Rajiv Gandhi University of Knowledge Technologies - AP

Pre - University Course - I

Semester - I

Department of
INFORMATION
TECHNOLOGY

PUC -1 Semester - I

Unit. No	Unit Name
I	Fundamentals of Computer
II	Computer Hardware and Software
III	Basics of Number Systems
IV	Boolean Logic
V	Basics of Networking
VI	Internet and Cyber Safety

Unit – 1: Fundamentals of Computer

Module-1

1.1 Introduction

Computers have become one of the most essential parts of human life. At present, computers can be easily seen in almost every sector or field even where it is most unexpected. There can be several different reasons why computers are actually required. We can summarize the reasons for the requirement of computers in three words: Efficiency, Accuracy and Reliability.

This is designed to meet the prerequisite need of everybody that are interested and wish to know about computers science and computing in general.

A computer is an electronic device, operating under the control of instructions stored in its own memory. These instructions tell the machine what to do. The computer is capable of accepting data (input), processing data arithmetically and logically, producing output from the processing, and storing the results for future use.

Nowadays, computers are making jobs easier for people. Computers can be used in everything from entertainment to communication to navigation to research. That is why this era is called the era of IT (Information Technology). And now, one cannot imagine a world without computers.

1.2 History of Computing

The first counting device was used by the primitive people. They used sticks, stones and bones as counting tools. As human mind and technology improved with time more computing devices were developed. Some of the popular computing devices starting with the first to recent ones are described below;

Early computing machines:

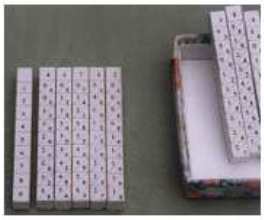
1.2.1 Abacus (-2500BC): The history of computer begins with the birth of abacus which is believed to be the first computer. It was a wooden rack which has metal rods with beads mounted on them. The beads were moved by the abacus operator according to some rules to perform arithmetic calculations. The rods correspond to positions of the digits while the beads correspond to the digits.

Old abacus

New abacus

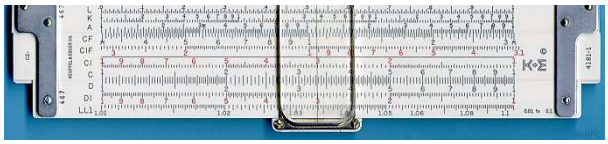
1.2.2 Napier's Bones (2500BC): This was invented by John Napier's (1550 - 1617). This consists of small rods with appropriate markings on them. It is a mechanical aid to computation that consists of nine such rods (called bones) with one for each digit 1 through 9. He also invented logarithms which made possible to do division and multiplication by performing addition and subtraction.

An original set of Napier's Bones

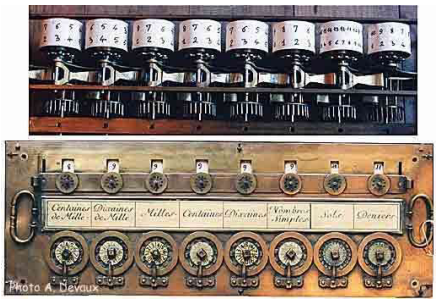


A more modern set of Napier's Bones

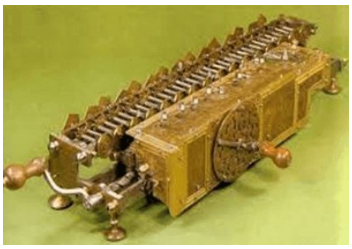
1.2.3 Slide Rule (1600AD) by William Oughtred (1575 – 660): He invented it in 1622 but announced it in 1632 this consist of rules on which markings represent logarithms of numbers and also permits calculation involving exponents, trigonometric functions, etc.



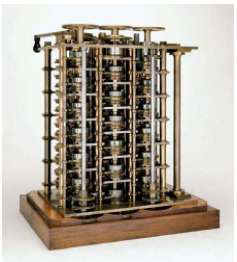
1.2.4 Pascaline: Pascaline is also known as Arithmetic Machine or Adding Machine. It was invented between 1642 and 1644 by a French mathematician-philosopher Biaise Pascal. It is believed that it was the first mechanical and automatic calculator.Pascal invented this machine to help his father, a tax accountant. It could only perform addition and subtraction. It was a wooden box with a series of gears and wheels. When a wheel is rotated one revolution, it rotates the neighboring wheel. A series of windows is given on the top of the wheels to read the totals. An image of this tool is shown below;



1.2.5 Stepped Reckoner or Leibnitz wheel: It was developed by a German mathematician-philosopher Gottfried Wilhelm Leibnitz in 1673. He improved Pascal's invention to develop this machine. It was a digital mechanical calculator which was called the stepped reckoner as instead of gears it was made of fluted drums.



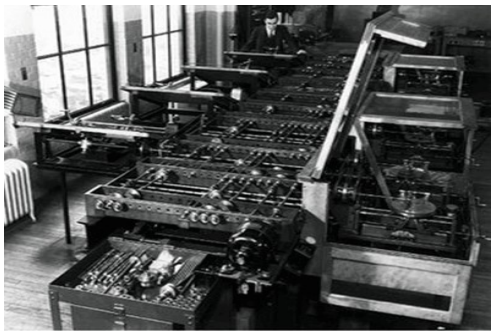
1.2.6 Difference Engine: In the early 1820s, it was designed by Charles Babbage who is known as "Father of Modern Computer". It was a mechanical computer which could perform simple calculations. It was a steam driven calculating machine designed to solve tables of numbers like logarithm tables.



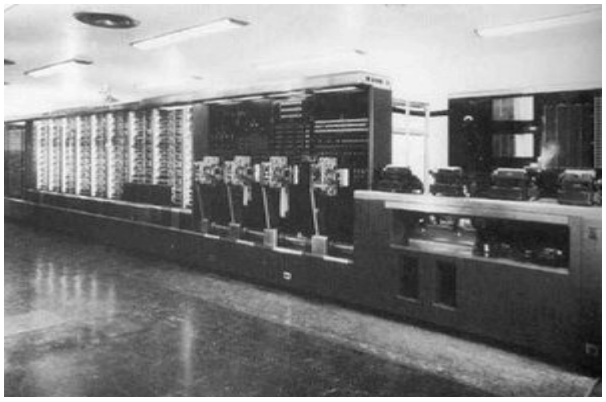
1.2.7 Analytical Engine: This calculating machine was also developed by Charles Babbage in 1830. It was a mechanical computer that used punch-cards as input. It was capable of solving any mathematical problem and storing information as a permanent memory.

1.2.8 Tabulating Machine: It was invented in 1890, by Herman Hollerith, an American statistician. It was a mechanical tabulator based on punch cards. It could tabulate statistics and record or sort data or information. This machine was used in the 1890 U.S. Census. Hollerith also started the Hollerith's Tabulating Machine Company which later became International Business Machine (IBM) in 1924.

1.2.9 Differential Analyzer: It was the first electronic computer introduced in the United States in 1930. It was an analog device invented by Vannevar Bush. This machine has vacuum tubes to switch electrical signals to perform calculations. It could do 25 calculations in few minutes.



1.2.10 Mark I: The next major changes in the history of computer began in 1937 when Howard Aiken planned to develop a machine that could perform calculations involving large numbers. In 1944, Mark I computer was built as a partnership between IBM and Harvard. It was the first programmable digital computer.



In summary, the history of computing began with an analog machine. In 1623 German scientist Wilhelm Schikard invented a machine that could add, and with the aid of logarithm tables, multiply and divide. Since then, the development has pass through a lot of stages such as the invention of punched cards to program patterns to create woven fabrics by Joseph-Marie Jacquard a French inventor in 19th century. Another early mechanical computer was the Difference Engine, designed in the early 1820s by British mathematician and scientist Charles Babbage. In the 1930s American mathematician Howard Aiken developed the Mark I calculating machine, which was built by IBM. This electronic calculating machine used relays and electromagnetic components to replace mechanical components.

1.3 Generations of Computer

Generations of Computers Generation in computer terminology is a change in technology a computer is/was being used. Initially, the generation term was used to distinguish between varying hardware technologies. Nowadays, generation includes both hardware and software, which together make up an entire computer system.

There are five computer generations known till date. Their can be discussed in terms of

1. The technology used by them (hardware and software),

2. Computing characteristics (speed, i.e., number of instructions executed per second),
3. Physical appearance, and
4. Their applications

There are five computer generations known till date.

1.3.1 First Generation (1940 to 1956): Using Vacuum Tubes

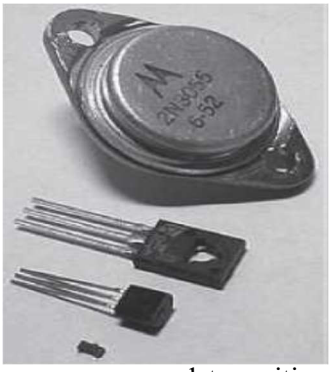
- **Hardware Technology:** The first generation of computers used vacuum tubes for circuitry and magnetic drums for memory. The input to the computer was through punched cards and paper tapes. The output was displayed as printouts.
- **Software Technology:** The instructions were written in machine language. Machine language uses 0s and 1s for coding of the instructions. The first-generation computers could solve one problem at a time.
- **Computing Characteristics**: The computation time was in milliseconds.
- **Physical Appearance:** These computers were enormous in size and required a large room for installation.
- **Application:** They were used for scientific applications as they were the fastest computing device of their time.

Examples:UNIVersal Automatic Computer (UNIVAC), Electronic Numerical Integrator and computer (ENIAC), and Electronic Discrete Variable Automatic Computer (EDVAC).

Fig. 1.1 The first Generation Computer technology

The first-generation computers used a large number of vacuum tubes and thus generated a lot of heat. They consumed a great deal of electricity and were expensive to operate. The machines were prone to frequent malfunctioning and required constant maintenance. Since first generation computers used machine language, they were difficult to program

1.3.2 Second Generation (1956 to 1963): Using Transistors



- **Hardware Technology:** Transistors replaced the vacuum tubes of the first generation of computers. Transistors allowed computers to become smaller, faster, cheaper, energy efficient and reliable. The second-generation computers used magnetic core technology for primary memory. They used magnetic tapes and magnetic disks for secondary storage. The input was still through punched cards and the output using printouts. They used the concept of a stored program, where instructions were stored in the memory of computer.
- **Software Technology:** The instructions were written using the assembly language. Assembly language uses mnemonics like ADD for addition and SUB for subtraction for coding of the instructions. It is easier to write instructions in assembly language, as compared to writing instructions in machine language. High-level programming languages, such as early versions of COBOL and FORTRAN were also developed during this period.
- **Computing Characteristics:** The computation time was in microseconds.
- **Physical Appearance:** Transistors are smaller in size compared to vacuum tubes; thus, the size of the computer was also reduced.

- **Application:** The cost of commercial production of these computers was very high, though less than the first-generation computers. The transistors had to be assembled manually in second generation computers.

Examples PDP-8, IBM 1401 and CDC 1604.

Second generation computers generated a lot of heat but much less than the first-generation computers. They required less maintenance than the first-generation computers

1.3.3 Third Generation (1964 to 1971): Using Integrated Circuits

- **Hardware Technology:** The third-generation computers used the Integrated Circuit (IC) chips. The use of IC chip increased the speed and the efficiency of computer, manifold. The keyboard and monitor were used to interact with the third-generation computer, instead of the punched card and printouts.
- **Software Technology:** The keyboard and the monitor were interfaced through the operating system. Operating system allowed different applications to run at the same time. High-level languages were used extensively for programming, instead of machine language and assembly language.
- **Computing Characteristics:** The computation time was in nanoseconds.
- Physical Appearance The size of these computers was quite small compared to the second-generation computers.
- **Application:** Computers became accessible to mass audience. Computers were produced commercially, and were smaller and cheaper than their predecessors.

Examples: IBM 370, PDP 11.

The third-generation computers used less power and generated less heat than the second-generation computers. The cost of the computer reduced significantly, as individual components of the computer were not required to be assembled manually. The maintenance cost of the computers was also less compared to their predecessors.

1.3.4 Fourth Generation (1971 to 1990): Using VLSI Microprocessors

- **Hardware Technology:** They use the Large-Scale Integration (LSI) and the Very Large-Scale Integration (VLSI) technology. Thousands of transistors are integrated on a small silicon chip using LSI technology. VLSI allows hundreds of thousands of components to be integrated in a small chip. Microprocessor is a chip containing millions of transistors and components, and, designed using LSI and VLSI technology. This generation of computers gave rise to Personal Computer (PC). The computers were linked to form networks that led to the emergence of the Internet. This generation also saw the development of pointing devices like mouse, and handheld devices.
- **Software Technology:** Several new operating systems like the MS-DOS and MSWindows developed during this time. This generation of computers supported Graphical User Interface (GUI). GUI is a user-friendly interface that allows user to interact with the computer via menus and icons. High-level programming languages are used for the writing of programs. Like c, c++, java, databases .. etc.
- **Computing Characteristics:** The computation time is in picoseconds.
- Physical Appearance they are smaller than the computers of the previous generation. Some can even fit into the palm of the hand.
- **Application:** They became widely available for commercial purposes. Personal computers became available to the home user.

Examples: The Intel 4004 chip was the first microprocessor. The components of the computer like Central Processing Unit (CPU) and memory were located on a single chip. In 1981, IBM introduced the first computer for home use. In 1984, Apple introduced the Macintosh.

The microprocessor has resulted in the fourth-generation computers being smaller and cheaper than their predecessors. The fourth-generation computers are also portable and more reliable. They generate much lesser heat and require less maintenance compared to their predecessors. GUI and pointing devices facilitate easy use and learning on the computer. Networking has resulted in resource sharing and communication among different computers

1.3.5 Fifth Generation (1990 and Present): Using Artificial Intelligence

The period of fifth generation is 1980-till date. In the fifth generation, VLSI technology became ULSI (Ultra Large-Scale Integration) technology, resulting in the production of microprocessor chips having ten million electronic components.

This generation of computers uses parallel processing that allows several instructions to be executed in parallel, instead of serial execution. Parallel processing results in faster processing speed.

The fifth-generation computers are based on Artificial Intelligence (AI). They try to simulate the human way of thinking and reasoning. Artificial Intelligence includes areas like Expert System (ES), Natural Language Processing (NLP), speech recognition, voice recognition, robotics, etc

1.4 Comparison between generations of computers

First Generation	Second Generation	Third Generation	Fourth Generation	Fifth Generation
Use of Vacuum tubes	Use of transistors and diodes	Use of ICs	Used of LSI, and VLSI	Use of ICs with ULSI technology- Based on artificial intelligence
Limited storage capacity	Increased storage capacity	Used semiconductor memory	Increased storage	Larger capacity storage(RAID, optical disks)
Slow speed	Faster speed	Smaller in size and better performance	Considerably faster and smaller	Very fast
Problems of over-heating	Reduction in size and heat generation	Less heat generation and reduced size comopare to second	Less heat generation and reduced size comopare to third	-
Machine Language	Assembly Language	High Level Language	High Level langauage	Hign level language

	High-level programming languages (COBOL, FORTRAIN)	Remote processing and time sharing	Sophisticated programs and languages for special applications	Support for more complex applications

Module - 2

1.5Definition of Computer

"A computer is a programmable electronic machine designed to take input, perform prescribed arithmetic and logical operations at fast speeds, and provide the output of these operations."

(Another definition)

Computer is an advanced electronic device that takes raw data as input from the user and processes these data under the control of set of instructions (called program) and gives the result (output) and saves output for the future use. It can process both numerical and non-numerical (arithmetic and logical) calculations

The term 'Computer' is derived from the Latin word 'computare' which is defined as "to calculate", "to count" or "to sum up", etc. In other words, "a computer is a device that performs computation".

Note: The first mechanical computer was designed in 1837 by Charles Babbage. It was called "Analytical Engine". It was the first general-purpose computer. Charles Babbage is known as the Father of the computer

Functionalities of a Computer

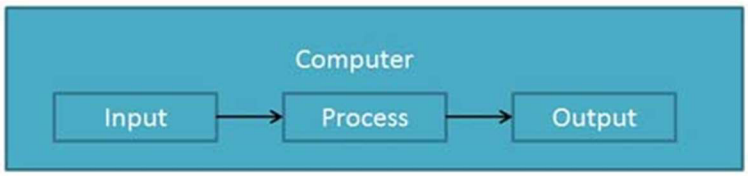
If we look at it in a very broad sense, any digital computer carries out the following five functions −

Step 1 − Takes data as input.
Step 2 − Stores the data/instructions in its memory and uses them as required.
Step 3 − Processes the data and converts it into useful information.
Step 4 − Generates the output.
Step 5 − Controls all the above four steps.

Input (Data): Input is the raw information entered into a computer from the input devices. It is the collection of letters, numbers, images etc.

Process: Process is the operation of data as per given instruction. It is totally internal process of the computer system.

Output: Output is the processed data given by computer after data processing. Output is also called as Result. We can save these results in the storage devices for the future use.



Note:

- *All the computer equipment Associated with it are known as computer hardware such asmonitor,keyboard, mouse, CPU, modem, speaker, and printer etc.*
- *Set of instructions that is used to tell the computer what to do are known as program.*
- *Set of programs that are used to perform particular task is known as computer software.*

Finally, you can define a computer as an electronic data processing machine that can be used for a wide range of activities. Here activities mean storing data, processing data, retrieving data and many more etc.

1.6Block Diagram of a Computer

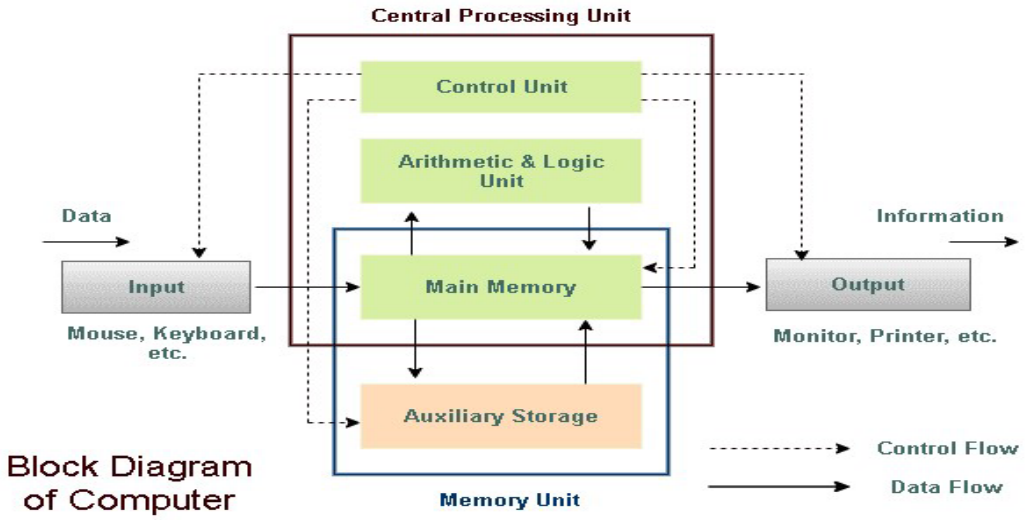
A computer is made up of a number of integrated elements like

- The central processing unit,
- The input and output devices and
- The storage devices.

Each of these units performs a specific task. However, none of them can function independently on their own. They are logically related and controlled to achieve a specific goal. When they are thus integrated, they form a fully-fledged computer system

The basic parts of computer system are:

1. Input Unit
2. The Central Processing Unit
3. Output Unit



Block Diagram of Computer

1.6.1 The Input Unit:

The Input Unit consists of input devices such as mouse, keyboard, scanner, joystick, etc. These devices are devices are used to input information or instruction into the computer system. Like other electronic machines, a computer takes inputs as raw data (binary data) and performs necessary processing giving out processed data.

The Input Unit performs the following major functions:

- The input unit converts the inputted data or instructions into binary form for further processing.
- Input Unit transmits the data to the main memory of the computer.
- Provide this converted data to the computer for further processing.

1.6.2 The Central Processing Unit:

This is the brain of any computer system. The central processing unit or CPU is made of three parts:

- The control unit.
- The arithmetic logic unit
- The primary storage unit

The Control Unit:

The Control Unit controls the operations of the entire computer system. The control unit gets the instructions from the programs stored in primary storage unit interprets this instruction subsequently directs the other units to execute the instructions. Thus, it manages and coordinates the entire computer system.

The Arithmetic Logic Unit:

The Arithmetic Logic Unit (ALU) actually executes the instructions and performs all the calculations and decisions. The data is held in the primary storage unit and transferred to the ALU whenever needed. Data can be moved from the primary storage to the arithmetic logic unit a number of times before the entire processing is complete. After the completion, the results are sent to the output storage section and the output devices.

The Primary Storage Unit:

This is also called as Main Memory. Before the actual processing starts the data and the instructions fed to the computer through the input units are stored in this primary storage unit. Similarly, the data which is to be output from the computer system is also temporarily stored in the primary memory. It is also the area where intermediate results of calculations are stored. The main memory has the storage section that holds the computer programs during execution.

Thus, the primary unit:

- Stores data and programs during actual processing
- Stores temporary results of intermediate processing
- Stores results of execution temporarily

The Secondary Storage Unit:

The use of primary memory is not possible to store data permanently for future access. Therefore, there are some other options to store the data permanently for future use, which is known as secondary memory or auxiliary storage or permanent storage. The data stored in the secondary memory is safe even when there is a power failure or no power supply. Hard Disk is usually considered a secondary memory.

The Central Processing Unit performs the following major functions:

- The CPU controls all components, software and data processing of the computer system.
- The CPU takes data from input devices, executes the data, and sends output to the output devices.
- The CPU processes all the operations, including all the arithmetical and logical operations.

1.6.3 Output Unit:

The output devices give the results of the process and computations to the outside world. The output units accept the results produced by the computer, convert them into a human readable form and supply them to the users. The more common output devices are printers, plotters, display screens, magnetic tape drives etc.

1.7Advantages and Disadvantages of Computers

1.7.1Advantages

Following are certain advantages of computers.

Speed

- Computer is a very fast device.

- It is capable of performing calculation of very large amount of data.
- The computer has units of speed in microsecond, nanosecond, and even the picosecond.
- It can perform millions of calculations in a few seconds as compared to man who will spend many months to perform the same task

Accuracy

- In addition to being very fast, computers are very accurate.
- The calculations are 100% error free.
- Computers perform all jobs with 100% accuracy provided that the input is correct.

Storage Capability

- Memory is a very important characteristic of computers.
- A computer has much more storage capacity than human beings.
- It can store large amount of data.
- It can store any type of data such as images, videos, text, audio, etc.

Diligence

- Unlike human beings, a computer is free from monotony, tiredness, and lack of concentration.
- It can work continuously without any error and boredom.
- It can perform repeated tasks with the same speed and accuracy.

Versatility

- A computer is very flexible in performing the jobs to be done.
- This machine can be used to solve the problems related to various fields.
- At one instance, it may be solving a complex scientific problem and the very next moment it may be playing a card game.
- A computer is a very versatile machine.

Reliability

- A computer is a reliable machine.
- Modern electronic components have long lives.
- Computers are designed to make maintenance easy.

Automation

- Computer is an automatic machine.
- Automation is the ability to perform a given task automatically. Once the computer receives a program i.e., the program is stored in the computer
- memory, then the program and instruction can control the program
- execution without human interaction.

Reduction in Paper Work and Cost

- The use of computers for data processing in an organization leads to reduction in paper work and results in speeding up the process.
- As data in electronic files can be retrieved as and when required, the problem of maintenance of large number of paper files gets reduced.
- Though the initial investment for installing a computer is high, it substantially reduces the cost of each of its transaction.

1.7.2 Disadvantage

No I.Q.

- A computer is a machine that has no intelligence to perform any task.
- Each instruction has to be given to the computer.
- A computer cannot take any decision on its own.

Dependency

- It functions as per the user's instruction; thus, it is fully dependent on humans.

Environment

- The operating environment of the computer should be dust free and suitable.

No Feeling

- Computers have no feelings or emotions.
- It cannot make judgment based on feeling, taste, experience, and knowledge unlike humans

Unemployment

- As we discussed above that computers can perform many tasks a automatically, this reduces the need for people and increases unemployment in the society. It has also negatively affected many others who do not have knowledge of working of computer systems.

Health Issues

- Improper and prolonged use of computers can negatively affect your health. For example, if you are constantly working on the computer, your eyes will become dry, which can result in eye strain, headache, etc.

Cyber Crimes

- There are some people who use computers and the internet for negative activities. They attempt to break the computer's security system and gain unauthorized access to hack credit card details and other personal information. By accessing information, they violate all laws and misuse the information for their own benefit.

1.8Characteristics of Computer

Basic characteristics about computer are:

Efficiency: The computer processed data in nano second which is beyond of human capacity.

Speed: Speed is one of the major characteristics of the computer system. A computer works so fast that it can process any task and provide the output in fractions of seconds. A powerful computer can handle trillions of instructions per second which is really incredible.

The speed of a computer is measured in microseconds and nanoseconds.

Accuracy: Computers not only provide incredible speed, instead, they are also capable of consistently working with accuracy. The degree of accuracy in computers is vey high; computers can perform calculations at almost 100% accuracy. Errors may occur in a computer system, but only because of wrong human input or inaccurate data.

Diligence: Unlike a human, the computer doesn't get tired or lacks its concentration. Due to this characteristic, it overpowers human being in most of the regular tasks. It can work for hours without any fault. This means that if millions of calculations are to be done, a computer will perform every calculation and provide all the results with the same accuracy.

Versatility: Versatility is one of the most wonderful features of computers. This means that the computer has the ability to perform completely different kinds of works with the same accuracy and efficiency at the same time. It is not just a calculating machine anymore.

For example: for one moment it can be used to create invoices or bills, and the next moment it can be used for inventory management or any multimedia task, etc.

Power of Remembering: Computer has the power of storing any amount of information or data. Any information can be stored and recalled as long as you require it, for any numbers of years. It depends entirely upon you, how much data you want to store in a computer and when to lose or retrieve these data.

No IQ: Computer is a dumb machine and it cannot do any work without instruction from the user. It performs the instructions at tremendous speed and with accuracy. It is you to decide what you want to do and in what sequence. So, a computer cannot take its own decision as you can.

No Feeling: It does not have feelings or emotion, taste, knowledge and experience. Thus, it does not get tired even after long hours of work. It does not distinguish between users.

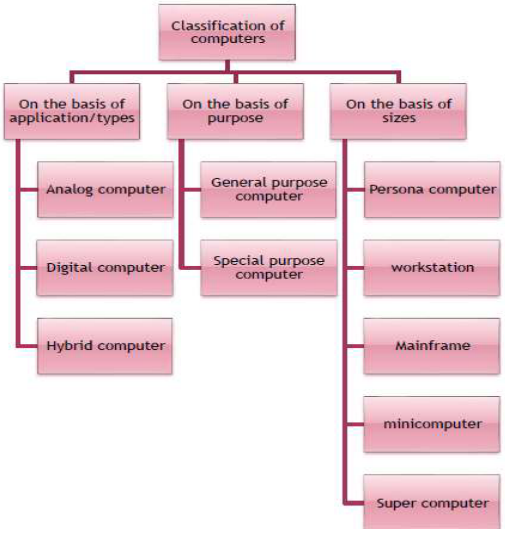
Storage Capacity: Computers can store vast amounts of data. Today's computers have increased storage capacity compared to earlier days. Besides, we also have the option to store data in secondary devices such as external drives, or floppies, etc. These secondary devices can be kept separate from the computer or attached to other computers.

