UNIT – 1 COMPUTER BASICS

STRUCTURE

1.0 OBJECTIVES

After studying this unit, you will be able to:

- Learn the concept of a system in general and the computer system in specific.
- Learn and understand how the computers have evolved dramatically within a very short span, from very huge machines of the past, to very compact designs of the present with tremendous advances in technology.
- Understand the general classifications of computers.
- Study computer applications.
- Understand the typical characteristics of computers which are speed, accuracy, efficiency, storage capacity, versatility.
- Understand limitations of the computer.
- Discuss the similarities and differences between the human and the computer.
- Understand the Component of the computer

1.1 INTRODUCTION

Today, almost all of us in the world make use of computers in one way or the other. It finds applications in various fields of engineering, medicine, commercial, research and others. Not only in these sophisticated areas, but also in our daily lives, computers have become indispensable. They are present everywhere, in all the dev ices that we use daily like cars, games, washing machines, microwaves etc. and in day to day computations like banking, reservations, electronic mails, internet and many more.

The word **computer** is derived from the word **compute.** Compute means to calculate. The computer was originally defined as a super fast calculator. It had the capacity to solve complex arithmetic and scientific problems at very high speed. But nowadays in addition to handling complex arithmetic computations, computers perform many other tasks like accepting, sorting, selecting, moving, comparing various types of information. They also perform arithmetic and logical operations on alphabetic, numeric and other types of information. This information provided by the user to the computer is **data.** The information in one form which is presented to the computer is the input information or **input data.**

Information in another form is presented by the computer after performing a process on it. This information is the output information or **output data.**

The set of instructions given to the computer to perform various operations is called as the **computer program.** The process of converting the input data into the required output form with the help of the computer program is called as **data processing.** The computers are therefore also referred to as data processors

Therefore a computer can now be defined as a fast and accurate data processing system that accepts data, performs various operations on the data, has the capability to store the data and produce the results on the basis of detailed step by step instructions given to it..

The terms **hardware and software** are almost always used in connection with the computer.

- **The Hardware:**

The hardware is the machinery itself. It is made up of the physical

parts or devices of the computer system like the electronic Integrated Circuits (ICs), magnetic storage media and other mechanical devices like input devices, output devices etc. All these various hardware are linked together to form an effective functional unit. The various types of

hardware used in the computers, has evolved from vacuum tubes of the first generation to Ultra Large Scale Integrated Circuits of the present generation.

- **The Software:**

The computer hardware itself is not capable of doing anything on its own. It has to be given explicit instructions to perform the specific task. The computer program is the one which controls the processing activities of the computer. The computer thus functions according to the instructions written in the program. Software mainly consists of these computer programs, procedures and other documentation used in the operation of a computer system. Software is a collection of programs which utilize and enhance the capability of the hardware

1.2 EVOLUTION OF COMPUTERS

The computers of today are vastly different in appearance and performance as compared to the computers of earlier days. But where did this technology come from and Where is it heading? To fully understand the impact of computers on today's world and the promises they hold for the future, it is important to understand the evolution of computers.

Electronic data processing doesn't go back more than just half a century. It has been in existence barely since early there 1940's. The very first modern electronic computer became operational only in early the 1940's. In fact, it's only a little more than five decades ago since the first modern electronic computer was brought into existence for the purpose of business data processing. Computers before that were used only in scientific and technological fields.

Although the present modern electronic computers are very recent, the idea was conceived far back. A brief outline of human history shows some interesting facts. In the early days when our ancestors used to live in caves, counting was a problem. They could, of course, count on their fingers, but gradually it started becoming difficult. As the belongings and possessions increased, the need for more counting tools grew. It was not possible to have more than 20 fingers (ten on hands and ten on feet). The record keeping system switched over to counting on a number of stones and scribbling on the walls of their caves. The inconvenience of being restricted to stones and walls forced them to look out for some other counting devices. In the mid-seventh century, adding tools and devices started being developed across the world. Thus we can say that the idea of

computing is as old as civilization itself. It is very important to learn how people attempted to create early computers as they played a very important role in reaching this stage.

When people started using stones to count their animals or their possessions, they never knew that this would lead to the computer of today.

People started following a set of procedures to perform calculations with these stones, which later led to the creation of a digital counting device, which could be thought of as the predecessor of a computer.

