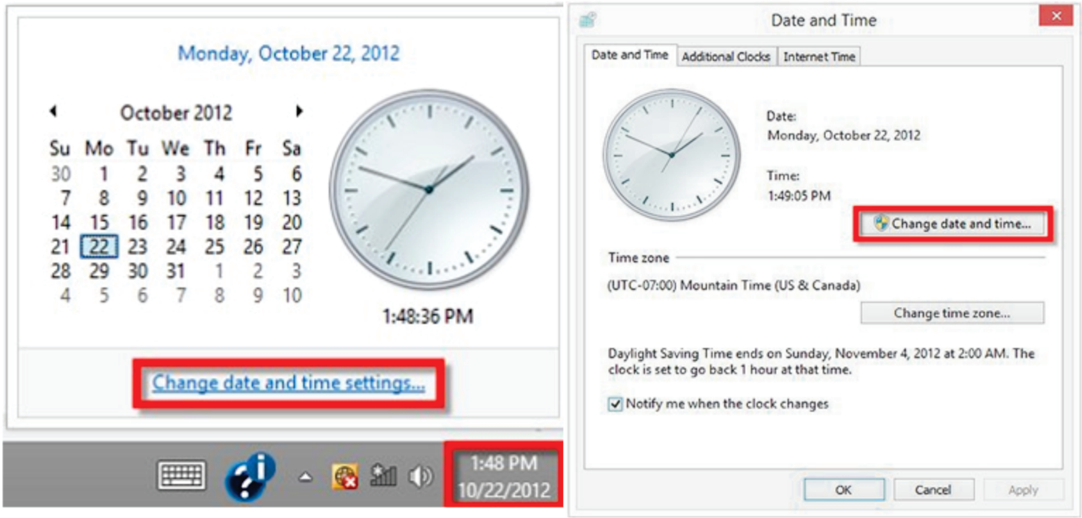


Figure-6.37: Change Date and Time

3. By clicking this, another window will be opened, here one can easily adjust date and time. Then press Ok button (Two times).

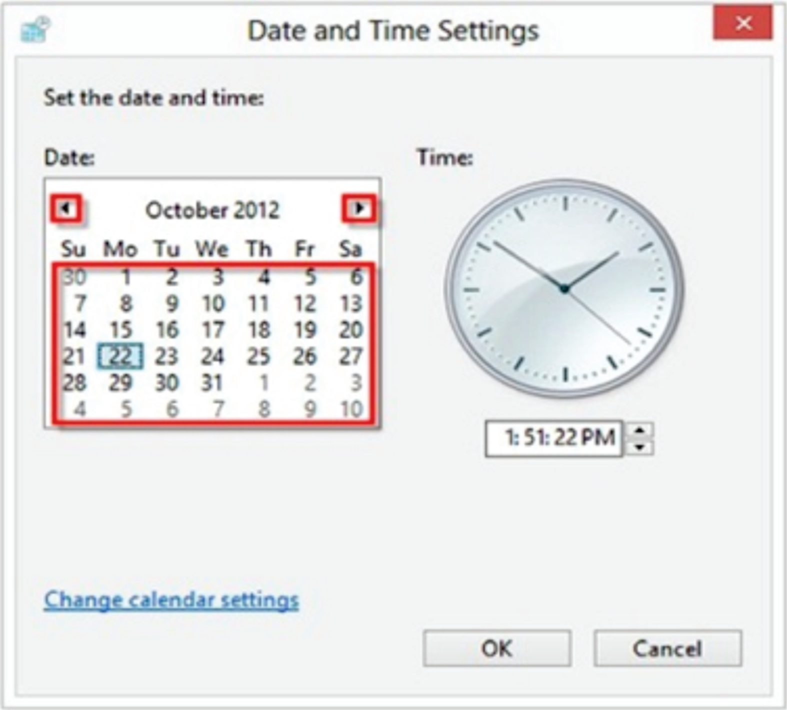


Figure-6.38: Adjust Date and Time

4. The date and time will be changed quickly as shown on desktop's lower right corner.

There are different ways of changing the color of desktop in Windows-7. An easy way is being described below in order to change the desktop background color:

1. First of all, click start menu (start button) then a list of different options will be opened.

2. Choose an option "Control Panel" then another window with different options will be opened.

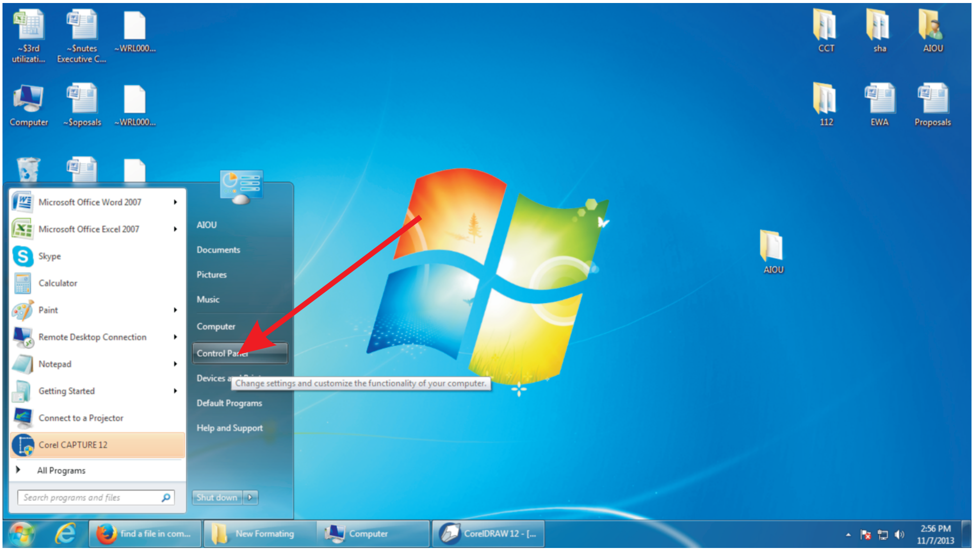


Figure-6.39: Change the Color of Desktop

3. One can see here an option "Appearance and Personalization". There are different sub-options which will be seen easily. In these sub-options, just click an option "Change Desktop Background". Then another window will be opened.

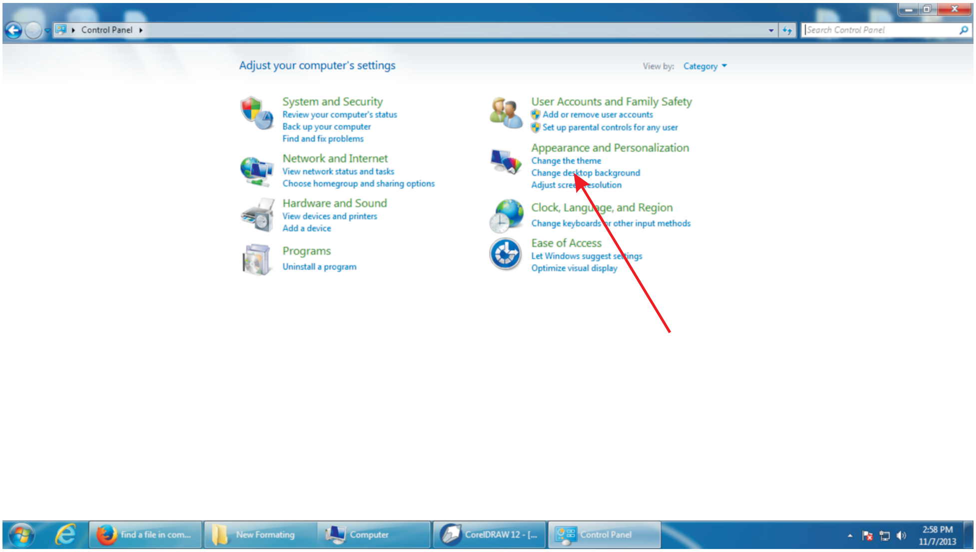


Figure-6.40: Change Desktop Background

4. In this window, just click “Picture Location” icon. Then some options will be seen, just click an option “Solid Colors”.

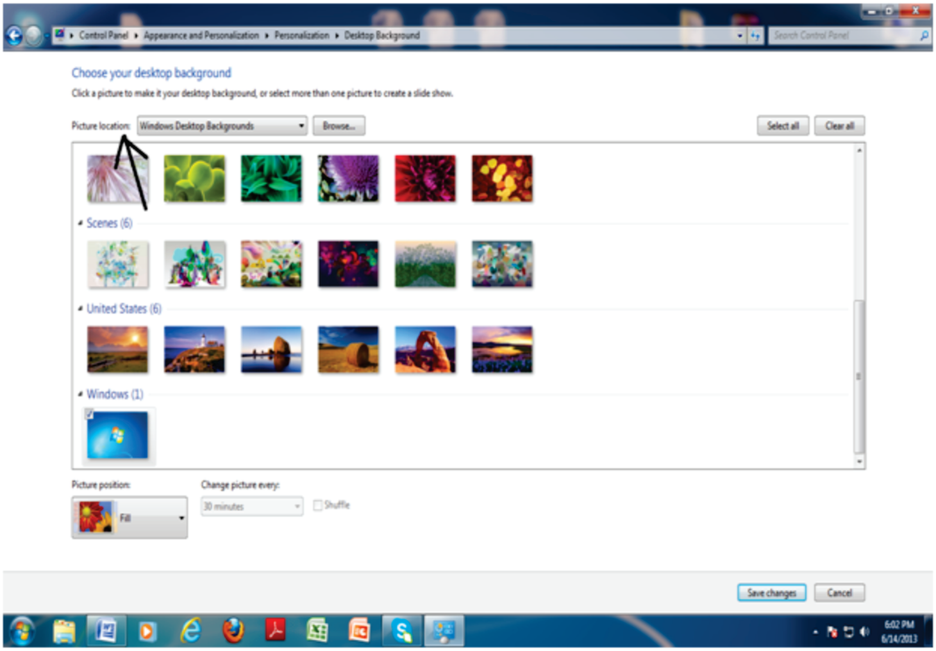


Figure-6.41: Picture Location

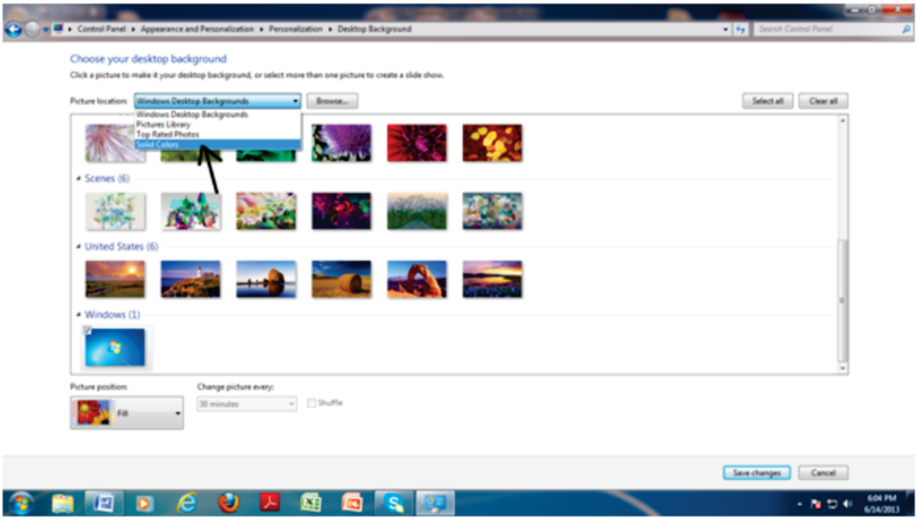


Figure-6.42 : Solid Colors

5. Many different color-icons will be shown here. You can choose the color of your choice. Just click once on any color and press "Save changes" button.

6. Then the desktop color will be changed.

6.10.9. Using Short-Cuts

The term short-cut means to do something within a short time period. There are a lot of keys (which are generally referred as short-cut keys) can be used in order to do different tasks. Some of the commonly used short-cut keys for Windows-7 are described below:

Sr. No.	Short-Cut Keys	Explanation
1.	ALT+F4	Close the active item/Quit the active program
2.	**CTRL+A**	Select all
3.	**CTRL+ESC**	Display the Start menu
4.	**CTRL+V**	Paste
5.	**F1**	Display Help in a dialog box
6.	**F10**	Activate the menu bar in the active program
7.	**CTRL+X**	Cut
8.	**CTRL+Z**	Undo
9.	**SHIFT+F10**	Display the shortcut menu for the selected item
10.	**ALT+SPACEBAR**	Opens the shortcut menu for the active window

6.10.10. Control Panel and its Usage

Control panel is basically a part of Microsoft-Windows which allows computer-users to view, manipulate and control system settings such as "System and Security", "Network and Internet", "Hardware and Sound", "Appearance and Personalization" as well as "Users Accounts" etc.

In order to use control panel, just follow the following steps:

1. First of all, click start menu (start button) then a list of different options will be opened. Choose an option "Control Panel".

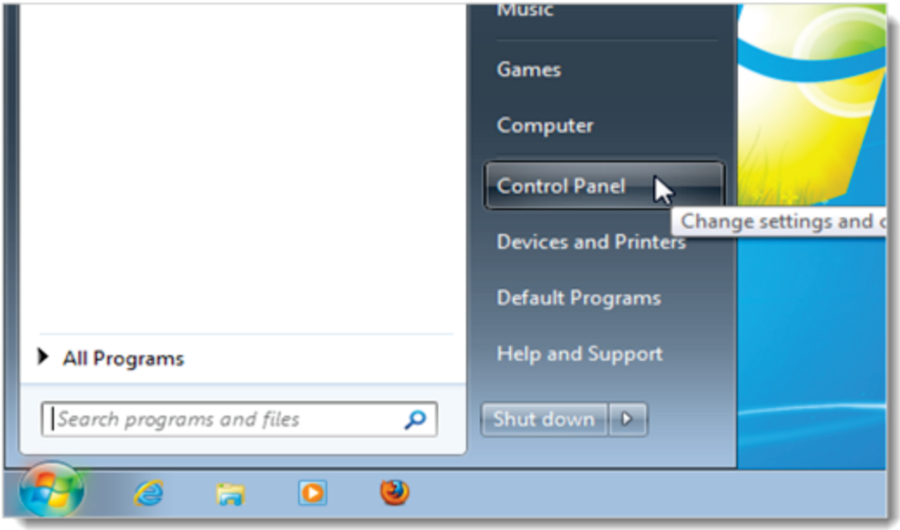


Figure-6.43: Control Panel

2. Then another window with different options will be opened. One can easily view, manipulate and control the system settings from there.

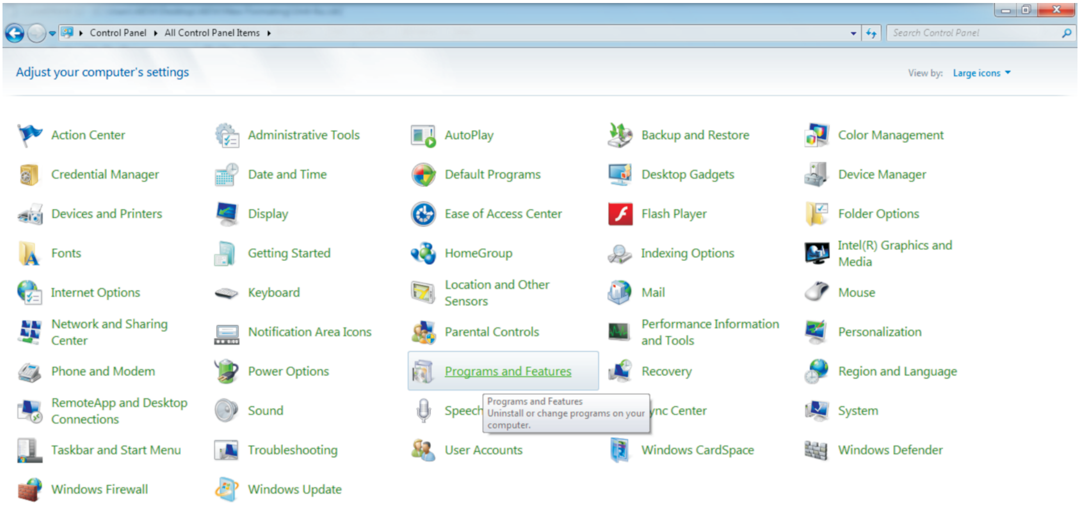


Figure-6.44: Control the System Settings

3. In order to use these options, just click any option of your choice e.g. choose an option "Programs and Features" as shown in the above figure.

4. Just click it; another window with some other options will be opened. One can view and understand this easily.

The above steps of "changing the color of desktop" are a good practice of control panel's usage.

