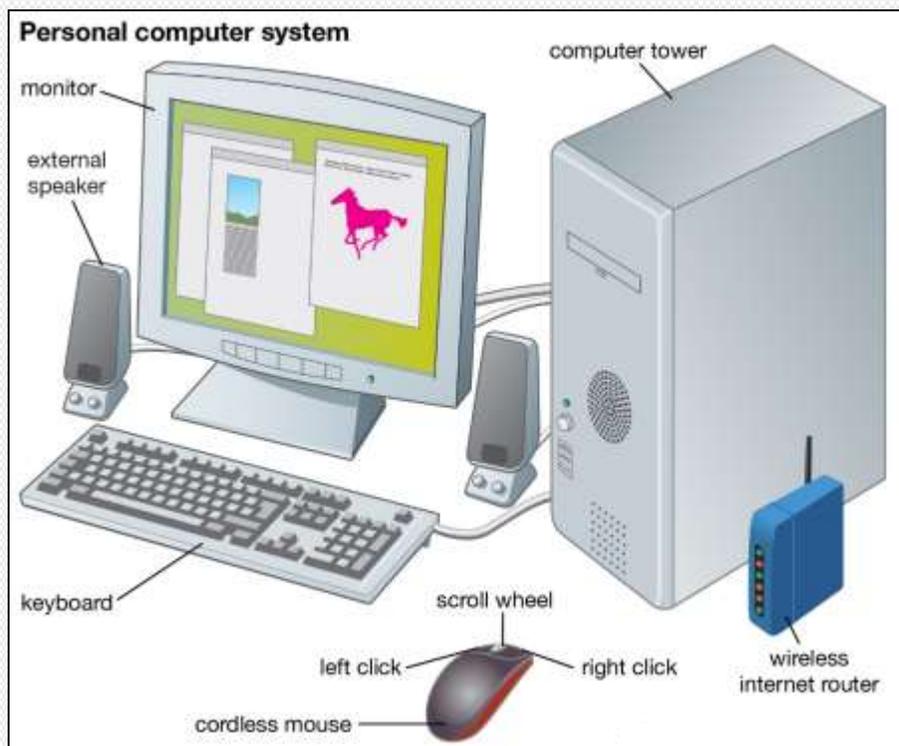


# INTRODUCTION AND EVOLUTION OF COMPUTER

## OBJECTIVE:

After completion of this chapter, the student will be able to describe:

- concept and characteristics of computer
- application areas of computer
- history of computer
- generation of computer



## 1.1 Concept and Characteristics of a computer

### Introduction of computer

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In English, computer means to calculate something. To calculate means to do some mathematical operations. About 30/40 years ago, calculator was introduced as a calculating device. Calculator computes the numbers or it does mathematical operations. This is also a digital operating device. But, computers originated with a huge size and extremely high processing capabilities. Later on, computers have become very powerful devices to aid the development of data processing and research. Their size reduced and processing capabilities and speed increased tremendously.

Computers exist in a wide range of forms, and thousands of computers are hidden in devices we use everyday but don't think of as computers such as cars, phones, TVs, microwave ovens, and access cards. Our primary focus is on universal computers, which are computers that can perform all possible mechanical computations on discrete inputs except for practical limits on space and time.

### Computer – Definition

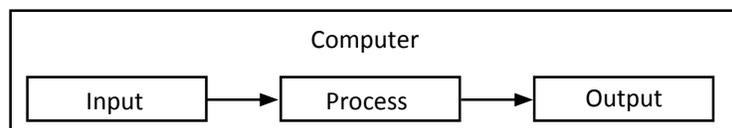
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A computer is an electronic device, operating under the control of instructions stored in its own memory. It manipulates information, or data. It has the ability to store, retrieve, and process data. A computer is a general purpose computing machine made up of digital circuitry, that accepts inputs, stores, manipulates, and generates output data as numbers, text, graphics, video files, etc.

**A computer is a machine that can:**

1. **Accept input.** Input could be entered by a human typing at a keyboard, received over a network, or provided automatically by sensors attached to the computer.
2. **Execute a mechanical procedure.** That is, a procedure where each step can be executed without any thought.
3. **Produce output.** Output could be data displayed to a human through display monitor, but it could also be anything that affects the world outside the computer such as electrical signals that control how a device operates.

A computer is an electronic machine that takes input from the user, processes the given input and generates output in the form of useful information. A computer accepts input in different forms such as data, programs and user supply. Data refer to the raw details that need to be processed to generate some useful information. Programs refers to the set of instructions that can be executed by the computer in sequential or non-sequential manner. User reply is the input provided by the user in response to a question asked by the computer. The main task of a computer system is to process the given input of any type in an efficient manner. Therefore, computer is also known by various other names such as data processing unit, data processor and data processing system. You may already know that you can use a computer to type documents, send email, play games, and browse the Web. You can also use it to edit or create spreadsheets, presentations, and even videos.



A computer includes various devices that function as an integrated system to perform several tasks described above. These devices are:

- **Central Processing Unit (CPU):** It is the processor of the computer that is responsible for controlling and executing instructions in the computer. It is considered as the most significant component of the computer. It is the "brain" of the computer.
- **Monitor:** It is a screen, which displays information in visual form, after receiving the video signal from the computer.
- **Keyboard and Mouse:** These are the devices, which are used by the computer, for receiving input from the user.

So, a computer is a multipurpose device that accepts input, processes data, stores data, and produces output, all according to a series of stored instructions.



## Characteristics of a computer

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Computer became so popular and more important part, unavoidable device of today's world. The computer is a name of accuracy, name of miracles and name of recent advance technology which has shrunken the world on a palm because of its characteristic like correct and dependable outputs, high speed, accuracy etc. Following are the characteristics of computer:

### 1. Speed:

The speed of computer is linked to the technology used to build it. ENIAC was built using vacuum tubes, with this technology, speed was measured in milliseconds. A computer is fast electronic device that can solve large and complex problems in few seconds. The speed of computer generally depends upon its hardware configuration. Computers can calculate at very high speed. It takes only few seconds for calculations that we take hours to complete. The computer can process more than 50 million instructions in one second. Now a day, very high speed computers are available with Pentium IV or Pentium V microprocessor chips.