1450 B.C. Abacus (China)

The abacus is the first known calculating device. It was invented by the Chinese and is still widely used in the Far East for commercial calculations. In its primitive form, it consists of a wooden frame with a number of wires with beads strung through them. The beads are used for counting and calculations. To show a number, beads are pulled down so that each rod represents a digit.

1600 Napier "Bones"

This is another counting device invented by John Napier, a Scottish mathematician. The "bones" were strips of ivory with numbers written on them. When the bones were arranged properly, the user could read the numbers in adjacent columns to get the answer of a multiplication operation.

Between the 16^{th} and 19^{th} centuries, Europeans contributed their bit by inventing several machines that used existing technologies like clockwise gears and levers.

1642 A.D. Adding Machines (Blaise Pascal)

The well known French scientist and mathematician, Blaise Pascal invented the first machine, which could add and carry digits automatically. He was only nineteen years old at that time. His machine was so revolutionary that the principle behind it is still used in most of the mechanical counters being used today. He became a great philosopher and mathematician in Europe. His father was a tax commissioner and he used to accompany his father to his office. There he felt the need for an automatic calculating device, which could save people like his father from that boring and tedious job of doing sums over and again. He came out with a machine "Pascaline" that worked with clockwise gears and levers. The machine was basically developed to perform addition and subtraction operations only. The machine rotated wheels to register values and the lever was used to perform the carrying operations from one wheel to another. Although the machine was not accepted by business, it, however,

initiated a series of inventions. To give honor to Pascal, a computer programming language was named after him.

Thislanguage, Pascal, is generally used to teach programming to budding programmers.

1692 A.D. Multiplying Machine (Gottfried Leibnitz)

Gottfried Leibnitz improved upon Pascal's machine and introduced a mechanism to carry out automatic multiplication of numbers. Leibnitz is best known for his work with Sir Isaac Newton in developing a branch of mathematics known as calculus. The calculator invented by him could add, subtract, multiply and divide accurately. It could even perform the square root function, although not always accurately.

1804 A.D. Jacquard Loom (Joseph Marie Jacquard)

In the early nineteenth century, a French weaver, Joseph Marie Jacquard developed a programmable loom, which used large cards and holes punched in them to control the pattern automatically. The output was a thick rich cloth with repetitive floral or geometric patterns.

Jacquard patterns are still produced to this day. Others adapted the punched cards and used them as the primary form of input. They were used till about 20-25 years ago.

1822 A.D. Difference Engine (Charles Babbage)

Since the early 19th Century, Charles Babbage, an Englishman, had been working on the development of a machine, which could perform complex calculations. In 1822 A.D., he invented the 'Difference Engine', which could perform complex calculations and print them out as well. This machine was a steam–powered machine. While Babbage was working on his doctorate, he had to solve many complex formulae and he found it difficult to cope up with them in the given time period. This led him to the invention.

1862 "Arithrometer" (Charles Xavier Thomas)

This was the first calculator with commercial prospects. Frenchman Charles Xavier Thomas (a.k.a. Charles of Colmar) developed it. He won a gold medal at the International Exhibition in London. The machine performed addition, subtraction, multiplication, division and square root functions accurately.

1863 A.D. Analytic Engine (Charles Babbage)

Babbage had been working on a very elaborate machine all this time. By 1863 he had all the plans ready for the machine, which he named the Analytic Engine. He had conceived of a mechanism, which could carry

out long sequence of complex calculations under automatic control. It would have the ability to store 1000, 50-digit numbers in one second and multiply 20-digit numbers in three minutes.

Babbage used a form of the punched card for inputting the data. That would have been a complete modern computer.

However, technology at that time was not advanced enough to provide him with the hardware he required. He was thinking too far ahead of his time and his ideas could not be implemented. However, he was the first person to conceive the "Stored Program" concept.

Babbage worked on his plans for years. He was accompanied by Augusta Ada Byron (daughter of the famous poet Lord Byron) herself a brilliant mathematician, whose contribution to Babbage's work is tremendous. She is regarded as the first female computer scientist and programmer. A computer programming language, Ada has been named in her honor.

Charles Babbage is recognized as "The Father of Computers". Although his plans could not be materialized and his analytical engine could not be completed in his life span a working analytical engine was finally developed from his plans in the year 1991, and is on display at the Charles Babbage Institute at Minnesota.