Overall, the use of control panel depends upon the user's choice. Because the Microsoft-Windows provides an easy way to view, manipulate and control the system settings through control panel.

6.10.11. Concept of Task Manager

The Windows task manager mainly provides information about all those processes or programs which are currently running on a system. The users can also access it by pressing (Ctrl + Alt + Delete). It displays the currently running services as well as all those services which have stopped due to any reason.

In order to view the task manager, just follow these following steps:

1. Write click on the task bar, a window will be opened. Just go to "Start Task Manger" option.

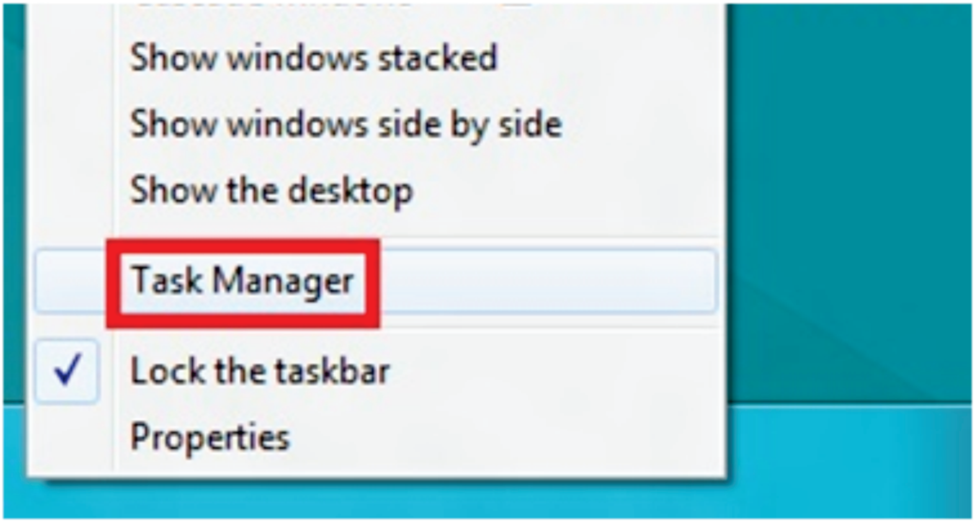


Figure-6.45: Start Task Manger

2. By clicking this, another window will be opened whose name is "Windows Task Manger"

3. Here one can get the information about different things such as:

- ➢ Applications
- ➢ Processes
- ➢ Services
- ➢ Performance
- ➢ Networking
- ➢ Users

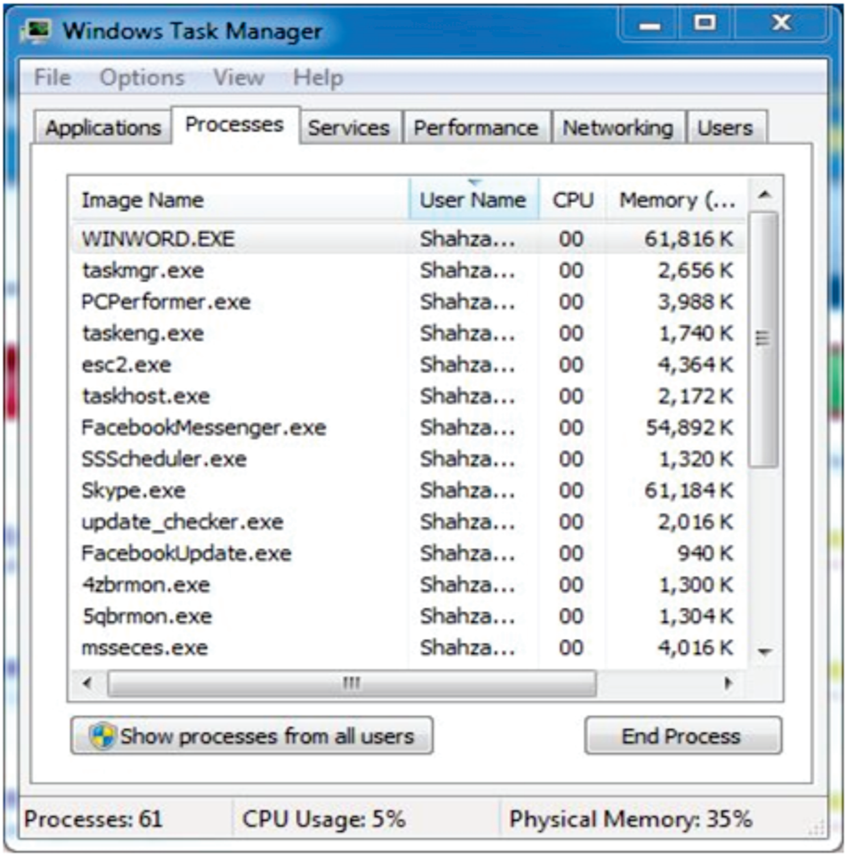


Figure-6.46: Windows Task Manger

It also provides information about general status of a system. It is basically used to terminate a process or a program.

6.10.12. Setting Up Network Connection

The purpose of setting up network connection is to use internet. To setup a "Network Connection" using "Network and Sharing Center" in Windows 7, follow the following steps:

1. Click "Start button" to view the "Start Menu" and then choose an option "Control Panel" as shown in the following image.

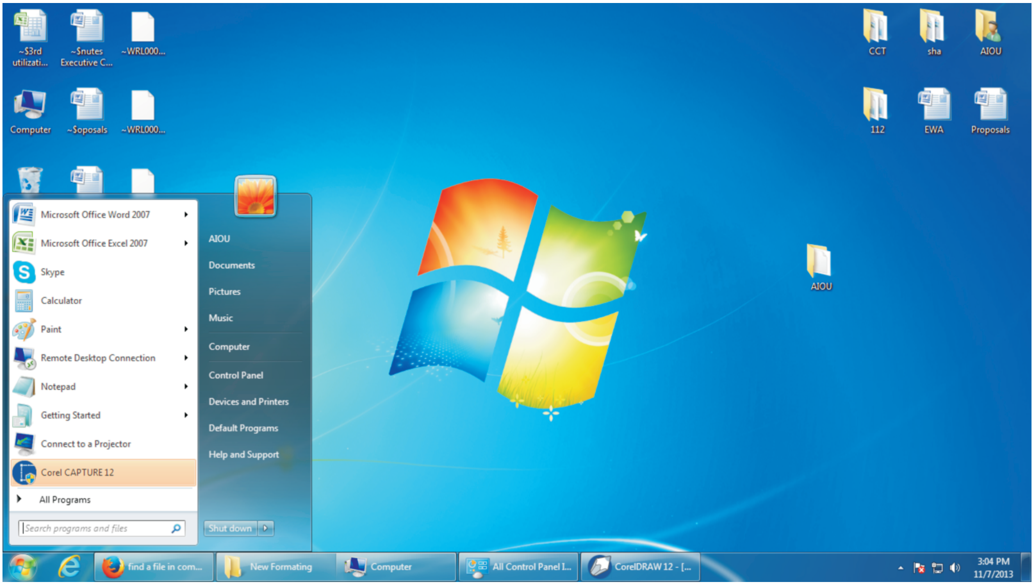


Figure-6.47: Start Menu

2. The"Control Panel" window opens up. Then click an option "Network and Internet".

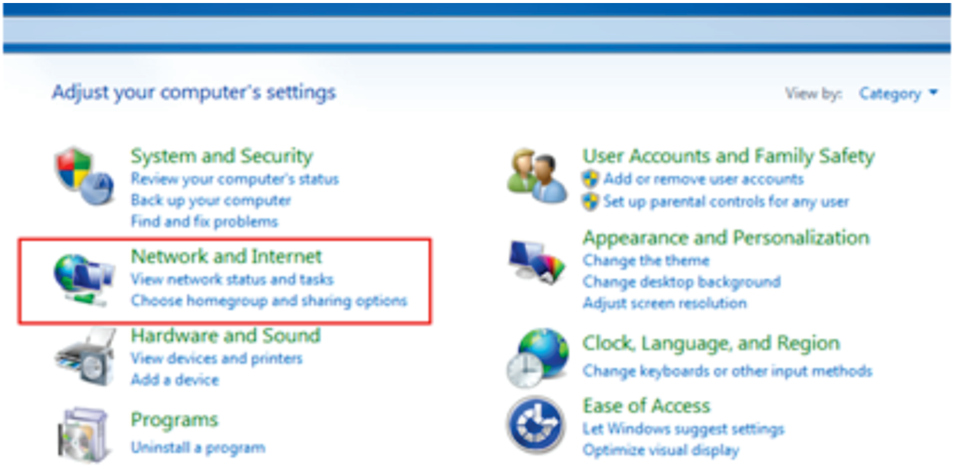


Figure-6.48: Network and Internet

3. Then click another option "Network and Sharing Center".

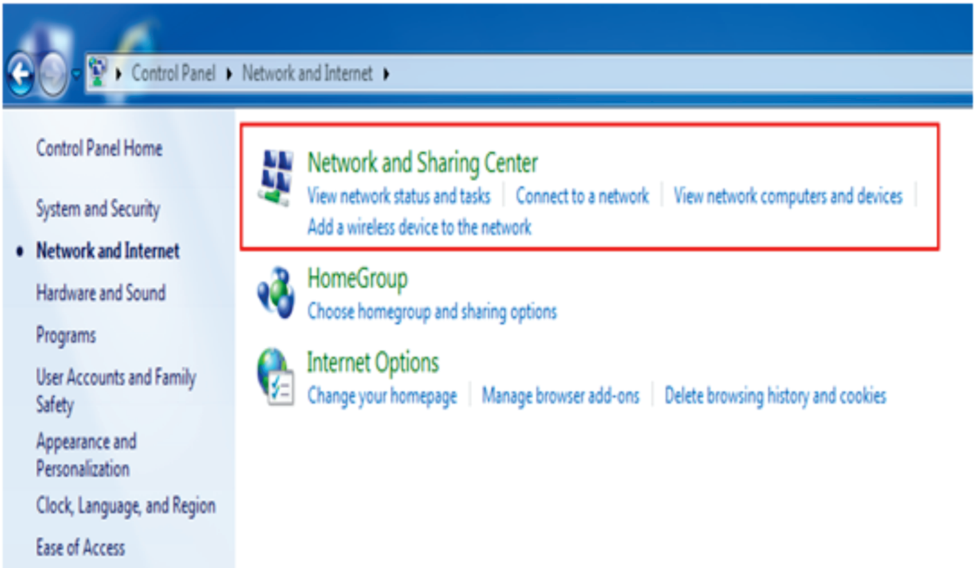


Figure-6.49: Network and Sharing Center

4. After that just click "Set up a new connection or network".

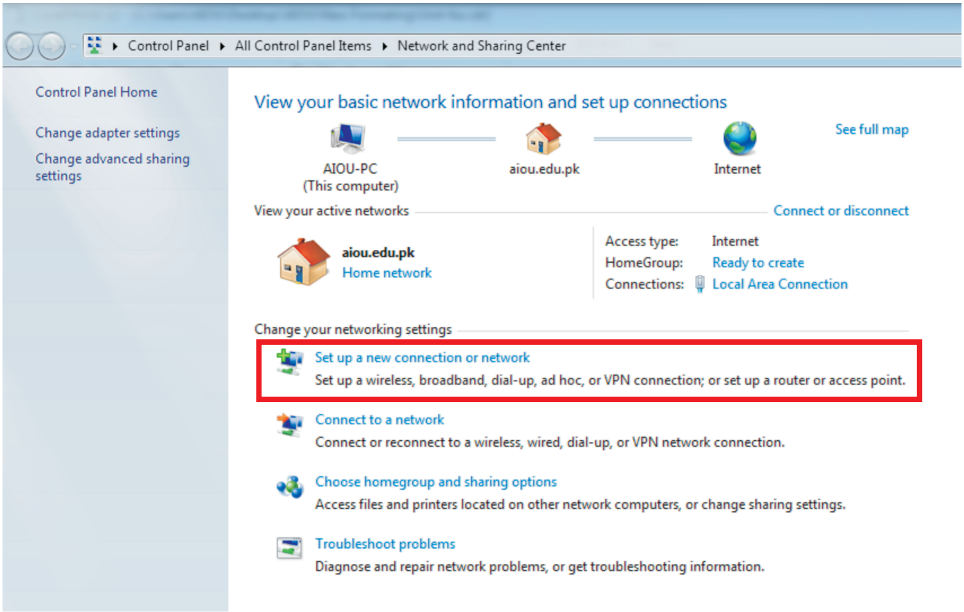


Figure-6.50: Set up a New Connection or Network

5. Another window will be opened then click “Connect to the Internet”. Then press “Next”.

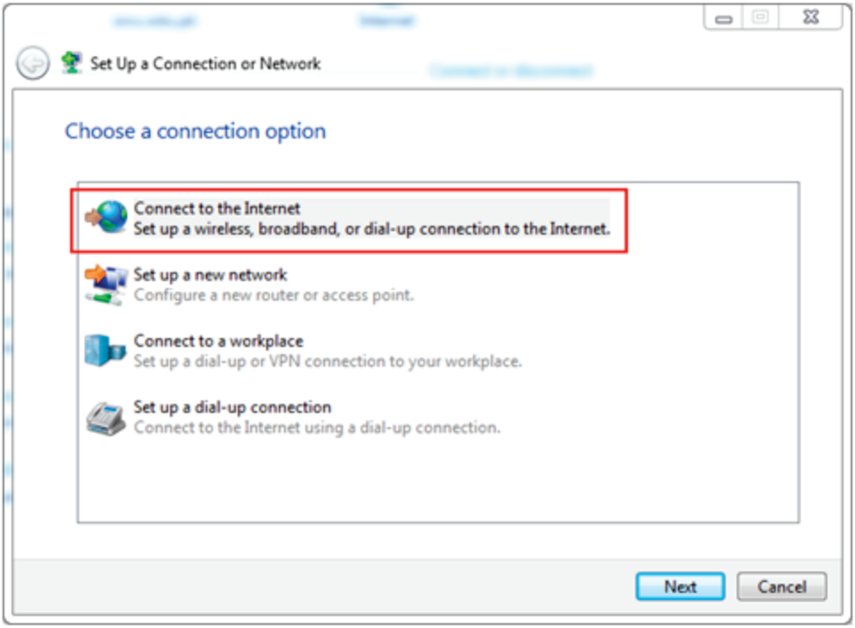


Figure-6.51: Connect to the Internet

Note: After the above step, if internet is working on your system then you will find a message

“You are already connected to the internet”.

It is simply meant that you can go to your internet browser and use internet. Otherwise follow the next step below:

6. If internet facility is not available on your system then after step 5 you will find a window with this message “How do you want to connect?” Here one can find different options such as Wireless or Broadband etc.

7. Select any one option like Broadband.

8. After selecting this option, you will enter a user name and password (which you will get from “Internet Service Provider (ISP)”).

