

# DEVELOPMENT OF COMPUTERS

## History of Computing

Before 1900, most data processing was done manually using simple tools like stones & sticks to count and keep records.

Around 2000 years ago, Asian merchants came up with a special calculating tool called **Abacus** that could be used to calculate large figures.

An Abacus is made up of a rectangular frame and a crossbar at the middle. It is fitted with wires or strings running across from the frame to the crossbar.

### **How to represent a number using an Abacus**

Each bead in the lower row has a value of 1, while each bead in the upper row has a value of 5. To represent a number, the bead is moved to the crossbar. Those beads away from the crossbar represent zeros.

- After Abacus, the first machine that is usually regarded as the forerunner of modern computers was named the **Analytical Engine**, and was developed by an English mathematician called *Charles Babbage*.
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- In 1939, *Professor Howard Aken* of *Horrard University* designed the first computer-like machine named **Mark 1**. Since then, a series of advancements in electronics has occurred. With each breakthrough, the computers based on the older form of electronics have been replaced by a new “generation” of computers based on the newer form of electronics

# Definition of a Computer

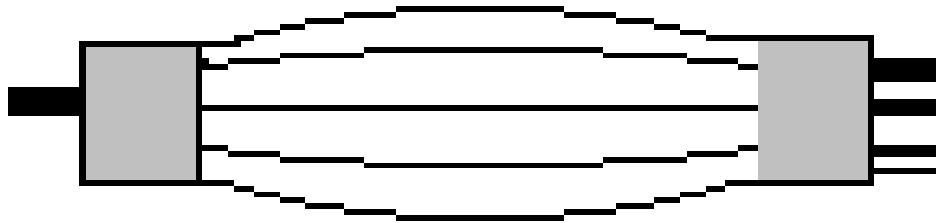
- A computer is defined in the following ways
  - By the work it does
  - By the kind of information it handles
  - By its size and price

- **Technology advances at exponential rates**
  - Computer memory capacity quadruples every 3 years?
  - Computer processor speed doubles every 3 years?
  - Computer networks - number of hosts doubles every year

# COMPUTER GENERATIONS

- A **Computer generation** is a grouped summary of the gradual developments in the computer technology. The historical events are not considered in terms of individual years, but are classified in durations (a period of more than a year).
- **1<sup>ST</sup> Generation computers (1946 – 1956)**
- The 1<sup>st</sup> generation of computers used thousands of electronic gadgets called ***Vacuum tubes*** or ***Thermionic valves*** to store & process information.

# ***Vacuum tube***



The tubes consumed a lot power, and generated a lot of heat during processing due to overheating.

The computers constantly broke down due to the excessive heat generated, hence were short-lived, and were not very reliable.

They also used *Magnetic drum memories*.

- Cards were used to enter data into the computers.
- Their internal memory capacity was limited. The maximum memory size was approx. 2 KB (2,000 bytes).
- The computers used big physical devices in their circuitry; hence they were very large in size, i.e. the computer could occupy several office blocks. For example, ENIAC occupied an area of about 150m<sup>2</sup> - the size of an average 3-bedroom house.
- They were very slow - their speed was measured in **Milliseconds**. E.g., ENIAC (the earliest electronic computer) could perform 5,000 additions per second & 300 multiplications per second.
- The computers were very costly - they costed millions of dollars.

# ***Examples of 1<sup>ST</sup> Generation computers:***

- **ENIAC** (Electronic **N**umerical Integrator **A**nd Calculator) built in 1946 for use in World War II. It contained 18,000 Vacuum tubes.
- **EDVAC** (Electronic **D**iscrete **V**ariable **A**utomatic Computer) developed in 1945 by Dr. John Von Neumann. It was the first computer that used instructions stored in memory.
- **UNIVAC** (**UNIV**ersal **A**utomatic Computer).
- **IBM 650**.
- **LEO** (**L**yon's **E**lectronic **O**ffice).



## 2<sup>ND</sup> Generation computers (1957 – 1963).

- The 2<sup>nd</sup> generation computers used tiny, solid-state electronic devices called ***Transistors***. The transistors were relatively smaller, more stable & reliable than vacuum tubes.

### ***Transistor***

- The computers consumed less power, produced less heat, were much faster, and more reliable than those made with vacuum tubes.
- They used *Magnetic core memories*.
- RAM Memory size expanded to 32 KB.

- Their operation speed increased to between 200,000 – 300,000 instructions per second. Their speeds were measured in **Microseconds**. E.g., a computer could perform 1 million additions per second, which was comparatively higher than that of the 1<sup>st</sup> generation computers.
- The computers were smaller in size & therefore, occupied less space compared to the 1<sup>st</sup> G computers.
- They were less costly than the 1<sup>st</sup> G computers.
- ***Examples of 2<sup>nd</sup> Generation computers:***
- NCR 501, IBM 300, IBM 1401, IBM 7070, IBM 7094 Series & CDC-6600 Mainframe computers.
- ATLAS LEO Mark III.
- UNIVAC 1107.
- HONEYWELL 200.

