Computer Basics

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A brief history of computer evolution

- Evolution started to perform fast calculations.
- The first calculating device was Abacus (discovered around 3000BC) which was used to perform addition and multiplication of numbers. (See Fig. 1)

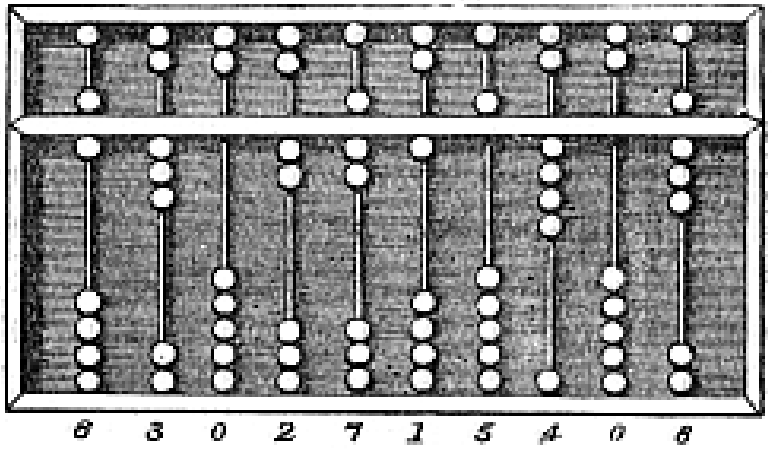


Figure 1: Abacus. Figure source-wikipedia

- In 1617, John Napier generated the concept of logarithm. He designed a set of numbering rods which is called as Napier's Bones which could calculate multiplication and devision of numbers. (See Fig. 2)

Figure 2: Napier's Logs. Figure source-wikipedia

- In 1642, Blaise Pascal (a French mathematician) developed an adding machine which consisted gears. This machine which was called Pascaline could add numbers rapidly. (See Fig. 3)
- Working principle-clock work mechanism concept.

Figure 3: Pascaline. Figure source-Internet

- In 1673, Gottfried Wilhelm Leibnitz (German mathematician) modified the Pascaline or Pascal's calculator to include features of multiplication and division of numbers. (See Fig. 4)

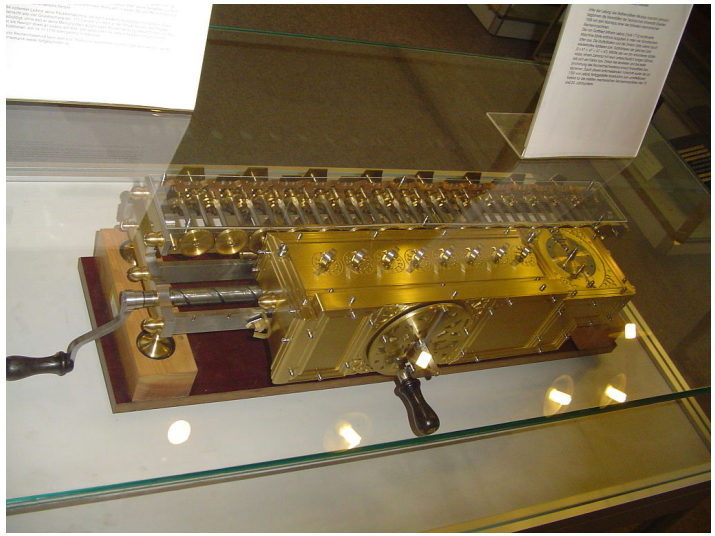
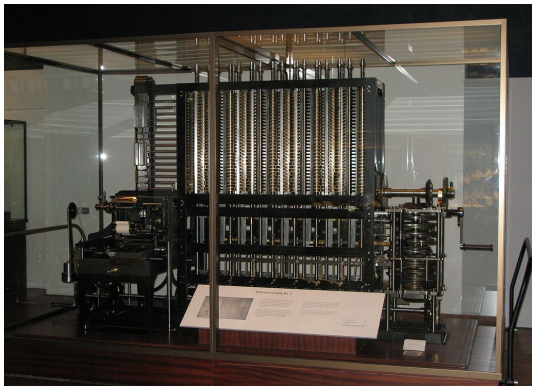