9. Then click “Connect”. When it is connected successfully then the window looks like the below image:

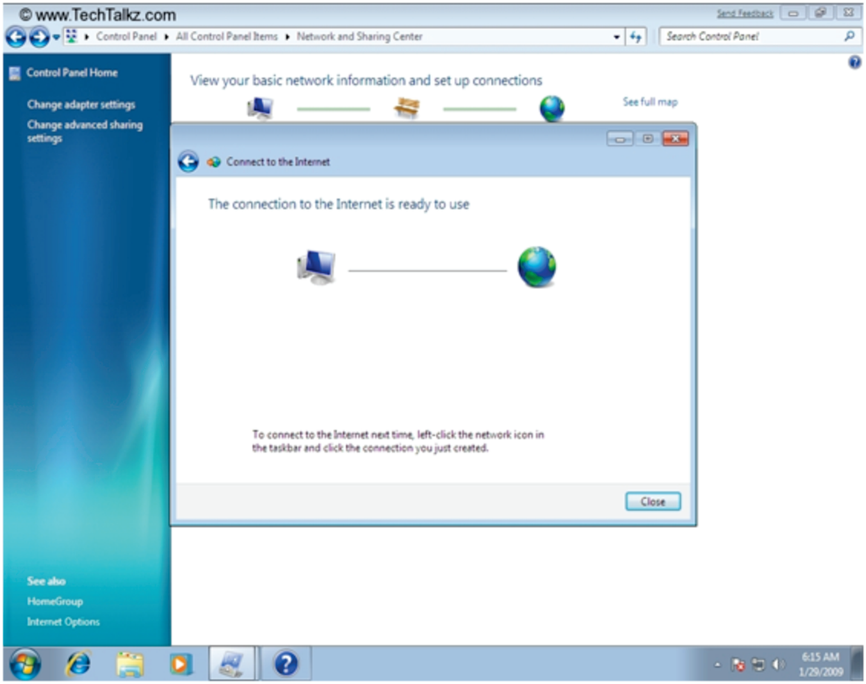


Figure-6.52: Connecting Internet

10. After that you can close the above window and simply go to your internet browser and use internet easily.

6.10.13. IP-Setting

An IP address (Internet Protocol address) is a numerical label. It is basically assigned to each computer which is being participated in a computer-network (that uses the "Internet Protocol" for communication). In order to assign an IP-address to a system (with an operating system "Windows-7"), just follow the following steps:

1. Click "Start button" to view the "Start Menu" and then choose an option "Control Panel".

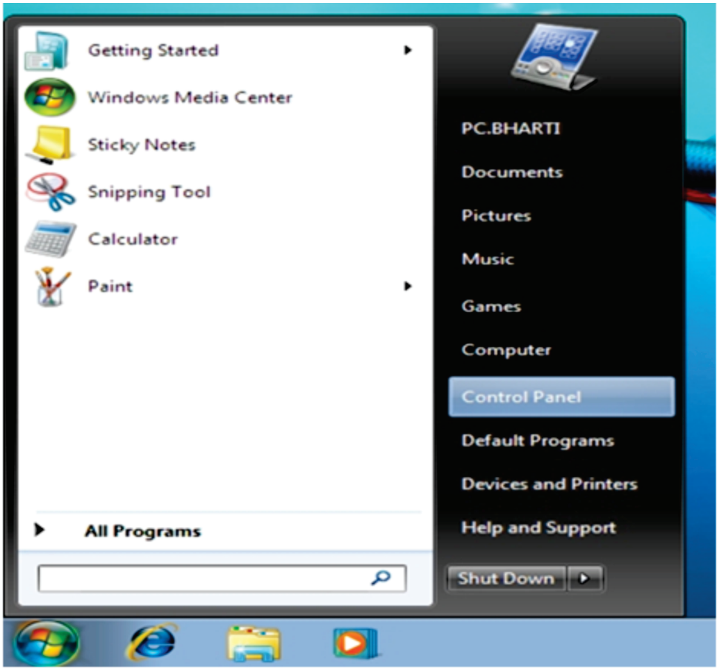


Figure-6.53: Control Panel

2. The"Control Panel" window opens up. Then click an option "Network and Internet".

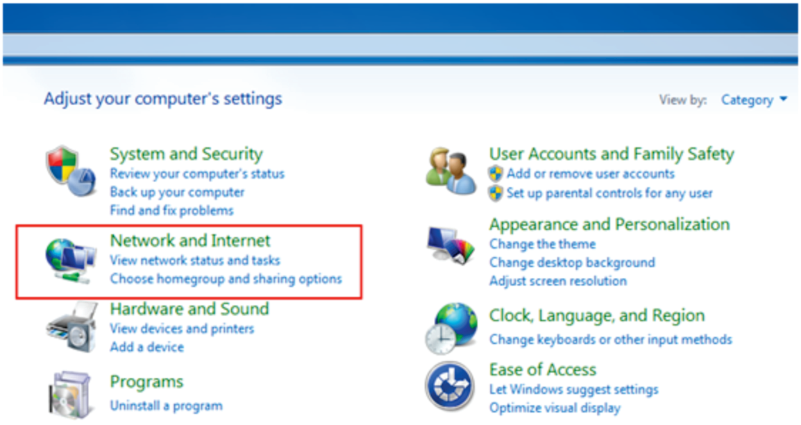


Figure-6.54: Network and Internet

3. Then click another option "Network and Sharing Center".

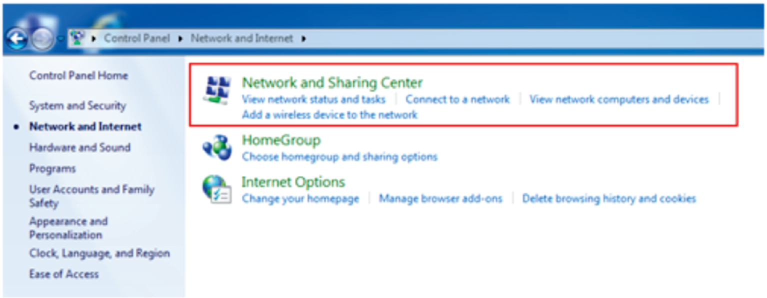


Figure-6.55: Network and Sharing Center

4. Then click an option "Local Area Connection".

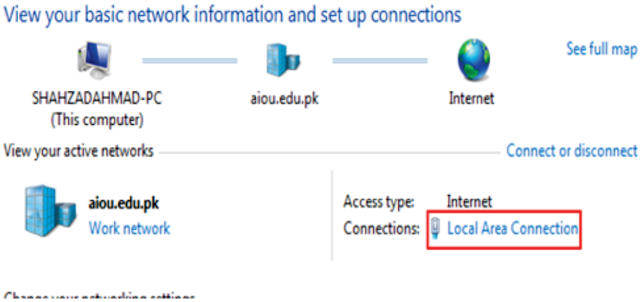


Figure-6.56: Local Area Connection

5. A window will be opened then press a button "Properties".

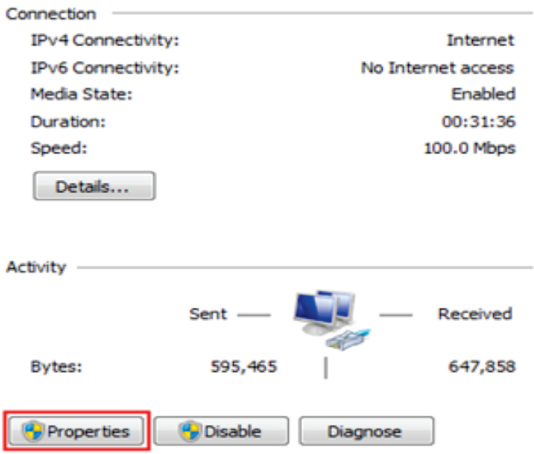


Figure-6.57: Properties

6. Another window will be opened then select an option "Internet Protocol Version 4 (TCP/IPv4)" and press button "Properties". After that another window will be opened immediately.

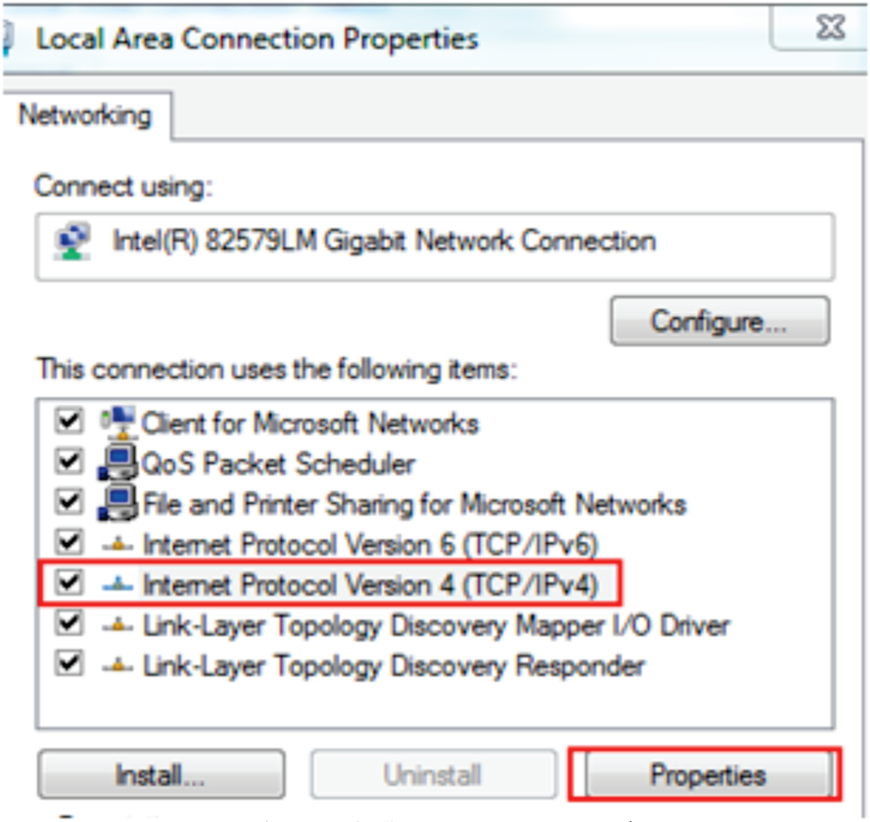


Figure-6.58: Internet Protocol

7. Here you will find two options which are described below:

   - "Obtain an IP address automatically". Select this option and then press button "OK". Your system will automatically get an IP address and you will be able to use internet.

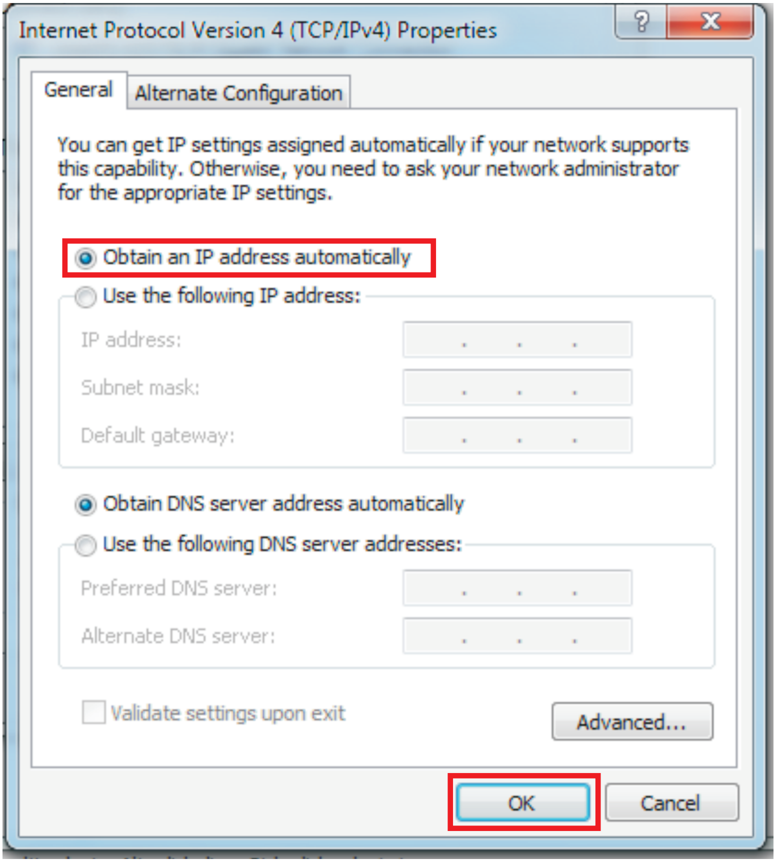


Figure-6.59: Obtain an IP Address Automatically

- On the other hand if you will select the second option "Use the following IP address". Then you will give the following information (which you will get from "Internet Service Provider (ISP)"):
- IP address
- Subnet mask
- Default gateway
- Preferred DNS server
- Alternate DNS server

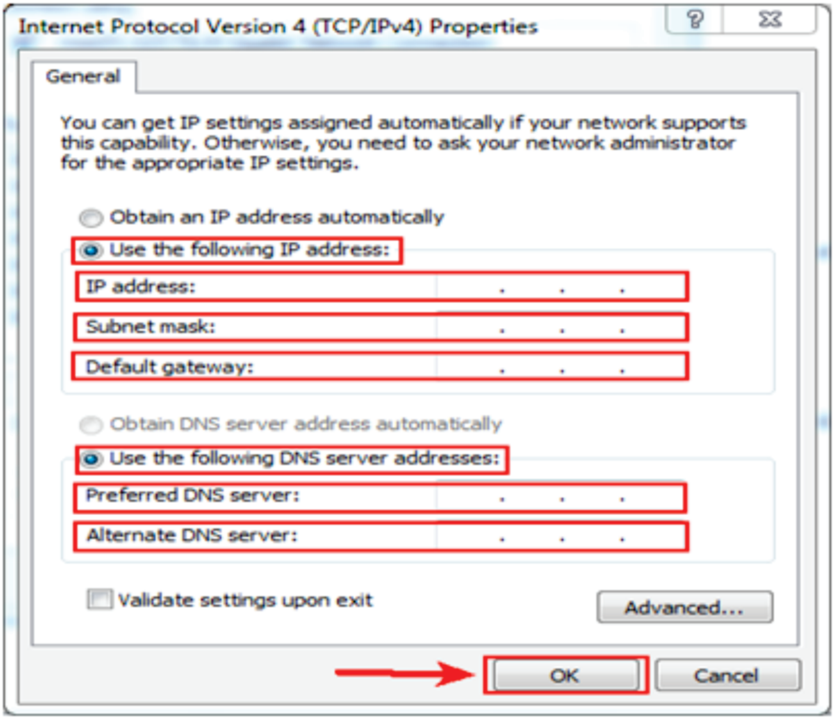


Figure-6.60: Use the following IP Address

After giving this information, just press “OK” and close all other windows. Now you will be able to use internet.

6.11. Self-Assessment Questions

Q.No.1. What is meant by operating system? Define it in detail with the help of different examples.

Q.No.2. Explain the different functions of an operating system.

Q.No.3. Write a note on the following topics:

- Process Management
- Simulation and Modeling

- Popular Operating Systems
- System Performance Measures
- Network Connection and IP-Setting

Q.No.4. Define system performance measures & process management tools.

6.12. Self-Assessment Activities

1. Identify the most common functionality of windows XP.
2. Compare features of a windows operating system installed on your computer, with at least two other operating systems which you have studied in this unit.
3. The major and positive influences of computer can be seen in many different fields/areas such as education, business, training and health etc. Explain it in detail with the help of different examples?
4. Explain the “Microsoft Windows Practice” in detail.

Unit 7

DATA COMMUNICATION AND NETWORKING

Written By: Moiz Uddin Ahmed
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

DATA COMMUNICATION AND NETWORKING

7.1 Introduction:

The rapid growth of the technology has enhanced the role of data communications in modern life. The knowledge of computer networks is now essential part of basic information technology concepts. Therefore this unit has been included at the bachelor level course. It covers fundamental view of the broad field of data communications and network

7.2 Objectives:

After completing this unit, students should be able to:

- Learn the conceptual model and basic elements of data communication system
- Differentiate between data transmission mode and data transmission forms.
- Understand different type of data transmission media
- Learn basic concepts of computer networks
- Have a knowledge of switching and routing techniques
- Understand concept of OSI layer model

7.3 Data Communication

Data communication is the flow of electronic data among two nodes (computers and other devices) through communication media.

In order to manage the communication, the nodes must be part of communication system and linked with each other via some media like cables or microwave. Furthermore the data communication software is used to transfer data from one node to another.

Figure-7.1: Data Communication

The communication system is governed by three fundamental principles that include deliver, accuracy, and timeliness.

1. Delivery: The system must carry data to the correct end or destination. Data must be received by the correct recipient (device/user).

2. Accuracy: The system must deliver the data with accuracy. The

altered or incomplete data is unusable, therefore it should be accurate as per sending format.

3. Timeliness: The system must deliver data in time. Late delivery of data may not be effective; therefore time delivery should be achieved.

7.4 Basic Elements of Communication System:

The following five basic elements are required for any communication system.

1. **Message:** Message is the information that is communicated over the communication system. It includes text, audio, video and images.

2. **Sender:** The node that is used for transferring data is called transmitter, source or sender. In recent digital communication system, the source is mostly a computer or a mobile device.

3. **Medium:** Medium is the pathway through which data is sent from one point to another. If the receiver and transmitter are within a building, a wire can connect them. If they are located at different locations, they may be connected through telephone lines, fiber optics or microwaves.

4. **Receiver**: The node that receives the data is called receiver. The receiver can be a computer, mobile device or a printer.

5. **Protocols:** A protocol is set of rules which govern the data

transmission between sender and receiver. Without protocol the information is useless for the receiver as a person understanding only Urdu cannot understand English messages. Therefore messages sent over through communication protocols can only be understood by the receiver.

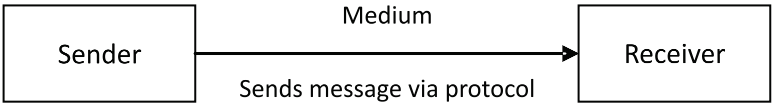


Figure-7.2: Elements of Communication System

7.5 Data Representations Forms:

Different kind of information can be sent over through a communication channel. It includes the following:

1. **Text and Numbers**

   Text and numbers are sequence of bits (0s or 1s). They are represented by a set of bit patterns called code. The code is sent over the communication channel from a sender to a receiver

2. **Images**

   Images are also characterized by special bit patterns. It is comprised of matrix of pixels (picture elements). The size of image is larger than that of text and numbers therefore data transmission speed is important for reliable and fast delivery of images.

