Module - I

Notes

Course Contents:

- Introduction to Computers
- History and Evolution
- Generation of Computer
- Applications of Computers
- Capabilities and Limitations
- Components of a Computer System – Control Unit, ALU, I/O Devices
- Memory – RAM, ROM, EPROM, PROM, Flash Memory and other types of memory.

Key Learning Objectives:

At the end of this block, you will be able to:

1. Define Computer
2. Describe the history and evolution of a computer
3. Define the generation of computer
4. Describe the application of a computer system
5. Define various component of a computer
6. Define Memory

Structure:

Unit 1.1: Basics of Computer

1.1.1 Introduction

1.1.2 Introduction to Computer

1.1.3 History and Evolution of a Computer

1.1.4 Generation of Computer

1.1.5 Applications of Computers

1.1.6 Capabilities and Limitations of Computer

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1.1.8.1 Primary Memory

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1.1.8.3 Flash Memory

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Unit - 1.1: Basics of Computer

Unit Outcome:

At the end of this unit, you will learn

1. Define Computer
2. Describe the history and evolution of a computer
3. Define the generation of computer
4. Describe the application of a computer system
5. Define various component of a computer
6. Define Memory

1.1.1 Introduction

Whether it is office or hospital, mall, home, everywhere we need computer. Computers help us store data, perform calculations and help us work in an organised manner. The computer is used to save time and money by speed and concentration in a wide range of tasks. Computer have made considerable progress in the field of Science, technology, education and society. In this unit we will discuss about the introduction to computer, the history and evolution of a computer, the generation of computer, the application of a computer system, the various component of a computer and the memory.

1.1.2 Introduction to Computer

A computer is an electronic device that takes raw data like input and processes it and gives proper and useful information as output.

In short, the computer works as follows.

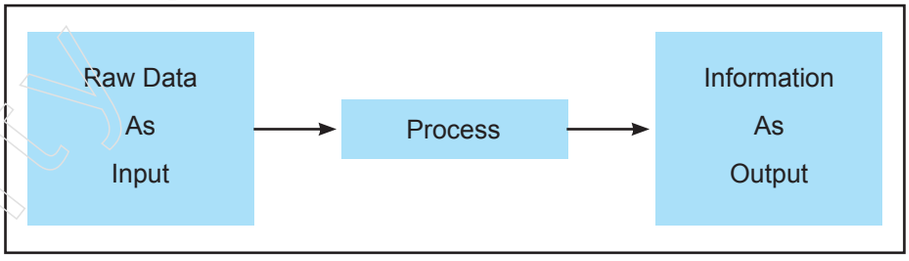

Fig. 1.1.1 Block Diagram of Computer Operation

Today, the computer has changed our life in true ways. Today, due to various types of electronic and computerized machines in this computer age, many of our life's tasks are becoming easier and completed in less time. The foundation of the computer which has made our life so easy was laid about 3000 years ago, i.e., the history of computer is almost 3000 years old. Computer was not so important earlier days, but today computer is a well-known word that is used in everyday life. Today, computer is being used in almost every area of our daily life. For example, nowadays computer is used for banking, education, medical services, bill payment, satellite system etc. In these

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areas, we can easily complete the biggest work with the use of computer in the least time. Today, there is no need to install long queue to make reservations in trains. We can make our own reservation sitting at home with the help of computer and Internet, keeping in mind the availability of seats in all trains. We also solve complex to complex calculations in seconds. Even after purchasing goods from a shop, its bill is also being made from the computer itself.

Today's era came to be known as 'Computer era'. Today computer is also being used as a means of communication. Today, due to computer, communication has not only been limited in writing but also has access to voice, video and graphics. Due to the use of computer, we can not only talk to our friends sitting abroad, but we can also see them. Keeping in view the properties of computers, today the number of works done on it is continuously increasing. Today's era is becoming so much dependent on computers that doing many tasks without the help of computer is becoming almost impossible. Today's dependence on computers has increased so much that if even one day the computer stops working, then many of our important tasks will either stop or be stalled. Today's extreme dependence on computers is proved by this fact that the whole world was shaken by the Y2 K problem, which happened on 31 December, 1999, because of the Y2 K problem and because of the excessive dependence on computers all over the world. We had to face a very serious situation which was solved due to intellectuals around the world in time, otherwise we do not know what would happen today.

Y2K means Year 2000 i.e., after 12 o'clock on the night of 31 December 1999, Computer's date would have become 1 January, 1900 not as 1 January, 2000. In this situation, all the computers around the world would go back a century and many important tasks, for which we have become highly dependent on the computer, would stop or go bad. Because until that time (December 31, 1999) the date format of the computer was MM - DD - YY not as MM - DD - YYYY, which was a very big and serious human mistake while making computer software which was diagnosed in time otherwise the results would have been very terrible.

1.1.3 History and Evolution of a Computer

In the context of computer, it is said that computer was invented in China 3000 years ago. Earlier the computer name was Abacus. Abacus can be considered the basis of a computer. These are still used to calculate digits in many countries like China, Japan. A brief introduction to Abacus and other early instruments is given below.

Abacus: Abacus is a frame of wire. Small balls are threaded in these wires. Initially, Abacus was used for business calculations. This machine was used to add, subtract, multiply and divide digits. This frame is divided into two distinct parts. In which each wire on one side has two balls, the value of which is 5 and in the other part each wire has 5-5 balls, the value of which is one.

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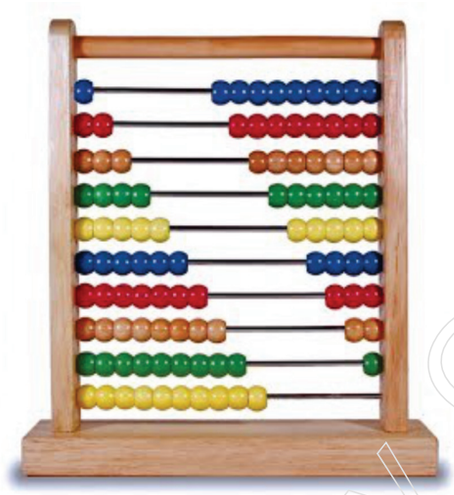

Fig. 1.1.2 Abacus [1]

Napier's Bones: John Napier contributed the most to the calculation method after the Abacus. The Scottish mathematician John Napier made some rectangular strips, with which multiplication could be done quickly. These strips were made of elephant teeth, so they were called Napier bones.

These strips are shown in Figure 1.1.3. These are a total of ten rectangular strips, on which the ranges from 0 to 9, respectively, are written in such a way that the tens digits of one strip come near the unit digits of the other strip. Later, Napier developed the Logarithm method.

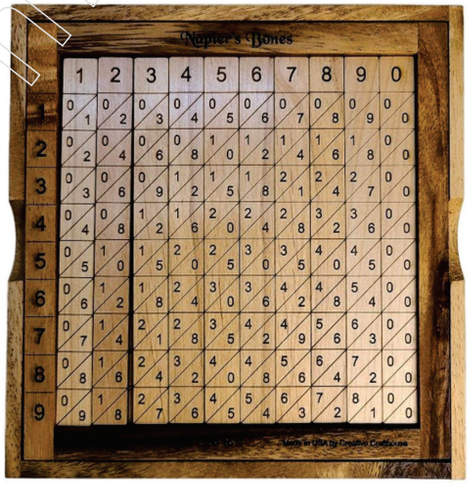

Fig. 1.1.3 Napier's Bones [2]

Slide Rule: John Napier invented the logarithm method of calculations. In this method product of two numbers, division of two numbers, square root of number, etc. are drawn by adding or subtracting the exponents of a chosen number. Even today, this method is used in big calculations, even in computers. In 1620, the German mathematician William Oughtred invented an object called slide rule that could easily

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perform calculations based on the logarithmic method. It has two specially marked strips, which can be moved back and forth in equal measure. The symbols are placed on them in such a way that the actual distance from the sign having zero of a number is proportional to the logarithm on a common basis of that number.

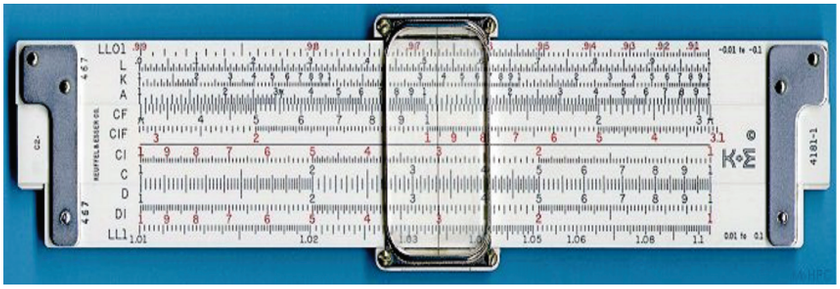

Fig. 1.1.4 Slide Rule [3]

Pascal's Calculator: A mechanical calculator came into existence that was invented by the great mathematician and philosopher Blaise Pascal of France when he was only 18 years old.

He made this machine to help his father who is tax superintendent. It is also called Pascal's calculator or Pascal's adding machine. This machine was used to add and subtract numbers. This machine had many serrated circles and dials. Each circle had 10 parts and they were connected in such a way that as a cycle rotated once, it rotated only one part (i.e., one-tenth part) to the left, thereby Carry effect was produced. The sum or difference of two numbers was found by dialling one number and rotating the circles equal to the other number respectively.

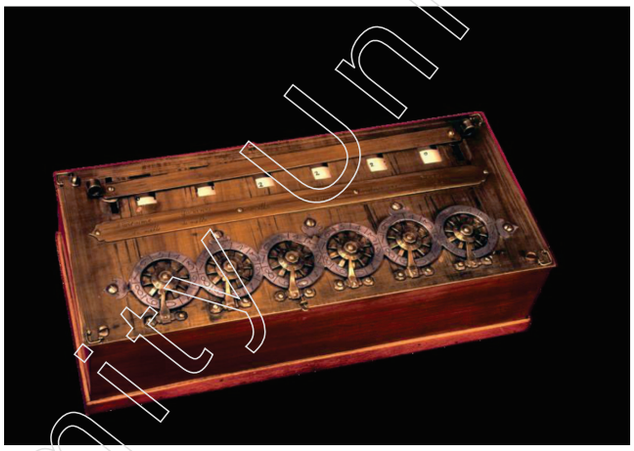

Fig.1.1.5 Pascal Calculator [4]

Leibnitz's Mechanical Calculator: Germany's Professors Leibnitz following the Pascal and made his own device in 1677. In which some parts of the calculator could move to the right or left. Leibnitz made many improvements to Pascal's calculator to build a complex machine that was able to add and subtract as well as multiply and divide. The speed of calculating this machine was very fast. This machine was produced in large amount. Similar machines are still used in many places.

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Fig. 1.1.6 Leibnitz's Mechanical Calculator

Difference Engine of Babbage: Mathematics professor Charles Babbage of Cambridge University is also known as the father of modern computers. In 1823, Charles Babbage developed a device based on modern computers. It was named 'Difference Engine'. It could accurately calculate the value of various algebraic functions to 20 decimal places.

Figure 1.1.7 shows the difference engine of the path. This machine was actually very useful, because it used to generate many types of mathematical tables in minutes, which were widely used in those days in insurance, post office, rail, production etc.

Later, the improved form of this machine was used by insurance companies in making life tables.

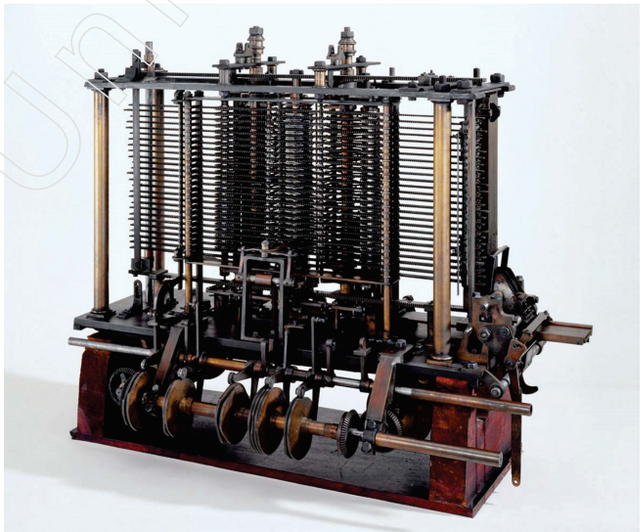

Fig. 1.1.7 Difference Engine [6]

Analytical Engine of Babbage: After the success of his difference engine, Charles Babbage developed 'Analytical Engine'. There were some arrangements for input, output, control, calculation and memory. This is how the modern computer was introduced here. This machine had proposed the following five major parts.

Input Unit- to receive data and instruction

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Storage- to store Data and Instructions.

Mill- For arithmetic operation

Control- for movement of data in -storage and mills.

Output unit- for output

This machine not only had the ability to perform all actions, but the idea of storing data was also first introduced in this. Not only this, the ability was also imagined.

Punched Card Devices: In 1880, another electronic device came into the field of computer's development, which made it easy to do calculations with the help of punched cards. Initially all the instruments were made for calculation, the jagged wheels were manually rotated to dial the numbers. But Charles Babbage first thought that reading numbers could be done through punched cards as well. He got this idea by looking at Jacquard's knitting machine. In fact, in the design he designed for his analytical engine, the work of giving input was done only through punched cards and Jacquard built a similar Machine, in which the weaving design was pierced in inserting cards were used. In other words, the input of the weaving design was on their card only. The real significance of Jacquard's discovery was recognized by Charles Babbage much later.

But the entire credit for implementing this work of Charles Babbage goes to the Dr. Harmon Hollerith. He was in the US Census Department of America. In America, all the work of the 1880 census was done by hand, which took many years. Therefore, the Census Bureau organized a contest before the 1890 census, in which suggestions and proposals were sought for early census work. The winner of this competition was Dr. Hollerith, who gave the idea of keeping the data on the punched card. He also made an electric machine that could sort and count these cards. With the help of such machines, the entire census work was completed in only two years, whereas it usually took 10 years.

This success of Dr. Hollerith gained popularity for his machines all over the world. Later Dr. Hollerith formed his own tabulating machine company, which produced punching machines in large amount. The company later became known as International Business Machine Corporation, i.e., IBM, which is still the largest computer making company in the world. IBM produced its own special Punching Machine, which punched information on a fixed size of cards by punching in the designated locations. Until a few years ago punched cards were widely used for the input of data, but after modern terminals came into existence, their use has stopped completely because they are very expensive.

Early Computers: Until the 1980s, all calculating machines were basically mechanical. Around this time IBM built MARK- I computer in 1943 in collaboration with Dr. Howard Ekins and Grace Hopper of Harvard University.

MARK - I was a very large device and its length was about 15 m. The length of the wires used in this is about 800 km. There were thousands of Electromagnetic Relay and other parts in it. It was the first general computer that could store and follow programs. It could multiply two numbers with 20 digits in 5 seconds. The biggest drawback of this computer was that it used to make a lot of noise and generate huge amounts of heat. It was very difficult and boring to find any defect in this computer. Nevertheless, in 1950,

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its improved form was sold in the European markets. It was the first computer that was based on relay switches. All subsequent computers were electronic. Some other computers came into existence after MARK-I, which are considered to be elementary computers. They are - ENIAC, EDSAC, EDVAC, LEO, UNIVAC - 1 etc.

1.1.4 Generations of Computers

The history of the development of computers in the modern era has been divided into several parts according to technology. These parts are called generations of computers. Five generations of computers exist so far. Each generation of computers is different from a technical point of view and the characteristics and brief introduction of each generation of computers is as follows.

First Generation Computers (1946–1958): First generation computers were very large and based on vacuum tubes and electric valves. At that time the vacuum tube was the only available electric component. Computers of this generation were also very large in size and they produced so much heat that it was mandatory to install air conditioner. Their speed was slow and they were very expensive. Since there was no operating system in them. Therefore, when required, the user had to do the task of pressing the switch etc. or installing or removing various devices, which was very inconvenient.

Following are the names of some computers of this generation- ENIAC, EDSAC, EDVAC, UNIVAC - I

Second Generation of Computers (1958–1964): In this generation computers, vacuum tubes were replaced by transistors and the second generation of computers came into existence. Due to the transistors, the sizes of computers of this generation have become smaller and their speed has also increased and the cost of computer of this generation also decreased. This generation of computers produced relatively less heat than the first-generation computers, but still the need for air conditioner remained. Input and Output devices were also very convenient in computers of this generation. Some of the major computers of this generation - IBM - 1401, IBM 1602, IBM - 7094, CDS - 3600 RCA - 5011 - IBM - 1401 is the most prominent among them which was very popular at that time and was produced in large amount. This generation of computers was used extensively in business and industry.

Third Generation Computers (1964–1970) - Third Generation Computers were came into existence to be between 1901 and 1970. Integrated circuits (IC) began to be used in computers of this generation. IC i.e., an integrated circuit is a complete electronic circuit that was built on a small silicon chip. This chip can be as large as an ant's size, in which thousands or millions of components are used. After the development of IC in 1965, the trend of transistors in computers almost stopped. Due to IC, the size of computers further reduced and computers started working at a faster pace. These integrated chips were considered the discovery of the next generation because it had many features like small size, cheap and reliability as per the wishes of the people. Early in the third generation IBM announced a computer called its 360 Series. These computers were designed for commercial and scientific use, and many models of these 360-series computer family were packed in blue boxes, due to which many people are known as it Blue. In this generation, along with computers, external

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devices that store data, such as Disk, Tape, etc. also developed, which also reduced the pressure on computers' memory and due to this it became easier to write programs. Multiprogramming (running multiple programs on the computer simultaneously) and Multiprocessing were also possible with this generation computers.

The computers of this generation were small in size as well as relatively cheap, due to which it was possible to install computers in many small companies and government offices as well. Some of the major computers of this generation were IBM-360, IBM-370 series, ICL-1900 and ICL-2900 series, Uniq-9000 series etc.

Fourth generation of computers (1970–1985): Fourth generation computers are considered to be from 1970 to 1985. In 1970, there was a significant increase in the efficiency of computers. But in reality, the fourth generation was the elaborate technology of the third generation of computers. Because in the early times of the third generation, chips were built specifically on the memory of the computer with economical capability, but in 1971 the first micro-processor came on the market, due to which the power of the computer was greatly increased. In fact, they are very large-Scale Integrated Circuit (VLSI) in which thousands - millions of transistors are mounted on a single microchip. Computers that use these chips are called Microcomputers. In the summer of 1961 IBM built its first personal computer (PC) and it became the most successful product in the market in a very short time. Both the keyboard and the monitor were used in this personal computer. The IBM company continued work to increase its computer memory. PCs used to first use the floppy disk and later the hard disk as well. RAM and ROM also came into vogue in this generation, due to which work started happening at a very fast pace and time savings also started.

Fifth Generation of Computers: (1985 - till the Date) - ULSI technology was used in place of VLSI in fifth generation computers and millions of transistors were installed on one chip. Many calculations were possible. CD (Compact Disk) was developed for storage. Internet, E - mail and www (World Wide Web) developed. In this generation very, powerful computers such as super computers, Laptop, Palmtop Computers etc. were developed. Development of Artificial Intelligence was also attempted in this era so that computers too can take decisions on their own according to the situation.

1.1.5 Applications of Computers

In today's era, there is hardly any area that is untouched by the use of computers or where computers are not being used. From the biggest project to the bill of goods taken from a shop, computer is being used. Today, hardly any other field has affected the human life as much as the computer has done. Here we will study the uses of computers in different areas of human life.

In the Field of Education: Today many such programs have been prepared in the field of education, with the help of which we make teaching effective and take advantage of it. Computer has had a great impact in the field of education. Various departments of education are benefiting from its use. For example, library, examination, laboratory, management work, teaching and study etc. In the field of education, computer is playing its important role as a source of information and storage. This education has become important in management, teaching and as a new subject. In the field of science: Ever since the use of computers has started in scientific work, since then we have been able to do many new scientific works. Since scientific calculations

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are quite complex, they take a long time to solve. But through computer these complex calculations can be solved in a few seconds.

Computer is being used in the field of Physics, Chemistry, Space Science, Meteorology, Weather Science, Mechanical Science, Geology and Atomic Science. Many computers are specially designed for scientific research centers. With their help, many important experiments can be done.

In the field of business: Computer is being widely used today in the field of trade and business. The computer is being used in financial modelling, stock management, statistical analysis, accountancy, payroll system, simulation, administration etc.

In the Field of Entertainment: Computer is also our means of entertainment. Many computer games have been developed today and with the help of Speakers we can also listen to music. If the computer has internet facility, information can be taken on various topics, newspapers can be read. You can talk to distant relatives and friends.

In Banking and Financial Institutions: Computer has become an important part of banking and financial institutions. In banks, it is used in keeping information related to accounts of account holders, in extracting and depositing funds, in the process of credit and other reports. Apart from this, computers are also used in record keeping, transactions of shares, money transfer method.

In the Health Sector: A lot of research is being done with the help of computers all over the world to prevent diseases.

In the Field of Desktop Publishing: In the publishing area, you can design the layout of books or pages by computer. A lot of software is available in the market for publication, with the help of which project, report, letter and pages of books can be easily prepared in a short time. Publishing work can be done by computer at a minimum cost in a short time.