Today, with the development in the computer technology, the speed is increasing and size and cost are decreasing. Because of technology development smaller portable computers like laptop computer(or notebook computer) or even smaller handheld devices like palmtop(or PDA) could be made.

If smallest unit of time for humans is seconds, computers work by the followings.

- a) 1 millisecond =  $10^{-3}$  or 1/1000 seconds
- b) 1 microsecond =  $10^{-6}$  or 1/1000000 seconds
- c) 1 nanosecond =  $10^{-9}$  or 1/1000000000 seconds
- d) 1 picosecond =  $10^{-12}$  or 1/1000000000000 seconds

In general, no human being can compete to solving the complex computation, faster than computer.

## **2 Accuracy:**

A computer carries out calculations with great accuracy. The accuracy achieved by a computer depends upon its hardware configuration and the instructions. Accuracy refers to the degree of correctness and exactness of operations performed by a computer. The degree of accuracy of computer is very high and every calculation is performed with the same accuracy. Errors in hardware can occur, but error detecting and correcting techniques will prevent false results. In most cases, the errors are due to the human factor. If the input data entering the computer are correct and if the program of instructions is reliable, then we expect that the computer will produce accurate output.

## **3 Diligence:**

Computers can perform repetitive calculations any number of times with the same accuracy. As computer is a machine, not a living being, it never gets tired. Computers do not suffer from human traits, such as tiredness, fatigue, lack of concentration, etc. Human beings suffer from weakness like tiredness, lack of concentration, etc. Humans have feelings, they become sad, depressed, bored, and negligent and it will reflect on the work they do. Moreover, human beings cannot perform the same or similar tasks over and over again with the same precision and accuracy as the first time. After some time, people will become bored. This will affect the performance. Being a machine, a computer does not have any of these human weaknesses. They won't get tired or bored. It can work for hours without creating any error. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy and speed.

## **4 Versatility:**

A computer can perform more than one work having different characteristics. Computers are versatile machine. They can perform many different tasks and can be used for many different purposes. It means the capacity to perform completely different type of work. They can perform activities ranging from simple calculation to performing complex CAD modeling and simulations, satellites, communication and so on. For example, they are capable of performing wide range tasks such as hotel billing, construction of payroll, hospital management, inventory management in a factory, banking sectors and any imaginable task in everyday life. It is as useful in business, science, education, engineering, music, medicine, art, communication, research, design, space study, and networking. . In other words, they are capable of performing almost any tasks. Computers can communicate with other computers and can receive and send

data in various forms like text, sound, video, graphics, etc. through the development of computer networks, internet, WWW and so on. It has capacity of multitasking. You can enjoy multimedia, word processing, printing, and communicating jobs from one platform without closing other. This type of facilities has made it versatile and popular.

**5. Automation:**

Computer is said to be an automatic machine. The biggest advantage of computers is that it is automatic in its operation. Once a programming logic is started the computer performs repeated operations, without human interventions until program completion. Computer stores a set of instructions as well as data and one instruction is enough for the computer to complete tasks without any further instruction. Computers can be programmed to perform a series of complex tasks involving multiple programs. Computers will execute the programs in the correct sequence, provided they are programmed correctly. The computers can start and close the power automatically, process the programs in strict sequence, maintain the records without the interference of human beings.

**6. Storage capacity:**

Computer has a very large storage capacity. It is achieved through its main memory; data are entered into the main memory and then transferred to auxiliary memory for permanent storage. The computers have vast storage facilities these days which can occupy numerous data of users. The Hard disks, Floppy disk, Compact Disc (CD) and Magnetic Tape storage are examples of secondary storages. The storing capacity of a computer is measured in terms of bytes, kilobytes and gigabytes.

Bit	Byte	Kilobyte	Megabyte	Gigabyte
8	1	-	-	-
8,192	1,024	1	-	-
8,388,608	1,048,576	1,024	1	-
8,589,934,592	1,073,741,824	1,048,576	1,024	1

**7. Reliability:**

A computer produces results with no error. Most of the errors generated in the computer are human errors that are created by the user itself. The computers can give 100% accurate results with predetermined values. The computer is a reliable electronic multipurpose and multiprocessing machine. It processes data with high accuracy without any mistakes.

**9. Cheaper (Reduction of cost):**

Computers are short term investment in order to achieve a long term gain. Though the investment is high they reduce the cost of each and every transaction. They reduce man power and leads to an elegant and efficient way for computing various tasks.

**10. No Thoughts:**

Computers have no thoughts because they are machine. They have no feelings. Since, computers have no thoughts and feelings so they can't make judgment based on thoughts and feelings.

## **Advantage of Computer**

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Computers can quickly process huge amount of data. Computers can complete various tasks more effectively than most human-beings. Computer has greatly increased our efficiency to do various tasks. The advantages of computer are given below:

**1. Stores data in digital format:**

Computers can store millions of pages of information in digital format.

**2. Huge storage:**

We can store huge information. The present day hard-disks can store 100s of Gigabytes (GB) of information. Large businesses store their marketing and sales data in their computer systems. Even sensitive data of customers are securely protected in a computerized environment.

**3. Play games:**

When it comes to games, the choices are almost unlimited.

**4. Calculations:**

Businesses are increasingly using spreadsheets and other software as a tool for performing mathematical calculations.

**5. Prepare and store official documents:**

You can use word processing software to prepare, edit and save any text document. The concept of paperless offices is finally taking its shape. excel- calculations

**6. Presentations:**

If your office demands that you prepare presentations, you can prepare it in a PowerPoint.

