Evolution of Computers

Dear Teacher,
We wonder how computers actually came into being. How these amazing machines were invented? Who created them?

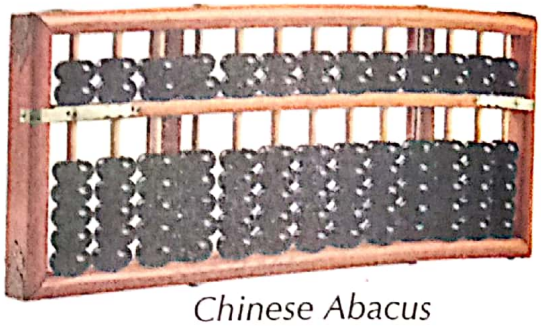
Dear Students,
In this chapter we shall learn about the evolution of computers and their classification across generations.

There had been many contributors to the development of computers. Of course, this development did not happen at once, there were various stages across several years till today where we have computers so small that they fit in our palms. But earlier, computers were not that compact and smart. Let us briefly discuss the different stages in the development of computers.

Evolution of Computer

The term 'Computer' came from the word 'compute', which means 'to count' or 'to calculate'. Early men used their fingers, stones and bones to count.

Abacus (5000 years ago)



Chinese Abacus

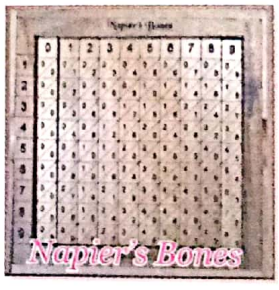
Abacus was the first calculating device invented by the Chinese around 5000 years ago. The working of this device was based on the movement of its beads up and down along wooden or metal rods.

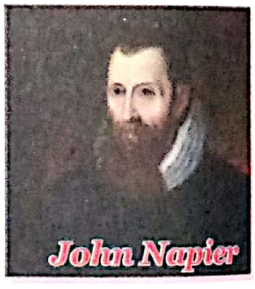
Amazing Fact

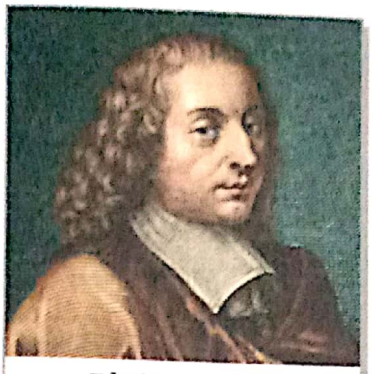
The three most popular abacuses were- Chinese abacus, Japanese abacus and Russian abacus.

Napier's Bones (1550 -1617)

Napier's Bones was invented by John Napier (1550-1617), a Scottish mathematician and scientist. Napier's bones were multiplication tables written on strips of wood or bones. This invention helped in multiplying, dividing, taking square roots and cube roots. There are 9 different 'bones' or strips with numbers marked on them.


Napier's Bones


John Napier



Blaise Pascal

Pascaline (1642)

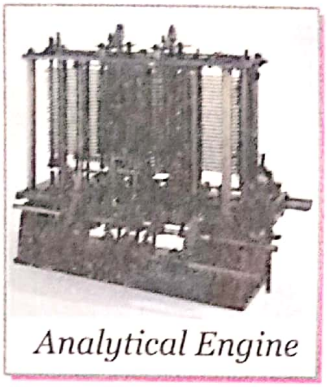
The Pascaline, invented by Blaise Pascal (France) in 1642, was a mechanical calculator. This device was invented for the purpose of addition and subtraction, via turning discs at the bottom of the device.

After crunching the handle the answers appeared on a window.

Pascaline

Analytical Engine (1833)

The Analytical Engine, an important step in the history of computer, was the fully-automatic calculating machine, designed by Charles Babbage in 1833. He is known as "the father of modern computer". This machine was designed to perform complex mathematical calculations.

