BIM

Semester: I

FOUNDATION OF INFORMATION TECHNOLOGY

Introduction to Computers

REFERENCE NOTE

Unit-1: Introduction to Computers

Concept of computer

The word computer is derived from the Latin word 'computare' which means to calculate or the word computer is comes from the English word 'compute' which means to calculate. So that computer is a calculating device.

Introduction to computer

A computer is a machine that manipulates data according to a list of instructions. A computer is a device capable of performing computations and making logical decisions at speed millions and even billions of times faster that human being can. Computer is an electronic machine which is useful for data processing. The output which comes after processing data is known as information.

Computer is an electronic device that manipulates information or data. It has the ability to store, retrieve, process the data given to it. The multi functionality of the computer system has made it more common device in modern world. The mathematical and logical operations are done at very high speed and the result are stored and displayed.

> *A computer is an electronic device that accepts raw data and instructions from users; processes it according to the given set of instructions, stores and gives meaningful information.*

➢ Computer is an electronic device that accepts raw data and instruction, store it, process it and produce meaningful information.

➢ Computer is an electronic device that receives raw data and instruction, store it, process it according to the given set of predefined instructions and them gives the meaningful information as a result.

➢ A computer can be defined as a multipurpose, programmable, electronic data processing device that is capable of accepting input (data), processing it and producing a refined data (information) output at high speed.

➢ Computer is an electronic device which can perform computation as well as logical action at high speed.

➢ Computer is a high speed electronic digital data processing device.

➢ Computer is a multi-tasking programmable electronic machine which performs the calculations and processes information with very high speed.

Computer Means

✓ **C**= Commonly
✓ **O**= Operating
✓ **M**= Machine
✓ **P**= Purposed by
✓ **U=** Unlimited
✓ **T=** Technology for
✓ **E=** Education and
✓ **R=** Research
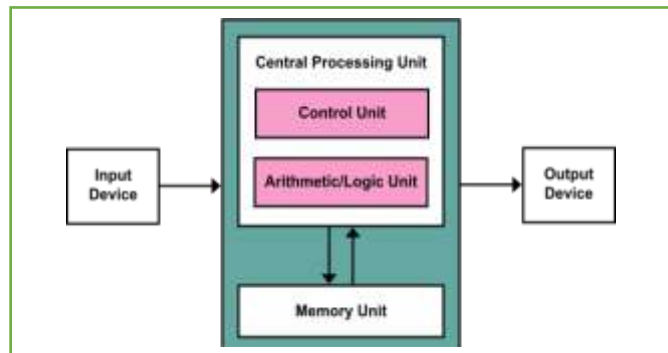
Working of a computer/General function or Basic Operation of Computer

1. *Inputting:* It is the process of entering data and instruction into computer system.
2. *Processing:* It is the process of performing arithmetic and logical operation.
3. *Storing:* It is the process of saving or holding data, information and programs for future use.
4. *Outputting:* It is the process of producing useful information as a result.

Some basic terms

1. **Data:** It is the collection of raw facts and figures about a person, place, and things etc. which can be recorded in the form of text, number, sound or image. Example, ram, 102, male etc.
2. **Instruction:** It is a command given to the computer to do s specific task.
3. **Information:** It is the processed form of data which we get in the required form. So it is very meaningful and useful to us.
4. **Process:** Processing is the conversion of inputted data into output (information) which is done by the processing unit of the computer.
5. **Program:** Program is set of instructions to perform specific task in a computer, a component of software.

6. **Software:** Software is the collection of computer programs to perform special work in a computer. Software tells the computer how to do and what to do.
7. **Hardware:** It is the physical parts of computer system which can be touch, felt and seen.
8. **Input:** It is data and instruction entered into computer for processing.
9. **Output:** It is called result or information.
10. **Memory device:** The device which is used to store data, instruction and information (temporarily or permanently) is called memory device. Examples are RAM, ROM, Hard Disk, Pen drive etc.

Characteristics of a Computer / Features of Computer

A computer is powerful and useful in all areas. The use of computer is increasing with time. The main features or characteristics of computer are described below:

1. Automatic

A computer is an automatic device. It can do tasks automatically as instructed by software. It can automatically control various devices attached with computer system. The capability of doing work without any external effort or interferences is known as automation. They are capable of performing the tasks automatically once the process is started.

2. Speed

The working speed of much faster than the human beings. The computers works with much greater speed and accuracy as compared to the human beings while performing mathematical and other complex tasks. They are capable of processing the data within the fractions of the seconds. The calculation in the computer is at very high speeds.

For example, a micro-computer can perform millions of instructions per second as many times without any mistake. The speed increases, as the power of computer increase. For example, a super computer can operate at speed measures on nanoseconds and even picosecond.

➢ A computer performs tasks accurately.

➢ The operations on data in computer are performed through electronic circuit according to given instructions.
➢ Computer can perform millions and billions of operations on data within a second.
➢ The speed of computer is measured in MegaHertz (MHz) or GigaHertz (GHz). The time taken to perform a task is measured in fraction of second.

Unit of Time	Meaning	Part of Second	Power of 10
Millisecond (ms)	One thousandth of second	1/1000	10^{-3} sec.
Microsecond(us)	One millionth of second	1/1,000,000	10^{-6} sec.
Nanosecond(ns)	One billionth of second	1/1,000,000,000	10^{-9} sec.
Picosecond (ps)	One trillionth of second	1/1,000,000,000,000	10^{-12} sec.
Femtosecond (fs)	One quadrillionth of second	1/1,000,000,000,000,000	10^{-15} sec.

3. **Accuracy**

A computer performs tasks accurately. If data and instructions given to the computer are correct then it gives an accurate output. It means output totally depends on the given instructions and input data. If input data is incorrect then the output will be incorrect which is called GIGO (Garbage in Garbage out).

4. **Storage:**

Computer system consists of data storage unit. A computer has main storage and secondary storage. A large amount of data can be stored in secondary storage like hard disk, pen drive, CD/DVD, etc. for future use. The main memory (RAM) stores currently used data. Computer stores data in term of 0 and 1.

0 or 1	1 Bit
4 bits	1 Nibble
8 bits	1 Byte
1024 bytes	1 Kilobytes (KB)
1024 Kilobytes	1 Megabyte (MB)
1024 Megabytes	1 Gigabytes (GB)
1024 Gigabytes	1 Terabytes (TB)
1024 Terabytes	1 Petabyte (PB)
1024 Petabytes	1 Exabyte (EB)
1024 Exabyte	1 Zetta byte (ZB)
1024 Zetta byte	1 Yotta byte (YB)
1024 Yotta byte	1 bronto byte (BB)

5. Diligence

A computer can continuously work for a long time without losing its speed and accuracy. So it is called diligent device. It doesn't get tired or bored or lazy while working.

6. Versatile

A computer is a versatile device which means it is flexible. It has capability of performing different types of tasks like drawing paints, playing games, music, calculations, sending an e-mail, desktop publishing work, etc. in different field efficiently. So it is used in different fields to perform varieties of tasks.

7. Reliability

Computers are used widely as they are reliable. The computer never gives the wrong result as long as the input is given correctly. The probability of error in the computer is negligible. A Huge amount of verities of data like monetary transaction, banking account, personal information is stored in a computer with the strong reliability to the computer.

8. Word Length

All digital computers operate on binary digits-0 and 1 to represent any kind of data. Bit stands for binary digit. It is the smallest unit of information a computer can hold. The value of a bit is 1 or 0. Byte is the amount of memory space used to store one character, which is usually 8 bits. The number of bits that a computer can process at a time in parallel is called word length. Commonly used word lengths are 8, 16, 32 or 64 bits. Word length is the measure of the computing power of a computer.