Figure 4: Leibnitz's Calculator. Figure source-wikipedia

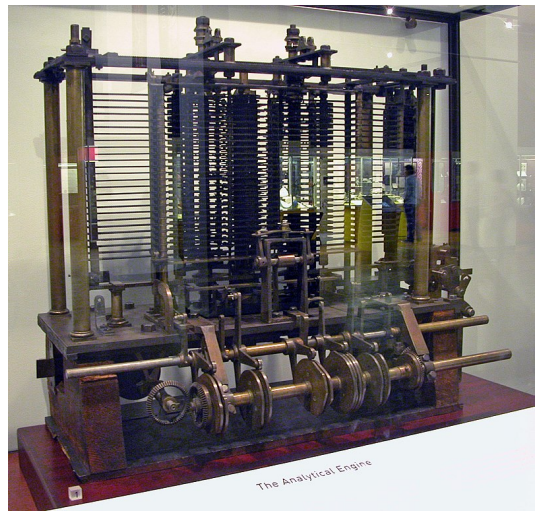
- In 1801, Joseph Jacquard designed punch cards (a piece of stiff paper) for automation of cotton waving process of Jacquard machine. The concept of punch card lead to the development of the idea of storing and retrieving data. (See Fig. 5)

Figure 5: A Jacquard loom using punched card. Figure source-wikipedia

- Charles Babbage (an English mathematician) is the father of modern computers.
- He developed the design of Difference Engine (1822) and Analytical engine (1833). (See Fig. 6)



(a) Difference engine.



(b) Analytical engine.

Figure 6: Difference engine and Analytical engine. Figure source-wikipedia.

- Difference Engine could calculate a variety of mathematical functions and could solve differential equations theoretically.
- Analytical engine was more advanced version of difference Engine and could perform all four arithmetic operations, i.e., addition, subtraction, multiplication, and division. Also, it could make a comparison.
- Design of analytical engine was based on the notion of memory storage, central processor, and input-output devices.
- Today's modern computers work on the key ideas of Babbage Analytical engine.

- In 1944, an electromechanical computer was build by Prof Howard Aiken in collaboration with IBM. This computer was named as Mark 1 and was able to multiply two ten digit numbers in five seconds. Mark 1 was based on the idea of Babbages Analytical engine. (See Fig. 7)
- This could run preprogrammed command automatically.

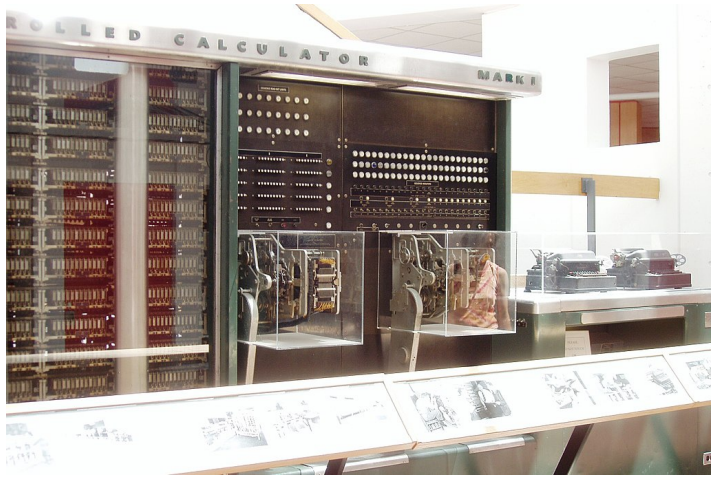


Figure 7: Mark 1. Figure source-wikipedia

- One year later, in 1945, Von Neumann presented the idea of a stored program computer and according to this idea the program and data could be stored in the same memory unit. (See Fig. 8)

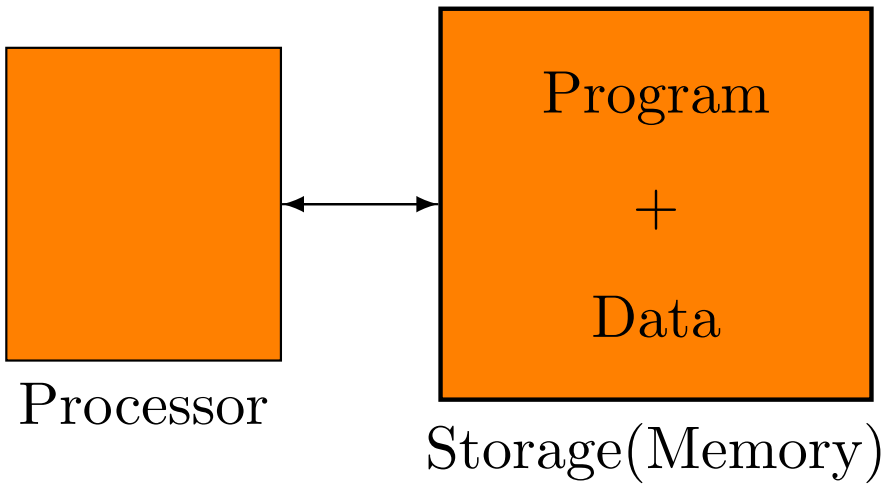


Figure 8: Von Neumann Computer.