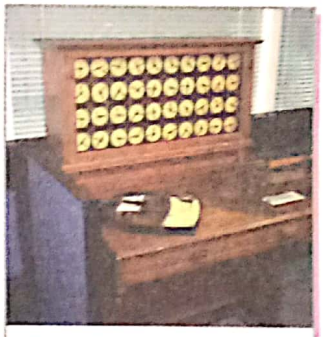


Analytical Engine

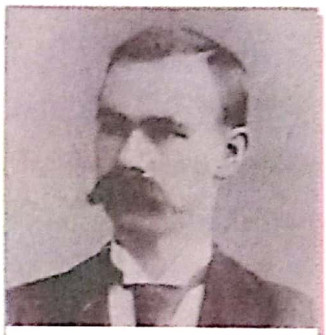
Charles Babbage

Tabulating Machine (1890)

In 1890, Herman Hollerith invented the tabulating machine to process the data (for U.S. Census). This device could automatically read information which had been punched on the card. In later years, Hollerith's machine became very useful for wide varieties of statistical applications. In February 1924, Hollerith's company changed its name to International Business Machines, or IBM.



Tabulating Machine



Herman Hollerith

Generations of Computers

Now-a-days, computers are being used at different places. The volume of work, features, functionality, etc. varies from place to place. So, it was required to develop different types of computers.

Generation refers to the time period when a computer is being developed. After each and every generation, the technology of computer advanced significantly to fulfill human needs. Let us look at distinct generations of computers.

First Generation of Computers (1940 - 1956, Vacuum Tubes)

Technology used: Vacuum tubes for the circuits and magnetic drums for memory.

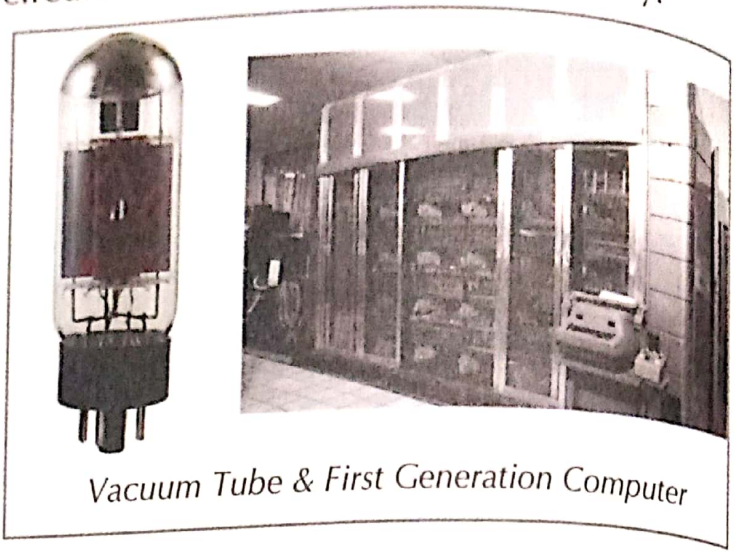
Size: As big as a room.

Programming Language: Machine language.

Input: Punched cards, paper tape and switches. No keyboard.

Output: Printouts.

Features: Expensive, immense electricity consumption, generation of huge amount of heat



Vacuum Tube & First Generation Computer

Examples: The UNIVAC (UNIVersal Automatic Computer) and ENIAC (Electronic Numerical Integrator And Calculator) are the examples of first generation computers. Howard Aiken's Mark 1 (1944), Maunchly and Eckert's ENIAC (1946).

Second Generation of Computers (1956 - 1963, Transistors)

Technology used: Transistors. Magnetic cores were used as primary memory, magnetic tapes and disks as secondary storage devices.

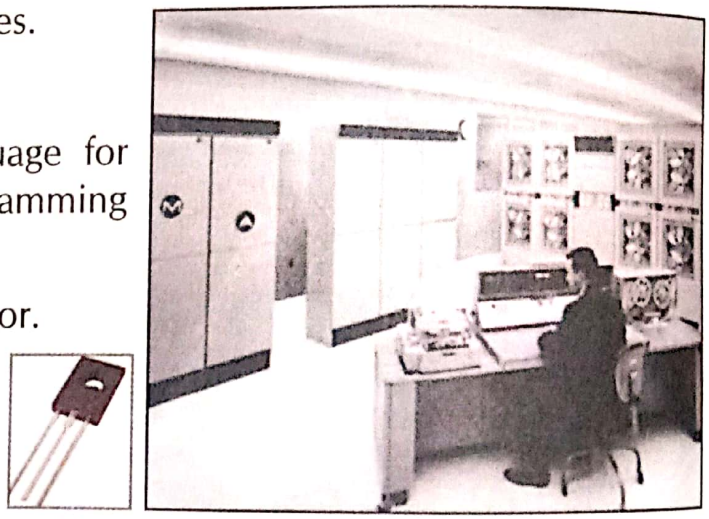
Size: As big as a small room.

