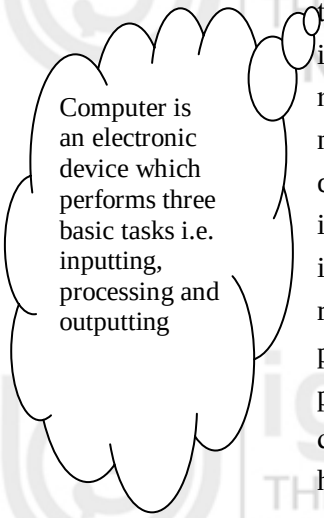
UNIT 1 COMPUTER THEIR ORIGIN AND APPLICATIONS

Structure **Page No.**

1.0 INTRODUCTION



Perhaps Computer is the most powerful and versatile tool created by human beings. In today's scenario, computer plays a major role in almost every aspect of life and influences our lives in one way or the other. Today, you can hardly find any area which is not influenced by computer. The word computer comes from the word "compute" which means to calculate. Computer is also meant for calculation but it is much more than just a calculating machine. Computer is an electronic device which performs three basic tasks i.e., inputting, processing and outputting. A computer accepts the input through various input devices. After receiving the input data, computer performs different operations required by the user on these input. Finally, computer generates the resultant of the processed data as the output through various output devices. Hence, a computer is a data processing device. This unit will provide details about computers, its origins and also descriptions about computer's different components, their applications and some current hardware platforms of computer.

Since, computer is vastly used for making calculations or controlling operations that are expressible in numerical or logical terminology yet the development of computer started from Abacus and its journey of development is still going on. This unit also focuses on major development during different periods.

1.1 OBJECTIVES

After studying this unit, you should be able to understand:

- the basic concepts about computer's origin and development;
- functions of computer;
- role & current applications of computer in various field; and
- limitations of a computer.

1.2 ORIGIN OF COMPUTERS

Origin of computer could be rigorous efforts of men to count large numbers. This process of counting of large numbers generated various systems of numeration like Babylonian system of numeration, Greek system of numeration, Roman system of numeration and Indian system of numeration. Out of these the Indian system of numeration has been accepted universally. It is the basis of modern decimal system of numeration 0-9.

1.2.1 Abacus

Nearly 5,000 years ago, the "abacus" was developed in China in 3000 B.C. The word abacus means calculating board. The "abacus" may be considered the first computer and it has been used since ancient times by a number of civilizations for basic arithmetical calculations. A modern form of abacus is given in Figure 1.1.

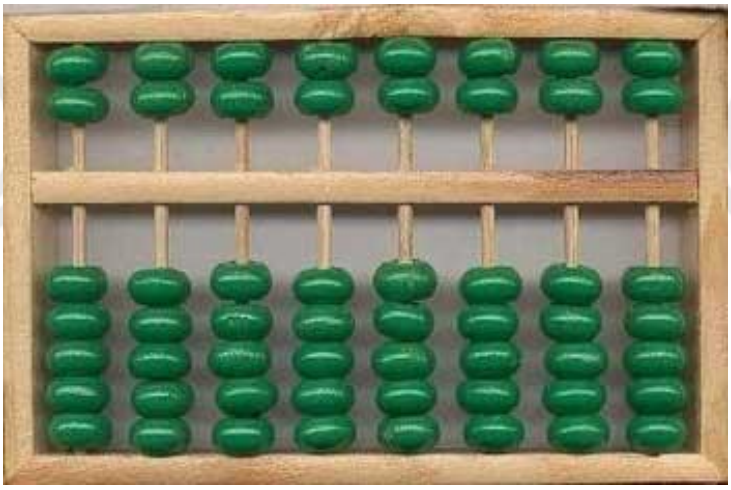


Figure 1.1: Abacus

The abacus is also called a counting frame, which is a calculating tool for performing arithmetic operations. The Chinese abacus has a frame holding vertical wires, with seven beads on each wire. A horizontal divider separates the top two beads from the bottom five, sometimes referred to as the heaven and the earth beads. The arithmetic calculations are performed by manipulating the beads by using the principle of positional weight of beads on a rack. Abacus is used even today to teach small children how to count. A skilled abacus operation can be as fast as a hand held calculator.

1.2.2 Napier's Bones

John Napier was a mathematician who became famous for his invention of logarithms. The used of "logs" enabled him to reduce any multiplication problem. John Napier built a mechanical device for the purpose of multiplication in 1617 A.D. The device was known as Napier's bones. His "bones" are set of eleven rods side by side products and quotients of large numbers can be obtained. The sticks were called "bones" because they were made of bone of ivory.

1.2.3 Slide Rule

English mathematician E. Gunter developed the slide rule. This machine could perform operations like addition, subtraction, multiplication, and division. Although the slide rule appeared in various forms during the seventeenth century, it consists of two movable rulers placed side by side. Each ruler is marked off in such a way that the actual distances from the beginning of the ruler are proportional to the logarithms of the numbers printed on the ruler. By sliding the rulers, one can quickly multiply and divide.

1.2.4 Pascal's Calculator

Blaise Pascal was a French mathematician and one of the first modern scientists to developed and build calculator. He developed a machine at the age of 19 that was capable of adding and subtracting numbers. The machine was operated by dialing a series of wheels, gears and cylinders.

1.2.5 Leibniz's Multiplication and Dividing Machine

Like Pascal, Gottfried Leibniz was a seventeenth century scientist who recognized the value of building machines and built around 1673 a mechanical device that could do mathematical calculations and save labor too.

1.2.6 Difference Engine

The first step towards the creation of computers was made by an English mathematics professor, Charles Babbage. Early on, he realized that all mathematical calculations can be broken up into simple operations which are then constantly repeated, and that these operations could be carried out by an automatic machine. In the 1820s Charles Babbage started working on a 'Difference Engine', but after ten years he abandoned it for the 'Analytical Engine' – the real predecessor of the Computer.