Generations of computers

- **First generation**
  - Period of first generation computer: **1942-1955**.
  - Used vacuum tube technology for controlling and amplifying electronic signals.
  - Computers occupied lot of space due to their enormous size.
  - Electricity consumption and heat generation was too much and required permanent air conditioning.
  - Programing language was machine language.
  - Some examples are UNIVAC 1, EDVAC, ENIAC.

- **Second generation**
  - Period: **1955-1964**.
  - Used transistor based technology and were smaller and cheaper as compared to first generation.
  - Electricity consumption and heat generation was less than earlier generation computers.
  - Used magnetic core memories for primary storage and magnetic disks for secondary storage.
  - Development of first operating system. Used programing in assembly language and in later stage used high level language.
  - They too required permanent air-conditioning.
  - Some examples: IBM 1620, IBM 1401, UNIVAC 1108

- **Third generation**
  - Period: **1964-1975**.
  - Used Integrated Circuits or ICs or chips.
  - Computers were more portable, performance was faster and more safer to use.
  - Electricity consumption and heat generation was less than the earlier generation computers.
  - Memory size also increased.
  - Some examples: Honeywell 6000 series, IBM 360 series

- **Fourth generation**
  - Period: **1975 onwards**.
  - Made use of ICs with Large Scale Integration (LSI) and Very Large scale integration (VLSI) technology. One could use 300K transistors on a single chip.
  - Electricity consumption and heat generation much less.
  - Microprocessors and portable computers developed. Reliable and small in size.
  - Various types of secondary memory with high storage capacity developed and their access became fast.
  - Production cost is much less.

- **Fifth generation**
  - Still under development.
  - People working on **artificial intelligence** (simply this means that computers of the generation are supposed to behave like humans).
  - Using idea of **parallel processing** (grouping many processors together).
  - Use of **superconductivity** to develop device which will be able to respond to human language and previously obtained knowledge will be used to perform the task.

Components of a computer

Basic functional components of a computer: *Input Unit, Memory Unit, Arithmetic Logic Unit (ALU), Output Unit, Control Unit.* (See Fig. 9)

- **Input Unit**: Reads and accepts data instruction given to computer. Convert the data to computer understandable binary language. Example- Keyboard, mouse, scanner, etc.

- **Memory Unit**
  - *Internal memory (Primary memory or Main memory)*: Connected to CPU and used for data storage and instructions. This memory holds the data during processing of Central Processing Unit (CPU). After shutdown of the computer, data stored in primary memory is permanently deleted. Primary memory is also called as Random Access Memory (RAM).
  - *Secondary memory*: Required to store data permanently for later use. Examples-pen drives, hard disk, CDs, DVDs, etc.
- **Arithmetic Logic Unit (ALU)**: Data processing is done in this unit. It executes arithmetic and logical operations.

- **Output Unit**: Consists of output devices connected with the computer. It converts the binary data coming from CPU to human understandable language. Example- Monitor, printer, etc.
- **Control Unit (CU)**: It controls the entire system, i.e., it controls and coordinates to all the units of the system in proper completion of a task.

Note: Memory, ALU, Control Unit taken together is called the **Central Processing Unit (CPU)**. CPU is called the brain/heart of the computer.