Advantages and disadvantages of computer

Advantages/ Capabilities/ Benefits/ Merits

1. The computer can perform a complex operation in a short time.
2. The computer can process a large volume of data.
3. Computer can work continuously for a long time
4. A single computer can perform multiple tasks such as watching a movie, playing games, listening song and others.
5. The computer does not make a mistake.

Disadvantages/Limitations/ Drawbacks/ De-merits

1. The computer does not have a brain and cannot decide itself.
2. It does not have its own intelligence.
3. The computer does not have emotion and feelings.
4. It needs electricity to operate.
5. It cannot operate itself, unless, a human command is given.

Application of computer

A computer is given great importance in every field of work. Nowadays, it is impossible to find where computer are not used. Computer and its technology are used in education, agriculture, industries, banking, engineering, scientific research and many more. The main applications of computer are described below.

1. Home
2. Education
3. Industry
4. Business

5. Banking & Insurance
6. Communication
7. Health and Medical Field
8. Agriculture
9. Desktop publishing
10. Scientific Research
11. Defense
12. Entertainment
13. Science and engineering

Application of computer

Computers at Home

Computers have already changed our lives at home. New gadgets such as automatic washing machines, dishwashers and microwaves have made our lives easier. Many of the educational software programs are used by children at homes. These programs enrich students' knowledge and skills. Encyclopedia, dictionaries, telephone directories and medical references are now available in optical disk which contains multimedia capabilities.

Internet connections also provide electronic mail, discussion groups, and other communication options for home users. Apart from learning, computers also offer a new form of entertainment. They are used for playing computer games.

Computers in Education

Computers are used as teaching aids, research tools and analyzing systems in educational institutions. Teachers use computers to organize and prepare course materials. Teachers may use pictures, graphs and graphical presentations to easily illustrate a difficult concepts. Nowadays more and more educational institutions are using computer-assisted instruction systems. A computer's voice recognition capabilities and its connection to the Internet makes it possible for distance learning.

*   The computer provides a tool in the education system known as CBE (Computer Based Education).
*   CBE involves control, delivery, and evaluation of learning.
*   Computer education is rapidly increasing the graph of number of computer students.
*   There are a number of methods in which educational institutions can use a computer to educate the students.
*   It is used to prepare a database about performance of a student and analysis is carried out on this basis.

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.

*   Payroll calculations
*   Budgeting
*   Sales analysis
*   Financial forecasting
*   Managing employee database
*   Maintenance of stocks, etc.

Computers in Medicine

Computers have played very important roles in the growth and improvement of health care. They are used in medicine to keep the records of patients' case-histories, diagnosis and treatment of diseases. They are also used to monitor vital data during surgery in the operating theatre. They provide a complete, accurate, up-to-date and readily available source of information about patients' health.

They are also used to monitor the availability of bed, staff payroll, hospital accounting, patient billing, drug inventory and location of doctors and patients in large hospitals. They have reduced the barriers of distance and time via telemedicine and on-line access to laboratory test results and medical researches.

Following are some major fields of health care in which computers are used.

- **Diagnostic System** – Computers are used to collect data and identify the cause of illness.
- **Lab-diagnostic System** – All tests can be done and the reports are prepared by computer.
- **Patient Monitoring System** – These are used to check the patient's signs for abnormality such as in Cardiac Arrest, ECG, etc.
- **Pharma Information System** – Computer is used to check drug labels, expiry dates, harmful side effects, etc.
- **Surgery** – Nowadays, computers are also used in performing surgery.

Computers in Government

Computer is also used by the government to collect, process and store vast amounts of information. The web sites of the different government departments provide information to the users. It is used for the filing of income tax return, paying taxes, online submission of water and electricity bills, for the access of land record details, etc.

- Budgets
- Sales tax department
- Income tax department
- Computation of male/female ratio
- Computerization of voters lists
- Computerization of PAN card
- Weather forecasting

Communication

Communication is a way to convey a message, an idea, a picture, or speech that is received and understood clearly and correctly by the person for whom it is meant. A computer plays a key role in the field of communication. The Internet and computer are used to send and receive information. A computer uses various communication services like e-mail, video conferencing, net phone, chatting, Facebook, Twitter, Instagram, etc.

Some main areas in this category are –

- E-mail
- Chatting
- Usenet
- FTP
- Telnet
- Video-conferencing

Computers in Industry

Modern factories and industries cannot work without computers. They control huge numbers of machines, especially robot-type devices for creating, assembling and testing products and their components. Computers also help humans to control complex machines, such as power stations, ships and space crafts. Rows of levers and switches can be replaced with computers that take care of routine tasks automatically. This leaves the human operator free for more important decisions. Many industries now use **Computer Aided Design (CAD)** to develop products and **Computer Aided Manufacturing (CAM)** to produce them. Computers are used for inventory control, planning and process control.

Computers in Law and Order

Computers are used by lawyers to research and store volumes of cases and judicial proceedings in the computer. Law enforcement agencies from local police to international organizations use computers to store information about criminals and suspected criminals. Minute details of speech intonation, physical characteristics, criminal habits and finger prints can be matched for accurate detection through computers.

Computer systems are used in conjunction with video cameras to provide internal surveillance and to ensure the safety of prisoners and officers.

Computers in Entertainment

Computers have now become an important part of the entertainment industry. They are widely used to create special effects in movies. They are used in editing movies and multimedia presentations. They help in composing, editing, recording and reproducing music and sound effects. They are used in sports to analyze the movements of sports persons and to find faults in the movements and optimize the movements so that maximum efficiency is achieved. They are used by sports professionals to analyze their techniques to find their strengths and weaknesses. They are used to simulate games and to try out different game strategies.

Computers in Banking and Insurances

The banking business has been revolutionized by computer technology. They are used for various tasks such as online enquiry of customer's balance, cheque verification, updating the balance, calculating interests and printing customer statements. Many leading banks have installed Automated Teller Machines **(ATMs).** These enable the customers to draw money from accounts, transfer money, obtain bank statements, etc. All these can be done using a special plastic card which is inserted into the input device of a computer. This also eliminates the need for a clerk. The list of applications of computers is so long that it is not possible to discuss all of them here. In addition to the applications of the computers discussed above, computers have also proliferated into areas like investments, stock trading, accounting, ticket reservation, military operations, meteorological predictions, social networking, business organization, police department, video conferencing and book publishing.

- Online accounting facility, which includes checking current balance, making deposits and overdrafts, checking interest charges, shares, and trustee records.
- ATM machines which are completely automated are making it even easier for customers to deal with banks.

- Procedure to continue with policies
- Starting date of the policies
- Next due installment of a policy

- Maturity date
- Interests due
- Survival benefits   - Bonus

Science and Engineering

A computer is used in all types of scientific research. Scientists collect the latest information by using internet all over the world. It is used in weather forecasting, space research, complex research in various scientific fields etc. One of the major areas is CAD (Computer Aided Design) that provides creation and modification of images. Some of the fields are –

- **Structural Engineering** – requires stress and strain analysis for design of ships, buildings, budgets, airplanes, etc.
- **Industrial Engineering** – Computers deal with design, implementation, and improvement of integrated systems of people, materials, and equipment.
- **Architectural Engineering** – Computers help in planning towns, designing buildings, determining a range of buildings on a site using both 2D and 3D drawings.