3. Audio and Video

Audio refers to the recording or broadcasting of music or sound and video refers to the recording or broadcasting of a movie or picture. They both are also sent over the communication system.

7.6 Data Transmission Modes:

There are three modes of data communication simplex, half-duplex, or full-duplex.

7.6.1 Simplex Mode

In a simplex connection, the data flows only in one direction, from the source to the destination. This type of transmission is used when data do not need to flow in both directions. For example, the instructions flow from your key board to CPU and from CPU to printer. Another important example is the television and radio transmission.

Figure-7.3: Simplex

7.6.2 Half-duplex

In half-duplex the data flows in both directions but one at the same time. It means that data can be either sent or received in turn-wise. If a device is receiving data then it cannot sent any data at the receiving time. Walkie-talkie is an example of half duplex where a user ends his transmissions with announcements of "over" to prevent overlap and facilitate other to talk. Surfing on Internet is also an example of half-duplex, as a client issues a request for a web document and server sends the document before the client issues another request.

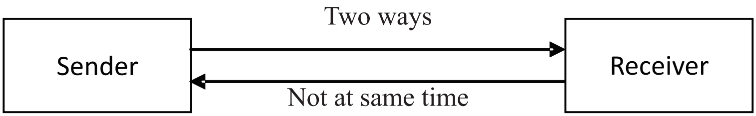


Figure-7.4: Half-duplex

7.6.3. Full-duplex

In full-duplex the data flows in both directions at the same time. Each node can thus transmit and receive the data simultaneously. Telephones are common examples of full-duplex devices. They allow both users to hear each other and talk at the same time.

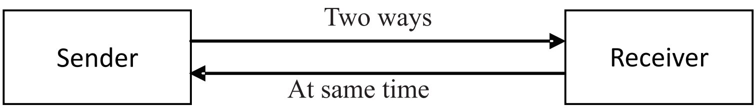


Figure-7.5: Full duplex

7.7 Data Transmission Speed:

Data Transmission speed is measured in bandwidth. It is a measure of the amount of data transferred through a network over a given amount of time. It is also called data transfer rate or baud and expressed in bits per second (bps).

A bit is the unit of information that is stored and processed by computers; it is either 0 or 1. A data transmission speed of 100 baud means 100 bit are transferred in one unit of time. All transmitted signals have a certain bandwidth, as do the receiving systems.

7.8 Data Transmission Forms:

There are two forms of data transmission i.e. Analog and Digital.

7.8.1 Analog Transmission

Analog is the transmission of data in a continuous wave form. Analog signals are represented by continuous signals which reflect the time varying quantities over a time interval. The human voice is an example of analog data. When someone talks, an analog wave is created in the air medium. The voice can be captured by a microphone and transformed to an analog signal. The outputs of many sensors, such as temperature and pressure sensors, are also examples of analog data. Analog signals are represented by continuous range of values as shown in the following figure.

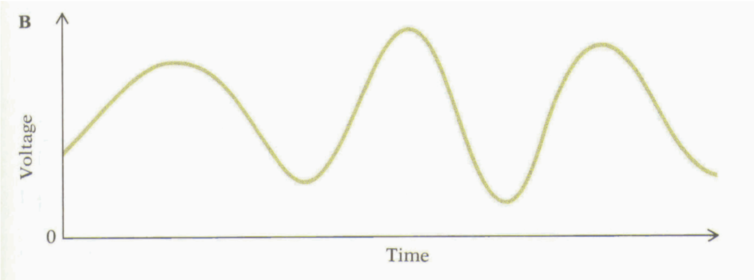


Figure-7.6: Analog Transmission

7.8.2 Digital Transmission:

Digital is the transmission of data using distinct on and off electrical states. As you can switch on or off your light the data bit can have values 0 or 1. The combination of these bits actually forms the binary code. In this way the signals are converted into a binary code by grouping of binary numbers 0 (off) and 1 (on). The binary code forms the digital data. The data stored in computer memory is an example of digital data. It can be converted into digital signal where it is transferred from one computer to other. At the receiving end it is again converted into analog signal. Digital signals are represented by discrete or discontinuous values as shown in the figure.

Figure-7.7: Digital Transmission

7.9 Data Transmission Media:

Data Transmission Media is the pathway used to carry a communication signal from one system to another. It is the means of communication from sender to receiver. There are two types of transmission media:

- Guided Media: Use a physical path for communication
- Un-guided-Media: Does not require any physical path for communication

7.9.1 Guided Media:

Guided Transmission media is based on a cabling mechanism that direct the signals of data transmission along a specific path. The data signals are dependent upon the physical characteristics of the medium; therefore it is also called bound media.

There are three basic types of Guided Media:

7.9.1.1 Twisted Pair

7.9.1.2 Coaxial Cable

7.9.1.3 Optical Fiber

7.9.1.1 Twisted Pair Wire:

Twisted Pair is a couple of copper wires, twisted together and enfolded with a plastic coating. Each pair consists of two wires used for the positive data signal and negative data signal.

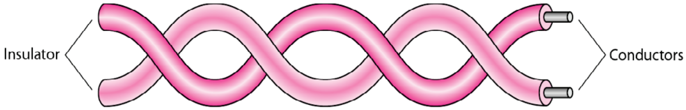


Figure 7.8: Twisted Pair

One wire carries the signal while the other provides the ground reference. The difference between the two is used by the receiver. If a noise appears on one wire it also emerges on the other. However the twisting maintains the balance and reduces the distortion among the cable. It also decreases the tendency of the cable to give out radio frequency noise due to nearby cables and electronic components. There are two kinds of twisted pair wire:

- **Shielded Twisted Pair**
- **Unshielded Twisted Pair**

- **Shielded Twisted Pair:**

  Shielded Twisted Pair cable is composed of two cables, twisted with each other and enclosed in a foil cover and woven copper shielding. STP cable uses shields to reduce outside interference. It is more secure cable since it keeps the signal from leaking out from it.

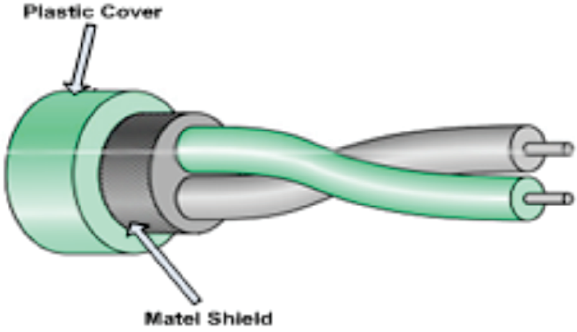


Figure-7.9: Shielded Twisted Pair

- **Unshielded Twisted Pair:**

  Unshielded twisted-pair cable is not enclosed in any cover. UTP cable is usually very flexible and is easy to use. However it can get unnecessary interference and data from other cables and networks. The other disadvantage is that the UTP while traveling through it may leak to other nearby cables. UTP cables are used in local telephone communications and short distances up to 1 km.

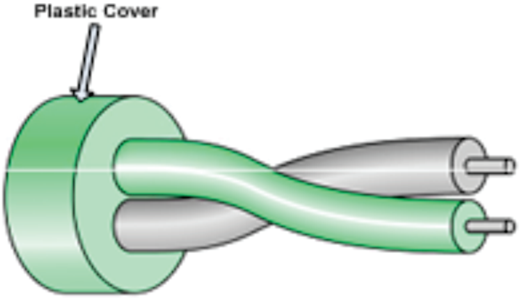


Figure-7.10: Un-shielded Twisted Pair

7.9.1.2 Coaxial Cable:

Coaxial cable like twisted pair is comprised of two conductors. However its construction is slightly different as compared to coaxial cable. It consists of two cylinders; a hollow outer cylindrical conductor and an inner conductor. The outer cylinder surrounds a single inner wire conductor and includes physical channel that carries the signal. It is covered with a jacket or shield The inner conductor is a solid dielectric material surrounded by regularly spaced insulating rings..

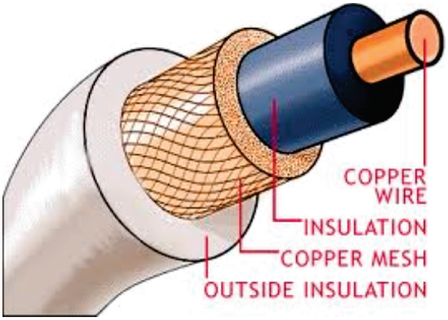


Figure-7.11: Coaxial Cable

A signal coaxial cable has a diameter which varies from 1 to 2.5 cm. Due to protected construction; coaxial cable is much less vulnerable to interference and crosstalk as compared to twisted pair. Coaxial cable can be used over longer distance and support more stations on a common line than twisted pair.

Coaxial cable is one of the most common types of flexible transmission medium. Due to its flexibility it is used in wide variety of data transmission applications. The most important of these includes:

- **Television Network**
- **Long-Distance Telephone Communication**
- **Local Area Networks**

Coaxial cable is also effectively used in the scenarios where distance is short and high data communication rate is required.

7.9.1.3 Optical Fibers:

An optical fiber is a slim, flexible and transparent medium for data transmission. The optical fiber transports the data with very high speed by converting electrical data signals into light signals and transmits it through a thin glass fiber. These signals are re-converted into electrical signals.

The shape of optical fiber is like a cylinder that consists of three sections: the core, cladding, and the jacket.

Core: Core is the inner most section which serves as light-carrying device. Cladding: Cladding is the middle layer, which serves to detain the light to the core. Jacket: Jacket is the outer layer which protects the core and cladding from damage. It also serves as a "shock absorber" against crushing and other environmental damages.

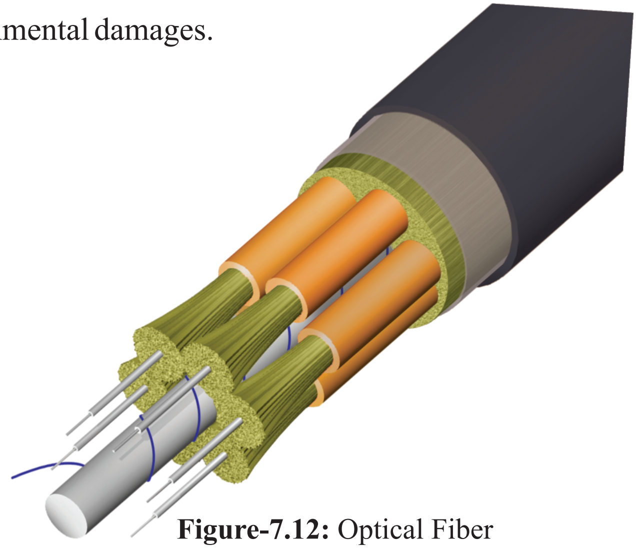


Figure-7.12: Optical Fiber

Some important features of optical fiber include the following:

1. Optical fiber provides protection against external electromagnetic fields.
2. Optical fiber has low attenuation than coaxial cable or twisted pair.
3. They are smaller in size and lighter in weight.
4. They have greater capacity of data transmission.

Uses of optical fibers include the following:

1. Optical fibers are used as light guides and imaging tools for microscopic study and factory automations.
2. Optical fibers are used as lasers for surgeries in medical field.
3. Optical fibers are used to construct networks of different topologies.
4. Optical fibers provide high speed data transmission with accuracy.
5. Broadcast/cable companies are using fiber optic cables for wiring purposes.

7.9.2 Unguided Media:

Unguided media doesn't use any physical path between the two devices communicating. It simply carries electromagnetic waves without using any physical medium. Signals are normally broadcasted through the atmosphere and carry on to the receiving end. Important types of unguided media include microwave systems and communication satellite.

7.9.2.1 Microwave Systems:

Microwaves are of high frequency radio signals that transmit data through space. It is used to provide communication link when it is unrealistic or too costly to install physical media.

Following are the types of Microwaves.

- **Terrestrial Microwaves**
- **Satellite Microwaves**
- **Terrestrial Microwaves:**

Terrestrial Microwaves are used to broadcast wireless signals across a distance (few miles). The transmitter is a parabolic dish (shaped like a bowl) and is mounted as high as possible to get the best frequency and transmission. These waves cannot bend or pass through buildings and hills therefore unblocked line of sight must be available between the source and the receiver. Repeaters are also used at a distance of 25-30 km between transmitting and receiving stations. Both private networks and common carriers can use terrestrial microwaves.

Terrestrial microwaves are used for both radio (voice) and television transmission. It can also be used for closed-circuit television but short point-to-point connections between buildings will be needed for the transmission to work.

- **Satellite Microwaves:**

  Satellites are transponders (units that receive on one frequency and retransmit on another) that are set in orbits directly over the equator. Communication satellites are microwave relay stations placed in space.

  Satellite dishes are used to send the signals to the satellite where it is again send back down to the receiver satellite. The uplink is the transmitter of data to the satellite and the downlink is the receiver of data. Uplinks and downlinks are also called Earth stations because they are located on the Earth.

  The communication satellite is a technological revolution in modern data communication. They are used in different data communication applications like:

  i. Television distribution
  ii. Long-distance telephone communication
  iii. Private commercial networks

Because of their broadcast nature, satellites are used to broadcast live cricket matches and other sports programs and therefore extensively used throughout the world. Programs are transmitted to the satellite and then broadcasted down to a number of stations. The stations distribute the programs to different destinations.

Satellite communication also provide one-to-one link between telephone exchange networks. It provides an efficient and reliable way to connect international trunks.

Another important use of satellite communication is its use in business data applications for satellite. The total channel capacity of satellite is divided into sub-channels and individual business users are given access to it. They use special antennas and dishes to download the sub-channel transmissions.

7.10 Switching Techniques:

A network is a connection of interlinked nodes. If there are more than two nodes then one to one communication requires some complex arrangements. One solution is to connect each node with the other but if there are large number of nodes than this solution is not possible

A better solution is switching. A switch is a connecting device that links network segments or network devices. Switches are also capable of building provisional connections between two or more network nodes. Some of the nodes are connected with the end systems. There are two important methods of switching i.e circuit switching and packet switching.

7.10.1 Circuit Switching:

In circuit switching a devoted channel (or circuit) is built during transmission of data. In this method a physical path is created for a single connection between two end-points in the network for the period of the connection.

After the circuit or channel has been established, the data transfer takes place. The transmission path is booked during the transfer of data and other systems/devices cannot use it until the data transfer is completed and the circuit is released. The most common example of a circuit-switched network is the public telephone network like PTCL which provides telephone services.

7.10.1.1 Advantages of Circuit Switching:

- The circuit switching communication is efficient.
- There are less chances of errors.
- It is also highly reliable.

7.10.1.2 Disadvantages:

- Circuit switching requires a lot of formalities, during formation of the circuit.

- The bandwidth may be wasted, especially; when a user is only listening, and not talking.
- The set up of the channel may take longer time.

7.10.2 Packet Switching:

Packet switching is another communication method which divides data into small size blocks called packets. The packets have different type of transmitting data regardless of content, type, or structure. Each packet contains a "header" which consists of routing information from source to destination.

The same data path is shared among the users in a network due to division of different data items into packets. The packets are also independent of each other and therefore dedicated communication link is not required. This type of communication between sender and receiver is also known as connectionless. The example of packet switching includes Internet where most of the applications transfer data via connectionless mode of communication.

7.10.2.1 Advantages of Packet Switching

- It makes efficient use of network resources.
- It can manage variable data rates.
- It can easily handle increase number of transactions.

7.10.2.2 Disadvantages of Packet Switching

- It is not good scheme for small data packages.
- The ordering of packets may alter during the transmission and re-ordering may take more time.

7.11 Routing Techniques:

Routing is the process of transferring information from one location to another across a network. It's also referred to as the procedure of selecting a path to send the packets over a network. Routing is one of the most important features of the Internet because it takes messages from one node to other. Each node receives information and passes it to other until it reaches to its destination.

A router is a device that carries route to the routing process. It receives the packet and forwards it to its next destination node. It is located at gateways, the network connection point which connects two networks with each other.

A router can also maintain a data structure of the available routes and their conditions. The information is used to manipulate distance and cost algorithms in order to determine the best route for a given packet. Two popularly used routing techniques include source and hop by hop routing.

7.11.1 Source Routing:

Source routing is a technique that is used to specify the route of a packet through the network. In this routing technique, the source needs to pass information along a specified way. Therefore the path through the network is set by the source or a device. The device provides complete information about the desired path to the network source. It is also assumed that packet source is familiar with the design of the network and can indicate the optimal path for the packet. Source routing can be used to troubleshoot a network and increase the network performance.