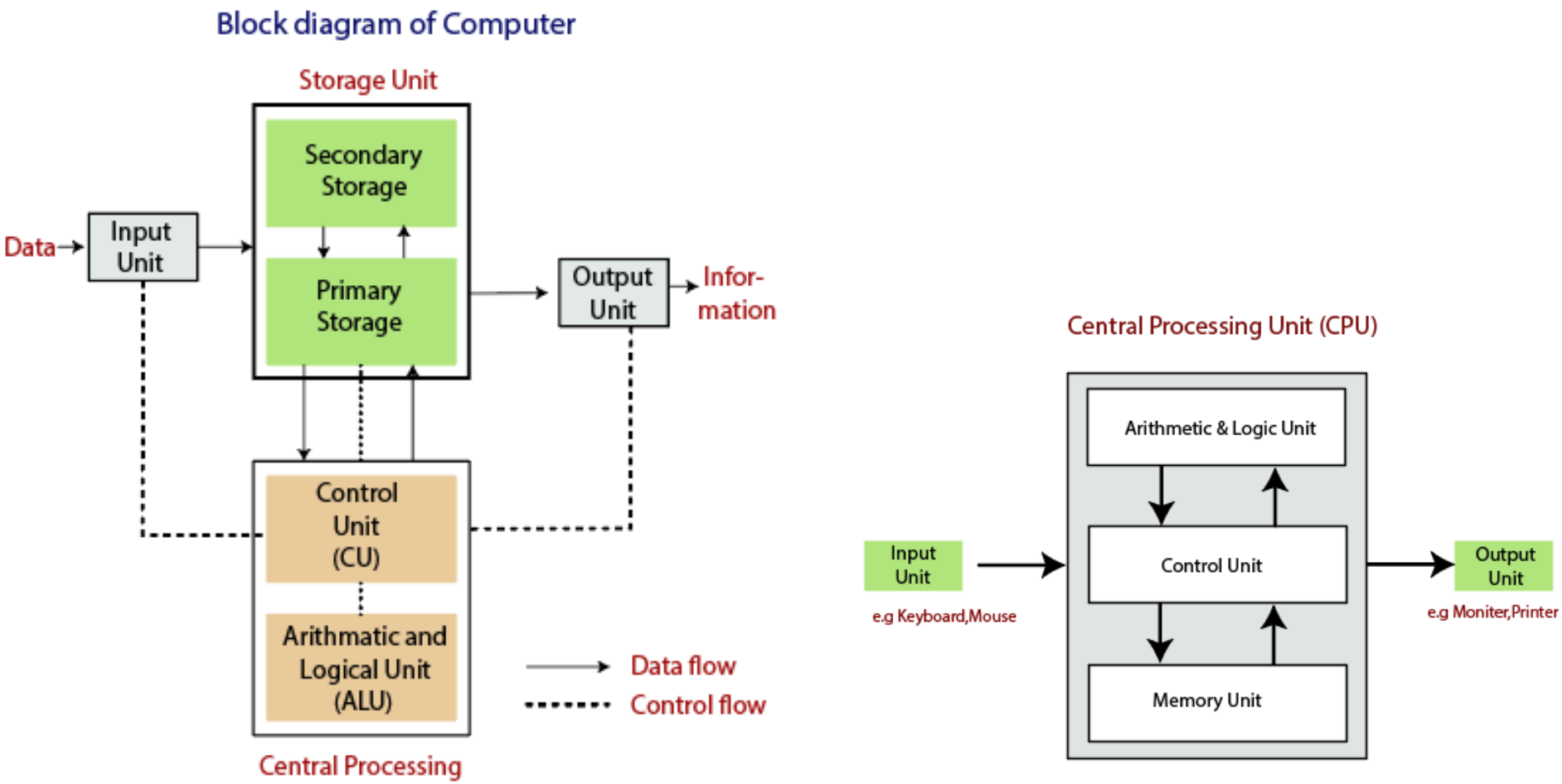


Figure 9: Components of a computer. Figure source-Internet.

Types of computers

On the basis of functionality, computers can be classified as *Digital, Analog and Hybrid*

- **Digital computers**
  - Execute information in discrete form.
  - Information/data are represented in terms of binary form 0s and 1s.
  - Mainly used in industries, scientific applications, business.

- **Analog computers**
  - Analog computers are used to process analog data (data is not discrete but is of a continuous nature, e.g., mercury level of a thermometer).
  - Measures data directly from continuously changing of physical quantities, such as fluid pressure, mechanical motion, current and voltage change.
  - Accuracy is less than digital computers but these computers are more useful for a particular situation where it is required to measure data directly without converting it into numerals.
  - Some of the common examples are hydraulic and electronic networks, nuclear power plants, simulations in aircrafts.

- **Hybrid computers**
  - These type of computers use both analog and digital technology.
  - They accept both analog and digital signals but conversion of data from digital to analog and analog to digital has to be done.
  - They have precision of digital computer and speed of analog computer.

Types of digital computers

On the basis of computing capacity, digital computers can be classified as: *Micro Computers, Mini Computers, Main frames and Supercomputers*

- **Micro Computers**
  - Micro computers are also known as Personal computers (PCs). These types include desktops and laptops.
  - Used as work stations, computer-aided design(CAD), multimedia and advertising applications.
  - Also include smartphones, video game consoles, etc.

- **Mini computers**
  - These computers are designed such that multiple users can work simultaneously on same machine.
  - Useful for research organizations, small business organizations where computers installed on different departmental units are interconnected.
  - These are more powerful than Personal Computers.

- **Main frames**
  - They are large and very powerful. Memory capacity is too high.
  - Can support thousands of users and application programs simultaneously accessing various resource.
  - Can process thousands of instructions per second.
  - Very useful for industries, big organizations, banks, research organizations, etc.

- **Supercomputers**
  - Fastest high-performance computers.
  - They contain multiple CPUs.
  - Can process billions of instructions per second.
  - Common applications include testing mathematical models for complex physical phenomena, like weather forecasting, aerodynamic research, nuclear weapons and reactors, Molecular Dynamics Simulation.

Thank You