Due to their incredible speed, computers can quickly retrieve data from storage device. The storage capacity of the computer is commonly measured in Mega-Byte (MB), Giga-Bytes (GB), Tera-Bytes(TB) and Peta-Bytes(PB).

Module - 3

1.9 Classification of Computers (Types of Computer)

Computers are broadly classified into two categories depending upon the logic used in their design as:

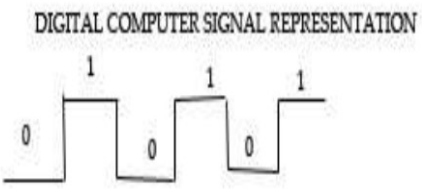


1.9.1 On the Basis of Application/Types (Operational Based)

Analog Computers: The computers used to process analog data (continuously varying data) are called 'Analog Computers'. Analog computers are the most complicated machines for computation and process control. Examples of continuous data are pressure, temperature, Voltage, Weight and Speed, etc.

1. Thermometer		2. Speedometer	
3. Petrol Pump Indicator		4. Multimeter	

Digital Computers: Digital computers are personal computers. These are the widely used computers. These are commonly used for processing the data with a number using digits by utilizing the binary number system. These computers are intended to perform arithmetic and logical operations at a very high rate.



Example of Digital computers arePersonal Computers (Desktops and Laptops),Smartphones, and Tablets,Scientific Calculators,Digital Weighing Machine,Accounting machines,Digital clock

Hybrid Computers (Analog + Digital): Hybrid computers are the combination of analog computers and digital computers. These are as fast as analog computers and include memory and precision as digital computers.

Example of Hybrid computers areAutomated teller machine (ATM), Electrocardiogram

1.9.2 On the Basis of Purpose

Purpose wise computer can be classified into two types

- Special Purpose Computer
- General Purpose Computer

Special purpose Computers:A Special Purpose Computer is the one that is designed to perform only one special task. The program or instructions set is permanently stored in such a machine. It does its single task very quickly and it cannot be used for any other purpose.

Examples of special purpose computers are Computers for chemical processes and Computers in digital watches, weather forecasting. It incorporates the instructions needed into the design of internal storage so that it can perform the given task on a simple command. It, therefore, does not possess unnecessary options, and costs less.

General purpose computers: Theses computer can store different programs and can thus be used in countless application. A General-PurposeComputer can perform any kind of jobs with equal efficiency simply by changing the application program stored in main memory.

Thus, a general-purpose machine can be used to prepare paybills, manage inventories, print sales reports, do scientific calculations and so on.

1.9.3 On the Basis of Size

Computers can be broadly classified by their speed and computing power:

S.No	Type	Specifications
1	Micro Computer	It is a single user computer system having moderately powerful microprocessor
2	Mini Computer	It is a multi-user computer system, capable of supporting hundreds of users simultaneously.
3	Main Frame	It is a multi-user computer system, capable of supporting thousands of users simultaneously.
4	Supercomputer	It is an extremely fast computer, which can execute hundreds of millions of instructions per second.

Microcomputer: Microcomputers are inexpensive and support multi-user platform. These types of computers are mostly used by small organizations. Microcomputers are slower compared to supercomputers and mainframe computers. Microcomputers are called Personal Computer (PC).

Examples of microcomputers. Microcomputers include desktop computers, notebook computers or laptop, tablet computer, handheld computer, smart phones and note book.

Mini Computer: They are smaller version of the mainframes.Minicomputers are digital computers, generally used in multi-user systems. They have high processing speed and high storage capacity than the microcomputers. Minicomputers can support 4–200 users simultaneously. The users can access the minicomputer through their PCs or terminal. They are used for real-time applications in industries, research centers, etc.

Mainframe Computer: Mainframe Computers are smaller than super computers, still, they comparatively huge. Mainframe computers are multi-user, multi-programming and high-performance computers. They operate at a very high speed, have very large storage capacity and can handle the workload of many users. Mainframe computers are large and powerful systems generally used in centralized databases and it can store huge amounts of data and they are capable to handle large calculations. These computers are usually found in banks and educational sectors.

Super computer: Super computers are large and require huge space for the installation. They are the fastest and most expensive computers compared to others. Supercomputers are one of the fastest computers currently available. Supercomputers are very expensive and are employed for

specialized applications that require immense number of mathematical calculations (number crunching).

For example, weather forecasting, scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (e.g. in petrochemical prospecting).

1.10 Process of Booting

Starting a computer or a computer-embedded device is called **booting**. Booting takes place in two steps

- Switching on power supply
- Loading operating system into computer's main memory
- Keeping all applications in a state of readiness in case needed by the user

The first program or set of instructions that run when the computer is switched on is called **BIOS** or **Basic Input Output System**. BIOS is a **firmware**, i.e. a piece of software permanently programmed into the hardware.

If a system is already running but needs to be restarted, it is called **rebooting**. Rebooting may be required if a software or hardware has been installed or system is unusually slow.

There are two types of booting

- **Cold Booting** − When the system is started by switching on the power supply it is called cold booting. The next step in cold booting is loading of BIOS.
- **Warm Booting** − When the system is already running and needs to be restarted or rebooted, it is called warm booting. Warm booting is faster than cold booting because BIOS is not reloaded.

1.11 Basic Applications of Computer

Computers play a role in every field of life. They are used in homes, business, educational institutions, research organizations, medical field, government offices, entertainment, etc.

- **Home**
  Computers are used at homes for several purposes like online bill payment, watching movies or shows at home, home tutoring, social media access, playing games, internet access, etc. They provide communication through electronic mail. They help to avail work from home facility for corporate employees. Computers help the student community to avail online educational support.

- **Medical Fields**
  Computers are used in hospitals to maintain a database of patients' history, diagnosis, X-rays, live monitoring of patients, etc. Surgeons nowadays use robotic surgical devices to perform delicate operations, and conduct surgeries remotely. Virtual reality technologies are also used for training purposes. It also helps to monitor the fetus inside the mother's womb.

- **Entertainment**
  Computers help to watch movies online, play games online; act as a virtual entertainer in playing games, listening to music, etc. MIDI instruments greatly help people in the entertainment industry in recording music with artificial instruments. Videos can be fed from computers to full screen televisions. Photo editors are availablewith fabulous features

- **Industry**
  Computers are used to perform several tasks in industries like managing inventory, designing purpose, creating virtual sample products, interior designing, video conferencing, etc. Online marketing has seen a great revolution in its ability to sell various products to inaccessible corners like interior or rural areas. Stock markets have seen phenomenal participation from different levels of people through the use of computers.

- **Education**
  Computers are used in education sector through online classes, online examinations, referring e-books, online tutoring, etc. They help in increased use of audio-visual aids in the education field.

- **Govt**.
  In government sectors, computers are used in data processing, maintaining a database of citizens and supporting a paperless environment. The country's defense organizations have greatly benefitted from computers in their use for missile development, satellites, rocket launches, etc.

- **Banking**

  In the banking sector, computers are used to store details of customers and conduct transactions, such as withdrawal and deposit of money through ATMs. Banks have reduced manual errors and expenses to a great extent through extensive use of computers.

- **Business**
  Nowadays, computers are totally integrated into business. The main objective of business is transaction processing, which involves transactions with suppliers, employees or customers. Computers can make these transactions easy and accurate. People can analyze investments, sales, expenses, markets and other aspects of business using computers.
  .
- **Training**
  Many organizations use computer-based training to train their employees, to save money and improve performance. Video conferencing through computers allows saving of time and travelling costs by being able to connect people in various locations.

Questions

1. What is computer?
2. Write short notice on CPU and its components?
3. Explain types of computers?
4. What are the Characteristics of the Computer?
5. What are the advantages and disadvantages of the Computer?
6. What are the generations of the Computer?
7. Explain the booting process?
8. Draw a block diagram of a computer. Explain the function of each of the block?
9. Write short note on computer types on the basis of size?
10. Write the classification of computer on the basis of working principle?

Multiple Choice Questions

1. Who is the father of the computer?
   a. **Charles Babbage**
   b. John Napier
   c. Wilhelm Schikard
   d. None of the above
2. In how many generations a computer can be classified?
   a. 6
   b. **5**
   c. 4
   d. 3

3. What is the mean of the Booting in the system?
    a. **Restarting computer**
    b. Install the program
    c. To Scan
    d. To turn off
4. The central processing unit is located in the _____.
    a. Hard disk
    b. **System unit**
    c. Memory Unit
    d. Monitor
5. CPU controls----------?
    a. **All input, Output and processing**
    b. Controls memory
    c. Controlled by the input data
    d. None
6. ALU stands for……?
    a. Arithmetic Legal Unit
    b. **Arithmetic Logic Unit**
    c. Arithmetic Local Unit
    d. Arithmetic Logic Utility
7. ……term is used in computer terminology is a change in technology a computer is/was being used?
    a. Development
    b. **Generation**
    c. Advancement
    d. Growth
8. __generation of computer started with using vacuum tubes as the basic components.
    a. **1st Generation**
    b. 2nd Generation
    c. 3rd Generation
    d. 4th Generation
9. Batch processing was mainly used in this generation.
    a. 3rdGeneration
    b. 2nd Generation
    c. **1stGeneration**
    d. 4th Generation
10. Which one of the following technologies was developed during Fourth Generation ofComputers?
    a. Artificial Intelligence
    b. **VLSI**
    c. Integrated Circuits
    d. Valve
11. Execution of two or more programs by a single CPU is known as:
    a. Multiprocessing
    b. Time sharing
    c. **Multiprogramming**
    d. None of the above
12. The basic architecture of computer was developed by
    a. **john von neumann**
    b. Charles babbage

c. Blaise pascal
d. None of these

13. Which part interprets program instructions and initiate control operations?
    a. Input
    b. Storage Unit
    c. Logic Unit
    d. **Control Unit**
14. The time required for the fetching and execution of one simple machine instruction is.?
    a. Delay time
    b. **CPU Cycle**
    c. Real time
    d. Seek time
15. The section of the CPU that selects, interprets and sees to the execution of program instructions?
    a. Memory
    b. Register Unit
    c. **Control Unit**
    d. ALU
16. BIOS is used?
    a. **By operating system**
    b. By compiler
    c. By Interpreter
    d. By application software
17. What kind of language can computer understand?
    a. LowLevel Language
    b. Computer Language
    c. Assembly Language
    d. High-Level Language
18. Which of the following is an input device?
    a. Printer
    b. Monitor
    c. Keyboard
    d. Speakers
19. Second generation computers are made of
    a. Vacuum Tubes
    b. Transistors
    c. LSI
    d. VLSI
20. GUI stands for
    a. Graph Use Interface
    b. Graphical Universal Interface
    c. Graphical User Interface
    d. Graphical Unique Interface

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UNIT-2: Computer Hardware and Software

Module – 1

Introduction

Computer is basically a group of electronic devices that can accept data, conduct a series of arithmetic and logical operations on it and give the result of these operations as information. A computer system consists of two major components, which are as follows.

a. **Hardware**
b. **Software**

All physical components that form computer systems are known as **computer hardware**. Software is basically a collection **of different programs** that tells computer's hardware what to do. The terms hardware and software are almost always used in connection with the computer.

2.1 The Hardware:

The hardware is the machinery itself. It is made up of the physical parts or devices of the computer system like the electronic Integrated Circuits (ICs), magnetic storage media output devices etc. All these various hardware are linked together to form an effective functional unit. The various types of hardware used in the computers, has evolved from vacuum tubes of the first generation to Ultra Large-Scale Integrated Circuits of the present generation. **Some of the commonly used hardware in our computer are described below.**

2.1.1 System Unit

It is a box-like structure of the computer. Inside this box you can find the power supply, storage device, hard disk and floppy drives, and the mother board containing CPU and memory.

2.1.2 Motherboard:

The motherboard is generally a thin circuit board that holds all parts of a computer except input and output devices. All crucial hardware like CPU, memory, hard drive, and ports for input and output devices are located on the motherboard. It is the biggest circuit board in a computer chassis.

It allocates power to all hardware located on it and enables them to communicate with each other. It is meant to hold the computer's microprocessor chip and let other components connect to it. Each component that runs the computer or improves its performance is a part of the motherboard or connected to it through a slot or port.
There can be different types of motherboards based on the type and size of the computers. So, a specific motherboard can work only with specific types of processors and memory.

2.1.3 Peripheral Devices

Peripheral devices are connected to the computer externally. These devices are used for performing some specific functions. Peripheral devices are as follows:

1. Input Devices
2. Output Devices

1. Input Devices

Input unit is used for transfers' raw Data and control signals into the information processing system by the user before processing and computation. All the input unit devices provide the instructions and data are transformed into binary form for further and it transmits the data to the primary memory (RAM).
Input device enables the user to send data, information, or control signals to a computer. The Central Processing Unit (CPU) of a computer receives the input and processes it to produce the output. Following are the examples of various input devices, which are connected to the computer for this purpose.

1. Keyboard
2. Mouse

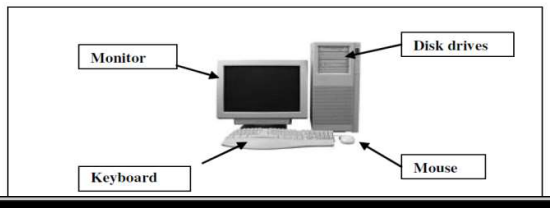


Fig. 1.2 Different peripheral devices of Computer

3. Light Pen
4. Optical/magnetic Scanner
5. Touch Screen
6. Microphone for voice as input

a. Keyboard

It is designed to allow you input text, characters and other commands into a computer. A keyboard (as shown in figure) is the most common input device.Including performing various other functions like copy, paste, delete, enter, etc. Keyboards are connected to a computer through USB or a Bluetooth device for wireless communication.
There are three types of Keyboards which are as follows

1. QWERTY Keyboards
2. AZERTY Keyboards
3. DVORAK Keyboards

b. Mouse

Device designed to control or move the pointer (computer screen's cursor) in a GUI (graphical user interface). A mouse is an electro-mechanical, hand-held device (as shown in figure). It allows you to point to or select menu commands, moving icons, and resizing windows, starting programs, and choosing options. The most common mouse uses an internal, magnetically coated ball, to detect the movement of the mouse across a flat surface, usually a desktop. Now a day's Optical or laser mouse is used to detect the movement. All windows-based applications today are designed to work with a mouse. A mouse is used to replace hard-to-remember key combinations with easier "Point and Click" actions. However, it cannot substitute all keyboard operations. It can be an alternative for commands-based operations.
There are different types of mouses available which are as follows...

1. Trackball mouse
2. Mechanical Mouse
3. Optical Mouse
4. Wireless Mouse

c. Light pen

A light pen is a computer input device that looks like a pen. The tip of the light pen contains a light-sensitive detector that enables the user to point to or select objects on the display screen. Its light sensitive tip detects the object location and sends the corresponding signals to the CPU.

d. Optical Scanner

These devices are used for automatic data collection. The devices of this category completely eliminate manual input of data. For example, the barcode reader is actually just a special type of image scanner. An image scanner translates printed images into an electronic format that can be stored in a computer's memory, and with the right kind of software, one can alter a stored image. Another example of a scanner is optical character recognition (OCR) device, used by banks to convert the scanned image of a typed or printed page into text that can be edited on the computer.

e. Touch Screen

It is the display screen of a device such as a smartphone, tablet, etc., that allows users to interact or provide inputs to the device by using their finger. Today, most electronic devices come with touch screens as an alternative to a mouse

for navigating a graphical user interface. For example, by touching, you can unlock your phone, open emails, open files, play videos, etc. Besides this, it is used in lots of devices such as Camera, Car GPS, Fitness machine, etc

f. Microphone

The microphone is a computer input device that is used to input the sound. It receives the sound vibrations and converts them into audio signals or sends to a recording medium. The audio signals are converted into digital data and stored in the computer. There are two types of microphones available (as shown in figure):

1. Desktop Microphone
2. Handheld Microphone

2. Output Devices

The output device displays the result of the processing of raw data that is entered in the computer through an input device. There are a number of output devices that display output in different ways such as text, images, hard copies, and audio or video.

Output Devices are:

1. Monitor (Visual Display Unit)
2. Printers
3. Plotter
4. Speakers
5. Projectors

a. Monitor:

The monitor is the display unit or screen of the computer. It is the main output device that displays the processed data or information as text, images, audio or video. Out of all the output devices, a monitor (as shown in figure) is perhaps the most important output device because people interact with this device more intensively than others. Computer information is displayed, visually with a video adapter card and monitor. Information processed within the CPU, that needs to be visually displayed, is sent to the video adapter. The video adapter converts information from the format used, in the same manner as a television displays information sent to it by a cable service.

These types of monitors are used with microcomputers, which are as follows:

Fig. 1.10 CRT and LCD Monitor

1. CRT
2. LCD
3. LED

Cathode Ray Tube (CRT):

CRT monitors are work based on the cathode ray tubes. They are like vacuum tubes which produce images in the form of video signals. Cathode rays tube produces a beam of electrons through electron guns. This type uses a large vacuum tube, called cathode ray tube (CRT).

Liquid Crystal Displays (LCD):

An LCD screen comprises two layers of polarized glass with a liquid crystal solution between them. When the light passes through the first layer, an electric current aligns the liquids crystals. The aligned liquid crystals allow a varying

level of light to pass through the second layer to create images on the screen. The LCD screen has a matrix of pixels that display the image on the screen.
Old LCDs had passive-matrix screens in which individual pixels are controlled by sending a charge. A few electrical charges could be sent each second that made screens appear blurry when the images moved quickly on the screen.
Modern LCDs use active-matrix technology and contain thin film transistors (TFTs) with capacitors. This technology allows pixels to retain their charge. So, they don't make the screen blurry when images move fast on the screen as well as are more efficient than passive-matrix displays.

Light Emitting Diode (LED):

The LED monitor is an improved version of an LCD monitor. It also has a flat panel display and uses liquid crystal display technology like the LCD monitors. The difference between them lies in the source of light to backlight the display. The LED monitor has many LED panels, and each panel has several LEDs to backlight the display, whereas the LCD monitors use ***cold cathode fluorescent light*** to backlight the display

b. Printer

A printer is an electromechanical device which receives signals from the computer and acts accrodingly. It is made up of bothelectronic circuits and mechanical assembiles. They electronic circuit is used to control the mechanical assembly. The electronic circuit mainly consists of the circuits to activate the mechanical assembly and interpret the signals send via commnads. On the other hand, the mechanical assembly has a prirnt head, paper mover, carriage motor, sensor and ribbon.

Based on the printing mechanism, the printers are of two types:

1. **Impact Printers**
   - **a.** Character Printers
     - i. Dot Matrix printers
     - ii. Daisy Wheel printers
   - b. Line printers
     - i. Drum printers
     - ii. Chain printers
2. **Non-impact Printers**
   - **a.** Laser printers
   - b. Inkjet printers

c. Plotter

A plotter is a special kind of output device that, like a printer, Produces images on paper in a different way. Plotters are designed to produce large drawings or images, such as construction plans for buildings or blueprints for mechanical objects. A plotter can be connected to the port normally used by a printer.

d. Speaker

An output device connected to a computer's sound card that outputs sounds generated by the computer. Speakers (as shown in figure) are another type of output device, which allow you to listen to voice like music, and conversation with people.

.

e. Projectors

A projector is an output device that enables the user to project the output onto a large surface such as a big screen or wall. It can be connected to a computer and similar devices to project their output onto a screen. It uses light and

lenses to produce magnified texts, images, and videos. So, it is an ideal output device to give presentations or to teach a large number of people.

2.1.4 Microprocessor

A **microprocessor** is an electronic component that is used by a computer to do its work. It is a central processing unit on a single integrated circuit chip containing millions of very small components including transistors, resistors, and diodes that work together. Microprocessor is the brain of a computer, which does all the work. It is a computer processor that incorporates all the functions of CPU (Central Processing Unit) on a single IC (Integrated Circuit) or at the most a few ICs.

These are the most important defining characteristics of Microprocessor --

1. Clock speed
2. Instruction set
3. Word size

Clock Speed:

The speed at which the microprocessor executes instructions is called clock speed. Clock speeds are measured in MHz or GHz where 1 MHz means 1 million cycles per second whereas 1 GHz equals 1 billion cycles per second.

CPU SPEED MEASURES	
1 hertz or Hz	1 cycle per second
1 MHz	1 million cycles per second or 1000 Hz
1 GHz	1 billion cycles per second or 1000 MHz

Instruction Set:

A command given to a digital machine to perform an operation on a piece of data is called an instruction. Basic set of machine level instructions that a microprocessor is designed to execute is called its instruction set.

Word Size:

Number of bits that can be processed by a processor in a single instruction is called its word size.

2.1.5 Types of Microproccessors

Therer are different types of microprocessors available. But, invariably they do same kind of work and the same wayt. Microprocessors are classified into different types based on:

1. Semicconductor Technology of their design
2. Data Width
3. Instruction set

Semicondoucrtor Technologies

There are different semiconductor technologies used in the design of a microprocssor. Some of them are given below.

- TTL – Transistor-Transistor Logic
- CMOS – Complementary-Metal-Oxide Semiconductor
- ECL – Emitter-Coupled Logic

TTL technology is most commonly used, while CMOS is favored for portable computers and other battery-powered devices because of its low power consumption. ECL is used where the need for its greater speed offsets the fact that it consumes the most power.

Data Width

The data width of a microprocessor depends on the number of bits it would process. Following are the width of data format.

4-bit, 8-bit, 16-bit, 32-bit, 64bit

The 4-bit devices are good only for simple control applications. And they are inexpensive. In general, the wider the data format, the faster and more expensive the device.

Instruction sets

The instruction sets play an important role in the design of a microprocessor. There are two basic types of instruction set.

- ❖ CISC (Complex-Instruction-set computer)
- ❖ RISC (Reduced-Insrtuction-set computer

The CISC Processors, which have 70 to several hundred instructions, are easier to program than RISC processors, but CISC are slower and more expensive

2.1.5. Computer Memory

Memory is an essential part of the computer system because a computer can't process any task without it. It is used to store data and instructions for performing specific tasks on the computer system. A memory is just like a human brain. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored. The memory is divided into a large number of small parts called cells. Each location or cell has a unique address or index number. One of the major advantages of computers is its storage capacity where a huge amount of information can be stored.

In the previous concept, we studied how the different types of input devices are used to enter different types of data in the computer. But when the data and instructions are entered into the computer, where they are stored. In fact, inside the computer, there are different storage areas where it keeps data or information permanently or temporarily while working. This storage area is known as the Memory of the computer.

We can simply say Computer **memory** is any physical device capable of storing information temporarily or permanently. Memory is primarily four types of Computer Memory, which are as follows

a. Register memory
b. Cache Memory
c. Primary Memory/Main Memory
d. Secondary Memory

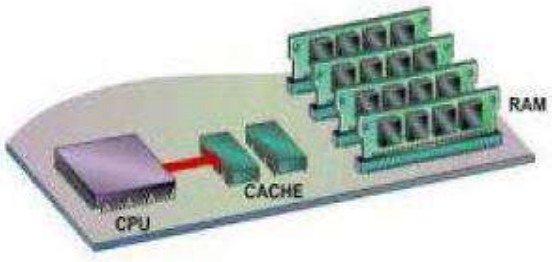
a. Register memory:

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

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

b. Cache Memory:

Cache memory is a high-speed memory, which is small in size but faster than the main memory (RAM). The CPU can access it more quickly than the primary memory. So, it is used to synchronize with a high-speed CPU and to improve its performance.



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

Cache memory is a very high-speed semiconductor memory which can speed up CPU. It acts as a buffer between the CPU and main memory. It is used to hold those parts of data and programs which are most frequently used by the CPU.

The beside picture shows the communication between CPU, Cache and RAM.

Advantages of cache memory:

The advantages of cache memory are as follows:

- Cache memory is faster than main memory.
- It consumes less access time as compared to main memory.
- It stores data for temporary use.

Disadvantages of cache memory:

- Cache memory has limited capacity.
- It is very expensive.

c. Primary Memory

Primary memory holds only those data and instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. This is the main memory of the computer. CPU can directly read or write on this memory. It is fixed on the motherboard of the computer. It is divided into two subcategories RAM and ROM.

Primary memory is further divided in two types:

1) RAM (Random Access Memory)
2) ROM (Read Only Memory)

RAM (Random Access Memory)

It is a volatile memory. It means it does not store data or instructions permanently. When you switch on the computer the data and instructions from the hard disk are stored in RAM.CPU utilizes this data to perform the required tasks. As soon as the computer, the RAM loses all the data.RAM is measured in **megabytes (MB) or gigabytes (GB)**.

ROM (Read only Memory)

ROM stands for **Read Only Memory**. The memory from which we can only read but cannot write on it. This type of memory is non-volatile. The information/instructions are written permanently on it at the time of manufacture. So it is a permanent memory that contains all important data and instructions needed to perform important tasks like the boot process.

Read Only Memory

Difference between RAM and ROM

RAM	ROM
Random Access Memory	Read Only Memory
It is Volatile or Temporary memory	It is Non Volatile or Permanent memory
Data gets erased when power supply off.	Data stored permanently
Faster memory	Slower memory
It is used in the normal operations of a computer after starting up and loading operating system	A ROM chip is used primarily in the start-up process of a computer

d. Secondary Memory

The secondary storage devices which are built into the computer or connected to the computer are known as a secondary memory of the computer. It is also known as external memory or auxiliary storage. The secondary memory is accessed indirectly via input/output operations. It is non-volatile, so permanently stores the data even when the computer is turned off or until this data is overwritten or deleted. CPU directly does not access these memories. The contents of secondary memories are first transferred to the main memory, and then the CPU can access it.

Secondary storage devices are:

1. Hard Disc
2. Compact Disc
3. DVD
4. Flash Drive

Hard Disc:

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

Compact Disc (CD):

Compact Disk is a portable secondary storage device in the shape of a round medium disk. It is made of polycarbonate plastic.

DVD:

DVD stands for Digital Versatile Disc. It is an optical storage device which reads data faster than a CD. DVD can store data up to 4.7 GB, i.e. around 6 times than that of CD. Though DVDs look just like CDs, they can hold much more data.

Flash Drive:

Pen drive is a compact secondary storage device. It is also known as a USB flash drive, thumb drive or a jump drive. It connects to a computer via a USB port. It is commonly used to store and transfer data between computers. It's capacity can vary from 2 GB to 256 GB.

