UNIT – I: COMPUTER HISTORY

Learning Objectives :

After learning the Unit the students will be able to:

➢ learn about the various inventions in computers

➢ understand the technological changes occurs in computer in terms of hardware and software

➢ identify and classify computers in its various categories

➢ understand the basic difference between various types of computers

➢ differentiate computers according to the way they process data, according to their size and the function performed.

As we have seen that since its inception computer has been evolved a lot for the last couple of decades. In earlier days a computer was such a big machine that required space like a complete room and hence its maintenance cost was very much far away from a common man. A common man could not have thought to have a computer for his personal use. But now-a-days one in every three person is using computer in one way or the other. From bulky machine to as small as like a SIM card, this is possible because of the ever changing technological world.

The old adage "Necessity is the mother of inventions" holds true for computer also because computers are invented as a result of man's search for fast, accurate and reliable calculating devices.

The Evolution of Computers is defined in terms of various eras. Let us take a look of them :

A) MANUAL ERA :

The earliest device that qualifies as a digital computer is the **'Abacus'**. This device allows the user to represent numbers by the position of beads on a rack. Simple addition and subtraction can be carried out rapidly and efficiently by positioning the beads on the rack appropriately. Although Abacus was invented around 600 B.C. and was used by the Chinese and Egyptians, it is still being used in Far East.
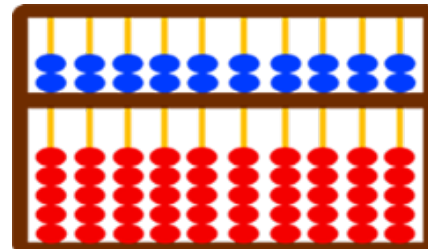
Another manual calculating device to speed up the multiplication process was John Napier's bone or Cardboard Multiplication Calculator developed by Scottish man named John Napier. A complete set of Napier bone's consists of rods , one for each of the digit 0 to 9 called bones, with number carried on them. It was designed in the 17th Century and they first appeared in print in 1614.
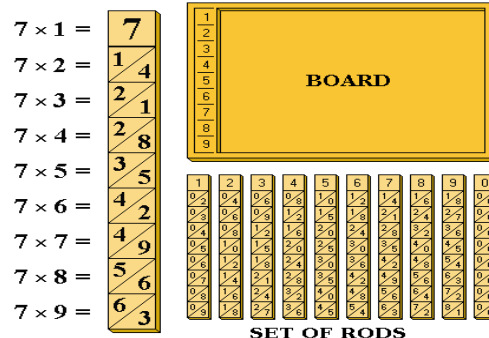
B) MECHANICAL ERA :

The first mechanical calculator was developed by **Wilhelm Schickhard** , a professor at the University of Tubingen.

In 1642, the young French philosopher and mathematician **Blaise Pascal** developed another mechanical adding machine called *Pascaline,* which could add and subtract numbers.

Pascaline used a system of gears and wheels.

Later in year 1671 **Baron Gottfried Wilhelm Von Leibiniz** of Germany developed a similar mechanical calculator that could also perform multiplication and division.

In early 19th Century a Frenchman Joseph Jacquard invented a loom that used punched cards to automatically control the manufacturing of patterned cloth.

Charles Babbage , a 19th Century professor at Cambridge University, is considered to be **the Father of Modern Digital Computers.** Babbage designed a *Difference Engine* in year 1822, which was capable of performing automatic multistep calculation and can produced reliable mathematical and statistical tables automatically. In the year 1842, Babbage conceived the new idea of *Analytical Engine*, that was intended to be completely automatic. It was capable of performing the basic arithmetic functions for any mathematical problem at an average speed of 60 additions per minute. The Analytical Engine incorporated many features of modern computers including punched card instructions, internal memory , an arithmetic unit to perform calculation any many other number of principals which have been shown to be fundamental to the design of any digital computer.
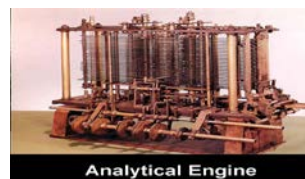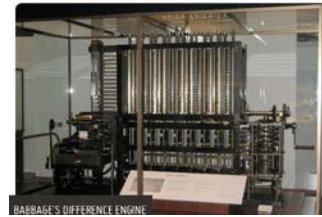
> *Analytical Engine was programmable and in order to write program Babbage employed ada Augusta Lovelace (daughter of poet Lord Byron) , who became the first programmer in the world.*

In the late 19th century a young statistician **Harmen Hollerith**, the inventor of Punched Card Tabulating Machine , used it for processing Census data. Later in 1911, by merging several other firms, he formed IBM Corporation.