7.11.2 Hop by Hop Routing:

In hop by hop routing, the source does not have all the information about the destination. In this method each node along the path passes the information packet only to the next node. The packet forwarding process keeps on working until the final destination is reached. Hop by hop routing decisions are based on channel availability and readiness of adjacent nodes.

7.12 Difference between Switching and Routing:

The switching method makes use of switches only. A switch acts as a connector only, it receives packets and sends them directly. It connects one point of a network to other turning it on and off as necessary. Switches work at layer 2 of the OSI model (we will study OSI model in next section). A switch examines the MAC address and determines where a packet should be sent within the data link header of the packet, where the MAC address is unique identifier for a node over a network. A switch maintains information about MAC address and related ports in database and uses it to find next location.

The routing method makes use of routers. A router acts as a connector and a scheduler and manages traffic of the network. It determines the optimal path (shortest or fastest) in a network, and routes packets accordingly. A router makes use of Network ID within the Network layer header to determine next destination of the packet. The information about destination host is maintained in routing table. The router makes use of this routing to determine the route to the destination host.

7.13 Network Topologies:

Network topology is the connection arrangement of the various links and nodes of a computer network. It is the topological structure of a network that defines configuration of cables, computers, and other peripherals.

The major types of network topologies include Star, Ring, Bus and Hybrid topologies.

7.13.1 Star Topology:

Star Topology is the most general type of network arrangement that is used in offices and homes. In Star topology, all the components of network are connected to a connection device. This device is known as “hub”.

The communications take place via Hub, which acts as a common connection device. All the data initiated by nodes passes through the Hub. The Hub forwards it to the destination node. Hub also manages and controls the whole network.

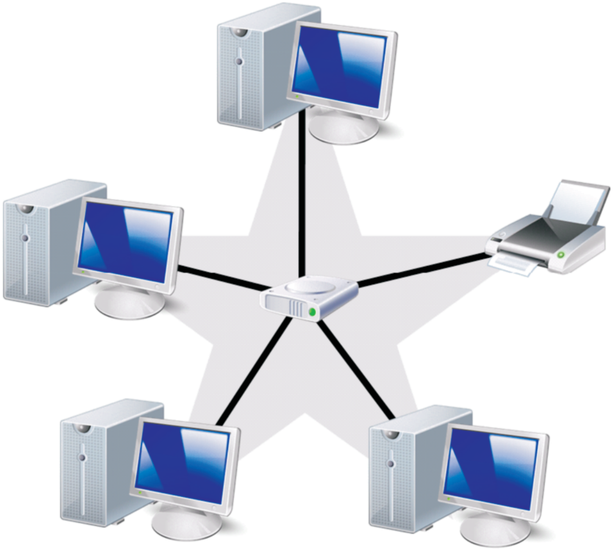


Figure-7.13: Star Topology

7.13.1.1 Advantages of a Star Topology:

1. The star topology is easy to install.
2. The wiring arrangement is also easy.
3. The transmission delays do not increase if a new node is added.
4. If any node fails, it does not affect the network
5. It is easy to detect faults.
6. Addition and removal of parts is easy in star topology.

7.13.1.2 Disadvantages of a Star Topology

1. Star topology requires large cable length.
2. If the hub goes down, the whole network will be blocked.

7.13.2 Ring Topology:

In a ring network; the nodes are attached with each other in a closed loop. Each node has exactly two neighbors. The computers and devices connect each other and complete the network. Each packet is initiated across the circle and passes through all nodes until it reaches its final destination. Any breaks in the connection loop might take down the entire network. Today, the ring topology is seldom used.

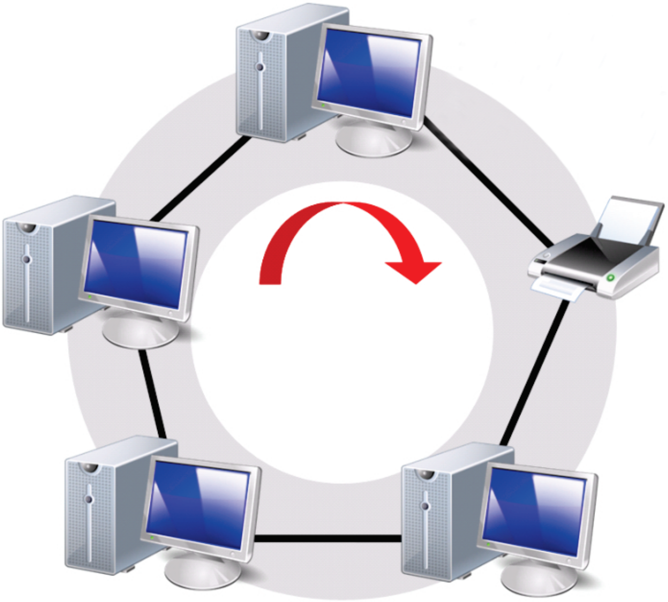


Figure-7.14: Ring Topology

7.13.2.1 Advantages of a Ring Topology:

1. There is no central node for controlling the network.
2. Ring topology is easy to install
3. The wiring arrangement is also easy.
4. It provides equal access to devices and not a single node use all the bandwidth

5. It is easy to detect faults.
6. Adding and removing node is also simple

7.13.2.2 Disadvantages of a Ring Topology

1. The transmission signals go in sequential order which create delays.
2. A single break in cable can disturb the flow of whole network

7.13.3 Bus Topology:

Bus Topology is one of the most simple network topology. In bus topology all the nodes are connected into a single cable. This central cable is the backbone of the network and therefore it is known as the Bus. Every node send and receive through this Bus.

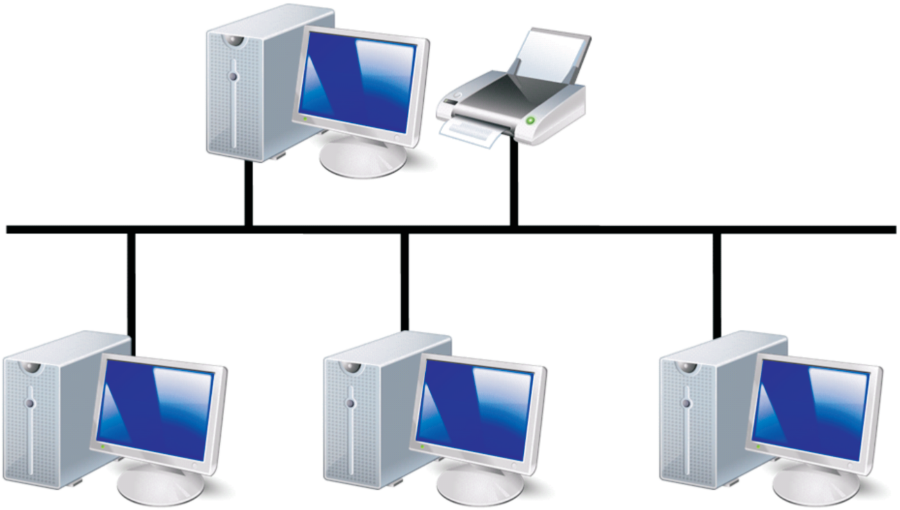


Figure-7.15: Bus Topology

7.13.3.1 Advantages of a Linear Bus Topology:

1. It is easy to add a new node in bus topology.
2. Bus topology requires smaller cable length as compared to star topology.
3. It is also cheaper as compared to star topology.
4. It is suitable for small networks.

7.13.3.2 Disadvantages of a Bus Topology:

1. If main cable breaks the whole communication system goes down.
2. All nodes should be capable to respond immediately against messages.
3. The main cable requires terminators at both ends.
4. If the number of devices is increased it drops down the efficiency of bus network.
5. It is not appropriate for networks with heavy amount of traffic.
6. The security of bus network is low because all the nodes receive the signals from the source.

7.13.4 Mesh Topology:

A mesh topology is made up of a network where each node is interconnected with each other. It provides a one-to-one connection between devices on the network. The arrangement of mesh technology is very expensive as dedicated connections are required between every node of the network and it results in many redundant connections. The mesh topology is not frequently used to develop media based computer networks. Therefore it is mostly used in wireless networks.

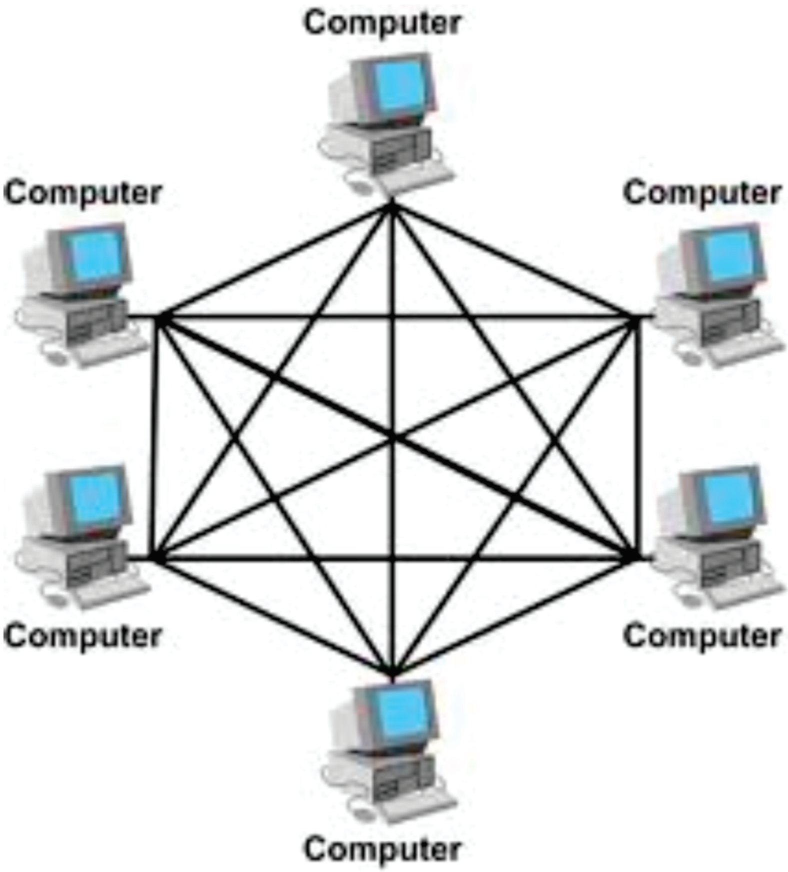


Figure-7.16: Mesh Topology

7.13.4.1 Advantages of Mesh Topology

1. Mesh topology allows to send data from different devices simultaneously.
2. If one of the nodes fails it does not affect the network.
3. Extension and alteration in mesh topology can be done without disturbing the other nodes.

7.13.4.2 Disadvantages of Mesh Topology

1. There are high chances of redundancy in many of the network connections.
2. Overall cost of mesh network is high as compared to other topologies.
3. Set-up and maintenance of this topology is also very difficult.

7.14 Types of Network:

A computer network connects two or more systems in order to exchange data and information with each other. Computer Networks are classified into three broad categories i.e. LAN, MAN and WAN.

7.14.1 Local Area Network (LAN):

A Local Area Network (LAN) is a connection network that connects group of systems and devices with each other within a limited geographical area, such as office or school. Most LANs connect personal computers and other devices including printers; with each other. Each node in a LAN has its own CPU and storage area. In addition, it has the access to the resources of other nodes anywhere on the LAN. It allows the users to share sophisticated devices, such as laser printers, data and other resources in LAN. They can also communicate with each other, by sending messages and e-mails. LANs are characterized by the following properties:

i. They transfer data with very high speed.
ii. They exist in a small geographical area.
iii. The LAN technology is less expensive.

7.14.2 Metropolitan Area Network (MAN):

A MAN (Metropolitan Area Network) is a larger network than LAN and usually covers several buildings and offices in the same city or area. It can connect several nearby LANs to one another (over an area of up to a few kilometers) at high speeds.

7.14.3 Wide Area Network (WAN):

A Wide Area Network (WAN) interconnects LANs and MANs. A WAN may be located within a province or country, or it may be interconnected around different parts of the world. WANs are characterized by the following properties:

i. They can span in an unrestricted geographical area.
ii. They interconnect multiple LANs and MANs.
iii. They are more complicated and complex than LANs and MANs.
iv. The WAN technology is expensive.

7.15 Communication Protocol:

A computer network connects two or more nodes together to share data, information and resources. Multiple networks are connected together to form a grand network. Besides the cables, there are many processes that execute behind the scene in order to run the network smoothly. However the smooth running of network is governed by some standards and specifications. These standards and specifications define set of rules for data communication and network.

A protocol is a set of rules and procedure that governs a process. A communication protocol describes the rules and regulations for data transfer between nodes over a network.

In a computer network, a communication protocol performs the following functions.

1. It defines the size of data blocks/packets.
2. It provides numbering scheme of data packets.
3. It provides error and flow control.
4. It also defines mechanism of connection establishment and termination.
5. It manages the data security.
6. It manages the data routing algorithms for delivery of data.
7. It also manages the communication log information.

The communication networks use layered protocols to manage the communication.

A layered protocol provides a conceptual framework to simplify the network design by dividing it into functional layers. These functional layers take the responsibility of data exchange in different forms and levels. Each protocol layer has a defined functionality. A layer provides a communication interface to the next higher protocol layer. It also conceal the details of the main physical network infrastructure.

The most important network protocol is OSI.

7.6 Concept of OSI Model:

The Open Systems Interconnection (OSI) is most commonly used protocol in network communication. The OSI model was first released in 1984 by the International Standards Organization (ISO). It describes the data transmission procedure in the form of seven layers. It explains how information is sent through a sender to a receiver and also describes different stages where information takes different forms through the underlying architecture of seven layers.

The OSI model consists of seven layers, each corresponding to a specific network function. The seven layers are Physical, Data Link, Network, Transport, Session, Presentation and Application.

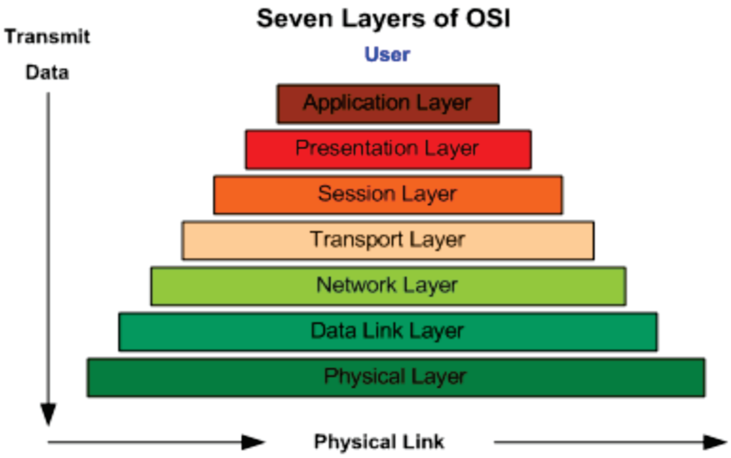


Figure-7.17: OSI Layers

7.16.1 Layer 1: Physical Layer

Physical layer is concerned with the bit stream that is transmitted over the physical medium. It deals with electrical, mechanical and timing specification of the interface and transmission medium. It also defines the functional and procedural specifications of the medium.

The physical layer is hardware-specific and describes procedures and functions for dealing hardware over the network. It also deals with physical characteristics of medium, data rate, synchronization and line configuration and physical topology of the network.

7.16.2 Layer 2: Data Link Layer

The Data Link layer is responsible for transmission of data over the network. It receives messages, from upper layers and assembles it into frames. Data Link layer converts these frames into bits for transmission over the network. It also receives the bit at the other end and reconverts it into the frames. The

Data Link layer has other functions as well, such as physical addressing, error, flow and access control for a single link between network nodes.

7.16.3 Layer 3: Network Layer

The network layer is responsible for delivery of messages from source to destination. It deals with routing of messages by translating logical addresses into physical addresses. It determines the path of the data on the basis of network environment, urgency of service, and other factors. It also manages traffic flow and associated problems on the network, such as switching, routing and congestion of data.

The network layer handles the routing and packet filtration using the logical addressing mechanism.