**7. Internet:**

You can connect your computer to internet and browse through huge data. People use internet for various purposes. Students can use internet to download study materials. A research analyst can do market research over internet. A marketing person can gather relevant data across various geographical boundaries. A prospective customer can find a service provider over internet.

**8. Multimedia:**

Computer can also be used as an entertainment device. We can play various multimedia applications such as music, video, etc.

**9. Prepare books of accounts:**

With the help of accounting software, we can prepare our books of accounts.

**10. Reduced cost:**

The introduction of computer has resulted into a reduction of cost to perform various complicated tasks.

## **Disadvantages of Computer**

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It is true that even computer is not free from defects. The disadvantages of computer are given below:

**1. Ever changing technology:**

The technology that is new today may soon become obsolete. We need to regularly upgrade the hardware and software in a computerized environment. This involves additional time and cost.

## 2. **Increased manpower cost:**

The computer needs to be operated by skilled person. This has led to an increase in manpower cost for organizations. Due to the inherent risks, huge expenditure is made ensure data security.

## 3. **Computer stops responding:**

At times the operating system of the computer may stop responding or functioning. Though this problem is generally solved by restarting the computer, but sometimes you may have to take the support of the technician.

## 4. **Viruses:**

The threat of virus and malware attack always remains in the computerized environment. To cope up with these risks, various anti-virus software are available in the market. If you are using a good antivirus, you are almost sure that your private information and other sensitive data are secured.

## 5. **Reduction in employment opportunity:**

The introduction of computers has negatively impacted the employability of computer illiterate people.

## 1.2 Applications of Computer

Today, computers are used in almost every sphere of life. The users from different locations can easily and quickly communicate with each other with the help of computers. The user of computers has reduced the paper work to a large extent. Thus, computers have become a basic need to perform various tasks in our day-to-day life. Some common applications of computers are discussed below:

- **Education:**

Computers are used in schools and colleges to teach students in better and easy way. The students can get more information about a specific topic or subject using the Internet. Computers help in easy learning by creating presentations on a specific topic. Today, students can fill their application forms and give their exams online that facilitates distance education. Computer-based learning and web-based learning are very popular amongst student.

- **Business:**

Computers are used in different types of business to store a large amount of information in the form of database. Using computers, business meetings can be held between people sitting at remote locations through web conferencing. Buyers and sellers can conduct business online through the use of computers and Internet. Computers are used for payroll calculation, budgeting, sales analysis managing employee database.

- **Communication:**

Computers that are connected with each other can be used to transfer data to and from other computers. In order to establish communication between two users, Internet is one of the most common mediums. Email is a popular system through which a user can send/receive text messages, graphic messages and file attachments.

- **Engineering:**

Computers are used by the engineers for the creation of complex drawings and designs while working in different fields, like automobiles and construction. Engineers use computers

extensively for numerical computing. It is also used in architectural engineering , industrial engineering, structural engineering.

- **Entertainment:**

Computers are used in the entertainment industry for creating graphics and animations. There are various free as well as proprietary graphics software available for creating graphics and animations.

- **Banking:**

Nowadays, banking is almost totally dependent on computers. So, computers are being increasingly used for online banking. Through online banking the users or customers can transfer and receive money by using computers and Internet. Some banks also provide the facility of online bill payment through their websites.

- **Health:**

Computers are used by doctors to diagnose various kinds of diseases and ailments. Several analog and digital devices are connected with computers enabling the doctors to monitor the condition of a patient and view the internal organs of the body. Hospitals use computer to maintain and manage patient record and billing systems. They also use the concept of 'tele-medicine' to serve the patients at remote locations. It is also used in scanning, diagnosing different diseases, ECG, surgery, etc.

- **Government:**

Computers play a crucial role in almost all government departments. Revenue, industry, census, police, defense and many other departments use computers extensively to serve the people better. The concept of 'e-governance' is becoming popular among various government agencies. Government play important role in government field such as Budget, sales tax department, computerization of voter lists, driving license, PAN cards, etc.

## 1.3 History of Computer

The history of computing hardware covers the developments from early simple devices to aid calculation to modern day computers.

Before the 20th century, most calculations were done by humans. Early mechanical tools to help humans with digital calculations were called "calculating machines", by proprietary names, or even as they are now, calculators. The machine operator was called the computer.

The first aids to computation were purely mechanical devices which required the operator to set up the initial values of an elementary arithmetic operation, then manipulate the device to obtain the result. Later, computers represented numbers in a continuous form, for instance distance along a scale, rotation of a shaft, or a voltage. Numbers could also be represented in the form of digits, automatically manipulated by a mechanical mechanism. Although this approach generally required more complex mechanisms, it greatly increased the precision of results.

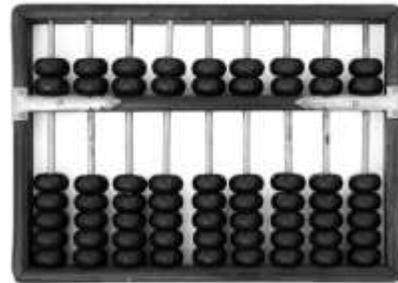
Generally, the history of computer development can be categorized into the following three different Eras

## Mechanical Calculating Era

The Mechanical calculating devices were based on the counting principles. They were based on the decimal number system. These devices were constructed with the mechanical part for computing that is the counting.

### The Abacus

The abacus, also called a counting frame, is a calculating tool that was in use in Europe, China and Russia, centuries before the adoption of the written Hindu-Arabic numeral system and is still used by merchants, traders and clerks in some parts of Eastern Europe, Russia, China and Africa. The abacus, is invented Babylonia in the fourth century BC, is considered by many the first computing device. Today, abaci are often constructed as a bamboo frame with beads sliding on wires, but originally they were beans or stones moved in grooves in sand or on tablets of wood, stone, or metal.