In 20th Century, under the direction of **George Stibitz** of Bell Telephone Laboratories, five large scale computer were developed by using Electromechanical Relays and were called as **Bell Relay Computers.** These computers were capable to perform calculations with a high speed and accuracy.

The **Mark-I** computer, the world first general purpose mechanical digital computer was developed by **Howard H. Aiken**, a professor of Physics at Harvard University, in collaboration with IBM. Its designed was based on he technique already developed for punched card machinery. This machine was also known as **Automatic Sequence Controlled Calculator**, and may be regarded as the first realization of Babbages' Analytical Engine.

C) ELECTRONIC ERA :

The first electronic computer using 45 vacuum tubes (valves) for internal logic and capacitors for storage and having the concept of binary system was developed by **John Vincent Atanasoff** and his assistant Clifford Berry in 1939. This prototype of automatic electronic calculator was known as Atanasoff-Berry Computer or ABC, capable of solving variables with a high degree of accuracy.

In 1946, an all electronic version of Mark-I called Electronic Numerical Integrator And Calculator (ENIAC) was developed by **J. Presper Eckert and John W. Mauchly** at the University of Pennsylvania, USA. It was the first large scale fully electronic computer installed at Marryland to cater the military need.

The basic behind the stored program digital computers was developed by **Dr. John Von Neumann.** And in 1952 by using the concepts of stored program, John Von Neumann with his collaborator H.H. Goldsteine designed Electronic Discrete Variable Automatic Calculator (EDVAC). It was John Von Neumann who introduced the idea od storing both instructions and data in the binary form.

In 1949, at Cambridge University, a group of British Scientists headed by professor Maurice Wilkes developed *Electronic Delay Storage Automatic Calculator (EDSAC)*, that was capable of performing Addition operation in 1500 microseconds and multiplication operation in 4000 microseconds.

The **UNIversal Automatic Computer (UNIAC) was first digital computer**, produced by many companies like IBM, Universal Accounting Company, General Electronic Corporation etc . It was first commercial large scale digital computer produced in 1951.

During the period of late 1940's and early 1950's many other stored program computers like JOHNIAC, MANIAC, ILLIAC etc were developed.

1.1 GENERATION OF COMPUTERS

Generation in computer era provides a framework for the growth of computer industry and generally characterizes the major developments in the computer industry. The modern computer era can be divided into Five generations distinguished by the basic electronic component within the computer. Each new logic unit let the computers faster in speed, smaller in size, more reliable and less expensive than their predecessors. Modern computers came in a variety of shapes, sizes and costs.

Computers were developed in Five different phases known as the Generation of Computers. Let's discuss one by one in a little detail :

First Generation (1942-1955) The computers of this generation used Electronic Valves (an array of Vacuum Tubes) as the basic component for memory and circuitry for central processing unit. These vacuum tubes were a fragile glass device like electric bulb, that could control and amplify electronic signals. They produced a lot of heat and were prone to frequent fusing/ damaging of the installations.

Therefore, they were used very expensive and could be afforded onlyby very large organizations.

Advantages :
i) these computers were the fastest calculating device of their time. They could perform computations in milliseconds.
ii) vacuum tube technology made possible the advent of electronic digital computers.

Disadvantages :
i) Too bulky in size
ii) Air conditioning required to control the temperature
iii) Prone to frequent hardware failure.
iv) Commercial production was difficult and costly.
v) Slow input and output operations.