Programming Language: Assembly language for processing. High level languages for programming such as COBOL and FORTRAN.

Input/Output: Keyboard. Display on monitor.

Features: Smaller, faster, cheaper, more energy- efficient and reliable than the first generation computers.

Examples: IBM 1401, PDP-1.



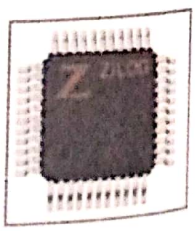
Transistor and Second Generation Computers

Third Generation of Computers (1964 - 1971, Integrated Circuits)

Technology used: Transistors shrunk into silicon chips called Integrated Circuit (IC).

Size: Smaller. Could be kept on a desktop.

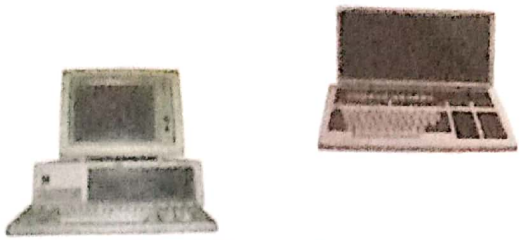
Programming Language: High level languages for programming such as C and PASCAL. Single user, single tasking operating system such as DOS.



Input/Output: Keyboard. Display on monitor.

Features: Smaller, faster, cheaper than its predecessors.

Examples: PDP-8, PDP-11, ICL 2900, IBM 360 and IBM 370.

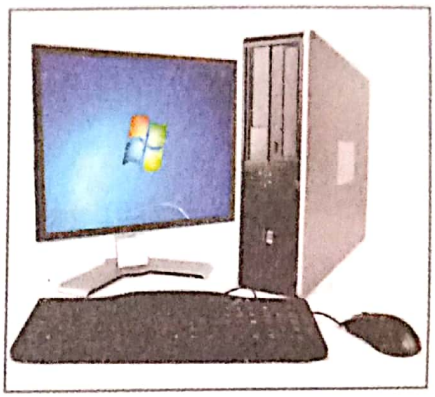


IC and Third Generation Computers

Fourth Generation of Computers (1971 - present, VLSI Microprocessor)

Technology used: Thousands of Integrated Circuits built into a single microprocessor. Data storage as primary memory and storage devices as secondary memory (disks). Computers can be connected to form networks. Wireless technology and Internet.

Size: Smaller. Could be kept on a desktop, laptops, notebooks, handheld devices.



Programming Language: High level languages C++, Java, Python etc. Powerful multi-user, multi-tasking operating systems such as Windows, MacOS etc with Graphical User Interface (GUI).

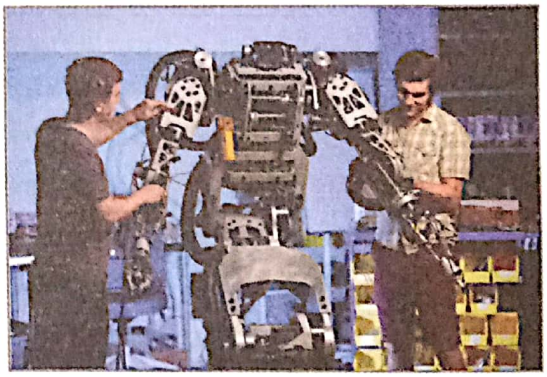
Input/Output: Keyboard, mouse, scanners, microphone. Output on monitor, printer, plotters, speakers etc.

Features: Smaller, faster, cheaper, huge data storage.