Module - 2

2.2 The Software:

Software is a set of programs, which is designed to perform a well-defined function. A program is a sequence of instructions written to solve a particular problem. The computer hardware itself is not capable of doing anything on its own. It has to be given explicit instructions to perform the specific task. The set of instructions that tells the computer what is to be done with the input data. In computer terminology, this set of instructions is called a program and one or more programs is termed as software.

Basically, there are two different kind of computer software as given below:

1. **System Software**

2. Application Software

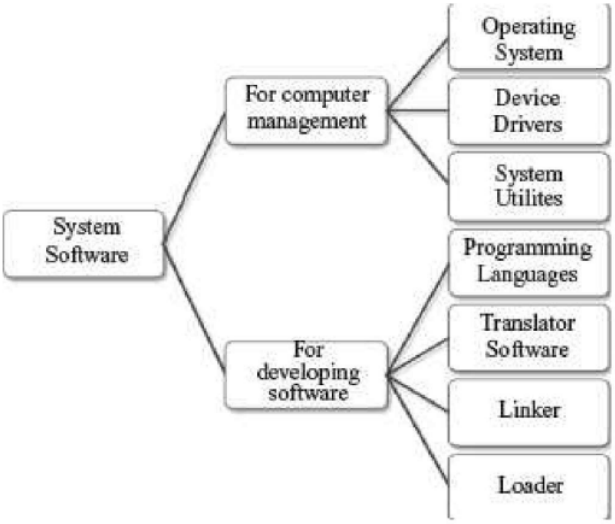
System software is computer software designed to operate computer hardware and to provide/maintain a platform for running application software. Application software is specific purpose software which is used by users for performing specific tasks.

2.2.1 System Software

The system software is a collection of programs designed to operate, control, and extend the processing capabilities of the computer itself. System software is generally prepared by the computer manufacturers and provides basic functionality to the computer. The user of a computer does not need to be aware about the functioning of system software, while using the computer.
The purposes of the system software are:

1. To provide basic functionality to computer,
2. To control computer hardware, and
3. To act as an interface between user, application software and computer hardware**.**

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



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

A. Operating System

An operating system is the system software that works as an interface between the user and computer OS intermediates between the user of a computer. It is an integrated set of specialized programs used to manage overall resources and operations of the computer. It provides an interface that is convenient for the user to use, and facilitates efficient operations of the computer system resources. Some available operating systems are Microsoft Disk Operating System (MS-DOS), Windows, Apple Mac, Linux and UNIX.

B. Device Driver:

A device driver acts as a translator between the hardware and the software that uses the devices. Some devices that are commonly connected to the computer are—keyboard, mouse, hard disk, printer, speakers, microphone, joystick, webcam, scanner, digital camera, and monitor. For proper working of a device, its corresponding device driver must be installed on the computer.

C. System Utility Software:

System utility software is required for the maintenance of computers. System utilities are used for supporting and enhancing the programs and the data in the computer. Some system utilities may come embedded with OS and others may be added later on. Some examples of system utilities, which are as follows...

★ Anti-virus utilities are used to scan computer for viruses

- ★ Data Compression utilities are used to compress files to a smaller size
- ★ Cryptography utilities are used to encrypt and decrypt files.
- ★ Disk Compression can be used to enhance the capacity of the disk by compressing/un-Compressing the contents of a disk .
- ★ Disk Cleaners to find files that have not been used for a long time. It helps the user to decide What to delete when the hard disk is full.

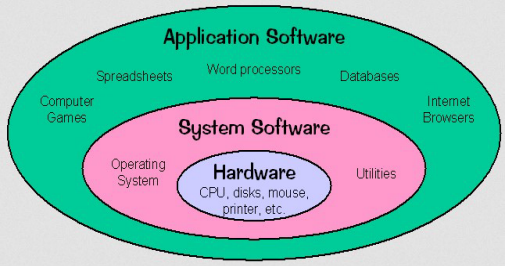
2.2.2 Application Software

Application software is a set of programs designed to perform a specific task. It does not control the working of a computer as it is designed for end-users. A computer can run without application software. Application software can be easily installed or uninstalled as required. It can be a single program or a collection of small programs. It may also consist of a collection of programs; Application software is a type of computer program that performs a specific personal, educational, and business function. Each program is designed to help the user with a particular process, which may be related to productivity, creativity, and communication.

a. **Word Processing Software**: This software allows users to create, edit, format, and manipulate the text and more. It offers lots of options for writing documents, creating images, and more. For example, MS Word, WordPad, Notepad, etc.
b. **Spreadsheet Software**: It is designed to perform calculations, store data, create charts, etc. It has rows and columns, and the data is entered in the cell, which is an intersection of a row and column, e.g., Microsoft Excel. **Multimedia Software**: These software are developed to perform editing of video, audio, and text. It allows you to combine texts, videos, audio, and images. Thus, you can improve a text document by adding photos, animations, graphics, and charts through multimedia software. For example, VLC player, Window Media Player, etc.
c. **Enterprise Software**: These software are developed for business operational functions. It is used in large organizations where the quantum of business is too large. It can be used for accounting, billing, order processing and more. For example, CRM (Customer Relationship Management), BI (Business Intelligence), ERP (Enterprise Resource Planning), SCM (Supply Chain Management), customer support system, and more.

The most common application software programs are used by millions every day and include:

- Microsoft suite of products (Office, Excel, Word, PowerPoint, Outlook, etc.)
- Internet browsers like Firefox, Safari, and Chrome



2.3 Difference between System Software and Application Software

System Software	Application Software
System software is used for operating computer hardware	Application software is used by user to perform specific task
System software are installed on the computer when operating system is installed	Application software are installed according to user's requirements
In general, the user does not interact with system software because it works in the background	In general, the user interacts with application software
System software can run independently. It provides platform for running application software	Application software can't run independently. They can't run without the presence of system software

Some examples of system software are Operating Systems (*Windows XP, Windows 7, Windows 8, Mac OS, Linux, Unix*), compiler, assembler, debugger, driver, etc	Some examples of application software are word processor, web browser, media player, Gaming software etc

Module - 3

2.4 Laptop Ports

A port is a connection or a jack provided on a computer to connect external or peripheral devices to the computer, for example, keyboard, mouse, pen-drives, etc. So, it acts as an interface or a point of attachment between computer and external devices. It is also called a communication port, as it is the point where you plug in a peripheral device to allow data transfer or communication between the device and computer. It can also be programmatic docking point through which information flows from a program to the computer or over the Internet.

There are different types of ports available which are as follows…

1. Power Port (adapter)
2. HDMI Port
3. Audio (IN/OUT) port
4. SD Card port
5. Network Port(LAN)
6. VGA port
7. USB Port

Power port:

Power port is used for connecting power adapters to the laptop. Connects to the computer's power cable that plugs into a power bar or wall socket.

HDMI Port:

High Definition Multimedia Interface, (**HDMI)** is a connector and cable capable of transmitting high-quality and high-bandwidth streams of audio and video between devices. The HDMI technology is used with devices such as an HDTV, Projector and DVD player. The picture to the right is an example of an HDMI port.

Audio (IN/OUT) Jack:

An **audio port** on a computer is any receptacle or **jack** to which an **audio** device such as speakers, headphones or a microphone can be connected. All laptops and some desktops have built-in speakers, but for better sound or privacy, you will need to connect external **audio** through one of the **ports**.

SD (secure digital) Card port:

SD (Secure Digital) or SDXC (Secure Digital Extended Capacity) **card slot** that lets your computer or laptop read and write data to **SD** media, such as digital camera memory **cards**.

LAN Ports:LAN ports are used to connect the laptop to a network with the help of LAN cable.

VGA (Video Graphics Array) Connector: A VGA connector is a three-row 15-pin connector, which is used to connect output devices like projector and monitor.

USB Ports: USB stands for Universal Serial Bus. USB allows data to be transferred between devices. USB ports can also supply electric power across the cable to devices which does not have their own power source.

2.5 Memory Units

Memory unit is the amount of data that can be stored in the storage unit. This storage capacity is expressed in terms of Bytes. Data in the computer's memory is represented by the two digits 0 and 1. These two digits are called B**inary Digits** or **Bits**. A bit is the smallest unit of a computer's memory. To represent each character in memory, a set of 8 binary digits is used. This set of 8 bit is called a Byte. So, one Byte is used to represent one character of data.

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

Bit: The computer memory units start from bit. A bit is the smallest memory unit to measure data stored in main memory and storage devices. A bit can have only one binary value out of 0 or1.

Byte: It is the fundamental unit to measure data. A byte is a collection of eight bits or is equal to 8 bits. Thus, a byte can represent 2*8 or 256 values.

Bits = 0 or 1
Nibble: It is a collection of 4 bits
Word: It is a collection of 16 bits
1 Byte= 8 bits (e.g,11001011)

To represent a large amount of data in memory, higher data storage units are used like KB (Kilobyte), MB(megabyte), GB (Gigabyte), TB (terabyte) etc. But all these unites are formed with the set of bytes like,
1 bit = 0 or 1
1 Byte (B) = 8 bits
1 Kilobyte (KB) = 1024 bytes
1 Megabyte (MB) =1024Kilo Kilobytes
1 Gigabyte (GB) = 1024 Megabytes
1 Terabyte (TB) = 1024 Gigabytes'
1 Petabyte (PB) = 1024 Terabytes
1 Exabyte (EB) = 1024 Petabytes
1 Zettabyte (ZB) = 1024 Exabytes
1 Yottabyte (YB) = 1024 Zettabytes

Multiple Choice Questions

1. Which of the following is not an input device? (C)
   A. Joystick
   B. Microphone
   C. Monitor
   D. Keyboard
2. The Programs that run on a computer are referred to as (B)
   A. Hardware
   B. Software
   C. File ware
   D. Soft firm
3. Computer hardware consists of (D)
   A. Input/Output Devices
   B. CPU
   C. Storage Devices
   D. All of these
4. RAM Stands for (A)
   A. Random Access Memory
   B. Read Access Memory
   C. Read Arithmetic Memory
   D. Random Arithmetic Memory
5. The Central Processing Unit (CPU) consists of (D
   A. Control unit
   B. Arithmetic and Logic unit
   C. main store
   D. all of above
6. Which kind of storage device can be carried around? (A)
   A. Floppy Disk
   B. Hard Disk
   C. System Cabinet
   D. Hard Disk Drive
7. Operating system is a (B)
   A. Application Software
   B. System Software
   C. Firmware
   D. Hardware
8. The most common input device is the(B)
   A. Pen
   B. Keyboard
   C. Monito
   D. Mouse
9. The brain of any computer system is(C)
   A. ALU
   B. Memory
   C. CPU
   D. Control Unit
10. _____ is the high speed memory used in computer?(C)
    A. RAM
    B. Hard Disk
    C. Cache
    D. BIOS
11. Operating System is the most common type of?(B)
    A. Application Software
    B. System Software
    C. Hardware
    D. Word Processing Software

12. The term 'memory' applies to which one of the following?(D)
    A. Logic
    B. Input Device
    C. Output Device
    D. Storage
13. A collection of 8 bits is called(A)
    A. Byte
    B. Recode
    C. Word
    D. Nibble
14. Which of the following memory is non-volatile?(C)
    A. SRAM
    B. DRAM
    C. ROM
    D. All of the above
15. .A kilobyte also referred to as KB, is equal to(B)
    A. 1000 bytes
    B. 1024 bytes
    C. 2048 bytes
    D. 512 bytes
16. The operating system manages(D)
    A. Memory
    B. Processor
    C. Disk and I/O Devices
    D. All of the above
17. Any data or instruction entered into the memory of a computer is considered as?(B)
    A. Output
    B. Input
    C. Storage
    D. Information

Descriptive Questions:

1. What are the input and output devices?
2. Define Hardware and Software with examples?
3. Define RAM and ROM?
4. Difference between System Software and Application Software?
5. Explain about Laptop External ports and its usage?
6. What is bit and byte? Describe available memory units?

UNIT-3: Basics of Number Systems

Module – 1: Introduction of Basic Number System

3.1 Introduction

We use Computer to process the data and get the desired output. The data input can be in the form of alphabets, digits, symbols, audio, video, magnetic cards, finger prints, etc. Since Computer can only understand 0 and 1, the data must be represented in the Computer in 0s and 1s. The purpose of this chapter is to introduce you to the data representation in the Computer.

The data stored in the Computer may be of different kinds, as follows

- Numeric data (0, 1, 2, …, 9)
- Alphabetic data (A, B, C, …, Z)
- Alphanumeric data — Combination of any of the symbols — (A, B, C… Z), (0, 1… 9), or special characters (+,−, Blank), etc.

This chapter discusses the Number Systems that are commonly used in the Computer. The number systems discussed in this chapter are — (1) Decimal number system, (2) Binary number system, (3) Octal number system, and (4) Hexadecimal number system. The number conversions described in this chapter are:

- Decimal (Integer, Fraction, Integer. Fraction) to Binary, Octal, Hexadecimal
- Binary, Octal, Hexadecimal (Integer, Fraction, Integer. Fraction) to Decimal
- Binary to Octal, Hexadecimal
- Octal, Hexadecimal to Binary

This chapter also discusses the binary arithmetic operations and the representation of signed and unsigned numbers in the computer. The representation of numbers using binary coding schemes and the logic gates used for the manipulation of data are also discussed.

3.2 Number System

A Number System in ***base(r)*** or ***radix(r)*** uses unique symbols for **r** digits. One or more digits are combined to get a number. The base of the number decides the valid digits that are used to make a number. In a number, the *position* of digit starts from the right-hand side of the number. The rightmost digit has position '0', the next digit on its left has position '1', and so on.

The digits of a number have two kinds of values (i) Face value (ii) Position value.
The **Face value** of a digit is the digit located at that position. For example, in decimal number 52, face value at position '0' is 2 and face value at position '1' is 5.
The **Position value** of a digit is (base ^{position}). For example, in decimal number 52, the position value of digit *2 is* 10^0 and the position value of digit *5 is* 10^1. Decimal numbers have a base of 10.

The number is calculated as the sum of, ***face value * base*** ^{position}, of each of the digits. For decimal number 52, the number is $5*10^1 + 2*10^0 = 50 + 2 = 52$.

In computer, there are following four kinds of Number Systems used for representing data:

- Decimal (Base 10) — (0,1,2,3,4,5,6,7,8,9)
- Binary (Base 2) — (0,1)
- Octal (Base 8) — (0,1,2,3,4,5,6,7)
- Hexadecimal (Base 16) — (0,1,2,3,4,5,6,7,8,9A,B,C,D,E,F)

3.2.1 Decimal Number System

- In Decimal Number system, the base is 10. Hence, the decimal number system consists of 10 digits i.e., 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.

- All numbers in this Number System are represented as combination of digits 0 to 9. For example, 34, 5965 and 867321.
- Successive positions to the left of the decimal point represent units, tens, hundreds, thousands, etc.
- Each position represents a specific power of the base (10).
- The position value and quantity of a digit at different positions in a number are as follows:

Position	:	3	2	1	0	.	-1	-2	-3
Base/Radix	:	10	10	10	10	.	10	10	10
Calculation	:	10^3	10^2	10^1	10^0	.	10^{-1}	10^{-2}	10^{-3}
Position Value	:	1000	100	10	1	.	1/10	1/100	1/1000

- For example, decimal number 2586 (written as 2586) consists of digit '6' in units position, '8' in tens position, '5' in hundreds position, and '2' in thousands position, and its value can be written as:
  $(2 \times 10^3) + (5 \times 10^2) + (8 \times 10^1) + (6 \times 10^0) = 2000 + 500 + 80 + 6 = 2586$

3.2.2 Binary Number System

- In Binary Number system, the base is 2. Hence, the binary number system consists of two digits: '0' and '1'.
- All Binary numbers are formed using combination of '0' and '1'. For example, 1001, 11000011 and 10110101.
- Each position represents a specific power of the base (2)
- The position value and quantity of a digit at different positions in a number are as follows:

Position	:	3	2	1	0	.	-1	-2	-3
Base/Radix	:	2	2	2	2	.	2	2	2
Calculation	:	2^3	2^2	2^1	2^0	.	2^{-1}	2^{-2}	2^{-3}
Position Value	:	8	4	2	1	.	1/2	1/4	1/8

- Therefore, decimal equivalent of binary number 10101 (written as 10101) is :
  $(1 \times 2^4) + (0 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) = 16 + 0 + 4 + 0 + 1 = 21$

3.2.3 Octal Number System

- In Octal Number system, the base is 8. Hence, the octal number system consists of eight digits: '0' to '7'. (i.e., 0, 1, 2, 3, 4, 5, 6, 7)
- All octal numbers are represented using these eight digits. For example, 273, 103, 2375, etc.
- Each position in an octal number represents a power of the base (8).
- The position value and quantity of a digit at different positions in a number are as follows:

Position	:	3	2	1	0	.	-1	-2	-3
Base/Radix	:	8	8	8	8	.	8	8	8
Calculation	:	8^3	8^2	8^1	8^0	.	8^{-1}	8^{-2}	8^{-3}
Position Value	:	512	64	8	1	.	1/8	1/64	1/512

- Therefore, decimal equivalent of octal number 2057 (written as 2057) is:

  $(2 \times 8^3) + (0 \times 8^3) + (5 \times 8^1) + (7 \times 8^0) = 1024 + 0 + 40 + 7 = 1071$

- Observe that since there are only 8 digits in octal number system, 3 bits ($2^3 = 8$) are sufficient to represent any number in binary.

3.2.4 Hexadecimal Number System

- In hexadecimal number system, the base is 16. Hence, there are 16 symbols or digits.
- The hexadecimal number system consists of sixteen digits: 0 to 9, A, B, C, D, E, F, where (A is for 10, B is for 11, C-12, D-13, E-14, F-15).
- All Hexadecimal numbers are represented using these 16 digits. For example, 3FA, 87B, 113, etc.
- Each position in hexadecimal Number system represents a power of the base (16).

- The Position and Position value of a digit at different positions in a number are as follows:

Position	:	3	2	1	0	.	-1	-2	-3
Base/Radix	:	16	16	16	16	.	16	16	16
Calculation	:	16^3	16^2	16^1	16^0	.	16^{-1}	16^{-2}	16^{-3}
Position Value	:	4096	256	16	1	.	1/16	1/256	1/4096

- Therefore, decimal equivalent of hexadecimal number 1AF (written as $1AF_{16}$) is

  $(1 \times 16^2) + (A \times 16^1) + (F \times 16^0) = (1 \times 256) + (10 \times 16) + (15 \times 1) = 256 + 160 + 15 = 431$

  Hence, $1AF_{16} = 431_{10}$

- Observe that since there are only 16 digits in hexadecimal number 4 bits ($2^4 = 16$) are sufficient to represent any hexadecimal number in binary.

  Summarizes the base, digits and largest digit for the above discussed Number Systems

Number Systems	Base	Digits	Largest Digit
Decimal	10	0-9	9
Binary	2	0,1	1
Octal	8	0-7	7
Hexadecimal	16	0-9, A-F	F (15)

Shows the Binary, Octal and Hexadecimal equivalents of the Decimal numbers 0–16

Decimal	Binary	Octal	Hexadecimal
0	0000	000	0
1	0001	001	1
2	0010	002	2
3	0011	003	3
4	0100	004	4
5	0101	005	5
6	0110	006	6
7	0111	007	7
8	1000	010	8
9	1001	011	9
10	1010	012	A
11	1011	013	B
12	1100	014	C
13	1101	015	D
14	1110	016	E
15	1111	017	F
16	10000	020	10

3.3 Language of Bits

A bit is a binary digit, the smallest increment of data on a computer. A bit can hold only one of two values: 0 or 1, corresponding to the electrical values of off or on, respectively.

Because bits are so small, you rarely work with information one bit at a time. Bits are usually assembled into a group of eight to form a byte. A byte contains enough information to store a single ASCII character, like "h".

A kilobyte (KB) is 1,024 bytes, not one thousand bytes as might be expected, because computers use binary (base two) math, instead of a decimal (base ten) system.

Computer storage and memory is often measured in megabytes (MB) and gigabytes (GB). A medium-sized novel contains about 1 MB of information. 1 MB is 1,024 kilobytes, or 1,048,576 (1024x1024) bytes, not one million bytes.

Similarly, one 1 GB is 1,024 MB, or 1,073,741,824 (1024x1024x1024) bytes. A terabyte (TB) is 1,024 GB; 1 TB is about the same amount of information as all of the books in a large library, or roughly 1,610 CDs worth of data. A petabyte (PB) is 1,024 TB. 1 PB of data, if written on DVDs, would create roughly 223,100 DVDs, i.e., a stack about 878 feet tall, or a stack of CDs a mile high. Indiana University is now building storage systems capable of holding petabytes of data. An exabyte (EB) is 1,024 PB. A zettabyte (ZB) is 1,024 EB. Finally, a yottabyte (YB) is 1,024 ZB.

Bit (Binary Digit): A bit is a binary digit, the smallest increment of data on a Computer. A bit can hold only one of two values: 0 or 1.

Byte: A group of 8 bits is called byte. A byte is the smallest unit, which can represent a data item or a character.

We count in base 10 by powers of 10:

$10^1 = 10$
$10^2 = 10*10 = 100$
$10^3 = 10*10*10 = 1,000$
$10^6 = 1,000,000$

Computers count by base 2:

$2^1 = 2$
$2^2 = 2*2 = 4$
$2^3 = 2*2*2 = 8$
$2^{10} = 1,024$
$2^{20} = 1,048,576$

Name	Equal To	Size(In Bytes)
Bit	1 Bit	1/8
Nibble	4 Bits	1/2 (rare)
Byte	8 Bits	1
Kilobyte	1024 Bytes	1024
Megabyte	1, 024 Kilobytes	1, 048, 576
Gigabyte	1, 024 Megabytes	1, 073, 741, 824
Terrabyte	1, 024 Gigabytes	1, 099, 511, 627, 776
Petabyte	1, 024 Terabytes	1, 125, 899, 906, 842, 624
Exabyte	1, 024 Petabytes	1, 152, 921, 504, 606, 846, 976
Zettabyte	1, 024 Exabytes	1, 180, 591, 620, 717, 411, 303, 424
Yottabyte	1, 024 Zettabytes	1, 208, 925, 819, 614, 629, 174, 706, 176

Module – 2 : Direct Conversion

Two Types of Conversions are there

1. Direct Conversion
2. Indirect Conversion

3.4 Direct Conversion

3.4.1 Conversion from Decimal to Binary, Octal, Hexadecimal

A decimal number has two parts — integer part and fraction part. For example, in the decimal number 23.0786, 23 is the integer part and 0.0786 is the fraction part. The method used for the conversion of the integer part of a decimal number is different from the one used for the fraction part. In the following subsections, we shall discuss the conversion of decimal integer, decimal fraction and decimal integer.fraction number into Binary, Octal and Hexadecimal number.

3.4.2 Converting Decimal Integer to Binary, Octal, Hexadecimal

A decimal integer is converted to any other base, by using the division operation.

To convert a Decimal integer to—

- Binary-divide by 2,
- Octal-divide by 8, and,
- Hexadecimal-divide by 16.

Let us now understand this conversion with the help of some examples.

Example 1: Convert 25 (base 10) to base 2.

1. Make a table as shown below. Write the number/quotient in centre and Base on the left side

Base	Number/ (Quotient)	Remainder
2	25	

2. Divide the number with to *Base*. After each division, write the remainder on right-side column and quotient in the next line in the middle column. Continue dividing till the quotient is 0.

Base	Number/ (Quotient)	Remainder
2	25	
2	12	1
2	6	0
2	3	0
2	1	1
	0	1

3. Write the digits in remainder column starting from downwards to upward, then the binary equivalent of number $(25)_{10}$ is $(11001)_2$

Example 2: Convert 23 from Base (10) to Base (2), Base (8), Base (16).

Base	Number/ Quotient	Remainder
2	23	
2	11	1
2	5	1
2	2	1
2	1	0
	0	1

The Binary equivalent of $(23)_{10}$ is $(10111)_2$

Base	Number/ Quotient	Remainder
8	23	
8	2	7
	0	2

The Octal equivalent of $(23)_{10}$ is $(27)_8$

Base	Number/ Quotient	Remainder
16	23	
16	1	7
	0	1

The Hexadecimal equivalent of $(23)_{10}$ is $(17)_{16}$

Example 3: Convert 147 from Base (10) to Base (2), Base (8), Base (16).

Base	Number/ Quotient	Remainder
2	147	
2	73	1
2	36	1
2	18	0
2	9	0
2	4	1
2	2	0
2	1	0
	0	1

The Binary equivalent of $(147)_{10}$ is $(10010011)_2$

Base	Number/ Quotient	Remainder
8	147	
8	18	3
8	2	2
	0	2

The Octal equivalent of $(147)_{10}$ is $(223)_8$

Base	Number/ Quotient	Remainder
16	147	
16	9	3
	0	9

The Hexadecimal equivalent of $(147)_{10}$ is $(93)_{16}$

Example 4: Convert 94 from Base(10) to Base(2), Base(8), Base(16).

Base	Number/ Quotient	Remainder
2	94	
2	47	0
2	23	1

Base	Number/ Quotient	Remainder
8	94	
8	11	6
8	1	3

Base	Number/ Quotient	Remainder
16	94	
16	5	14(E)
	0	5

2	11	1
2	5	1
2	2	1
2	1	0
	0	1

The Binary equivalent of $(94)_{10}$ is $(1011110)_2$

	0	1

The Octal equivalent of $(94)_{10}$ is $(136)_8$

The Hexadecimal equivalent of $(94)_{10}$ is $(5E)_{16}$

3.4.3 Converting Decimal Fraction to Binary, Octal, Hexadecimal

A fractional number is a number less than 1. It may be .5, .00453, .564, etc. We use the multiplication operation to convert Decimal fraction to any other base.

To convert a decimal fraction to

- binary-multiply by 2,
- octal-multiply by 8, and,
- hexadecimal-multiply by 16

Steps for conversion of a decimal fraction to any other base are:

1. Multiply the fractional number with the *Base*, to get a resulting number.
2. The resulting number has two parts, non-fractional part and fractional part.
3. Record the non-fractional part of the resulting number.
4. Repeat the above steps at least four or five times.
5. Write the digits in the non-fractional part starting from upwards to downwards

Example 5: Convert 0.2345 from Base (10) to Base (2).