In the Field of Communication: Computer has revolutionized the communication field. With the help of this, contact can be established with any person in the world in seconds, no matter where they are. Additionally, any type of information can be exchanged. With the help of computer network, we can work on any computer connected to that network. With the help of internet, we can get information from any corner of the world because it is a store of unlimited information.

In the Field of Traffic: Computer has a very important contribution in the field of traffic. In fact, the computer plays a very important role in the miraculous progress in the field of traffic. In the field of traffic, computers are being used mainly in rail traffic, air traffic, road traffic etc.

In the Industrial Sector: Today, it has become very easy to work using computers in various industrial areas. Today, due to computer, complex machines have been fully computerized in various industries, due to which the machine has become fully automated and that is why day-to-day work is being taken from those machines and for this task, need of any special men power is also over. Due to the use of computers in industries, the quality of the product increases and the quantity of scrap wastage is also reduced to a minimum. Some of the major industries in which computer production is helping in many ways are paper and printing, steel etc.

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In the Field of Sports: Computer also has good contribution in the field of sports. Today, with the help of Computer Animation, many such games have been developed, which are actually played on wide fields, such as cricket, hockey, tennis, polo, football etc. Apart from the appropriate areas mentioned, the use of computer is being done in many areas, such as - conduct any exam, translate one language into another language, manage libraries, etc.

1.1.6 Capabilities and Limitation of Computer

Capability of Computer:

Automation - We use many types of automated machines in our daily life. Computer also does all its work in an automatic way. The computer keeps doing its work automatically once the program is loaded.

Accuracy - Computer does all its work without any fault. If you are asked to multiply 10 different numbers, then you will make many mistakes in it. But generally, the computer can complete any process without any fault. The biggest reason for a mistake by the computer is wrong data input because the computer itself never makes any mistake.

Versatility - The computer has increased its dominance in the whole world faster due to its universalism. Computer is being used for doing mathematical tasks as well as for business tasks. Computer is being used in many fields like Bank, Railway, Airport, Business, School etc.

High Storage Capacity - There is a capacity to store a lot of data in a computer system. Computer can store millions of words in very less space, it can store all types of Data, Picture, Files, Program, Games and Sound. We can store it for many years and later we can get any information and use it in a few seconds.

Diligence - Today a man is tired after doing some work for a few hours. But the computer has the ability to do a task continuously for many hours, days, months, even though its ability to work is neither decrease nor does the accuracy of the result of the work decrease. Computer performs any given task without any discrimination whether the task is interesting or not.

Reliability - The memory of a computer is more powerful. The entire process related to computer is reliable, it does not get tired while working for years and Stored Memory remains accurate even after many years.

Power of Remembrance - The person does many things in his life but remembers only the important things, but the computer keeps all the things, whether important or not, stored inside the memory and later it provides information when required.

Limitations of Computer

Lack of Intelligence - A computer is a machine. It does not have the same intelligence as human beings, it only follows the instructions given by the user, in any case the computer neither works nor does more than the instructions given.

Lack of Common Sense - It is also important to know that the computer never makes any mistake, but if the user takes the wrong work from it, then he does not get

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the general sense of it i.e., if you have not told the computer, “Riya is a girl”, then he will consider her by default boy, she does not know the difference in name, Computer is not an intelligent machine, it does not recognize right or wrong.

Dependence on electricity - A computer requires electricity to work, without electricity, the computer is nothing but a metal box.

Upgrade and Update - A computer is a machine that has to be upgraded and updated from time to time, if it is not done then the computer is not able to function properly.

Virus threat - The computer is always at risk of virus, once a virus arrives, it can damage the computer operating system as well as the protected files in it.

1.1.7 Components of Computer

The basic structure of any computer that is being used is always the same. The structure of any computer, whether it is small or big, old or new, would have the following parts.

- Control Unit
- ALU (Arithmetic and Logic unit)
- Main memory
- Secondary memory
- Input Devices and Output Devices

Here the raw data is entered into the computer by the input unit and that raw data is given to ALU and it processed by the Arithmetic and Logical unit, actually ALU is the major part of CPU which processes the data. ALU is responsible for solving all logical and arithmetic calculation. After receives the data by ALU, it is stored in the appropriate location in the memory and various processes are done on this data as per the instruction of control unit and the result is sent to the output unit.

Main memory, ALU and Central unit are collectively called as CPU i.e., Central Processing Unit. Input and output devices are used to be interact with the user. While the user accesses the raw data to the computer through the input devices, the computer transmits the process information to the user through the output device.

Input - Output Devices - If a user is directly related to something in a computer, then it is input and output devices: So, input and output devices have an important place in the computer systems. It is through the input devices that the users enter the raw data to process in the computer system and with the help of the output devices it receives the necessary and processed information. Since the other parts of the computer responsible for the process (e.g. CPU, RAM, Hard Disk etc.) have no direct interaction with the user, the user has no matter of where and how the process is happening. It is only meant by giving input and taking output. Therefore, input and output devices have an important place not only for computer but also for User.

In a nutshell, the function of input devices is to collect data from the user in user readable form and after that the data is converted by computer software’s and CPU etc. to be Computer readable form and again the computer with the help of CPU and

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software, the processed data converted into computer readable form to user readable form and presented to the user with the help of output devices like Monitor.

In modern computers, Input Devices like Key board, Mouse, MICR, OCR, OMR, Joy Stick, Light Pen, Microphone, Touchpad, Trackball, Barcode Reader, Graphic Tablet etc. are being used and Monitor, Speaker, USB, Headphones, Printer, Graphic Plotter, LCD Projector etc. are used as output devices.

Example of some latest input devices are given here.

1. **Laser Bluetooth Keyboard:** This device projects a QWERTY keyboard on a flat opaque surface. It is an innovative data input device which uses intelligent 3D electronic recognition technology.

Fig. 1.1.8 Laser Bluetooth Keyboard [2]

2. **Wireless Mouse:** It has a speed adaptive scroll wheel, dark field laser tracking, dual connectivity, and easy tracking. This has rechargeable battery as well.

Fig. 1.1.9 Wireless Mouse [2]

3. **MBLOK:** MBLOK is a Bluetooth wireless flash drives, no wires are required just plug in the MBLOK with an integrated USB into your computer. It contains 256 GB of storage. You can watch movies hear music or anything without the need of accessing the internet.

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Fig. 1.1.10 MBLOK [10]

4. **Barcode Reader:** Barcode is the unique code represented by the image having a series different thickness of lines like some of lighter and some are darker in black color. Generally, these barcodes appeared on the label of the different types of goods like books, clothes, etc.

Fig. 1.1.11 Barcode Reader [11]

5. **Electronic Card Reader:** These are used to read a small plastic type of electronic card, which has encoded data. After reading the encoded data convert and transferred to computer further processing.

Fig. 1.1.13 Electronic Card Reader [8]

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Example of some latest output devices are given here.

1. **LCD Monitor:** LCD stands for Liquid Crystal Display. It is a thin flat-panel display or other electronically modulated optical device that uses the light-modulating properties of liquid crystals combined with polarizers. Liquid crystal does not emit light directly, instead using a backlight or reflector to produce images in color.

Fig. 1.1.14 LCD Monitor [12]

2. **Digital Projector:** This is a display device that projects a computer- created image onto another surface, usually some sort of whiteboard or wall. The computer transmits the image data to its video card, which then sends the video image to projector. It is most often for presentations or for viewing videos.

Fig. 1.1.15 Digital Projector [2]

3. **Plotter:** This generates a hard copy of a digitally depicted design. The design is sent to the plotter through a graphics card and the design is formed by using a pen. It is generally used with engineering applications and essentially draws a given image using a series of straight lines.

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Fig. 1.1.16 Plotter [8]

4. **Wireless Headset:** This is a combination of speakers and microphone. It is mostly used by gamers and is also a great tool for communicating with family and friends over the internet using some VOIP program for other.

Fig. 1.1.17 Wireless Headset [2]

5. **3D Printers:** 3d printing or additive manufacturing is the construction of a three-dimensional object from a CAD model or a digital 3D model. 3D printing is used to manufacture molds for making jewelry and even the jewelry itself.

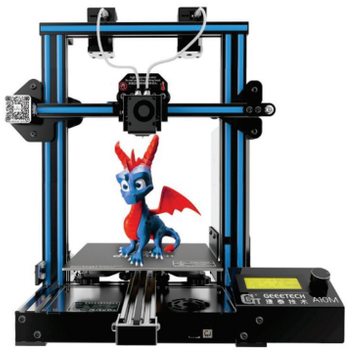

Fig. 1.1.18 3D Printer [13]

Central Processing Unit (C.P.U.)

The Central Processing Unit is really the main part of any computer. It can also be called the brain of any computer system. In short, a Central Processing Unit is often called a C.P.U. Often we call the box shown in the following figure 1.1.8 as the C.P.U. but this is incorrect. We know the following box as System Unit. If other parts of the

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computer like mother board, RAM, hard disk etc. are properly assembled in it, otherwise it is just a cabinet.

Fig. 1.1.19 C.P.U. [7]

All the work done in computer is controlled by C. P. U. itself. That is why it is also called computer's brain.

The C. P. U. mainly consists of three important parts which are as follows

- Memory unit
- Arithmetic and logic unit
- Control unit

Memory Unit: The Main memory stores all the data or programs that come into the computer for the process. The importance of this memory unit becomes clear from this point that if there is no memory unit, then any data given to the computer will be instantly destroyed and the process of processing will be stopped. Hence it is a basic component of computer.

Arithmetic and Logic Unit: Arithmetic and Logic unit abbreviated to A.L.U. All types of arithmetic operations (such as adding, subtracting, multiplying and dividing, etc.) and logical operations for the CPU (such as comparing small and large numbers in two numbers, i.e., whether the numbers are equal or which of them is small or large etc.). In this, all actions take place in a binary system.

Control Unit: The main function of a control unit is actually to control the various components of the computer. It monitors the parts of the computer. Therefore, it is a very important part of the C.P.U. and its function is very important for computer. This unit is responsible for properly executing the programs by creating synergy in all parts of the computer.

The first CPU used in PCs had a clock speed of approximately 4.77MHz. Today's latest CPU have clock speed 5.3GHz.

AMD Opteron, AMD Athlon XP, AMD Thunderbird Athlon, AMD Duron, AMD K-6 Series, Intel Itanium, Intel Itanium II, Intel Pentium II, Intel Pentium III, Intel Pentium 4, Pentium III, Pentium II, Core i3, Core i5, Core i7, Core i9 etc. are the example of some CPU.

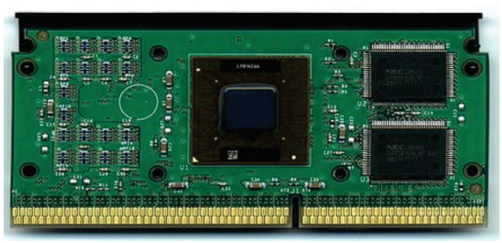


Fig. 1.1.20 Intel Pentium II Microprocessor [13]

Notes

Fig. 1.1.21 AMD K-6 series Microprocessor [14]

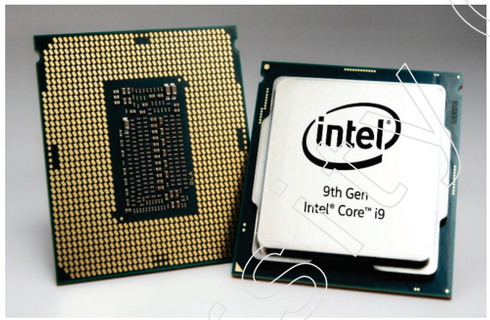


Fig. 1.1.22 Core i9 Microprocessor [15]

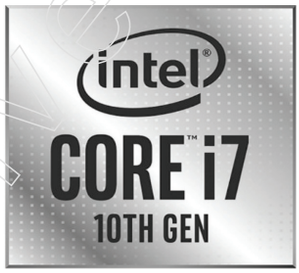


Fig. 1.1.23 Core i7 Microprocessor [15]

1.1.8 Memory

There is a system to store data and instructions in any computer, this arrangement is called computer memory. The computer holds the data and instructions in its memory and processes it based on the same data and instructions when the command is received. In fact, the computer has no mind of its own. It works only on the basis of the data and instructions stored in its memory and the commands given by the user. Memory is compulsory for every computer because memory stores the programs which are followed by the central processing unit of the computer i.e., C.P.U.

The part of memory in any computer which is in directly touch of the computer is known as main memory, internal memory or primary memory and that part of memory in a computer which is used for storage and which can be easily moved from one place to another is known as auxiliary memory, external memory or secondary memory. Thus, the computer memory can be divided into two parts which are as follows

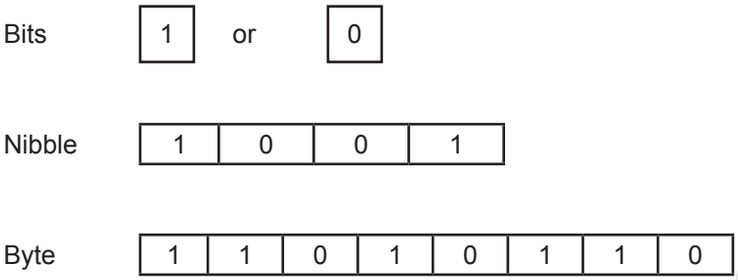
- Primary Memory
- Secondary Memory

Notes

1.1.8.1 Primary Memory

Primary memory is also called as Internal Memory or Main Memory since any data in memory is stored as Bytes. There are millions of Bytes in it, each Bytes is made of eight Bits. Bits are actually 0 and 1 digits i.e., combination of primary digits, in which any information or data can be stored in the computer.

A bit is the smallest unit to store information as is clear from its name “Primary Digits” that it only stores that data as two digits and that two digits are “0” and ‘1’. Here “0” means “FALSE” or “OFF” and “1” means “TRUE” or “ON”. The combination of 8 Bits is called a Byte and the Combination of 4 Bits is known as NIBBLE.



1 Byte	8 Bits
1 Kilo Byte	1024 Bytes
1 Mega Byte	1024 Kilo Bytes
1 Giga Byte	1024 Mega Bytes
1 Tera Byte	1024 Giga Bytes
1 Peta Byte	1024 Tera Bytes
1 Exa Byte	1024 Peta Bytes

In the main memory, running programs and their input data and output are stored temporarily for some time. As soon as their need is finished, they can be removed and other data or programs can be kept there. The size of main memory is limited, but its speed is very fast, so that whenever any data is needed, it can be taken instantly.

The following information can be kept in main memory

- All the data to be processed and the instructions required to process it are obtained by input means.
- Intermediate results of processing.
- Final processing results that are kept until output is sent to the instrument.

Main or Primary Memory can be mainly divided into two parts which are as follows

- Random Access Memory (RAM)
- Read Only Memory (ROM)

Apart from these, C.P.U. also have a memory called cache memory.

Random Access Memory: Random Access Memory is also called RAM. RAM is called Random Access Memory because this memory is organized in such a way that any memory location can be accessed directly and anytime without accessing the

Notes

location prior to that location. This memory is on a chip made of a Metal Oxide Semi-Conductor (MOS). Figure 1.1.9 shows a RAM.

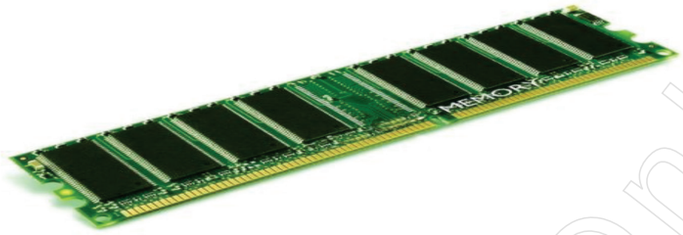


Fig. 1.1.24 R.A.M. [8]

RAM can select any location and use it directly to store any data or read data from it. RAM is made up of such registers and connected circuits that make it possible to transfer data to and from there. Each such location has a fixed address, with the help of which that location can be reached.

The RAM is divided into several sections so that the information can be stored in it in an orderly manner and they can be found instantly when needed. Each such section is given a fixed address and with the help of any data bus, any information can be extracted from RAM and any information can be stored in it. RAM is mainly divided into the following two parts.

- Dynamic RAM
- Static RAM

Dynamic RAM: Dynamic RAM is cheaper than Static RAM. That is the reason dynamic RAM is mostly used as main memory.

Since a capacitor are used to store information or data in D RAM. So, if any data is stored in such RAM, then it cannot be retained in it. Unless the data is refreshed periodically. After a few milli seconds, the process of repeatedly writing all the contents of RAM or data to the memory of D RAM is called refreshing process. Special Refresh Circuit is used for this task.

D RAM is mainly divided into the following parts.

- SD RAM
- RD RAM
- DD RAM

SD RAM: It is the short name for Synchronous Dynamic Random Access Memory. It is such an extended memory that it is possible to transfer data at any time. Using this increases memory performance unexpectedly.

RD RAM: It is short name for Rambus Dynamic Random Access Memory. With the help of this RD RAM, data can be transferred at speeds up to 800 Mega Hz. Very high speed bus is used in this.

DD RAM: It is the short name for Double Data Dynamic Random Access Memory. It almost doubles the RAM capacity as data is transferred from both sides of the system bus.

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Static RAM: Any information or data in static RAM can be retained in memory as long as the power supply is received to the S RAM Chip. S RAM does not need to be refreshed as often as D RAM. S RAM transfers data much faster than D RAM and is also more expensive than D RAM. Flip - Flops technology is commonly used to store information in S RAM.

Read Only Memory: Read Only Memory is also abbreviated as ROM. ROM is the memory in which data is pre-loaded and can only be read. That data cannot be changed. In fact, only some necessary programs and data are written in the ROM chip, which are permanent. Even when the computer power is turned off, the information stored in the ROM chip remains secure.

A simple ROM chip is shown in Figure 1.1.10.

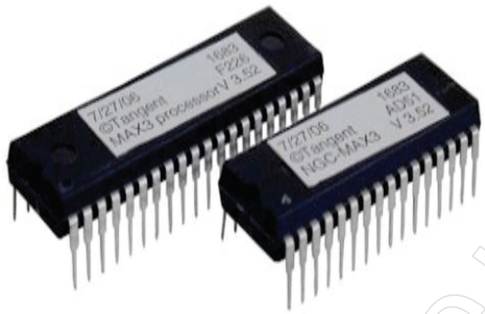

Fig. 1.1.25 R.O.M. [9]

Such information is usually stored in ROM which is permanent and important. Apart from this, programs are also stored in ROM that do not need to be changed. For example, any computer booting program, in personal computers, also stores the BIOS i.e., Basic Input Output System in ROM, which allows the computer to keep information about the input and output devices connected to it. Like RAM, there are several types of ROM memory which are as follows

- P ROM
- EP ROM →
- EEP ROM

P ROM: P ROM is an abbreviation for Programmable Read Only Memory. It is a memory in which information is stored permanently with the help of programs. While building the computer, this memory is inserted into the C.P.U. and no changes are possible in the future.

EP ROM: EP ROM is an Erasable Programmable Read Only Memory. This memory is also inserted into the computer while building the computer, but it can be erased later with ultraviolet light.

EEP ROM: It is an electrically Erasable Programmable Read Only Memory. We need ultraviolet light to erase the EP ROM, and it is also relatively complex and difficult to erase, but EEP ROM can be erased easily only by electric current.

Cache Memory: This is a special type of memory that resides as a buffer between the processor and the RAM. New instructions and its data are kept in Cache memory

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only. When needed, the C.P.U. first looks at the cache memory. Cache Memory allows any C.P.U. to work more quickly and the efficiency of the computer is also greatly increased by its use.

1.1.8.2 Secondary Memory

This is the memory to be inserted into the computer as an external device. Large amounts of data can be stored in these devices and they can be easily transported from one place to another.

Because this type of memory is outside the computer, Hence, it is also called external memory and since the information in it is inserted after the primary memory. Hence it is also called secondary memory. The devices under secondary memory can be divided into the following classes.

- Magnetic disk
- Magnetic tape
- Optical disk

Magnetic Disk: Magnetic Disk is the best way to store data. The following Disks come under Magnetic Disc.

- Floppy Disk
- Hard Disk

Floppy Disk: Just as songs can be moved from one place to another by storing songs in the tape recorder's cassette. In the same way floppy disks perform the work of transferring data and information in a computer. With the help of floppy disk, information can be moved from one place to another or from one computer to another. Floppy disk is available in two sizes 5.25 '' and 3.5 '', but nowadays the trend of floppy disk has almost stopped.

In Figure 1.1.11 and 1.1.12, both types of Floppy Disk and Drives are shown.

Fig. 1.1.26 Floppy Disk [2]

Fig. 1.1.27 Hard Disk [2]

Hard disk: A hard disk is similar to a floppy disk, but it is large and fast in size. It is permanently installed in the computer. So, it cannot be moved around like a floppy disk. Hence, they are also called fixed disks.

Nowadays the capacity of modern hard disks is up to 200 GHz.

Magnetic Tape: Magnetic tape is used to securely store data inserted in a computer. This lace is usually a 1 inch long joint of plastic strip with a magnetic layer over it. This strip is called magnetic tape.