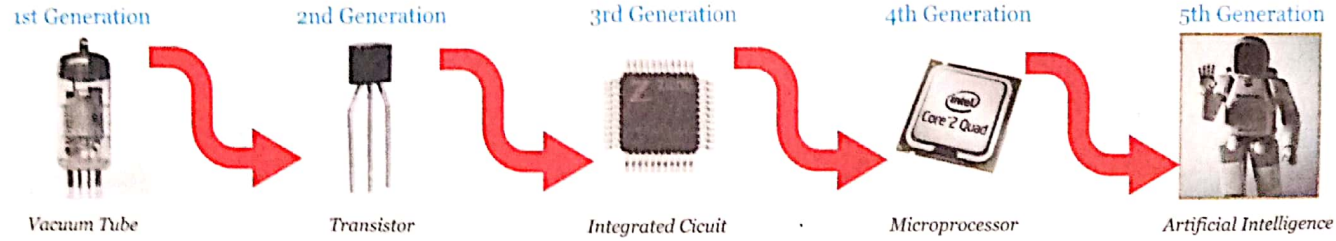
Examples: IBM- PC, Apple- Macintosh, Compaq PC.

Fifth Generation of Computers (Present and Beyond, Artificial Intelligence)

Research in the field of developing computers which could learn and respond like humans are going on. This field is called Artificial Intelligence (AI) involving Machine Learning. Some AI applications are voice or face recognition, thumb impression recognition, robotics, natural language processing like humans do, capability of self-learning and recalling computers.



The major technology changes in the generations of computer.



Characteristics of Computers

Today, computers can perform most of the tasks quickly and accurately saving a lot of time and efforts. Computers work for longer hours without getting tired and store a lot of data. Let us see the characteristics of computers that make them the most revolutionary machine of this age.

1. Computers are fast! (Speed)

Computers *think* in milliseconds. That means, processor of a computer can perform billions of calculations in a second.

Amazing Fact

IBM's Deep Blue supercomputer could think 200 million positions of chess pieces in one second.

2. Computers don't goof-up! (Accuracy)

Computers are accurate in calculation however, their accuracy depends on the accuracy of input. This means, computers will only give incorrect output if input is incorrect. This is called Garbage In Garbage Out (GIGO).

3. Computers are efficient! (Versatile)

Computers are capable to perform a variety of tasks and at the same time. This is called their versatility. For example, you can play a game on computer while it is playing music, printing a multi-page document and downloading a file.

4. Computers are tireless! (Diligent)

Computers work for longer hours without getting tired. They do not get bored doing the same task again and again. Ability to perform repetitive task for longer duration is called diligence. For example, computers working as web servers over the internet work constantly for days.

5. Computers store a lot of data! (High storage capacity)

Computers store bulk data. A common micro-computer can hold data in Tera Bytes. Even a simple handheld computer has storage capacity in Giga Bytes.

6. Computers are automatic!

There are several tasks which computers can perform automatically as a routine. For example, computers in a packaging unit control entire process without human intervention. Another example is taking a multiple pages printout. Once command is given, computer can print pages without assistance.

7. Computers are programmable !

For the tasks that need to be done regularly, the set of instructions is fed into the computer

once and then computers execute these instructions in sequence. This set of instructions is called program. To run several instructions again and again , we just need to run the program. For example, calculating the grade for all students, a computer program is used, to control the traffic, a traffic control program runs on the computers that control the traffic.

Limitations of Computers

While computers offer remarkable benefits, they have certain limitations also. Let us have a look at them.

1. Computers do not have self-intelligence

Computers perform exactly as the instructions are fed to them. They cannot figure out situation on their own. They are unable to take their own decisions.

2. Computers cannot learn

Computers are not able to retain the knowledge and use it further just like we humans do. Computers just store the data.

3. Computers cannot express emotions

Computers do not react to the situations. The warnings and errors they display are the part of the programs they run. They do not have emotions and feelings.

4. Computers need human care

Computers need to be maintained by human beings. They will get spoilt or malfunction if humans do not take good care of them.

5. Computers cannot replace human processes entirely

Computers are automatic but up to some extent only. As on date, computers are mere tools to accomplish tasks accurately, faster and efficiently but they are not reliable completely. Still, many computer systems need monitoring and control by humans to work.