Defense

Computers are largely used in defense. Modern tanks, missiles, weapons, etc. Military also employs computerized control systems. Some military areas where a computer has been used are –

- Missile Control
- Military Communication
- Military Operation and Planning
- Smart Weapons

Agriculture

Computer has not only made changes in modern occupation but also made changes in the traditional occupation sector like agriculture. Through the social networking site, farmers can get connect with other experts and exchange their views and other details when they have internet connected computers. Farmers can get information on different agricultural issues through internet surfing. Farmers can get connect with foreign customer which can help to improve their product and increase their production capacity. Farmers can use the computer to keep financial record, production record, online banking, online sales, online purchased the required resources through the internet. The amount of water sprinkled in a balanced quantity can also computerized.

Desktop Publishing:

Desktop Publishing refers to the process of making documents in proper format for printing. Computers are used in desktop publishing. The newspapers, magazines and articles are made printable using computer software like page maker, word processor, Adobe InDesign etc.

Evolution of computer

Evolution of computer is a study of past development of computer i.e. it is meant by the gradual improvements of accuracy, speed and efficiency of computers through generations, whereas generations of computers may be defined as the development of computer in an average period of time in which old computer technology may be replaced by newer technology.

Ancient people lived on the earth for centuries without counting. Then, they started to count their ten figures. It became so difficult to live and to remember anything. These phenomena were gradually replaced by the use of stones, counting notches on sticks or marks on walls. The different generations are described below which has helped the humans for keeping records with the passing of time.

1.) The Mechanical Era (Zeroth generation)

The calculator of this age was developed by using mechanical components like wood, metal, stone, bone, etc. It was used for simple mathematical calculations. Some of the popular calculations used in this ages are:

- **Abacus**

In ancient period, it was used to calculate mathematical calculation. Abacus is considered as the **first calculating device.** It was developed by Chinese and Egyptians around 3000 BC. It was used for performing simple calculation like counting, addition, subtraction and multiplication of number. An abacus consists of a rectangular frame carrying a number of wooden rods. Mid-bar divides each of these rods in top unequal -upper and lower parts.
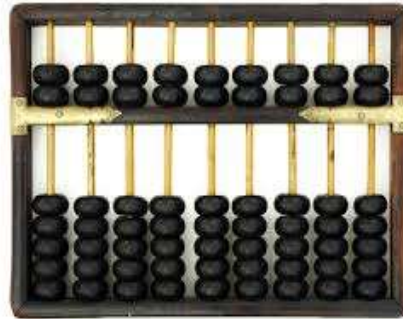

Fig: Abacus

The upper part is called heaven, whereas lower part is called earth. The heaven consists of two beads, whereas the earth part consists of five beads to each rod. The value of bead on heaven part is five and earth is one. Each abacus consists of nine or eleven or thirteen rods.

- **John Napier (1550-1617 AD)**

THE SCOTTISH mathematician John Napier first published the table of logarithms in 1614 AD. It was very used and consists of a large number of calculations.

He invented bone rods and used bones to demonstrate by subtracting and multiplication by addition according to his principle. These are made of strips of bones on which numbers were carved and painted that`s why it is also called **Napier's bone.**

Fig: Napier bone

- **William Oughtred (1575-1660AD)**

Slide Rule was developed by an English mathematician William Ought red in 1620 AD. It is considered as the **first analog device.** It consists of two sets of scales overlapping together with marginal space between them. The rules were slide together for calculating. It is used for performing multiplication and division using the method of addition and subtraction.

It is a rectangular device-**slide-rule.** It was a calculating device based on the principle of a log. A rule consists of two graduated scales, one of which slips upon other. It is devised in such a way that suitable alignment of one scale against the other makes it possible to find products and quotient of any numbers.
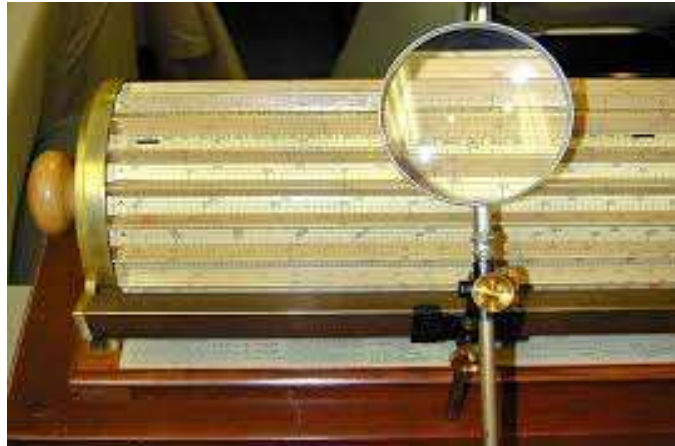

Fig: Oughtred ruler

- **Blaise Pascal (1623-1662AD)**

The man name Blaise Pascal, was a brilliant mathematician and religious thinker. Pascal made a mercury barometer and measured atmospheric pressure to assist his father in his work accounting. Pascal invented the **first mechanical calculation machine** in Paris. It could only do addition and subtraction with numbers being entered by manipulating its dials.

Fig: Pascal Calculator

It has a complex arrangement of wheels, gears and dials. It was operated by a series of dials attached to the wheels that had the numbers zero to nine on their circumference. One once complete turn of a wheel, it was advanced to the wheel to the left of it. It is also known as **Arithmetic Machine** or **Adding Machine**.

- **Baron Gottfried Wilhelm Von Leibniz (1646-1716AD)**

He develops a new method of calculation called **'Calculus'**. The concept of Pascaline was used for developing this machine. So Stepped Reckoner is considered as the advance version of pascaline. This machine was able to perform addition, subtraction, multiplication and division. But could find out square root. Each with nine teeth of varying lengths instead of wheels it was called **'Leibniz Calculator'** or **'Stepped Reckoner'.**

Fig : Leibniz Calculator

- **Joseph Marie Jacquard (1752-1834 AD)**

The french man, Joseph Marie Jacquard, was a textile manufacturer who invented a mechanism for automated weaving clothes for the textile industry at Lyon, in 1802 AD. This machine was used to automatically control weaving looms to facilitate the production of weaving cloth with complex patterns.

Fig: Jacquard loom

This was an automatic weaving machine. This machine was useful for weaving the patterns on the textiles. Punched cards were used to intricate design and produce the pattern in woven clothes.

- **Charles Babbage (1791-1871 AD)**

The English Professor and Mathematician, Charles Babbage, invented the **Different Engine** at Cambridge University, in 1822 AD. This machine can solve differential equations and calculate various mathematical functions. Charles Babbage contribution was one of the most significant milestones in the development of the modern digital computers. He developed the first mechanical computer called **difference engine.** It is capable of computing several sets of numbers and making hard copies of the results. Due to a lack of funding, he was never able to complete a full-scale functional version of this machine. It is also called **"Analytical Engine ".**
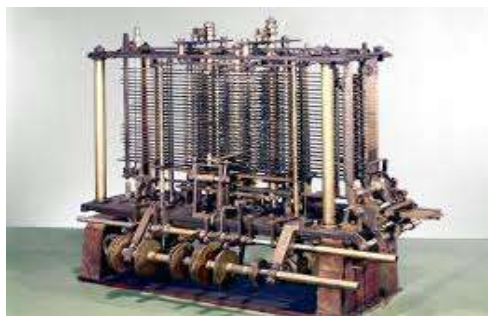

Fig: Analytical engine

Charles Babbage designed another machine named analytical engine that could be programmed to solve particular problems. The Analytical Engine was to be a general-purpose, **fully program-controlled, automatic mechanical digital computer.** It would be able to perform any calculation set before it. The machine was designed to consist of four components: the mill, the store, the reader, and the printer. These components are the essential components of every computer today. The mill was the calculating unit, analogous to the central processing unit (CPU) in a modern computer; the store was where data

were held prior to processing, exactly analogous to memory and storage in today's computers; and the reader and printer were the input and output devices. So, Charles Babbage is considered as **Father of Modern computer.**

- **Lady Augusta Ada Byron Lovelace (1515-1852 AD)**

The English intelligent and independent-minded woman, Lady Augusta, was a daughter of English poet Lord Byron and a very Great follower, assistant of Charles Babbage. Lady documents Babbage`s work and writes programs for Babbage.