Babbage outlined the basic elements of a modern general purpose computer which was based on the method of finite differences. It uses only arithmetical addition and removes the need for multiplication and division which are more difficult to implement mechanically. Charles Babbage is called the father of the computer.

1.2.7 The Analytical Engine

The Analytical Engine marks the progression from the arithmetic calculation to general-purpose computation. It was also developed by Charles Babbage. This machine was based on the principle that, for certain formulas, the difference between certain values is constant. The Analytical Engine has many essential features found in the modern digital computer.

The Engine had a 'Store' (memory) where numbers and intermediate results could be held, and a separate 'Mill' (processor) where the arithmetic processing was performed. It had an internal stock of the four arithmetical functions and could perform direct multiplication and division. It was also capable of functions like: conditional branching, looping (iteration), microprogramming, parallel processing, latching, and polling etc. The logical structure of the Analytical Engine was essentially the same as that which has dominated computer design in the electronic era.

1.2.8 Mechanical and Electrical Calculator

In the beginning of 19^{th} century, the mechanical calculator was developed to perform all sorts of mathematical calculations. Up to the 1960s, it was widely used. Later the rotating part of mechanical calculator was replaced by electric motor. So it was called the electrical calculator.

1.2.9 Modern Electronic Calculator

The electronic calculator used in 1960s was run with electron tubes, which was quite bulky. Later it was replaced with transistors and as a result the size of calculators became

fairly small. The modern electronic calculator can compute all kinds of mathematical computations and mathematical functions. It can also be used to store some data permanently. Some calculators have in-built programs to perform some complicated calculations. Modern electronic calculators contain a keyboard with buttons for digits and arithmetical operations. These calculators can perform sophisticated arithmetic and financial computations such as converting from polar to rectangular coordinates, taking square roots, computing logarithms and trigonometric relationships.

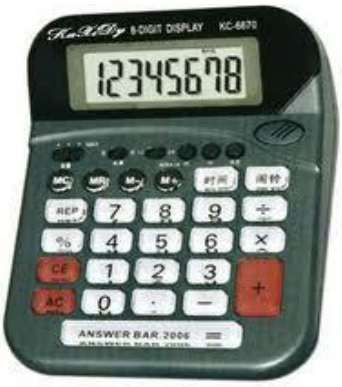


Figure 1.2: Electronic Calculator

1.3 COMPUTER GENERATIONS

The period, during which the evolution of computer took place, can be divided into five distinct phases known as generations of computers

The evolution of computer started from 16th century and resulted in today's modern machines. The present day computer, however, has also undergone rapid change over the years. This period, during which the evolution of computer took place, can be divided into five distinct phases known as Generations of Computers. Each new generation of computers is not only superior from their predecessor in processing and capabilities but also differs in looks and sizes. Each phase is distinguished from others on the basis of the type of *switching circuits* used. These Generations are:

- First Generation Computers (1940-1956)
- Second Generation Computers (1956-1963)
- Third Generation Computers (1964-1971)
- Fourth Generation Computers (1971-Present)
- Fifth Generation Computers (Present and Beyond)

1.3.1 First Generation Computers: Vacuum Tubes (1940-1956)

First generation computers are characterized by the use of vacuum tube

First generation computers are characterized by the use of vacuum tube. A vacuum tube was a fragile glass device, which used filaments as a source of electronics. It could control and amplify electronic signals. These vacuum tubes were used for calculation as well as storage and control. The first general purpose programmable electronic computer was the Electronic Numerical Integrator and Computer (ENIAC), built by J. Presper Eckert and John V. Mauchly at the University of Pennsylvania. The ENIAC was 30-50 feet long, weighed 30 tons, contained 18,000 vacuum tubes, 70,000 registers, 10,000 capacitors and required 150,000 watts of electricity. First generation computers were too bulky in size which required large room for installation and they used to emit large

amount of heat, so air-condition was must for the proper working of computers. Programs written in high level programming languages retranslated into assembly language or machine language by a compiler. Assembly language program retranslated into machine language by a program called an assembler (assembly language compiler).

Before ENIAC was finished, Von Neumann designed the Electronic Discrete Variable Automatic Computer (EDVAC) with a memory to hold both a stored program as well as data. This enabled much faster operation since the computer had rapid access to both data and instructions. The other advantages of storing instruction were that computer could do logical decision internally. Eckert and Mauchly later developed what was arguably the first commercially successful computer, the Universal Automatic Computer (UNIVAC), in 1952.

Examples: ENIAC, EDVAC, UNIVAC-1

1.3.2 Second Generation Computers: Transistors (1956-1963)

Second generation computers are characterized by the use of transistors

Solid-State components (transistors and diodes) and magnetic core storage formed the basis for the second generation of computers. Transistor is a device composed of semiconductor material that amplifies a signal or opens or closes a circuit. Invented in Bell Labs, transistors have become the key ingredient of all digital circuits, including computers. Transistor replaced the bulky electric tubes in the first generation computer. Transistors perform the same functions as a vacuum tube, except that electrons move through solid materials instead of through a vacuum. Transistors were made of a semi-conducting material and controlled the flow of electricity through the circuit. They also allowed computers to become smaller and more powerful and faster at the same time. They are also less expensive, required less electricity and emitted less heat than vacuum tubes. Manufacturing cost was also very low.

It is in the second generation that the concept of Central Processing Unit (CPU), memory, programming language and input and output units were developed. Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology. During the second generation many high level programming languages were introduced, including FORTRAN (1956), ALGOL (1958) and COBOL (1959).