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#### Why was the abacus used?

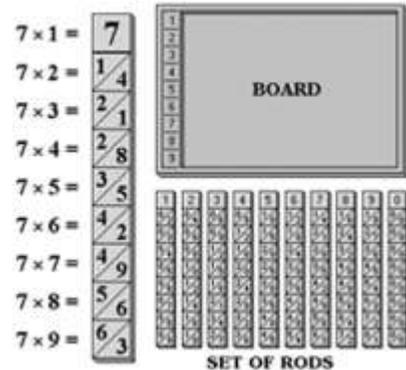
Before computers, calculators, or even arithmetic using paper and pencil, the abacus was the most advanced device for crunching numbers. Before the abacus, the only methods people had to use for their mathematical calculations were their fingers and toes, or stones in the dirt. There are many different types of abacus'. For example, the classical abacus or Chinese abacus has five beads on the bottom and two beads at the top. The modern abacus, Japanese abacus, or soroban has four beads at the bottom and one bead at the top.

It is divided into two parts: heaven and earth. Each bead in heaven is equivalent to 5 and each bead in earth is equivalent to 1. Calculation is done sliding the beads in both sections.

### Napier's Bone

Napier's bones is a manually-operated calculating device created by John Napier of Merchiston for calculation of products and quotients of numbers. The method was on Arab mathematics and the lattice multiplication.

Using the multiplication tables embedded in the multiplication can be reduced to addition operations and division to subtractions. More advanced use of the rods even extract square roots. Note that Napier's bones are not same as-logarithms, with which Napier's name is also associated.



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The complete device usually includes a base board with a rim; the user places Napier's rods inside the rim to conduct multiplication or division. The board's left edge is divided into 9 squares, holding the numbers 1 to 9. The Napier's rods consist of strips of wood, metal or heavy cardboard. Napier's bones are three-dimensional, square in cross section, with four different rods engraved on each one. A set of such bones might be enclosed in a convenient carrying case.

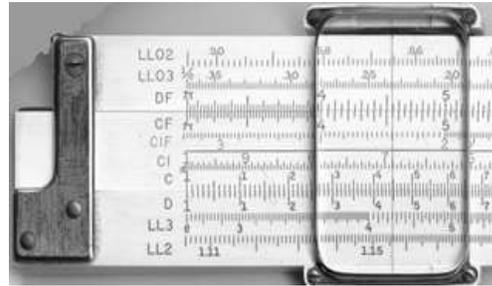
## Slide Rule

The Reverend William Oughtred and others developed the slide rule in the 17th century based on the emerging work on logarithms by John Napier. Before the advent of the pocket calculator, the most commonly used calculation tool in science engineering.

The slide rule is used primarily for multiplication and division, and also for functions as roots, logarithms and trigonometry, but is not normally used for addition or subtraction.

Though similar in name and appearance to a standard ruler, the slide rule is not ordinarily used for measuring length or drawing straight lines.

Slide rules exist in a diverse range of styles and generally appear in a linear or circular form with a standardized set of markings (scales) essential to performing mathematical computations. Slide rules manufactured for specialized fields such as aviation or finance typically feature additional scales that aid in calculations common to those fields.



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## Pascaline

Pascal's calculator is a mechanical calculator-invented by Blaise Pascal in the early 17th century. It was called the arithmetic machine and later became known as Pascaline. Pascal was led to develop a calculator by the laborious arithmetical calculations required by his father's as supervisor of taxes in Rouen. He designed the machine add and subtract two numbers directly and to perform multiplication and division through repeated addition or subtraction.



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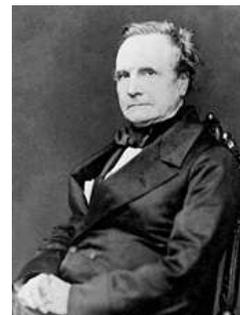
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Pascal's calculator was especially successful in the design of its carry mechanism, which adds 1 to 9 on one dial, and when it changes from 9 to 0, carries 1 to the next dial. His innovation made each digit independent of the state of the others, which enabled multiple carries to rapidly cascade from one digit to another regardless of the machine's capacity. Pascal was also the first to shrink and adapt for his purpose a gear, used in turret clocks and water wheels, which could resist the strength of any operator input with very little added friction.

## Charles Babbage

Charles Babbage (26 December 1791 – 18 October 1871) was English polymath. A mathematician, philosopher, inventor and mechanical engineer, Babbage, along with Ada Lovelace, is best remembered for originating the concept of a programmable computer.

Considered by some to be a "father of the computer", Babbage, with Lovelace, is credited with inventing the first mechanical that eventually led to more complex designs. His varied work in fields has led him to be described as "per- eminent" among the many polymaths of his century.



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## Difference Engine

A difference engine is an automatic mechanical calculator designed to tabulate polynomial functions. The name derives from the method of divided differences, a way to interpolate or tabulate functions by using a small set of polynomial coefficients. Most mathematical functions commonly used by engineers, scientists and navigators, trigonometrical functions, can be approximated by polynomials, so a difference engine can compute many useful-tables of numbers.

## Analytical Engine

In 1833, Charles Babbage developed Analytical Engine which was a kind of a general purpose computer designed to solve any arithmetical problems. It was significant in a way that it had most of the elements present in today's digital computer system, that's why he's called "Father of modern Computer Science".

**His analytical engine had four major units:**

**a. The store:**

A mechanical memory unit which could store data and intermediate.

**b. The Mill:**

An arithmetic unit, which was capable of performing four basic arithmetic operations, addition, subtraction, multiplication and division.

**c. Control Unit:**

A gears and Shafts by which data and results were transferred between the store and Mills.

**d. Cards (Input / Output devices):**

Punch cards were used as input and output device.

His efforts guided a number of principles which have been shown to be fundamental to the design of today's digital computer. So he is considered as a "Father of modern day's computer".

