

Evolution of Computers and Computer Organization

1. What is Computer? Mention its characteristics.

A computer is an electronic device which consists of hardware and software. Hardware components describe the physical parts of the computer and software controls hardware and run the operating system, different programs & applications like Microsoft Windows, Microsoft word, Microsoft Excel etc.

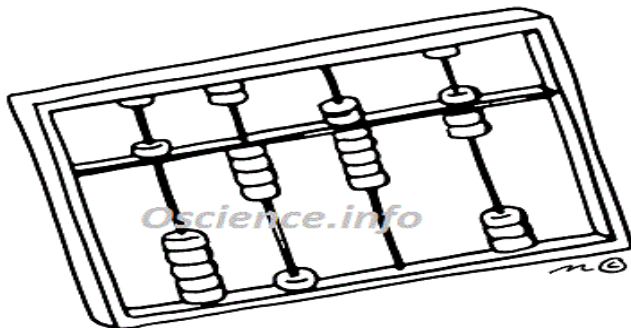
The characteristics are as follows:

- **Automatic:** It works on a problem without any human intervention.
- **Speed:** It is a very fast device. A powerful computer is capable of performing about 3-4 million instructions simple per seconds.
- **Accuracy:** It is accurate with high consistency.
- **Diligence:** It is free from monotony, tiredness, lack of concentration and may work for hours without creating any error and without any lack of interest.
- **Versatility:** A computer is capable of performing almost any task provided that the task can be reduced to a series of logical steps.
- **Memory:** It has a huge storage capacity.
- **Lack of human feelings:** As a machine it is not influenced by feelings, instincts and experiences.

2. Evolution of Computers:-

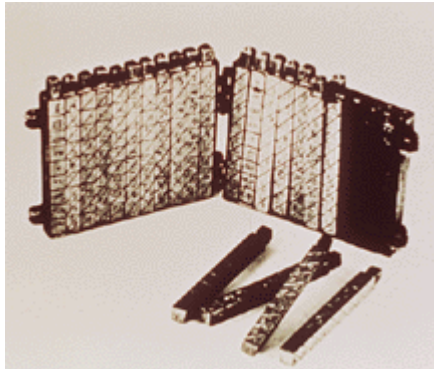
History of computer began many thousands years ago. The idea of computer is originated from simple computing machine like as Abacus, Pascaline, Napier bone etc.

(a) Abacus: Abacus was the *first mathematical computing machine*, originated between 600 and 500 BC, in Asia Minor and is still in use in some countries. The round beads of wood or bone are used to perform addition and subtraction sliding back and forth on the rods (rack). Early merchants used the abacus to keep trading transaction.



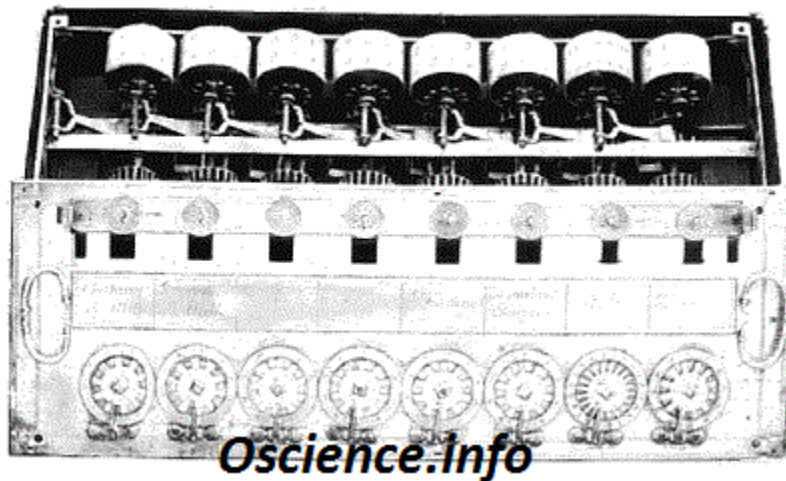
Abacus

(b) Napier's Bone: The inventor of logarithms, Scottish mathematician, John Napier, invented a device called Napier's Bone. It was a rectangular rod of wood or bone on which multiplication tables were inscribed.