Examples: PDP-8, IBM1400 series, IBM 1620, IBM 7090, CDC 3600

Third generation computers are characterized by the use of integrated circuits (ICs)

1.3.3 Third Generation Computers: Integrated Circuits (1964-1971)

The third generation computers were introduced in 1964. Transistors were miniaturized and placed on silicon chips, called semiconductors, which drastically increased the speed and efficiency of computers. They used Integrated Circuits (ICs). The development of

ICs proved to be a milestone in the field of computer and electronics. These ICs are popularly known as chips.

Silicon is the basic material used to make computer chips, transistors, silicon diodes and other electronic circuits and switching devices because its atomic structure makes the element an ideal semiconductor. Silicon is commonly doped, or mixed, with other elements, such as boron, phosphorous and arsenic, to alter its conductive properties. A typical chip is less than ¼-square inches and can contain millions of electronic components (transistors). Computers consist of many chips placed on electronic boards called printed circuit boards. There are different types of chips. For example, CPU chips (also called microprocessors) contain an entire processing unit, whereas memory chips contain blank memory.

A single IC, has many transistors, registers and capacitors built on a single thin slice of silicon. Development in ICs ranges from small scale integration (SSI) to medium scale integration (MSI). Multilayered printed circuits were developed and core memory was replaced by faster, solid state memories. The IC technology was also known as "microelectronics" technology, since large number of circuit could be integrated on a single chip.

Computers of this generation were small in size, low cost, large memory and processing speed is very high. Higher level language such as BASIC (Beginners All purpose Symbolic Instruction Code) was developed during this period. Integrated solid-state circuitry, improved secondary storage devices, and new input/output devices were the most important advantages in this generation. The new circuitry increased the speed of the computer. Arithmetic and logical operations were now being performed in microseconds or even nanoseconds. The development of mini computers also took place during this generation.

Examples: NCR 395, B6500, IBM 360,370

1.3.4 Fourth Generation Computers: Microprocessors (1971-Present)

Fourth generation computers started around 1971 by using large scale of integration (LSI) in the construction of computing elements. LSI circuits built on a single silicon chip called microprocessors. A microprocessor contains all the circuits required to perform arithmetic, logic and control functions on a single chip. Because of microprocessors, the fourth generation includes more data processing capacity than equivalent-sized third generation computers. Due to the development of microprocessor it is possible to place computer's central processing unit (CPU) on single chip. These computers are called microcomputers. Later very large scale Integrated *(*VLSI) circuits replaced LSI circuits. What in the first generation filled an entire room could now fit in the palm of the hand. The Intel 4004chip, developed in 1971, located all the components of the computer - from the central processing unit and memory to input/output controls - on a single chip.

Fourth generation computers are characterized by the use of microprocessor

The major innovations in this generation were the development of microelectronics and the different areas in computer technology such as multiprocessing, multiprogramming, time-sharing, operating speed, and virtual storage. During this period, high speed vector processors changed the scenario of high performance computing. Mostly microcomputers

and workstations were introduced for time shared mainframe computers. Thus the computer which was occupying a very large room in earlier days can now be placed on a table. The personal computer is a Fourth Generation Computer. It is the period when evolution of computer networks also took place.

Examples: Apple II, Alter 8800

1.3.5 Fifth Generation Computers (Present and Beyond)

Fifth generation computers are based on Artificial Intelligence

Fifth generation computers, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today. Artificial Intelligence is the branch of computer science concerned with making computers behave like humans and allow the computer to take its own decision. Currently, no computers exhibit full artificial intelligence (that is, are able to simulate human behavior). The greatest advances have occurred in the field of games playing. The best computer chess programs are now capable of beating humans. Today, the hottest area of artificial intelligence is neural networks, which are proving successful in an umber of disciplines such as voice recognition and natural-language processing. There are several programming languages that are known as AI languages because they are used almost exclusively for AI applications. The two most common are LISP and Prolog. The speed is extremely high in fifth generation computer. In the development of Fifth generation computers, parallel processing attended the main focus of developers. Until this time, parallelism was limited to pipelining and vector processing. This generation introduced machines with hundreds of processors that could all be working on different parts of a single program. Developments of more powerful computers are still in progress. It has been predicted that such a computer will be able to communicate in natural spoken language with its user, store vast knowledge databases, search rapidly through these databases, making intelligent inferences, drawing logical conclusions, image processing and see objects in the way that humans do.

Table 1.1 shows the comparative features of five generations of computers:

Table 1.1 : Features of five Generations of Computers

Criteria	First Generation Computer	Second Generation Computer	Third Generation Computer	Fourth Generation Computer	Fifth Generation Computer
Technology	Vacuum Tube	Transistor	Integrated Circuit	Microprocessor	Artificial Intelligent
Speed	Slowest	Slow	Medium	Faster	Fastest
Size	Largest	Large	Medium	Smaller	Smallest
Reliability	Unreliable	Less Reliable	More Reliable	More Reliable	More Reliable
Operating System	None	None	Yes	Yes	Yes
Language	Machine	Assembly	High Level	High Level	High Level
Period	1940-1956	1956-1963	1964-1971	1971-Present	Present and Beyond

☞ **Check Your Progress 1**

1) What is a computer ? Why is it known as data processor ?

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2) Into how many generations the evolution of computer is divided?

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1.4 COMPUTER SYSTEM

Each computer consists of a series of devices that together operate as an integrated unit or computer system. The processor is made up of the memory, arithmetic, logic and control units. A large computer system will normally have one or more auxiliary units, where input and output data are stored. A brief description of computer system is given here. More detailed study about this will be covered in unit 2 in this block.

1.4.1 How Computers Work ?

Input: This is the process of entering data and programs in to the computer system. Since computer is an electronic machine like any other machine which takes as inputs raw data and performs some processing giving out processed data, the input unit takes data from user to the computer in an organized manner for processing. Information and programs are entered into the computer through input devices such as the keyboard, disks, or through other computers via network connections or modems connected to the internet.