## Lady Ada Lovelace

Augusta Ada King-Noel, Countess of Lovelace (née Byron; 10 December 1815 – 27 November 1852) was an English-mathematician writer, chiefly known for her work on Charles Babbage's early mechanical general-purpose computer, the Analytical Engine. Her work on the engine include what is recognized as the first algorithm intended carried out by a machine.

As a result, she is often regarded as the first computer programmer.



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## Herman Hollerith

Herman Hollerith (February 29, 1860 – November 17, 1929) was an American inventor who developed an electromechanical punched card tabulator to assist in summarizing information and, later, accounting. He was the founder of The Tabulating Machine Company that was consolidated in 1911 with three other companies to form the Computing-Tabulating-Recording Company, later renamed IBM. Hollerith is regarded as one of the seminal figures in the development of data processing. His invention of the punched card tabulating machine marks the beginning of the era of semiautomatic data processing systems, and his concept dominated that landscape for nearly a century.



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IBM.

## The Jacquard Loom

Calculators such as the Ari thermometer remained a fascination after 1820, and their potential for commercial use well understood. Many other mechanical devices built during 19th century also performed repetitive functions more or less automatically, but few had any application to computing. There was one major exception: the Jacquard loom, invented in 1804–05 by a French weaver, Joseph-Marie Jacquard.

The Jacquard loom was a marvel of the Industrial Revolution. A textile-weaving loom, it could also be called the first practical information-processing device. The loom worked by tugging various-colored threads into patterns by means of an array of rods. By inserting a card punched with holes, an operator could control the motion of the rods and thereby alter the pattern of the weave. Moreover, the loom was equipped with a card-reading device that slipped a new card from a pre-punched deck into place every time the shuttle was thrown, so that complex weaving patterns could be automated.



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## The Electro Mechanical Era

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In the electromechanical era the computational devices is composed with the mechanical and electrical parts and used electricity for the operation. They were partially programmable. The most common computer of this era are as follows:

## Mark I

Mark I was developed by Howard Aiken and Grace Hopper at Harvard University USA. It was built by IBM in 1944 and was brought into operation until 1959. This giant computer was 5-ton weight with dimension 51 feet long, 8 feet height and 2 feet in depth. This huge device was used by US Navy for gunnery and ballistic calculation. This computer could carry out addition, subtraction, multiplication, division and reference to previous results.



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## Atanasoff-Berry Computer (ABC)

Atanasoff-Berry Computer (ABC), an early digital computer. It was generally believed that the first electronic digital computers were the Colossus, built in England in 1943, and the ENIAC, built in the United States in 1945. However, the first special-electronic computer may actually have been invented by Vincent Atanasoff, a physicist and mathematician at State College (now Iowa State University), during 1937– (Atanasoff also claimed to have invented the term analog to describe machines such as Vannevar Bush's Differential Analyzer.) Together with his graduate Clifford E. Berry, Atanasoff built a successful small in 1939 for the purpose of testing two ideas central to his design: capacitors to store data in binary form and electronic logic circuits to perform addition and subtraction.



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They then began the design and construction of a larger, more general-purpose computer, known as the Atanasoff-Berry Computer or the ABC.

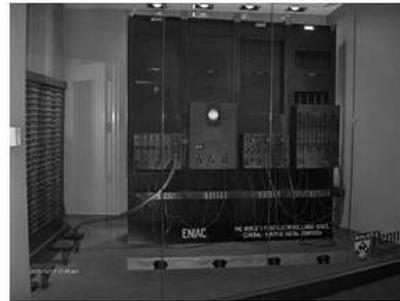
Various components of the ABC were designed and built from 1939 to 1942, but development was discontinued with the onset of World War II. The ABC featured about 300 vacuum tubes for control and arithmetic calculations, use of binary numbers, logic operations (instead of direct counting), memory capacitors, and punched cards as input/output units. (At Atanasoff's invitation, another early computer pioneer, John Mauchly, stayed at Atanasoff's home and was freely shown his work for several days in June 1941.)

## The electronic Era

Electronic era begins with the invention of the first real computers as a result of convergence of technology, people and motivation. The development of electronic era is often describes in reference to the different generation of computer devices. This era is fully driven by electronic devices as components of computer. Some of the machines developed during this era are described here.

## ENIAC (1946-1947)

ENIAC, is full Electronic Numerical Integrator and Computer, the first programmable general-purpose electronic digital computer, built during World War II by the United States. In the United States, government funding during the war went to a project led by John Mauchly, J. Presper Eckert and their colleagues at the Moore School of Electrical Engineering at the University of Pennsylvania. Under contract to the army and under the direction of Herman Goldstine, work began in early 1943 ENIAC.



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ENIAC was enormous. It occupied the 50-by-30-foot (15-by-9-metre) basement of the Moore School, where its 40 panels were arranged, U-shaped, along three walls. Each of the units was about 2 feet wide by 2 feet deep by 8 feet high (0.6 metre by 0.6 metre by 2.4 metres). With approximately 18,000 vacuum tubes, 70,000 resistors, 10,000 capacitors, 6,000 switches, and 1,500 relays, it was easily the most complex electronic system theretofore built. ENIAC ran continuously (in part to extend tube life), generating 150 kilowatts of heat, and could execute up to 5,000 additions per second, several orders of magnitude faster than its electromechanical predecessors. It and subsequent computers employing vacuum tubes are known as first-generation computers. (With 1,500 mechanical relays, ENIAC was still transitional to later, fully electronic computers.)

## EDVAC (1947-1952)

Short for Electronic Discrete Variable Automatic Computer, EDVAC is one of the first electronic computers that utilized the binary system that first began performing basic tasks in 1951.



utilized

ENIAC inventors John Mauchly and J. Presper Eckert proposed the EDVAC's construction in August 1944. A contract to build the new computer was signed in April 1946 with an initial budget of US\$100,000. EDVAC was delivered to the Ballistics Research Laboratory in August 1949.