Optical Disk: Optical Disk converts data into machine language before it is stored. The transformed form is then stored on the layer of disk with the help of a laser beam. The diameter of this disk is about 4.5 inches. It is silver or golden color. It can have a capacity of storing data up to 700 MB. Laser beam performs the work of writing and reading facts on this disk.

There are three types of optical disks.

CD ROM: The data stored in it is permanent. These can be read only so this compact disk (CD) is called Read Only Memory (ROM).

A Compact Disk (CD) is shown in Figure 1.1.13.

Fig. 1.1.28 C.D. R.O.M. [8]

Notes

Worm Disk: It is written only once, but can be read many times. It is not possible to amend the facts collected in it.

Magneto Optical Disk: It uses both optical and magnetic techniques.

Solid-State Drive: An SSD is a storage medium that uses non-volatile memory to hold and access data. Unlike a hard drive, an SSD has no moving parts, which gives it disadvantages, such as faster access time, noiseless operation, higher reliability and lower power consumption.

Fig. 1.1.29 Solid State Drive [2]

Smart card: A smart card is a special type of card like device which contains an integrated circuit chip embedded on it. The IC chip can be microprocessor with memory or just simple memory circuit. A smart card is connected to the host computer or controller via a card reader which gets information to the host computer or controller.

Fig. 1.1.30 Smart card [2]

Online and Cloud storage: Clouding is systematically model for storing data in computer and in which entire data are stored in logically nature. Those clouding systems are managed by other hosting companies. With the help of online clouding, all data can be access by couples of users anytime and anywhere. Big advantages are not place limitation as well as no need carry any storage device. Google drive, Jio cloud etc. are the example of cloud storage.

1.1.8.3 Flash memory

It is a non-volatile computer memory that can be erased and reprogrammed electrically. This technique is mainly used in flash memory cards in which normal

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storage and transfer of data is done by two computers or other digital products. It is used more due to its low price. It is a non-volatile memory, i.e., information remains in it even when there is no electricity. Nowadays this memory is used in abundance. It is a type of EEP ROM memory. Large blocks in flash memory can be deleted or copied at a time, while the EEP ROM can be erased or programmed only by one byte. Thus, it takes less time to write new data to Flash memory. Flash memory is also cheaper than EEP ROM memory. Pen drives, memory cards used in digital cameras and digital products, etc. are examples of Flash memory.

Fig. 1.1.31 Pen drive [2]

Fig. 1.1.32 Memory Card [2]

Image sources

[1] - www.sites.google.com

[2] - www.amazon.in

[3] -www.computersciencelab.com

[4] – www.collection.sciencemuseumgroup.org.uk

[5] – www.dokumente.leibnizcentral.de

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Notes

[13]. – www.wikiwand.com

[14]. – www.cpu-world.com

[15]. – www.newsroom.intel.com

Summary:

- A computer is an electronic device that takes raw data like input and processes it and gives proper and useful information as output.
- Abacus is a frame of wire. Small balls are threaded in these wires. This machine was used to add, subtract, multiply and divide digits.
- The Scottish mathematician John Napier made some rectangular strips, with which multiplication could be done quickly.
- John Napier invented the logarithm method of calculations. In this method product of two numbers, division of two numbers, square root of number, etc. are drawn by adding or subtracting the exponents of a chosen number.
- Germany's Professors Leibnitz following the Pascal and made his own device in 1677. In which some parts of the calculator could move to the right or left.
- In 1823, Charles Babbage developed a device based on modern computers. It was named 'Difference Engine'. It could accurately calculate the value of various algebraic functions to 20 decimal places.
- After the success of his difference engine, Charles Babbage developed 'Analytical Engine'. There were some arrangements for input, output, control, calculation and memory.
- Until the 1980s, all calculating machines were basically mechanical. Around this time IBM built MARK- I computer in 1943 in collaboration with Dr. Howard Ekins and Grace Hopper of Harvard University.
- First generation computers were very large and based on vacuum tubes and electric valves.
- Second generation computers, vacuum tubes were replaced by transistors and the second generation of computers came into existence.
- Third Generation Computers were came into existence to be between 1901 and 1970. Integrated circuits (IC) began to be used in computers of this generation. IC i.e., an integrated circuit is a complete electronic circuit that was built on a small silicon chip.
- Fourth generation computers are considered to be from 1970 to 1985. In 1970, there was a significant increase in the efficiency of computers. In 1971 the first micro-processor came on the market, due to which the power of the computer was greatly increased.
- ULSI technology was used in place of VLSI in fifth generation computers and millions of transistors were installed on one chip.
- The Central Processing Unit is really the main part of any computer. It can also be called the brain of any computer system. In short, a Central Processing Unit is often called a C.P.U.
- The Main memory stores all the data or programs that come into the computer for the process.

Notes

- Arithmetic and Logic unit abbreviated to A.L.U. All types of arithmetic operations (such as adding, subtracting, multiplying and dividing, etc.) and logical operations for the CPU (such as comparing small and large numbers in two numbers, i.e., whether the numbers are equal or which of them is small or large etc.).
- The main function of a control unit is actually to control the various components of the computer. It monitors the parts of the computer.
- Primary memory is also called as Internal Memory or Main Memory since any data in memory is stored as Bytes. There are millions of Bytes in it, each Bytes is made of eight.
- The combination of 8 Bits is called a Byte and the Combination of 4 Bits is known as NIBBLE.
- Random Access Memory is also called RAM. RAM is called Random Access Memory because this memory is organized in such a way that any memory location can be accessed directly and anytime without accessing the location prior to that location.
- Read Only Memory is also abbreviated as ROM. ROM is the memory in which data is pre-loaded and can only be read.
- Secondary memory is the memory to be inserted into the computer as an external device. Large amounts of data can be stored in these devices and they can be easily transported from one place to another.
- With the help of floppy disk, information can be moved from one place to another or from one computer to another. Floppy disk is available in two sizes 5.25 '' and 3.5 ''.
- A hard disk is similar to a floppy disk, but it is large and fast in size. It is permanently installed in the computer. So, it cannot be moved around like a floppy disk.
- It is a non-volatile computer memory that can be erased and reprogrammed electrically. This technique is mainly used in flash memory cards in which normal storage and transfer of data is done by two computers or other digital products.

Exercise

Check your progress

1. The main parts of the computer are
   (a) 6
   (b) 7
   (c) 8
   (d) 9
2. Processed data is known as
   (a) Data
   (b) Information

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(c) Knowledge

(d) Analysis

3. The main purpose of software is to convert data into

(a) Website

(b) Information

(c) Program

(d) Object

4. The four basic tasks performed by CPU are fetch, ……, manipulate and output.

(a) Design

(b) Decode

(c) Display

(d) Regulate

5. MIPS stands for

(a) Marginal Input Storage

(b) Memory Image Processing State

(c) Micro Information Processing Storage

(d) Million Instruction per Second

6. Which of the following is not a component of Central Processing Unit?

(a) Arithmetic and Logic Unit

(b) Control Unit

(c) Registers

(d) Random Access Memory

7. Which of the following memories is directly accessible by the CPU?

(a) RAM

(b) Hard Disk

(c) Magnetic Tape

(d) DVD

8. High power microprocessors are

(a) Pentium, Pentium pro

(b) Pentium II and III

(c) Pentium II

(d) All of these

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9. Which of the following transmits different commands or control signals from one component to another component of a computer system?
   (a) Data Bus
   (b) Address Bus
   (c) Both Data and Address Bus
   (d) Control Bus
10. Which of the following basic operations are performed by a computer?
   (a) Arithmetic operation
   (b) Logical Operation
   (c) Storage and Retrieval
   (d) All of these
11. What name has been given to the first super computer made in India?
   (a) Akash
   (b) Param
   (c) Arjun
   (d) Siddharth
12. A mouse, trackball and joystick are example of
   (a) Pointing devices
   (b) Pen input devices
   (c) Data collection devices
   (d) Multimedia devices
13. OCR stands for
   (a) Optical Character Recognition
   (b) Optical CPU Recognition
   (c) Optimal character Rendesing
   (d) Other character Recognition
14. A keyboard is used
   (a) to enter text and numbers and send commands to the computer
   (b) to create new keys to use with your computer
   (c) to open the computer
   (d) all of these
15. How many keys are there on keyboard for alphabet?
   (a) 24
   (b) 25

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(c) 26

(d) 27

16. Ctrl, shift and alt are called

(a) Adjustment keys

(b) Function keys

(c) Modifier keys

(d) Alphanumeric keys

17. The blinking symbol on the computer screen is called

(a) Mouse

(b) Hand

(c) Cursor

(d) Logo

18. Which of the following is used by banking industry for faster processing of large volume of cheques?

(a) Bar-code Reader

(b) OCR

(c) MICR

(d) OMR

19. OMR stands for

(a) Optical Mark Reader

(b) Optical Marked Reading

(c) Optical Moon Right

(d) Optical Me Right

20. An automatic machine that is made to perform routine human tasks is

(a) Computer

(b) Robot

(c) Tanker

(d) None of these

21. Computer network is a

(a) A distributed data processing system

(b) Multiple computers are linked together for the purpose of data communication and resource sharing

(c) Both (a) and (b) are false

(d) Both (a) and (b) are true

Notes

22. A storage device where the access time is effectively independent of the location of the data is referred as
    (a) Direct access
    (b) Secondary storage
    (c) Primary Storage
    (d) None of these
23. The primary memory of a Personal Computer consists
    (a) ROM only
    (b) RAM only
    (c) Both ROM and RAM
    (d) Memory Module
24. Which of the following is input/output device?
    (a) Monitors
    (b) Punched Cards
    (c) Optical Scanners
    (d) All of these
25. Magnetic tape can serve as
    (a) Input media
    (b) Output media
    (c) Secondary-storage media
    (d) All of these
26. A semiconductor memory which allows the eraser of the information stared in it so that new information can be stared in it is referred as
    (a) EPROM
    (b) ROM
    (c) RAM
    (d) None of these
27. Audio response is
    (a) Output medium
    (b) Produce verbal responses from the computer system
    (c) Both (a) and (b)
    (d) None of these

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28. Computer output which is displayed on the screen of a terminal without a permanent copy is called
    (a) Soft copy
    (b) Hard copy
    (c) Hardware
    (d) None of these
29. Speech recognition is
    (a) Ability to input data directly into computer system by speaking to it
    (b) Ability to output data directly from a computer system by speaking
    (c) Processing of voice in computer systems
    (d) None of these
30. Which of the following is not true of a magnetic disk?
    (a) Users can update records by writing over the old data
    (b) It provides sequential access to stored data
    (c) It is slow relative to magnetic tape
    (d) All of the above are true.

Answer Key:

1-a
2-b
3-b
4-b
5-d
6-d
7-a
8-d
9-d
10-d
11-b
12-a
13-a
14-a
15-c
16-c
17-c

18-c

19-a

20-b

21-d

22-a

23-c

24-d

25-d

26-a

27-c

28-a

29-a

30-b

Notes

Notes

Module - II

Course Contents:

- Introduction to Number Systems – Binary, Hexadecimal, Octal, BCD
- Conversion between Number Systems
- One's Complement
- Two's Complement
- Boolean Algebra and Laws

Key Learning Objectives:

At the end of this block, you will be able to:

1. Define Various Types of Number Systems
2. Conversion between Number Systems
3. Define One's Complement
4. Define Two's Complement
5. Describe Boolean Algebra

Structure:

Unit 2.1: Introduction to Number Systems

2.1.1 Introduction
2.1.2 Decimal Number System
2.1.3 Binary Number System
2.1.4 Hexadecimal Number System
2.1.5 Octal Number System
2.1.6 Binary Coded Decimal
2.1.7 Decimal to Binary Conversion
2.1.8 Decimal to Octal Conversion
2.1.9 Decimal to Hexadecimal Conversion
2.1.10 Binary to Decimal Conversion
2.1.11 Octal to Decimal Conversion
2.1.12 Hexadecimal to Decimal Conversion
2.1.13 BCD to Binary Conversion
2.1.14 Binary to BCD Conversion
2.1.15 1's Complement
2.1.16 2's Complement

Unit 2.2: Boolean Algebra and Laws

2.2.1 Introduction
2.2.2 Boolean Algebra
2.2.3 Boolean Laws

Unit - 2.1: Introduction to Number Systems

Notes

Unit Outcomes:

At the end of this unit, you will learn

1. Define various types of Number Systems
2. Conversion between Number Systems
3. Define 1's Complement
4. Define 2's Complement

2.1.1 Introduction

The study of number systems is very important from the point of view of understanding how data are represented before they will be processed by any digital system including a computing device. It's a basis for counting various items. Modern or digital computers communicate and operate with binary numbers which use only the digits 0 and 1. Here, we are going to study all of those numbers systems.

In this unit we are going to discuss about the varied sorts of number systems, conversion between number systems, 1's complement and 2's complement.

2.1.2 Decimal Number System

In decimal number system we will express any decimal numbers in units, tens, hundreds, thousands and so on. After we write a decimal number say, 1234.5, we all know it is represented as

$$1000 + 200 + 30 + 4 + 0.5 = 1234.5$$

The decimal number 1234.5 can even be written as, where the ten subscript indicates the radix or base.

In the power of 10, we are able to write as

$$1 \times 10^3 + 2 \times 10^2 + 3 \times 10^1 + 4 \times 10^0 + 5 \times 10^{-1} = 1234.5$$

This say, that the position of a digit with regard to the decimal point determines its value/ weight. The sum of all the digits/bits multiplied by their weights give the total number being represented. The leftmost digit/bit, which has the greatest weight is called the Most Significant Bit (MSB) and the rightmost digit/bit, which has the least weight, is called the Least Significant Bit (LSB).

2.1.3 Binary Number System

We know that decimal number system with its ten digits is a base-ten system. Similarly, binary system with its two digits/bits is a base two system. The two binary bits are 1 and 0. Like decimal system, in binary system each binary digit commonly known as bit, has its own value or weight. However, in binary system weight is represented as a power of 2.

Example 2.1.1 5 is written to 0101 in the binary number system.

Notes

2.1.3 Hexadecimal Number System

The hexadecimal number system has a base of 16 having 16 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F. The place value or weights of different digits in a mixed hexadecimal number are 16^0,16^1,16^2 and so on (for the integral part) and 16^{-1},16^{-2},16^{-3} and so on (for the fractional part). The decimal equivalent of hexadecimal digits A, B, C, D, E and F are 10, 11, 12, 13, 14 and 15 respectively.

2.1.4 Octal Number System

The octal number system has a radix of 8 and therefore has eight distinct digits. The independent digits are 0, 1, 2, 3, 4, 5, 6 and 7.

The place values for the different digits in the octal number system are 8^0,8^1,8^2 and so on (for the integral part) and 8^{-1},8^{-2},8^{-3} and so on (for the fractional part).

2.1.5 Binary Coded Decimal

The binary coded decimal (BCD) is a type of binary code that is used to represent a given decimal number in an equivalent binary form. BCD to decimal and decimal to BCD conversion are very easy and straightforward.

The BCD equivalent of a decimal number is written by replacing each decimal digit in the integer and fractional parts with its four-bit binary equivalent. As an example, the BCD equivalent of $(23.15)_{10}$ is written as $(0010\ 0011.0001\ 0101)_{BCD}$ .The BCD code described above is more precisely known as the 8421 BCD code, with 8, 4, 2 and 1 showing the weights of different bits in the four-bit groups, starting from MSB and proceeding towards LSB. This feature makes it's a weighted code, which means that each bit in the four-bit group representing a given decimal digit has an assigned weight.

2.1.6 Decimal to Binary Conversion

Suppose we have to give a decimal number. So, we will first separate the integral and fractional part of it.

For the integral part, the binary equivalent can be found by successively dividing the integer part of the number by 2 and recording the remainders until the quotient becomes 0. The remainders written in reverse order that constitute the binary equivalent.

For the fractional part, it is obtained by successively multiplying the fractional part of the decimal number by 2 and recording the carry until the result of multiplication is 0. The carry sequence written in forward order constitutes the binary equivalent of the fractional part of decimal number. If the result of multiplication does not seem to be heading towards zero in the case of fractional part, the process may be continued only until the requisite number of equivalent bits has been obtained.

Example 2.1.2 Convert decimal number12 to binary number.

Notes

Solution:

2	12	R
2	6	0 (LSB)
2	3	0
2	1	1
	0	1(MSB)

Therefore, $(12)_{10}=(1100)_2$

2.1.7 Decimal to Octal Conversion

The process of decimal to octal conversion is analogous to that of decimal to binary conversion. The progressive division with in the case of the integer part and therefore the progressive multiplication while working on the fractional part here are by 8 which is the radix of the octal number system. Again, the integer and fractional parts of the decimal number are treated separately.

Example 2.1.3 Convert decimal number 359 to octal number.

Solution:

8	359	R
8	44	7 (LSB)
8	5	4
	0	5 (MSB)

Therefore, $(359)_{10}=(547)_8$

2.1.8 Decimal to Hexadecimal Conversion

The process of decimal to hexadecimal conversion is also analogous. Since the hexadecimal number system has a base of 16, the progressive division and multiplication factor in this case is also 16.

Example 2.1.4 Convert decimal number 650 to hexadecimal number.

Solution:

16	650	R
16	40	10 = A (LSB)
16	2	8
	0	2 (MSB)

Therefore, $(650)_{10}=(28A)_{16}$

Notes

2.1.9 Binary to Decimal Conversion

The value of a given binary number in terms of its decimal equivalent can be determined by adding the products of each bit and its weight. The right-most bit is the least significant bit (LSB) in a binary number and has a weight of 2^0=1. The weights increase by a power of two for each bit from right to left.

Example 2.1.5 Convert $(1101101)_2$ to decimal number.

Solution: Decimal Number

$$= 1\times 2^6 + 1\times 2^5 + 0\times 2^4 + 1\times 2^3 + 1\times 2^2 + 0\times 2^1 + 1\times 2^0$$
$$= 1\times 64 + 1\times 32 + 0\times 16 + 1\times 8 + 1\times 4 + 0\times 2 + 1\times 1$$
$$= 64 + 32 + 0 + 8 + 4 + 0 + 1$$
$$= 109$$

2.1.10 Octal to Decimal Conversion

Since the octal number system contains a base of eight, each successive digit position is an increasing power of eight, beginning within the right most column with 8^0. The estimation of an octal number in terms of its decimal equivalent is accomplished by multiplying each digit by its weight and summing the products.

Example 2.1.6 Convert $(0.325)_8$ to decimal number.

Solution: Decimal Number $= 3\times 8^{-1} + 2\times 8^{-2} + 5\times 8^{-3}$

$$= 3\times 0.125 + 2\times 0.015625 + 5\times 0.001953$$
$$= 0.416015$$

2.1.12 Hexadecimal to Decimal Conversion

To convert a hexadecimal number to its decimal equivalent is by multiplying each hexadecimal digit by its weight and then taking the sum of these products.

Example 2.1.7 Convert $(A85)_{16}$ to decimal number.

Solution: Hexadecimal Number $(A85)_{16}$

Equivalent Binary Number $(101010000101)_2$

Equivalent Decimal Number

$$= 1\times 2^{11} + 1\times 2^9 + 1\times 2^7 + 1\times 2^2 + 1\times 2^0$$
$$= 2048 + 512 + 128 + 4 + 1$$
$$= 2693$$

2.1.13 BCD to Binary Conversion

A given BCD number is converted into an equivalent binary number by first writing its decimal equivalent and then converting it into its binary equivalent.

Example 2.1.8 Find the Binary equivalent of the following BCD number 0010 1001.0111 0101.

Solution: BCD number = 0010 1001.0111 0101

Notes

Corresponding decimal number = 29.75

The Binary equivalent of 29.75 can be determined to be 11101 for the integral part and .11 for the fractional part.

Therefore, $(0010\ 1001.0111\ 0101)_{BCD}=(11101.11)_2$

2.1.14 Binary to BCD Conversion

The process of binary to BCD conversion is that the same as the process of BCD to binary conversion executed in reverse order. A given binary number can be converted into an equivalent BCD number by first determining its decimal equivalent and then writing the corresponding BCD equivalent.

Example 2.1.9 Find the BCD equivalent of the following binary number 10101011.101.

Solution: Decimal equivalent = 171.625

So, BCD equivalent = 0001 0111. 0001.0110 0010 0101

2.1.15 1's Complement

The 1's complement in the binary number system is similar to 9's complement in the decimal system. To obtain 1's complement of a binary number each bit of the binary number is subtracted from 1. For Example, the 1's complement of the binary number 010 is 101. The 1's complement of 1110 is 0001. Thus 1's complement of a binary number may be formed by simply changing each 1 to a 0 and each 0 to a 1.

2.1.16 2's Complement

The 2's complement in the binary number system is similar to 10's complement in the decimal number system. The 2's complement of a binary number is equal to the 1's complement of the number plus one.

For example, The 2's complement of 0101 = 1010 + 1 = 1011

Summary:

- In decimal number system we can express any decimal numbers in units, tens, hundreds, thousands and so on.
- The leftmost digit, which has the greatest weight is called the Most Significant Bit (MSB) and the rightmost digit, which has the least weight, is called the Least Significant Bit (LSB).
- The two binary digits/ bits are 1 and 0. Like decimal system, in binary system each binary digit commonly known as bit, has its own value or weight.
- The hexadecimal number system has a base of 16 having 16 digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E and F.
- The octal number system has a radix of 8 and therefore has eight distinct digits. The independent digits are 0, 1, 2, 3, 4, 5, 6 and 7.
- The binary coded decimal (BCD) is a type of binary code that is used to represent a given decimal number in an equivalent binary form.