0.2345 x 2 = **0**.4690

0.4690 x 2 = **0**.9380

0.9380 x 2 = **1**.8760

0.8760 x 2 = **1**.7520

0.7520 x 2 = **1**.5040

0.5040 x 2 = **1**.0080

The Binary equivalent of $(0.2345)_{10}$ is $(0.001111)_2$

Example 6: Convert 0.865 from Base (10) to Base (2), Base (8), Base (16)

Base (2)	Base (8)	Base (16)
0.8650 x 2 = **1**.7300	0.8650 x 8 = **6**.9200	0.8650 x 16 = **13**.8400
0.7300 x 2 = **1**.4600	0.9200 x 8 = **7**.3600	0.8400 x 16 = **13**.4400
0.4600 x 2 = **0**.9200	0.3600 x 8 = **2**.8800	0.4400 x 16 = **7**.0400

0.9200
x 2
1.8400

0.6800
x 2
1.3600

The Binary equivalent of $(0.8650)_{10}$ is $(0.110111)_2$

0.8800
x 8
7.0400

The Octal equivalent of $(0.8650)_{10}$ is $(0.6727)_8$

The Hexadecimal equivalent of $(0.8650)_{10}$ is $(0.DD7)_{16}$

3.4.4 Converting Decimal Integer.Fraction to Binary, Octal, Hexadecimal

A decimal integer.fraction number has both integer part and fraction part. The steps for conversion of a decimal integer.fraction to any other base are:

1. Convert decimal integer part to the desired base following the steps shown in section 3.4.1
2. Convert decimal fraction part to the desired base following the steps shown in section 3.4.2.
3. The integer and fraction part in the desired base is combined to get integer.fraction.

Example 7: Convert 34.4674 from Base (10) to Base (2)

Base	Number/ Quotient	Remainder
2	34	
2	17	0
2	8	1
2	4	0
2	2	0
2	1	0
	0	1

The Binary equivalent of $(34)_{10}$ is $(100010)_2$

0.4674
x 2
0.9348

0.9348
x 2
1.8696

0.8696
x 2
1.7392

0.7392
x 2
1.4784

0.4784
x 2
0.9568

0.9568
x 2
1.9136

The Binary equivalent of $(0.4674)_{10}$ is $(0.011101)_2$

The Binary equivalent of $(34.4674)_{10}$ is $(100010.011101)_2$

Example 8: Convert 34.4674 from Base (10) to Base(8).

Base	Number/ Quotient	Remainder
8	34	
8	4	2
	0	4

The Octal equivalent $(34)_{10}$ is $(42)_8$

0.4674
x 8
3.7392

0.7392
x 8
5.9136

0.9136
x 8
7.3088

0.3088
x 8
2.4704

The Octal equivalent $(0.4674)_{10}$ is $(0.3572)_8$

The Octal equivalent of $(34.4674)_{10}$ is $(42.3572)_8$

Example 9: Convert 34.4674 from Base (10) to Base (16)

Base	Number/ Quotient	Remainder
16	34	
16	2	2
	0	2

The Hexadecimal equivalent $(34)_{10}$ is $(22)_{16}$

0.4674
x 16
7.4784

0.4784
x 16
7.6544

0.6544
x 16
10.4704

0.4704
x 16
7.5264

The Hexadecimal equivalent $(0.4674)_{10}$ is $(0.77A7)_{16}$

The Hexadecimal equivalent of $(34.4674)_{10}$ is $(22.77A7)_{16}$

3.4.5 Conversion of Binary, Octal, Hexadecimal to Decimal

A Binary, Octal or Hexadecimal number has two parts — integer part and fraction part. For example, a Binary number could be 1011, 0.1001 or 1011.1001. The number 24, 0.36 or 24.36 are Octal numbers. A Hexadecimal number could be 4D, 0.21, or 4D.21.

The method used for the conversion of integer part and fraction part of Binary, Octal or Hexadecimal number to Decimal number is the same; multiplication operation is used for the conversion. The conversion mechanism uses the face value and position value of digits. The steps for conversion are as follows:

Find the sum of the **Face Value * (fromBase)^{position}** for each digit in the number.

1. In a non-fractional number, the rightmost digit has position 0 and the position increases as we go towards the left.

2. In a fractional number, the first digit to the left of decimal point has position 0 and the position increases as we go towards the left (1, 2, etc). The first digit to the right of the decimal point has position –1 and it decreases as we go towards the right (−2, −3, etc.)

Binary :	1	0	1	.	0	0	1
Position:	2	1	0	.	-1	-2	-3

Example 10: i) Convert 1011 from Base (2) to Base (10).
ii) Convert 62 from Base (8) to Base (10).
iii) Convert C15 from Base (16) to Base (10).

i) 1011 from Base 2 to Base 10:
$1011 = 1*2^3+0*2^2+1*2^1+1*2^0$
$=1*8+0*4+1*2+1*1$
$= 8+0+2+1$
$=11$
The Decimal equivalent of $(1011)_2$ is 11

ii) 62 from Base 8 to Base 10:
$62 = 6*8^1+2*8^0$
$=6*8+2*1$
$= 48+2$
$=50$
The Decimal equivalent of $(62)_8$ is 50

iii) C15 from Base 16 to Base 10:
$C15 = C*16^2+1*16^1+5*16^0$
$=12*256+1*16+5*1$
$= 3072+16+5$
$=3093$
The Decimal equivalent of $(C15)_{16}$ is 3093

Example 11: i) Convert .1101 from Base 2 to Base 10.
ii) Convert .345 from Base 8 to Base 10.
iii) Convert .15 from Base 16 to Base 10.

i) 0.1101from Base 2 to Base 10:
$0.1101 = 1*2^{-1}+1*2^{-2}+0*2^{-3}+1*2^{-4}$
$=1/2+1/4+0/8+1/16$
$= 13/16$
$=0.8125$
The Decimal equivalent of $(1011)_2$ is 0.8125

ii) 0.345 from Base 8 to Base 10:
$0.345 = 3*8^{-1}+4*8^{-2}+5*8^{-3}$
$=3/8+4/64+5/512$
$= 229/512$
$=0.447$
The Decimal equivalent of $(0.345)_8$ is 0.447

iii) 0.15 from Base 16 to Base 10:
$0.15 = 1*16^{-1}+5*16^{-2}$
$=1/16+5/256$
$= 21/256$
$=0.082$
The Decimal equivalent of $(0.15)_{16}$ is 0.082

Example 12: i) Convert 1011.1001 from Base 2 to Base 10.
ii) Convert 24.36 from Base 8 to Base 10.
iii) Convert 4D.21 from Base 16 to Base 10.

i) 1011.1001 from Base 2 to Base 10:
$1011.1001 = 1*2^3+0*2^2+1*2^1+1*2^{0+}1*2^{-1}+0*2^{-2}+0*2^{-3}+1*2^{-4}$
$= 8+0+2+1+1/2+0+0+1/16$
$= 11+9/16$
$= 11.5625$
The Decimal equivalent of (1011.1001)2 is 11.5625

ii) 24.36 from Base 8 to Base 10:
$24.36 = 2*8^1+4*8^0+3*8^{-1}+6*8^{-2}$
$= 16+4+3/8+6/64$
$= 20+30/64$
$= 20.4687$
The Decimal equivalent of $(24.36)_8$ is 20.4687

iii) 4D.21 from Base 16 to Base 10:
$4D.21 = 4*16^1+13*16^0+2*16^{-1}+1*16^{-2}$
$= 64+13+2/16+1/256$
$= 77+33/256$
$= 77.1289$
The Decimal equivalent of (4D.21)16 is 77.1289

3.4.6 Conversion of Binary to Octal, Hexadecimal

A binary number can be converted into octal or hexadecimal number using a shortcut method.
The shortcut method is based on the following information:

- An octal digit from 0 to 7 can be represented as a combination of 3 bits, since $2^3 = 8$.
- A hexadecimal digit from 0 to 15 i.e.,(0 to 9), and (A to F) can be represented as a combination of 4 bits, since $2^4 = 16$.

The Steps for Binary to Octal conversion are:

1. Partition the binary number in groups of three bits, starting from the right-most side.
2. For each group of three bits, find its octal number.
3. The result is the number formed by the combination of the octal numbers.

The Steps for Binary to Hexadecimal conversion are**:**

1. Partition the binary number in groups of four bits, starting from the right-most side.
2. For each group of four bits, find its hexadecimal number.
3. The result is the number formed by the combination of the hexadecimal numbers.

Example 13: Convert the binary number 1110101100110 to octal.

➔Given binary number 1110101100110

1. Partition binary number in groups of three bits, starting from the right-most side
   1 110 100 110
2. For each group find its Octal number.
   1 110 101 100 110
   1 6 5 4 6
3. The Octal number is 16546

Example 14: Convert the binary number 1110101100110 to hexadecimal

➔Given binary number 1110101100110

1. Partition binary number in groups of four bits, starting from the right-most side.
   1 1101 0110 0110
2. For each group find its Hexadecimal number.
   1 1101 0110 0110
   1 D 6 6
3. The Hexadecimal number is 1D66.

3.4.7 Conversion of Octal, Hexadecimal to Binary

The conversion of a number from Octal and Hexadecimal to Binary uses the inverse of the steps defined for the conversion of Binary to Octal and Hexadecimal.

The Steps for Octal to Binary Conversion are**:**

1. Convert each Octal number into a three-digit Binary number.
2. The result is the number formed by the combination of all the bits.

The Steps for Hexadecimal to Binary Conversion are**:**

1. Convert each Hexadecimal number into a four-digit Binary number.
2. The result is the number formed by the combination of all the bits.

Example 15: Convert the Hexadecimal number 2BA3 to Binary.

1. Given number is 2BA3
2. Convert each Hexadecimal digit into four-digit Binary number.
   2 B A 3
   0010 1011 1010 0011
3. Combine all the bits to get the result 0010101110100011.

Example 16: Convert the Octal number 473 to Binary.

1. Given number is 473
2. Convert each octal digit into three-digit Binary number.
   4 7 3
   100 111 011
3. Combine all the bits to get the result 100111011.

Module – 3 : Indirect Conversion

3.5 Indirect Conversion

3.5.1 Conversion of Decimal to Binary

The conversion of a number from Decimal to Binary uses the steps defined for the conversion of Decimal to Octal to Binary.

The Steps for Decimal to Octal Conversion are**:**

1. A decimal number is converted to Octal number by divided with 8
2. Make a table as shown below. Divide the number with base (8) and write the digits in remainder column starting from downwards to upward.

The Steps for Octal to Binary Conversion are**:**

3. Convert each Octal number into a three-digit Binary number.
4. The result is the number formed by the combination of all the bits.

Example 1: Convert 23 from base (10) to base(2)

Steps (1-2): Convert 23 to base (8):

Base	Number/ Quotient	Remainder
8	23	
8	2	7 ↑
	0	2

The Octal equivalent of $(23)_{10}$ is $(27)_8$

Step 3: Convert each Octal digit into three Binary

2	7
010	111

Step 4: Combine all the bits to get the result $(010111)_2$

3.6 Unsolved Questions

1. Convert the following Decimal numbers into Binary, Octal and Hexadecimal.
   a. 24
   b. 47
   c. 675
   d. 89
   e. 34.24
   f. 150.64
   g. .98
   h. .29
   i. 24.14
   j. 16.1
   k. 22.33
   l. 24.14
2. Convert the following Binary numbers into Decimal numbers.
   a. 110000111
   b. 110011
   c. 1001111
   d. 11000001
   e. 1100110.1110
   f. 11110.0000
   g. 01001.0101
   h. 1010.10101
   i. 11000011.111
   j. 11001.1101
   k. 100.111
   l. 101.0111
3. Convert the following Octal numbers into Decimal numbers.
   a. 234
   b. 36
   c. 456
   d. 217
   e. 25.33
   f. 65.34
   g. 34.56
   h. 267.12
4. Convert the following Hexadecimal numbers into Decimal numbers.
   a. E16
   b. 389
   c. 2AB
   d. FF
   e. E4.16
   f. 2A.1B
   g. 23.89
   h. AC.BD
5. Convert the following Binary into Octal.
   a. 1100011
   b. 110011001100
   c. 100111100
   d. 110000011

e. 110011011
f. 1111000
g. 0010101
h. 101010101

6. Convert the following Binary into Hexadecimal.
   a. 11000011111
   b. 1100110011
   c. 100111100
   d. 1100000100
   e. 11001101110
   f. 111100000
   g. 010010101
   h. 101010101
7. Convert the following Octal into Binary
   a. 25
   b. 65
   c. 34
   d. 267
   e. 45
   f. 71
   g. 150
   h. 111
8. Convert the following Hexadecimal into Binary.
   a. A1
   b. 2AB
   c. 239
   d. CCD
   e. 45C
   f. 71D
   g. 150
   h. AAA

Answers

1.
   a. (24)10 = (11000)2 = (30)8 = (18)16
   b. (47)10 = (101111)2 = (57)8 = (2F)16
   c. (675)10 = (1010100011)2 = (1243)8 = (2A3)16
   d. (89)10 = (10110001)2 = (131)8 = (59)16
   e. (34.24)10 = (100010.00111)2 = (42.1727)8 = (22.3D7100)16
   f. (150.64)10 = (10010110.1010)2 = (226.5075)8 = (96.A70A)16
   g. (0.98)10 = (0.1111)2 = (.7656)8 = (FAE1)16
   h. (0.29)10 = (0.0100)2 = (.2243)8 = (.4A3D)16
   i. (24.14)10 = (11000.0010)2 = (30.1075)8 = (18.231D)16
   j. (16.1)10 = (10000.0001)2 = (20.063)8 = (10.199)16
   k. (22.33)10 = (10110.0101)2 = (26.250)8 = (16.547)16
   l. (24.14)10 = (11000.0010)2 = (30.1075)8 = (18.231D)16

2.
   a. (110000111)2 = (391)10
   b. (110011)2 = (51)10
   c. (1001111)2 = (79)10
   d. (11000001)2 = (193)10
   e. (1100110.1110)2 = (102.087)10
   f. (11110.0000)2 = (30.0)10
   g. (01001.0101)2 = (9.312)10
   h. (1010.10101)2 = (10.65)10
   i. (11000011.111)2 = (195.875)10
   j. (11001.1101)2 = (25.8125)10
   k. (100.111)2 = (4.875)10
   l. (101.0111)2 = (5.4375)10

3.
   a. (234)8 = (156)10
   b. (36)8 = (30)10
   c. (456)8 = (302)10
   d. (217)8 = (143)10
   e. (25.33)8 = (21.4218)10
   f. (65.34)8 = (53.4375)10
   g. (34.56)8 = (28.7187)10

h. (267.12)8 = (183.1562)10

4.

a. (E16)16 = (3606)10
b. (389)16 = (905)10
c. (2AB)16 = (683)10
d. (FF)16 = (255)10
e. (E4.16)16 = (228.0859)10
f. (2A.1B)16 = (42.1054)10
g. (23.89)16 = (35.5351)10
h. (AC.BD)16 = (172.7382)10

5.

a. (1100011)2 = (143)8
b. (110011001100)2 = (6314)8
c. (100111100)2 = (474)8
d. (110000011)2 = (603)8
e. (110011011)2 = (633)8
f. (1111000)2 = (170)8
g. (0010101)2 = (025)8
h. (101010101)2 = (525)8

6.

a. (11000011111)2 = (61F)16
b. (1100110011)2 = (333)16
c. (100111100)2 = (13C)16
d. (1100000100)2 = (304)16
e. (11001101110)2 = (66E)16
f. (111100000)2 = (1E0)16
g. (010010101)2 = (095)16
h. (101010101)2 = (155) 16

7.

a. (25)8 = (010101)2
b. (65)8 = (110101)2
c. (34)8 = (011100)2
d. (267)8 = (010110111)2
e. (45)8 = (100101)2
f. (71)8 = (111001)2
g. (150)8 = (001101000)2
h. (111)8 = (001001001)2

8.

a. (A1)16= (10100001)2
b. (2AB)16= (001010101011)2
c. (239)16 = (001000111001)2
d. (CCD)16= (110011001101)2
e. (45C)16 = (010001011100)2
f. (71D)16 = (011100011101)2
g. (150)16 = (000101010000)2
h. (AAA)16 = (101010101010)2

3.8 Multiple Choice Questions (MCQs)

1. The value of radix/base in Octal number system is _____
   a) 2 **b) 8** c) 10 d) 1
2. The binary equivalent of the decimal number 10 is _____
   a) 0010 b) 10 **c) 1010** d) 010
3. The octal equivalent of 1100101.001010 is _____
   a) 624.12 **b) 145.12** c) 154.12 d) 145.21

4. The input hexadecimal representation of 1110 is _____
   a) 0111 **b) E** c) 15 d) 14
5. A bit in a computer terminology means either 0 or 1.
   a) True b) False
6. Convert the binary equivalent 10101 to its decimal equivalent.
   a) 21 b) 12 c) 22 d) 31
7. Which of the following is not a binary number?
   a) 1111 b) 101 **c) 11E** d) 000
8. Which of the following is the correct representation of a binary number?
   a) $(124)_2$ b) 1110 c) $(110)^2$ **d) $(000)_2$**
9. The value of base in a decimal number system is _____
   a) 8 b) 2 **c) 10** d) 16
10. Convert: $(110)_2$ = (____) $_{10}$.
    a) 4 b) 5 **c) 6** d) 9
11. The decimal equivalent of (0.101)2 will be _____
    a) 0.5 **b) 0.625** c) 0.25 d) 0.875
12. Which of the following is not a decimal number?
    a) 114 b) 43.47 **c) 99.9A** d) 10101
13. The binary number 111 in octal format is _____
    a) 6 **b) 7** c) 8 d) 5
14. Convert (22)8 into its corresponding decimal number.
    a) 28 **b) 18** c) 81 d) 82
15. The octal equivalent of the binary number (010010100)2 is _____
    a) 422 b) 242 **c) 224** d) 226
16. The hexadecimal equivalent of the binary number (000010010100)2 is :
    a) $(0B4)_{16}$ b) $(0A4)_{16}$ c) 224 d) 0114
17. ABC is a valid hexadecimal number.
    a) True b) False
18. 1 Gigabyte = _____
    a) 1024 TB **b) 1024 MB** c) 1024 KB d) 1024 PB
19. A byte consists of _____
    a) One bit b) Four bits **c) Eight bits** d) Sixteen bits
20. Which one is the smallest space?
    a) bit b) byte c) kilobyte d) megabyte
21. Which one is the largest space?
    a) kilobyte **b) petabyte** c) terrabyte d) gigabyte
22. 1 Petabyte = _____
    a) 1024 TB b) 1024 MB c) 1024 KB d) 1024 PB

3.9 Descriptive Questions

1. Convert the following Decimal numbers to its equivalent Binary, Octal, Hexadecimal?
   a) 255 b) 24 c) 126
2. Convert the following Binary, Octal, Hexadecimal to its equivalent Decimal?
   a) $(1011.1001)_2$ b) $(24.36)_8$ c) $(4D.21)_{16}$
3. Write the steps for the indirect conversion from Decimal to Binary and explain with example?
4. Write the steps for the following conversions and explain with example?
   a) Conversion of Binary to Octal
   b) Conversion of Binary to Hexadecimal
5. Write the steps for the following conversions and explain with example?
   a) Conversion of Octal to Binary
   a) Conversion of Hexadecimal to Binary

Web Resources:

1. https://www.tutorialspoint.com/basics_of_computers/basics_of_computers_number_system.htm
2. https://ncert.nic.in/textbook.php?kecs1=2-11

UNIT-4: Boolean Logic

Module – 1 : Logic GATES

4.1 Introduction

Nowadays, computers have become an integral part of life as they perform many tasks and operations in quite a short span of time. One of the most important functions of the CPU in a computer is to perform logical operations by utilizing hardware like Integrated Circuits, electronic circuits and software technologies. But, how these hardware and software perform such operations is a mysterious puzzle. In order to have a better understanding of such a complex issue, we must have to acquaint ourselves with the term Boolean Logic, developed by George Boole. For a simple operation, computers utilize binary digits rather than digital digits. All the operations are carried out by the Basic Logic gates.

4.1.1 Definition

A logic gate is a basic building block of a digital circuit that has two or more inputs and one output. The relationship between the input(i/p) and the output(o/p) is based on certain logic. These gates are implemented using electronic switches like transistors, diodes. Logic gates are used in microprocessors, microcontrollers, and embedded system applications and in electronic and electrical project circuits.

Basic Logic Gates Operation

The basic logic gates are used to perform fundamental logical functions. These are the basic building blocks in the digital ICs (integrated circuits). Most of the logic gates use two binary inputs and generates a single output like 1 or 0.

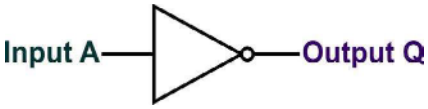
4.2 Types of Basic Logic Gates

The basic logic gates are categorized into seven: AND, OR, XOR, NAND, NOR, XNOR and NOT. These logic gates with their logic gate symbols and truth tables are explained below.

4.2.1 NOT Gate (or inverter)

NOT gate is also known as inverter. The simplest form of logic gates has only one input and one output. Its function is to invert the input signal - it turns a logic 0 input into a logic 1 output and vice-versa.

The symbol for a NOT gate is as follows:



The behavior of a logic gate is summarized in a table, called 'Truth Table' which is the simplest of all and is shown below:

Truth Table

Input A	Output Q
0	1
1	0

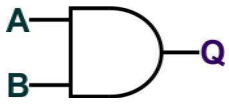
There is also a shorthand way of writing down the function of this logic gate, using a special type of algebra called Boolean algebra.

The Boolean expression for a NOT gate is: $Q = \bar{A}$

The 'bar' over the A indicates that output Q is the opposite of input signal A.

4.2.2 AND Gate

The AND gate is a logic gate with 'n' i/ps and one o/p, which performs logical conjunction based on the combinations of its inputs. The output of this gate is true only when all the inputs are true. When one or more inputs of the AND gate's i/ps are false, then only the output of the AND gate is false. The symbol and truth table of an AND gate with two inputs is shown below.



Truth Table

Inputs		Output
A	**B**	**Q**
0	0	0
0	1	0
1	0	0
1	1	1

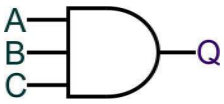
The output is logic 1 only when input A AND input B are both at logic 1.

The Boolean expression for a two input AND gate is: Q=A.B

The '.' between the A and B means AND in Boolean algebra.

Now, the three input **AND** gate:

The symbol is:



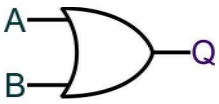
Inputs			Output
A	**B**	**C**	**Q**
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

The output is logic 1 only when input A, input B, input C are at logic 1.

The Boolean expression for a three input AND gate is: Q = A.B.C

4.2.3 OR Gate

The OR gate is a digital logic gate with 'n' i/ps and one o/p, that performs logical conjunction based on the combinations of its inputs. The output of the OR gate is true only when one or more inputs are true. If all the i/ps of the gate are false, then only the output of the OR gate is false. The symbol and truth table of an OR gate with two inputs is shown below.



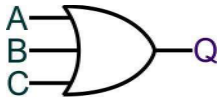
Inputs		Output
A	**B**	**Q**
0	0	0
0	1	1
1	0	1
1	1	1

The output is logic 1 when input A OR input B OR both are at logic 1.

The Boolean expression for a two input OR gate is: Q = A + B

The '+' between the A and B means OR in Boolean algebra.

The symbol for a three input OR gate is:



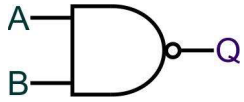
Inputs			Output
A	B	C	Q
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

The output is logic 1 when either input A OR input B OR input C OR any combination is/are at logic 1.

The Boolean expression for a three input OR gate is: Q = A + B + C

4.2.4 NAND Gate

The NOT gate is a digital logic gate with one input and one output that operates an inverter operation of the input. The output of the NOT gate is the reverse of the input. When the input of the NOT gate is true then the output will be false and vice versa. The symbol and truth table of a NOT gate with one input is shown below. By using this gate, we can implement NOR and NAND gates



Inputs		Output
A	B	Q
0	0	1
0	1	1
1	0	1
1	1	0

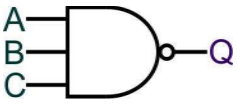
Compare this truth table with that for the AND gate. For the NAND gate, output Q is the exact opposite of that for the AND gate.

The Boolean expression for the two input NAND gate is: $Q = \overline{A.B}$.

The '.' between A and B means AND, and the 'bar' means 'invert' in Boolean algebra.

Now, the three input NAND gate:

The symbol is:



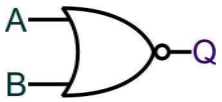
Inputs			Output
A	B	C	Q
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

The Boolean expression for a 3-input NAND gate is: $Q = \overline{A.B.C}$

4.2.5 NOR Gate

The NOR gate is a digital logic gate with n inputs and one output, that performs the operation of the OR gate followed by the NOT gate. NOR gate is designed by combining the OR and NOT gate. When any one of the i/ps of the NOR gate is true, then the output of the NOR gate will be false. The symbol and truth table of the NOR gate with the truth table is shown below.

The symbol for a 2- input NOR gate is:



Inputs		Output
A	B	Q
0	0	1
0	1	0
1	0	0
1	1	0

Compared to the OR gate, the NOR gate outputs are the exact opposite.

The Boolean expression for the two input NOR gate is: $Q = \overline{A + B}$.

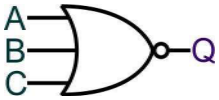
The '+' between A OR B means OR, and the 'bar' means 'invert' in Boolean algebra.

Now, the three input NOR gate:

The symbol is:

The Boolean expression for a 3-input NOR gate is:

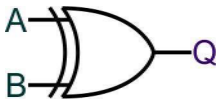
$Q = \overline{A + B + C}$.



Inputs			Output
A	B	C	Q
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

4.2.6 XOR Gate

The Exclusive-OR gate is a digital logic gate with two inputs and one output. The short form of this gate is Ex-OR. It performs based on the operation of the OR gate. If any one of the inputs of this gate is high, then the output of the EX-OR gate will be high. The symbol and truth table of the EX-OR are shown below.



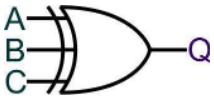
Inputs		Output
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	0

The output is logic 1 when either A or B is logic 1, but not when both A and B are logic 1. The Boolean expression for a two input XOR gate is: Q = A⊕Bor, alternatively:

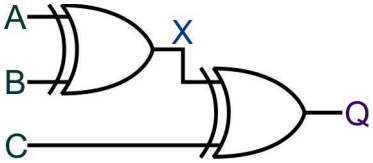
$$Q = \bar{A}.B + A.\bar{B}$$

The '⊕' between the A and B indicates Exclusive OR. The alternative form is more useful when simplifying Boolean expressions.

Next, the three input XOR gate. The symbol is:



The behavior is that of two 2 input XOR gates connected one after the other, as the following diagram shows:



The output of the first XOR gate, labelled X, is obtained using inputs A and B. Output Q, the output of the second XOR gate, is obtained using C and X as inputs.

Putting this information into a truth table gives:

Inputs			Outputs	
C	B	A	X	Q
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	0	1

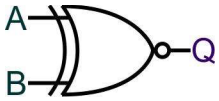
The Boolean expression for a two input XOR gate is:

$Q = A \oplus B \oplus C$

4.2.7 XNOR Gate

The Exclusive-NOR gate is a digital logic gate with two inputs and one output. The short form of this gate is Ex-NOR. It performs based on the operation of the NOR gate. When both the inputs of this gate are high, then the output of the EX-NOR gate will be high. But, if any one of the inputs is high (but not both), then the output will be low. The symbol and truth table of the EX-NOR are shown below. The XNOR (EXclusive-NOR) gate is the inverted form of the XOR gate.