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Functionally, EDVAC was a binary serial computer with automatic addition, subtraction, multiplication, programmed division and automatic checking with an ultrasonic serial memory capacity of 1,000 44-bit words. EDVAC's average addition time was 864microseconds and its average multiplication time was 2,900 microseconds.

By 1960 EDVAC was running over 20 hours a day with error-free run time averaging eight hours. EDVAC ran until 1961 when it was replaced by BRLESC. During its operational life it proved to be reliable and productive for its time.

## EDSAC (1947-1949)

EDSAC, in full Electronic Delay Storage Automatic Calculator, the first full-size stored-program computer, built at the University of Cambridge, Eng., by Maurice Wilkes and others to provide a formal computing service for users. EDSAC was built according to the von Neumann machine-principles enunciated by the Hungarian American scientist John Neumann and, like the Manchester Mark I, became operational in 1949. Wilkes built the machine chiefly to computer programming issues, which he realized would become as important as the hardware details.



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## UNIVAC-1 (1950-1951)

UNIVAC, in full Universal Automatic Computer, the earliest commercial computers. After leaving the Moore School of Electrical Engineering at the University Pennsylvania, J. Presper Eckert, Jr., and John Mauchly, had worked on the engineering design of the ENIAC computer for the United States during World War II, struggled to obtain capital to build their latest design, a computer they called the Universal Automatic Computer, or UNIVAC. (In the meantime, they contracted with the Northrop Corporation to build the Binary Automatic Computer, or BINAC, which, when completed in 1949, became the first American stored program computer.)



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The UNIVAC-I was designed as a commercial data-processing computer, intended to replace the punched-card accounting machines of the day. It could read 7,200 decimal digits per second (it did not use binary numbers), making it by far the fastest business machine yet built. Its use of Eckert's mercury delay lines greatly reduced the number of vacuum tubes needed (to 5,000), thus enabling the main processor to occupy a "mere" 14.5 by 7.5 by 9 feet (approximately 4.4 by 2.3 by 2.7 meters) of space. It was a true business machine, signaling the convergence of academic computational research with the office automation trend of the late 19th and early 20th centuries.

As such, it ushered in the era of "Big Iron" – large, mass-produced computing equipment.

## 1.4 GENERATIONS OF COMPUTERS

The history of the computer is also referred to its generation. Key technology development that vitally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful, efficient and reliable devices distinguished the generation of the computer. This division of computer according to the development period, memory, processing speed, efficiency, storage etc. is called computer generation.

Over the years, various computing devices were invented that enabled the people to solve different types of problems. All these computing devices can be classified into several generations. These generations refer to the phases of improvement made to different computing devices. The

different phases of improvement made to computing devices resulted in a small, cheap, fast, reliable and productive computer. The technological development in the field of computers not only refers to the improvements made to the hardware technologies, but also the improvements made to the software technologies. The history of computer development is often discussed in terms of different generation of computers, as listed below.

- First generation computers
- Second generation computers
- Third generation computers
- Fourth generation computers
- Fifth generation computers

## First Generation Computers (1940-1956)

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The first generation computers were employed during the period 1940-1956. These computers used the vacuum tubes technology for calculation as well as for storage and control purposes. Therefore, these computers were also known as vacuum tubes or thermionic valves based machines. A vacuum tube is up of glass and contains filaments inside it. The filaments when heated generate electrons, which eventually help in the amplification and deamplification of electronic signals. The input and output medium for generation computers was the punched card and printout respectively. examples of first generation computers are ENIAC, EDVAC, EDSAC UNIVAC.



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### Features

- They used vacuum tubes/valves as their main electronic components.
- The use of vacuum tube technology made these computers very large and bulky. Due to their large size, it was not an easy task to install them properly.
- Punch cards was used as input devices.
- They were not easily transferable from one place to another due to their huge size and also required to be placed in cool places.
- They generated huge amount of heat and hence were prone to hardware faults. Hence, they were not considered as reliable and required proper maintenance at regular intervals.
- The functioning of these computers depended on the machine language. A machine language is a language in which all the values are represented in the form of 0's and 1's. Therefore, these computers were not very easy to program.
- They were generally designed as special-purpose computers. Therefore, they were not very flexible in running different types of applications.
- They were single tasking because they could execute only one program at a time and hence, were not very productive.
- Storage capacity was limited to 1 KB to 4 KB.
- Processing speed was in a millisecond.
- They used the magnetic drum for primary memory.

- The operating systems of the first generation computers were very slow.

## **Second Generation Computers (1956-1963)**

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The second generation computers were employed during the period 1956-1963. The main characteristics of these computers were the use of transistors in the place of vacuum tubes in building the basic logic circuits. The transistors were invented by Shockley, Brattain and Bardeen in 1947 for which they won Nobel Prize. A transistor is a semiconductor device that is used to increase the power of the incoming signals by preserving the shape of original shape. It has three connections, which are emitter (E), base (B) and collector (C). The base of transistor is used as a gate through which the signal, needed to be amplified is sent. The signal sent through the base of the transistor is generally a small flow of electrons. Therefore, the base terminal also acts as the input gate for the transistor. The collector of the transistor is used to collect the amplified signal. The emitter of the transistors acts as the output gate for emitting the amplified signal to the external environment. The transistor was far superior than vacuum tube that made computers become smaller, faster, cheaper, more energy-efficient and more reliable than the first generation computers. Example: IBM 1401, UNIVAC-II, IBM 1620.



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The size of the computers decreases than first generation and available with cheap cost. Second-generation computers maintain binary and assembly level languages. The famous high level languages COBOL, FORTRAN developed in second generation computers. Second generation computers designed for atomic energy industry.