Storage: The process of saving data and instructions permanently is known as storage. Data has to be fed into the system before the actual processing starts. It is because the processing speed of Central Processing Unit (CPU) is so fast that the data has to be provided to CPU with the same speed. Therefore the data is first stored in the storage unit for faster access and processing. This storage unit or the primary storage of the computer system is designed to do the above functionality. It provides space for storing data and instructions. The storage unit performs the following major functions:

(a) All data and instructions are stored here before and after processing.

(b) Intermediate results of processing are also stored here.

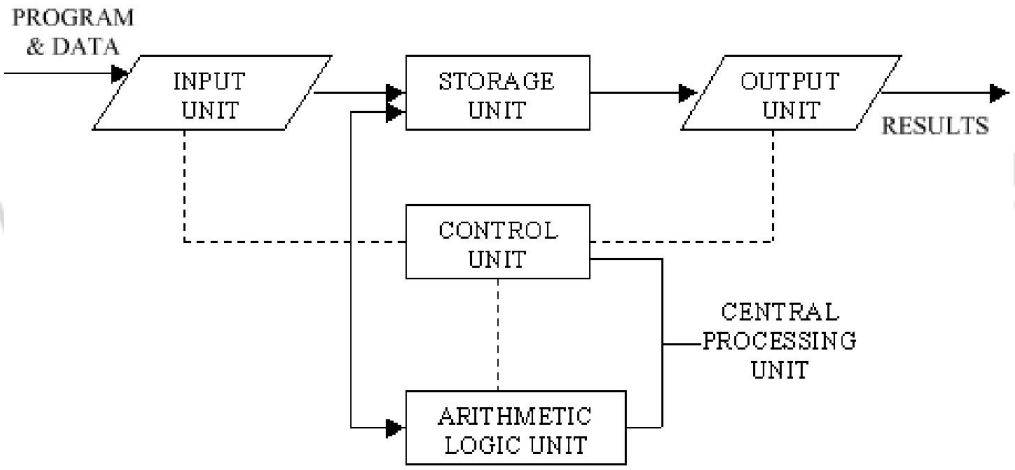


Figure 1.3 : Basic Computer Operations

Processing: The task of performing operations like arithmetic and logical operations is called processing. The CPU or central processing unit takes data and instructions from the storage unit and makes all sorts of calculations based on the instructions given and the type of data provided. It is then sent back to the storage unit. The coprocessor or the arithmetic-logic unit does arithmetic and logical operations. The RAM temporarily stores information.

Output: This is the process of producing results from the data for getting useful information. Output devices display information on the screen (monitor) or the printer and sends information to other computers. They also display messages about what errors may have occurred and brings up message or dialog box asking for more information to be input. Again the output is also stored inside the computer for further processing.

Figure 1.4 : Computer

1.4.2 Operational Unit

In order to carry out the operations, the computer allocates the task among its various operational units. These are 1) arithmetic logical unit, 2) control unit, and 3) central processing unit.

Arithmetic Logical Unit (ALU)

The Arithmetic Logical Unit is an important component of the CPU, which carry the actual execution of the instructions. After entering the data through the input device it is

stored in the primary storage unit. Then processing of the data and instruction are performed by Arithmetic Logical Unit. The major operations performed by the ALU are addition, subtraction, multiplication, division, logic and comparison. Data is transferred to ALU from storage unit when required. After processing, the output is returned to the storage unit for further processing or getting stored.

Control Unit (CU)

The next component of computer is the Control Unit, which acts like the supervisor seeing that things are done in proper fashion. The control unit determines the sequence in which computer programs and instructions are executed. Things like processing of programs stored in the main memory, interpretation of the instructions and issuing of signals for other units of the computer to execute them. It also acts as a switch board operator when several users access the computer simultaneously. Thereby it coordinates the activities of computer's peripheral equipment as they perform the input and output. Therefore, it is the manager of all operations mentioned in the previous section.

Central Processing Unit (CPU)

The ALU and the CU of a computer system are jointly known as the central processing unit. The term CPU relates to a specific chip or the processor. CPU may be considered as the brain of any computer system. It is just like brain that takes all major decisions, makes all sorts of calculations and directs different parts of the computer functions by activating and controlling the operations. The fundamental operation of most CPU is to execute a series of instructions called as a program. The different chip manufacturers use different measuring standards to measure the processor's speed. It depends on the circuit board that the chip is housed in, or the motherboard. The motherboard contains the circuitry and connections that allow the various components to communicate with each other.

The ALU and the CU of a computer system are jointly known as the central processing unit (CPU)

1.4.3 System Unit

A computer system unit contains many parts :

Ports and Connectors : A port is a connector located on the motherboard or on a separate adapter. Ports and Connectors allow the computer to communicate with different devices and peripherals attached with it.

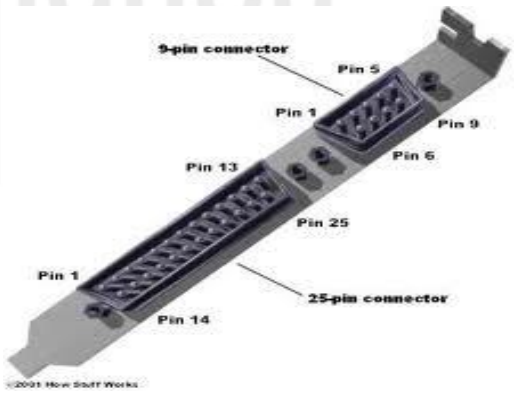


Figure 1.5 : Connector

Power Supply : Power supply changes normal household electricity into electricity that a computer can use. A power supply or power supply unit (PSU) is an internal component used to supply the power to the components of a computer. Power supply is rated by the number of watts it generates.