This plan is now regarded as the **first computer program.** That`s why, she was considered the first computer programmer and a software language developed by the US Defense Department, was named **Ada** in her honor.

- **Herman Hollerith (1860-1929 AD)**

An American Inventor, Herman Hollerith, also applied the Jacquard loom concept in computing and applies for patents for an automatic punch-card tabulating machine. He invented a machine knows as " **Tabulating Machine ".** This device could process on the punch cards and perform **census calculating faster** than ever before.

- **John Von Neumann (1903-1975 AD)**

The Hungarian Mathematician, John gave an idea of stored program computer in the sense that program is stored internally in the main memory of the computer along with its associated data, in 1945. So, he is called the **"Father of Stored Program".** Before that, program required for the computer were integrated and written permanently in chips. So, modification of program was not possible. But, after Neumann, such programs were stored on a computer in some storage media, so modification was easy and flexible.
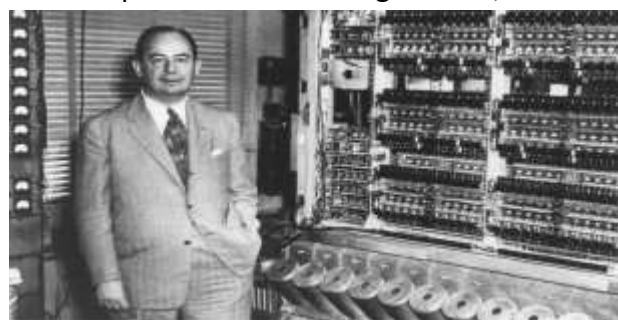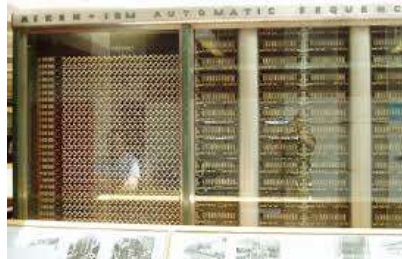
2.) The Electro-Mechanical Era

The calculator of this age was developed by using mechanical and electronic component **vacuum tube**. Successful **general purpose mechanical computers** were built, in the 1930s. Konrad Zuse developed mechanical computer, the Z1, in 1983 in Germany.

- **The Mark I Computer (1937 - 1944)**

A Professor of Physics, Howard H. Aiken designed a **general purpose mechanical computer** at Harvard University and IBM Automatic Sequence Controlled Calculator (IBM ASCC). It was the **first fully automatic calculating machine** and later as Harvard Mark I.

It used binary numbers for its operation. Later, Mark II was invented by Aiken and his colleagues that were working electromechanical relays for its operation. Mark I used 18000 valves.

The Harvard Mark I could perform four arithmetic operations and had built-in programs for processing logarithms and trigonometric functions. The Mark I received instructions on paper tape and loaded data output on punch cards.

- **The Mark II Computer**

It used about 18 thousand vacuum tubes as the main memory device with 7 lakes 50 thousand parts. It is 51 feet long, 8 feet height and 3 feet wide as bulky in size. It was capable of performing five basic arithmetic operations; additions, subtraction, multiplication, division and table reference. **The result was printed at the rate of one result per five seconds.**

- **The Atanasoff-Berry Computer (1939 - 1942)**

In 1939, John Vincent Atanasoff and Clifford Berry designed Atanasoff-Berry computer or ABC solving systems of mathematical simultaneous equation. This computer was **first electronic digital computer** and was the **first machine to use vacuum tubes.** It used 18000 valves and other 45 valves for internal logic and capacitors for storage.
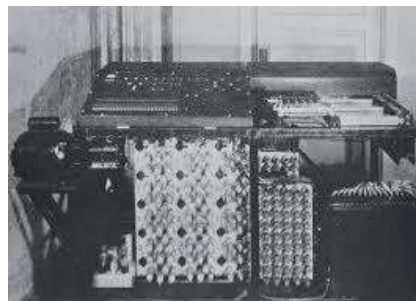
It used punch cards as input and output operation i.e secondary. It is considered as the first computing machine which introduced the **idea of binary arithmetic**, **regenerative memory and logic circuits.**

- **The Colossus (1941 - 1944)**

In 1944, Colossus computer is designed by Alan M. Turing and build by British mathematician Alan Mathison Neuman, Alan with some colleagues, creates a computer named colossus at the University of Manchester, England, which comprised 1800 vacuum tubes.
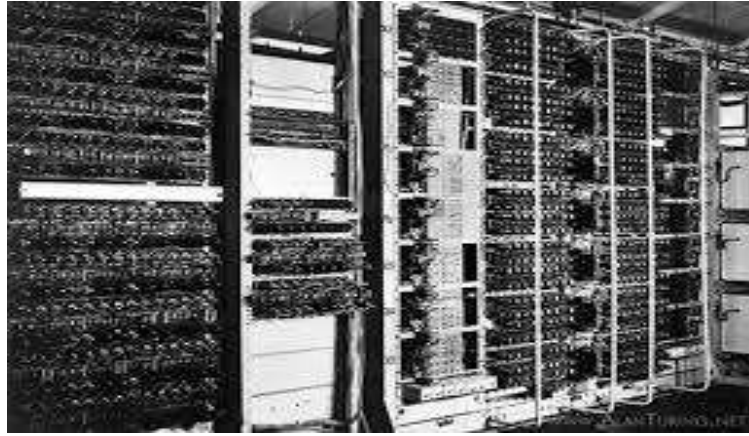
It was one of the world's earliest working **programmable electronic digital computers.** Colossus was a special purpose machine that suited a narrow range of tax (for example, it was capable of performing **decimal multiplication**).

- **The Electronic Computer Era**

The computers of this age are developed by using electronic components like a vacuum tube, transistors IC, VLSI, etc. These computers are smaller, faster and more reliable.

- **The ENIAC (1943-1946)**

In 1946, John W. Mauchly and J.presper Eckert constructed ENIAC (Electronic Numerical Integrated and Calculator), at the Moore School of Engineering of the University of Pennsylvania. USA ENIAC was the first popular **general purpose all electronic digital computers**. John Von Neumann was the consultant of the ENIAC project.
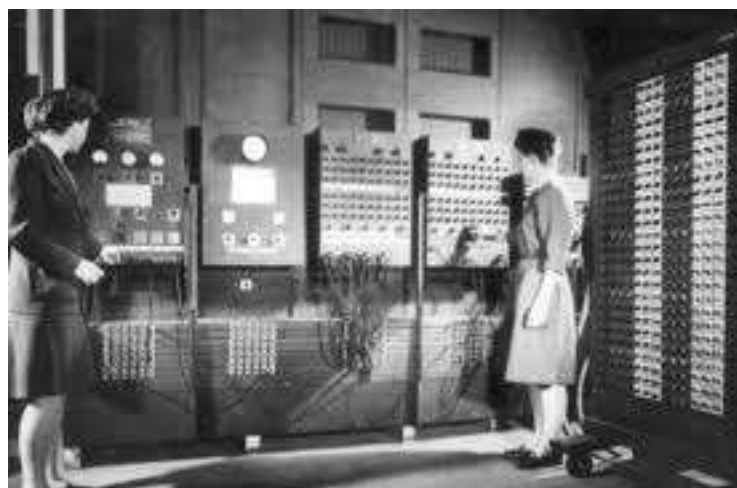
It was a very large machine weighing about 30 tons and containing about 17,468 vacuum tubes, 70,000 resistors, 5 million soldered joints and it consumed 160 kilowatts.