The symbol for a two input XNOR gate is:



Inputs		Output
B	A	Q
0	0	1
0	1	0
1	0	0
1	1	1

The output is the exact opposite to that of the XOR.

The Boolean expression for the two input XNOR gate is: $Q = \overline{A \oplus B}$

or, alternatively: $Q = \bar{A}.\bar{B} + A.B$

However, the alternative form will prove to be more useful later on in the course when simplifying Boolean expressions.

The 3-input XNOR is the exact opposite of the 3-input XOR gate. Its truth table is:

Inputs			Output
C	B	A	Q
0	0	0	1
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1

1	1	0	1
1	1	1	0

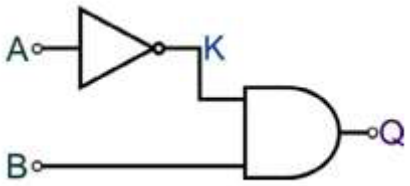
The Boolean expression for the 3-input XNOR is: $Q = \overline{A \oplus B \oplus C}$

Module – 2

4.3 Analyzing Simple Logic Circuits

Questions may focus on individual logic gates but are more likely to consider combinations of gates. For example, you could be asked to complete the truth table for a combinational logic system.

Example 1: Study the following logic system carefully and then complete the truth table that follows:



Inputs		Outputs	
A	B	K	Q
0	0		
0	1		
1	0		
1	1		

Solution:

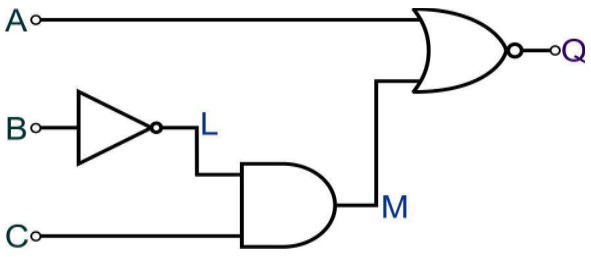
The output of the NOT gate is labeled**K**. The first step is to complete the column for output **K**, the inverse of **A**. This is shown below:

Inputs		Outputs	
A	B	K	Q
0	0	1	
0	1	1	
1	0	0	
1	1	0	

The next step is to complete the final column. Signal **Q** is the output of the AND gate which has B and **K** as inputs.

Inputs		Outputs	
A	B	K	Q
0	0	1	0
0	1	1	1
1	0	0	0
1	1	0	0

Example 2: Complete the truth table for the system shown below:



Inputs			Outputs		
A	B	C	L	M	Q
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Solution:

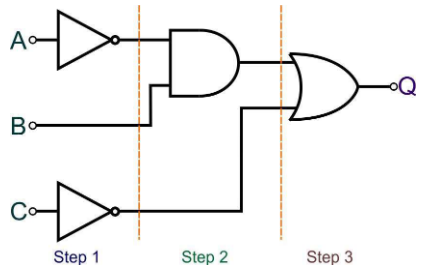
First step - complete the column for the NOT gate output (L). [Remember its input is B].

Second step - complete the column for the AND gate output (M). [Its inputs are L and C].Finally - complete the NOR gate output (Q). [Its inputs are A and M].

Inputs			Outputs		
A	B	C	L	M	Q
0	0	0	1	0	1
0	0	1	1	1	0
0	1	0	0	0	1
0	1	1	0	0	1
1	0	0	1	0	0
1	0	1	1	1	0
1	1	0	0	0	0
1	1	1	0	0	0

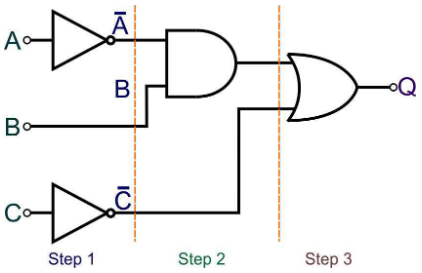
4.4 Generate The Boolean Expressions From A Circuit Diagram.

Example 1: Derive the Boolean expression for the following logic circuit.

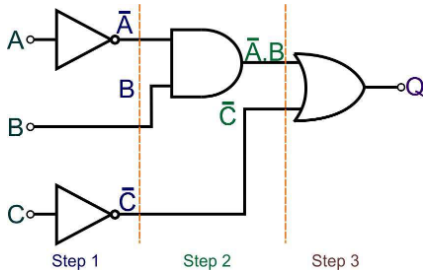


First of all, divide the circuit into stages as shown above. This breaks down a large circuit into smaller more manageable chunks.

Then, write down the Boolean expressions for all the outputs of Step 1.



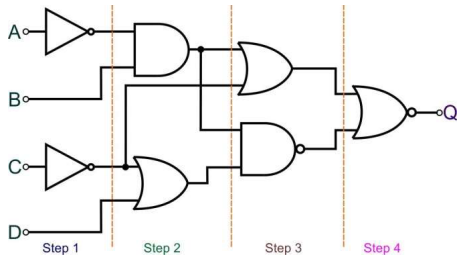
Now do the same for the outputs of Step 2, as shown below



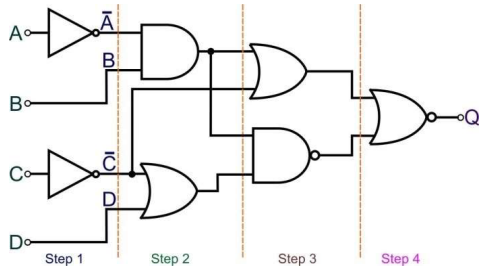
Finally do the same for Step 3, to arrive at the expression for the output of the whole system as

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

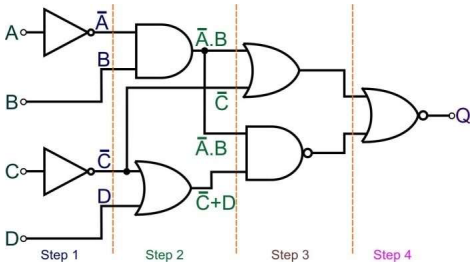
Example 2: Now do the same for this much larger system.



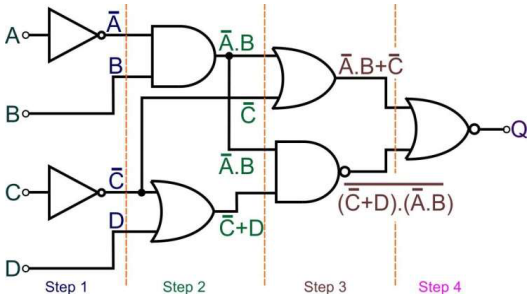
First of all, divide it into small steps:
Next, work out all of the outputs in Step 1



Now, do the same for Step 2



Now, the same for Step 3



Notice the use of brackets to keep the inputs to the NAND gate together.

Finally, the two large expressions are inputs into the NOR gate. Again, brackets are used to keep the inputs together. The final Boolean equation is:

$$Q = \overline{(\overline{A}.B + \overline{C}) + (\overline{\overline{A}.B}).(\overline{C} + D)}$$

4.4 Creating A Logic Circuit Diagram from A Boolean Equation

A written specification or a truth table can be used to develop a Boolean expression for the system. From that, a logic circuit diagram can be designed.The rule of thumb is to start with any bracketed terms, then AND and finally OR functions.

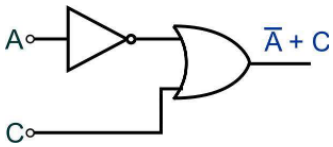
The following example should make this clearer.

Example 1:Draw the logic circuit diagram for the following Boolean expression:

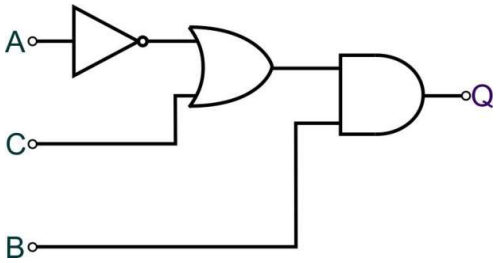
$$Q = B.(\overline{A} + C)$$

Solution:

First, create the logic for the bracketed term:



Then connect its output to an AND gate, with **B** as the other input:



4.5. Multiple Choice Questions

1. **The universal gate is?**
   - A. NAND gate
   - B. OR gate
   - C. AND gate
   - D. None of the above

2. **The inverter is?**
   - A. NOT gate
   - B. OR gate
   - C. AND gate
   - D. None of the above

3. **The NOR gate is OR gate followed by?**
   - A. AND gate
   - B. NAND gate
   - C. NOT gate
   - D. None of the above

4. **The NAND gate is AND gate followed by?**
   - A. NOT gate
   - B. OR gate
   - C. AND gate
   - D. None of the above

5. **The only function of NOT gate is to?**
   A. Stop signal
   B. Invert input signal
   C. Act as a universal gate
   D. None of the above

6. **When an input signal 1 is applied to a NOT gate, the output is?**
   A. 0
   B. 1
   C. Either 0 & 1
   D. None of the above

7. **In Boolean algebra, the bar sign (-) indicates?**
   A. OR operation
   B. AND operation
   C. NOT operation
   D. None of the above

8. **The output will be a LOW for any case when one or more inputs are zero in a/an?**
   A. OR Gate
   B. NOT Gate
   C. AND Gate
   D. NAND Gate

9. **The logic gate that will have HIGH or "1" at its output when any one of its inputs is HIGH is a/an?**
   A. OR Gate
   B. NOT Gate
   C. AND Gate
   D. NAND Gate

10. **The basic logic gate whose output is the complement of the input is?**
    A. OR gate
    B. AND gate
    C. INVERTER gate
    D. Comparator

11. **The output of an AND gate with three inputs, A, B, and C, is HIGH when**
    A. A = 1, B = 1, C = 0
    B. A = 0, B = 0, C = 0
    C. A = 1, B = 1, C = 1
    D. A = 1, B = 0, C = 1

12. **The output of an OR gate with three inputs, A, B, and C, is LOW when**
    A. A = 0, B = 0, C = 0
    B. A = 0, B = 0, C = 1
    C. A = 0, B = 1, C = 1
    D. all of the above

13. **Which of the following logical operations is represented by the + sign in Boolean algebra?**
    A. Inversion
    B. AND
    C. OR
    D. Complementation

14. **Output will be a LOW for any case when one or more inputs are zero for a(n):**
    A. OR gate

B. NOT gate
C. AND gate
D. NOR gate

15. The output of a NOR gate is HIGH if:

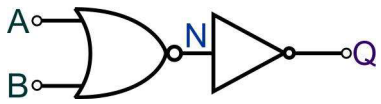
A. All inputs are HIGH
B. Any input is HIGH
C. Any input is LOW
D. All inputs are LOW

ANSWERS

1. A
2. A
3. C
4. A
5. B
6. A
7. C
8. C
9. A
10. C
11. C
12. A
13. C
14. C
15. D

4.6 Unsolved Questions

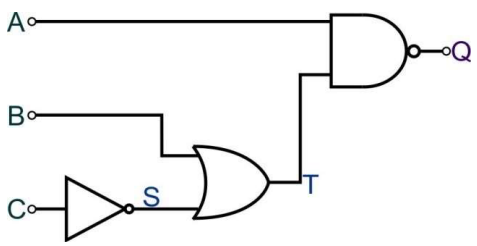
1. Complete the truth table for the system shown below:



Inputs		Outputs	
B	**A**	**N**	**Q**
0	0		
0	1		
1	0		
1	1		

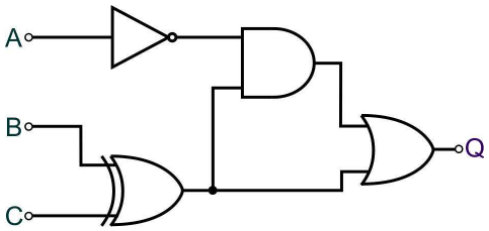
2. Complete the truth table for the system shown below:

Inputs			Outputs		
C	**B**	**A**	**S**	**T**	**Q**
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			



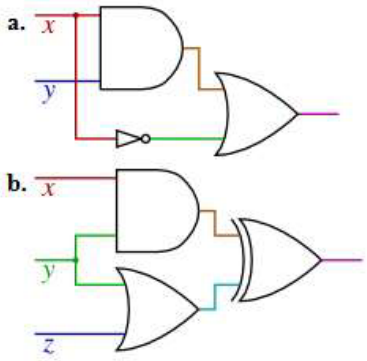
1	1	0			
1	1	1			

3. In this question, the intermediate outputs are not labeled. Create and complete the truth table for this system:



The same Q output could be produced by a single two input gate.

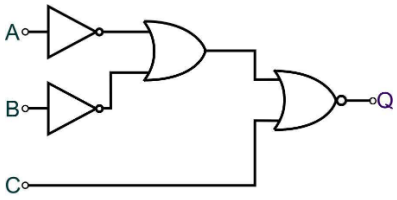
4. For each of the following circuits, write a truth table tabulating the circuit's output for each combination of inputs.



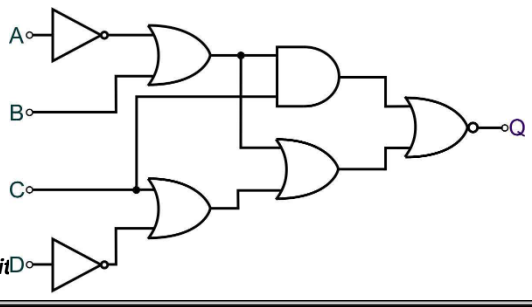
Exercise

1. Derive the Boolean equations for the output of the following logic systems

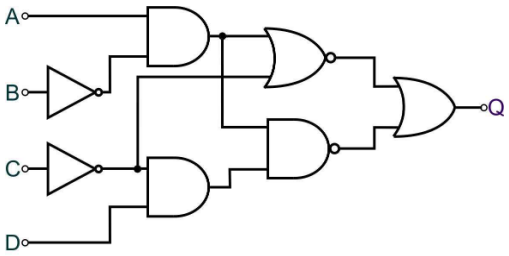
A.



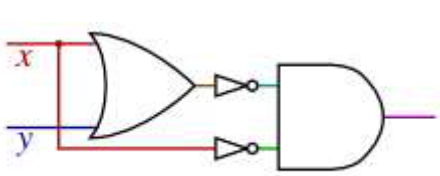
B.

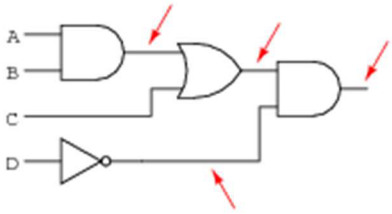


C.



2. For the following circuit, write the Boolean expression that most closely corresponds to the circuit.





Exercise

1. For each of the following, draw the corresponding logic circuit diagram:

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

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

$Q = \overline{A + B} + \overline{A}.(C + B)$

2. For each of the following Boolean expressions, draw the logic circuit corresponding most closely to it.

a. $\overline{x + y} + x$
b. $x\,y + \overline{x}\,\overline{y}$

Solutions for 2nd question is

a. $\overline{x}$

$\overline{y}$

b. $\overline{x}$

$\overline{y}$

4.7 Short Answer Questions

1. Define gates.
2. List out the basic gates.

3. Define AND gate.
4. What do you mean by truth table?
5. Define OR gate.
6. What do you mean by Boolean algebra?
7. List out the truth table entry for two input NAND gate.
8. Define logic circuit for expression

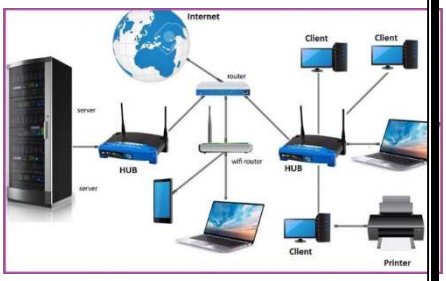
UNIT-5 :: Basics of Networking

Objectives

- Students will come to know about what is network and its implementation.
- Students can understand about bandwidth and data transfer rate.
- Students will learn network types and connection types.
- Students will able to know about different types of network topologies
- Students will understand Network types based on Architecture

Module – 1

5.1 Introduction to Networking



A **computer network** is an interconnection of two or more computers that are able to exchange information

Network is use for sharing resources; exchange files, or allow electronic communications. The computers on a network may be linked through cables, telephone lines, radio waves, satellites.

5.2 Evolution of Networking

1. **ARPANET:** In 1969, The US govt. formed an agency named ARPANET (Advanced Research Projects Agency NET work) to connect computers at various universities and defense agencies. The main objective of ARPANET was to develop a network that could continue to function efficiently even in the event of a nuclear attack.
2. **NSFNET:** The **National Science Foundation Network** (NSFNET) was a program of coordinated, evolving projects sponsored by the National Science Foundation (NSF) from 1985 to 1995 to promote advanced research and education networking in the United States. Network which was more capable than ARPANET, main aim was to use network only for academic research.
3. **Internet (INTERconnection NETwork):** The Internet is a worldwide network of computer networks. It is not owned by anybody.
4. **Interspace:** InterSpace is a client/server software program that allows multiple users to communicate online with real –time audio, video and text chat in dynamic 3D environments.

5.3 Bandwidth and Data transfer rate

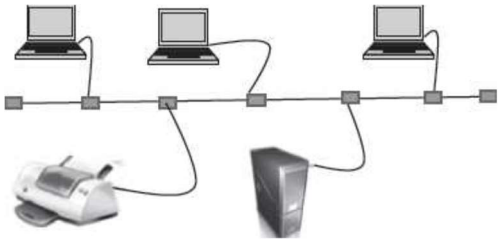
1. **Concept of Channel**: -A data channel is the medium used to carry information or data from one point to another.
2. **Baud:** It is the unit to measure the data transmission speed. It is equivalent to bps (bits per second).
3. **Bandwidth:** -The maximum volume of data that can be transferred over any communication channel at a given point of time is known as the bandwidth. In analog systems, it is measured in hertz (Hz) and in digital systems; it is measured in bits per second (bps)
4. **Data transfer rate**: -The amount of data transferred per second by the communication channel from one point to another is known as the data transfer rate. It is measured in bits per second (bps), bytes per second (Bps).

BITS	BYTES
Used to measure **speed** (of a connection)	Used to measure **size** (of a data file)
Written with a lower-case **b** (e.g. 25 bps, 20 Mbps)	Written with a capital **B** (e.g. 30 MBps, 5 GBps)
Kilobit (kb)—1,024 bits	Kilobyte (KB)—1,024 bytes
Megabit (Mb)—1,024 kilobits	Megabyte (MB)—1,024 kilobytes
Gigabit (Gb)—1,024 megabits	Gigabyte (GB)—1,024 megabytes
Terabit (Tb)—1,024 gigabits	Terabyte (TB)—1,024 gigabytes

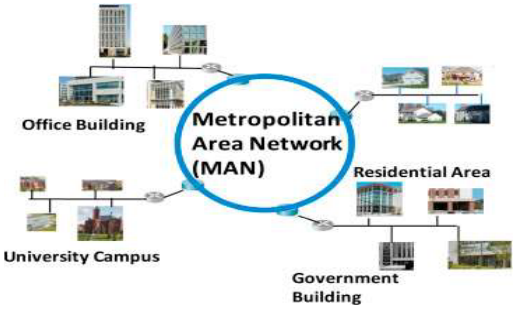
5.4 Types of Networks

Computer network is broadly classified into three types — (1) Personal Area Network (PAN), (2) Local Area Network (LAN), (3) Metropolitan Area Network (MAN), and (4) Wide Area Network (WAN).

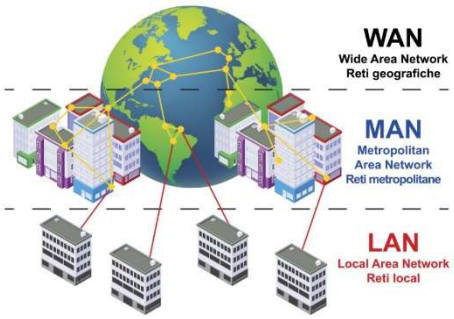
5.4.1 PAN (Personal Area Network): A Personal Area Network is computer network organized around an individual person. It generally covers a range of less than 10 meters. Personal Area Networks can be constructed with cables or wirelessly



5.4.2 Local Area Network (LAN): A Local Area Network (LAN) is a network that is confined to a relatively small area. LAN connects computers in a small area like a room, building, office or a campus spread up to a few kilometers. It is generally privately owned networks over a distance not more than 5 Km. LAN runs at a speed of 10 Mbps to 100 Mbps and has low delays. A LAN based on WiFi wireless network technology is called Wireless Local Area Network (WLAN).



5.4.3 Metropolitan Area Network (MAN): MAN is the networks cover a group of nearby corporate offices or a city and might be either private or public. These types of networks are larger than LANs but smaller than WANs – and incorporate elements from both types of networks. Cable television network is an example of MAN. The computers in a MAN are connected using coaxial cables or fiber optic cables. MAN also connects several LAN spread over a city



5.4.4 WAN (Wide Area Network): WAN is a network type which provides transmission of videos, images, data and voice covering large geographical areas. It is made up of LAN and MAN combinations. In order for carrying out the transmission it gets the help of modems, routers, hubs and switches.

Net work → Parameter↓	PAN	LAN	MAN	WAN
Area Covered	Small Area (Up to 10m radius)	A few meters to a few kilometers (Up to 10Km radius)	A City and its vicinity (Up to 100Km radius)	Entire country, continent,or globe (No upper limit)
Error Rates	Lowest	Low	Moderate	Highest
Transmission Speed	High Speed	High Speed	Moderate Speed	Low Speed
Networking Cost	Negligible	Inexpensive	Moderately expensive equipment	Expensive

5.5 Network Advantages and Disadvantages

Advantages:

- File sharing – you can easily share data between different users, or access it remotely if you keep it on other connected devices.

- Resource sharing – using network-connected peripheral devices like printers, scanners, or sharing software between multiple users to share anyone on the network and it saves money.
- Sharing a single internet connection – it is cost-efficient and can help protect your systems if you properly secure the network.
- Increasing storage capacity – you can access files and multimedia, such as images and music, which you store remotely on other machines or network-attached storage devices.
- Easy Communication – it is very easy to communicate through a network. Network provides a powerful communication medium people can enjoy benefits of e-mails, instant messaging, video conferencing etc.

Disadvantages:

- It comes with the risk of security issues - Considering the large number of people using a computer network and sharing files and resources, your security would normally be at risk.
- Security Threats - Security threats are always problems with large networks. There are hackers who are trying to steal valuable data of large companies for their own benefit. So it is necessary to take utmost care to facilitate the required security measures

Module – 2

5.6 Transmission media

The data is sent from one computer to another over a transmission medium. The transmission media can be grouped into guided media, and unguided media.

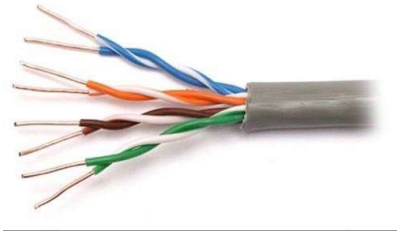
In the *guided media*, the data signals are sent along a specific path, through a wire or a cable. Copper wire and optical fibers are the most commonly used guided media. Copper wire transmits data as electric signals. Copper wires offer low resistance to current signal, facilitating signals to travel longer distances.

In the *unguided media*, the data signals are not bounded by a fixed channel to follow. The data signals are transmitted by air. Radio, microwave, and satellite transmissions fall into this category.

a. **Twisted pair cable**: A twisted pair cable consists of four pairs of copper wires coated with an insulating material like plastic or Teflon, twisted together. The twisting of wires reduces electromagnetic interference from external sources.

Twisted pair cabling is often used in data networks for short and medium length connections because of its relatively lower costs compared to optical fiber and coaxial cable.

Twisted pair cabling is the most common form of cabling found of LAN's today



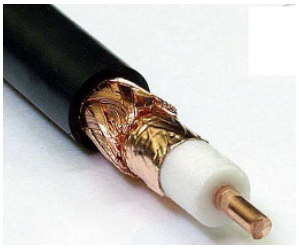
Advantages:

- It is easy to install and maintain.
- It is very inexpensive

Disadvantages:

- It is incapable to carry a signal over long distances without the use of repeaters.
- Due to low bandwidth, these are unsuitable for broadband applications.

b. **Co-axial Cables**: Coaxial cable is a two-conductor cable consisting of a center conductor and an outer conductor with an insulating spacer between the two. It is mostly used in the cable wires.



Advantages:

- Data transmission rate is better than twisted pair cables.
- It provides a cheap means of transporting multi-channel television signals around metropolitan areas.

Disadvantages:

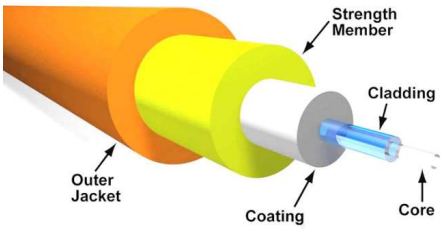
- Expensive than twisted pair cables.

- Difficult to manage and reconfigure.

c. **Optical fiber:** Optical fibers are being used for transmission of information over large distances more cost effectively than the copper wire connection. Communication systems are now unthinkable without fiber optics. Optical fiber transmits data as light signals instead of electric signals.

Advantages:

- Transmit data over long distance with high security.
- Optical fibers are ideally suited for carrying digital information, which is especially useful in computer networks.
- They are highly secure as they cannot be tapped and for lack of signal radiation.
- Data transmission speed is high
- Bandwidth is up to 10 Gbps.



Disadvantages:

- Installing an optical fiber requires special equipment.
- If a fiber breaks, finding the broken location is difficult.
- Repairing a broken optical fiber is difficult and requires special equipment.
- Due to its high installation costs, they are economical when the bandwidth utilization is high.

d. **Radio Wave Transmission:** The electromagnetic radio waves that operate at the radio frequency are also used to transmit computer data. This transmission is also known as Radio Frequency RF) transmission. The computers using RF transmission do not require a direct physical connection like wires or cable. Each computer attaches to an antenna that can both send and receive radio transmission.

Advantages:

i. Radio wave transmission offers mobility.
ii. It is cheaper than laying cables and fibers.
iii. It offers ease of communication over difficult terrain.

Disadvantages:

iv. Radio wave communication is insecure communication.
v. Radio wave propagation is susceptible to weather effects like rains, thunder storms etc.

e. **Microwave Wave Transmission**: The Microwave transmission is a line-of-sight transmission. Microwave signals travel at a higher frequency than radio waves and are popularly used for transmitting data over long distances.

Advantages:

i. It is cheaper than laying cable or fiber.
ii. It has the ability to communicate over oceans.