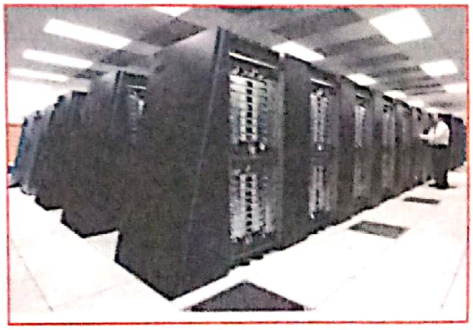
Classification According to Size

According to size, computers can be classified in the following categories:

1. Super computer
2. Mainframe computer
3. Mini computer
4. Micro computer

Super Computers

As the name super computer suggests, these are the most powerful computers in the world. They are used for special purposes. They handle most complex scientific, statistical applications or programs.



Super Computer

Key features:

- These computers use very high level of technology.
- They have very high memory capacity.

- Data processing is ultra fast.
- Highly sophisticated technology is used in these computers e.g. parallel processing
- Cost varies from 1 million to 5 million dollars or more.

Examples: PARAM Yuva-II, TATA' EKA (both are India's super computers)

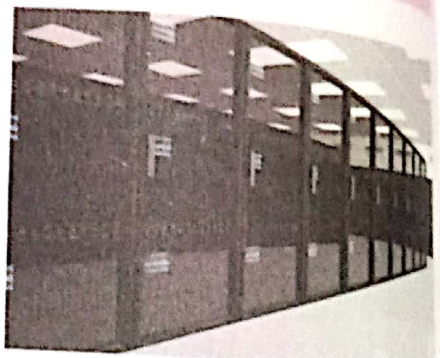
Drawbacks:

- Operating a super computer requires highly qualified staff.
- Experts are required for such computer engineering.
- They are highly sensitive to temperature, humidity, dust, etc.
- They are non-portable & very large in size.

Amazing Fact

World's first super computer was CRAY-1, developed by Seymour Cray, US, 1976.
PARAM 8000 is considered to be India's first supercomputer.

Mainframe Computers



These are very powerful and large computers. They can handle many users at a time. Terminals are used to connect users to this computer and users submit their task through terminals. Terminal is a device which has keyboard and a screen. These are mostly used as servers for website on the Internet.

Key features:

- Smaller in size than the super computer.
- Large memory capacity.
- Allows networking of up to 100 terminals.
- Cost in lakhs.

Examples: Fujitsu-ICL VME, IBM zSeries, etc.

IBM zSeries

Drawbacks:

- Experts and highly qualified professionals are required to operate it.
- Sophisticated technology is required for manufacturing and assembling the computer.

Mini Computers

These computers came into existence in 1960s. At that time mainframe computers were very costly. Mini computers were available at lower prices (costing less than 25,000 USD), so users started using these computers. These are obsolete now.

Mini Computer

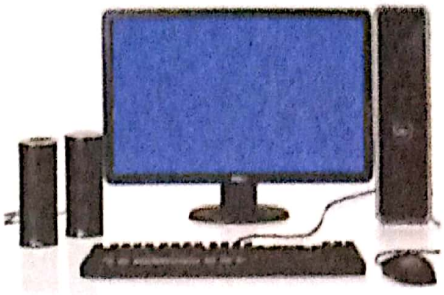
Key features:

- Higher processing speed than lower category computer but slower than super computer and mainframe computer.
- They are expensive and larger than microcomputers.
- Mostly used as servers to control the networks.

PDP-11

Examples: PDP-11, VAX, 7500 MAGNUM, etc.

Micro Computers



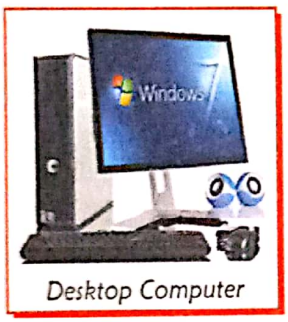
These computers use a microprocessor chip called CPU. Two major types of these computers are laptop and desktop computer. Only one user can use these computers at a time that's why they are also known as personal computers (PC). They are used everywhere like schools, offices, shops, home, etc.

Key features:

Apple iMac 20

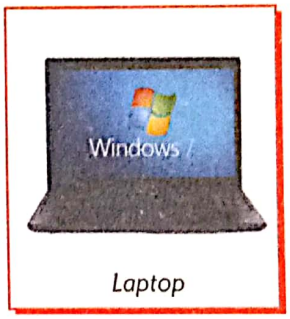
- These are smaller than mini computers.
- These are high speed computers.
- Costs in thousands.
- They are portable in size.
- These computers use RAM as primary memory.
- These computers support different type of secondary memories for permanent storage of data e.g. hard disk, DVD and flash drive.
- They support almost all modern computer languages e.g., FORTRAN, Basic, COBOL, Pascal, C, C++,C#, JAVA, SQL, etc.