# 3<sup>RD</sup> Generation computers (1964 – 1979).

- Used electronic devices called ***Integrated Circuits (ICs)***, which were made by combining thousands of **transistors & diodes** together on a semiconductor called a *Silicon chip*.
- ***Integrated circuit***
- The processing speed increased to 5 Million instructions per second (5 MIPS).
- The storage capacity of the computers (i.e. the RAM memory sizes) expanded to 2 MB.
- They were smaller in size compared to 2<sup>nd</sup> generation computers.
- The computers used a wide range of peripheral devices.

- The computers could support more than user at the same time. They were also able to support remote communication facilities.
- Magnetic disks were developed for storage purposes.
- The 1<sup>st</sup> microcomputer was produced during this period (1974).
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- ***Examples of 3<sup>rd</sup> Generation computers:***
- IBM 360, 370;
- ICL 1900 Series;
- 8-bit Microcomputers & PDP-11 Mainframe computers.

# 4<sup>TH</sup> Generation computers (1979 – 1989)

- The 4<sup>th</sup> generation computers used **Large Scale Integrated (LSI)** circuits & **Very Large Scale Integrated (VLSI)** circuits. These circuits were made by compressing more tiny circuits and transistors into even smaller space of the silicon chip.
- ***Very Large integrated circuit***

- The computers were small, and very fast. Their processing speeds increased to 50 Million instructions per second.
- Had large storage capacity, i.e., their memory sizes expanded to several hundred Megabytes.
- Memories used included Magnetic disks, Bubble memories & Optical disks.
- ***Examples of 4<sup>th</sup> Generation computers:***
  - IBM 308 and 4300;
  - Amdahl 580
  - Honeywell DPS-88
  - Burroughs 7700, and the 16-bit & 32-bit microcomputers. The first microcomputer was called *Apple II*.

# 5<sup>TH</sup> Generation computers (1990 – Present)

- In this generation fall today's computers.
- The technologies used are *Parallel architectures, 3-Dimensional circuit design & super conducting materials*.
- These technologies have led to the development of computers referred to as *Supercomputers*, which are very powerful, and have very high processing speeds. Their speeds are measured in **Nanoseconds & Picoseconds**.
- They are able to perform parallel (or multi-processing) whereby a single task is split among a number of processors.

- The memory sizes range between 1 Gigabyte & 1 Terabyte.
- The computers are designed using **VLSI** and the Microchip technology that has given rise to the smaller computers, known as Microcomputers used today.
- The computers have special instruction sets that allow them to support complex programs that mimic human intelligence often referred to as ***Artificial Intelligence***. Such programs can help managers to make decisions and also provide critical expert services to users instead of relying on human professionals.



# Review Questions

- Briefly describe the history of computers.
- What do you mean by computer generations?
- Describe the FIVE generations of computers in terms of technology used and give an example of a computer developed in each generation.
- Compare computer memory sizes during the Five computer generation periods.
- What was the most remarkable discovery during the second computer generation?

- Technology is the basis of computer classification. Based on this, explain briefly the difference between the first three computer generations.
- What is so peculiar in the fourth and fifth generation of computers?
- Match the following generations of computers with the technology used to develop them.
- Give four characteristics of First generation computer.
- Write the following abbreviations in full:
  - A) ENIAC
  - B) VLSI
  - C) IC
- What is Artificial Intelligence?

# Taxonomy of Computers

- Mainframes
- Minis
- Micros
- Supercomputers
- Embedded

# **FACTORS THAT DETERMINE THE TYPE OF COMPUTER.**

## **Type of processor (Central processing unit – CPU)**

- Microcomputers use microprocessors, which are manufactured on a single chip, as their CPU.
- In larger computers such as supercomputers, mainframe & minicomputers, the processing is carried out by a number of separate, high-speed components instead of a single processor.

## **Processing speed.**

- Every computer has a clock that drives its operations.
- Larger computers have faster clocks and therefore can process many instructions per second compared to small computers, which have slower clocks.

## **Amount of Main memory (RAM).**

- All computers have some amount of RAM (**Random Access memory**), which is used to hold the instructions required to perform a task.
- Larger computers have more RAM and therefore can handle large volumes of data & also support many and sophisticated programs which might require large memory sizes.

## **Storage capacity of the Hard disk.**

- The *storage capacity* is the amount of space that is available for storing the instructions required to manipulate data.
- Larger computers have higher storage capacities than microcomputers.

## **Cost of the computer.**

- The cost of computers is directly related to the size. Microcomputers are less costly compared to minicomputers, mainframes or Supercomputers.

## **Speed of Output devices.**

- The speed of an output device is determined by the amount of information that can be printed in a specified amount of time.
- The speed of microcomputer output device is less than that of the larger computers in that:
- For a microcomputer, the speed of its output device is measured by the **number of characters printed per second (cps)**. For larger computers, their output devices are faster and their speeds are measured depending on the **number of lines or pages printed per minute (lpm / ppm)**.