Disadvantages:

iii. Microwave communication is an insecure communication.
iv. Signals from antenna may split up and transmitted in different way to different antenna which leads to reduce to signal strength.
v. Microwave propagation is susceptible to weather effects like rains, thunder storms etc.
vi. Bandwidth allocation is extremely limited in case of microwaves.

f. **Satellite link:** The communication across longer distances can be provided by combining radio frequency transmission with satellites. The satellite transmission is also a kind of line-of-sight transmission that is used to transmit signals throughout the world.

Advantages:

i. Area covered is quite large.

ii. No line-of-sight restrictions such as natural mountains, tall building, towers etc.

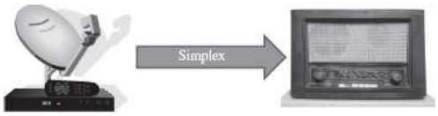
Disadvantages:

iii. Very expensive as compared to other transmission mediums.
iv. Installation is extremely complex.
v. Signals sent to the stations can be tampered by external interference.

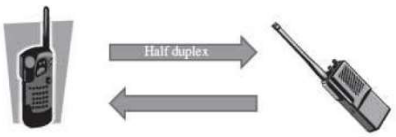
5.6.1 Transmission Modes

The direction in which data can be transmitted between any two linked devices is of three types

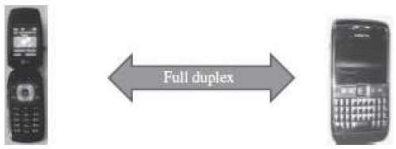
- **Simplex**: Simplex transmission is unidirectional data transmission. Of the two linked devices, only one of them can send data and the other one can only receive data.



- **Half-duplex**: Half–duplex transmission is bi-directional data transmission, but the linked devices cannot send and receive at the same time. When one device is sending data the other can only receive.

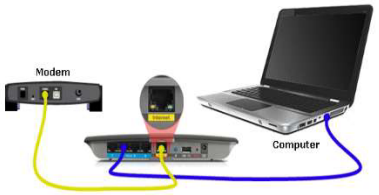


- **Full-duplex, or duplex:** Full-duplex transmission is bi-directional and the linked devices can send and receive data simultaneously. The linked devices can send data and at the same time receive data.



5.7 Connection Types (Wired and wireless)

5.7.1 Wired Connection: A wired network uses cables to connect devices, such as laptop or desktop computers, to the Internet or another network. A wired network has some disadvantages when compared to a wireless network. The biggest disadvantage is that your device is tethered to a router. The most common wired networks use cables connected at one end to an Ethernet port on the network router and at the other end to a computer or other device.



Advantages of Wired Network:

- The network offer higher data rate and hence fast transfer of information.
- The wired connection is more secure unless someone breaks the connection and tap the signal
- It is simple to configure.
- Cables offer higher bandwidth.
- It offers higher reliability and better quality of service (QoS).

Disadvantages of Wired Network:

- Installation of wired network is very difficult. Moreover, it is difficult to troubleshoot in faulty situation
- It requires devices such as amplifiers, regenerators, repeaters, hubs and switches in order to extend the coverage distance.
- There are more chances of damage to wired technology products compare to wireless counterpart
- Wired connection does not provide mobility during usage

5.7.2 Wireless Connection: A wireless network allows devices to stay connected to the network but no need to connect any wires. Access points, amplify Wi-Fi signals, so a device can be far from a router but still be connected to the network. When you connect to a Wi-Fi hotspot at a cafe, a hotel, an airport lounge, or another public place, you're connecting to wireless network.

What are the benefits of a Wi-Fi wireless network?

- **Convenience:** Access your network resources from any location within your wireless network's coverage area or from any Wi-Fi hotspot.
- **Mobility:** You're not tied to your desk, as you are with a wired connection. You and your employees can go online in conference room meetings, for example.
- **Productivity:** Wireless access to the Internet and to your company's key applications and resources helps your staff get the job done and encourages collaboration.
- **Easy setup:** You don't have to string cables, so installation can be quick and cost effective.
- **Expandability:** You can easily expand wireless networks with existing equipment, whereas a wired network might require additional wiring.
- **Security:** Advances in wireless networks provide robust security protections.
- **Reduced cost:** Because wireless networks eliminate or reduce wiring expenses, they can cost less to operate than wired networks.

Disadvantages of Wireless Network

- **Speed:** Wireless network technology is slower than wired network technology
- **Security:** Wireless network is less secured than wired network

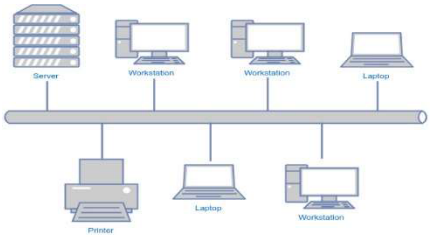
Module – 3

5.8 Network Topologies and types

Network topology: Network Topology is the schematic description of a network arrangement,connecting various nodes(sender and receiver) through lines of connection.

5.8.1 Bus Topology

- All devices on the network are connected through a central cable called a Bus.
- Each computer performs its task of sending messages without the help of the central server.
- It is good for connecting 15–20 computers.
- A single coaxial cable is generally used in bus topology, to which the computers or devices are connected.
- Ethernet is a commonly used protocol in networks connected by bus topology



Bus Topology Network

Advantages:

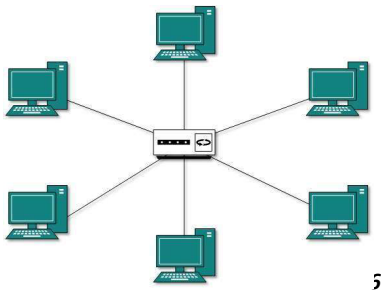
- Easy to connect and install.
- Involves a low cost of installation time.
- Can be easily extended.
- Requires less cable length than a star topology

Disadvantages:

- The entire network shuts down if there is a failure in the central cable.
- Only a single message can travel at a particular time.
- Difficult to identify the problem if the entire netwok shuts down.

5.8.2 STAR Topology

- All devices are connected through a central link forming a star-like structure.
- The central link is a hub or switch. The computers are connected to the hub or switch using twisted pair cables, coaxial cables or optic fibers.
- Star topology is the most popular topology to connect computer and devices in network.
- The data signal is transmitted from the source computer to the destination computer via the hub or switch.



- A STAR topology is common in homes networks where all the computers connect to the single central computerusing it as a hub.

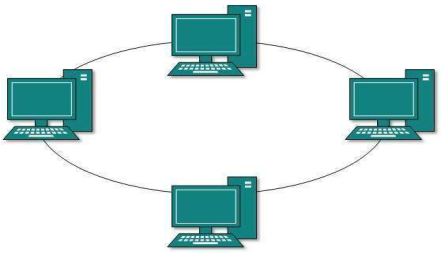
Advantages:

- Easy to install and wire.
- Easy to troubleshoot
- A single node failure does not affect the entire network.
- Fault detection and removal of faulty parts is easier.

Disadvantages:

- Difficult to expand.
- Longer cable is required.
- The cost of the hub and the longer cables makes it expensive over others.
- In case hub fails, the entire network fails.

5.8.3 RING Topology



- All devices in the network are connected in the form of a ring.
- Each device has a receiver and transmitter to receive the data signals and to send them to the next computer, respectively.
- Ring network does not have terminated ends, thus data signals travel in a circle.
- The computers or devices are connected to the ring using twisted pair cables, coaxial cables or optic fibers.

Advantages:

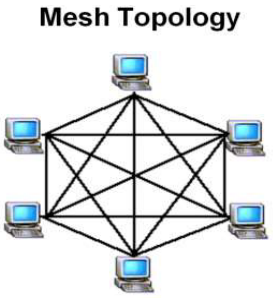
- Data is quickly transferred.
- The transmission of data is relatively simple as packets travel in one direction only
- Easy to install

Disadvantages:

- Data packets must pass through every computer between the sender and recipient therefore, this makes it slower.
- If any of the nodes fails then the ring is broken and data cannot be transferred successfully.
- Fault detection and removal of faulty parts is difficult

5.8.4 Mesh Topology

- In network setup where each computer and network device is interconnected with one another



Advantages:

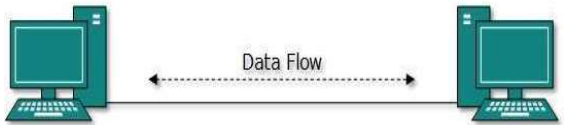
- Messages can be received more quickly if the route to the intended recipient is short
- each node can transmit to and receive from more than one node at the same time
- new nodes can be added without interruption or interfering with other nodes

Disadvantages:

- Full mesh networks can be impractical to set up because of the high number of connections needed
- many connections require a lot of maintenance

5.8.5 Point-to-Point

Point-to-point networks contain exactly two hosts such as computer, switches or routers, servers connected back to back using a single piece of cable. Often, the receiving end of one host is connected to sending end of the other and vice-versa.



Advantages:

- Only one cable enough to connect
- Data transfer will be high
- Less network issues

Disadvantages:

- Can not share information more that one.

5.9 Network devices

The cables are used to transmit data in the form of signals from one computer to another. But cables cannot transmit signals beyond a particular distance. Moreover there is a need to connect multiple computers and devices. A concentrator is a device having two or more ports to which the computers and other devices can be connected. A concentrator has two main functions — (1) It amplifies the signal to restore the original strength of the signal, and (2) It provides an interface to connect multiple computers and devices in a network. Repeater, hub, switch, bridge, and gateway are examples of network connecting devices.

Two or more LANs using different protocols may not be able to communicate with the computers attached to their network. For example, a LAN connected using Ethernet may not be able to communicate with a LAN connected using Token Ring. Bridge, Router, and Gateway are devices used to interconnect LANs.

Modem: Modem is abbreviation for Modulator – De-modulator. Modems are used for data transfer from one computer network to another computer network through telephone lines. The computer network works in digital mode, while analog technology is used for carrying massages across phone lines.

Modulator converts information from **digital mode to analog mode** at the transmitting end and de-modulator converts the same from **analog to digital at receiving end**. The process of converting analog signals of one computer network into digital signals of another computer network so they can be processed by a receiving computer is **referred to as digitizing.**

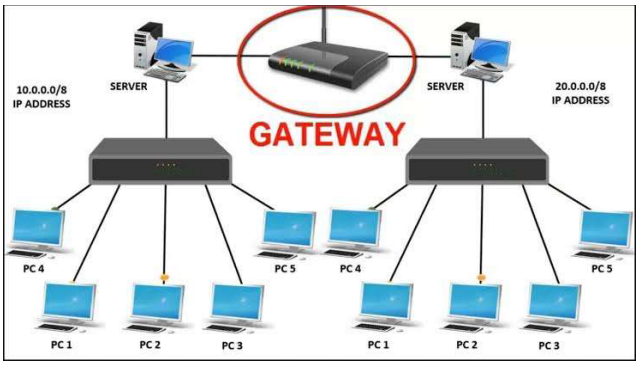
RJ45 connector: The RJ-45(Registered Jack) connectors are the plug-in devices used in the networking and telecommunications applications. They are used primarily for connecting LANs, particularly Ethernet.

Ethernet Card or Network Interface card : It is a hardware device that helps in connection of nodes within a network.

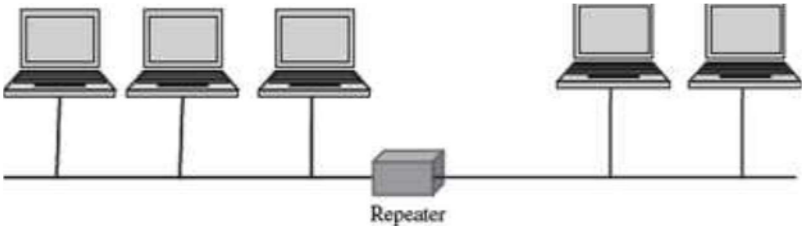
Hub: It is like a repeater with multiple ports. But, hub does not amplify the incoming signal. A hub is a hardware device used to connect several computers together. Hubs can be either active or passive. Hubs usually can support 8, 12 or 24 RJ45 ports. Hubs are used to connect multiple segments of the same network. Hubs are also used to connect computers to network that use Star topology.

Switch: Like hub, switch also connects multiple computers in a network or different segments of the same network. A switch (switching hub) is a network device which is used to interconnect computers or devices on a network. It filters and forwards data packets across a network. The main difference between hub and switch is that hub replicates what it receives on one port onto all the other ports while switch keeps a record of the MAC addresses of the devices attached to it.

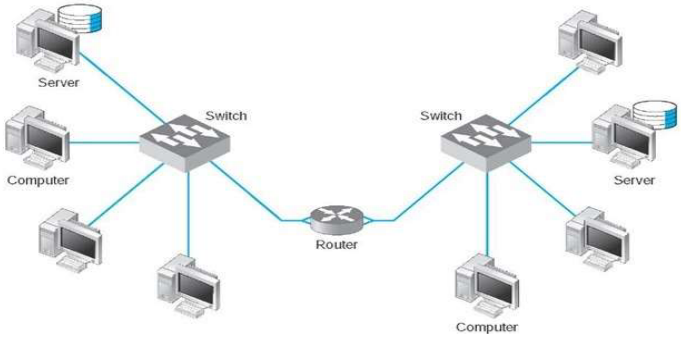
Gateway: A gateway is a device that connects dissimilar networks and performs the necessary translation so that the connected networks can communicate properly.



Repeater: A repeater is a network device that amplifies and restores signals for long distance transmission. When the data is transmitted over a network for long distances, the data signal gets weak due to attenuation. A repeater regenerates the received signal and re-transmits it to its destination. Generally repeaters are used to extend LAN. They are useful when computers in a network are located far away from each other.



Router: Router is a network device used to establish connection between two similar networks. They can connect networks with different architectures such as Token Ring and Ethernet. A router can connect two LANs, a LAN and a WAN, or two WANs.



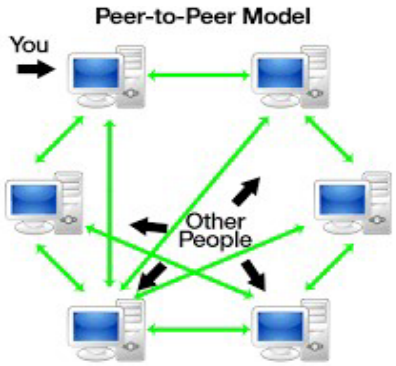
Wi-Fi Card: Wi-Fi cards are small and portable cards that allow your computer to connect to the internet through a wireless network.

5.10 Network Types based on Architecture

Network architectures are often classified into two broad categories:

- Peer-to-Peer architectures
- Client-server architectures

5.10.1 Peer-to-Peer Network: The Peer-to-Peer network is also called P2P or computer-to-computer network. 'Peers' are the nodes or computer system which is connected to each other. In this kind of network, each node is connected to each other node in the network**.**



- The nodes can share printers and allow other devices to read or write to its hard disk, allowing to sharing of files, access to its internet connection, and other resources
- In a peer-to-peer network, each node can work as either a server as well as a client
- Peer-to-Peer networks can be deployed very easily with most modern Operating Systems such as Windows and Mac O.S., etc.
- A peer-to-peer network can be configured as both wired as well as a wireless network. It is most commonly used in the Local Area Network, especially in small offices, or within a single department of a large organization.
- EX: Bit Torrent, HFS is a widely used peer-to-peer network.

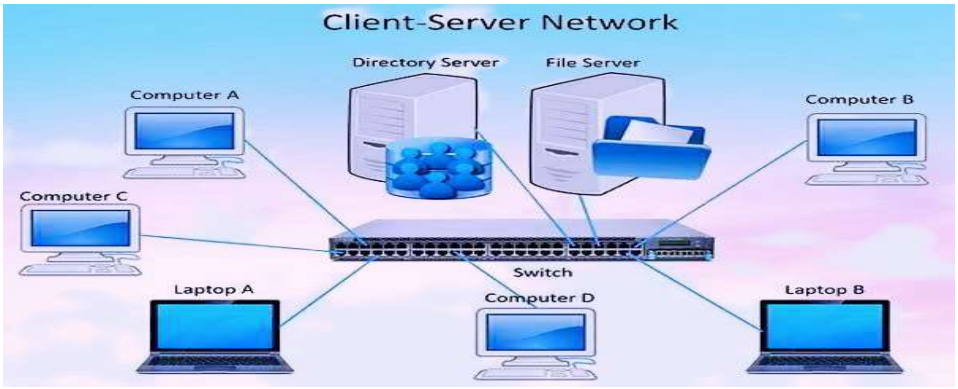
Advantages:

- Easy to implement and manage.
- Nodes or workstations are independent of one another. Also, no access permissions are needed.
- The network is reliable in nature. If a peer fails, it will not affect the working of others.
- There is no need for any professional software in such kind of networks.
- The cost of implementation of such networks is very less.

Disadvantages:

- Storage is decentralized, and also not so efficiently managed.
- No data backup options are available in peer-to-peer networks.
- These kinds of networks are not so secure.

Clint/Server based Networks: A Server-Based network can also be termed as a Client-Server network**.** A server is a node that acts as a service provider for clients. They wait for client requests and then respond to them



- The server is located elsewhere on the network it controls the level of access that users have to share resource In other words, a server provides functionality and serve other programs called clients.
- There is various kind of servers depending upon their use, they can be a web server (which servers HTTP requests), Database servers(which runs DBMS), File server(which provides files to clients), Mail server, print server, Game server, Application server, and so on. A server can contain web resources, host web applications, store user and program data, etc
- A client is a machine or program requesting services from a server. Clients are often situated at workstations or on personal computers

The Server-based network can be applied for various uses and applications.

Some of them are as follows:

- **Centralization:** The server administers the whole set-up in the network. Access rights and resource allocations are also done by the server.
- **Proper Management:** Due to centralized storage, it becomes easy to find a file or some other resource.
- **Backup and Recovery:** A centralized server makes data backup and recovery possible in a convenient manner.
- **Upgradation and Scalability:** Changes in the network can be made very easily by just upgrading the server. Also, the network is easily scalable.
- **Accessibility:** Servers can be accessed remotely from various platforms in the network.
- **Security:** Rules defining security and access rights can be defined at the time of the set-up of the server.

Advantages:

- It facilitates a Centralized storage system.
- Centralization makes administration easy.
- Data can be easily backed in such networks.
- The network is easy to scale.
- Data sharing speed is high.
- Servers can serve multiple clients at a time.

Disadvantages:

- Dependency is more on a centralized server.
- If the server's data is corrupted, all nodes will be affected.
- A network administrator is required.
- The cost of the server and network software is very high.

5.11 Network Applications

A network application is any application running on one host providing communication to another application running on a different host. Network applications allow network operators to easily manage and monitor network traffic as well as analyze data that can be used to improve network systems

Applications are

- File sharing
- Printer sharing
- Communication and collaboration
- Remote access
- Data protection
- Centralized support and administration

Multiple Choice Questions

1.what is computer network ?

a) Collection of hardware components and computers

b) Inter connected by communication channels

c) Sharing of information and resources

d) All of the above

2.what is firewall in computer network ?

a) The physical boundary of network

b) An operating system of computer network

c) A system designed to prevent unauthorized access

d) A web browsing software

3. What is the meaning of Bandwidth in Network ?

a) The transmission capacity of communication channels

b) Connected computers in the network

c) Class of IP used in Network

d) None of the above

4. _____ is a network device that amplifies and restores signals

a) Router

b) Gateway

c) Repeater

d) hub

5. which network device used to establish connection between two similar networks ?

a) Router

b) Gateway

c) Repeater

d) hub

6. What is the benefits of networking

a) File Sharing

b) Easier access to Resources

c) Easier backups

d) All of the above

7. Which of the following is not a network device

a) Router

b) Gateway

c) Repeater

d) Linux

8. 1 Mbps =

a) 1024 Kbps

b) 1024 Gbps

c) 1024 Bps

d) None of the above

9. All devices on the network are connected through a central cable is called _____ topology.

a) Bus topology

b) Mesh topology

c) Tree topology

d) star topology

10. which topology combines two or more different topologies to create a resultant topology

a) Hybrid

a) Bus topology

b) Mesh topology

c) Tree topology

Descriptive Solved Questions

1. **Define bandwidth.**
   Answer: ABandwidth is defined as a range within a band of frequencies or wavelengths. Bandwidth is also the amount of data that can be transmitted in a fixed amount of time.
   For digital devices, the bandwidth is usually expressed in bits per second(bps) or bytes per second. For analog devices, the bandwidth is expressed in cycles per second, or Hertz (Hz).

2. **Define computer network.**
   Answer: A computer network is a set of computers connected together for the purpose of sharing resources. The most common resource shared today is connection to the Internet. Other shared resources can include a printer or a file server. The Internet itself can be considered a computer network.

3. **What are the different types of networks?**
   Answer: There are 4 types of networks Personal Area Network (PAN), Local Area Network (LAN), Metropolitan Area Network (MAN) Wide Area Network (WAN)

4. **How many types of Topology are in the network?**
   Answer: There are 6 types of topology's are there they are Bus Topology, Ring Topology, Star Topology, Mesh Topology, Tree Topology, Hybrid Topology

5. **Explain the purpose of a router?**
   Answer: A router establishes connection between two network and it can handle network with different protocols. Using a routing table, routers make sure that the data packets are travelling through the best possible paths to reach their destination.

Descriptive Unsolved Questions

1) Explain about Bandwidth and data transfer rate**?**
2) What are the types of networks?
3) What are the connection types and describe them?
4) What are the benefits of a Wi-Fi wireless network?
5) What is physical topology, how many types are there explain them?
6) Explain about network devices?
7) What are the advantages of peer-to-peer network?
8) Explain Clint/Server based network?

Learning Resources

Web resources:

1. **https://www.javatpoint.com/computer-network-tutorial**
2. **https://ncert.nic.in/textbook.php?lecs1=10-13**

Text book:

1. CBSE XIIth Standard Computer Science Text book

UNIT-6: Internet and Cyber Safety

Course Learning Objectives:

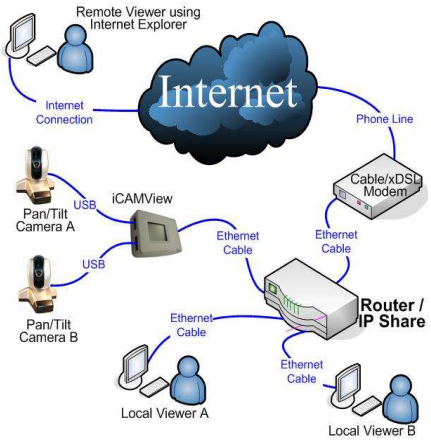
- Students will know about Internet, history of internet, function of internet and its advantages and disadvantages.
- Students will know about the URL and DNS.
- Students will be able to know Extension of websites; types of web browsers and Browser errors.
- Students can learn the usage of passwords, taking care on both identity protection and confidentiality of information while using internet.
- Student will know about the cyber stalking, cyber bullying and reporting cyber-crimes.
- Student will know about the Security Threats- viruses and malwares etc. while accessing websites.
- Student will learn the Safety Measures of Internet browsing.

Module – 1

6.1 What is Internet

The Internet is a network of networks. Millions of computers all over the world are connected through the Internet. Computer users on the Internet can contact one another anywhere in the world. If your computer is connected to the Internet, you can connect to millions of computers.

It is a global interconnected collection of networks that communicate using internet protocols. You can gather information and distribute your data. It is very much similar to the telephone connection where you can talk with any person anywhere in the world. In Internet a huge source of information is accessible to people across the world. Information in every field starting from education, science, health, medicine, history and geography to business, news, etc. can be retrieved through Internet. You can also download programs and software packages from anywhere in the world.

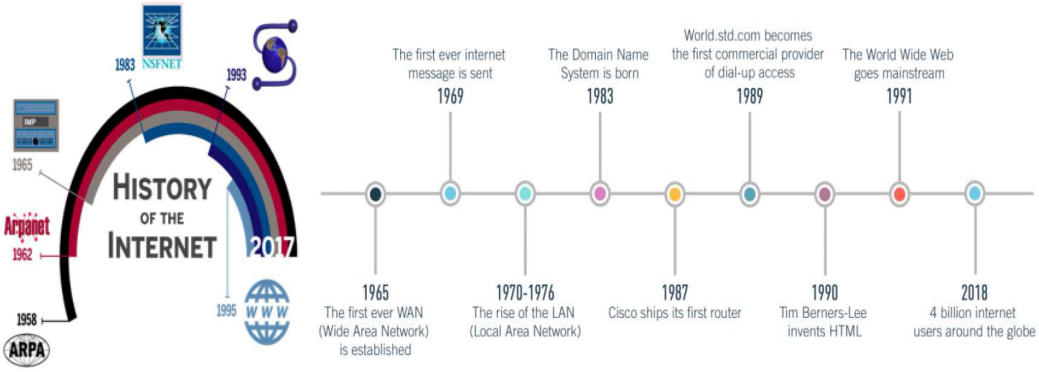


6.1.1 Internet Evolution

In 1969 Department of Defense (DOD) of USA started a network called ARPANET (Advanced Research Projects Administration Network) with one computer at California and three at Utah. Satellite and packet audio networks were added after a few years. Then a new version other software was released based on the TCP/IP (Transmission Control Protocol/Internet Protocol), which was developed at the university of California at Berkerly.

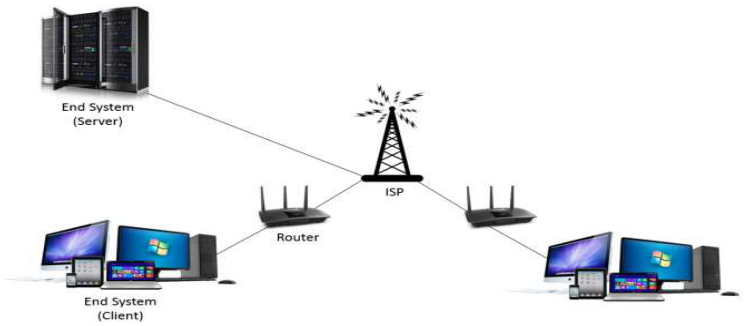
During 1980s additional networks, especially LAN was connected to the ARPANET. At that time Another federal agency, the National Science Foundation (NSF) created a new high capacity network called NSTNET (National Science Foundation Network), which was more capable than APRANET. The only drawback of NSFNET was it allowed only academic research on its network and not any kind of private business on it. Several private organizations and people started working to build their own networks, named private networks, which were later (in 1990's) connected with ARPNET and NSFNET to form the internet. As scale increased DNS was created to organize machines in to domains and map host names on to IP addresses. Later on other universities and R & D institutions

were allowed to connect to the Network. The internet really became popular in 1990's after the development of World Wide Web (WWW).