Napier's Bone

(c) Pascaline: The numerical wheel calculator, called Pascaline was invented by Blaise Pascal to help his father in tax calculation. The machine consists of a number of toothed wheels connected by gears. Each wheel consists of ten teeth representing the digits 0-9.



Pascaline

(d) Charles Babbage: Charles Babbage, Lucasian Professor of Mathematics at Cambridge, is known as father of computer science. He had designed difference engine (1822) and Analytical engine in 1833.

Difference Engine: the inspiration of building automatic calculating machine was arisen in Babbage's mind by first commercial calculator designed by Thomas Colmar. It uses methods of finite differences to perform mathematical calculations. The difference engine was mind baby of Babbage, which never built. It was steam-driven, fully automatic, and controlled by set of instructions.

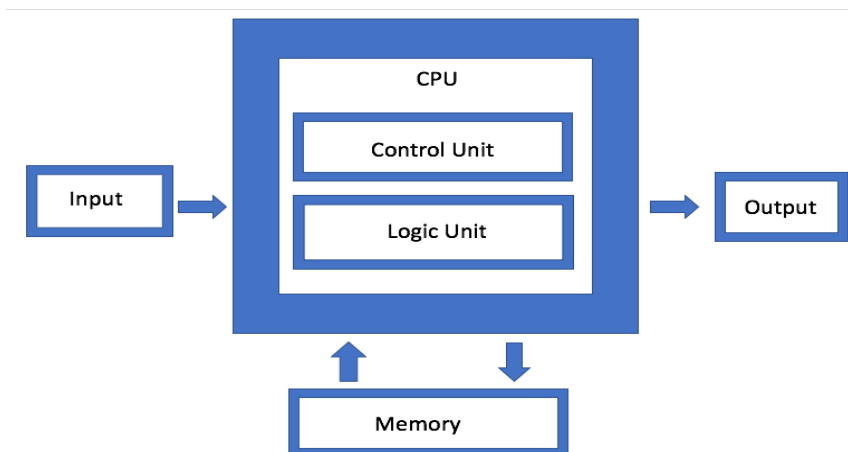
Analytical Engine: was pure mechanical computing machine made from thousands of cogs, geared wheels to perform computing.

3. Stored Program Concept, Von Neumann Concept / Architecture:-

(a) Stored program concept

- Stored-program concept is designed by Hungarian mathematician John Von Neumann.
- The von Neumann architecture is a design model for a stored-program digital computer that uses a processing unit and a single separate storage structure to hold both instructions and data.
- A stored-program digital computer is one that keeps its programmed instructions, as well as its data, in read-write, random access memory (RAM).

(b) Von Neumann Concept / Architecture:-



Design of the von Neumann architecture

- A von Neumann Architecture computer has five parts: an arithmetic-logic unit , a control unit , a memory , some form of input/output and a system bus that provides a data path between these parts.
- Role of computer's main memory M is to store programs and data as they are being processed by CPU.
- M is RAM (Memory)
- RAM permits the CPU to read or change its contents via load or store instructions respectively.
- M is backed with secondary memory that is hard disk

- You store programs and data in a storage medium (such as a hard disk) and work on them in a fast-access, volatile storage medium (RAM).
- The idea behind stored-program concept was to design a computer that includes instruction set architecture and can store in memory a set of instructions (a program) that details the computation.
- A stored-program design also lets programs modify themselves while running
- An instruction set is a list of all the instructions, and all their variations, that a processor can execute.
- Instructions include:-
 - a) Arithmetic such as add and subtract
 - b) Logic instructions such as and, or, and not
 - c) Data instructions such as move, input, output, load, and store
 - d) Control flow instructions such as goto, if ... goto, call, and return.

4.Computer Languages:

A language is defined as the medium of expression of thoughts. All the human beings in this world communicate with each other by a language. Similarly, computer also needs some expression medium to communicate with others.

A computer follows the instructions given by the programmer to perform a specific job. To perform a particular task, programmer prepares a sequence of instructions, known as program. A program written for a computer is known as Software.

1)First Generation Languages –1GLs (Machine language):When the human being started programming, the computer the instruction were given to it in a language that it could easily understand is called as machine language. The binary language of 1 and 0 is known as Machine language. Any instruction in this language is given in the form of 1s and 0s.