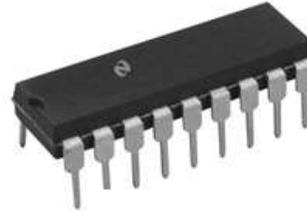
### **Features:**

- Second generation computer machines were based on transistor technology. i.e. They used transistors in place of vacuum tubes. 1 transistor was equivalent to 1000 vacuum tubes.
- Second generation computers were smaller as compared to the first generation computers
- They were more reliable as compared to first generation computers and hence, did not require maintenance at regular intervals of time.
- They could be transferred from one place to other very easily because they were small and light weight computing device and generated less amount of heat.
- They used the magnetic core as primary memory and magnetic tapes and magnetic disk as auxiliary memory.
- Second generation computers still require air conditioning.
- They were easy to program because of the use of assembly language.
- They required very less power in carrying out their operations.
- The cost of these computers was very high.
- The speed of processing was increased to the microsecond.
- They were special-purpose computers and could execute only specific applications.
- The computer used batch processing and multiprogramming OS.

## Third Generation Computer (1964-1971)

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The third generation computers were employed during the period 1964-1971. The major characteristics feature of third generation computer systems was the use of Integrated Circuits (ICs). The IC technology was also known as microelectronics technology. ICs are the circuits that combine various electronic components, such as transistors, resistors, capacitors, etc. onto a single small silicon chip. This development made computers smaller in size, reliable, and efficient. In this generation remote processing, time-sharing, multiprogramming operating system were used. The first IC was developed by Jack Kilby and Robert Noyce in the year 1958. Example: IBM 370, PDP-8, CDC 7600, NCR 395, B6500 etc.



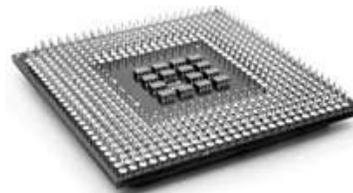
### Features:

- Integrated Circuit (IC) replaced transistors. 1 IC was equivalent to 100 transistors, resistor and capacitors. IC improves the quality as well as performance of the computer.
- Processing speed was increased to the nanosecond.
- They were very productive because of their small computational time.
- They were easily transportable from one place to another because of their small size.
- They used high-level language for programming.
- They could be installed very easily and required less space for their installation.
- They were able to execute any types of application, such as business and scientific applications. Hence, the third generations were also considered as general-purpose computers.
- They were more reliable and required less frequent maintenance schedules.
- In the beginning magnetic core memories were used. Later they were replaced by semiconductor memories (RAM & ROM)
- Magnetic disk was used as a secondary memory.
- Microprogramming, parallel processing (multiprocessor system), multi-programming, multi-user system (time shared system) etc. were introduced.
- The storage capacity of these computers was still very small.
- The cost of these computers was very high.
- They were still required to be placed in air-conditioned places.

## Fourth Generation Computers (1971-1989 or Present)

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The fourth generation computers were employed during 1971. The invention of Large Scale Integration (LSI) technology and Very Large Scale Integration (VLSI) technology led to the development of fourth generation computers. However, these computers still used the IC technology to build the basic circuits. The LSI technology allowed thousands of transistors to be fitted onto one small silicon chip. On the other hand, the VLSI technology allowed hundreds of thousands of transistors to be fitted onto a single



chip.

As a result, the manufacturers were able to reduce the size of the computers and made them cheaper as compared to the other generation of computers. With the help of VLSI technology microprocessor came into existence. The computers were designed by using microprocessor, as thousands of integrated circuits were built onto a single silicon chip. The fourth generation computers became more powerful, compact, reliable and affordable. As a result, they give rise to personal computer (PC) revolution. For the first time in 1981 IBM introduced its computer for the home user and in 1984 Apple introduced the Macintosh Microprocessor. The concept of microprocessor came into existence with this generation, which led to microcomputer. IBM PC, IBP PC/ AT, CRAY-I, IBM 4341, DEC 10, STAR 1000, PUP 11, Core2Duo PC and Apple are the examples of fourth generation computers.

### **Features**

- The fourth generation computers have microprocessor based systems.
- They are the cheapest among all the computer generation.
- The speed, accuracy and reliability of the computers are improved in fourth generation computers.
- The speed of processing is increased to Picosecond. Billions of instructions could be processed in a second.
- They are highly reliable and required very less maintenance.
- They provided a user-friendly environment while working because of the development of GUIs and interactive I/O devices.
- The program written on these computers are highly portable because of the use of high-level languages.
- They are very versatile and suitable for every type of applications.
- They required very less power to operate.
- Networking between the systems was developed.
- Semiconductor memory chips were used as the main memory.
- Secondary memory was composed of hard disks – Floppy disks & magnetic tapes are used for backup memory

### **Fifth Generation Computers**

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Fifth generation computers are in developmental stage which is based on the artificial intelligence. The goal of the fifth generation is to develop the device which could respond to natural language input and are capable of learning and self-organization. Quantum computation and molecular and nanotechnology will be used in this technology. So we can say that the fifth generation computers will have the power of human intelligence.

The different types of modern digital computers come under the categories of fifth generation computers. The fifth generation computers are based on the Ultra Large Integration (ULSI) technology that allows almost ten million electronic components to be fabricated on one small chip. The ULSI technology in increasing the power and speed of the microprocessor chips and the capacity of primary and secondary storage devices to a great extent. As result, the fifth generation computers are faster, cheaper and more efficient, as compared to the fourth generation computers. Some of the improvement or developments made during this generation of computers are as follows:

- Development of various portable computers such as laptop, pocket computer, Personal Digital Assistant(PDA), etc.
- Development of Parallel Processors.
- Development of centralized computers called servers.
- Invention of optical disk technology.
- Invention of the internet and its different services.
- The fifth generation computers are really enjoyed by their users.