6.1.2 How Internet functions?

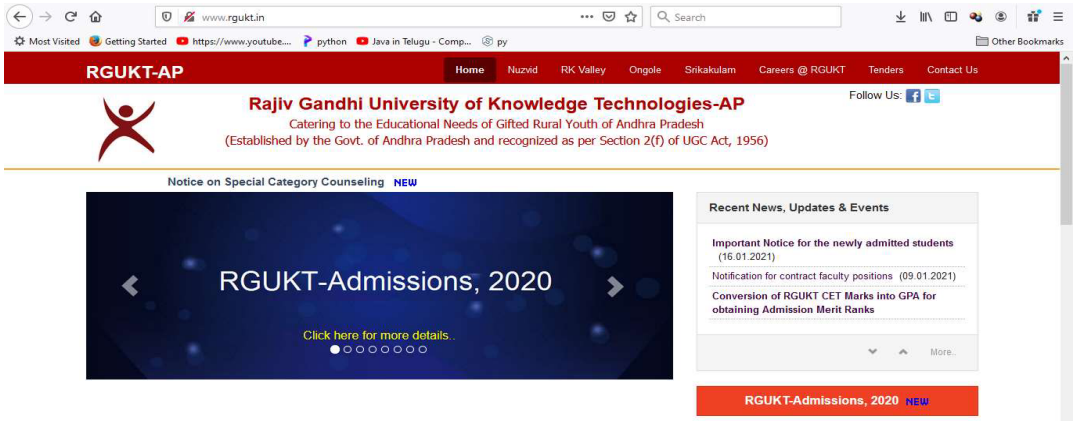
Internet is not a government organization. The ultimate authority of the Internet is the Internet Society. This is a voluntary membership organization whose purpose is to promote global information exchange. Internet has several million computers attached to it. It is a network that routes packers from a source computer to destination computer. The internet is made up of a massive network of specialized computers called routes. Each router's job is to know how to more packets along from their source to their destination.



6.1.3 World Wide Web (WWW)

WWW is the acronym for the World Wide Web and was introduced in 13th March 1989. It is also commonly known as 'The Web'. A web is a collection of websites or web pages stored in web server and connected to local computer through internet. These websites or web pages contain text pages, digital images, audios, videos, graphics, animations etc. The users can access content of these sites form any part of the world over the internet using their computer or laptop, tab, mobile phone. WWW is hypertext based information retrieval tool. The building blocks of the web pages which are formatted in HTML (Hyper Text Markup Language) and connected by links called "hyperlink". One can easily surf the Web by jumping from one document to another using the links in those documents. They may also be a combination of all these.

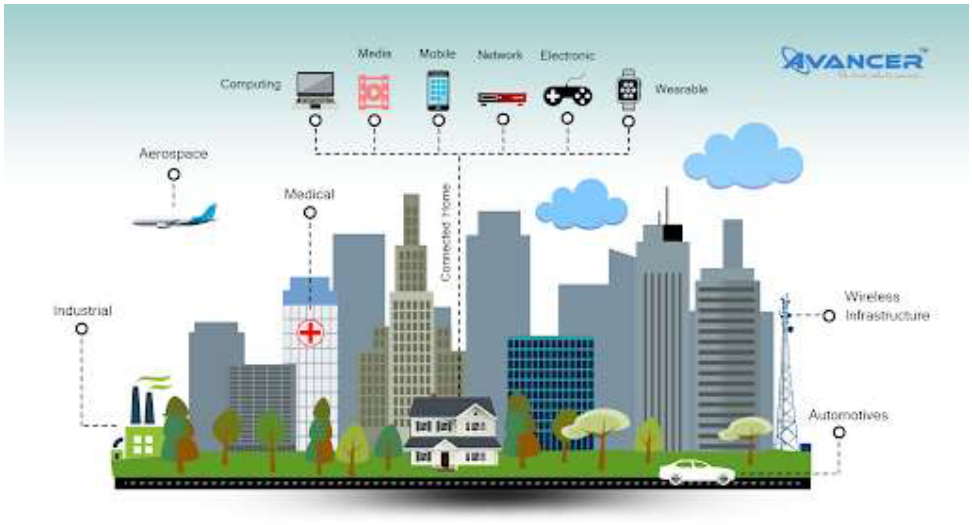
The tool used to view these Web Pages on Internet is known as Internet browser or simply browser. It is a software program specifically developed to extract information on user requests from the Internet and present them as a Web Page to the viewer. There are several browsers available in the market. However the most popular are Internet Explorer from Microsoft and Netscape from Netscape Inc. The process of using browser to view information on Internet is known as Browsing or Surfing.



6.2 Advantages and Disadvantages of Internet

Advantages

The Internet provides many facilities to the people. The main advantages of Internet are discussed below.



1. **Sharing Information:** You can share information with other people around the world. The scientist or researchers can interact with each other to share knowledge and to get guidance etc. Sharing information through Internet is very easy, cheap and fast method.
2. **Collection of Information:** There is a huge amount of information available on the internet for just about every subject known to man, ranging from government law and services, trade fairs and conferences, market information, new ideas and technical support
3. **News:** You can get latest news of the world on the Internet. Most of the newspapers of the world are also available on the Internet. They have their websites from where you can get the latest news about the events happening in the world. These websites are periodically updated or they are immediately updated with latest news when any event happens around the world.
4. **Searching Jobs:** You can search different types of jobs all over the world, Most of the organizations/departments around the world, advertise their vacant vacancies on the Internet. The search engines are also used to search the jobs on Internet. You can apply for the required job through Internet.

5. **Advertisement:** Today, most of the commercial organizations advertise their product through Internet. It is very cheap and efficient way for the advertising of products. The products can be presented with attractive and beautiful way to the people around the world.
6. **Communication:** You can communicate with other through Internet around the world. You can talk by watching to one another; just you are talking with your friends in your drawing room. For this purpose, different services are provided on the Internet such as;
    a. Chatting
    b. Video conferencing
    c. E-mail
    d. Internet telephony etc.
7. **Entertainment:** Internet also provides different type of entertainments to the people. You can play games with other people in any part of the world. Similarly, you can see movies, listen music etc. You can also make new friends on the Internet for enjoyment.
8. **Online Education:** Internet provides the facility to get online education. Many websites of different universities provide lectures and tutorials on different subjects or topics. You can also download these lectures or tutorials into your own computer. You can listen these lectures repeatedly and get a lot of knowledge. It is very cheap and easy way to get education.
9. **Online Results:** Today, most of the universities and education boards provide results on the Internet. The students can watch their results from any part of country or world.
10. **Online Airlines and Railway Schedules:** Many Airline companies and Pakistan Railway provide their schedules of flights and trains respectively on the Internet.
11. **Online Medical Advice:** Many websites are also available on the Internet to get information about different diseases. You can consult a panel of online doctors to get advice about any medical problem. In addition, a lot of material is also available on the Internet for research in medical field.
12. **Buy or sell products:** The internet is a very effective way to buy and sell products all over the world.
13. **Services:** Many services are now provided on the internet such as online banking, job seeking and applications, and online reservations. Often these services are not available off-line or cost more.

Disadvantages

Although Internet has many advantages but it also has some disadvantages. The main disadvantages are:

1. **Viruses:** Today, Internet is the most popular source of spreading viruses. Most of the viruses transfer from one computer to another through e-mail or when information is downloaded on the Internet. These viruses create different problems in your computer. For example, they can affect the performance of your computer and damage valuable data and software stored in your computer.
2. **Security Problems:** The valuable websites can be damaged by hackers and your valuable data may be deleted. Similarly, confidential data may be accessed by unauthorized persons.
3. **Wastage of times:** A lot of time is wasted to collect the information on the Internet. Some people waste a lot of time in chatting or to play games. At home and offices, most of the people use Internet without any positive purpose.
4. **Filtration of Information:** When a keyword is given to a search engine to search information of a specific topic, a large number of related links a displayed. In this case, it becomes difficult to filter out the required information.

5. **Accuracy of Information:** A lot of information about a particular topic is stored on the websites. Some information may be incorrect or not authentic. So, it becomes difficult to select the correct information. Sometimes you may be confused.

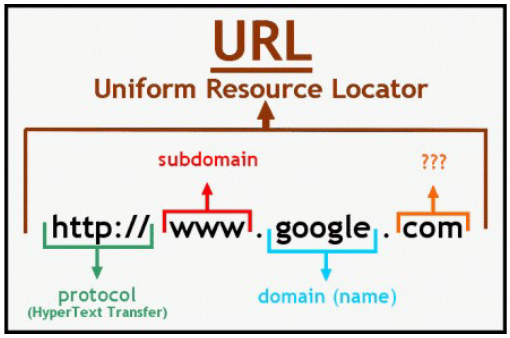
6.3 URL/Internet Address

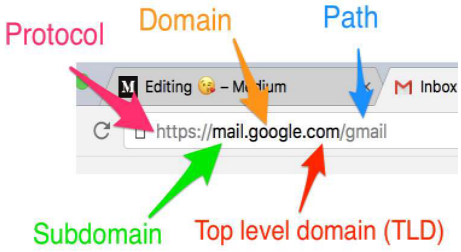
Just like every house, every office, every location has an address; every page on the Internet has a unique address. This address is used to get the web page for user from Internet.

Just as the address of a house or office is known as its postal address, the address on the Internet is known as URL (**Uniform Resource Locator**). A typical Internet address or URL would look like.www.google.com

The URL contains the components that specify the protocol, server. The protocol is followed by a colon (http:), the server is preceded by two slashes (://www.google.com)

https://www.google.com





6.4 DNS-The Domain Name System

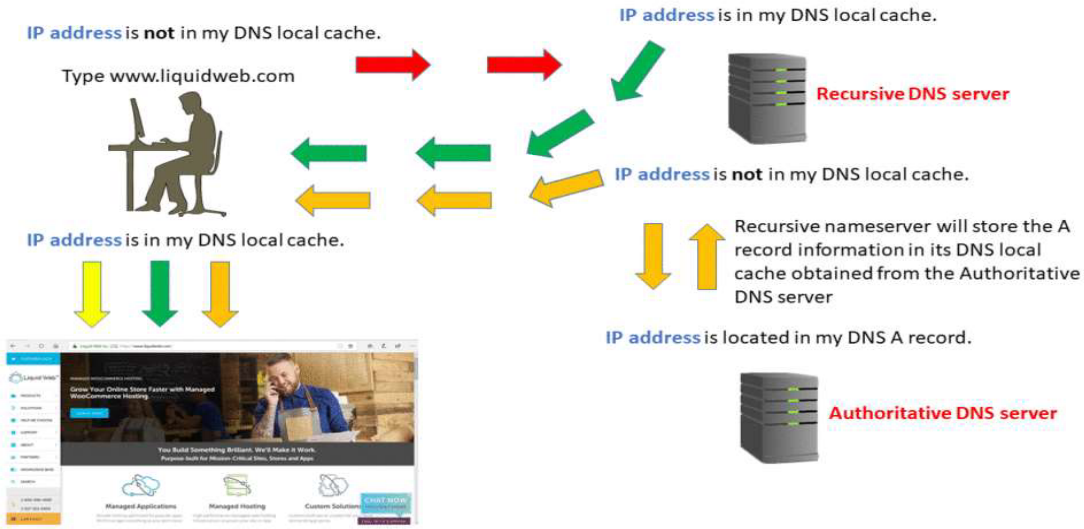
DNS invented in 1983. It has been a key part of the internet ever since.

DNS is the phone book of the Internet. The essence of DNS is the invention of hierarchical, domain-based naming scheme and a distributed database system for implementing this naming scheme. It is primarily used for mapping host names to IP address but can also be used for other purposes. Humans' access information online through domain names, like www.googel.com Web browser interact through Internet Protocol (IP) address's translated domain names to IP addresses so browsers can load internet resource.

DNS is defined in RFCs 1034,1035,2181, and further elaborated in many others.

How does DNS Work?

DNS convert www.google.com to 172.2.17.12.46.The IP address designates the location of server on the Internet. This conversion process is called a query. This is an integral part how devices connect with each other to communicate over the internet.



6.5 Extensions of Websites / Domain Names

Domain Name is a symbolic string associated with an IP address. There are several domain names available. There are six main categories;

- **.edu** --> Educational institutions
- **.com** − Stands for company/commercial, but it can be used for any website.
- **.net** − Stands for network and is usually used for a network of sites.
- **.org** − Stands for organization and is supposed to be for non-profit bodies.
- **.us, .in** − They are based on your country names so that you can go for country specific domain extensions
- **.biz** − A newer extension on the Internet and can be used to indicate that this site is purely related to business.
- **.info** − Stands for information. This domain name extension can be very useful, and as a new comer it's doing well.
- **.tv** − Stands for Television and are more appropriate for TV channel sites.
- **.gov**--> Stands for national and State Government Agencies.

6.6 Web Browser and Types of Web Browser:

A Web browser is software application that is used to locate, retrieve and display some content on the World Wide Web, including Web pages. It is an interface that helps a computer user to gain access over all the content on the internet. We can install more than one Web browser on a single computer.

Types of Web Browser:

1. **Text Based Web Browser:** A Web Browser that displays only text-based information is known as text Web browser. Ex: Lynx.

Lynx:

Lynx a fully –featured World Wide Web browser of Unix, VMS and other platforms running cursor-addressable, character –cell terminals or emulators.

2. Graphical Web Browser: A Web Browser that supports that supports both text and graphic information is known as graphical Web browser. Ex: Internet Explorer, Firefox, Netscape, Safari, Google Chrome, Opera.

The first Graphical Web Browser was NCSA Mosaic.

2.1 Internet Explorer

Internet Explorer (IE) is a product from software giant Microsoft. This is the most commonly used browser in the universe. This was introduced in 1995 along with Windows 95 launch and it has passed Netscape popularity in 1998.

2.2 Google Chrome

This web browser is developed by Google and its beta version was first released on September 2, 2008 for Microsoft Windows. Today, chrome is known to be one of the most popular web browsers with its global share of more than 50%.

2.3 Firefox

Firefox is a new browser derived from Mozilla. It was released in 2004 and has grown to be the second most popular browser on the Internet.

2.4 Safari

Safari is a web browser developed by Apple Inc. and included in Mac OS X. It was first released as a public beta in January 2003. Safari has very good support for latest technologies like XHTML, CSS2 etc.

2.5 Opera

Opera is smaller and faster than most other browsers, yet it is full- featured. Fast, user-friendly, with keyboard interface, multiple windows, zoom functions, and more.

2.6 Konqueror

Konqueror is a free and open-source web browser and file manager that provides web access and file viewer functionality of file systems. Konqueror can run most Unix-like operating systems.

6.7 Browser Errors

When a site is accessed through a browser like Chrome, Firefox, Internet Explorer, Safari, Opera, etc.you may be frequently seeing some error messages. After seeing these error messages you may come to conclusion that the site can't be accessed and probably close the page. However, a simple reading of these error messages thrown by the browser will help to solve the issue and try opening the site another way.

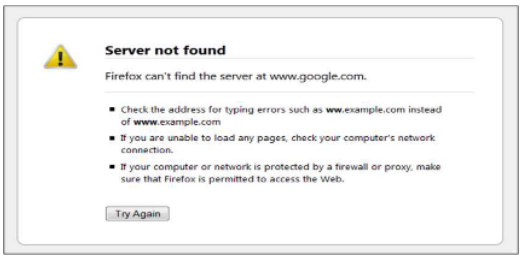
Some browser errors are:

1. Not Found-HTTP ERROR 404

2. Bad Request-HTTP Error 400
3. Unauthorized-HTTP Error 401
4. Internal Server –HTTP Error 500
5. Bad Gateway –HTTP Error 502

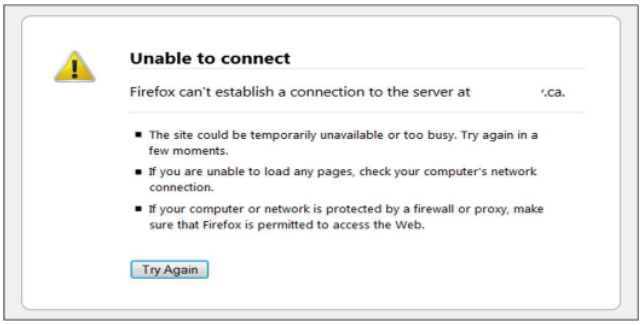
Server Not Found

A "Server not found" error in Firefox or "Google Chrome could not find [website.com]" message indicates that your browser could not find the website you're trying to access.



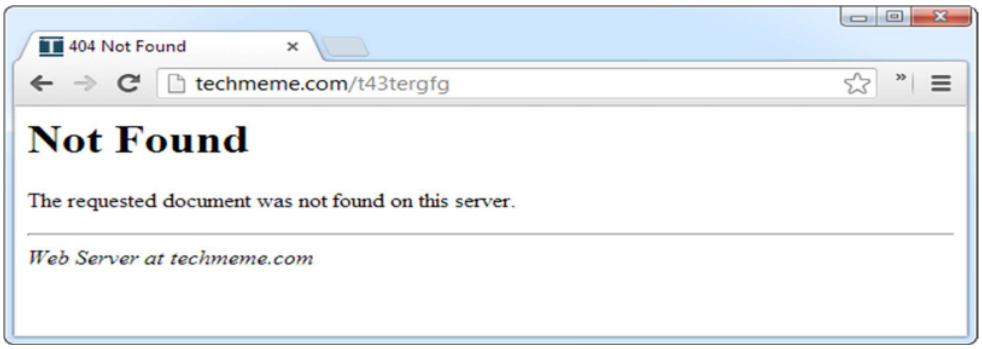
Unable to Connect

The "Unable to connect" error in Firefox or "Google Chrome could not connect to [website.com]" message looks similar to the "Server not found" message above, but each means something different.



1. Not Found-HTTP ERROR 404

You may see a variety of web server messages when accessing web pages. The most common one is "404 Not Found," which means you're trying to access a page that doesn't exist. Either the web page was removed or you were typing in an address and mistyped it.

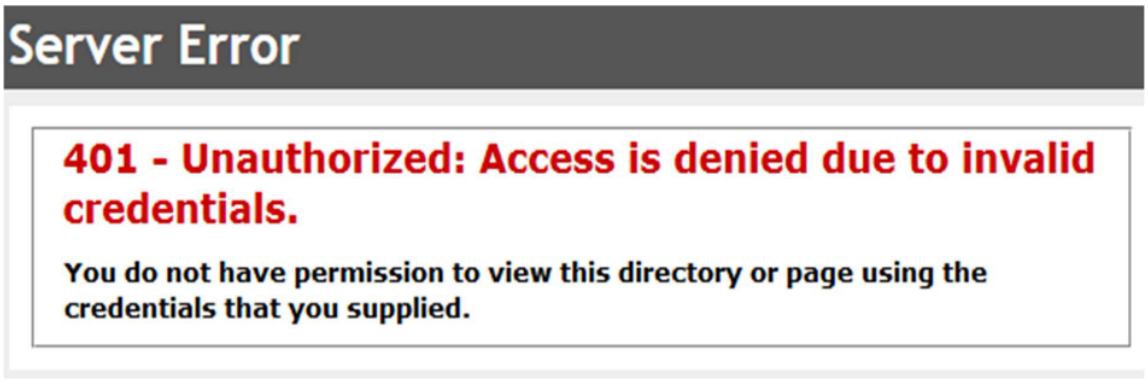


2. Bad Request-HTTP Error 400

The hypertext Transfer Protocol (HTTP) 400 Bad Request response status code indicates that the server received a wrong or invalid URL request from the user or client error. It could be a wrong URL when user typed or link user clicked might have been with special characters not recognized by the server. User can check the URL entered or the link clicked to see any mistakes in that.

3. Unauthorized-HTTP Error 401

This is very simple to understand, you have to rights or authorization to the page you are trying to view. The page could have protected with a password typically a page for site members that needs user id/ password and anyone trying to access the page without appropriate access will get "Unauthorized" error. Check you are supposed to view the page and have required login credentials. If yes then go to the login page of that site and try to login with your user id / password. If still not working ten follow the instructions on the login page for setting up an account or contact the webmaster of the site.



4. Internal Server –HTTP Error -500

This indicates the problem with the servers' internal configuration. Might be the server facing a momentary issue when you are trying access the page or could be different issue, which needs to be resolved by the site owner. You can refresh the page after a while and if the same error continues then reach out the site's support to resolve 500 server errors.

5. Bad Gateway-HTTP Error 502

Generally when a new page that was not accessed previously from the browser is opened, the request was sent to more than one server to get the exact location of the page of the web. The Bad Gateway message indicates that the servers between the browser and actual location of the site do not interact appropriately. Here, the solution could be to change the DNS settings of your browser and use different DNS server other than the default one so that the browser will try to get the site's location through different route.

Module – 2

6.8 Cyber safety

- Cyber safety is the safe and responsible use of information and communication technology.
- It's about keeping information safe and secure and responsible for that information.
- It's about being respectful other people online, and using good netiquette (Internet etiquette).

6.8.1 Safely browsing the web and using Networks

6.8.1.1 Identity protection

Identity protection means protect your personal data from a cyber thief.

To protect you from identity theft, experts recommended that individuals regularly check credit report with major credit bureaus, pay attention to billing cycles and follow up with creditors if bills do not arrive on time.

Some identities are Banking Cheques, ATM Cards, Social security number, Address, Passports, phone services, Driving License Number.

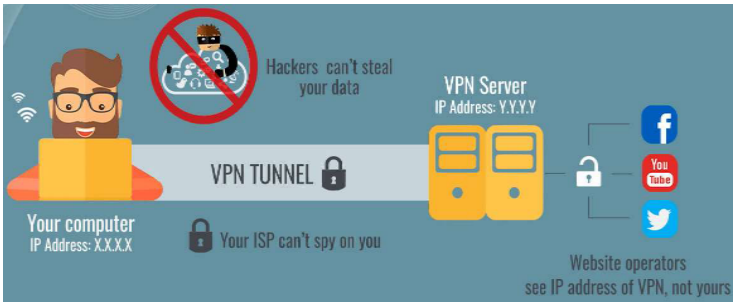
To protect yourself from identity protection these are the steps you can follow.

1. Protect your computer and smart phone with strong up to date security software. And also be sure that any operating system updates are installed.

2. Use pass codes for your devices and create strong and unique passwords for your online accounts.

3. **Limit to social media sharing:** Sharing too much on social media may put your personal information in the wrong hands. Don't put your phone number and address on your public profiles like Twitter, LinkedIn, Face book, Word Press Blogs, personal websits.etc.


4. **Be wary of free Wi-Fi:** Use password –protected Wi-Fi network than free public Wi-Fi networks(airport, hotel, library). If you transact online on public Wi-Fi, use a VPN(Virtual private network), which encrypts your activity, so that other on the same network can't easily determine your identity.



5. **Close unused accounts:** An old email address may have past bank statements and health care forms and those documents may be filled with personal data that could lead to identity theft. Identify those unused accounts and then close them.
6. **Keep distance from Shady website and Links:** Everyone must avoid any suspicious-looking links in emails of text messages as they can be a trapped. No one should ever type their login credentials to an unfamiliar or suspicious websites.
7. **Utilize browser extensions to help protect your online activity:**
   Browser extensions help you access the best parts of the internet without having to worry about safety and security.

Privacy badger: this extension prevents tracking and cookies, so your data and browsing history are kept safe from unwanted advertisers and other third-parties.

Adblock Plus: This extension will Block banner ads, pop-up ads rollover ads, and more. It stops you from visiting known malware-hosting domains and also disables third-party tracking cookies and scripts.

8. **Hide your personal information:** Any time you download and install a new browser on your computer you can first configure it to hide your personal information. To do this, you will access the set-up option on the browser and choose to configure the browser so that it doesn't reveal your name, email address or other information.

Shred: Use Document shredder for discard or recycle bank statements, bills, or any documents that contain personal information.

6.8.1.2 Proper Usage of Passwords

Passwords are an important form of protection for you online. You can enter into an online account only if you know the correct password for opening it. Creating a secure password is an important part of protecting you online.

A strong password helps to:

- Keep your personal information safe.
- Protect your emails, files, and other content.
- Prevent someone from breaking into your account.

Choosing a good password:

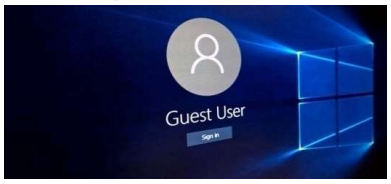
1. Phrased word, proper names of thing located around you and other combinations are no good when it comes to password. Develop mnemonics such as passphrases for remembering complex passwords.
2. Do not use a password that uses your personal information like nicknames, phone numbers, date of birth etc.

3. Don’t use foreign word, written in English letters. Hackers have special dictionaries, which contain such combinations. So, this method gives no additional security at all.
4. Invent meaningless and memorize reliable passwords. Langer passwords are more secure than shorter ones because there are more characters to guess.
5. A good password contains numbers, special symbols and combination of upper and lower case letters.
   Ex: **Se@b!061**

Usage of your password:

1. Never share your password with anybody, as well as the method you used to create it. Use complex password for online gaming and other online accounts. Change password at regular intervals.

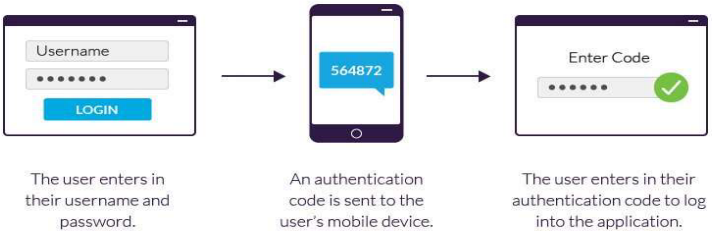
2. If we share our PC, a laptop or a tablet with our family members, never tell them our passwords. It is better to make a separate user account for them.



3. Use strong, unique passwords for our most important accounts, especially for our email, online bank and social networks. Do not use same /one password to different accounts. Cyber criminals might face certain troubles when stealing our login credentials from a bank.
4. Be careful while entering a password when someone is sitting beside you.

5. Don’t connect to an unknown or unrecognized wireless access point. Try to use known Wi-Fi links which are password protected.

6. Writing passwords somewhere is not advisable.
7. Do not keep sensitive information like user name and password on the USB.
8. Log out of your account when you plan to be inactive even for a short while. Always keep your system locked whenever it is not in use.
9. Apart from traditional password, we should enable two-factor authentication (2FA) on all important accounts. This security process requires the user to provide two different authentication factors to verify themselves to better protect both the user’s credentials and the resources the user can access.
   If a criminal hacks or somehow finds out our super-reliable password, this method will protect us.



6.8.1.3 Privacy

Internet privacy is primarily concerned with protecting user information. Information privacy is in regards to the collection of user information from a variety of sources. Certain online activities compromise the privacy of children.

Filling online forms for surveys, contests, downloading games on commercial or free websites. Some websites prompt the user fill-up their form for participating in games, surveys and contests. The name, email id, age and gender and at times the telephone number and postal address, obtained in this manner can be used to access information.

You can keep yourself safe from harmful content on the internet with a few simple precautions. A strong anti-virus program will keep your device free from all types of malwares, viruses, Trojans etc. You should activate your firewall to keep unwanted network traffic at bay.

Some requests are legitimate; much depends on the nature of the website requesting the information. Providing personal information online can result in a student being targeted for spam (unsolicited email), advertising materials and/or viruses.

Privacy issues also apply to students developing personal websites and publishing online. Personal details, including photographs of themselves or other students, may lead to the information being captured and reused by others for illegal purposes.