- **The EDVAC (1946-1952)**

EDVAC (Electronic Discrete Variable Automatic Computer) was developed by Dr.John Von Neumann,and a member of the Moore School of Engineering of the Unversity of Pennslyvania,J.P Eckert, and J.W Mauchly. The EDVAC is used for more school personnel and the Ballistics Research Laboratory of the US Army,which was based on **John Von Neumann`s ideas of Stored Program".**

- **EDSAC (Electronic Delay Storage Automatic Calculator):**

EDSAC was the **first full sized stored program computer** built at the University of Cambridge by the group of scientist. It was build according to the John Von Neumann principles of stored program. The input and output were provided by the paper tapes. It could do about 700 addition and multiplication per second. The machine occupied a room with 5/4 meters.

- **The UNIVAC (1951)**

UNIVAC (Universal Automatic Computer) was developed by J.P.Eckert and J. Mauchly in 1951. It was the **first computer manufactured for commercial use and general purpose digital computer**. It was designed to handle both numeric and textual information. Before this, all the computers were either used for defense or census was by General Electrical Corporation in 1954.

Generation of Computers

Computer generation is the classification of computers into different groups according to their manufacturing date, memory device, and other hardware and software technology used inside those computers. Generation of computer is a step in developing (advancing) technology.

The classification, time periods and main device are given below:

Generation	Time Duration	Memory device used
First	1945-1955	Vacuum tubes and valves
Second	1957-1963	Transistor
Third	1964-1971	ICs
Fourth	1972 onward	VLSI or Microprocessor
Fifth	Present and future	Bio- chips

Summary table of computer generation:

Features	First	Second	Third	Fourth	Fifth
Electronic Device	Valve/ Vacuum tube	Transistor	IC	Microprocessor	Bio-Chips
Speed	Milli Second	Micro Second	Nano Second	Pico Second	More than femto second
Internal Memory	Valve	Magnetic core	Semi Conductor	Semi Conductor	Super conductor
Permanent Storage	Punched Cards	Magnetic Tapes	Magnetic Disk(FDD)	Magnetic and Optical Disks (HD,CD,DVD, Pen Drive)	New Technology for storage
Computer Language	Fully Machine	Assembly and little bit of High	Fully High Level	High Level and 4GL	Natural Language
Cost, Size, Electrical consume, Heat generate	Very High	High	Low	Very Low	Not Known
Speed, Capability	Very less	Less	Moderate	High	Much higher
Examples	ENIAC, EDVAC, EDSAC, UNIVAC	IBM 7000, IBM 1401, IBM 1620, NCR 304, MARK III, ATLAS	PDP-8, PDP-11, ICL 2900 series, IBM 360, IBM 370	Apple Macintosh, IBM PC	Robert

1.) First Generation Computer (1945-1955)

The period of first generation was from 1946-1959. The computers of first generation used vacuum tubes as the basic components for memory and circuitry for CPU (Central Processing Unit). These tubes, like electric bulbs, produced a lot of heat and the installations used to fuse frequently. Therefore, they were very expensive and only large organizations were able to afford it.

In this generation, mainly batch processing operating system was used. Punch cards, paper tape, and magnetic tape was used as input and output devices. The computers in this generation used machine code as the programming language.

Fig: First Generation Computer

Features of first generation computers:
- Technology used: vacuum tube
- Machines languages were used to instruct the computer.
- Magnetic core memory was used as primary memory.
- Electrostatic tubes, Paper tape, punch card, magnetic tape
- Punched card, printing devices were used for input/output operations and store the result.
- It occupies very large space, slow processing, inefficient and unreliable due to low accuracy.
- Power consumption was very high and it generated much heat.
- It could only perform straight forward simple numerical calculation.
- Computer used to be much expensive.

The example of first generation computers is ENIAC, UNIVAC, EDVAC, and EDSAC.

2.) Second Generation Computer (1957-1963)

The period of second generation was from 1959-1965. In this generation, transistors were used that were cheaper, consumed less power, more compact in size, more reliable and faster than the first generation machines made of vacuum tubes. In this generation, magnetic cores were used as the primary memory and magnetic tape and magnetic disks as secondary storage devices.

In this generation, assembly language and high-level programming languages like FORTRAN, COBOL were used. The computers used batch processing and multiprogramming operating system.

Fig: Second Generation Computer

Some of its features are:
- Technology used: Transistor
- Operating speed was in terms of a microsecond.
- Assembly language and machines independent language such as COBOL (Common Business Oriented Language) and FORTRAN (Formula Translation) were introduced the size of the computer.
- Magnetic core memory was used as primary memory.
- Magnetic drum and magnetic tape were used as secondary memory.
- Power required to operate them was low.
- It could perform scientific calculation such as solving differential equations.
- Storage capacity and use of computers are increased.

3.) Third Generation Computer (1964-1971)

The period of third generation was from 1965-1971. The computers of third generation used Integrated Circuits (ICs) in place of transistors. A single IC has many transistors, resistors, and capacitors along with the associated circuitry.

The IC was invented by Jack Kilby. This development made computers smaller in size, reliable, and efficient. In this generation remote processing, time-sharing, multiprogramming operating system were used. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.

Fig: Third Generation Computer

Features of the third generation computers are:

- The technology used: IC (Integrated Circuit).
- Transistors were replaced by IC in their electronic circuitry.
- High-level languages like FORTAN, BASIC and other are used to develop programs.
- Semiconductor memory like RAM and ROM were used as primary memory.
- Monitor and keyboard were introduced for data input and output respectively.
- Multiprogramming facility was developed.
- The computer was used in census calculation, military, banks and industries.
- Size, cost, power requirement and heat generation decreased.
- Processing speed and storage capacity used of computer increased.

4.) Fourth Generation Computer (1972 onward)

The period of fourth generation was from 1971-1980. Computers of fourth generation used Very Large Scale Integrated (VLSI) circuits. VLSI circuits having about 5000 transistors and other circuit elements with their associated circuits on a single chip made it possible to have microcomputers of fourth generation.

Fourth generation computers became more powerful, compact, reliable, and affordable. As a result, it gave rise to Personal Computer (PC) revolution. In this generation, time sharing, real time networks, distributed operating system were used. All the high-level languages like C, C++, DBASE etc., were used in this generation.

Fig: Fourth Generation Computer

The invention of microprocessor chip marked the beginning of the fourth generation computers. Semiconductor memories replaced magnetic core memories. The invention of microprocessors led to the development of microcomputer or the personal computer.

The first microprocessor called **Intel 4004** was developed by American Intel Corporation 1971.

Features of the fourth generation computer are:

- Technology in use: VLSI is introduced and used Microprocessor-based technology.
- Problem-oriented fourth generation language (4GL) is used to develop the program.
- Semiconductor like RAM, ROM and cache memory is used as a primary memory.
- Magnetic disks like hard disk, optical disk (CD, DVD), Blue-ray disk, flashes memory (memory chip, pen drive) are used as secondary memory.
- E-mail, Internet and mobile communication are developed.
- Advanced, user-friendly, web page software are developed.
- Size, cost, power requirement, heat generation decreased compared to the previous generation.
- Operating speed, storage capacity ,use of computer increased compared to the previous generation

The example of the fourth generation computer is IBM-PC, HP laptops, Mac notebook etc.