2) Second Generation Languages- (2GLs)(Assembly Language):The first language similar to English was developed in 1950 which was known as Assembly Language or Symbolic Programming Languages. An assembly language is a low-level programming language for microprocessors (CPU) and other programmable devices.

3) Third Generation Languages- (3GLs) (High Level Languages):The languages developed which were nearer to the English language in 1960 were known as High Level languages. The different high level languages are FORTRAN, COBOL, BASIC, PASCAL, PL-1 and many others.

4) Fourth Generation Languages- (4GLs)(Query languages):The 3GLs are procedural in nature means HOW the problem get programmed and the procedures require the knowledge of HOW the problem will be solved. .4GLs are non-procedural that focuses on WHAT of the problem is coded means 'WHAT is

required'. The main aim of 4GLs is to be cut down on developed and maintenance time and making it easier for users. Example of 4GL is SQL (Structured Query Language).

5) Fifth Generation Language-(5GLs) The 5GLs are designed to make the computer "Smarter". The use of 5GLs language touches on expert systems, computerized collection of the knowledge of many human experts, artificial intelligence and independently smart computer systems. Examples of 5GL are Prolog, OPS5 and Mercury.

Graphical User Interface (GUI) based languages: These are the languages which use a Graphical User Interface to write, compile & execute the program with ease. Some of them are:-

- Visual Basic
- Visual C++
- C# (Pronounced as C sharp)
- Visual Basic.NET
- Visual Basic 2005

5.Generation of Computers along with components:

i. First generation Computer (1940-1956): Technology used: **Vacuum tube.**

Features: **Limited Storage capacity, slow speed and problems of over-heating.**

Examples: ENIAC, EDVAC and UNIVAC I.

Advantages of First Generation

1. Vacuum tubes were used as electronic component.
2. Electronic digital computers were developed for the first time.
3. These computers were the fastest calculating devices of their time.
4. Computations were performed in millisecond.

Disadvantages of First Generation

1. Too large in size.
2. They were unreliable.
3. Induce a large amount of heat due to the vacuum tubes.
4. Not portable.
5. Limited commercial use.

ii. Second generation Computer (1956-1963): Technology used: **Transistors and diodes.**

Features: **Increased storage capacity, faster speed, and reduction in size and heat generation.**

Examples: IBM 1401, ICL 1300.

Advantages of Second Generation

1. Smaller in size as compares to 1st generation.
2. Much more reliable.
3. Less heat generated.
4. Computation was performing in micro second. Less hardware and maintenance problem.
5. Could be used for commercial use.

Disadvantages of Second Generation

1. Very costly for commercial use.
2. It still required frequent maintenance.
3. Frequent cooling also required.

iii. Third generation Computer (1964-1971): Technology used: **Integrated Circuits (IC).**

Features: **More flexibility with input/output, smaller in size and better performance, extensive use of high level languages.**

Examples: IBM SYSTEM / 360, ICH-360, HONEY WELL-316 etc.

Advantages of Third Generation

1. Smaller in size as compared to second generation.
2. More reliable.
3. Portable
4. Less electricity consumption.
5. Heat generation was rare.
6. General purpose computer.

Disadvantages of Third Generation

1. Air conditioning was required in many cases due to ICs.
2. Very advance technology was required to make the ICs.

iv. Fourth Generation Computer (1971-1989 or present): Technology used: Very Large Scale

Integration (VLSI).

Features: **Increased storage, considerably faster and smaller modular designandcompatibility.**

Examples: IBM-PC, Apple Macintosh etc.

Advantages of Fourth Generation

1. Smaller in size and much reliable.
2. No cooling system required in many cases.
3. Much faster computation.
4. Portable and cheap.
5. The heat generated was negligible.
6. Totally general purpose computer.

Disadvantages of Fourth Generation

1. Very advanced technology was required to fabricate to the ICs

v. Fifth Generation Computer (Present and Beyond): Technology used: Ultra Large Scale

Integration (ULSI).

Features: **Based on artificial intelligence, very fast and larger capacity storage.**

Example: Laptop, Note book, Digital Diary, Palm top and Pocket PC.

Advantages of Fifth Generation

1. Very large storage capacity.
2. Long bit processor builds.
3. Artificial Intelligence Language developed.