Figure 1.6: Power Supply

Motherboard : The motherboard is the main circuit board of a microcomputer. It is also known as the main board or system board. It is the circuit board in which all the components are connected through cable within a personal computer. Many devices are connected with motherboard directly or indirectly. Motherboards usually provide the interface between the CPU memory and input/output peripheral circuits, main memory, and facilities for initial setup of the computer immediately after power-on.

1.4.4 Von Neumann Architecture

Mathematician John Von Neumann conceived a computer architecture which forms the core of nearly every computer system in use today

Mathematician John Von Neumann conceived a computer architecture which forms the core of nearly every computer system in use today. This architecture is known as Von Neumann architecture. It is a design model for the modern computers which has central processing unit (CPU) and the concept of memory used for storing both data and instructions. This model implements the stored program concept in which the data and the instructions both are stored in the memory. All computers share the same basic architecture which have memory, an I/O system, arithmetic logic unit (ALU) and control unit (CU).

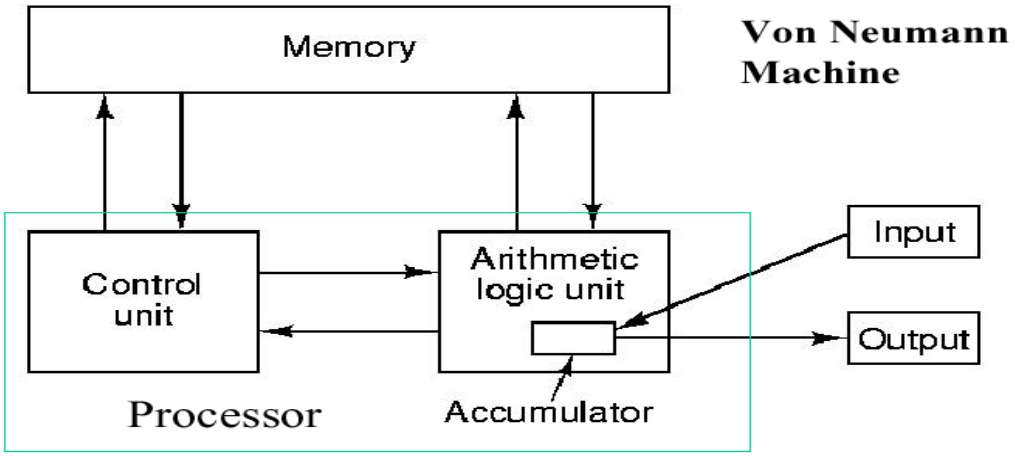


Figure 1.7 : Von Neumann architecture

1.4.5 Classification of Computers

Computers are available in different sizes, shapes, and weights. Due to these different sizes and shapes, they perform different sort of jobs from one another. They can be classified in different ways. All the computers are designed by qualified computer architects who design these machines as per different requirements. A computer that is used in a home differs in size and shape from the computer being used in a hospital. Following sections are going to describe different classifications of computers. The term "capacity" refers to the volume of work or the data processing capacity a computer can handle. Their performance is judged by the:

1. Amount of data that can be stored in memory
2. Speed of internal operation of the computer
3. Number and type of peripheral devices
4. Amount and type of software available for use with the computer

The capacity of early generation computers were determined by their physical size- the large the size, the greater the volume. In computer terms, size and speed of operation are at present proportionate to each other. Generally, though, recent, technology is tending to create smaller machines, making it possible to package equivalent speed and capacity in a smaller format.

Microcomputers: The mass production of silicon chips since 1971 has made it possible to put a "brain" into all sorts of machines. One such machine is the microcomputer. This machine has taken fullest advantage of the use of large-scale integration on silicon chips. The microprocessors literally contain a computer on a chip that can pass through the eye of needle. Microcomputers memories are generally made of semiconductors fabricated on silicon's chips. It is a digital computer system under the control of a stored program that uses a microprocessor, a programmable read-only memory (ROM), and a random-access memory (RAM). The ROM defines the instructions to be executed by the computer while RAM is the functional equivalent of computer memory. Today microcomputers are called as Personal Computers more commonly as PCs. These are small, relatively inexpensive computers designed for personal use in home or offices.

Minicomputers: Technological advances in the 1960's enabled manufactures to respond to the growing demand for a similar stand-alone machine, the minicomputer, to handle task that large computers could not perform economically. Minicomputer systems (or small mainframe computers) provide faster operating speeds and larger storage capacities than microcomputers systems. These Computers can support a large number of high-speed input/output devices. Several desk drives can be used to provide online access to large data files as required for direct - access processing. Operating system developed for minicomputer systems generally support both multiprogramming and virtual storage. This means that many programs can be run concurrently. This type of computer system is very flexible and can be improvised to meet the needs of users. Although the minicomputer is not as powerful as the medium or large-size computer, it is quite close.

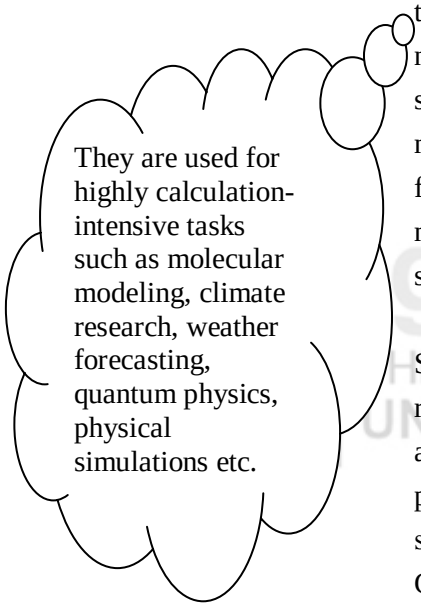
Medium-size Computers : It provides faster operating speeds and larger storage capabilities than small computer systems. These Computers can support a large number of high-speed input-output devices, and several disk drives can be used to provide online access processing. The possibility of increasing the data processing capability of a computer by adding devices, such additional memory, and other peripheral devices, is called expandability.