5.) Fifth Generation Computer (Present and future)

Fig: Fifth generation Computer

The aim is to bring machines with genuine IQ, the ability to reason logically and with real knowledge of the word. Thus, this computer will be totally different, totally novel and totally new than last four generations of computer.

Fifth generation computer was based on Artificial Intelligence (AI) and that is still developing process, but not yet a reality i.e this computer is incomplete. The scientists are working on it still.

These computers will be able to converse with people and will be able to mimic human sense, manual skills, and intelligence.

Features of the fifth generation computers are:

- Technology to be used: These machines will incorporate Bio-chip and VVLSI (Very Very Large Scale Integration) or Ultra-Large Scale Integration (ULSI)
- The computer will have Artificial Intelligence (AI).
- Natural language will be used to develop programs.
- The computer will have parallel processing in full fledge.
- The operating speed will be in terms of LIPS(Logical Inference per Second)
- This aim is to solve highly complex problems, which require great intelligence and expertise when solved by people.
- Quantum computation, molecular and nanotechnology will be used completely.

AI (Artificial Intelligence):

- It is a branch of computer science which concerned with programs that solves and analyze problems intelligently.
- Artificial intelligence is the science of making machines imitates human thinking and behavior.

Classification of Computer
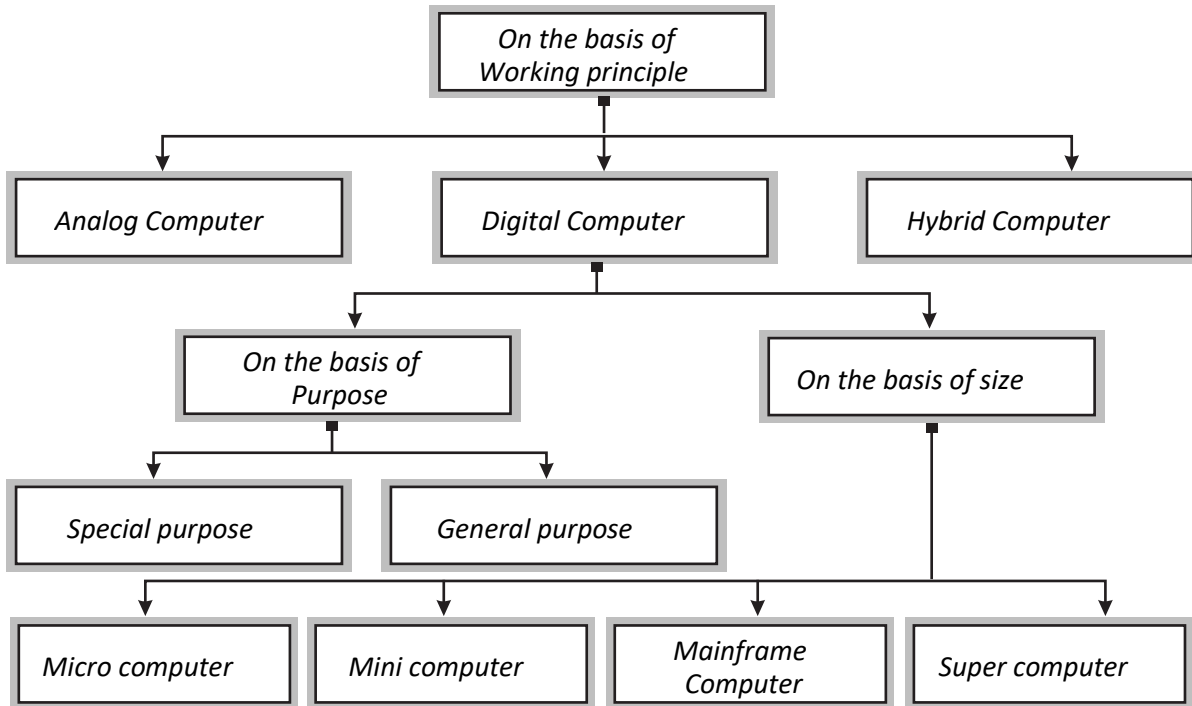
Classification of Computer

On the basis of purpose

1. **General Purpose computer**

   A **general-purpose computer** is a description of a computer capable of performing many different tasks rather than a specific one like a special-purpose computer. For example, the computer you're using now to read this web page is a general-purpose computer. In addition to browsing the Internet, you can play a game, write a letter in a word processor, and other tasks.

2. **Special Purpose computer**

   A special-purpose computer is embedded in almost all electronic devices and is the most widely-used computer. This computer is designed for a specific task and is found in ATMs, cars, microwaves, TVs, the VCR, and other home electronics. See our special-purpose computer page for further information and examples.

S.N.	Special Purpose Computer	S.N.	General Purpose computer
1	They are called single task.	1	They are also called multi task computer
2	The program is installed at the time of manufacturing in it.	2	Programs are installed later on as per the requirement of user.
3	A user cannot install program in it.	3	A user can install different programs according to their needs.
4	Programs are permanently stored.	4	Programs are temporary in the memory.
5	It is comparatively faster than general purpose computer.	5	It is comparatively slower than special purpose computer.
6	Example: Washing machine	6	Example: Microcomputer.

On the basis of Work:

1) Analog Computer:- Analog computer is one which operates on continuous data, usually of a physical nature such as length, voltage or current, etc. An analog machine is usually a special purpose device dedicated to a single task. Analog computers are based on analog signals that are continuous signals. These types of computers were widely used in scientific and industrial applications. These are used in a hospital to measure the size of the stone in kidney and mental diseases diagnostics.

Analog computer works by measuring rather than counting. It is usually used for scientific work rather than personal purpose and commercial use so it is special purpose computer. It is powerful in solving differential equations.

Characteristics of analog computer

➢ Based on continuous varying data.

➢ Measure only natural or physical values.

➢ Used for special purpose.

➢ Generally, no storage facility is available because they work on real time basis. If provided, then only a little amount of storage is available in it.

➢ Accuracy of these types of computer is very less because of noise and filtering facility.

Examples: - ohmmeter, speed meter, tetrameter, seismograph etc.

2) Digital Computer:-

The computer which works on discrete data or discontinuous data is known as a digital computer. It works on a binary system where 0 represent off and 1 represents on. It is based on digital signals i.e discrete signals.

So, the basic principle of these computers is either present or absence of an electric pulse in the signals. It is a multipurpose and programmable computer. It is fast processing, more accurate and has large memory capacity. It is usually general purpose computer. Some examples of a digital computer are IBM PC, Apple/Macintosh computer, etc. *Characteristics of digital computer*

➢ Based on discrete data which are not continuous with time.

➢ Based on principle of logic 1 and 0 or high and low voltage.

➢ Used for general purpose.

➢ They are more reliable because of less noise and filtering facility.

➢ It has large memory capacity because the calculations are to be stored internally for future use and re-programming.

➢ It is multipurpose and programmable so, it is of high cost and faster processing.

➢ Signal representation of digital pulse is as follows.

Example: - IBM PC, Apple/Macintosh etc.

3) Hybrid Computer:-

A computer, which has a combination best feature of both analog and digital computers, is called a hybrid computer. It helps the user to process discrete and continuous data. The hybrid computer can convert the analog signal into digital signals and digital signal into analog signal. Hybrid computers are used mainly in specialized applications where both kinds of data need to be processed. Therefore, they help the user to process both continuous and discrete data.