1896 A.D. Punch Card Machine (Dr Hermann Hollerith)

Dr Hollerith is also a great figure in the history of computers. Dr Hollerith used the idea of employing punched cards in speeding up the collation job of the American Census of 1880 (The US Constitution calls for a census of the population after every ten years so as to determine the representation in the US House of representatives). He devised a card in which holes would be punched to indicate the presence of a particular criterion in a respondent. Using wire brushes in his machine the hole punched earlier in the card, enabled a wire to touch a metal plate, which carried an electric charge. The charge was transmitted to respective electric counters which automatically incremented the numbers. After the census was completed, Hollerith perfected his punched card equipment and marketed it. He founded the Tabulating Machine Company in 1896 to continue his work. Although the machines were in great demand Hollerith was not happy as he could not pursue his research work. In 1911 the Tabulating Machine Company merged with other two companies to form the Computing Tabulating Recording Company. Then Hollerith again started concentrating on inventing better equipment.

One of the partners, the marketing expert named Thomas Watson Sr., led the new company. Under his guidance, the company wrote great success stories. Finally in 1924, the management decided on a new name for the

company and the Computing Tabulating Recording Company got converted into the International Business Machines Corporation (IBM).

His idea has been refined and improved further. Punched cards are still used for recording data items to be input to computers. During the Second World War, an acute need for fast calculating machines was felt to carry out complex defense calculations. The British and the American Governments sponsored a number of projects in major Universities for the development of fast and accurate calculators and computers. This proved to be a boon for the industry which has never looked back since then.

EARLY ELECTRONIC COMPUTERS

1930 Turing Machine

Alan Turing, an English mathematician, wrote a paper describing the capabilities and limitations of a hypothetical general - purpose computing machine called the "Turing Machine" in the late 1930's. Turing also helped in constructing Robinson (the British Computer used during the World War II) to decode German messages that were encrypted by the German Enigma machine. In the year 1950, Turing also published a book titled "Computer Machinery and Intelligence", in which he proposed the Turing test of Artificial Intelligence. That test is still used by scientists. Turing test basically explains that a computer is capable of "interacting" with its user.

1939 John Atanasoff's ABC (Atanasoff Berry Computer)

Professor John Atanasoff is remembered because of his contribution of some concepts which led to the development of electronic computers. He, along with a graduate student Clifford Berry, built an electronic calculating machine that could solve the problems of equations. ABC was the first special-purpose, electronic computer.

1940 A.D. Mark-I (University of Pennsylvania – USA)

A group of scientists devised the Mark-I, which was the first electromechanical calculator in the world. It utilized the punch card concepts of Hollerith and functioned by a series of electromagnetic relays and mechanical arithmetic counters.

During World War II American Military asked Dr John Mauchy of the University of Pennsylvania to develop a machine, which could quickly calculate the trajectories for missiles. A graduated student, Presper Eckert, helped him in building the device. It is another thing that the computer could not be completed until two months after the war ended.

1943 A.D. ENIAC (Harvard University – USA)

Following closely on the heels of Mark-I, scientists of Harvard University brought out the Electronic Numerical Integrator and Calculator (ENIAC), which was the first electronic computer. It weighed nearly 5 tons and occupied space equivalent to 2 big rooms and could perform all the calculations that a small pocket calculator of today can perform. It used vacuum tubes and was able to do 300 multiplications per second.

This was faster than Mark-I but the major problem of using this computer was that the staff had to rewire the machine completely for carrying out the new instructions.

1944 Mark-II (Dr Howard Aiken)

Dr Howard Aiken, who read the notes of Ada Byron, was keenly interested in constructing an "Analytical Engine". He approached IBM. In spite of doing very well with punched card equipments, IBM hired Aiken and allocated $1 million for the research. Aiken, with his team members, came out with Mark-II. Mark-II was partly electronic and partly mechanical. It was bulky, 8 feet high and 55 feet long. It took 3 to 5 seconds to perform a single multiplication operation.

1947 A.D. EDSAC (Cambridge University–England)

Electronic Delayed Storage and Calculation was the name given to the first electronic computer in the world. It was the first one to implement the 'stored program concept'. Known later as the 'Von Neumann Concept', it proposed the use of binary numbers and the internal storage of instructions in digital form.

1951 A.D. Univac-I (USA)

By now a number of commercial companies were working on the development of computing systems. Sperry Rand Corporation of USA introduced the first commercial computer to the world and named it UNIVAC-I. Its introduction was followed by the entrance of the IBM into the computer field with IBM-701 Computer.