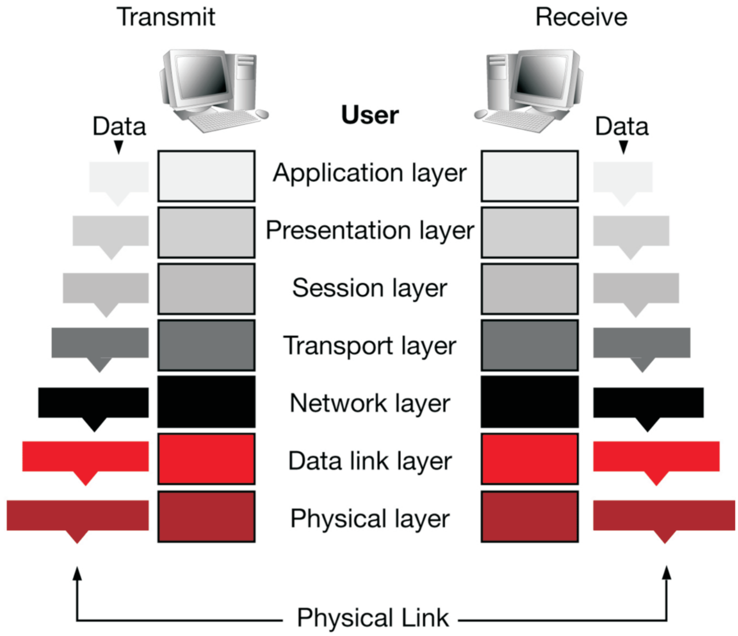


Figure-7.18: OSI Reference Model

7.16.4 Layer 4: Transport Layer

The Transport Layer receives messages from session layer and divides it in the form of packets. It submits the packets to network layer for transmission over the network. At the receiving node, it re-sequences the message by reassembling the packet segments. The transport layer ensures end to end delivery of packets and sequenced and ensures error delivery without losses or duplications.

The Transport Layer facilitate the upper but hiding the complexities of network operation from them. It also manages connection, flow and error control. It uses acknowledgment to manage source to destination flow control.

7.16.5 Layer 5: Session Layer

The Session Layer manages dialogues between two computers. It looks after identification of names and security parameters that are required by applications to communicate with each other. The session layer insert checkpoints in the data flow to synchronize the data stream. The checkpoints break the data into smaller groups for error detection.

The Session Layer also incorporates protocols to resume dialogues that have been interrupted.

7.16.6 Layer 6: Presentation Layer

The Presentation Layer looks after syntax (grammatical rules) and semantics of information needed for communication between two nodes. It defines the data and display format required to exchange information among network computers. The Presentation layer also handles the data formatting details, such as data encryption and data compression.

7.16.7 Layer 7: Application Layer

The Application Layer of the OSI reference model enables the user to access the network. It is concerned with providing user interfaces and services on the network, like file services, print and email services, and database services.

7.16.8 Network Interface Card:

Network Interface Card is a hardware device that physically makes the connection between the computer and the network cable. It is a printed circuit board that is installed on the expansion slot of the computer. It also provides a port to connect the network cable. The important functions of NIC are to:

1. Send the data to another host
2. Receive the incoming data and translate it into machine language
3. Prepare data from the computer for the network cable.

4. Control the flow of data.

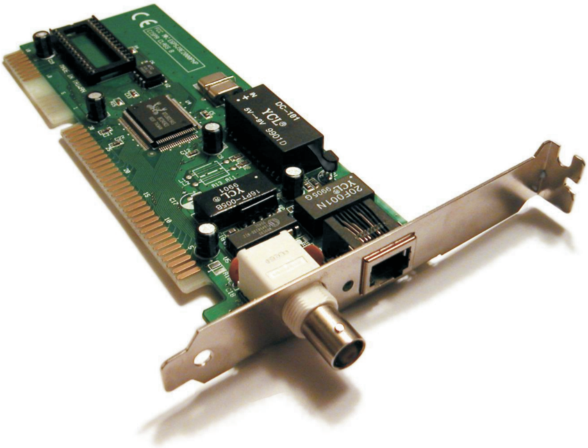


Figure-7.19: Network Interface Card

7.17 Self Assessment Questions:

Q.No.1. Identify basic elements of a communication system.

Q.No.2. Differentiate between Simplex, Half Duplex and Full Duplex.

Q.No.3. How speed of data transmission is measured?

Q.No.4. What are important types of communication media? Differentiate between analog and digital transmission.

Q.No.5. Differentiate between LAN and WAN. Also describe their features.

Q.No.6. Explain different types of network topologies with their characteristics.

Q.No.7. Explain the difference between Switching and Routing.

Q.No.8. Describe the basic concepts of OSI reference model.

7.18 Self Assessment Activities:

Visit IT department of any office or a company. Study the network architecture. Prepare a brief report.

Surf the Internet and explore mobile device communication standards.

Unit 8

MULTIMEDIA

Written By: Chaudhary Muhammad Shahbaz Anjum
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

MULTIMEDIA

8.1. Introduction

This unit mainly covers the basic concept of multimedia. It describes different multimedia components which enable readers how to use these components. It also describes various multimedia applications which help readers to understand the importance of multimedia.

8.2. Objectives

After reading this unit, the learners may be able to:

- Describe the basic concept of multimedia
- Explore the importance of multimedia
- Identify and use various multimedia components
- Identify and use different multimedia applications

8.3. Introduction

Newspaper was the first and foremost mass-communication medium in order to employ multimedia because it mainly used text, images or graphics. It was the major source of information for the people. Afterwards, motion pictures, radio and television were the major and significant new media till 20th century. These entire new media brought audio and video respectively and changed the whole world of mass-communication.

The integration (mixing) of all these media leads towards the creation of multimedia where text, images, graphics, audio and video are the major components. The term multimedia is derived from two different terms "multi" and "medium". Medium is usually defined as a distribution tool used to present or deliver/distribute information. Therefore multimedia can be defined as a combination of multiple media used to deliver information to the users digitally.

A figure named as "Overview of Multimedia" shows the history of multimedia briefly:

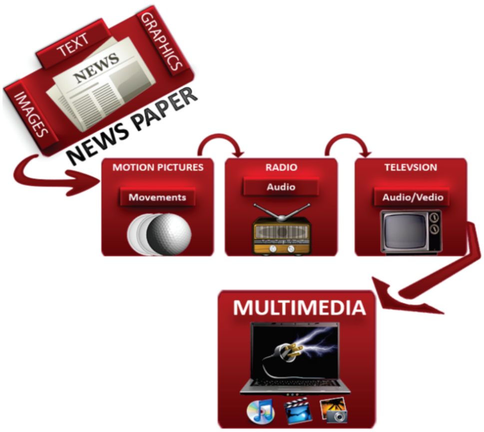


Figure-8.1: Overview of Multimedia

In order to fully understand the meaning of multimedia, the basic definitions, concept and examples of multimedia with illustrations are described below:

Multimedia is a field or a system concerned with computer-controlled integration/combination of text, animation, graphics, audio, video, images and any other form of media which can represent, store, transmit and process all information digitally. It can be said that multimedia generally means that computer information can represent through animations, audio and video in addition to other traditional medium such as text, graphics and images.

A figure named as "Multimedia: The Integration of Various Forms of Media" shows this concept in a clear way:

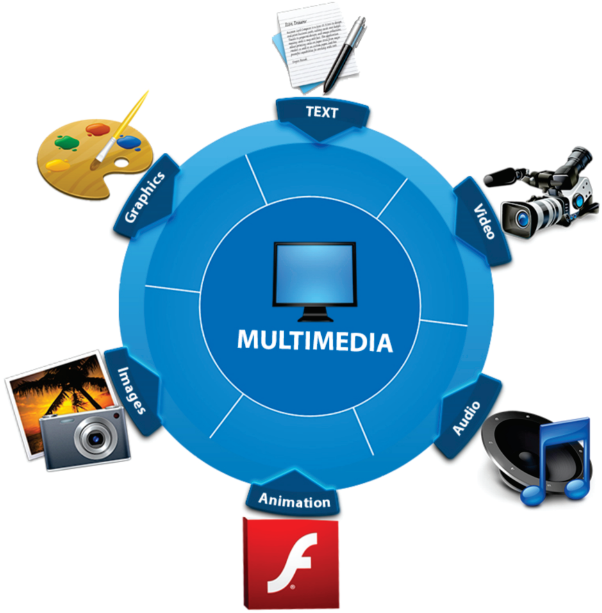


Figure-8.2: Multimedia: The Integration of Various Forms of Media

Various forms of multimedia mostly require huge disk space. In this regard, Compact Disks (CDs) and DVDs can be considered some good examples of multimedia because they mainly store information/data.

There are many examples of multimedia showing its importance and significance easily such as:

8.3.1. Multimedia Presentation

A presentation which involves audio or video clips as well as animations can be considered a pure multimedia presentation. These type of presentations put very positive impact on audience because with the help of audio and video clips, a presenter can present well and a viewer can understand the presentation easily.

8.3.2. Multimedia Software

Educational software involves text, audio, video and animation also called multimedia software. These types of software can help learners (students) to learn easily and improve their learning skills regarding their education. Multimedia CDs are the best examples where instructions are integrated through the form of text, images, audio, video, animations and graphics.

8.4. Multimedia System

A multimedia system is capable of representing multimedia information digitally and is characterized by storing, processing, generating and manipulating multimedia data/information or components.

8.4.1. Characteristics of a Multimedia-System

There are four main characteristics of a multimedia system as given below:

1) The multimedia-systems should be integrated.
2) A multimedia-system must be computer-controlled.
3) The information which these systems handle should be represented digitally.
4) The interface towards final presentation of medium should be typically interactive.

A figure named as "Characteristics of a Multimedia System" shows this concept simply:

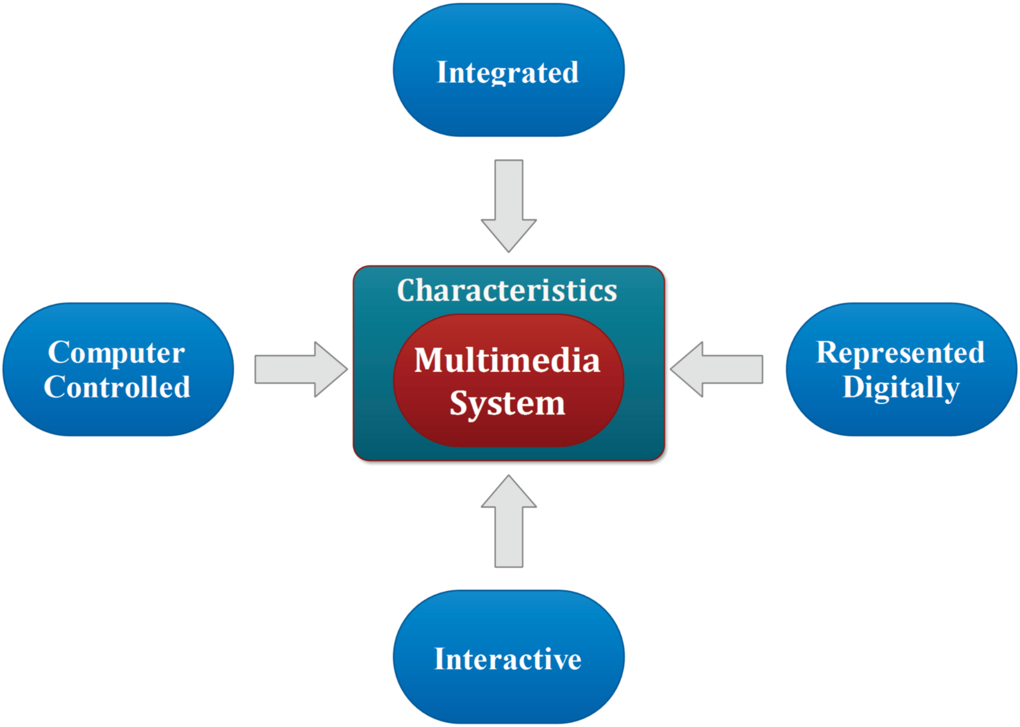


Figure-8.3: Characteristics of a Multimedia System

Without these characteristics, a multimedia application can't be effective, valuable or user friendly. In order to make the multimedia application valuable, these characteristics should be included in it.

There are lots of different fields where multimedia applications are being in use such as business, education, entertainment, home or public places etc. These fields alongside their different areas where multimedia applications play an essential part are described below:

- Business
  - Sales or marketing presentations
  - Trade show production
  - Staff training applications
- Education
  - Courseware
  - Simulations
  - E-Learning/Distance Learning
- Entertainment
  - Games
  - Interactive Movies
  - Video on demand (Online)
- Home
  - Television
  - Satellite TV
  - Mobile Phone

- Public Places
  - Information Kiosk
  - Smart Cards

8.5. Examples of Multimedia

There are many examples of multimedia applications where multimedia plays an important part and provides a lot of benefits (such as):

8.5.1. Multimedia Courseware

Multimedia Courseware is an important application of multimedia which is capable of:

1) Improving the learning skills of learners.
2) Enhancing their knowledge regarding their education.

The learners can easily understand the different concepts because of multimedia contents. Overall, it simply leads towards better educational results.

8.5.2. World Wide Web (www)

World Wide Web is commonly abbreviated by www. It has become one of the most important applications of multimedia.

There are many important features of World Wide Web such as:

1) The uers can easily gain precise knowledge by using world wide web.
2) It provides any required information instantly.
3) It is easily accessible etc.

8.5.3. Electronic Newspapers/Magazines

The electronic newspaper or magazine is the highly popular multimedia application. It is widely famous among the people of all ages.

It contains many features such as:

1) It is one and only one mass communication media which provides current information.
2) It always keeps people up-to-date with the fresh news related to all over the country plus abroad.
3) It is a reusable, refreshable and self contained version/adaptation of a traditional newspaper which holds all information electronically.

8.5.4. Video Conferencing

It is a live connection that allows people in different locations to interact with one another for the purpose of communication by using computer networks.

1) It includes both audio and video image.
2) It is a face to face communication which gives participants an opportunity to listen and see other's language and facial expressions.
3) It allows different people to communicate with each other.

These types of features made this multimedia application very eminent.

8.5.5. Interactive Movies

Entertainment is very necessary for everyone's life because it is an important key which keeps people glad and fresh. The multimedia applications such as interactive movies or games are best example of entertainment especially for children because:

1) The interactive movies and games are a source of pleasure for the children.
2) The children not only enjoy but also learn a lot, while watching interactive movies.

Digital Video Editing and Production System, On-Line reference works: E.g. Encyclopedias & Games etc., Home Shopping and Video-on-Demand are some of the other important multimedia applications which are used for different purposes.

8.6. Multimedia Components

Multimedia is generally a combination of different contents like text, computer graphics, animation, audio and video. These contents are called multimedia components. Each component has its own importance or worth which can be easily seen in different multimedia applications.

The detail of these components is described below:

8.6.1. Text

Text is a most important/essential component of every multimedia application.

Text can be mainly used for:
1) Title & Headlines
2) Labels & Captions
3) Menu (List of Options/Set of Choices)

4) Navigation
5) Content

Text is the use of a set of signs or symbols. Texts are mainly generated directly by computer/device.

Text in multimedia applications can easily express and convey specific information. It can work as reinforcement for that information which is contained in various other media items.

8.6.2. Graphics

Graphics is another significant part of any multimedia application.

It can be mainly used to:

1) Reinforce Text
2) Supplement Text
3) Create Impact

In graphics, there are two main levels of abstraction such as "Pictures" and "Images". The pictures can be easily originated in the world which is external to the computer. Oil paintings and photographs are the well-known examples of pictures.

On the other hand, the images are basically the computer's-realistic version/adaptation of pictures. It depends on two main factors: First one is the "Quality of System/Computer" and secondly the graphic designer's skills to use software(s).

Figure-8.4: Picture v/s Image

The computer graphics can be of two forms such as "Bitmap/Raster" & "Vector Based". Bitmap/Raster is basically an image-file-format which is used to save/store digital images. Many other image-file-formats like PNG (Portable Network Graphics), GIF (Graphics Interchange Format), TIF (Tagged Image File Format) and JPEG (Joint Photographic Experts Group) can also store bitmap images but these are not normally referred as bitmaps.

Vector-based computer graphics is based on sketching or drawing different elements and objects like circles, lines and rectangles to create an appropriate image. This is all based on mathematical equations which are used to represent images mainly in computer graphics.

- **Properties of Graphics**
  - o Graphics standards mainly include OpenGL (Open Graphics Library).
  - o Graphics are usually selectable, editable or revisable.
  - o Graphics are usually generated by a graphics editor program.

- o Graphics are a two-dimensional figure or illustration which can be produced manually by drawing or painting.
- o Graphics format is constructed by the composition of primitive objects such as lines, polygons, circles, curves and arcs.

8.6.3. Animation

Animation is the illusion of motion created by the consecutive display of images of static elements. With the help of this important component of multimedia, the multimedia applications can become interactive. The visual effects like dissolves or wipes are mostly used for primitive animations.

The major characteristics of this component are defined below:

1) It is mostly used to add some visual impacts to any multimedia application.
2) It is used to further enhance/enrich the experience of the user to further understand the information conveyed to them.
3) It is one of the major elements of a multimedia application which attracts audience rapidly.