Large Computers : These Computers are the ultimate in flexibility and speed. These usually contain full control systems with minimal operator intervention. Large computer systems range from single-processing configurations to nationwide computer based networks involving general large computers. Large computers have internal operating speeds measured in terms of nanoseconds, as a compared to smaller computers where speed in terms of microseconds.

Mainframe Computers : Mainframes are huge, multi-user systems designed to process millions of instructions per second and capable of accessing billions of data. They can handle gigantic processing jobs in large corporations or government agencies. This computer is commonly used in big hospitals, air line reservations companies and many other huge companies prefer mainframe because of its capability of retrieving data on huge basis. Mainframe allows its user to maintain large information storage at a centralized location and be able to access and process this data from different computers located at different locations.

Mainframe computers are normally too expensive and out of reach from a salaried person who wants this computer for his home. Mainframe is the second largest in capability and size of computer family.

Supercomputers : The most expensive in price, biggest and fastest machines today are the supercomputers that are used when billions or even trillions of calculations are needed. Supercomputers are ultra fast computers designed to process huge amounts of scientific data then display the underlying patterns that have been discovered. These machines are essential for applications ranging from nuclear weapon to accurate weather forecasting. Super Computers are used for highly calculation-intensive tasks such as molecular modeling, climate research, weather forecasting, quantum physics, physical simulations etc.



Supercomputers are machines that have speed in the 100-million-instructions-per-second range. Governments specially use this type of computer for their different calculations and heavy duty. Different industries also use this huge computer for designing their products. It is also used for animation purpose. The PARAM supercomputer is one of the supercomputer developed by India's Center for Development of Advanced Computing(C-DAC) and promises processing speeds of up to 1 trillions instructions per second. Since October 2010, the Tianhe-1A supercomputer is considered as the fastest supercomputer in the world which is located in China. Some of the examples of Supercomputer are: IBM Blue Gene/L, IBM Roadrunner, Cray Jaguar etc.

1.4.6 Classification by Technology

There are essentially two different types of computer processing. Each is made possible by a different kind of circuitry, and each is suitable for different purposes.

Analog Computers: The name analog comes from the word "analogous", meaning similar. Analog signal is a continuous signal whose amplitude can take any value in a continuous range. It can have infinite number of values. Analog computers deal with quantities that are continuously variable. They give only approximate results. These types of computer provide an analog or simulation of the object or system it represents. It is especially useful for solving problems that involve relationships between variable quantities in systems that change with time. The analog compute may express changing relationships in output in the form of graphs. It is able to create such pictures because it responds to changes in electrical voltages that match changes in variable quantities.

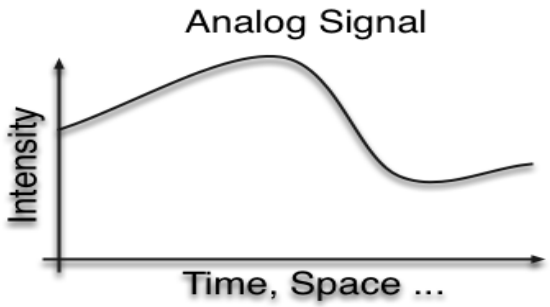


Figure 1.8: Analog Signal

Digital Computers : It is a machine that specializes in counting. It operates by counting values that are discrete, or separate and distinct, unlike the continuous quantities that can be measured by the analog computer. Digital signal is a discrete time signal that has a discrete number of levels. It can only assume one of the two values 0 or 1. While analog technology uses continuous signals, digital technology encodes the information into discrete signal states. Digital Computers are used for both business data processing and accuracy. The basic operation performed by a digital computer is addition. It can store the sums of addition problems as they accumulate, and can complete a single calculation in a fraction of a nanosecond. The digital computer is capable of storing data as long as needed, performing logical operations, editing input data, and printing out the results of its processing at high speed. Advantages of digital systems include flexible processing, easy to design, accuracy and precision, simple operation, easy data storage, less prone to noises etc.

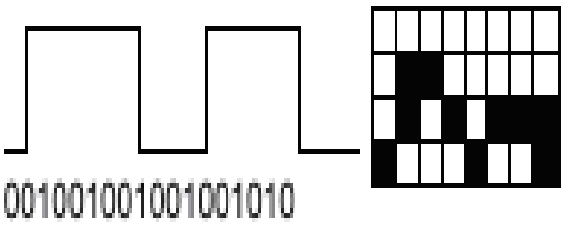


Figure 1.9: Digital Signal

Hybrid Computers: Although both analog and digital computers are extremely used and widely accepted in various industries, manufacturers have to attempt to design a computer that combines the best features of both types. This special-purpose machine called a hybrid computer which combines the measuring capabilities of the analog computer and the logical and control capabilities of the digital computer. It offers an efficient and economical method of working out special types of problems in science and various areas of engineering. Some Hybrid machines contain special equipment to convert analog voltages into digital voltages, and vice-versa.

☞ Check Your Progress 2

1) Distinguish between Microcomputer and Mainframe computer.

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2) What are the five basic operations performed by the computer?

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3) How can you classify computers according to technology?

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1.5 INTEGRATED CIRCUITS

Our world is full of integrated circuits (semiconductor devices with several transistors built into one physical component). It is an electronic circuit which involves thousands or millions of interconnected components like transistors, diodes and resistors. They are usually called ICs. We can find several of them in computers. For example, most people have probably heard about the microprocessor. The microprocessor is an integrated circuit that processes all information in the computer.