1.3 CHARACTERISTICS OF COMPUTERS

A few notable features of computers are:

Speed

The computer was initially invented as a very high-speed calculator. It helped in completing many scientific projects that were previously impossible. The landing on the moon would not have been possible if

computers had not been there, neither would we today take an umbrella, if saw a clear sky, if the weather, forecast did not tell us that it would rain in the afternoon. We would have taken a lot of time in making the arrangements for flying abroad if computers were not there to book our seats so easily and fast. The ability to get the answers fast enough so that one has time to take an action on them (to make alternative arrangements in case of reservations) makes real time computing possible. Electrical pulses travel at incredible speed and a computer, an electronic machine, works on electrical pulses, so its speed is virtually instantaneous.

When talking about the speed of computers, we don't talk in seconds or microseconds but in nanoseconds (10^{-9} seconds) or even Pico seconds (10^{-17} seconds). You can very well imagine the speed of computer by the fact that a computer can add two 18-digit numbers in 300 to 400 nanoseconds: that means that it can do about 3 million such calculations per second.

Storage

The human mind acquires some knowledge and after it has used it, it might keep it in its subconscious mind or might even forget it after some time. But computers can store massive amounts of information. This information can be used and reused time and again for years (unless something goes wrong with the hardware). Today's computers have disks with a capacity of storing billions of characters. This is big enough to store the complete Britannica thesaurus, dozens of computer programs or the applications, thousands of songs, huge databases, all the projects we have ever done in our life and much more.

Accuracy

Computers are very accurate. They do make mistakes, but seldom. This is because of their physical circuit. They make mistakes because of faulty programs, some mistake made while feeding in the data or poor designing. Highly efficient error detecting techniques of computers prevent showing false results.

Versatility

Computers are capable of performing any type of task, provided the activity can be put into logical steps. It can be used from cooking (microwave oven) to spending a night on the moon (through satellites). In today's world it is difficult to imagine even a single field which is untouched by computer invasion.

Automation

A computer is much more than just a calculator in which we need to give the instructions at every step. It is an intelligent device and, if programmed

for an activity, it keeps doing it till it finishes, without any human intervention.

Diligence

A computer, being a machine, does not show any signs of fatigue, tiredness, lack of concentration, or loss in interest. The speed, accuracy and the quality would be absolutely the same in the first and the last calculation, even if the computer does millions of calculations. It won't complain even once of boredom. Thus, it is best suited for monotonous and voluminous work although that may seem like a threat to the people who are working on the same kind of jobs.

Reliability

All the above qualities of computers make them reliable and also make us too dependent on them. They can be run for years and years without any loss of data or facing any other problem.

Although computers can potentially solve all the problems when instructed appropriately, they are not creative. They are designed and run by humans only. They might make an exact copy of Picaso's paintings but actually can not give the world their original creations. They might print out countless copies of Shakespeare's Hamlet but can never write anything on their own. They might replicate the Taj Mahal but will never be able to produce architecture like that on their own. And we must be happy about that as we humans still are superior to computers.

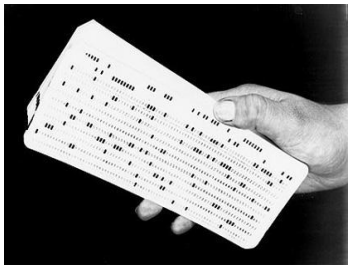
1.4 COMPUTER GENERATIONS

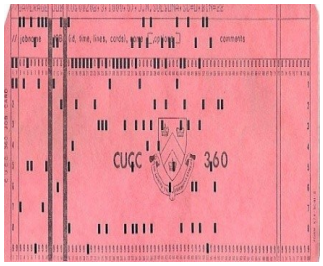
1.4.1 The First Generation:

The first generation computers made use of:

- Vacuum tube technology,
- Punched cards for data input,
- Punched cards and paper tape for output,
- Machine Language for writing programs,
- Magnetic tapes and drums for external storage.

The computers of the first generation were very bulky and emitted large amount of heat which required air conditioning. They were large in size and cumbersome to handle. They had to be manually assembled and had limited commercial use. The concept of operating systems was not known at that time. Each computer had a different binary coded program called a machine language that told it how to operate.