Examples: HCL, Wipro, IBM-PC, HP, Apple iMac 20.



Desktop Computer

Apple iMac 20



Laptop

Amazing Fact

Today, computers come in different shapes and sizes e.g. smart phones, digital cameras, wristwatches, GPS systems and heart rate monitors. Some people prefer to buy a tower case and fill it with components they find locally - then, they assemble the computer by hand to save money and get the features and power they want.

Quick Review

- Abacus, Napier's Bones, Pascaline, Analytical Engine and Tabulating machine were the primary inventions in the field of computing.
- Charles Babbage is known as "the father of modern computer".
- The first generation of computers used vacuum tubes and magnetic drums.
- Transistors replaced vacuum tubes in the second generation of computers.
- Third generation computers used integrated circuit (IC).
- The microprocessor is a single silicon chip with thousands of integrated circuits.
- Computers are fast, accurate, versatile, diligent, automatic, programmable and store bulk data.
- Computers cannot learn, express feelings, have no experience, need human care and cannot replace humans entirely.

Exercise

A. Choose the correct answer.

1. _____ was the first calculating device invented by Chinese around 5000 years ago.

   a) Napier's Bones ◯ b) Pascaline ◯

   c) Abacus ◯ d) Tabulating machine ◯

2. Thousands of integrated circuits were built into single silicon chip called _____.

   a) Vacuum Tube ◯ b) LED ◯

   c) Microprocessor ◯ d) AI ◯

3. _____ is known as the father of modern computer.

   a) Charles Babbage ◯ b) Bill Gates ◯

   c) John Napier ◯ d) Pascaline ◯

4. Which of the following is not a characteristic of a computer?

   a) Accuracy ◯ b) Diligence ◯

   c) Self-intelligence ◯ d) Programmable ◯

5. Which of the following is not a limitation of computers?

   a) Computers cannot learn ◯ b) Computers lack emotions ◯

   c) Computers need human care ◯ d) Computers are fast ◯

B. Fill in the blanks.

Program, Assembly, Silicon chip, Versatile, Napier's Bones

1. _____ contain the multiplication tables written on strips of wood or bones.
2. Second generation computers used _____ language for processing.
3. _____ is the basic component of Fourth generation of computers.
4. A set of instructions is called a _____.
5. Computers are _____ because they can perform a variety of tasks.

C. Tick (✓) the correct statement and cross (✗) out the wrong one.

1. Computers can learn and take decisions. ◯
2. Computers can work for long hours without getting tired. ◯
3. Artificial Intelligence computers are first generation computers. ◯
4. Transistors replaced Vacuum Tubes in Third generation of computers. ◯
5. Computers do not need humans to take care. ◯

D. Answer the following questions.

1. What do you mean by Generations of Computers?

_____

_____

_____

2. Distinguish between the following:

a) First and Second generation of computers.

_____

_____

b) Third and Fourth generation of computers.

_____

_____

_____

3. Briefly list any 3 limitations of computers.

_____

_____

_____

E. Describe the following characteristics of computers very briefly:

1. Diligent: _____

2. Versatile: _____

3. Fast: _____

F. Briefly list 2 key features of each type of computer classified on the basis of size.

G. Match the following.

Column-I	Column-II
1. First generation of computer	a. PDP-8, ICL- 2900, IBM 360
2. Second generation of computer	b. Artificial Intelligence
3. Third generation of computer	c. NIVAC, ENIAC
4. Fifth generation of computer	d.. IBM 1401, PDP-1

Teacher's Signature : _____ *Teacher's Remark :* ☆☆☆☆☆

http://www.webopedia.com/DidYouKnow/Hardware_Software/FiveGenerations.asp
http://www.btob.co.nz/article/five-generations-computers

Teacher's Corner...

Dear teacher, give information about the modern computers /IT gadgets to the students. For example, smart watch, etc.