Figure 1.10: Chip

It keeps track of what keys are pressed and if the mouse has been moved. It counts numbers and runs programs, games and the operating system. The first integrated circuits (ICs) were based on small scale integration (SSI) circuits, which had around 10 devices per circuit (or 'chip'), and evolved to the use of medium-scale integrated (MSI) circuits, which had up to 100 devices per chip. Integrated circuits are also found in almost every modern electrical device such as cars, television sets, CD players, cellular phones, etc. The main benefits of ICs are lower costs, high reliability and smaller space requirements. But what is an integrated circuit and what is the history behind it?

1.5.1 Electronic Circuits

The integrated circuit is nothing more than a very advanced electric circuit. An electric circuit is made from different electrical components such as transistors, resistors, capacitors and diodes, which are connected to each other in different ways. It is an unbroken loop of conductive material that allows electrons to flow continuously. If a circuit is "broken", its conductive elements will no longer form a complete path and continuous electron flow cannot occur. The transistor acts like a switch. It can turn electricity on or off, or it can amplify current. It is used for example in computers to store information.

The resistor limits the flow of electricity and gives us the possibility to control the amount of current that is allowed to pass. For example resistors are used, among other things, to control the volume in television sets or radios.

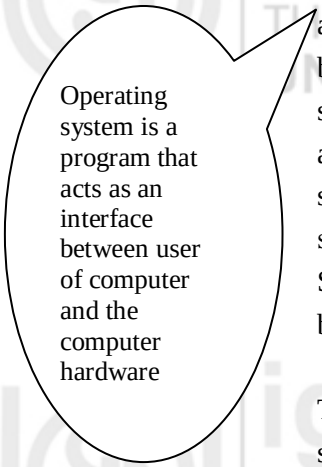
The capacitor collects electricity and releases it all in one quick burst. The diode stops electricity under some conditions and allows it to pass only when these conditions change. This is used in, for example, photocells where a light beam that is broken triggers the diode to stop electricity from flowing through it.

The flashlight is an example of electric circuits. It contains electrical energy (dry cells) as a source, a load (the bulb) which changes the electrical energy into light and a switch to control the energy delivered to the load.

1.5.2 The Transistor vs. the Vacuum Tube

The transistor is the most important one for the development of modern computers. Before the transistor, engineers had to use vacuum tubes. Just as the transistor, the vacuum tube can switch electricity on or off, or amplify a current. So why was the vacuum tube replaced by the transistor? There are several reasons.The vacuum tube looks and behaves very much like a light bulb; it generates a lot of heat and has a tendency to burn out. Also, compared to the transistor it is slow, big and bulky. When engineers tried to build complex circuits using the vacuum tube, they quickly became aware of its limitations. The first digital computer ENIAC, for example, was a huge monster that weighed over thirty tons, and consumed 200 kilowatts of electrical power. It had around 18,000 vacuum tubes that constantly burned out, making it very unreliable. When the transistor was invented in 1947 it was considered a revolution. Small, fast, reliable and effective, it quickly replaced the vacuum tube.

1.6 OPERATING SYSTEM



All computers need some sort of hardware platform to run the software; these platforms are called Operating System (OS). Operating system is a program that acts as an interface between user of computer and the computer hardware. The purpose of an operating system is to provide an environment in which user can execute program in a convenient and efficient manner. Operating system is an important part of almost every computer system. It manages all resources of computer system. Operating system is installed in secondary memory, while it's some part are stored permanently in read only memory. Some part of the operating system resides in random access memory and the computer begins to execute this part of the system.

The majority of modern home computers use some form of Microsoft's operating systems. The original Microsoft operating system was called DOS (Disk Operating System) though most computers use Windows. Windows comes in various versions beginning with version 3.x then 95, 98, XP and currently Windows 7. A few computers use IBM's O/S2. Apple's Mac use their own operating system beginning with OS 1 though most modern Macs use version 8.x or 9.x. Apple's latest version is OS 10.1.x. Some computer professionals, Internet Service Providers (ISP) and mainframe computer users use an operating system such as UNIX, Windows NT or 2000 or server based operating systems. The operating system controls the input and output or directs the flow of information to and from the CPU. Much of this is done automatically by the system. In short, we can say that an Operating System is one of the most important components of the computer software which is essential to operate a computer. When computer is turned on, it first needs to load the operating system sometimes referred to a booting up. It checks all its components and will usually display a message if there is a problem. It is also known as Power on Self Test (POST). Loading the system is usually automatic. Once the system is loaded, the user can start the application or program that he/she going to use.

1.7 CURRENT APPLICATIONS OF COMPUTER

Some major applications of Computers are given below :

Banking : When there was no computer, every where manual system was followed which was a very complicated and hard work but now with the arrival of computer, every thing has become much more systematic and easy to use. Every bank is now using a computerized system because it is very fast and user friendly. Personal Computer banking lets us view our bank balance, request transfers between accounts and pay bills electronically. Now-a-days, online banking is getting very popular which offers more convenience and ease to the customers.

Traffic Light Control : In traffic light control, the computer is being employed to orchestrate the traffic light. There are some programmed codes like turn off/on the red light which control the traffic light and also to carry out other instructions.

Sports : Computers have revolutionized the sports industry. Computer is used to maintain player records, track scores, create virtual playing field etc. The sports equipment industry also relies heavily on computer-aided design (CAD).In sports, computers are used in conjunction with video cameras. These are used to record the motion of all the sports men. 3D programs are used to help the trainers see their movements and could improve their styles of playing. Online games allow us to play with other people regardless of their physical locations.