Characteristics of Hybrid computer are as follows.

• It is the combination of qualities of analog as well as a digital computer.

• It can process both continuous and discrete data.

- It is special purpose computer.
- It can convert one type of data into another.
- It is mostly used in radar communication, rocket launching, and weather forecasting and in other fields.
- It usually high cost compared to analog and digital computer.
- Hybrid Machines are generally used in scientific applications or in controlling industrial processes.

S.N.	Digital Computer	S.N.	Analog Computer
1	These computers work with digits.	1	These computers work with natural or physical value.
2	It works upon discrete data.	2	It works upon continuous data.
3	It operates by counting and adding, i.e. it calculates.	3	It operates by measuring and comparing.
4	Its accuracy is high.	4	Its accuracy is low.
5	Results are obtained after complete computation.	5	Output is continuous.
6	It is general purpose in nature.	6	It is special purpose computer.
7	Larger storage capacity (memory).	7	No any or smaller storage capacity.
8	Higher cost then analog computer.	8	Lower cost than Digital computer.
9	It can be reprogrammed.	9	Normally, it cannot be reprogrammed.
10	Example: IBM PC, Apple etc.	10	Example: Presley, Speedometer etc.

2.) On the basis of Size:

1) Micro Computer:-

These are the smallest computer systems on the basis of size. These computers are based on microchips because microprocessor is used as memory device and they are very small. These computers are also called PC (personal computer) or home computers. The smallest of this category are laptop, notebook and palmtop computers. This size is reducing day- by-day.

Characteristics of micro computer

- ➢ Smallest in terms of size can be kept on top of a desk (desktop), on top of laptop and like a notebook.
- ➢ Speed and cost is also smaller.
- ➢ Since a single user system is used, storage devices and memory are smaller sized.

Example: IBM Pentium Pc, Apple/ Macintosh etc.

Types of Micro Computer:

    a) Portable: Desktop   **b) Non-Portable:** Laptop, Tablet pc, Handheld computer

1. *Desktop Computer:* A Desktop computer is a personal computer that is designed to fit on top of a typical office desk.
2. *Laptop Computer:* A Laptop computer is a portable personal computer light and small enough to sit on a person's lap.
3. *Handheld computer:* It can fit one hand and we can operate it with the other hand. Because of its reduced size, the screen of handheld computer is quite small. Similarly, it also has small keyboard.

- **Notebook:** Notebook is also designed for the people in move. But it is smaller in size compared to laptop. It is device with a reduced keyboard, screen, functionality, and software support than laptop.

- **Palm top:** A small computer that literally fits in your palm. Compared to full size computers, palmtops are severely limited, but they are practical for certain function such as phone books and calendars.

- **Tablet Pc:** A tablet PC is a wireless, portable personal computer with a touch screen interface. The tablet is typically smaller than a notebook computer but larger than a smart phone

- **Smart phone/ PDA:** A smart phone is a mobile phone that includes advanced functionality beyond making phone calls and sending text messages.

2) Mini Computer:-

Minicomputer is medium in size it is bigger than micro and smaller than mainframe computer. A centrally located server or CPU is connected with more than 50 terminals. At a time 50 people can work with single minicomputer for data processing, Desktop publishing etc. It is linked with network and used for Bank, Business field.

Characteristics of mini computer

➢ Medium sized computer occupying approximately 10 sq. feet of area.
➢ More than 50 terminals and large capacity storage devices than microcomputer.
➢ But minicomputer is smaller than mainframe computer.
➢ Used for general purpose.
➢ Used in medium sized organizations and corporations for their database administration.

Examples: - Prime 9755, vax 36 etc.

3) Mainframe Computer:-

These are the largest computer on the basis of the size. It has more storage capacity and fast processing speed. It takes about 100 sq. feet. At least 100 people can work at a time. A centrally located server or CPU is connected with more than 100 terminals.

Fig. Mainframe computer

Characteristics of mainframe computer

➢ Largest in size with approximately 10000 sq. feet area.
➢ Central processor, central administration
➢ More than 100 terminals, large capacity storage devices used.
➢ Fastest and very expensive system.
➢ General purpose computer.
➢ Used by large agencies and government for large scale data processing.

Examples: - IBM 1401, ICL 2950/10 etc.

4) Supper Computer:-Super computer is very large machine which works in MIPS. They are most powerful and expensive computers. They have extremely large storage capacities and processing speed is at least 10 times faster than other computer.

Characteristics of super computer

➢ It is very large and powerful computer.
➢ It is large storage capacities and work is done by very fast.
➢ It can calculate about 400 million numbers every second.
➢ It can result is always exactly correct.
➢ Super computers are used in weather forecasting petroleum engineering and medicine and for creating computer graphics.
➢ It is used in weather research and scientific research.

Some examples of the super computers are CRAY, NEC Super SX11, and CYBER 205 etc.

Micro Computer	Super Computer
1. It is less powerful.	a. It is more powerful.
2. It is the smallest computer on the basis of size.	2. It is larger in size.
3. It is cheaper.	3. It is the most expensive computer.
4. It can be handled by only one person.	4. It required numbers of experts to operate.
5. It is used in office, house.	5. It is used in weather forecasting, Scientific research.
6. Example are IBM PC, Apple/ Macintosh etc.	6. Example are CRAY I, CYBER 205 etc.

On the basis of Brand

1) IBM Computer (IBM PC):-

IBM, which established by Dr. Herman Hollerith in 1923 AD, is the largest computer manufacturing company in the world till today. It is leading the market of mainframe and PCs. It uses the processors multimedia devices and some other hardware parts developed by some other Companies like Intel but use the principle of its own. So, all the computers developed by IBM Company are called IBM computers. Example: - IBM PC and IBM Compatible.

1) IBM Compatible:-

The computers developed by IBM company is itself are called branded or IBM PC computer which are developed or assembled by other companies using the parts and principle of IBM PCs are called IBM compatibles. So, IBM compatibles are also called duplicate of IBM PCs.

2) Apple / Macintosh Computer:-

Apple Corporation was established in 1970 AD is USA. Within these 3 decades. It has gone much forward and produced PCs with good qualities and user friendly. So, the entire computers that are developed by Apple Corporation are called Apple/Macintosh (Mac) computers. These computers are architecturally totally different than that of IBM's. Not only hardware part, but their software architecture is also totally different. Software made for IBM PC can't be run in Macintosh or vice versa. Floppy disks or hard disks formatted in one can't be recognized by on other.

IBM PC	IBM Compatible
1. These computers are developed by IBM Company itself.	1. These computer are developed by the companies other than IBM Company
2. These computer are also called branded or original PCs.	2. These computer are generally called assembled or duplicate of PCs.
3. Generally Expensive	3. Comparatively cheaper.
4. It is more reliable.	4. It is less reliable.
5. These computer are reliable, durable and have better quality than IBM Compatible.	5. These computers are less reliable, less durable, have low quality.

Data:

Data is defined as the raw facts and figures. It could be any numbers, pictures, sound, alphabets or any combination of it. Which do not provide clear meaning. Examples, 101, Hari, Bharatpur etc.
Data is the collection of raw facts and figures which don't have clear meaning. Data are the basic and key elements for any organization which are processed to generate the meaningful information after some calculations. These data provides base for the progress of any organization.

1. ***Primary Data:*** Facts and figures newly collected. Examples, observation data, questionnaire data, surveys data etc.
2. ***Secondary data:*** Facts and figures already collected. Examples, Financial statements, customer list, sales report, census report etc.