Overall, animations can become any multimedia application more interactive, valuable and effective in use.

8.6.4. Video

Video is another most important component of multimedia. There are many major characteristics of this component which makes a multimedia application very effective and valuable.

In an interactive multimedia application, the video component plays an essential role by:

1) Capturing
2) Recording
3) Processing
4) Transmitting and
5) Reconstructing the moving pictures.

It is used to portray real time moving pictures in a multimedia project. It is a most powerful and main tool in a multimedia application. It can add very good imapct to any multimedia application in order to make it more intearctive, valuable and effective.

8.6.5. Audio

It is another most important component of multimedia. It provides the listening pleasure of music.

It can be used for different important purposes such as:

1) It gives instructions in order to understand the available material.
2) It basically comes in multimedia applications in different forms such as speech or sound effects.

8.7. Multimedia Applications

The multimedia applications include different things such as multimedia presentation, foreign language learning, video games, special effects in movies, multimedia kiosk, animated advertisements and multimedia conferencing.

8.7.1. Multimedia Presentation

The multimedia presentation is one of the major multimedia applications. It includes almost every component of multimedia.

There are many important features of this application such as:

1) It can be used almost everywhere such as educational areas, industrial areas or business sectors.
2) It is a best way to present different views to others. The presenter can deliver his/her ideas in a very good way with the help of different significant multimedia components.
3) The learners can understand different views easily with the help of images, audio, videos and animations.

4) Overall, these types of multimedia presentations put very fine and positive impact on target audience.

8.7.2. Foreign Language Learning

Learning is basically a complete process where a learner adopts information or knowledge from different ways. In case of language learning, it is very essential for every learner to choose an easy way of learning.

The learners can adopt knowledge from many other different multimedia applications such as:

1) Multimedia CDs
2) Multimedia Presentations
3) Electronic Newspapers
4) World Wide Web (www)
5) Interactive Movies

The foreign language learning is not an easy choice but these types of multimedia applications can provide a way by which the learners can learn easily. World Wide Web is an easy way from where one can easily get information and learn quickly. There are many ways in order to learn a foreign language online such as educational areas (colleges or universities), dictionaries, online movies, online interactive games, online books or online presentations etc. One can observe that everywhere the multimedia applications or multimedia components exist which help learners to learn efficiently and easily.

8.7.3. Animated Advertisements

Advertisement is basically a form of promotion in order to get attention of audience such as viewers, listeners and readers towards the desired product or a thing. Today, there are a lot of platforms where different things are being advertised efficiently like:

1) Face-Book
2) You-Tube
3) Twitter
4) MySpace
5) LinkedIn
6) Google

In all these platforms, the multimedia components play an essential part in advertising different contents. It can be said that these platforms fully revolve around multimedia components. There are many multimedia applications where multimedia component "animation" is used for advertising such as multimedia presentations, electronic newspapers, World Wide Web (www) or interactive movies etc.

Animated advertisements can easily capture the attention of target audience. It can prove to be very useful for media centres or telecommunication networks.

With the help of animations, the advertisements can become:

1) More Interactive

2) Valuable
3) Effective
4) Attractive
5) Well accepted

Overall, the fine animated advertisements can prove to be very beneficial for a company, a firm or media centre in order to increase productivity. From selling point of view, this strategy can be useful and increase the productivity level easily.

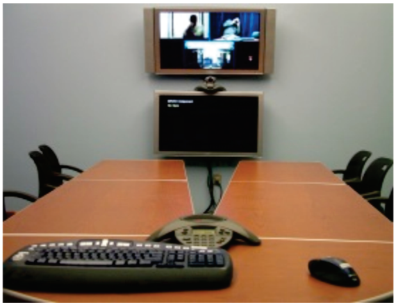
8.7.4. Multimedia Conferencing

The multimedia conferencing is an important and significant application of multimedia. It is basically a videoconferencing which is a computer based multi modal medium called multimedia because it includes almost every multimedia component. It is a platform where two or more people can be linked together and can be interacted with each other with the help of computer networks. A multi modal system is basically a system in which user is capable to use natural communication modalities which include voice, video, facial expressions and body movements. As in this system, the users can be able to utilize natural communication modalities, so they can interact with each other and the information can be exchanged easily between them.

The videoconferencing is a live connection that allows people in different locations to interact with one another for the purpose of communication by using computer networks. It includes both audio and moving video images. The most important part of videoconferencing is suitable network service. To provide predictable performance, a broadband or high speed internet connection is needed for videoconferencing. The videoconferencing requires adequate upload and download speeds from both sides, it requires significant bandwidth with minimal delay in data transfer, jitter (a distortion in digitally transmitted or recorded sounds or images) and data loss. The inability to provide the suitable network service can be the big hurdle in the popularity and success of IP videoconferencing.

The videoconferencing is basically used for the purpose of communication by using computer networks. There are many advantages of this multimedia application but the main feature of this application is defined as:

- Persons or users interact with each other by using their communication modalities such as:
  - Voice
  - Video and
  - Facial expressions



With the help of these modalities, everyone can see and understand each other in an easy way. The videoconferencing has become very popular because it's a face to face communication. For the successful videoconferencing, it is very important that the users are completely satisfied and are communicated easily. With the increasing popularity of videoconferencing, one can say that it will become more prominent and gain more success in future.

8.7.5. Video Games

The video games are also one of the major applications of multimedia which is basically known as electronic games. These types of games generally involve the interaction of human with user interfaces in order to generate some visual feedback on video devices. Various interactive electronic devices are being used with different display formats to make these video games more effective and valuable.

There are various types of video games which can be considered as a good source of entertainment for the people of different thoughts such as:

1) Action Games
2) Educational Games
3) Political Games
4) Puzzle Strategy and Board Games
5) Sports Games

All these types of video games are equally popular among the people of all ages. Especially children and youngsters widely attract towards playing different interactive games because these types of games have become a source of entertainment for them.

There are many platforms where these games can be played efficiently such as:

1) Computers
2) Internet
3) Mobile Phones

In personal computers, every operating system contains different video games which can be played easily. To use this multimedia application efficiently, the following hardware/software components are necessarily needed in a system: Personal computer with high resolution monitor, CD-ROM or DVD, external speakers/headphones, sound card, microphone and multimedia support software (s) etc.

Many online video games are also available today which are very interactive and interesting in use. There are many websites which provide this facility of playing various types of video games on internet. Overall, internet provides an easy way to play these types of online video games.

Almost every mobile phone contains different types of games which a user can play at any time for the purpose of entertainment. Mobile games are also very popular among children and teen-agers. Their interest towards playing such games is increasing with the passage of time.

The multimedia components especially images, graphics and animations make this multimedia application very interactive and significant.

8.7.6. Special Effects in Movies

A visual effect which is added to a film (movie), television/theatre or a video game in order to simulate different imagined events in a virtual world or story is generally referred as special effect.

It can also be simply defined as the illusions which are used in:

1) Movies
2) Video Games
3) Television Programs
4) Multimedia Courseware Design

In movies, the special effects are considered very important as compared to video games, television programs and multimedia courseware design.

The movie/film is one of the major applications of multimedia and special effects make this multimedia application very interactive, significant and valuable. There are different types of movies where the special effects are used widely such as horror, animated and science fiction movies. These types of films are hugely dependent on special effects because of their unique genres

The special effects belong to two different segments such as art and science. The science part basically provides a way to understand how audio-visual sensory organs/parts of a body/brain observe the whole world around us. On the other hand, the art part generally includes the planned or strategic use of all information in order to fool this sensory system.

Overall, the growing or rapid use of multimedia components especially computer animations and images produce very sensible and realistic visual effects in movies.

8.7.7. Multimedia Kiosk

Any type of big computer terminal which is mostly located in a public-place where people may use it for various purposes are generally referred to as kiosk.

The multimedia kiosk which can also be called interactive kiosk basically contains a physical structure which holds various essential hardware components like:

1) Central Processing Unit (CPU)
2) Touch Screen Monitor

3) Stereo Speakers and
4) Printer etc.

The multimedia kiosk also contains different software applcations in order to store data, exchange mesages, administer transactions or dispense various products to customers etc.
In addition, the multimedia components like text, images, graphicas as well as animations make this important application of multimedia very attractive, useful and effective. With these major multimedia components, the people can use this multimedia application effeciently and gain a lot of benefits.

The major and most important example of the multimedia kiosk is ATMs (Automatic Teller Machines). Almost every bank offers the facility of ATM. This facility provides a lot of benfits to the users and the users also engage in a self-service activity. Today, a lot of people use ATMs because it provides the facility of safe transaction and one can withdraw cash at any time without visiting bank(s).

The multimedia kiosks are mostly found in some major places like:

1) Supermarkets
2) Shopping Malls
3) Airports
4) Banks
5) Educational Areas

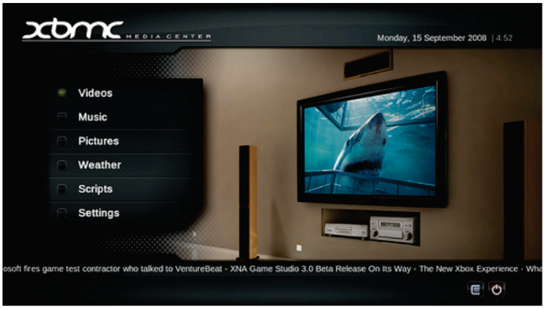
Overall, after viewing the above description, it can be said that all these multimedia applications play an important role in different areas and are very useful, valuable and effective.

8.8. Media Centre Computer

The term media centre is basically an audio-visual software application which is used in home theatre PC (personal computer), home cinema, windows media centre or media portal etc.

The media centre computer is a (convergence) device which combines almost all the capabilities or functionality of a PC with some software applications that support music, video, photo or video recording etc. Basically it directly relates to multimedia as almost all the components of multimedia exist in a media centre computer. The media centre computer revolves around multimedia components which makes it very interactive and efficient.

There are number of characteristics of a media centre computer which make this interface very famous such as:



1) Easy to use
2) Interactive Interface
3) Efficient
4) Resourceful
5) Very Customizable
6) Artistic and
7) Great Plug-in capabilities etc.

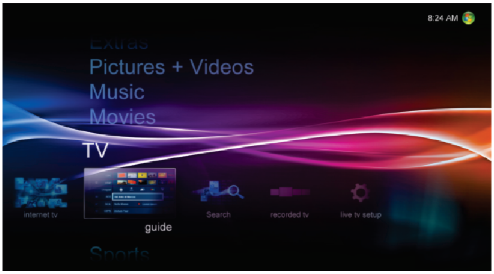
These features make a media centre computer very attractive. Overall, it can be said that it is a product of numerous technology innovations which may include high powered home computers and digital media.

One can transform his/her PC into a self contained media centre with the help of right software(s) (audio-visual software applications) plus some extra hardware contents which give his/her machine a new life.

The term windows media centre is usually referred as a digital video-recorder or media player which has been developed by Microsoft.

Basically it is that type of application which allows users to:

1) Play Music
2) Watch Videos
3) See Pictures
4) Watch Movies
5) View and Record Live Television etc.



This application is almost included in different versions of Windows XP, Windows Vista and Windows7 etc.

8.9. Self-Assessment Questions

Q.No.1. What is meant by the term multimedia? Also define it with the help of at least three different examples.

Q.No.2. Define multimedia system with the help of a diagram and also explain its different characteristics.

Q.No.3. Expalin concept of multimedia. Identify ten different examples of multimedia and also describe five of them in detail.

Q.No.4. Explain the different components of multimedia in detail with the help of illustrations.

Q.No.5. Explain the different applications of multimedia in detail with the help of illustrations.

Q.No.6. Define the following terms: media centre, media centre computer and windows media centre.

Q.No.7. Write a note (in your own words) on the following:

- ➢ Multimedia kiosk
- ➢ Multimedia Software
- ➢ Multimedia Presentation
- ➢ Multimedia Conferencing
- ➢ Animated Advertisements

8.10. Self-Assessment Activities

1 Explore the importance of multimedia in daily life.

2 Identify and use different multimedia components.

3 Identify various applications of multimedia which paly an important role in our daily lives.

4 How we can make a digital presentation more interactive. Explain it in detail.

5 How different multimedia components make "multimedia conferencing" an important and significant application of multimedia?

6 Why the advertisements can become so popular with the help of animations?

7 What are those various essentail hardware components which a multimedia kiosk holds? Explain the different examples of multimedia kiosk.

Unit 9

INTRODUCTION
To
COMPUTER LANGUAGES

Written By: Moiz Uddin Ahmed
Reviewed By: Dr. Mohammad Daud Khattak

CONTENTS

INTRODUCTION TO COMPUTER LANGUAGES

9.1 Introduction

Programming language is one of the important domains in Information Technology paradigm. The choice of the programming language is critical for the success of IT applications. This unit describes different types of programming languages and generations of programming languages. The concept of compiler, interpreter and linker is also explained.

9.2 Objectives

After completing this unit, students would be able to:

- Understand basic concept of computer languages.
- Familiar with the domain of high level and low level languages
- Differentiate between compiler, interpreter and linker
- Have knowledge about different generations of programming languages and their characteristics.

9.3 Programming Language:

A computer cannot perform any operations at its own. It requires some instructions to perform a task. The computer executes these instructions in a sequence and performs the required job. Now the question is how to formulate the instructions that a computer can understand? The instructions are formulated according to a pre-defined format and that format is based on the syntax and semantics of a programming language.

A computer language is an artificial language used for writing instructions or programs. A computer language is also known as programming language. A programming language provides a way of giving instructions to the computer. It is used to communicate and give commands to a computer.

9.4 Computer Program:

A program is set of commands or instructions given to computer to perform a task. A program instructs the computer to perform the task and produce the required result. The computer executes these instructions and gives the desired output. A person who writes a program for computers is known as software programmer.

The process of writing set of instructions in a computer language is called programming. The purpose of programming is to create a set of instructions that computers can understand and execute to perform explicit operations in order to produce the desired results.

9.5 Types of Programming Languages:

There is a large number of programming languages developed by different organizations and each language has its own characteristics and scope. The computer languages are divided into two broad categories. These are:

9.5.1 Low-Level Language
9.5.2 High-Level Language

9.5.1 Low Level Language:

Low level language is a language that comprises of instructions directly understood by the computer. These languages are considered to be closer to computers. Programs and applications written in low-level language are directly executable on the computing hardware without any interpretation or translation. Therefore low level language programs run very quickly and use very small memory. There are two kinds of low level languages. These are:

9.5.1.1 Machine Language.
9.5.1.2 Assembly Language

9.5.1.1 Machine Language:

Machine language is the fundamental language of the computer. Originally, computer programs were written in machine language and the machine language was the only language the computer can use while giving instructions. Machine language statements are generally composed of a string of On, Off or 0s and 1s i.e. binary numbers.

Off On On Off On On Off Off	or	0 1 1 0 1 1 0 0
Off Off Off On On Off On Off	or	0 0 0 1 1 0 1 0

Figure-9.1: Machine Language Statements

The computer uses the language directly during the processing. Today most programs are written in High Level Languages; however, all programs executed by the computer are actually processed in machine language.

Machine language instructions are composed of an operation code and an operand. The operation code defines the function that the computer must perform. Typical operation involves reading, writing, adding, subtracting, and so on. The operand represents the variables or items of data involved in this function. Each instruction tells the control unit of the CPU what to do and the length and location of the data fields that are involved in the operations.

- **Advantages of Machine Level Language:**
  - It has fast execution.
  - It requires no translator to decode the instructions.

- **Disadvantages of Machine Level Language:**
  - These languages are machine specific i.e. a particular machine language can be used on only one type of a system.
  - A programmer has to know the details of computer hardware of the computer before writing a program.

- It is difficult to find errors in a program coded in machine language
- A programmer has to memorize large number of instructions to write a program. In case of any small mistake an error may be raised in the program.
- A program becomes lengthy and creates difficulty for debugging.

9.5.1.2 Assembly Language:

Assembly language was developed by the programmers to overcome the drawbacks of the machine level language. It was a remarkable improvement over machine language.

Assembly language uses letters, words and symbols instead of binary digits. Assembly language is a little bit easier than machine language. Since; Assembly language is also machine dependent language; the programmers need to know many mnemonics for each computer. A mnemonic code is usually an abbreviation of words used in Assembly language. Examples of mnemonics include add, which add up the data items, and move, which moves data from one location to another. A program written in assembly language is called source program. This program is converted into machine code by an assembler.

The important elements of Assembly Language include Label, OP Code and Operand. The Label identifies each instruction and distinguishes one instruction from another. The label is also referred to as the tag. OP code defines the computer operations to be performed. The mnemonics identifies specific operations and directs the computer to complete these operations. A sample of assembly language coding is given below.