Notes

- To obtain 1's complement of a binary number each bit of the binary number is subtracted from 1.
- The 2's complement in the binary number system is similar to 10's complement in the decimal number system. The 2's complement of a binary number is equal to the 1's complement of the number plus one.

Solved Examples

Ex-2.1 Convert decimal number15 to binary number.

Solution:

2	15	R
2	7	1 (LSB)
2	3	1
2	1	1
	0	1(MSB)

Therefore, $(15)_{10}=(1111)_2$

Ex-2.2 Convert decimal number 25 to binary number.

Solution:

2	25	R
2	12	1(LSB)
2	6	0
2	3	0
2	1	1
	0	1(MSB)

Therefore, $(25)_{10}=(11001)_2$

Ex-2.3 Convert decimal number 100 to octal number.

Solution:

8	100	R
8	12	4(LSB)
8	1	4
	0	1(MSB)

Therefore, $(100)_{10}=(144)_8$

Ex-2.4 Convert decimal number 150 to octal number.

Notes

Solution:

8	150	R
8	18	6(LSB)
8	2	2
	0	2(MSB)

Therefore, $(150)_{10}=(226)_8$

Example 2.5 Convert decimal number 80 to hexadecimal number.

Solution:

16	100	R
16	6	4(LSB)
16	0	6(MSB)

Therefore, $(100)_{10}=(64)_{16}$

Example 2.6 Convert decimal number 250 to hexadecimal number.

Solution:

16	250	R
16	15	10 = A(LSB)
16	0	15 = F(MSB)

Therefore, $(250)_{10}=(FA)_{16}$

Example 2.7 Convert $(1101)_2$ to decimal number.

Solution: Decimal Number $= 1\times 2^3 + 1\times 2^2 + 0\times 2^1 + 1\times 2^0$

$= 1\times 8 + 1\times 4 + 0\times 2 + 1\times 1$

$= 8 + 4 + 0 + 1$

$= 13$

Example 2.8 Convert $(11111)_2$ to decimal number.

Solution: Decimal Number $= 1\times 2^4 + 1\times 2^3 + 1\times 2^2 + 1\times 2^1 + 1\times 2^0$

$= 1\times 16 + 1\times 8 + 1\times 4 + 1\times 2 + 1\times 1$

$= 16 + 8 + 4 + 2 + 1$

$= 31$

Example 2.9 Convert $(1.325)_8$ to decimal number.

Solution: Decimal Number $= 1\times 8^0 + 3\times 8^{-1} + 2\times 8^{-2} + 5\times 8^{-3}$

Notes

$= 1 + 3 \times 0.125 + 2 \times 0.015625 + 5 \times 0.001953$

1.416015

Example 2.10 Convert $(325)_8$ to decimal number.

Solution: Decimal Number $= 3 \times 8^2 + 2 \times 8^1 + 5 \times 8^0$

$= 3 \times 64 + 2 \times 8 + 5 \times 1$

$= 213$

Example 2.11 Convert $(B86)_{16}$ to decimal number.

Solution: Hexadecimal Number = $(B86)_{16}$

Equivalent Binary Number = $(101110000110)_2$

Equivalent Decimal Number

$= 1 \times 2^{11} + 1 \times 2^9 + 1 \times 2^8 + 1 \times 2^7 + 1 \times 2^2 + 1 \times 2^1$

$= 2048 + 512 + 256 + 128 + 4 + 2$

$= 2950$

Example 2.12 Convert $(A8)_{16}$ to decimal number.

Solution: Hexadecimal Number = $(A8)_{16}$

Equivalent Binary Number = $(10101000)_2$

Equivalent Decimal Number

$= 1 \times 2^7 + 1 \times 2^5 + 1 \times 2^3$

$= 128 + 32 + 8$

$= 168$

Example 2.13 Find the Binary equivalent of the following BCD number 1000 1001.0111 0101

Solution: BCD number =1000 1001.01110101

Corresponding decimal number = 89.75

The Binary equivalent of 89.75 can be determined to be 1011001 for the integral part and .11 for the fractional part.

Therefore, $(0010\ 1001.0111\ 0101)_{BCD} = (101001.11)_2$

Ex-2.14 Find the BCD equivalent of the following binary number 1001011.101.

Solution: Decimal equivalent = 75.625

So, BCD equivalent =0111. 0101.0110 0010 0101

Ex-2.15 Find the 1's complement of binary number 110010.

Solution: To find the 1's complement of a binary number, simply invert the given number.

So, the 1's complement of 110010 = 001101

Ex-2.16 Find the 1's complement of binary number 110011.

Notes

Solution: To find the 1's complement of a binary number, simply invert the given number.

So, the 1's complement of 110011 = 001100

Ex-2.17 Find the 2's complement of binary number 110010.

Solution: To find the 2's complement of a binary number, simply add 1 to 1's complement of the given number.

So, the 1's complement of 110010 = 001101

2's complement of 110010 = 001101 + 1 = 001110

Ex-2.18 Find the 2's complement of binary number 10010.

Solution: To find the 2's complement of a binary number, simply add 1 to 1's complement of the given number.

So, the 1's complement of 10010 = 01101

2's complement of 10010 = 01101 + 1 = 01110

Notes

Unit - 2.2: Boolean Algebra and Laws

Recall Session:

In the previous unit, you studied about:

(a) Various types of Number Systems

(b) Conversion between Number. Systems

(c) One's Complement

(d) Two's Complement

Unit Outcome:

At the end of this unit, you will learn

1. Describe Boolean Algebra and Laws

2.2.1 Introduction

In the previous unit we studied about the various types of number systems, conversion between number systems, one's complement and two's complement.

In this unit we will discuss about Boolean algebra and laws.

2.2.2 Boolean Algebra

Boolean algebra is an algebra of logic. It is one of the most basic tools to analyse and design logic circuits. It is named after George Boole who developed it in 1854. The original purpose of this algebra was to simplify logical statements and solve logic problems. It had no utilization until 1939 when Shannon applied it to telephone switching circuits. Shannon's work gave an idea that Boolean algebra could be applied to computer electronics. Today it is back bone design and analysis of computer and other digital circuits.

2.2.3 Boolean laws

1. Law of Union

$$A + 0 = A$$
$$A + 1 = 1$$

2. Law of Intersection

$$A.0 = 0$$
$$A.1 = A$$

3. Law of Tautology

$$A + A = A$$
$$A.A = A$$

4. Law of Complements

$$A + \overline{A} = 1$$
$$A.\overline{A} = 0$$

Notes

5. Law of Double Complements

$$\overline{\overline{A}} = A$$

6. Law of Commutation

$$A + B = B + A$$
$$AB = BA$$

7. Law of Association

$$A + (B + C) = (A + B) + C$$
$$A(BC) = (AB)C$$

8. Law of Distribution

$$A(B + C) = AB + AC$$
$$(A + B)(C + D) = AC + AD + BC + BD$$

9. Law of Absorption

$$A(A + B) = A$$
$$A + AB = A$$
$$A(\overline{A} + B) = AB$$
$$AB + \overline{B} = A + \overline{B}$$
$$A\overline{B} + B = A + B$$

10. De Morgan's Theorem

$$\overline{A + B} = \overline{A}.\overline{B}$$
$$\overline{A.B} = \overline{A} + \overline{B}$$

Summary:

- Boolean algebra is an algebra of logic.
- George Boole (1815 – 1864) is known as the father of Boolean algebra.

Further Reading:

6. Anil K. Maini, "Digital Electronics", John Wiley & Sons, Ltd
7. A. P. Godse, D. A. Godse, "Digital Electronics", Technical Publications, Pune.
8. B. Ram, "Computer Fundamentals – Architecture and Organisation", New Age International (P) Limited, Publishers.

Exercise:

Check your progress:

1. Find the 2's complement of binary number is

   (a) $(01101)_2$

   (b) $(01110)_2$

   (c) $(01100)_2$

   (d) (11100)2

Notes

2. The decimal equivalent of the Hexadecimal number is
   (a) $(28)_{10}$
   (b) $(18)_{10}$
   (c) $(38)_{10}$
   (d) $(48)_{10}$
3. Hexadecimal equivalent of binary number $(1100101001010111)_2$ is
   (a) CB57
   (b) CB67
   (c) CA57
   (d) DA57
4. The $(100110)_2$ is numerically equivalent to
   (a) $(26)_{16}$
   (b) $(36)_{16}$
   (c) $(46)_{16}$
   (d) $(38)_{16}$
5. The $(100110)_2$ is numerically equivalent to
   (a) $(26)_8$
   (b) $(36)_8$
   (c) $(46)_8$
   (d) $(38)_8$
6. The $(100110)_2$ is numerically equivalent to
   (a) $(26)_{10}$
   (b) $(36)_{10}$
   (c) $(46)_{10}$
   (d) $(38)_{10}$
7. The base of the hexadecimal number system is
   (a) 6
   (b) 8
   (c) 16
   (d) 10
8. The number of digits in a binary number system are
   (a) 10
   (b) 2
   (c) 4

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(d) 6

9. The number system, which uses alphabets as well as numerals is
   (a) Binary Number System
   (b) Octal Number System
   (c) Decimal Number System
   (d) Hexadecimal Number System
10. The 1's complement of a binary number is obtained by changing
   (a) Each '1' to a '0'
   (b) Each '0' to a '1'
   (c) Both (a) and (b)
   (d) None of these
11. The number of bits in one nibble are
   (a) 2
   (b) 4
   (c) 8
   (d) 16
12. The equivalent decimal number of a maximum binary number of length one byte is
   (a) 8
   (b) 64
   (c) 255
   (d) 256
13. The equivalent decimal number of a maximum binary number of length half byte is
   (a) 2
   (b) 4
   (c) 8
   (d) 15
14. Which out of the following binary numbers is equivalent to decimal number 24
   (a) 1101111
   (b) 11000
   (c) 111111
   (d) 11001
15. Simplified form of Boolean expression $\overline{AB} + \overline{A} + AB$ is
   (a) $\overline{A}$
   (b) $\overline{B}$
   (c) 1

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(d) $\overline{A}+\overline{B}$

16. Simplified form of Boolean expression $AB+A\left(\overline{B}+C\right)+\overline{B}\left(B+C\right)$ is

(a) $A+\overline{B}C$

(b) $C+\overline{A}B$

(c) $B+\overline{A}C$

(d) $B+AC$

17. The simplified form of a logic function $Y=A\left(B+C\left(\overline{AB+AC}\right)\right)$ is

(a) $\overline{AB}$

(b) AB

(c) $\overline{A}B$

(d) $A\overline{B}$

18. Simplified form of Boolean expression $AB+A\left(B+C\right)+B\left(B+C\right)$ is

(a) $A+BC$

(b) $B+AC$

(c) $C+AB$

(d) AC

19. Simplified form of Boolean expression $BC+\overline{B}+\overline{B}\left(B+A\right)$ is

(a) $A+BC$

(b) $B+AC$

(c) $C+AB$

(d) $\overline{B}+C$

20. Simplify the Boolean function

$Y=\overline{A}\overline{B}\overline{C}\overline{D}+\overline{A}B\overline{C}\overline{D}+A\overline{B}\overline{C}\overline{D}+\overline{A}BCD+\overline{A}\overline{B}CD+A\overline{B}C\overline{D}+\overline{A}BC\overline{D}$

(a) $\overline{B}\overline{D}$

(b) $\overline{B}\overline{D}+\overline{A}C$

(c) $BD+\overline{A}CD$

(d) $\overline{B}\overline{D}+\overline{A}CD$

Answer Key:

1-b

2-a

3-c

4-a

5-c

6-d

7-c

8-b

9-d

10-c

11-b

12-c

13-d

14-b

15-c

16-a

17-b

18-b

19-d

20-b

Notes

Notes

Module - III

Course Contents:

- Introduction to IT
- Need of IT
- Introduction to information storage and processing
- Role and Applications of IT
- Internet
- WWW
- Different Type of software
- Introduction to information systems
- Business data processing

Key Learning Objectives:

At the end of this block, you will be able to:

1. Define IT
2. Describe the need of IT
3. Define Information storage and processing
4. Describe the role and applications of IT
5. Define Internet
6. Define WWW
7. Describe the different Type of software
8. Describe the information systems
9. Define business data processing

Structure:

Unit 3.1: Introduction to Information System

Unit - 3.1: Introduction to Information System

Notes

Unit Outcome:

At the end of this unit, you will learn

1. Define IT
2. Describe the need of IT
3. Define Information storage and processing
4. Describe the role and applications of IT
5. Define Internet
6. Define WWW
7. Describe the different Type of software
8. Describe the information systems
9. Define business data processing

3.1.1 Introduction

In this unit we will studied about, introduction to IT, need of IT, information storage and processing, the role and applications of IT, Internet, WWW, the different type of software, the information systems and business data processing.

3.1.2 Introduction to IT

Information technology (IT) is a combination of telecommunications and computing to obtain, process, store transmit and output information in the form of the voice, pictures or text. It includes the following:

- Software applications and operating systems
- Web based information and applications such as distance learning
- Telephones and means of telecommunications
- Video equipment and multimedia products
- World Wide web (WWW)
- Electronic devices such as photocopiers

The components of information technology include hardware, software, data and people. These components are essential for the proper functioning of a system in the IT and are as follows:

- **Hardware:** It consists of physical components that form a computer system or any other electronic gadget. To run a computer, both hardware and software are required. Examples of hardware include monitor, keyboard, mouse, mobile phone and television, which are the popular inventions in the field of IT.
- **Software:** It is a set of instructions in the forms of programs, which control the sequence of tasks. It runs along with the hardware on the digital systems. For example, the software present in the mobile phones allows users to perform

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various functions like sending messages, recording a person's voice and taking photographs.

- **Data:** They are an unprocessed collections or representations of raw facts, concepts, or instructions in manner suitable for communication, interpretation, and processing by humans or by automatic means. They include constants, variables, arrays, and character strings, they can be meaningful or meaningless. They are gathered for the purpose of communication, interpretation, or processing of tasks.
- **People:** They play an important role in IT. They perform various functions with the help of the hardware and software to produce the desired output using the IT.

3.1.3 Need of IT

The present era is the era of information technology. Information technology is prominent among the amazing achievements made by innovators in the fields of science, which have made mankind prosperous. Today, sitting in any corner of the world, we can get any information from anywhere with the help of scientific instruments. This facility of receiving information has ended the distance of countries. Now it seems that the whole world has shrunk in our grasp. The concept of "globalization" and "Vashudhaiva Kutumbakam" seems to be flourishing rapidly in this era of scientific progress.

Today, let us remember the era when there was no proper system for sending mail. Information was exchange was messengers. This work took a long time. It is not easy to estimate how difficult life must have been that time. Time took a turn and new innovations were being made in the field of information. Post telegram, telephone telegram. were arranged. Messages started reaching through letters. Life got momentum and radio as well as television took steps in the direction. With the access of computer, revolution started in the information field. After the development of the internet, all computers were interconnected and instant communication became easier. New changes are coming in the information world and new information is available is immediately. Today human being can easily advertise any of their product in the world. He can fight war without fighting conventional weapons. Computer and internet facilities are available in almost all homes and offices today with the help of it, tickets for aeroplane, rail, bus and cinema etc. can be easily booked Reservation status system can be obtained. The condition of road traffic can be ascertained. Today everything can be obtained sitting at home through internet on mobile. It is really the cheapest means of communication and information communication.

3.1.4 Information Storage and Processing

All information or data stored on the storage media, whether it is stored in hard disk drives (HDDs), solid state drives (SSDs), external hard drives, USB flash drives, SD cards, etc., can be converted into strings of bits. It is also known as binary digit. The value of these binary digits is 1 or 0. A byte is the most common unit of storage and is equal to 8 bits.

All of the computer's data is stored as a binary number. For example, letters become binary numbers, photographs are converted into a set of binary numbers that indicate the location, color, and brightness of each pixel. While convention numbers

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use ten digits (0, 1, 2, 3, 4, 5, 6, 7, 8, 9), binary numbers use two digits to represent all possible values. Convention numbers 0-9 translate into binary numbers: 0, 1, 10, 11, 100, 101, 110, 111, 1000 and 1001.With binary numbers, any information can be stored as a series of 1's and 0's where 1 means true and 0 means false.

Binary data is primarily stored on the hard disk drive (HDD). The device is made up of a spinning disk (or disks) with magnetic coatings and heads that can both read and write information in the form of magnetic patterns. In addition to hard disk drives, floppy disks and tapes also store data magnetically. Newer laptops, as well as mobile phones, tablets, USB flash drives and SD cards, use solid state (or flash) storage. With this storage medium, the binary numbers are instead stored as a series of electrical charges within the NAND flash chips. Because all data is made up of a string of binary numbers, just one number out of place can cause a file to become corrupt.

Data is stored as lots of binary numbers, by magnetism, electronics or optics. While the computer is operating, data is also stored in many temporary locations. Software is responsible for organizing, moving and processing all those numbers. The computer's BIOS contains simple instructions, stored as data in electronic memory, to move data in and out of different storage locations and around the computer for processing. The computer's operating system, for example, contains instructions for organizing data into files and folders, managing temporary data storage, and sending data to application programs and devices such as printers. Finally, application programs process the data.

Data processing refers to the use of data and converting it to the desired form. This conversion or "processing" is done manually or automatically using a predefined sequence of operations. Most of the processing is done using a computer and is thus done automatically. Output or "processed" data can be obtained in various forms. Examples of these forms include image, graph, table, vector file, audio, chart, or any other desired format. The form received depends on the software or method of data processing. When done manually it is called automatic data processing. The data center is the major component as it enables the processing of data, data storage, data access, data sharing and data analysis, etc.

3.1.5 Role and Application of IT

Information technology is being used in the following areas:

Business: IT plays an important role in the business environment as every organization adopts it in some form or the other to perform the tasks in effective manner. In the past few years, the rapid development in IT, particularly in communications, electronic service net- works, and multimedia have opened up new opportunities for corporates. All these are contributing towards new and effective ways of processing business transactions, integrating business processes, transferring payments, and delivering services electronically. Electronic commerce (also known as e-commerce) refers to the electronic means to conduct commerce between business communications and transactions over the Internet. It includes buying and selling over the Internet, electronic fund transfers, smart cards, digital cash, and all other ways of doing business over digital networks. E-commerce websites are critical to the industry for increasing e-commerce sales, improving productivity, and lowering costs and user grievances. IT can provide the company a significant competitive advantage. The e-business approach consolidates a company's position by opening up new business

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opportunities and improving financial status. It has affected business in many ways. Some of them are as follows:

Competitiveness: E-business offers a reliable and cost-effective means of doing business. Routine tasks can be automated. The customers can be provided support round the clock, that is, 24 hours a day. With advancement in the IT sector, corporates are spreading business around the world, thus increasing their presence and entering new markets.

Security: With growth of IT in business, there is more insecurity of the data and important computer programs. Due to this factor, almost every organization has some security programs to avoid the illegal access of the company's information by unauthorized persons. The three fundamental attributes of a security program are confidentiality, integrity, and availability, which allow access to only authorized persons in an organization.

Cost benefit: The extensive availability of Internet-based information means that companies have a wider choice of suppliers, which leads to a more competitive pricing. Due to the presence of Internet, the role of the middleman becomes less important as companies can sell their product or services directly to the customer.

Marketing: Corporates engaged in e-business can take the help of their respective web- sites to create brand awareness of their products, thus creating new avenues of promotion of their products. In addition, companies' websites can also provide better services such as after-sales service to the customer.

Mobile Computing: It is a technology of wireless networking that uses common frequencies for transmission to permit networked devices move freely within the broadcast coverage area yet remain connected to the network, it enables people to access network services any- time and anywhere and allows the transmission of data, with the help of computers. This is done by integrating the cellular telephone technology with the portable computers having cabled network. Mobile voice communication has been established throughout the world and has seen an increase in the number of subscribers to the various cellular networks. An extension of this technology is the ability to send and receive data across the cellular networks, which is the principle of mobile computing. Similarly, mobile data communication has become a rapid technology as it allows the users to transmit data from one remote location to another remote location. Thus, technology mobility has proved to be the solution to the biggest problem of business for the people on the more. The mobile data communications have a significant difference when compared with the mobile voice communications. In the voice communication, mobile phones allow a user to move around and talk at the same time. One of the latest technologies used in mobile computing is general packet radio service (GPRS), which is a packet-based data transfer technology that provides increased capacity and higher data rates for access to the mobile Internet. It allows full mobility and wide area coverage as information is sent and received across a mobile network. A cellular network consists of a number of mobile units that are linked together to the switching equipment. The switching equipment interconnects the different parts of the network and allows access to the fixed public switched telephone network (PSTN). Every base station covers a given area. A number of adjacent cells grouped together form an area. Due to this reason, it is called cellular communication. The corresponding base stations communicate through a mobile switching center (MSC), which is

Notes

responsible for routing or switching calls from the originator to the destination. Mobile computing is used in many fields such as in emergency services, stock information control, credit card verification, and e-mail It relieves the users from working on desk and provides them access to information they need, in addition, it provides a better lifestyle through improved communication and personal data management.