Program:

Program is a group of instructions given to the computer to perform a certain task. A program is used to solve a problem in computers. The program is written using a series of instruction that consists of all symbols, characters and certain rules.

A computer specialist who is responsible for designing, writing and modifying computer program is known as computer programmer. Programmer had depth knowledge about programming tools, techniques and programming language.

Feature of good program

1) **Integrity:** A program should be complete and must give the desire output.
2) **Clarity:** A program should be clear and should not be ambiguously.
3) **Simplicity:** A method for solving a problem should be very simple and easily understandable.
4) **Efficiency:** A program should take less memory and processing time, as a result it runs faster. Such kind of program automatically increases the efficiency of computer.
5) **Maintainability:** A program should be easy to maintain and update in future.
6) **Reliability:** It should be reliable so that user can depend on it.
7) **Generality:** It should be flexible and easy to operate with a wide range of platform.
8) **Modularity:** A program should be divided into different modules in order to complete a complex problem.
9) **Robustness:** A program should be almost 100 % perfect.
10) **Documented:** Documentation helps for smooth operation for the users and even helps for further modification and maintenance.

Data and Program representation in computer

The smallest unit of memory measurement is bit (binary digit- 0 or 1). The data stored in a computer is a binary digit, byte, kilobyte, megabyte, gigabyte, terabyte, etc.

Bit

Bit stands for Binary digit. The value of the binary digit is 0 or 1.

Nibble

Nibble is the combination of 4 bits.

Byte

Byte is the combination of 8 bits.

The units of memory measurements are as follows:

S.N.	Memory Unit	Description
1	Bit	1 Bit = 0 or 1
2	Nibble	1 Nibble = 4 Bits
3	Byte	1 Byte = 8 Bits
4	Kilobyte (KB)	1 Kilobyte (KB) = 1024 Bytes
5	Megabyte (MB)	1 Megabyte (MB) = 1024 KB
6	Gigabyte (GB)	1 Gigabyte (GB) = 1024 MB
7	Terabyte (TB)	1 Terabyte (TB)= 1024 GB
8	Petabyte (PB)	1 Petabyte (PB) = 1024 TB

Binary Coding schemes represent the data such as alphabets, digits 0–9, and symbols in a standard code. The binary coding schemes that are most commonly used are:

➢ Extended Binary Coded Decimal Interchange Code (EBCDIC),
➢ American Standard Code for Information Interchange (ASCII), and
➢ Unicode

Introduction to codes

A computer can only understand binary numbers which are in the form of two electronic states i.e. high voltage and low voltage. Such notations are further derived into standard codes and such codes can represent the data for users' convenience. Some of the popular codes are:

1. Absolute Binary (pure binary):

In an absolute binary method, 0 is placed before the binary number to represent positive number and 1 is placed before the binary number to represent a negative number. The most significant bit in binary number denotes the sign bit and the rest bits represent the actual number.

The binary number is expressed in 8,16,32,64, etc. bit format.

2. BCD (Binary Coded Decimal):

It is a simple system for converting decimal numbers into a binary form where each decimal number is converted separately into binary and placed spaces in between numbers. In BCD, each decimal digit occupies 4 bit. For example, the decimal number 24 can be represented in BCD as $(0010\ 0100)_2$.

Decimal	0	1	2	3	4	5	6	7	8	9
BCD	0000	0001	0010	0011	0100	0101	0110	0111	1000	1001

Fig: Binary Coded Decimal

3. ASCII (American Standard Code for Information Interchange):

ASCII is a standard coding system that assigns numeric values to the letter, numbers, punctuation marks and control characters to achieve compatibility with different hardware and peripherals. ASCII was developed in 1968 and was divided into 2 sets: Standard ASCII (7 bits code, 128 characters) and Extended ASCII (8 bits code, 256 characters). Most systems use 8 bit extended ASCII to represent foreign language characters and other graphical symbols.

Fig: ANSI Extended ASCII

In ASCII, each character is represented by a unique integer value from 0 to 255. The value 0 to 31 is used for non-printing control characters and the range from 32 to 127 is used to represent the letters of the alphabet and common punctuation symbols. For example: ASCII code for capital letter A is 65, for * is 42, etc. Since, ASCII code uses 8 bits, each character represented in ASCII Code occupies 1-byte storage space in a computer.

4. Unicode:

It is a 16-bit character code defined by the Unicode Consortium and International Standard Organization (ISO) that supports up to 65,536 characters. It allows all the characters and symbols in any language in the world to be represented by a single code. For example, the Chinese language has almost 10,000 characters which can be represented by Unicode only. If Unicode is universally adopted, then it will make multilingual software much easier to write and maintain.

Fig: Unicode in Python

Since, Unicode uses 16 bits, each character represented in Unicode occupies 2 bytes storage space in the computer. This coding system has been developed to overcome the drawback of ASCII code that supports only 256 different characters, which is sufficient only for English language but not for all the languages like Chinese, Japanese, etc. which has more than 256 characters. The Unicode Worldwide Character Standard provides up to 4 bytes (32 bits) now.

5. EBCDIC (Extended Binary Coded Decimal Interchange Code):

It is an 8-bit code system which is commonly used on large IBM mainframe computers, most IBM minicomputers and computers from many other manufacturers. It allows 256 characters to be represented in computers.

In this code, placement of the letters of the alphabet is discontinuous and there is no direct character to character match when converting from EBCDIC to ASCII and vice versa.

EBCDIC Format

Bits	5	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
	6	0	0	0	0	1	1	1	1	0	0	0	0	1	1	1	1
	7	0	0	1	1	0	0	1	1	0	0	1	1	0	0	1	1
	8	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1

1	2	3	4																
0	0	0	0	NUL	SOH	STX	ETX	PF	HT	LC	DEL			SMM	VT	FF	CR	SO	SI
0	0	0	1	DLE	DC1	DC2	DC3	RES	NL	BS	IL	CAN	EM	CC		IFS	IGS	IRS	IUS
0	0	1	0	DS	SOS	FS		BYP	LF	EOB	PRE			SM			ENQ	ACK	BEL
0	0	1	1			SYN		PN	RS	US	EOT					DC4	NAK		SUB
0	1	0	0	SP										¢		<	(	+	|
0	1	0	1	&										!	$	*	)	;	¬
0	1	1	0	–	/										,	%	_	>	?
0	1	1	1											:	#	@	'	=	"
1	0	0	0		a	b	c	d	e	f	g	h	i						
1	0	0	1		j	k	l	m	n	o	p	q	r						
1	0	1	0			s	t	u	v	w	x	y	z						
1	0	1	1																
1	1	0	0		A	B	C	D	E	F	G	H	I						
1	1	0	1		J	K	L	M	N	O	P	Q	R						
1	1	1	0			S	T	U	V	W	X	Y	Z						
1	1	1	1	0	1	2	3	4	5	6	7	8	9						

PF	Punch off
HT	Horizontal tab
LC	Lower case
DEL	Delete
SP	Space
UC	Upper case
RES	Restore
NL	New line
BS	Backspace
IL	Idle
PN	Punch on
EOT	End of transmission
BYP	Bypass
LF	Line feed
EOB	End of block
PRE	Prefix (ESC)
RS	Reader stop
SM	Start message
DS	Digit select
SOS	Start of significance
IFS	Interchange file separator
IGS	Interchange group separator
IRS	Interchange record separator
IUS	Interchange unit separator
Others	Same as ASCII

Fig: EBCDIC Format