USEFUL POINTS :
- Period : 1942-1955
- Component used : Vacuum tubes
- Speed : milliseconds
- Maximum memory capacity : 2000 inch
- Mean-time before failure : minutes
- Peripherals :
  - I/O : Punched cards, Paper tape, Magnetic tape, Printer (online)
  - Secondary Storage : Punched Cards, Paper Tape, Magnetic Drum, Magnetic Disk etc

- Operating System : Mainly Batch Processing
- Languages : Machine Code and Electric Wired board
- Application Areas : Payroll Processing, Record Keeping etc.
- Example : ENIAC, EDVAC, EDSAC and IBM 650 (the first modern digital computer produced on mass scale)

Second Generation (1955-1964)
The second generation computer used Semi-conductor transistor instead of vacuum tubes after the invention of transistor by a team led by William Shockley.

This generation computers used transistors which were cheaper, consumed less power, more compact in size, more reliable and faster than the vacuum tubes used in first generation computers.
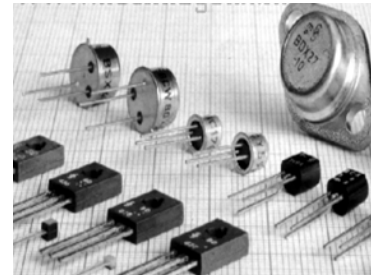
Advantages :
i) Smaller in size as compared to first generation computers
ii) More reliable
iii) Less heat generated.
iv) Less prone to hardware failure
v) Wider commercial use

Disadvantages :
i) Air conditioning required
ii) Manual assembly of individual components into a functioning unit was a cumbersome task.

USEFUL POINTS :
- Period : 1955-1964
- Component used : Transistors
- Speed : microseconds
- Maximum memory capacity : 128000 inch
- Mean-time before failure : days
- Peripherals :
    - I/O : Paper tape, Magnetic tape, Visual Display Unit
    - Secondary Storage : Paper Tape, Magnetic Drum, Magnetic Disk etc
- Operating System : Multiprogramming, Time-Sharing and Real Time processing
- Languages : Assembly Language, High Level Languages like FORTRON, COBOL etc
- Application Areas : Batch –oriented application like Billing, Payroll processing, Updating Inventory etc.
- Example : IBM 1401, IBM 7090, IBM 1620, IBM 7094, IBM 700 series, CDC 1604, CDC 3600, UNIVAC 1108

Third Generation (1964-1975)
The third generation computers used Integrated Circuits (or IC Chips) in which many transistors, resistors, capacitors and other components (circuit elements) are fabricated or integrated and packaged together into a very small surface of silicon known as Chips.
This new microelectronic technology was called Integrated Circuits.
The IC was invented by Jack Kilby in 1958
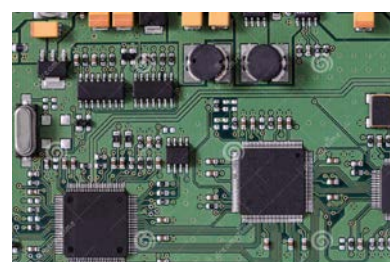
Advantages :

i) Smaller in size as compared to previous generation

ii) More reliable than second generation computers

iii) Low maintenance cost

iv) Easily portable

v) Commercial production was easier and cheaper.

Disadvantages :

i) Air conditioning required in many case

ii) Highly sophisticated technology required for the manufacture of IC chips

USEFUL POINTS :

- Period : 1964-1975
- Component used : Integrated Circuits (IC)
- Speed : nanoseconds
- Maximum memory capacity : 4 million inch
- Mean-time before failure : weeks to months
- Peripherals :
     - I/O : Typewriter terminal, Visual Display Unit, Optical Character Reader etc
     - Secondary Storage : Magnetic Disk, Extended Core Storage, Mass Storage devices
- Operating System : Multiprogramming, Time-Sharing, Real Time processing and Remote processing
- Languages : High Level Languages like FORTRON-II to IV , COBOL , BASIC, ALGOL-68, PASCAL-1 etc
- Application Areas : Airline System, Market forecasting, Credit Card billing etc
- Example : IBM 360/370 series, ICL 1900 series, PDP 11, RCA Spectra 70 etc.

Fourth Generation (1975 onwards) Initially, the Integrated Circuits contained only about 10 to 20 components called Small Scale Integration (SSI). Later on with the advancement in technology for manufacturing Integrated Circuit Silicon Chips (ICS), it became possible to integrate up to a hundred components on a single chip called Medium Scale Integration (MSI).