Operation Defined	Mnemonic Code	Operation Defined	Mnemonic Code
Addition	A	Move data	MVC
Division	D	Multiplication	M
Store data	ST	Subtraction	S

Figure-9.2: Assembly Language Statements

- **Advantages of Assembly Language:**
  - The programs written in machine language are replaced by mnemonics which are easier to remember.
  - It is easy to make insertions and deletions in programs.
  - It requires fewer instructions than machine to accomplish the same result.

- **Disadvantages of Assembly Language:**
  - The language Assemblers are exclusive to particular types of computers.
  - The programs are not portable and therefore cannot be executed on other computers.

9.5.2 High Level Language:

High Level Language (HLL) is a type of computer language that uses English and mathematical symbols for its program construction. They are also considered as third generation. In a HLL, each statement is equivalent to large number of assembly language commands or instructions that perform complex computing operations. The programmers concentrate only on the logic of applications without considering about the machine architecture.

- **Advantages of High Level Language:**
  - The high level language is machine independent and program oriented.
  - It is easy to learn and use.
  - It requires less time and effort to write a program in a HLL.
  - It provides better documentation of programs due to similarity with natural language.
  - The debugging of programs is also easy in HLL.

As a result high level languages are used more often than machine or assembly language. However the programs written in high level language need to be translated into machine language during execution process. For this purpose language translators and linkers are used for this purpose. Language translators include Compiler and Interpreter. High level language comes with compilers and interpreters.

9.6. Compiler, Interpreter and Linker:

9.6.1 Compiler:

A compiler is a computer program(s) that transforms source code into the object code. The source code is the program written in a programming language and object code is the executable form of the code often in a binary format.

A user writes a program in a high level language and uses the specific compiler designed for that language to execute the program. The compiler scans the entire program first and identifies errors (if required) and then translates the program into machine code. The machine code is then executed by the processor.

9.6.1.1 Interpreter:

An interpreter is a computer program which translates a high level computer program into its equivalent machine language program. It reads one line of code at a time, converts it into binary language and then runs the code on the machine.

9.7 Difference between Compiler and Interpreter:

The interpreter takes one statement at a time, translates and executes it and then takes other statement. While the compiler reads the entire program in one scan and then translates and executes it.

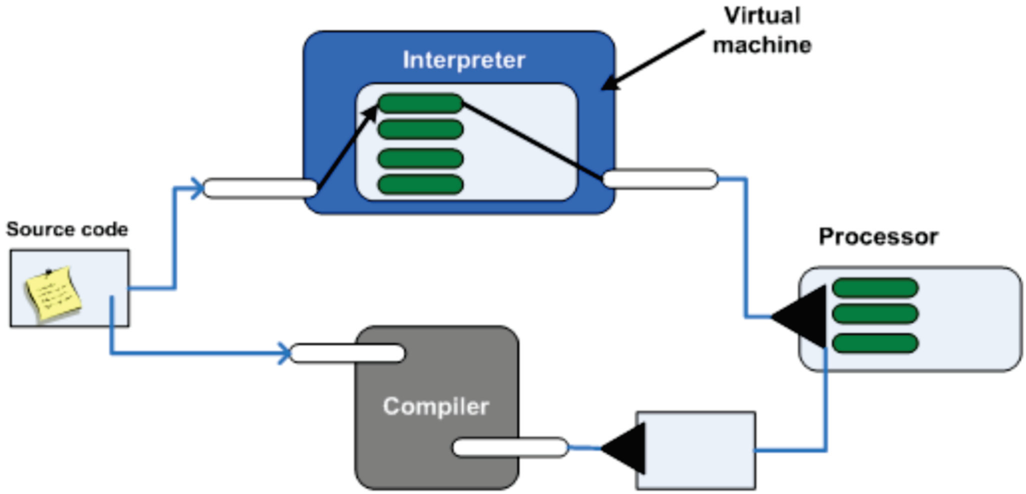


Figure-9.3: Difference between Compiler and Interpreter

Due to scanning a program in one go; a compiler takes a larger amount of time in translating and executing a high level language code and interpreter on the other hand scans line by line and therefore takes lesser time in the same process.

9.8 Linker:

A linker or link editor is a computer program that links one or more object files generated by a compiler and combines them into a single unit to execute the program.

Computer programs are comprised of several components or modules; all these components and modules need not to be confined within a single object file. When a program comprises of more than one object files, the linker combines these files into a single unit executable program.

9.9 Commonly used High Level Languages:

9.9.1 Procedure Oriented Language:

The disadvantages of machine and assembly language led the development of procedural languages in late 1950s and 1960. These languages are also called 3rd generation languages. These languages consist of English like statements that are used for the development of computer programs.

Procedural language is based upon the concept of the procedure call. A procedure consists of series of steps executed by the computer system. A procedure can consist of routines, subroutines, methods, or functions. Programmer converts the source program into machine language by using compiler or interpreter.

There are hundreds of procedural languages available for computer programming. However only few of them are used widely in the market and are also recognized as standard programming languages. Let's have some introduction of important procedural languages.

9.9.2 FORTRAN:

The FORTRAN was developed by a team of professionals at IBM headed by John Backus, and was first published in 1957. The name FORTRAN is an acronym for FORmula TRANslation. It was developed for programming scientific and mathematical applications. The language is still in use these days for the development of scientific programs that have extensive mathematical computations.

Some of the significant features of the language are:

- The language is easy to learn.
- The programs are portable or machine independent
- The complex mathematical equations can be written in simple regular algebraic notations.
- It provides efficient execution of program.
- It allows to control the allocation of storage
- It provides more autonomy in code layout as compared to low level languages.

A sample program written in FORTRAN language is shown in the following figure:

```
Comment:    LIST THE SQUARES AND CUBES FROM 1 TO 10
    INTEGER N,TOP
    TOP = 10
    PRINT *, ' NUMBER        SQUARE      CUBE'
    DO 10 N = 1 , TOP, 1
        PRINT *, N, N**2, N**3
    END
```

Figure-9.4: A Sample of Fortran-Program

9.9.3 COBOL:

COBOL (Common Business Oriented Language) was one of the older high-level languages. It was developed in 1959 by a group of computer expert consortium called Conference on Data Systems Languages (CODASYL). It is a programming language designed for business applications. For over four decades COBOL has been the dominant programming language for the development of business computing applications. The syntax of COBOL was designed to make it possible for non-programmers such as directors, managers and users, to read and understand it without any difficulty. As a result, COBOL contains such English-like instruction format such as verbs, nouns, sentences and sections.

Some of the significant features of the language are:

- COBOL is suitable for programming business applications.
- COBOL is a simple language, it encourages a simple programming style
- File records and variables are defined in detail.
- The language is portable as its standard does not belong to any particular vendor

```
IDENTIFICATION DIVISION.
PROGRAM-ID.   HELLO WORLD PROGRAM.
AUTHOR.       AIOU.
*The Hello world program

ENVIRONMENT DIVISION.

DATA DIVISION.
WORKING STORAGE SECTION.
01 TEXT-OUT    PIC X(20) VALUE 'Hello World ! How are You'.

PROCEDURE DIVISION.
MAIN-PARAGRAPH.
       DISPLAY TEXT-OUT
       STOP RUN.
```

Figure-9.5: A Sample of COBOL Program

A sample COBOL program displaying Hello World is shown in the following figure:

9.9.4 C Language:

The C language was designed and developed at AT&T Bell Labs in the early 1970s by Dennis Ritchie. The foundation of C language was an earlier Bell Lab's language "B" which itself was based on another language named BCPL. It was initially designed for the UNIX operating system, but it soon demonstrated itself a powerful, general used programming language. The capability of C language to communicate with computer system hardware makes it a dominant choice for system programmers. The popular operating systems such as UNIX and Linux were developed entirely in C language. Moreover, compilers and interpreters for other languages such as FORTRAN, Pascal, and BASIC were also developed in C language. However the scope of C language is not just limited to developing languages compilers and interpreters. It is also used to develop various types of applications, including complex business and commerce applications.

Some of the significant features of the language are:

- C is a general purpose programming language, and not limited to any particular kind of programming.
- It is an efficient and powerful programming language, and support system and application software development.
- It is independent of any particular machine architecture. Programs can be executed on a wide range of hardware.
- The modularity allows breaking a large program into small manageable pieces, which can be reused in other programs.

A sample C program for addition of two numbers is shown in the following figure:

```
#include<stdio.h>
 main()
{
  int x, y, z;
   printf("Give two numbers to add\n");
  scanf("%d%d", &x, &y);
   z = x + y;
   printf("Sum of entered numbers = %d\n",z);
   return 0;
}
```

Figure-9.6: A Sample of C-Program

9.10 Object-Oriented Programming Languages: OOP

Object-Oriented Programming (OOP) is a programming domain which uses real world entities and objects to design applications and computer programs. The objects are the instances of a class which provides a template for defining real world objects. Each object can receive messages, process data, and send messages to other objects. Object oriented programming encourages a programmer to decompose a problem into related sub groups. Each sub group becomes a self-contained object that includes its own code and data that relates to that object. In this way, complexity is reduced and the programmers can manage larger programs. All OOP languages share three common traits i.e. encapsulation, polymorphism and inheritance.

There are varieties of languages available that support object oriented programming. Let's look at few important ones:

9.10.1 JAVA:

Java is an object oriented programming language initiated by James Gosling and released in 1995 by Sun Microsystems. Computer programs developed in the Java programming language can run on any hardware and operating-system platform. The java code is compiled to an intermediate representation called Java bytecode. Later this code is interpreted for execution by an Interpreter called Java Virtual Machine.

Some of the significant features of the language are:

- Java language has both compiler and interpreter.
- It is platform independent.
- The Code of Java is robust as it first checks the reliability of the code before execution.
- It has built-in capabilities to ensure that violations of security do not occur.
- Java is a distributed language because it supports network programming
- It is capable to employ multi-threading techniques for program execution.

A sample JAVA program for calculating average of N numbers is shown in the following figure:

```
import java.util.Scanner;
public class Average {
public static void main(String[] args) {
Scanner input = new Scanner(System.in);
System.out.print("Enter numbers " +
"for calculating average : ");
final int elements = input.nextInt();;
System.out.println("");
double[] numbers = new double[elements];
double sum = 0;
for (int i = 0; i < elements; i++) {
System.out.print("Enter number "+(i+1)+" : " );
numbers[i] = input.nextDouble();
sum += numbers[i];
}
double average = sum / elements;
System.out.println("");
System.out.println("Average is " + average);
}
}
```

Figure-9.7: A Sample of Java Program

9.10.2 C++:

The C++ programming language is an extension of C Language with some additional features. It was developed by Bjarne Stroustrup in the early 1980s at Bell Laboratories. C++ is an object oriented programming language; which comprises of all the features of C language, additionally it has the capability for working with objects, classes and other object oriented concepts.

C++ is one of the most popular programming languages and is used on different varieties of hardware platforms and operating systems. It covers a vast area of application development including application software, system software, hardware device drivers, embedded software, client and server applications, and entertainment software such as video games.

Some of the more significant features of the language are:

- C++ is an elegant language. It lets the users to program in either procedural style, or an object-oriented style, or both.
- C++ has a wide range of compilers that run on many different platforms and machines.
- It has a large function library.
- It is suitable for development of reusable modules, thus reduces cost of software development.
- It provided fast execution of source code.

A sample C++ program displaying Hello World is shown in the following figure:

```
#include <iostream>

using namespace std;

int main()
{
        cout << "Hello World , how are you!" << endl;
        return 0;
}
```

Figure-9.8: A sample of C++ program

9.11 Fourth Generation Language: 4GLs

Fourth-generation programming language, or 4GL (1970s-1990), is a class of non-procedural, high-level programming language. It allows the users to simply specify what data to retrieve, delete or insert rather than how to perform the operation. It is intended to maximize the user effort and decrease the development time and cost of the applications.

Fourth generation language includes the following:

9.11.1 Database Query Language:

Database query language is used to manipulate the database applications. It allows formation of queries that process several records from one or more database tables. Structured query Language (SQL) is most important example of database query language.

9.11.2 Report Generator:

Report generator allows extracting data from a database and presenting it in the form of a formatted report. It also allows applying arithmetic and logical operations on the desired data.

9.11.3 Visual Programming Languages:

Visual Language is event driven processing. Visual language has replaced text-based instruction with symbolic icons. An event can be a mouse click, a button press, a drop down menu selection or an internal action for windows activity. Visual basic & Visual C are the example of visual language.

While writing program in any visual languages the programmer does not write code of the program in some specific order as in the case of text base programming. Similarly users also not follow the order. They might want to choose from a pull down menu, click a mouse button or key etc. and might do these tasks in any order. Visual programming is more complex than programming for textual application but execution of visual program is highly user friendly.

Some authors refer visual programming languages as fifth generation languages.

9.12 Web Page Development:

The term Web development refers to different activities related to the development of a website for the Internet or an Intranet (a private network). The web development activities include the web designing, the web content development, and the client and server-side coding. Web development can range from simple to complex website including simple text based static page to more complex web-based applications including e-business, e-learning and social networking applications.

A variety of techniques are available in order to develop web pages. These techniques make use of programming languages discussed previously and some special hypertext and scripting languages.

9.12.1 Hypertext Markup Language (HTML):

HTML is a special tag based language used to develop web pages. HTML allows users to publish variety of documents on the Internet in a platform independent way, create links within the same documents or with some other document, and include graphics and multimedia within the web page document.

HTML is written in the form of HTML elements which forms the building block of a website. Each element has specified attribute that apply on word, text or paragraph. The elements are written with a start and an end tag, with the content in between. For example if the user wants to bold a text he can use the following HTML tag.

This text is bold

A sample HTML page is given in the following figure:

```
<html>
<body>
<p><b>This text is bold</b></p>
<p><i>This text is italic</i></p>
<p><u>This text is underline</u>></p>
</body>
</html>
```

Figure -9.9: A Sample of HTML

Users can write HTML code using any text editor such as notepad, besides this many tools are available that generate HTML tags automatically according to the document formatting. These tools include Microsoft Front Page and Dreamweaver etc.

XHTML (Extensible HTML) is a markup language that enables websites to be displayed on mobile phones and other mobile devices.

9.12.2 Scripting Languages:

A scripting language is a programming language that supports the writing of script. Most of the scripting languages are interpreter based which makes the code execution efficient. Scripting languages are used to facilitate the development of web pages. The program development in scripting language is fast and it also provides easy communication mechanism with the programs written in other languages. Some of the more significant features of the language are:

- Scripting languages are easy to use and learn
- They require minimum programming knowledge or experience
- They handle complex programming tasks in relatively fewer steps
- A variety of text editors are available to support script language programming.
- They allow to create dynamic and interactive activities on web pages
- They also provide fast editing of web pages.

A variety of scripting languages are available that include the following:

- Java Script
- VB Script
- PHP (Preprocessor Hypertext)
- PERL (Practical Extraction and Report Language)

9.13 Characteristics of a Good Programming Language:

There are large numbers of high level languages available in the software industry. Some languages are very popular due to their features. There might be many reasons for the success of a language, but one obvious reason is the characteristics of the language. There are some notable characteristics that play important role in success of a programming language. These characteristics include the following:

- A programming language should be simple and user friendly.
- The syntax of the language should be in resemblance with the natural language
- The language should be capable of handling different programming approaches like procedural, structural and object oriented.
- Language should have compactness and extensibility features
- The program execution should be efficient.
- The error discovery and removal should not be a cumbersome task

9.14 Selecting a Programming Language:

The following factors are important for the language selection process:

- The language should be suitable for the application domain. For example COBOL is suitable for business applications.
- The language should be selected keeping in view the targeted platform where the application will be executed.
- If there are multiple languages available then expertise of the staff should be considered and only that language should be selected for which proper expertise are available.
- Time to produce is very dependent on the size of the code/language. The language should be selected to meet the project deadline.
- The availability of program development tools like compiler, libraries should also be taken into consideration.
- The language should also have a strong community support behind it.
- The future enhancement should also be considered.

9.15 Self Assessment Questions:

Q.No.1. What is programming language? How computer program is related with a programming language?

Q.No.2. What is the difference between Low Level and High level Language?

Q.No.3. Why High Level Languages are easier to use?

Q.No.4. Highlight significant features of important High Level Languages

Q.No.5. Differentiate between Compiler and Interpreter.

Q.No.6. What are the important characteristics of a programming language

Q.No.7. What are the important parameters that influence the selection of a programming language?

9.16 Self Assessment Activities:

1. Collect information about high level languages. Choose any one language of your choice and learn installation and basic use.

2. Study the sample programs of high level languages mentioned in this chapter and understand its basic syntax.

   (You may take help from your tutor/internet/any relevant book)

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