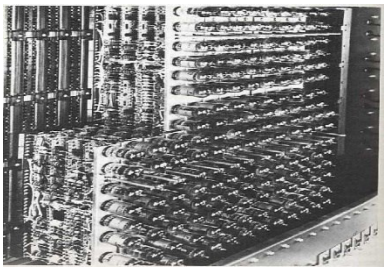


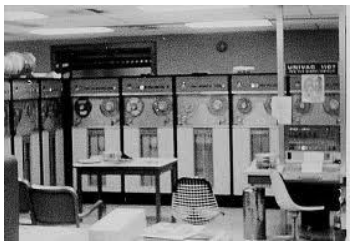


Punched cards ***Paper tape*** ***Vacuum tube***

Fig. 1.1 The first Generation Computer technology

The **Abacus,** which emerged about 5000 years ago in Asia Minor and is still in use today, allows users to make computations using a system of sliding beads arranged on a rack. Early merchants used Abacus to keep trading transactions.





Pascaline

Abacus

Fig. 1.2 the first Generation Computers

Blaise Pascal, a French mathematician invented the first mechanical machine, a rectangular brass box, called **Pascaline** which could perform addition and subtraction on whole numbers. This was in the seventeenth century. **Colmar,** a Frenchman invented a machine that could perform the four basic arithmetic functions of addition, subtraction, multiplication and division. Colmar's mechanical calculator, "**Arithmometer",** presented a more practical approach to computing. With its enhanced versatility, the "Arithmometer" was widely used until the First World War, although later inventors refined Colmar's calculator, together with fellow inventors, Pascal and Leibniz, he helped define the age of mechanical computation.

Charles Babbage a British mathematician at Cambridge University invented the first **analytical engine or difference engine.** This machine could be programmed by instructions coded on punch cards and had mechanical memory to store the results. For his contributions in this field **Charles Babbage** is known as **'the father of modern digital computer.**

Some of the early computers included: Mark I –

This was the first fully automatic calculating machine. It was designed by Howard Aiken of Harvard University in collaboration with IBM. This machine was an electronic relay computer. Electromagnetic signals were used for the movement of mechanical parts. Mark I could perform the basic arithmetic and complex equations. Although this machine was extremely reliable, it was very slow (it took about 3-5 seconds per calculation) and was complex in design and large in size.

Atanasoff-Berry Computer (ABC) –

This computer developed by John Atanasoff and Clifford Berry was the world's first general purpose electronic digital computer. It made use of vacuum tubes for internal logic and capacitors for storage.

ENIAC (Electronic Numeric Integrator and Calculator) –

The first all electronic computer was produced by a partnership between the US Government and the University of Pennsylvania. It was built using 18,000 vacuum tubes, 70,000 resistors and 1,500 relays and consumed 160 kilowatts of electrical power. The ENIAC computed at speed about thousand times faster than Mark I. However, it could store and manipulate only a limited amount of data. Program modifications and detecting errors were also difficult.

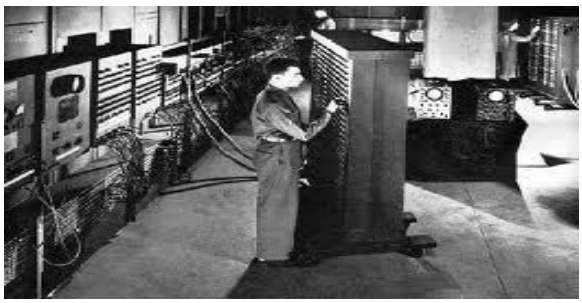


Fig. 1.3 ENIAC

EDVAC –

In the mid 1940's Dr. John von Neumann designed the **Electronic Discrete Variable Automatic Computer** with a memory to store both program and data. This was the first machine which used the stored program concept. It had five distinct units - arithmetic, central control, memory, input and output. The key element was the central control. All the functions of the computer were co-ordinate through this single source, the central control. The programming of the computers was done in machine language **UNIVAC • I** –

Remington Rand designed this computer specifically for business data processing applications. The **Universal Automatic Computer** was the first general purpose commercially available computer.

Fig 1.4 UNIVAC

1.1.1. The Second Generation:

In the second generation computers:

- Vacuum tube technology was replaced by transistorized technology,
- Size of the computers started reducing,
- Assembly language started being used in place of machine language,
- Concept of **stored program** emerged,
- High level languages were invented.