Now the manufacture of integrated circuits became so advanced as to incorporate hundreds of thousands of active components in volume of a fraction of inch, leading to Large Scale or Very Large Scale Integration (VLSI).

Integrated Circuits which have the entire computer circuit on a single silicon chip are called Microprocessors. The development of microprocessors made it possible to place complete CPU of a computer on a single chip.

The first Microprocessor Intel 4004 consisted of 2250 transistors on a microprocessor was designed by Intel Corporation engineer Ted Hoff in 1971. It was 4-bit microprocessor.

Advantages :

i) Smaller in size because of high component density

ii) Heat generated is negligible

iii) Much faster in computation then previous generations

iv) Less power consumption

v) No air conditioning is required in most cases

Disadvantages :

i) Highly sophisticated technology is required for the manufacturing of VLSI chips

ii) Highly skilled people are required in its manufacturing

USEFUL POINTS :

- Period : 1975 onward
- Component used : Very Large Scale Integrated Circuits (IC)
- Speed : picoseconds
- Maximum memory capacity : 200 million inch
- Mean-time before failure : months
- Peripherals :
   - o I/O : Visual Display Unit, Optical Character Reader, Magnetic Ink Character Reader, Voice Recognition, Laser Printer etc
   - o Secondary Storage : Floppy disk , Hard Disk, CD-ROM, DVD etc
- Operating System : Time-Sharing, Real Time processing and Network Distribution
- Languages : All High Level Languages like C, C++, Java and other 4th generation languages (declarative languages used in Database)
- Application Areas : Mathematical Modelling, Simuation, Electronic Fund Transfer, Computer Aided Manufacturing and Design etc
- Example : CRAY-1, CRAY-2, IBM 3090/600, IBM AS/400 HP 9000, IBM ES/9000, VAX etc

Fifth Generation (Future Generation: 1991 onwards) : the fifth generation computers are
under development stage. These computers will use Ultra Large Scale Integration (ULSI) chips instead of VLSI. These will be employing two or more processors which compute in parallel.

The fifth generation machine are proposed to be based on Parallel Processing hardware and Artificial Intelligence software with genuine I.Q. (Intelligence Quotient). That provide the ability to reason logically and with real knowledge of the world like human do.

Characteristics of future generation computers :

i) Decreasing cost of hardware and software

ii) High speed processing

iii) Knowledge based processing system

iv) Development of natural language processing

v) Advancement in supercomputer technology

vi) Artificial Intelligence , think and behave like human (humanoid)
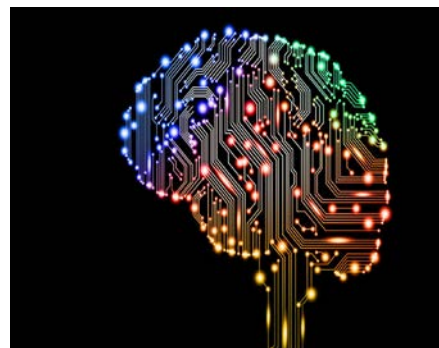
1.2 CLASSIFICATION OF COMPUTERS : Depending upon the ways the data can be handled, computers are basically classified into three categories (a) Analog   (b) Digital and (c) Hybrid , but the digital computers can further be categorized depending upon the purpose they do and based on their size and performance. The exhaustive classification tree of computers can be defined as below :
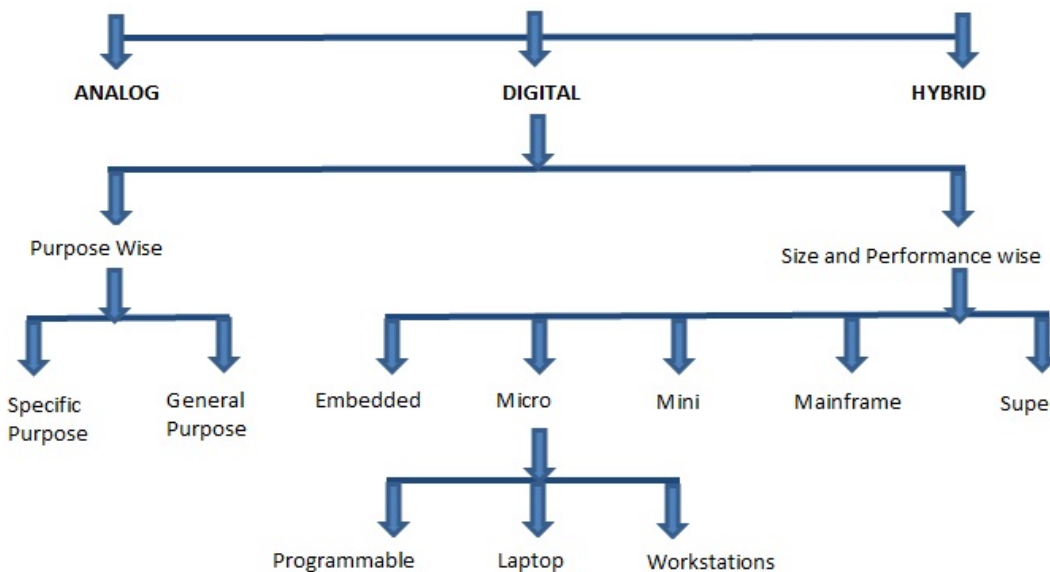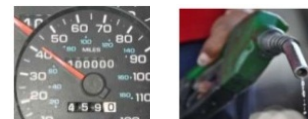