IT in manufacturing: Corporates are developing a manufacturing society to provide manufacturers, distributors, and researchers with structured methods and practices for implementing technologies in manufacturing environments. Initial implementations of this collaborator-enhanced research in robotics are welding, which requires asynchronous and synchronous support and the use of diverse data formats (such as video, audio, and image annotations). Using IT, simulation systems have been developed, which enable manufacturers to virtually prepare prototype plant layouts, optimize raw material usage, and assess ergonomic factors prior to investing in plant redesigns or new factories. Corporates are investigating ways to augment commercial modelling and simulation software systems with programmable human modelling capabilities to harness manufacturing resources. Researchers are developing natural language interfaces that can help simulate human tasks in a manufacturing operations environment.

IT in public sector: In recognition of the serious staffing and equipment situation in the public sector, there is currently a great deal of activity in outsourcing of information services. In countries where public sector is still developing, and is under the control of government, there is a great requirement to automate services such as booking of railway tickets and payment of electricity bills. The IT sector has become a boon for public sector companies by helping them to increase their output and efficiency. In addition, IT has enabled the Com companies to have a greater quality control so that they are able to meet the laid standards. This has been possible as IT has been able to do the following

1. Minimize duplication and sharing of scarce resources.
2. Promote and ensure that IT solutions are cost-effective, efficient, and business-driven.
3. Promote transparency and accountability in the public service by facilitating the availability, accessibility, and sharing of information

IT in defense services: Today, military operators are restricted in their access to information. Most often, military operators use voice over radio or formatted text messages to communicate during crisis. To help the military improve readiness and response, more flexible, timely, and dependable access to information is needed. Key research areas in this field include dialogue management, context tracking, language generation, input language understanding, and hands-free and eyes-free interaction. New IT capability allows military personnel to literally converse with computers to create, access, and manage information and solve problems. The presence of IT helps to gain relevant information in an organized and integrated manner that is readily usable by military personnel equipped with smart information devices. For example, pilot-less warplanes have been developed to combat enemies at the time of war. This has been possible by gathering information and converting it into technology through means of research and development (R&D). Thus, the battlefield of the future will include weapons, unmanned combat vehicles, and communication systems that can

Notes

navigate, reconfigure, and cooperate autonomously to accomplish time-critical military operations.

3.1.6 Internet

Internet is an interconnection between several computers of different types belonging to various networks across the world. It is a network of networks. Millions of people use the internet to search and share information and ideas, etc. it has grown into an important infrastructure supporting a widespread, multidisciplinary community. This community now consists of students, scientists and researchers, large corporations, non-profit organisations, government agencies and individual consumers.

The internet is an immensely complex combination of thousands of technologies and dozens of services used by millions of people around the world each day. The internet links thousands of computers network. Every network and every computer in this network exchange information according to certain rules called protocols. These different computer and networks are united with the common thread of two protocols, i.e., Internet Protocol (IP) and Transmission Control Protocol (TCP).

3.1.7 WWW

The WWW is a huge collection of hypertext pages on the Internet. The concept of WWW was developed in Switzerland at the European Particle Research Centre (known as CERN), in the year 1989. The first text-based prototype was operational in 1991. In the month of December 1991, a public demonstration was given at Hypertext 91 conference in San Antonio, Texas (USA). In the year 1993, the first graphical interface software package called Mosaic was released. The mosaic became so popular that a year later, the author of Mosaic, namely, Marc Andreessen left the national centre for Supercomputing Applications, where Mosaic was developed, forming a company called Netscape Communications.

The web is the most popular internet service next to e-mail. If accesses a larger quantity and greater variety of data than any other service on the internet. The WWW is an Internet based global information system. It makes available multimedia information from over 4 million computers around the world. The Web offers video, interactive multimedia and live audio, in addition to more basic data types, such as text documents and still photographs.

3.1.8 Different Types of Software

Software fall into two categories: system software and application software.

The software that we see and work with is the application software. The system software, like behind-the-scene people in films, stays in the background, though it has very important work to do.

System Software: System software is a collection of complex programs related to coordinating computer operations. It plays a central role in all interactions with the computer and can be put into three categories.

1. Operating system

Notes

2. Language processor
3. Utilities

1. **Operating system** The operating system forms the basis of the kind of work a computer can do. It is a type of software that acts as a supervisor for all applications, games or other types of software. It manages all hardware and software, input, output and processing activities within the computer system, the flow of information to and from the processor, sets priorities for handling different tasks, and so on. For instance, when we command the system to say, CUT, PASTE, what inside the computer and the system actually cuts, or pastes the selected matter. Operating system is the one that decides on "how to", when to", "what to" of all the commands to spare the user of all such stuff, by acting like his/her secretary. The term system software is sometimes used for operating system, but system software actually includes operating system. it that goes MS-DOS.
2. **Language processor:** A computer understands only the machine language, the language of 0s and 1s. Writing programs in machine language is very difficult. Programmers, being humans, can work better and faster with meaningful words and figures. They prefer writing programs in languages using regular English words. Such languages are called high-level languages. High and low-level languages have been described in greater detail later in this lesson. Some examples of high-level languages are COBOL, BASIC, Pascal and C++. To make the computer understand the program written in such a language, a software is needed to translate it to machine language. Such a software is called language processor. "C compiler", a language • processor, converts programs written in C language into machine language.
3. **Utilities:** The job of utility programs is to keep the computer system running smoothly. They perform many standard chores like copying a file, sorting a file, or merging two files into one. Antivirus program is also a utility program that checks the computer system for computer viruses.

Application Software: Application software is a set of programs developed to carry out complete operations for a specific purpose. For instance, a set of programs developed for reserving railway tickets carries out all the operations that may be required for this purpose, like availability of seats, alternatives available, actual booking, waiting list status, cancellations, amount due for refund/deductions. So, 'railway reservation software is an application software. Other examples of application software are "payroll processing software', "electricity billing software', 'examination results processing software'.

3.1.9. Introduction to Information System

The past decade has witnessed tremendous growth in the information innovation and application In- formation Technology has become a vital component for the success of business because most of the organizations require fast dissemination of information, information processing, storage and retrieval of data. Today management of an organization involved in the business requires high speed processing of huge amount of data, fact and figures. High speed communication between organization, customers, clients etc. is also playing an important role to achieve high business goal.

Notes

These requirements of modem business led to development of a business information system which provides appropriate information to appropriate person in desired format and at correct time. The timely processing of data also helps and enable management to take important decision at earliest possible time. Information System may be defined as organized collection of human, software, hardware and communication equipment and database, in which the person controls, process and communicate the information. The overall objective of the Information System is to gather the data, processing of data communicating the information to the user of the system. User group includes the person from all level i.e. top, middle and operational level. The information obtained from the information system allows the different persons to take decisions. To provide the appropriate information to user, it is necessary to collect the data, process and output of the data. Information System may include feedback mechanism under which processed data or output are fed back to the system to make changes in processing activities. For example, sales, inventory report generated may he fed back to appropriate managers to take appropriate decision in time. Therefore, the high-end information systems are designed around feedback and control mechanism, based on user-based criteria to produce and communicate the information for planning and control of business. Information System may be broadly categorized into two categories (i) Manual (i) Computer Based Information System (CBIS), As discussed before, the major objective of the information system is to collect, process and disseminate the data to appropriate user. Traditionally, the business analyst in the organization study the pattern of investment, expenditure, sales etc., to evaluate the performance and to take decision for future. These analyst used to collect the data and prepare the report in the form of chart, table, graph etc., to analyze the business, Now-a-days, the requirement of a business analyst may he programmed and a computer based system may be developed to study and analyze these reports, These Information System are called Computer based Information System. For example, in earlier days the rail reservation system was manual. Traveler used to fill application form and allotment of seat in different quota on different train. These reservations used to be on the basis of certain well-defined rule. After the introduction of the computer, these rules and guidelines have been programmed in computer along with the required software that has emerged as reservation agent.

3.1.10 Business Data Processing

Data processing, as distinct from word processing, image processing, or music and speech processing, refers to the use of computer to record, store, retrieve, analyze, and communicate data. That data will often be in numerical form, but will include textual data such as names, addresses, product codes, and so on.

Data processing may include Scientific and engineering number crunching applications, but it mainly refers to the processing of business transactions, such as sales and purchases. The term transaction processing is sometimes used to distinguished the latter from scientific number crunching.

In small businesses, data processing will normally be carried out on PCs, using off the shelf applications packages and accounts packages.

In a complete data processing operation, you should note what is happening in the five different business data processing steps:

Notes

Editing - What data do you really need? To obtain useful results, you must come out and edit the relevant data.

Coding - This step is also known as bucketing or netting and it aligns the data in a systematic way that can be understood by computer systems.

Data Entry - Entering data into software is an essential step that can be done efficiently by data entry professionals.

Validation - After a "cleansing" step, validating the data involves checking for the desired quality level.

Tabulation - arranging data in a way that facilitates further use and analysis.

Image Source:

- [1] – www.indiamart.com
- [2]. – www.javatpoint.com
- [3] - www.amazon.in

Further Reading/ Reference:

1. V. Rajaraman, "Introduction to Information technology", PHI Learning Private Limited, Delhi – 110092
2. R. Jayaprakash Reddy, "Business Data Processing", A P H Publishing Corporation, New Delhi

Summary:

- Information technology (IT) is a combination of telecommunications and computing to obtain, process, store transmit and output information in the form of the voice, pictures or text.
- There is a system to store information and instructions in any computer, this arrangement is called computer memory.
- The computer memory can be divided into two parts which are as follows
  - ♦ Primary Memory
  - ♦ Secondary Memory
- RAM is called Random Access Memory because this memory is organized in such a way that any memory location can be accessed directly and anytime without accessing the location prior to that location.
- A capacitor is used to store information or data in D RAM.
- D RAM is mainly divided into the following parts.
  - ♦ SD RAM
  - ♦ RD RAM
  - ♦ DD RAM
- ROM is the memory in which data is pre-loaded and can only be read. Such information is usually stored in ROM which is permanent and important.
- There are several types of ROM memory which are as follows

Notes

- ♦ P ROM
- ♦ EP ROM →
- ♦ EEP ROM

- The devices under secondary memory can be divided into the following classes.
  - ♦ Magnetic disk
  - ♦ Magnetic tape
  - ♦ Optical disk
- Internet is an interconnection between several computers of different types belonging to various networks across the world. It is a network of networks.
- The WWW is a huge collection of hypertext pages on the Internet.
- The WWW is an Internet based global information system. It makes available multimedia information from over 4 million computers around the world.
- System software is a collection of complex programs related to coordinating computer operations. It plays a central role in all interactions. It plays a central role in all interactions with the computer and can be put into three categories.
  - ♦ Operating system
  - ♦ Language processor
  - ♦ Utilities
- Application software is a set of programs developed to carry out complete operations for a specific purpose.
- Data processing, as distinct from word processing, image processing, or music and speech processing, refers to the use of computer to record, store, retrieve, analyze, and communicate data.

Exercise

Check your understanding

1. Semiconductor memory device in which stored data will remain permanently stored as long as power is supplied is
   (a) Static memory device
   (b) Flash device
   (c) Storage device
   (d) Dynamic memory device
2. Computer word size is a multiple of
   (a) 1024 bits
   (b) 10 bits
   (c) 4 bits
   (d) 16 bits

Notes

3. Type of computer memory in which access time is not constant but varies depending on the address location is known as
   (a) RAM
   (b) SAM
   (c) RWM
   (d) ROM
4. Computer general- purpose software is basically a
   (a) System software
   (b) Package software
   (c) Data base software
   (d) Application software
5. In computer, testing of a program's component is called
   (a) Pilot testing
   (b) Isolation testing
   (c) System testing
   (d) Unit testing
6. Information in computer read only memory is stored by
   (a) Engineer
   (b) Programmer
   (c) Manufacturer
   (d) User
7. Form of information which is written as a phrase or sentence is termed as
   (a) Data
   (b) Text
   (c) Character
   (d) Message
8. Computer memory is measured in terms of
   (a) Bits
   (b) Cells
   (c) Bytes
   (d) Units
9. Memory of a computer which is volatile is
   (a) RAM
   (b) EEPROM

Notes

(c) ROM

(d) CMOS

10. Computer memory in which user cannot write new information or instructions is

(a) RWM

(b) ROM

(c) CMOS

(d) RAM

11. Which of the following is an attribute of information?

(a) Timeliness

(b) Accuracy

(c) Relevancy

(d) All of these

12. Information is needed for

(a) Communication

(b) Decision- making

(c) Both (a) and (b)

(d) None of these

13. Which of the following tool is used to provide online learning experience to students?

(a) WebCT

(b) Enspire

(c) WebEx

(d) All of these

14. With the emerging role of IT, which of the following option has been affected?

(a) Cost benefits

(b) Marketing

(c) Security

(d) All of these

15. One of the latest technologies used in mobile computing is

(a) PSTN

(b) Multimedia

(c) GPRS

(d) None of these

16. With the advancement of IT in business, it has affected

(a) Cost and competition

Notes

(b) Marketing and security

(c) Both (a) and (b)

(d) None of these

17. Types of system programs are

(a) Logical programs

(b) Application programs

(c) Replicate programs

(d) Both (b) and (c)

18. Set of programs which consists of full set of documentations is termed as

(a) Database packages

(b) File packages

(c) Software packages

(d) Bus packages

19. Examples of system programs includes

(a) Operating system of computer

(b) Trace program

(c) Compiler

(d) All of the above

20. Protocol which assigns IP address to the client connected in the internet is

(a) DHCP

(b) IP

(c) RPC

(d) HTML

21. WWW stands for

(a) World Wide Women's

(b) World Wide Web

(c) World Wide Wildlife

(d) None of these

22. Several programs run at the same time and storage is shared especially in

(a) Mainframe computer

(b) Inquiry computer

(c) Dump computer

(d) Microcomputer

Notes

Answer key:

1-a

2-d

3-b

4-d

5-c

6-d

7-c

8-a

9-b

10-d

11-c

12-d

13-d

14-d

15-c

16-c

17-d

18-c

19-d

20-a

21-b

22-a

Module - IV

Notes

Course Contents:

- Operating system – Definition and Use
- Types of OS – Batch Processing, Multiprogramming, Multi-tasking, Multiprocessing
- Data Communication

Key Learning Objectives:

At the end of this block, you will be able to:

1. Define Operating Systems
2. Describe the uses of Operating system
3. Define the types of Operating System
4. Define the Data Communication

Structure:

Unit 4.1: Operating System

4.1.1 Introduction

4.1.2 Definition of Operating System

4.1.3 Uses of Operating System

4.1.3.1 Operating System as a User Interface

4.1.3.2 Operating System Service

4.1.3.1 Operating system as Resource Manager

4.1.4 History of Operating System

4.1.5 Types of OS

4.1.5.1 Batch System

4.1.5.2 Spooling

4.1.5.3 Multiprogramming System

4.1.5.4 Time sharing or Multi-Tasking System

4.1.5.5 Multiprocessing System

4.1.6 Data Communication

4.1.6.1 Data Communication System

4.1.6.2 Direction of data flow

Notes

Unit - 4.1: Operating System

Unit Outcome:

At the end of this unit, you will learn

1. Define Operating Systems
2. Describe the uses of Operating system
3. Define the types of Operating System
4. Define the Data Communication

4.1.1 Introduction

Operating system is a system software that manages the resources of computer software and hardware and provides common service. The operating system also manages the memory and processing of the computer. No computer can run without an OS because the operating system is the most important program of the computer to understand all the simple and important tasks likes Keys being inputted by the keyboard, sending the output to the monitor screen, files and directories on the hard disk, managing and communicating with all parts of all computers. So, in this unit we are going to discuss about the definition of operating system, uses of operating system, types of operating system and the data communication.

4.1.2 Definition of Operating System

An operating system is a program that controls the execution of an application program and acts as an interface between the user of the computer and the computer hardware.

The operating system performs three functions:

1. **Convenience:** An OS provides a more convenient form for a computer to use.
2. **Efficiency:** An OS allows to use the computer's resources in an efficient manner.
3. **Ability to develop:** An OS should be constructed in such a way that effective development, testing and new system functions can be initiated simultaneously at the same time without interfering.

4.1.3 Uses of Operating System

4.1.3.1 Operating System as a User Interface

For every general-purpose computer, there are hardware, operating systems, system programs, application programs. Hardware consists of CPU, ALU, I/O device, peripheral device and storage device. The system program consists of compiler, loader, editor, OS etc. The application program consists of business programs and database programs.

Fig. 4.1.1 depicts the conceptual landscape of a computer system.

Notes

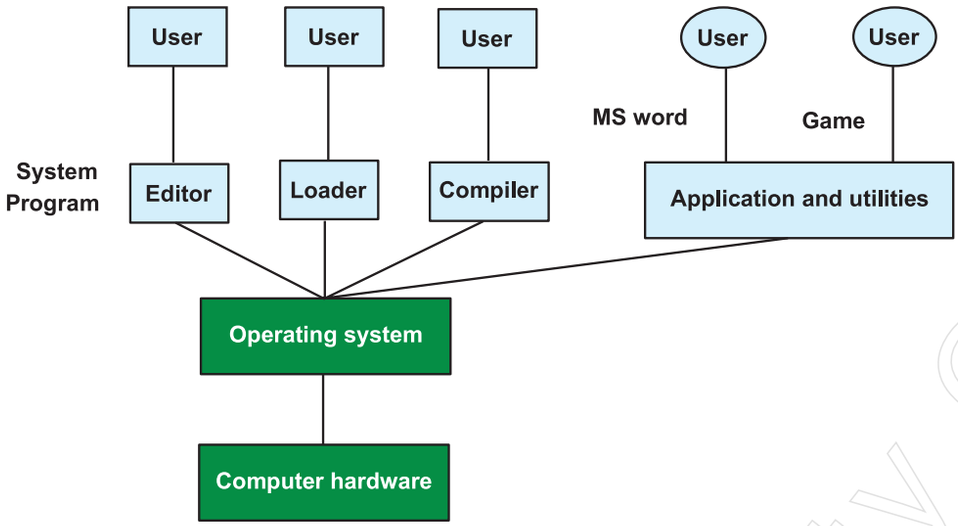

Fig. 4.1.1 Conceptual view of computer system

Each computer must have an operating system to run other programs. The operating system serves to control and instruct the use of hardware between different system programs and application programs for different users. it simply provides an environment within which other programs can function usefully.

The operating system is a set of special programs that run on a computer system that allows it to function properly. It performs basic functions such as identifying input from the keyboard, tracking files and directories on disk, sending output to the display screen, and controlling peripheral devices.

The OS is designed for two basic purposes:

1. It controls the allocation and use of resources of computing systems between different users and functions.
2. It provides an interface between computer hardware and programmer that makes it easy for coding, creation and debugging of application programs.

The operating system must support the following functions. Its function is

1. Provides an editor with facilities to create and improve programs and data files.
2. Ensures the compiler's access to the program's translation from the user's high-level language to the machine language.
3. Provides a loader program to transfer the compiled program code to the computer's memory for execution.
4. Provide routines that handle the details of I / O programming.

4.1.3.2 Operating System Service

An operating system provides services to programs and users using those programs. It provides an environment for execution of programs. The services provided by one operating system are different than those of other operating systems.

The operating system makes programming tasks easier. Common services provided by the operating system are listed below.

Notes

1. Program execution
2. I/O Operation
3. File System Manipulation
4. Communication
5. Error detection.

    1. **Program execution:** The operating system loads a program into memory and executes that program. Programs should be able to terminate its execution, either normally or abnormally.
    2. **I/O Operation:** I/O means any file or a specific I/O device. Any I/O device may be required while running the program. Therefore the operating system should provide the necessary I / O.
    3. **File system manipulation:** The program is required to read a file or write a file. The operating system grants the permission to the programs for operation on the file.
    4. **Communication:** Data transfer between two processes is necessary for some time. Both processes take place on one computer or on different computers but they are connected through a computer network. Communication can be implemented in two ways: shared memory and message passing.
    5. **Error detection:** Error may occur in CPU, in I/O device or in the memory hardware. The operating system must be constantly aware of these possible errors. Appropriate actions must be taken to ensure correct and consistent computing. The operating system provides the following services with multiple users.
        1. Resource allocation
        2. Accounts
        3. Protection

Fig. 4.1.2 Shows the view of OS with components.

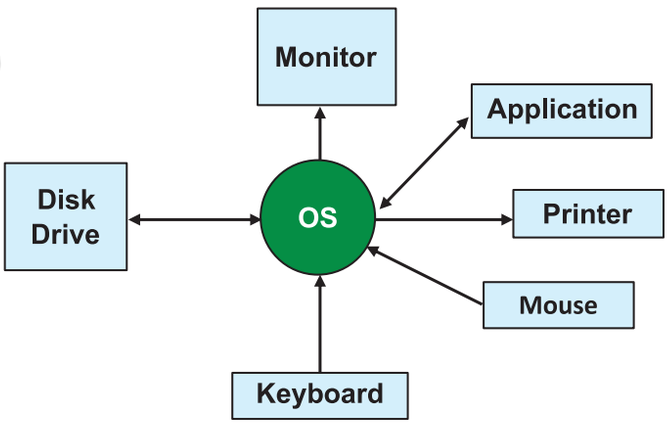

Fig. 4.1.2 View of OS with components

The operating system is a low-level software on which users run programs. The OS is built directly on the hardware interface and provides an interface between the

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hardware and the user program. It shares properties with both software and hardware.