Use the following advice when browsing the web reduces your risk of being a victim of cybercrime.

Setting and security models are different for each browser.

To harden firefox security go fore the **three vertical lines** located in the top right corner in Firefox browser and select Options.
OR, Just type **about: preferences** in the browser address bar also.

First thing Keep your Firefox Up to date for best performance, stability and security and also make sure **Automatically install updates (recommended)** is selected in the **General section.**

In the Search section make sure you have selected a trusted search engine in the **Default Search Engine.**

In the **Content Blocking** area of **Privacy & Security** section make sure the **Standard** protection or **Strict** protection is selected. Strict protection may cause some sites to break but Standard protection will be good enough.

In **Cookies and Site Data** check the option **Delete cookies and site data when Firefox is closed.** It will delete all of your cookies after you close the Firefox browser.

Check the **Ask to save logins and passwords** for websites option in the Login and Passwords Check **Use a master password.** It will pop up a window where you can set a master password. A master Password is used to protect sensitive information like site password. If you create a Master Password you will be asked to enter it once per session when Firefox retrieves saved information protected by the password.
In **Permissions** Click the **Settings** right beside **Location** and add the trusted sites which can access the Location.

Click the **Settings** right beside **Camera** and add the trusted sites which can access the **Camera.**

Click the **Settings** right beside **Microphone** and add the trusted sites which can access the **Microphone.**

Check **Block websites from automatically playing sound** and also you can set exception for the sites which trust.

Check **Block pop-up windows** and also you can set exception for the sites which trust.

Check **Warn you when websites try to install add-ons** to prevent anty third party website to install add-ons in the browser.

In the **Firefox Data Collection and Use** uncheck **Allow Firefox to send technical and interaction data to Mozilla.**

Uncheck **Allow Firefox to make personalized extension recommendations.**

Uncheck **Allow Firefox to send backlogged crash reports on your behalf.**

In the **Security** make sure that **Block dangerous and deceptive content** is checked.

Check **Block dangerous downloads** option.

Check **Warn you about unwanted and uncommon software.**

Select **Ask you every time** when a server requests your personal certificate.

Check **Query OCSP responder servers to confirm the current validity of certificates.**

6.8.1.4 Confidentiality of information:

The sites you visit on internet, the things you search on it, the posts that you put on social networking site are all visible to public. But you want some information keep confidential like your emails, bank details, credit history etc. And you want that crucial information is protected and is not publically visible on your computer system or on a private network.

Confidentiality of information ensures that only authorized user get access to sensitive and protected data.

To ensure Confidentiality of information:

While using computer, network, internet, you can follow certain practices to safeguard your data and ensure its confidentiality.

- Use firewall whenever possible.
- Control Browser setting to block tracking.
- Browse privately wherever possible.
- Be careful while posting on internet.
- Ensure safe sited while entering crucial information.
- Carefully handle e-mails.
- Do not give sensitive information on wireless networks.
- Avoid using public computers.

1. **Use firewall whenever possible:** Most operating systems come with a firewall preinstalled. Fire wall is program that can monitor incoming and outgoing communications and traps the illicit ones.
2. **Control Browser setting to block tracking:** search engines generally record your queries together with your computer identifications, building up a profile of your interests over time.
   To minimize these threats, you can turn your default browser setting exclude cookies especially third party cookies, since they can be used to build up detailed profiles of your surfing patterns over time.
3. **Browse privately:** Private browsing does not save your browsing information,such as history and cookies, and leave no trace after you end the session. To avoid the tacking by websites,you should try to browse internet privately whenever possible.
4. **Be careful while posting on internet:** When you post anything to a public internet such as social networking site like Instagram, Facebook etc. you generally give up right to the content and any expectation of privacy or confidentiality. So ensue that you never post your crucial information like your personal details like address, mobile phone number, bank details, credit card details etc. on public internet sites.
5. **Ensure safe sites while entering crucial information:**
   Type the URL of the websites in the address bar of the browser. Do not click on any link that takes to this; or do not cut/copy the link of this websites and paste it.
   Ensure that the address contains a pad lock sign(). A safe site's URL starts with https:// (not http://). Also it shows a closed pad lock.
6. **Carefully Handle Emails:** While opening an email, make sure that you know the sender. Even if you open the email message by accident from unrecognized source, make sure not to open attachment in an email. Also your email might contain a link to legitimate looking website; never click on any link inside an email to open it, if you click it may take you to a fraudulent site. If you need to visit the linked website, type the URL of the website on your own in the address bar of the web browser.
7. **Do not give sensitive information on wireless networks:** Sometimes you get access to some wireless connections such as the Wi-Fi connection available on Airports or Railway stations. While using such Wi-Fi connections not to open any sensitive information or provide any sensitive information on a website. The reason for this is that most free wireless networks are not encrypted and hence information on it can be tapped and used for fraudulent purpose.
8. **Avoid public computers:** Always try not to use the public computer especially if have to deal with your crucial data. But if you need to work on a public computer then make sure these things:
   Browse privately, first of all.
   Don't save your login information.
   Never save passwords while working on a public computer.
   Avoid entering sensitive information on to a public computer.

Don't' leave the computer unattended with sensitive information on the screen.
Disable the feature that stores passwords.
Properly log out before you leave the computer.
Erase history and traces of you work i.e., clear history and cookies.

Module – 3

6.9 Cyber bullying

Cyberbullying and cyber harassment are also known as online bullying. It has become increasingly common, especially among teenagers, as the digital sphere has expanded and technology has advanced.

Cyber bullying is when someone, typically a teenager, bullies or harasses others on the internet and in other digital spaces, particularly on social media sites. Harmful bullying behavior can include posting rumors, threats, sexual remarks, a victims' personal information, or pejorative labels (i.e. hate speech).

Bullying or harassment can be identified by repeated behavior and an intent to harm.

Victims of cyberbullying may experience lower self-esteem, increased suicidal ideation, and a variety of negative emotional responses including being scared, frustrated, angry, or depressed.

6.9.1 Cyberstalking

Cyberstalking is when an individual is repeatedly or constantly followed, watched or contacted through any

electronic means. The movement of the child is tracked and privacy is invaded or persistent efforts are made to contact someone against their will through text, email, social media, or other digital platforms.

Cyberstalking a child may be directed at sexually harassing a child or for other malafide motives. It could be done by an adult or an older child.

Cyber stalking causes stress, anxiety disorders, fear and psychological trauma regardless of the fact whether the victim actually meets the harasser or not and experiences a feeling of helplessness and may be lack of support. Change in eating and sleeping patterns may also be observed.

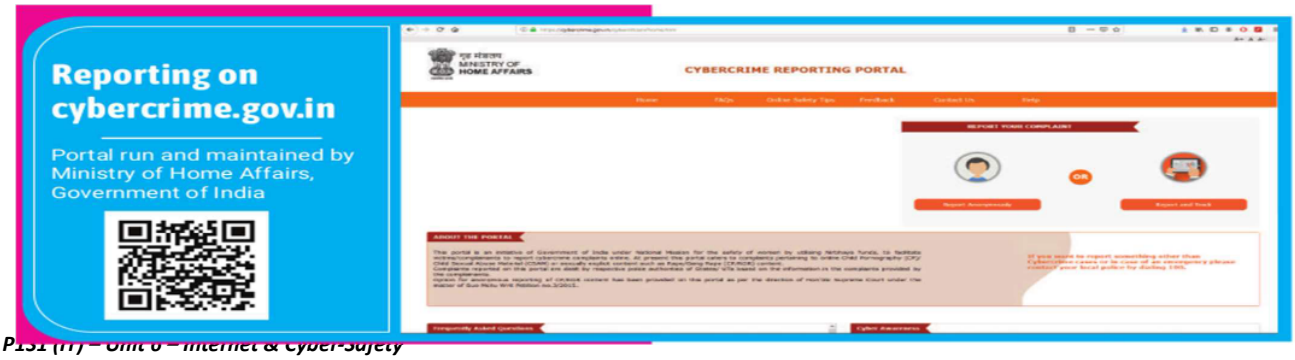
If a child has been the victim of cyber stalking is experiencing any of the signs of harm described above, the child must immediately inform a trusted adult, either parent, teacher, counselor or relative. They will initiate the actions required for addressing the offender as well as take measures to provide help for coping with ill effects. If not, the offender confidence to trouble other children as well.

How do they operate?

They collect all personal information about the victim such as name, family background, Telephone Numbers of residence and work place, daily routine of the victim, address of residence and place of work, date of birth etc. If the stalker is one of the acquaintances of the victim he can easily get this information. If stalker is a stranger to victim, he collects the information from the internet resources such Network Security as various profiles, the victim may have filled in while opening the chat or e-mail account or while signing an account with some website.

6.9.2 Reporting on Cybercrimes

Log into the cybercrime portal of the Ministry of Home Affairs www.cybercrime.gov.in



The Ministry of Home Affairs, Government of India, has set up a portal to facilitate online complaints of cybercrimes, including online child pornography, child sexual abuse materials, and sexually explicit content (e.g, sexual harassment, abuse, rape and gang rape).Police authorities of relevant states and union territories initiate investigations and legal processes based on the information provided by the complaints. The portal also has the option for anonymous reporting of child pornography and sexually explicit content.

1. Reporting to the police cyber cell

Children, parents or other concerned adults on their behalf can approach the cyber cells of the State police to report any online offence. Unlike other crimes, cyber-crimes are not limited by jurisdiction. You can report to the cyber-cell of any city, even if the offense was committed when you were in a different city.

2. Filling and FIR with the local police:

In case you are unable to file a complaint in the cyber cell, you can file an FIR with the local police station. It is not necessary to know the name of the person responsible for the crime to lodge an FIR. Tell the police whatever you know. The local police is expected to coordinate with the cyber cell in the investigation and legal processes.

3. Legal Penalties for Online Offences

Indian laws deal with many of the core issues related to digital technologies. You need to understand that some of your online actions may be on the borderline of an offence and some may actually be infringing the law.

6.10 Safely accessing websites

6.10.1 Security Threats while accessing websites

With the wide spread use of internet, networks and computers have become increasingly susceptible to threats. These threats destroy data as well the programs that computers use. The objective of these threats is to destroy the data and to steal the vital information stored in computers. This information is used by the attackers for their benefit.

1. Viruses: It produces copies of itself and inserts them into other programs or files, in turn destroying the data and performing other malicious actions.

2. Macro viruses: Macro viruses can corrupt data, create new files, move text, flash colors, insert pictures, send files across the Internet, and format hard drives. Macro viruses are increasingly used as transport mechanisms to drop off even nastier bugs. Macro viruses modify registries, forward copies of it through emails, look for passwords, copy documents, and infect other programs</p>
Example of macro Virus is Wazzo, W97M etc.

3. WormS: Worms are very similar to viruses in the manner that they are computer programs that replicate copies of themselves (usually to other computer systems via network connections)
Some examples of the worst Worms that impacted the web are as follows:

Jerusalem is one of the earliest worms that spread in 1987

In 2007 Storm Worm hit the computers. Once hit, your machine becomes part of a large botnet which performs automated tasks that range from gathering data on the host machine, to sending infected emails to others.

Since Worms spread mostly through the email attachments, the best ways to avoid them is using caution in opening emails. If the email is from an unidentified source, it is always best to delete it. Most of the time worms attach themselves to email

4. Trojan Horses: The Trojan program does not attach itself to the files like a virus nor replicate itself like a worm but it does provide unauthorized access to user's computer. They are mostly spread through internet downloads and online gaming programs.
This software is capable of taking over the functionality of your computer. An infected computer will begin to operate slowly and will exhibit pop-ups from time to time.

The best way to avoid the Trojans is to adopt safe download practices.

5. Spyware: A Spyware as the name suggest is a program used to spy on the computer system. This program will try to get all the confidential and sensitive information such as your bank account numbers, passwords etc. Then this confidential data is misused to access user's accounts. Spyware can also change the configuration of your computer, generally without obtaining your consent first

Once installed, the Spyware monitors user activity on the Internet and transmits that information in the background to someone else. Spyware can also gather information about e-mail addresses and even passwords and credit card numbers.

SpyWare have the ability to monitor keystrokes, scan files on the hard drive, snoop other applications, such as chat programs or word processors

Some of the common Spywares are CoolWebSearch, Internet optimizer and Zango

6. Malware: Malware is short for "malicious software." Malware is any kind of unwanted software that is installed without your adequate consent. The intent of the malware is to damage the data or functionality of the computer or network. In fact all the threats mentioned above such as virus, Trojans etc are examples of Malware

7. Spams: The term "spam" refers to unsolicited commercial email (UCE) or unsolicited bulk email (UBE). It is flooding the Internet with many copies of the same message, in an attempt to force the message on people who would not otherwise choose to receive it.

The most commonly seen spam includes the following:

Phishing scams, a very popular and dangerous form of email fraud

Foreign bank scams or advance fee fraud schemes

Other "Get Rich Quick" or "Make Money Fast" (MMF) schemes

8. Hackers and Crackers: Hackers were the gifted programmers who gain access to the systems or network to show case the security loop holes to the administrators.

Cracker was coined for such activist who had intentions of doing malicious activities.

9. Phishing

How does phishing happen?

- Phishers sets up a replica page of a known financial institution or a popular shopping website
- Bulk e-mails are sent to users asking for their personal data like account details, passwords etc
- When the user clicks on the link, the replica of the website will open. Or while the user is online, a form will populate through an "in-session pop-up"
- On updation, the data goes to phishers. Post which the user is redirected to the genuine website
- Phishers have refined their technology to launch sophisticated attacks and use advanced social engineering techniques to dupe online banking users.

10. Ethical Hacking: Hacking is nothing but taking unauthorized access of Data into the System or into the Network. Everybody knows that there are three types of hackers. Black Hat, White Hat, Gray Hat. Now we know what hacking is, now let's understand the Term Ethical, it's nothing but being in accordance with the rules or standards for right conduct practice, So here we can Say Ethical hacking is practice done by Ethical Hackers with the permission of Organization or Authority which can be useful to avoid the Future Hacking of System and Network for malicious purpose.

11. WIFI Hotspot: It is the public Place where many users can have access to free internet access.

12. BotNet: Now let's understand what is Botnet? A Botnet is a network of computer infected with Malware that response to an attacker to perform any activity they want. These infected Computers also known as Zombie. So how does it spread and why? It spread through viruses, Trojan horse .it can be used for commit crimes, financial fraud,

malware distribution, identity theft, mass mailing of spam, storing illegal content, Collapse the websites through massive attacks on network. With Single Botnet Cyber Criminals connect to many computers in a second and make use of users' sensitive data, Even users don't know that they are infected.

6.10.2 Safety Measures

How To Browse The Internet Safely?

1. Anti-Virus tools: Anti-Virus tools are the software programs that help us detect the virus in emails or files and hence protect our computers. These tools can detect virus, worms, Trojans as well as spyware and adware. They block us from visiting unsafe websites, and also downloading unsafe programs from such websites. They protect us from identity thefts and threats from phishing websites. There is several commercial antivirus software available such as **Norton, Mcafee, K7, Quickheal etc.**

2. Avoiding Spyware and Other Threats on The Internet: You may think that spyware and other malicious actors on the internet only lurk on shady websites that you would never end up on. It turns out that spyware, software that steals your private data without consent, can hide in many places on the internet. All it takes is to end up on a "bad" page at the wrong time and spyware or malware could inject itself into your computer, even when you least expect it.

3. Internet Browsing Safety & Security Tips: Normal use of the internet can feel safe enough, but can end up leading to malicious sites pretty quickly. Unfortunately, it is relatively easy for a website or software to appear to offer valuable and reputable service without actually doing so. It is always a good idea to be critical of the websites you visit and the services you download.

Some websites may be entirely counterfeit. For example, phishing sites pose as a popular website and then try to trick you into their scams. While phishing or other scams can really exist on any website, some may leave you more vulnerable than others.

Beware of software or other downloads from:

- File Sharing Sites
- Social Networking Sites

Safety Tips For Security on the Internet

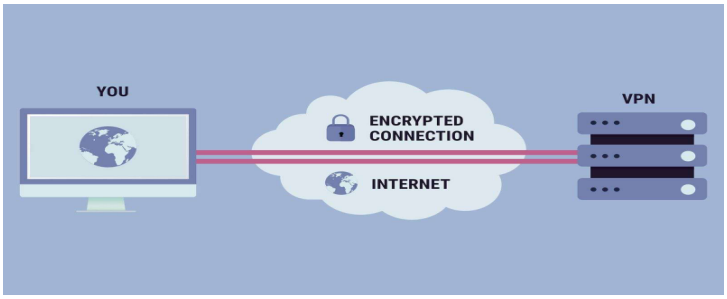
- Avoid questionable websites, especially those without HTTPS enabled.
- Don't download software from sites you don't trust. Be sure to pay close attention to free software and applications before you download them.
- Update your existing software often, including your operating systems. Software uses updates to patch security vulnerabilities.
- Make sure you have privacy and security settings fully enabled.
- Rather than clicking links or banners in an email or on the web, simply type the website into the address bar.
- If you have anti-virus or other security software installed on your products, make sure it is reputable and up-to-date.
- Use browser extensions and other safety products to block tracking and other malicious scripts from loading.

6.10.3 Who Are You Protecting Yourself From?

1.Hackers

The term "hacker" is definitely overused to the point that the term's meaning is a bit cloudy. However, hackers are individuals trying to gain access to your information for personal or political gain. These cyber-criminals use a number of methods but their motivation is mainly getting your financial information, passwords, or social security number. They then use this information for identity theft or to access your bank accounts.

2. Advertisers: Much of the internet is built around advertising. To make their ads more effective or to get insight into how you interact with their websites, companies and businesses use the massive amounts of data they collect.
Google operates the largest advertising network in the world. With its analytics software and advertisements on a majority of the internet's websites, Google knows a lot about you. If the idea of one company knowing most of what you do on the internet makes you uncomfortable, you are not alone.
3. Internet Service Providers (ISPs): The companies who provide internet service also monitor how people use the web. Congress passed a bill that allows ISPs to sell data about their user's habits on the internet. This could lead to your browsing data ending up in third parties' hands. ISPs can arguably access the most information about you because they see all of your internet activity, not just the browsing on specific websites.
4. Manage Your Cookies: Cookies are a way for websites to store certain bits of information in your browser. Their original purpose was to make browsing more convenient for users, by storing login information for example. They have certainly achieved that purpose, but have also morphed into "tracking cookies". These let websites track you after you've left their sites.
Clearing cookies that you don't want or need is the best way to keep sites from tracking you once you've navigated to new, unrelated websites.
5. Use Two-Factor Authentication: Two-factor authentication is when a service requires two measures of verifying your identity. This could mean you need a password and a link sent to your email, or a code text messaged to you to log in. Adding this second layer of protection is a reliable way to keep your data safe.
6. Use Tracker Blockers: The majority of websites have some sort of analytics or tracking scripts that load on their pages. Most of this data is used for advertising purposes or for tracking the effectiveness of a company's marketing.
In recent years, tracking across the internet has grown more advanced. It can paint a more complete picture about who each individual visitor actually is. Because each website can store this information on their own, it creates vulnerabilities for your data from many angles. If you let these scripts load, you have to trust every website you visit with storing your data in a secure way.
7. Use A VPN: VPNs, or virtual private networks, are a way of obscuring your internet connection. They redirect your browsing through different virtual networks so it appears you are in a different location than you actually are. People often use VPNs to get around school or office content filters.



These are valuable tools for keeping websites you visit from linking your data to you personally.

Recommended VPN Providers:

NordVPN, ExpressVPN, Private Internet Access, PureVPN, Perfect Privacy.

8. Other Privacy Tools: Browser Extensions: Opinions are a bit mixed on this one. While adding extensions, or add-ons, to your browser can protect you, it also just opens up your data to another third party. It's important to do your research before installing.

9. Private Search Engines: These search engines work like normal, popular search engines except they make your privacy a priority. Generally, private search engines don't track your searches or link your search terms to your personal data. These search engines also use encryption to hide your search terms locally and from other users on your network. Try these out and see if you like a certain one best:

Search Encrypt,StartPage,DuckDuckGo.

10. Be Vigilant About Your Internet Privacy: Privacy and security on the internet are constantly evolving. What keeps you safe one day may change completely the next. Because the internet is generally an open platform, new threats emerge all the time. Technology and opinions surrounding it are constantly changing. It's important to get second (and third) opinions on the products you use and the protection measures you take. Your privacy is in your hands.

11. How to avoid malware: Malware is one of the most common hazards to your computer when you're online, but it's easy to avoid. Developing safe and smart browsing habits can protect you from malware and other threats, like viruses. Securing your computer and learning how to identify and avoid suspicious links are the fundamentals of safe browsing habits.

12. Avoid suspicious links: Most malware requires you to click something to download and install it. These links are often disguised as something they are not. If you are aware of what suspicious links can look like, you can avoid them. Here are some examples of misleading links concealing malware downloads.

13. Cyber security guidelines: In following cyber safety guidelines a user will recognize online risks, make informed decisions, and take appropriate actions to protect himself while using technology, technology systems, digital media and information technology. He would adhere to privacy and safety guidelines, policies, and procedures.

Here are some cyber safety guidelines to follow.

- Set secure passwords and don't share them with anyone. Avoid using common words, phrases, or personal information and update regularly.
- Restrict access and make personal information secure to prevent identity theft.
- Be suspicious of unsolicited contact from individuals seeking internal organizational data or personal information. Verify a request's authenticity by contacting the requesting entity or company directly.
- Immediately report any suspect data or security breaches to your supervisor and/or authorities.
- Limit the amount of personal information you post. Do not post information that would make you vulnerable, such as your address or information about your schedule or routine. If your friend posts information about you, make sure the information is something that you are comfortable sharing with strangers.
- Be wary of strangers and cautious of potentially misleading or false information.
- Take advantage of privacy and security settings. Use site settings to limit the information you share with the general public online.
- Be suspicious of unknown links or requests sent through email or text message. Do not click on unknown links or answer strange questions sent to your mobile device, regardless of who the sender appears to be.
- Download only trusted applications from reputable sources or marketplaces.

Multiple Choice Questions and Answers

1. Who launched first internet?
   A. Department of Defense (DOD) of USA
   B. Microsoft
   C. IBM
   D. The U.S National Science Foundation
2. DNS means
   A. Domain Name System
   B. Data Network System
   C. Daily News System
   D. Data Navigate Symbol
3. What is URL?
   A. Unit Report Letters
   B. Universal Route Locator
   C. Universal Resource Locator
   D. Uniform Resource Locator
4. What is domain name for Educational institutions?
   A. .com
   B. .info
   C. .edu
   D. .net
5. Which server error message would you get if you access a page that doesn't exist?
   A. Server not found
   B. 404
   C. Unable to found
   D. All of the above.
6. Cyber safety is
   A. It is safe use of internet/communication.
   B. It is safe and responsible use of information.
   C. Taking security measures to avoid information theft online.
   D. All of the above
7. Firewall examines each---------- that are entering or leaving the internal network.
   A. Emails users
   B. Updates
   C. Connections
   D. datapackets/communications
8. By encryption of a text we mean
   A. Compressing it
   B. Expanding it
   C. Scrambling it to preserve its security
   D. None of the above
9. Which one is good password?
   A. Jna12
   B. Jkldmn
   C. 345
   D. Kn#a@2gc
10. Which one is correct statement?
    A. Use public free Wi-Fi for confidential data.
    B. Write your password anywhere for remembering.
    C. Use two-factor authentications for all important accounts.

D. Click on links from unrecognized source in your email.

11. Which malicious program cannot do anything until actions are taken to activate the file attached by the malware.
    A. Trojan Horse
    B. Worm
    C. Virus
    D. Bots
12. What is an antivirus?
    A. A bigger and more dangerous virus
    B. Software used to duplicate viruses
    C. Computer software used to prevent, detect and remove malicious software
    D. A biological agent that reproduces itself inside the cells of living things
13. What are the examples of Malware Spreads?
    A. Social network
    B. Pirated software
    C. Removable media
    D. All of the above
14. Which of the following is a software that, once installed on your computer, tracks your internet browsing habits and sends you popups containing advertisements related to the sites and topics you've visited?
    A. Backdoors
    B. Adware
    C. Malware
    D. Spyware
15. Malware is short form of ?
    A. malicious hardware
    B. malicious software
    C. Both A and B
    D. None of the above

Descriptive Questions:

1. What is internet?
2. Advantages and Disadvantages of Internet?
3. Type of errors while browsing?
4. What are the extensions of Browsers?
5. Define URL and DNS?
6. What is the cyber safety? How do you protect your identity while using internet?
7. How do you protect your information from cyber thieves?
8. What is cyber stalking? How you report cyber crimes?
9. Describe about viruses and malwares?
10. How to Browse the Internet Safely?

Reference:

CBSC -Cyber_Safety_Manual : http://cbseacademic.nic.in/web_material/Manuals/Cyber_Safety_Manual.pdf

NCERT Computer Science-Book for class 9&10.

Illegal online activity	Laws covering offense	Penalty
Posting or sharing of inappropriate images and comments online or through WhatsApp.	Protection of Children Against Sexual Offences Indian Penal Code, Information Technology Act, 2000.	A term of up to 3-5 years imprisonment and also a fine.
Revenge porn If an inappropriate picture or explicit selfie has been shared by a friend, for taking revenge threatening to circulate this to a wider group or demanding a favour for not doing so.	POCSO, 2012 Indian Penal Code.	A term of up to 7 years imprisonment with a fine
Violation of privacy Uses any electronic device and/or online medium to record, circulate, transmit, publish or bring into the public domain any image, photograph, film, videotape, MMS etc. that has private parts of a child captured in violation of his privacy commits the offence of 'Violation of privacy of a child'.	IT Act 2000 POCSO Act, 2012.	In case of extreme effect of the said act like committing suicide or attempt to commit suicide, the punishment may go upto life term as well.
Impersonation Sending someone messages by assuming a false identity.	Information Technology Act, 2000.	A term of upto 7 years imprisonment or a fine or both.
Unauthorised access Hacking someone's computer, email or social networking account.	Information Technology Act, 2000.	A term of up to 3 years imprisonment and also a fine.
Online piracy Downloading movies and music for free.	Copyright Act, 1957.	A term of up to 2-3 years imprisonment or fine or both.
Illegally copying or distributing software using the internet without the consent of the rights owner.		Punishment of a term up to 6 months to 3 years of imprisonment and fine.
Plagiarism Using words, ideas, images or data of another person without attributing the source.	Copyright Act, 1957.	A term of imprisonment from 6 months to 3 years and fine.
Misrepresentation Falsification of age for the purpose of creating accounts or accessing certain websites. It amounts to entering under a contract with the service provider based on misrepresentation of facts and real identity.	Indian Contracts Act together with IPC.	A term of imprisonment up to three years, or fine, or both.
Defamation Posting defamatory statements, images or videos, about a person on social media, chats, bulletin boards or any digital space.	Indian Penal Code.	A term of upto 2-3 years imprisonment , or fine, or both.