Types of computers according to the data they handle or process

(a) **Analog Computers :** are those computers in which data or number is represented in the form of continuously varying physical quantities such as pressure, temperature, voltage, current etc.

Analog computers measure things.

Application areas : Speedometer of a car, Gasoline pump etc

(b) **Digital Computers :** are those computers that solves problems by operating on discrete data (numeric data) representing variables by performing arithmetic and logical processes on data from a stored program.

Digital computers count things.

Application areas : home, educational institutions, office, scientific fields, business etc.

(c) **Hybrid Computers :** are analog computers controlled by digital computers instead of human beings.

*Application areas :* Hospitals, Meteorology Department etc

Types of Digital computers according to the purpose they are used for

1) **Special purpose computers:** They are designed to do single specific task. The programs or instructions to carry out the specific task are permanently stored in the machine. For Example – computer for military application or purpose, computers at billing counter in malls etc.

2) **General purpose computers:** They are designed to solve wide variety of problems having different set of inputs. For Example – computers for banking, sales analysis etc.

Types of Digital computers according to the size and performance

1) **Embedded computers :** are designed to be used within the circuitry of appliances such as television, washing machine, refrigerator, bike etc
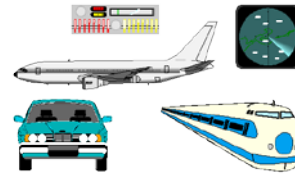
2) **Microcomputers :** are designed to be used by single user for performing basic operations like educational activities, playing games. These are mainly used in homes, offices, shops, school etc.

Microcomputers have the following three basic categories

i) Programmable Computers or Personal Digital Assistant or PDA : are designed to carry out day to day task related to sharing or exchange of information by connecting to desktop computers regardless of location. They are used as notepads and address book.

ii) Laptop or Desktop or Notebook or Personal Computers : are designed to carry out our day to day personal task. They are used in business and at home.

iii) Workstations : are similar to personal computers but have greater memory and processing capabilities. They are generally used in industrial, business and in scientific environment that require high levels of computational abilities.

3) **Mini computers :** are more powerful computers than microcomputers in terms of processing power and capabilities. They are generally multi-user systems.

4) **Mainframe computers :** are designed to handle large volumes of data and information. They are multi-user and multi-processors systems.

5) **Super computers :** are designed to be used for doing extremely complicated computations , that also in minimum possible time. They are the fastest, the largest and most expensive digital computers available today. They are best used in Weather forecasting, Nuclear Science, Aerodynamic modeling etc.

PARAM series by CDAC (Centre for Development of Advanced Computing) and (Processor for Aerodynamic Computation and Evaluation) by ANURAG (Hyderabad based Advanced Numerical Research and Analysis Group) are supercomputers produced by India