We can view an operating system as a resource allocator. The OS monitors the status of each resource and decides who gets the resources, by when, and at what time. The OS ensures that different programs and users are running at the same time, but do not interfere with each other. It is also responsible for security, ensuring that unauthorized users do not use the system. The primary purpose of an operating system is to increase the productivity of a processing resource, such as computer hardware or users.

The operating system is the first program to run on the computer when the computer boots. The services of the OS are implemented with a system call directive that is used just like any other hardware instruction.

Some operating systems are named as DOS, Windows 95, Windows NT / 2000, Unix, Linux etc.

4.1.3.3 Operating System Resource Manager

A computer is a set of resources for the circulation, storage and processing of data and for the control of these functions. The OS is responsible for managing these resources.

Fig. 4.1.3 shows the OS as a resource manager.

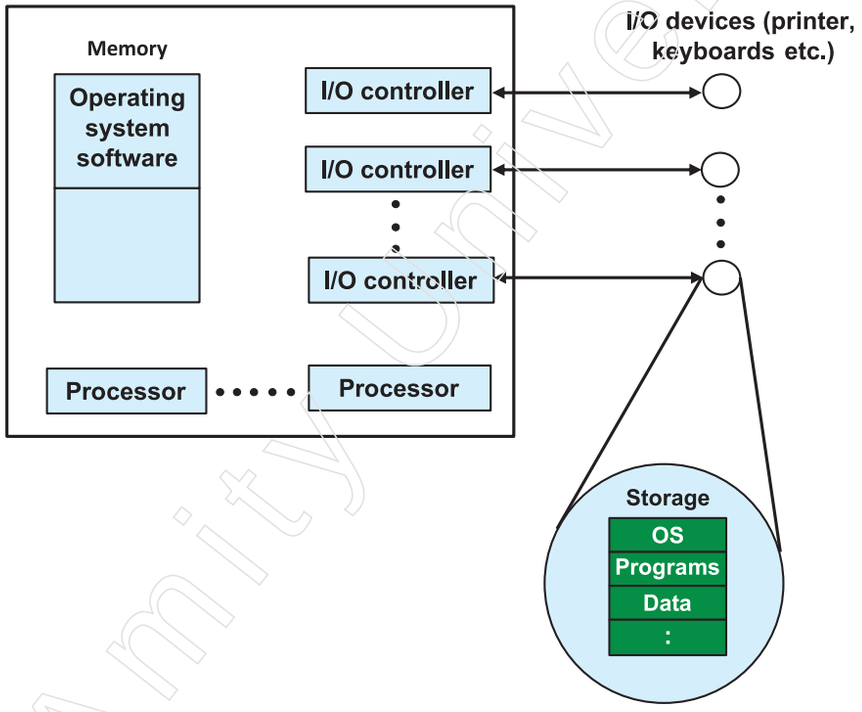


Fig. 4.1.3 OS as a resource manager

A part of the operating system is in main memory. This includes the kernel, which includes the most frequently used functions in the operating system and at the same time, other parts of the OS are also in use.

The remaining part of the main memory contains other user programs and data. The allocation of main memory is controlled jointly by the OS and memory management hardware in the processor.

Notes

The operating system decides when a program can use an I/O device in the execution process and access and control files. The processor is a resource in itself, and the operating system must determine how much time to devote to the processor for the execution of a particular user program.

4.1.4 History of Operating System

The operating system has been evolving over the years. The following table shows the history of the OS.

Generation	Year	Electronic devices used	Types of OS and devices
First	1945-1955	Vacuum tubes	Plug boards
Second	1955-1965	Transistors	Batch system
Third	1965-1980	Integrated circuit	Multiprogramming
Fourth	Since 1980	Large scale integration	PC

Table 4.1.1 History of the OS

4.1.5 Types of Operating System

4.1.5.1 Batch System

Some computer systems could carry only one information at a time. They had a list of instructions to carry and could be carried one after the other. It is also called a serial system. Mechanics for the development and preparation of programs in such environments are quite slow and many manual operations are also involved in this process.

A batch operating system is one where programs and data are collected together in a batch before processing begins. A job is a predefined sequence of commands, programs and data that are combined into a single entity called a job.

Fig. 4.1.4 shows the memory layout for a simple batch system. Memory management in batch systems is very simple. Memory is usually divided into two areas: the operating system and the user program area.

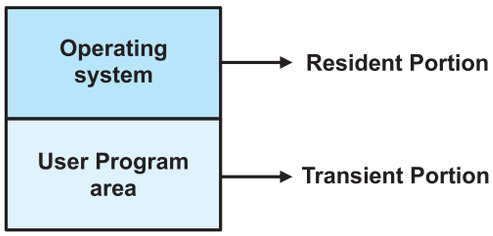


Fig. 4.1.4 Memory layout for a simple batch system

Scheduling is also simple in batch systems. Jobs are processed in order of submission i.e. first come first served.

When a job completes execution, its memory is released and the job's output is copied to the output spool for later printing.

Notes

Spooling an acronym for simultaneous peripheral operation on line. Uses the spooling disk as a large buffer for the output of data from printers and other devices. It can also be used for input, but is typically used for output. Its main use is to prevent two users from moving from an alternate printing line to a line printer on the same page, so that their output is fully coupled. It also helps in reducing idle time and overlapped I/O and CPU.

Batch systems often provide a simple form of file management. Access -to file in serial. Batch systems do not require any time significant device management.

The batch system is inconvenient for users because users cannot interact with their jobs to fix the problems. Long-term changes may also occur. Generating monthly bank statements is a simple example of this system.

4.1.5.2 Spooling

Spooling acronym for simultaneously peripheral operation on line. Spooling refers to working in a buffer, a particular area in memory or on a disk where the device can access them when ready.

Spooling is useful because the device access data from different rates. Buffer provides a waiting station where the data can rest until the slow device does not hold it.

Fig 4.1.5 shows the spooling.

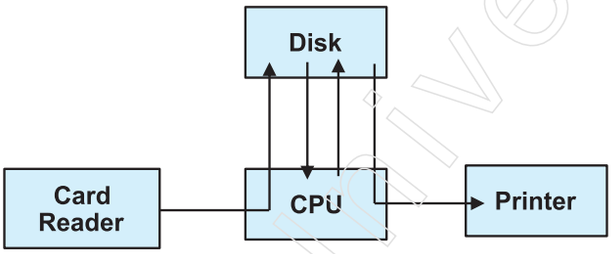


Fig. 4.1.5 Spooling

Computer can perform I/O in parallel with computation, it is possible when the computer was calculating, it reads the deck of the card from tape, drum or disk and to write out to a tape printer. This process is called spooling.

The most common spooling application is print spooling. In print spooling, documents are loaded in a buffer and then the printer pulls them from buffer to its own rate.

Spooling is also used to process data on remote locations. CPU sends data to a remote printer through communication path. Spooling also overlaps a JOB's I/O with the calculation of other jobs.

One difficulty with the simple batch system is that the computer still needs to read the deck of the card, before he starts to perform the job. This means that during the relatively slow operation, the CPU is inactive.

Spooling batch system is the first and the simplest multiprogramming system.

Advantage of Spooling

1. The spooling operation uses a disk as a very large buffer.

Notes

2. Spooling is also able to overlap the I / O operation of a job, though with processor operations for other work.

Advantages of batch systems

1. Move much of the work of the operator to the computer.
2. To increase the performance related to starting the job as soon as the previous work is over.

Disadvantages of Batch system

1. Turn around time can be large from user standpoint.
2. Difficult to debug program.
3. A job could enter an infinite loop.
4. A job could corrupt the monitor, thus affecting pending jobs.
5. Due to lack of protection scheme, one batch job can affect pending jobs.

4.1.5.3 Multiprogramming Operating System

When two or more programs are in memory at the same time, the processor being shared is called a multiprogramming operating system. Multiprogramming considers it to be a single processor that is being shared. It increases the usability of the CPU by organizing the jobs so that the CPU always executes one job at a time.

Fig. 4.1.6 shows the memory layout for the system.

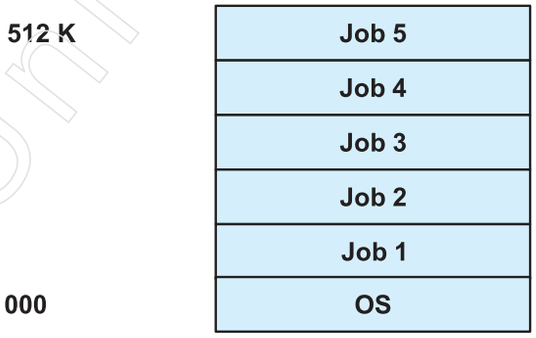


Fig. 4.1.6 Memory layout for a Multiprogramming System

The operating system keeps many jobs in memory at one time. This set of jobs is a subset of jobs placed in the job pool. The operating system picks up and starts executing one of the jobs in memory.

Multiprogrammed systems provide an environment in which different systems can use resources effectively, but they do not provide user interaction with computer systems.

Jobs entering into the system are kept into the memory. The operating system selects the jobs and starts executing one of the jobs in memory. Having several programs in memory at the same time requires some form of memory management.

The multiprogramming operating system monitors the status of all active jobs and system resources and ensures that the CPU is never idle until there is no job remaining.

Notes

Advantages

1. High CPU utilization.
2. It appears that many programs are allocated CPU almost simultaneously.

Disadvantages

1. CPU scheduling is required.
2. To accommodate multiple jobs in memory, memory management is required.

4.1.5.4 Time Sharing or Multitasking System

The time-sharing system supports interactive users. Time sharing is also called multitasking. This is a logical extension of multiprogramming. The time-sharing system uses CPU scheduling and multiprogramming to provide affordable interactive systems for two or more users.

In the time-sharing system, each user is given a time-slice to perform their job in a round-robin fashion. The job continues until the time-slice ends.

Time sharing systems are more complex than multiprogramming operating systems. Memory management in a time management system provides isolation and protection of co-resident programs.

Time sharing uses medium-term scheduling such as round-robin for the foreground. The background may use a different scheduling technique.

The time-sharing system can run multiple programs at the same time, so it is also a multiprogramming system. But multiprogramming operating system is not a time-sharing system.

The difference between both the systems is that, time sharing systems allow for more frequent context switches. This assures each user that the entire computer is dedicated to its use. A context switch in a multiprogramming system only occurs when the currently executed process stalls for some reason.

4.1.5.5 Multiprocessor Systems

Multiprocessor systems have more than one processor for the communication process. They also share computer buses, system clock and input-output devices, and sometimes memory. In multiprocessing systems, it is possible to run two processes in parallel.

There are two types of multiprocessor systems: symmetric multiprocessing and asymmetric multiprocessing.

In symmetric multiprocessing, each processor runs an identical copy of the operating system and they communicate with each other as needed. All CPUs share the same memory.

Fig 4.1.7 shows the symmetric multiprocessing system.

Notes

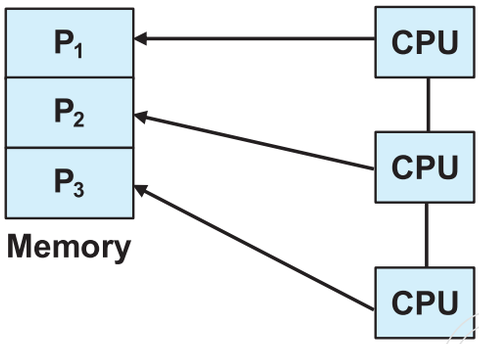


Fig. 4.1.7 Symmetric Multiprocessing System

In asymmetric multiprocessing, each processor is assigned a specific task. It uses the master-slave relationship. A master processor controls the system. The master processor allocates schedules and tasks to the slave processors.

Fig 4.1.8 shows asymmetric multiprocessor.

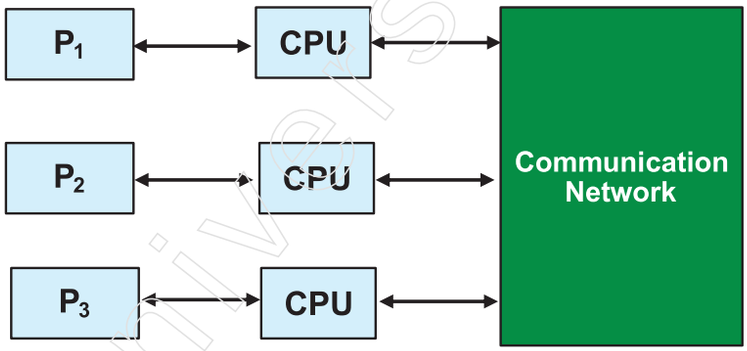


Fig. 4.1.8 Asymmetric Multiprocessing System

Features of Multiprocessor System

1. If one processor fails, another processor must retake the interrupted process state so that execution of the process can continue.
2. The processor must support efficient context switching operation.
3. Multiprocessor system supports large physical address space and large virtual address space.
4. The IPC mechanisms should be implemented and implemented in hardware as it becomes efficient and easy.

4.1.6 Data Communication

Data communications is the exchange of data between two devices by means of any transmission medium. The effectiveness of data communication system depends on three fundamental characteristics delivery, accuracy and timeliness.

1. Delivery

The data must be delivered to the intended device or user.

Notes

2. Accuracy

The data must be delivered accurately i.e., without alteration.

3. Timeliness

The system must deliver data in a timely manner.

4.1.6.1 Data Communication System

A data communication system consists of five components.

1. Message
2. Sender
3. Receiver
4. Medium
5. Protocol

Fig.4.1.9 shows the components of data communication system.

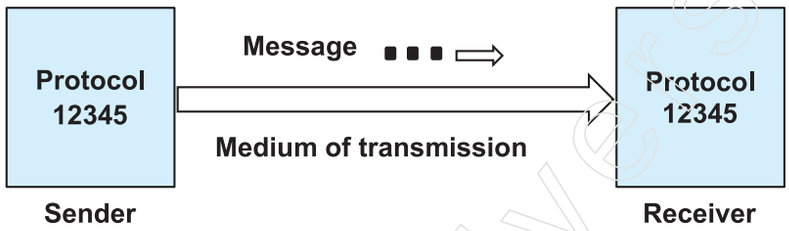


Fig.4.1.9 Data communication components

1. Message

The message is data or information to be communicated. It can be any format like text, image, numbers, audio and video.

2. Sender

The sender is device that sends data. Various device can be used to send the data.

3. Receiver

The receiver receives the message/information transmitted by sender.

4. Medium

It is a physical path through which message passes from sender to receiver. The transmission medium can be twisted-pair cable, co-axial cable, optical-fibre cable or radio waves.

5. Protocol

Protocol is a set of rules that governs data communications. Protocol is a predecided terms for communications.

Notes

4.1.6.2 Direction of data flow

Communication between two devices i.e. sender and receiver can be of three types:

1. Simplex
2. Half-Duplex
3. Full-Duplex

1. Simplex

In simplex mode of communication, data can flow in one direction only (unidirectional). One device can transmit data and other device accepts the data and works accordingly. Fig.4.1.10 shows simplex communication mode.

Fig.4.1.10 Simplex Communication

Typical example of simplex communication is a computer system, data from flow from CPU to monitor or from keyboard to monitor in one direction only.

2. Half-Duplex

In half-duplex mode of communication each station can transmit or receive the message (data). Fig.4.1.11 shows half-duplex communication mode.

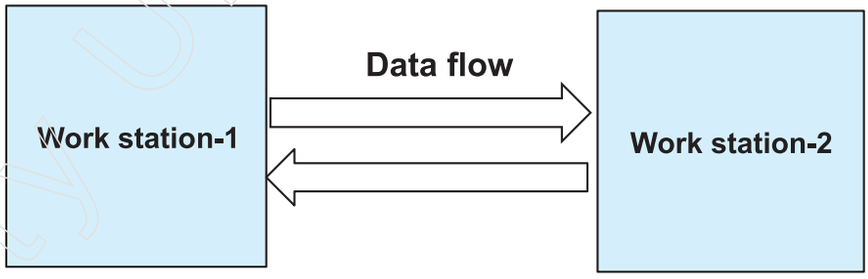


Fig.4.1.11 Half-duplex Communication

An important condition in half-duplex mode is that both devices cannot transmit at a time. The entire channel capacity is used by any device transmitting at that time.

3.Full-duplex

In full-duplex mode, both stations may transmit and receive data simultaneously. Fig 4.1.12 shows full-duplex mode of communication.

Notes

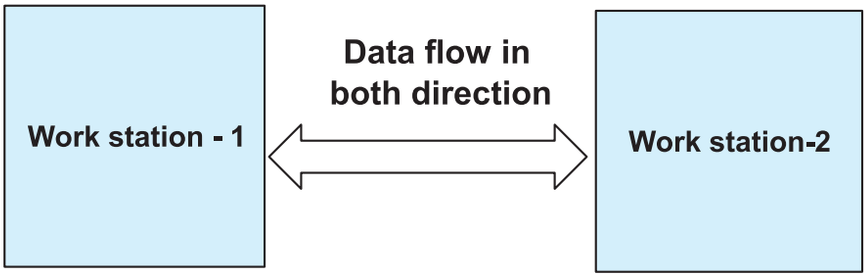


Fig.4.1.12 Full-duplex Communication

In full-duplex mode of communication, data flow in both directions share the channel capacity. A common example of full-duplex communication is telephone network. Subscriber at both ends can talk and listen at the same time.

Further Reading:

1. I.A. Dhotre, "Operating Systems", Technical Publication Pune.
2. Harry Chaudhary, "Hands on Operating Systems 1500 MCQ", I.T. Exam Guruji Publications.

Summary:

- An operating system is a program that controls the execution of an application program and acts as an interface between the user of the computer and the computer hardware.
- The operating system performs three functions:
  (a) **Convenience:** An OS provides a more convenient form for a computer to use.
  (b) **Efficiency:** An OS allows to use the computer's resources in an efficient manner.
  (c) **Ability to develop:** An OS should be constructed in such a way that effective development, testing and new system functions can be initiated simultaneously at the same time without interfering.
- The OS is designed for two basic purposes:
  (a) It controls the allocation and use of resources of computing systems between different users and functions.
  (b) It provides an interface between computer hardware and programmer that makes it easy for coding, creation and debugging of application programs.
- The operating system must support the following functions. Its function is
  (a) Provides an editor with facilities to create and improve programs and data files.
  (b) Ensures the compiler's access to the program's translation from the user's high-level language to the machine language.
  (c) Provides a loader program to transfer the compiled program code to the computer's memory for execution.
  (d) Provide routines that handle the details of I / O programming.