### Features

- These computers will use parallel processor made from superconductors Gallium Arsenide (GaAs)/biochip.
- This generation based on parallel processing hardware and AI software. AI interprets the means and method of making computer think like human beings.
- They will be able to recognize image and graphs.
- Fifth generation computer aims to be able to solve highly complex problem including decision making, logical reasoning.
- They will be able to use more than one CPU for faster processing speed.
- Fifth generation computers are intended to work with natural language.
- The language of operating system will be PROLOG, LISP etc.
- They are the fastest and powerful computers till date.
- They are able to execute a large number of applications at the same time and that too at a very high speed.
- The users of these computers find it very comfortable to use them because of the several additional multimedia features.
- They are versatile for communication and resource sharing.
- It is expected that speed of fifth generation of computer will be significantly higher than other generations.
- The natural languages such as English, German, French, and Sanskrit etc will be used as programming language.
- Knowledge Information Processing system (KIPS) architecture will be used.
- Bio chips made up of protein fiber Gallium Arsenide (GaAs) will be used as memory devices.



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- These computer will have IQ and logical power, decision making capability, expert system similar to human being.

## 1.5 Computer speed and Measurement Unit

We come across different measuring units like kilogram, meter, and liter and so on to measure weight, length and capacity or volumes of different commodities. We have to measure the capacity of computer's memory, storage devices and length of programs. We use the units like BIT, NIBBLE, BYTE and WORD.

### BIT

BIT is an abbreviation of the words Binary digit and is the smallest unit of information. It is either '0' or '1'. The raw data fed into the computer are first converted into an electrical pulses or BITS, as the computers do not recognize the general form of data like numbers (0-9), alphabets (a-z or A-Z) and special characters like punctuation marks and arithmetical signs. The 0 and 1 of the binary system corresponds to the ON and OFF of the flow of electricity in the computer's circuits.

### NIBBLE

A NIBBLE is a string of four BITS. The earliest form of code, called 'Binary coded decimal (BCD) used a NIBBLE for every character.

### BYTE

It is the unit of measuring computer's memory and size of a program. One Byte is the string of eight binary digits (BITS). It may represent a single letter, numeral or other characters. Computer memory is expressed in terms of BITS, BYTES, KILOBYTES (KB), MEGABYTES (MB), GIGABYTES (GB) and TERABYTES (TB), PETABYTE (PB), EXABYTE (EB), ZETTABYTE (ZB) and YOTTABYPE (YB).

0 or 1	=	BIT
4 BITS	=	NIBBLE
8 BITS	=	1 BYTE
1024 BYTE	=	1 KILO BYTE (KB)
1024 KB	=	1 MEGA BYTE (MB)
1024 MB	=	1 GIGA BYTE (GB)
1024 GB	=	1 TERA BYTE (TB)
1024 TB	=	1 PETA BYTE (PB)

### WORD

A computer word is defined in terms of bytes. A word may be formed by combining two or more bytes. The most common combination is of four bytes. Word-Length is a length of bits that occupy one location in memory. A computer having a smaller world-length is slower that another having a larger word-length is, though the speed of both is same. Word-length is generally fixed for a computer. But some computers have a changeable word-length i.e. they can be used in doing small or big tasks. Now-a-days computers have word-length of 16,32,48,64,128 or even more bits.

## Measurement of speed-MIPS and MHZ

An electronic device like computer that provides a series of pulses at extremely regular intervals of time. The interval between successive pulses, i.e. their rate of repetition, is known as the clock speed. In computers the clock rate is measured in Mega Hertz (MHz), i.e. there are at least one million pulses per second. Now-a-day computers come with still stunning clock speed of Giga Hertz (GHz).

MIPS-short form of millions of instructions per second. The execution speed of computer is measured in terms of MIPS. For example, 0.5 MIPS is 500000 instruction per second. High speed computer and workstation perform at 200 MIPS and even higher.

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### Exercise

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#### Short Answer Questions

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1. Why computer is known as versatile and diligent device? Explain. [HSEB 2069]
2. What are the application areas of computer? Explain in brief. [HSEB 2067]
3. Why is Charles Babbage known as 'Father of the computer'? [HSEB 2062]
4. Describe at least five ways in which information technology can help students studying subjects other than computing. [HSEB 2062]
5. Write brief note on the achievement of the following computer scientists: Howard Aiken. [HSEB 2062]
6. Explain the evolution of computer describing the technologies used in different generations. [HSEB 2059]
7. What do you mean by generation of computer? Explain the characteristics of third generation of computers. [HSEB 2061]
8. Compare and contrast between first and second generation of computers. [HSEB 2011]
9. Differentiate between second and third generation of computer. [HSEB 2070]
10. What is generation of computer? Describe the third generation of computer. [HSEB 2070]
11. Describe the major characteristics of fourth generation of computers. [HSEB 2064/70/71]
12. Explain the technologies used in different generation of computer. [HSEB 2069]
13. Compare the distinctions between third and fourth generations of computer. [HSEB 2060/2071]
14. Describe the fourth generation of computer. [HSEB 2072 set c]
15. What is super computer? List out application area of super computer. [HSEB 2072 SET D]
16. List out the advantages of AI. [HSEB 2072 SET E]
17. How Do You Measure The Capacity Of Speed And Memory Of Computer System? Explain. [HSEB 2073 SET C]
18. Write short notes on:
  - (a) Charles Babbage [HSEB 2064]

## Long Answer Questions

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1. What are the application areas of computer? Explain in detail. [HSEB 2065]
2. Discuss about how the development of the PCs (personal Computers) has extended the use of computer at present days. [HSEB 2058]
3. Explain the different generation of computers. [HSEB 2065, 66]
4. What do you mean by generation of computer? Explain the technology used in different generation of computer. [HSEB 2067]
5. Explain any five fields of usage of computer in present days. [HSEB 2069]
6. What is generation of computer? Explain the different generation of computer with their major features.