## **Number of users who can access the computer at the same time.**

- Most microcomputers can support only 1, 2 or 3 users at the same time. However, they can be networked to share resources.
- Larger computers can support hundreds of users at the same time.

# CLASSIFICATION OF COMPUTERS

- Computers can be classified according to the following factors:
- Physical size & processing power.
- Purpose for which they are designed.
- Functionality (Method/ mode of operation).

# **CLASSIFICATION ACCORDING TO PHYSICAL SIZE.**

Computers can be classified into 5 main groups according to their size as:

- Supercomputers.
- Mainframe computers.
- Minicomputers.
- Microcomputers.
- Portable computers (Laptops, Notebooks & Palmtops).



## Supercomputers

- Supercomputers are the fastest, largest, most expensive & also the most powerful computers available.
- They are very fast in processing. They can perform many complex calculations in a fraction of a second.
- Most Supercomputers use multiple processors. In this case, a single task is split among the processors for faster execution. However, all the processors are controlled by a single central processor.
- Supercomputers generate a lot of heat, & therefore require special cooling systems. Sometimes, the whole CPU is deeped in a tank containing **liquid Fluorocarbon** to provide cooling.
- Supercomputers are very large & heavy, and are usually kept under special environmental conditions (i.e., in a special room).
- They are operated by computer specialists. A Supercomputer can be operated by over 500 users at the same time.

## *Areas where supercomputers are used*

- Supercomputers are mainly used for complex scientific applications that involve many calculations & require a lot of computational power. Some of the applications that use supercomputers include;
- Weather forecasting.
- Petroleum research.
- Defence and weapon analysis.
- Aerodynamic design and simulation.
- **Note.** These tasks use large amounts of data, which need to be manipulated within a very short time.

# CLASSIFICATION ACCORDING TO PURPOSE.

Digital computers can be classified further according to the tasks they perform either as:

- General-purpose.
- Special purpose
- Dedicated computers.

## **General-purpose computers**

- General-purpose computers are designed to perform a wide variety of tasks. They use specifically written instructions (programs) to carry out the desired processing tasks.

### ***Example;***

- A single computer can be used to process documents, perform calculations, process the Payroll, simulate the loading on a bridge, process Insurance policies, and play games, among others.

The programs used in a general-purpose computer are exchangeable. This means that, to perform a particular task, the appropriate set of instructions required to perform that particular task are loaded into the computer memory.

- E.g., if you want to play a game, the appropriate program is loaded into the computer's memory & the computer is instructed to execute the instructions which make up the game.
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- ***Examples of general-purpose computers:*** Mainframes, Minicomputers, Microcomputers & Laptops used in most offices & schools.
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- **Special-purpose computer**
- A special-purpose computer is designed to handle/accomplish a particular specific task only.
- Such computers cannot perform any other task except the one they were meant to do. Therefore, the programs which are used in a special-purpose computer are fixed (hard-wired) at the time of manufacture.
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***For example;***

In a computer Network, the **Front End Processor (FEP)** is only used to control the communication of information between the various workstations and the host computer.

A Special-purpose computer is dedicated to a single task; hence it can perform it quickly & very efficiently.

# ***Examples of special-purpose computers:***

- Robots used in a manufacturing industry for production only.
- Mobile phones used for communication only.
- Calculators that carry out calculations only.
- Computers used in Digital watches.
- Computers used in Petrol pumps.
- Computers used in Washing machines.
- An Automatic pilot – a computer dedicated to the task of operating an aircraft.
- A Word processor – a special-purpose computer used in the production of office documents, letters, etc.

## Reasons why a Mobile phone is regarded to be a computer

- It is electronic.
- Has a screen.
- It has a Keypad.
- Has a Memory.
- It is programmable.
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- **Dedicated computer**
- A **Dedicated computer** is a general-purpose computer that is committed to some processing task; though capable of performing a variety of tasks in different application environments.
- E.g., the computer can be dedicated to carrying out Word processing tasks only.

# CLASSIFICATION ACCORDING TO FUNCTIONALITY.

Usually, there are two forms of data; **Digital data**, and **Analogue data**. Computers can be classified according to the type of data they can process as either.

- Digital computers.
  - Analogue computers, or
  - Hybrid computers.
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- **Digital computers**
  - This is the most commonly used type of computers.
  - A **Digital computer** is a computer that operates on discrete data only. It can process both numeric & alphabetic data within the computer, e.g., 0, 1, 2, 3..., A,B,C....
  - Their operation is based on 2 states, “ON” & “OFF” or on digits “1” & “0”. Therefore, any data to be manipulated by a digital computer must first be converted to digital form.



- Their output is usually in form of numbers, alphabets, & symbols.
- Digital computers are usually general-purpose computers; hence, they are widely used in different areas for data processing.
- Most of the devices found at homes today are digital in nature.
- Digital computers are less accurate, i.e. may not solve all your problems since the facilities provided are generalized.

## ***Examples:***

- A Television with a button which is pressed to increase or decrease the volume.
- Digital watches.
- Calculators.
- Microcomputers. They are said to be digital because they possess the ALU.
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