Notes

- The operating system makes programming tasks easier. Common services provided by the operating system are listed below.
  (a) Program execution
  (b) I/O Operation
  (c) File System Manipulation
  (d) Communication
  (e) Error detection
- A batch operating system is one where programs and data are collected together in a batch before processing begins.
- The batch system is inconvenient for users because users cannot interact with their jobs to fix the problems.
- Spooling refers to working in a buffer, a particular area in memory or on a disk where the device can access them when ready.
- When two or more programs are in memory at the same time, the processor being shared is called a multiprogramming operating system.
- Multiprogrammed systems provide an environment in which different systems can use resources effectively, but they do not provide user interaction with computer systems.
- In the time-sharing system, each user is given a time-slice to perform their job in a round-robin fashion. The job continues until the time-slice ends.
- The time-sharing system can run multiple programs at the same time, so it is also a multiprogramming system.
- Multiprocessor systems have more than one processor for the communication process.
- In multiprocessing systems, it is possible to run two processes in parallel.
- There are two types of multiprocessor systems: symmetric multiprocessing and asymmetric multiprocessing.
- In symmetric multiprocessing, each processor runs an identical copy of the operating system and they communicate with each other as needed.
- In asymmetric multiprocessing, each processor is get to a specific task. It uses the master-slave relationship. A master processor controls the system. The master processor allocates schedules and tasks to the slave processors.
- Data communications is the exchange of data between two devices by means of any transmission medium.
- A data communication system consists of five components.
  (a) Message
  (b) Sender
  (c) Receiver
  (d) Medium
  (e) Protocol

Notes

- Communication between two devices i.e. sender and receiver can be of three types:
  a) Simplex
  b) Half-Duplex
  c) Full-Duplex

Exercise

Check your progress

1. Which of the following shutdown methods is often called warm boot?
   (a) Shut down
   (b) Restart
   (c) Sleep
   (d) Hibernate
2. What is operating system?
   (a) Collection of programs that manage hardware resources
   (b) System service provider to the application programs
   (c) Link to interface the hardware and application programs
   (d) All of the above
3. To access the services of OS, the interface is provided by the
   (a) System calls
   (b) API
   (c) Library
   (d) Assembly instruction
4. Which one of the following is not true?
   (a) Kernel is the program that constitutes the central core of the operating system
   (b) Kernel is the first part of operating system to load into memory during booting
   (c) Kernel is made up of various modules which cannot be loaded in running operating system
   (d) Kernel remains in the memory during the entire computer session
5. Which one of the following error will be handle by the operating system?
   (a) Power failure
   (b) Lack of paper in printer
   (c) Connection failure in the network
   (d) All of the above

Notes

6. The main function of the command interpreter is
   (a) to get and execute the next user-specified command
   (b) to provide the interface between the API and application program
   (c) to handle the files in operating system
   (d) none of these
7. By operating system, the resource management can be done via
   (a) time division multiplexing
   (b) space division multiplexing
   (c) both time and space division multiplexing
   (d) none of these
8. If a process fails, most operating system write the error information to a _____
   (a) log file
   (b) another running process
   (c) new file
   (d) none of these
9. Which one of the following is not a real-time operating system?
   (a) VxWorks
   (b) Windows CE
   (c) RT Linux
   (d) Palm OS
10. The OS X has _____
   (a) Monolithic kernel
   (b) Hybrid kernel
   (c) Microkernel
   (d) Monolithic kernel with modules
11. The systems which allows only one process execution at a time, are called
   (a) Uniprogramming system
   (b) Uniprocessing system
   (c) Unitasking system
   (d) None of these
12. In operating system, each process has its own
   (a) Address space and global variables
   (b) Open files
   (c) Pending alarms, signals and signal handlers
   (d) All of the above

Notes

13. A process can be terminated due to
    (a) Normal exit
    (b) Fatal error
    (c) Killed by another process
    (d) All of the above
14. What is interprocess communication?
    (a) Communication within the process
    (b) Communication between two processes
    (c) Communication between two threads of same process
    (d) None of these
15. The number of process completed per unit time is known as
    (a) Output
    (b) Throughput
    (c) Efficiency
    (d) Capacity
16. The degree of multiprogramming is
    (a) The number of processes executed per unit time
    (b) The number of process in the ready queue
    (c) The number of processes in the I/O queue
    (d) The number of processes in memory
17. A single thread of control allows the process to perform
    (a) Only one task at a time
    (b) Multiple tasks at a time
    (c) Only two tasks at a time
    (d) All of the above
18. The objective of multiprogramming is to
    (a) Have some process running at all times
    (b) Have multiple programs waiting in a queue ready to run
    (c) To minimize CPU utilization
    (d) None of these
19. When the process issues an I/O request
    (a) It is placed in an I/O queue
    (b) It is placed in a waiting queue
    (c) It is placed in the ready queue
    (d) It is placed in the job queue

Notes

20. When a process terminates
    (a) It is removed from all queues
    (b) It is removed from all, but the job queue
    (c) Its process control block is de-allocated
    (d) Its process control block is never de-allocated
21. Co- processor
    (a) is relatively easy to support in software
    (b) causes all processor to function equally
    (c) works with any application
    (d) is quite common in modern computer
22. Microsoft windows is
    (a) Operating system
    (b) Graphics program
    (c) Word processing
    (d) Database program
23. Which of the following is not an application software?
    (a) Windows NT
    (b) Page Maker
    (c) Win-word XP
    (d) Photoshop
24. Which of the following windows version supports 64-bit processor
    (a) Windows 98
    (b) Windows 2000
    (c) Windows XP
    (d) Windows 95
25. Which of the following windows has not start button?
    (a) Windows 3.1
    (b) Windows 3.11
    (c) Windows 95
    (d) Windows 98

Answer Key

1-b

2-d

3-a

4-c

5-d

6-a

7-c

8-a

9-d

10-b

11-b

12-b

13-d

14-b

15-b

16-d

17-a

18-a

19-a

20-a

21-a

22-a

23-a

24-c

25-c

Notes

Notes

Module - V

Course Contents:

- Introduction to programming concepts – Define program
- Process of programming
- Algorithms
- Introduction to flow charts
- Basic symbols and drawing of flow charts
- Advantage and limitations of flow charts
- Pseudocodes – Sequence logic, Selection logic, Iteration logic
- Advantage and disadvantage of Pseudocode

Key Learning Objectives:

At the end of this block, you will be able to:

1. Define Program
2. Describe the process of Programming
3. Define Algorithm
4. Define flowchart, basic symbols of flowchart and drawing of flowcharts
5. Describe advantages and limitations of flowcharts
6. Define pseudocodes, sequence logic, selection logic and iteration logic
7. Define advantages and disadvantages of pseudocodes

Structure:

Unit 5.1: Introduction to Program, Flowchart and Pseudocode

5.1.1 Introduction
5.1.2 Program
5.1.3 Process of programming
5.1.4 Algorithms
5.1.5 Introduction to flow charts
5.1.6 Basic symbols of flow charts
5.1.7 Rules for drawing flow charts
5.1.8 Advantage of flow charts
5.1.9 Limitations of flow charts
5.1.10 Pseudocodes
5.1.11 Sequence logic
5.1.12 Selection logic
5.1.13 Iteration logic
5.1.14 Advantage of Pseudocode
5.1.15 Disadvantage of Pseudocode

Unit - 5.1: Introduction to Program, Flowchart and Pseudocode

Notes

Unit Outcome:

At the end of this unit, you will learn

1. Define Program
2. Describe the process of Programming
3. Define Algorithm
4. Define flowchart, basic symbols of flowchart and drawing of flowcharts
5. Describe advantages and limitations of flowcharts
6. Define pseudocodes, sequence logic, selection logic and iteration logic
7. Define advantages and disadvantages of pseudocodes

5.1.1 Introduction

The computer can solve the problem by executing a program fed to it. The programmer has to write this program for solving the given problem. Before starting the process of writing program, the programmer has to determine the problem. The programmer must know the problem exactly. After understanding the problem clearly, he/she must start writing a program or coding. The different techniques are developed to solve the problems. In most of the cases, it is necessary to break the problem into a series of smaller steps.

In this unit we will studied about, definition of program, the process of programming, algorithm, flowchart, basic symbols of flowchart and drawing of flowcharts, advantages and limitations of flowcharts, pseudocodes, sequence logic, selection logic and iteration logic and advantages and disadvantages of pseudocodes.

5.1.2 Program

The computer can perform a variety of tasks, but not by its own. An instruction is to be given a computer for performing even a simple task. When a set of sequential instructions is written to perform any task by a computer, it is called a 'computer program'. The computer executes the program, i.e., it follows the instructions and accordingly perform the stepwise operation. Thus, computer performs the specified task with the help of program.

We, the human beings can use natural languages such as English, Japanese, French, to communicate. But computer is a machine. It cannot understand human languages. So, computer user has to communicate with a computer in a language understood by it. This can be accomplished by providing instructions or program to a computer understood by it. The different types of languages are developed for this purpose, called "programming language" or "computer language".

Notes

5.1.3 Process of the Programming

The development of a program is the technique which is commonly used for solving problems this technique uses number of steps. However, these steps may vary from person to person since the steps depend on the approach used by the person to solve the program. Using this technique, the program development is carried out in steps. After completing these required steps, new demands may appear and all the steps are repeated. Thus, often the process runs in a loop. The steps included in the development cycle are:

1. Analyse or define the problem

An understanding of the problem is an important step. So, firstly the problem is analysed precisely and completely. After this analysis, the developer comes to know the scope within which the development of the problem is to be done.

2. Task analysis

After analysing the problem, the developer has to develop different solutions, but the optimum solution is to be selected. While selecting the solution, easiness and cost factors are considered.

3. Developing algorithms

After choosing the appropriate solution, next step is developing an algorithm. That is, logical steps are depicted according to the selected solution. Then, the pictorial representation of an algorithm, that is flowchart is generated. The pseudocodes of the program are also obtained in the same step.

4. Testing the algorithm for accuracy

The accuracy of the algorithm should be checked before obtaining the actual code. During this checking, logical errors are identified. It is very difficult to detect and correct the logical errors at later stage. S, it is better to do at early stage. The testing also makes sure that the algorithm is true. It also ensures that the algorithm works for both normal as well as unusual data.

5. Coding

This step involves actual coding of the program in the selected programming language. There are different levels of programming languages such as machine language, assembly language or high-level language. The selection of the language is done according to the available resources and application area.

6. Testing and debugging

Usually the initial program code contains errors. The syntax errors are found by a compiler and test data machine – designed by programmer. The result is also calculated manually. The results obtained are compared with results calculated manually from the test data. Several rounds of testing may be required. This depends on the complexity of the program.

Notes

7. Documentation

After removing all errors in the program, program developer has to make suitable documentation. These documents should be provided to the program users. This helps the user to operate the program correctly. It also can be used by other persons as a guide to understand the program clearly. The others can make corrections or modify the program if necessary.

8. Implementation

This step involves installing the program on the end user's machine. The user can understand the working of the program. When the user uses the program, he comes to know the short comings or drawbacks of the program if any. The user informs this to the developer. The programmer can make changes or modify the program based on the feedback from user. Thus, the implementation can be viewed as the final testing phase.

9. Maintenance and enhancement

After implementation, the developer has to maintain the program properly. It is the responsibility of the developer to take care of the changing requirements of the user and system. The improvements in the program are done and it is regularly enhanced by including additional capabilities. Some of the errors may be missed during testing phase. Those are detected and corrected in this step. After modifications or reconstructing the program, again the program is supplied to the use, the feedback is taken and this cycle of development of program is continued.

Since the developer has to repeat all the steps of the program development to satisfy the needs of the user, the program development process becomes the cycle.

Fig. 5.1.1 shows the program development cycle.

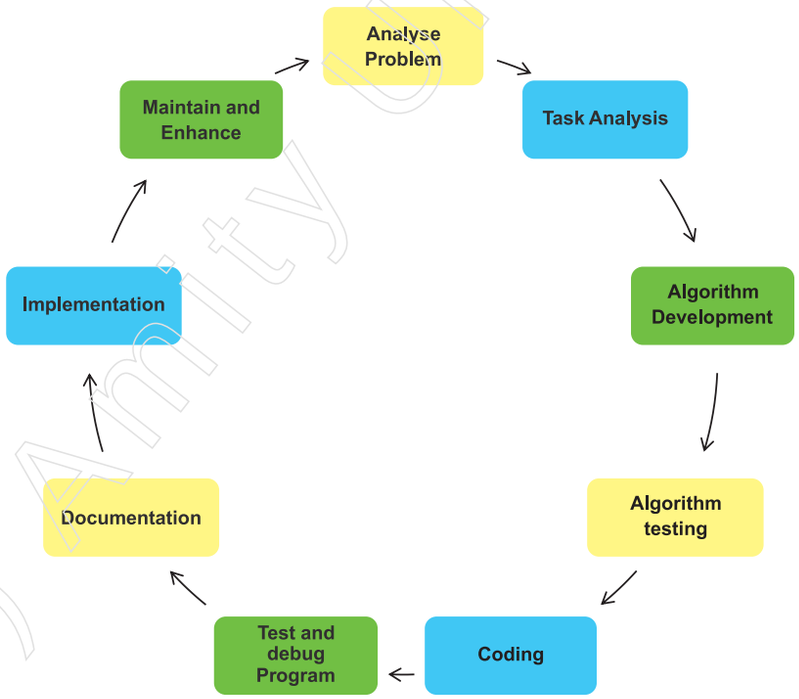


Fig.5.1.1 Program Development Cycle

Notes

5.1.4 Algorithm

Algorithm is a finite sequence of explicit and unambiguous steps required to solve the given problem. When the required input values are provided, it produces an output and then terminates. The steps may repeat or require decisions as per the requirement.

The same problem can be solved with different methods. So, for solving the same problem, different algorithms may be accomplished. In these algorithms, the steps, time, space and efforts may vary more or less. User writes algorithm in his/her own language. So, it cannot be executed on computer.

Properties of Algorithm

1. The steps used in algorithm must be unambiguous and precisely defined.
2. The uncertainty about the instruction to be executed next, should be avoided.
3. The steps used in algorithm should be finite and the algorithm should be terminated, that is, it cannot be open -- ended.
4. The execution of the algorithm should conclude after a finite number of steps.
5. The algorithm must be general enough to deal with any situation.

5.1.5 Introduction of Flowcharts

A pictorial representation of an algorithm is called a flowchart. In Flowchart, the steps in the algorithm are represented in the form of different shapes of boxes and the logical flow is indicated by interconnecting arrows. The boxes are used to represent different operations and the arrows are used to represent the sequence of these operations. Since this is a visual way of algorithm representation, it helps the programmer in understanding the logic of the program. The general procedure to solve the problem is outlined by the flowchart. It is always not necessary to include all the steps in detail.

5.1.6 Basic Symbols of Flowchart

Flowcharts have only a few symbols of different sizes and shapes for showing necessary operations. Each symbol has specific meaning and function in a flowchart. These symbols have been standardized by the American National Standards Institute (ANSI). The basic rules that a user must keep in mind while using the symbols are:

1. Use the symbols for their specific purposes.
2. Be consistent in the use of symbols.
3. Be clear in drawing the flowchart and the entries in the symbols.
4. Use the annotation symbol when beginning a procedure.
5. Enter and exit the symbols in the same way.

The flowchart symbols along with their purpose are given below:

Notes

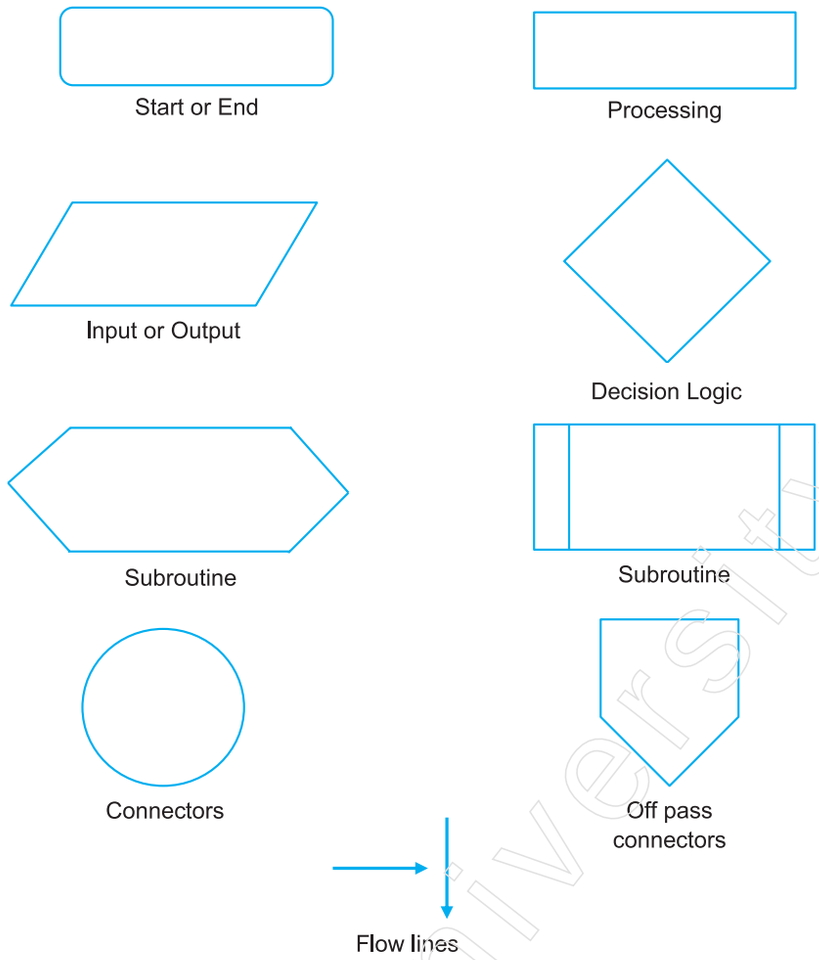
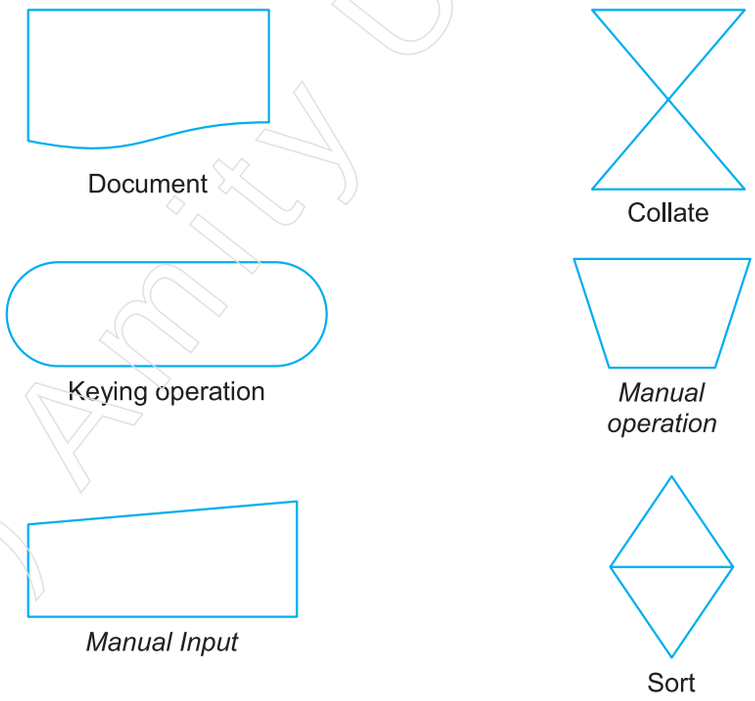


Fig.5.1.2 Standards symbols for flowcharts



Notes

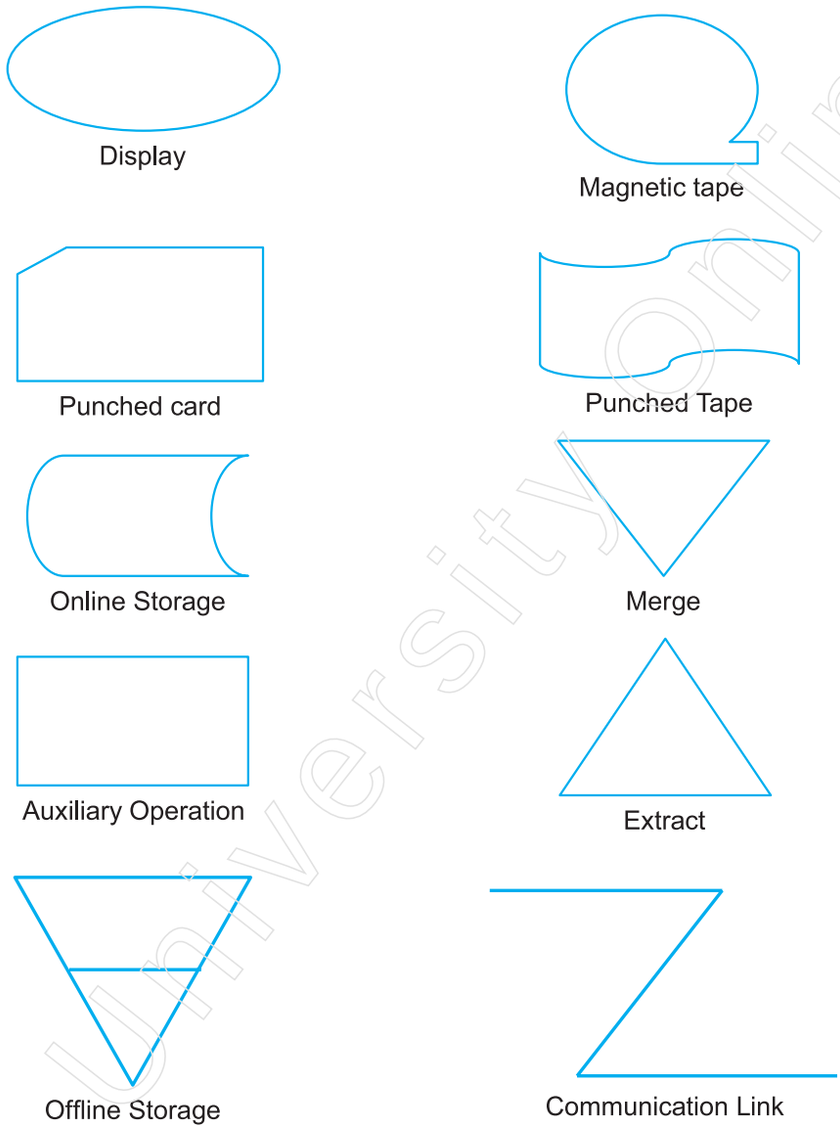


Fig.5.1.3 Special symbol for flowcharts

5.1.7 Rules for Drawing Flowcharts

1. First consider the main logic, then incorporate the details.
2. Maintain a consistent level of details in a flowchart.
3. Do not include all details in flowchart.
4. Use Meaningful description in the flowchart symbols. These should be easy to understand.
5. Be consistent in using variables and names in the flowchart.
6. The flow of the flowchart should be from top to bottom and from left to right.
7. For a complex flowchart, use connectors to reduce the number of flow lines. The crossing of lines should be avoided as far as possible.

Notes

8. If a flowchart is not drawn on a single page, it is recommended to break it at an input or output point and properly labelled connectors should be used for linking the portions of the flowchart on separate pages.
9. Avoid duplication so far as possible.

5.1.8 Advantages of Flowcharts

The various advantages of flowcharts are as follows:

Synthesis: Flowcharts are used as working models in designing new programs and software systems.

Documentation: Program documentation consists of activities, such as collecting, organizing, storing and maintaining all related records of a program.

Coding: Flowcharts guide the programmer in writing the actual code in a high-level language, which is supposed to give an error free program developed expeditiously.