Schools and Colleges : There are many uses of computer in schools and colleges e.g. every students details need to be stored so a computer program comes to help in. Multimedia, animations, graphics and charts could be used to teach the students and many boring topics can be made interesting using multimedia. Students could access internet for online help and courses for more information. Computers are used in a variety of ways in the educational field. Computers can be used in school management such as budget, inventory, student records, communications, library circulation, and library public access catalog.

Learning and Instruction : Computer applications can be used in education for learning and for instruction. Instruction and learning can be divided into two major areas, teacher-centered instruction and student-centered learning. Teacher-centered instruction examined the computer as the object of instruction as well as a tool of instruction and the management of instruction. With the advancement in the Technology and Internet, Online Education, e-learning, m-learning are getting very popular which offers more flexibility and convenience to the learners.

Student-centered learning views the computer as a tool for the student to use and create access, retrieve, manipulate, and transmit information in order to solve a problem. Understanding the concept of the computer as an information tool relies on accepting the fact that the computer is a productivity tool for the student and the teacher alike.

Educational Research : Computers are used widely in all educational research. Educational research includes functions relating to information gathering and processing. The teacher/researcher may examine student performance data in new and revealing ways. Bibliographic citations of studies performed by educators around the world can be acquired and perused by the desktop computer.

Entertainment : Computers and Internet are a major source of entertainment. It is one of the latest forms of entertainment for the modern society. It allows us to play computer games, listen to music, watch videos and movies etc.

Agriculture : Computer usage among agronomists and farmers has risen rapidly in the recent times. With the flow of information becoming faster and easier, the agricultural sector is also getting benefited from computer. Computer allows the farmer to collect adequate information related to prices, latest farming techniques, weather conditions, cultivation of crops, farm machineries etc. which enhances the decision making capability of the farmers.

Health Care Management and Hospital : Today almost every hospital is computerized and utilizing the benefits of computer. Many computer applications, such as patient information system, monitoring and control system and diagnostic systems have been used to enhance health care. Hospital Information System (HIS) allows to manage the administrative, financial and clinical aspects of a Hospital more easily. It also allows easy access to patient data from a centralized database which helps the doctor in retrieving the history of all the patients. Computers are also being used in medical diagnosis and surgery.

Some of the other applications include Transport Management, Weather forecasting, Industries etc.

1.8 LIMITATIONS OF A COMPUTER

The computer can outperform human beings in speed, memory and accuracy but still the computer has limitations. Following are the limitations of computer.

Programmed and Supervised by Human : Though computer is programmed to work efficiently, fast and accurately but it is programmed by human beings to do so. Without a program, computer is nothing. Computer only follows these instructions. If the instructions are not accurate the working of computer will not accurate. Without supervision, computers will operate poorly when dealing with unexpected circumstances, such as information or instructions that are incorrect or incomplete.

No Intelligence : Although computers are faster, more diligent, accurate and versatile than human beings, it cannot replace them. Unlike human beings, computers do not have any intelligence. Its performance is depends on instructions given to it. It cannot carry any task at its own and can't take any decision on its own.

Self Care : Computer can not care for itself like a human. A computer is dependent still to human beings for this purpose.

Emotionless : Computers are emotionless. They do not have emotion and feelings. A computer can not feel about something like a human. A computer can not compete human in respect of relations. Computers are simply machines which work as per the instruction given to them.

Thinking : Computer can not think itself. The concept of artificial intelligence shows that the computer can think. But still this concept is dependent on set of instructions provided by the human beings.

Retrieval of Memory : Computer can retrieve data very fast but this technique is linear. A human being's mind does not follow this rule. A human mind can think randomly which a computer machine can not.

1.9 SUMMARY

Computer is an electronic device that performs mathematical and non-mathematical operations in order to achieve the results. Its' first generation used the vacuum tube. The second generation used the transistors which were much smaller than vacuum tube. Integrated circuits were used in third generations. VLSI comes in fourth generation computer and now fifth generation growing towards parallel computing. The operating system is an important component of modern computer. The two main objectives of operating system are controlling the computer's hardware and providing an interactive interface between the user and machine. Computer have enters almost in every field of human life and found applications in various fields like medicine and health care, business, science, technology, engineering, entertainment etc.

1.10 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1) A computer is an electronic device, which is used to accept, store, retrieve and process the data at faster speed and with greater accuracy. It is also called as data processor because it is mainly used for processing the input data given to it and producing the desired result.

2) Evolution of computer can be divided into five generations: First Generation (Vacuum tubes), Second Generation (Transistors), Third Generation (ICs), Fourth Generation (Microprocessor), Fifth Generation (Artificial intelligence).

Check Your Progress 2

1) **Microcomputer** is at the lowest end of the computer range in terms of speed and storage capacity. Its CPU is a microprocessor. The first microcomputers were built of 8-bit microprocessor chips. The most common application of personal computers (PC) is in this category. The PC supports a number of input and output devices. An improvement of 8-bit chip is 16-bit and 32-bit chips. Examples of microcomputer are IBM PC, PC-AT.

   Mainframes computers are generally 32-bit microprocessors. They operate at very high speed, have very large storage capacity and can handle the work load of many users. They are generally used in centralized databases. They are also used as controlling nodes in Wide Area Networks (WAN). Example of mainframes are DEC, ICL and IBM 3000 series.

2) The five basic operations that a computer performs are accepting data as **input**, **storage** of these data, **processing** of data, **outputting** the information and **process control**.

3) As per technology variations computers can be classified into analog, digital and hybrid computers.

1.11 FURTHER READINGS

P. K. Sinha , *Computer Fundamental* (BPB Publication).

V. Rajaraman, *Computer Fundamental* (PHI Publication).

D. P. Sharma, *Fundamentals of Computer, IT & Programming with "C"* (CBC Publication).

Web link:

- www.wikipedia.org