Debugging: The errors in a program are detected only after its execution on a computer. These errors are called bugs and the process pf removing these errors is called debugging. In the debugging process, a flowchart acts as an important tool in detecting, Locating and removing bugs from a program.

Communication: A flowchart is a pictorial representation of a program. Therefore, it is an excellent communication technique to explain the logic of a program to other programmers/people.

Analysis: Effective analysis of a logical problem can be easily done with the help of a related flowchart.

Testing: A flowchart is an important tool in the hands of a programmer, which helps him in designing the test data for systematic testing of programs.

5.1.9 Limitation of Flowcharts

The various limitations of flowcharts are as follows:

1. The developing of a flowchart is a very time-consuming process and laborious especially for large, complex problems.
2. The redrawing of flowcharts is even more difficult and time consuming. It is very difficult to include any new step in the existing flowchart, redrawing of the flowchart is the only solution.
3. There are no standards, which specify the detail that should be included in any flowchart.
4. If an algorithm has complex branches and loops, flowcharts become very difficult to draw.
5. Sometimes flowcharts are not as detailed as desired.

5.1.10 Pseudocode

Pseudocode is a kind of structured English for describing algorithms. It is made up of two words: Pseudo and code. Pseudo means imitation and code refers to

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instructions, written in a programming language. As the name suggests, pseudocode generally does not actually obey the syntax rules of any particular language. Thus, it is not a real programming code. It allows the designer to focus on the logic of the algorithm without being distracted by details of language syntax. At the same time, the pseudocode needs to be complete. I describe the entire logic of the algorithm so that implementation becomes a mechanical task of translating line by line into source code.

In the text and lectures, algorithms are often being expressed in pseudocode. It uses plain English statements rather than symbols, to processes of a computer program. It strikes a sometimes-precarious balance between the understandability and informality of English and the precision of code. If we write an algorithm in English, the description may be at so high a level that it is difficult to analyse the algorithm and to transform it into code. If instead we write the algorithm in code, we have invested a lot of time in determining the details of an algorithm we may not choose to implement. The goal of writing pseudocode, then, is to provide a high – level description of an algorithm which facilitates analysis and eventual coding, but at the same time suppresses any of the details that are insignificant.

5.1.11 Sequence Logic

The steps in an algorithm can be divided into three categories.

The steps described in the algorithm are performed successively one by one without skipping any step. The sequence of steps defined in the algorithm should be simple and easy to understand. Each instruction of such an algorithm, because no selection procedure or conditional branching exists in a sequence algorithm. Fig.5.1.4 represents the sequence of steps for a telephonic conversation with your friend.

Consider an example described in the topic “Algorithm”.

1. Dial the phone number.
2. Phone rings at the called friend.
3. You wait for the response.
4. Called friend picks up the phone.
5. The conversation begins between both of you.
6. Release of connection.

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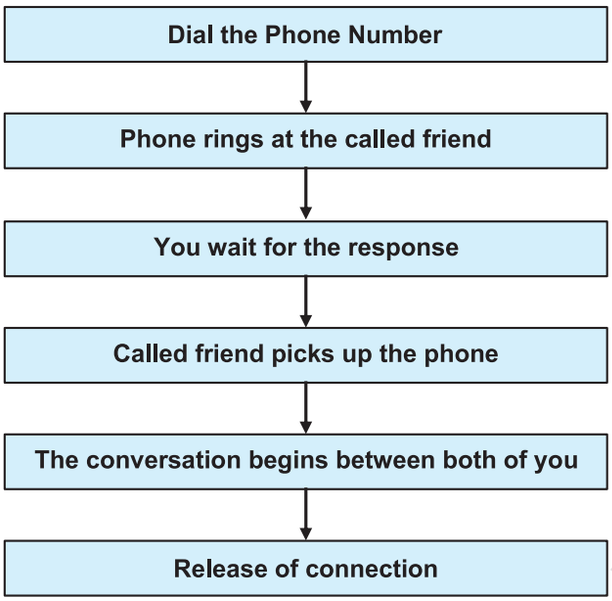

Fig. 5.1.4. Sequence algorithm

The above is a sequence algorithm and all the above six instructions are followed by the system. In case some problem occurs, for example, after step 1, after dialling if the line is busy, there is no alternative operation defined in the sequence to either exit or redial. In such a case, remaining instructions will not be followed. This problem can be overcome by using selection method.

5.1.12 Selection logic

We understood that the algorithms written in sequence fashion are not reliable. There must be a procedure to handle operation failure occurring during execution. The selection statements can be shown in fig. 5.1.5.

```
If (condition)
Statement 1;
Else
Statement 2;
```

Fig.5.1.5 Selection statements

In case the operation is unsuccessful, the sequence of algorithm should be changed/corrected in such a way that the system will re-execute until the operation is successful. The above sequence of algorithm can be modified as follows so that the system responds.

1. Dial the phone number

   If line is busy

   Go to step 1

Notes

2. Phone rings at the called friend.
3. You wait for the response.
4. Called friend picks up the phone.
5. The conversation begins between both of you.
6. Release of connection.

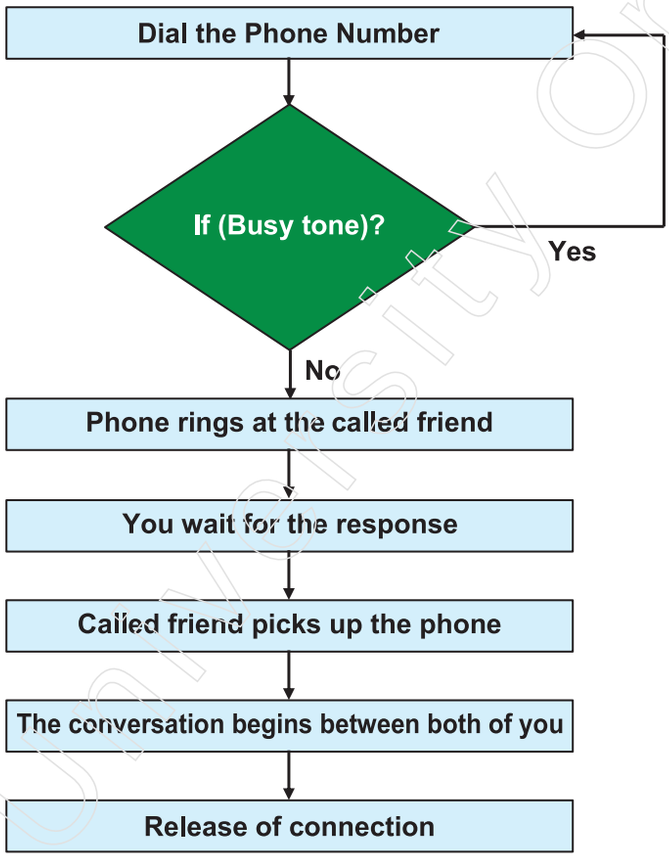

Fig. 5.1.6 Selection Logic

5.1.13. Iteration

In a program, sometimes, it is very necessary to perform the same action for a number of times. If the same statement is written repetitively, it will increase the program code. To avoid this problem, iteration mechanism is applied. The statement written in iteration block is executed for a given number of times based on certain conditions.

Consider an example in the form of “Algorithm”.

1. The test condition is evaluated and if it is true, the body of the loop is executed.
2. On execution of the body test condition is repetitively checked and if it is true the body is executed.
3. The process of execution of the body will be continued till the test condition becomes false.

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4. The control is transferred out of the loop.

The flow chart of the iteration is

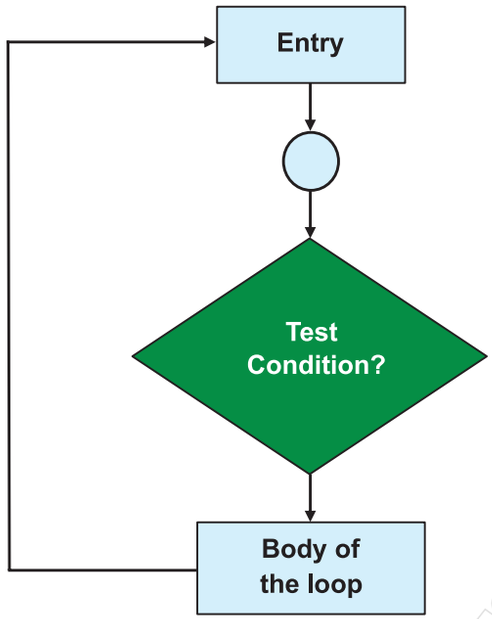

Fig.5.1.7 Iteration

5.1.14 Advantages of Pseudocode

The advantages of pseudocode are

1. It allows the designer to focus on the logic of the algorithm without being distracted by details of language syntax.
2. Since it is language independent, it can be translated to any computer language code.
3. It allows designer to express the design in plain natural language.
4. It is easier for designer to develop a program from a pseudocode than with a flowchart.
5. Less experienced programmers can also do the translation of pseudocode into a programming language.
6. Unlike flowcharts, pseudocodes are concise, more readable and easier to modify.

5.1.15 Limitations of Pseudocode

Some of the common limitations of pseudocode are:

1. It does not provide visual representation of the program's logic.
2. There are no accepted standards for writing pseudocodes. Designers use their own style of writing pseudocode.
3. Pseudocode cannot be complied not executed hence its correctness cannot be verified by the computer.

Notes

Further Reading/References

1. Ashok N. Kamthane, “Programming and Data structures”, Pearson.
2. D.A. Godse, A.P. Godse, “Fundamental of programming”,

Summary:

- When a set of sequential instructions is written to perform any task by a computer, it is called a ‘computer program’.
- Algorithm is a finite sequence of explicit and unambiguous steps required to solve the given problem. When the required input values are provided, it produces an output and then terminates.
- Properties of Algorithm
  - The steps used in algorithm must be unambiguous and precisely defined.
  - The uncertainty about the instruction to be executed next, should be avoided.
  - The steps used in algorithm should be finite and the algorithm should be terminated, that is, it cannot be open – ended.
  - The execution of the algorithm should conclude after a finite number of steps.
  - The algorithm must be general enough to deal with any situation.
- A pictorial representation of an algorithm is called a flowchart. In Flowchart, the steps in the algorithm are represented in the form of different shapes of boxes and the logical flow is indicated by interconnecting arrows.
- The basic rules that a user must keep in mind while using the symbols are:
  - Use the symbols for their specific purposes.
  - Be consistent in the use of symbols.
  - Be clear in drawing the flowchart and the entries in the symbols.
  - Use the annotation symbol when beginning a procedure.
  - Enter and exit the symbols in the same way.
- Rules for Drawing Flowcharts
  - First consider the main logic, then incorporate the details.
  - Maintain a consistent level of details in a flowchart.
  - Do not include all details in flowchart.
  - Use Meaningful description in the flowchart symbols. These should be easy to understand.
  - Be consistent in using variables and names in the flowchart.
  - The flow of the flowchart should be from top to bottom and from left to right.
  - For a complex flowchart, use connectors to reduce the number of flow lines. The crossing of lines should be avoided as far as possible.

Notes

- ♦ If a flowchart is not drawn on a single page, it is recommended to break it at an input or output point and properly labelled connectors should be used for linking the portions of the flowchart on separate pages.
- ♦ Avoid duplication so far as possible.

- The various advantages of flowcharts are as follows:
  - ♦ Synthesis
  - ♦ Documentation
  - ♦ Coding
  - ♦ Debugging
  - ♦ Communication
  - ♦ Analysis
  - ♦ Testing
- The various limitations of flowcharts are as follows:
  - ♦ The developing of a flowchart is a very time-consuming process and laborious especially for large, complex problems.
  - ♦ The redrawing of flowcharts is even more difficult and time consuming. It is very difficult to include any new step in the existing flowchart, redrawing of the flowchart is the only solution.
  - ♦ There are no standards, which specify the detail that should be included in any flowchart.
  - ♦ If an algorithm has complex branches and loops, flowcharts become very difficult to draw.
  - ♦ Sometimes flowcharts are not as detailed as desired.
- Pseudocode is a kind of structured English for describing algorithms. It is made up of two words: Pseudo and code.
- Pseudo means imitation and code refers to instructions, written in a programming language.
- In a program, sometimes, it is very necessary to perform the same action for a number of times. If the same statement is written repetitively, it will increase the program code. To avoid this problem, iteration mechanism is applied.
- The advantages of pseudocode are
  - ♦ It allows the designer to focus on the logic of the algorithm without being distracted by details of language syntax.
  - ♦ Since it is language independent, it can be translated to any computer language code.
  - ♦ It allows designer to express the design in plain natural language.
  - ♦ It is easier for designer to develop a program from a pseudocode than with a flowchart.
  - ♦ Less experienced programmers can also do the translation of pseudocode into a programming language.

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- ♦ Unlike flowcharts, pseudocodes are concise, more readable and easier to modify.

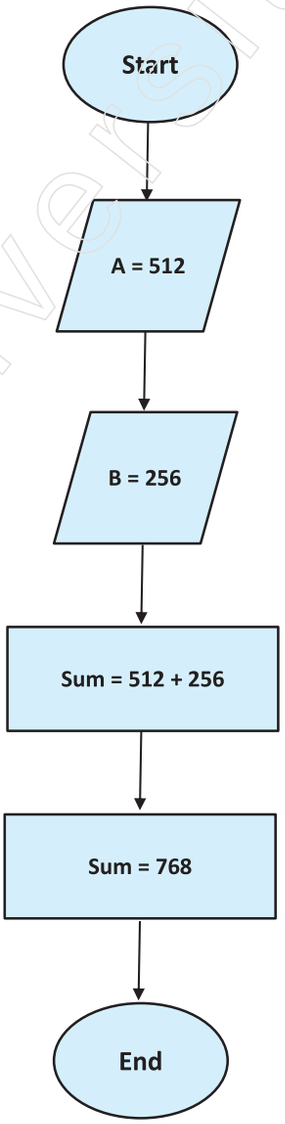
- The limitations of pseudocode are:
  - ♦ It does not provide visual representation of the program's logic.
  - ♦ There are no accepted standards for writing pseudocodes. Designers use their own style of writing pseudocode.
  - ♦ Pseudocode cannot be complied not executed hence its correctness cannot be verified by the computer.

Solved Examples:

Ex-5.1. Construct a flowchart for the following program:

"Find the sum of 512 and 256"

Solution: Flowchart for a given program is

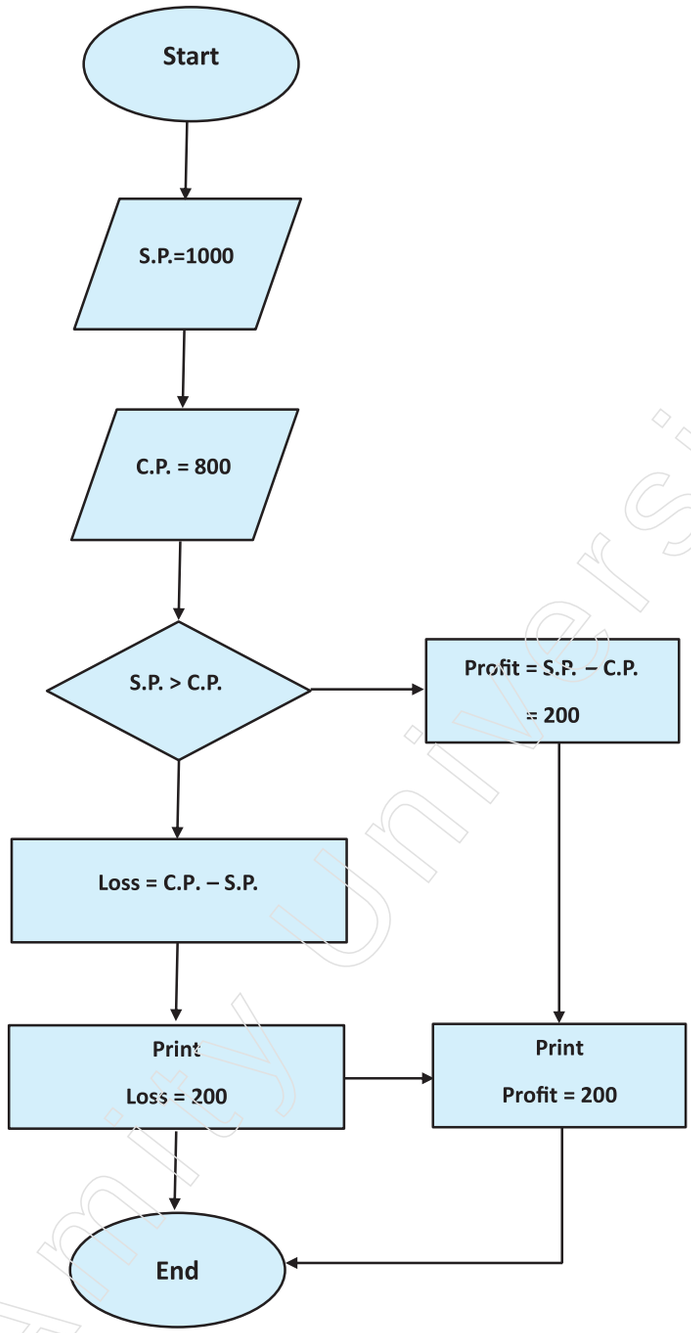


Ex-5.2. Construct a flowchart for the following program:

Notes

"Find the profit/loss when the selling price of a commodity is 1000 rupees and the cost price is 800 rupees"

Solution: Flowchart for a given program is



Exercise:

Check your understanding

1. Method which uses a list of well-defined instructions to complete a task starting from a given initial state to end state is calls as

Notes

(a) Program

(b) Flowchart

(c) Algorithm

(d) Both (a) and (b)

2. Which of the following structures are used in computer programs?

(a) Sequential

(b) Decision

(c) Timesharing

(d) None

3. Execution of two or more programs by a single CPU is known as

(a) Multiprogramming

(b) Multiprocessing

(c) Timesharing

(d) None of these

4. In structure charts modules are described as

(a) Circle

(b) Triangles

(c) Rectangles

(d) Ellipse

5. Flowcharts and Algorithms are used for

(a) Better programming

(b) Easy testing and Debugging

(c) Efficient Coding

(d) All

6. The chart that contains only function flow and no code is called as

(a) Flowchart

(b) Structure chart

(c) Both (a) and (b)

(d) None

7. Which of the following is a program planning tool?

(a) Sequential

(b) Pseudo code

(c) Decision

(d) Both (b) and (c)

Notes

8. A structured chart is
   (a) A document of what has to be accomplished
   (b) Beginners all purpose
   (c) A statement of information processing requirements
   (d) A hierarchical partitioning of the program
9. The sequence logic will not be used while
   (a) Accepting input from user
   (b) Comparing two sets of data
   (c) Giving output to the user
   (d) Adding two numbers
10. An algorithm represented in the form of programming languages is
   (a) Program
   (b) Pseudocode
   (c) Flowchart
   (d) None of these
11. Which of the following is not a basic control structure?
   (a) The decision
   (b) The sequential
   (c) The prog
   (d) The loop
12. Which of the following is not a principle of good programming style?
   (a) Use descriptive variable names
   (b) Test the program
   (c) Provide a welcome message
   (d) Identify using text the numbers that are output
13. Which of the following is a pictorial representation of an algorithm?
   (a) Flowchart
   (b) Algorithm
   (c) Pseudocode
   (d) Program
14. A flowchart that outlines with all detail is called as
   (a) Micro flowchart
   (b) Flowchart
   (c) Algorithm
   (d) Macro flowchart

Notes

15. Selection logic also called as
    (a) Decision logic
    (b) Iteration logic
    (c) Sequence logic
    (d) Looping logic
16. In which of the following pseudocode instructions are written in the order or sequence in which they are to be performed>
    (a) Looping logic
    (b) Iteration logic
    (c) Selection logic
    (d) Sequence logic
17. Pseudocode is also known as
    (a) Hardware language
    (b) Program design language
    (c) Algorithm
    (d) Software language
18. A flowchart that outlines the main segments of program is called as
    (a) Macro flowcharts
    (b) Flowchart
    (c) Algorithm
    (d) Micro flowchart
19. Pseudocode emphasizes on
    (a) Development
    (b) Coding
    (c) Design
    (d) Debugging
20. Which of the following can be replaced by if?
    (a) While
    (b) For
    (c) Continue
    (d) Switch
21. The functions get called when the function name is followed by
    (a) Colon
    (b) Bracket
    (c) Semicolon
    (d) Statement

Notes

22. The mechanism used to convey information to the function is the
    (a) Loops
    (b) Statements
    (c) Commands
    (d) Argument
23. The condition being tested within the loop may be relational or logical operations
    (a) While
    (b) Switch
    (c) Break
    (d) Continue
24. Algorithm is
    (a) Object file
    (b) Source file
    (c) Step by step execution of program
    (d) Executable file
25. Go to statement is
    (a) Used to jump the control of program
    (b) Same as switch case statement
    (c) Used for user defined iteration
    (d) None of above

Answer key

1-c
2-d
3-b
4-b
5-d
6-b
7-d
8-d
9-c
10-a
11-c
12c
13-a

Notes

14-a

15-a

16-d

17-b

18-a

19-c

20-d

21-c

22-d

23-a

24-b

25-a