This was the generation of **Transistorized Computers.** Vacuum tubes were replaced by transistors. As a result, the size of the machines started shrinking. These computers were smaller, faster, more reliable and more energy efficient. The first transistorized computer was TX-0. The first large scale machines that took advantage of the transistor technology were the early supercomputers, Stretch by IBM and LARC by Sperry Rand. These machines were mainly developed for atomic energy laboratories. Typical computers of the second generation were the IBM 1400 and 7000 series, Honeywell 200 and General Electric.

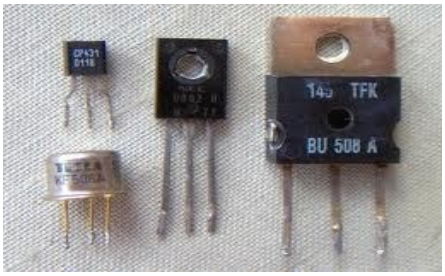


Fig 1.5 Transistors

IBM 1401 was universally accepted throughout the industry and most large businesses routinely processed financial information using second generation computers. The machine language was replaced by assembly language. Thus the long and difficult binary code was replaced with abbreviated programming code which was relatively easy to understand.

The stored program concept and programming languages gave the computers flexi bility to finally be cost effective and productive for business use. The **stored program** concept implied that the instructions to run a computer for a specific task were held inside the computer's memory and could quickly be modified or replaced by a different set of instructions for a different function. High level languages like COBOL, FORTRAN and AL- GOL were dev eloped. Computers started finding vast and varied applications. The entire software industry began with the second generation computers.

1.1.2. The Third Generation:

The third generation computers were characterized by:

- Use of Integrated circuits,
- Phenomenal increase in computation speed,
- Substantial reduction in size and power consumption of the machines,
- Use of magnetic tapes and drums for external storage,
- Design-of Operating systems and new higher level languages,
- Commercial production of computers.

This generation was characterized by the invention of **Integrated Circuits (ICs).**

The 1C combined electronic components onto a small chip which was made from quartz.

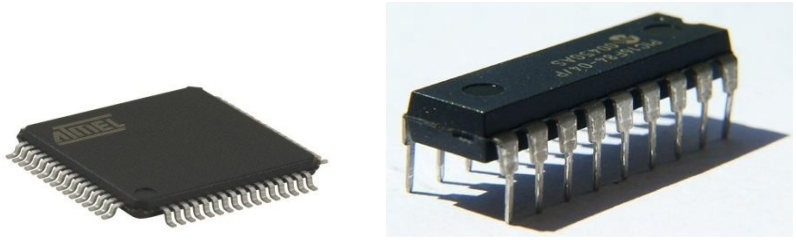


Fig 1.6 i) Integrated Circuit ii) Integrated Circuit

Later, even more components were fitted onto a single chip, called a **semiconductor.** This reduced the size even further. The weight and power consumption of computers decreased and the speed increased tremendously. Heavy emphasis was given to the development of software. Operating systems were designed which allowed the machine to run many

different programs at once. A central program monitored and co-ordinate the computer s memory. Multiprogramming was made possible, whereby the machine could perform several jobs at the same time. Computers achieved speeds of executing millions of instructions per second. Commercial production became easier and cheaper.

Higher level languages like Pascal and Report Program Generator (RPG) were introduced and applications oriented languages like FORTRAN, COBOL, and PL/1 were developed.

1.1.3. The Fourth Generation:

The general features of the fourth generation computers were:

- Use of Very Large Scale Integration,
- Invention of microcomputers,
- Introduction of Personal Computers,
- Networking,
- Fourth Generation Languages.

The decade of 1970's marked the beginning of a new generation of computers, produced by computer giants like IBM, ICL, NCR and Burrough. From the design viewpoint, the new generation provided increased input-output capability, longer component-life as well as greater system reliability. From the functional viewpoint, new powerful languages were developed to broaden the use of multi-programming and multi-processing, which brought about a major shift from batch processing to online processing as well as remote interactive processing.

The development of the microprocessor chip, which contains an entire Central Processing Unit (CPU) on a single silicon chip led to the mushrooming growth of inexpensive computers. Microprocessors are not computers by themselves but they can perform all the functions of arithmetic logic and control units of the CPU. When these microprocessors are connected with memory and input-output devices, they become microcomputers. Semi-conductor memories are also very small and very cheap. There are several types of memory chips. Three of the most commonly used are:

(i) Random Access Memory (RAM), in which data can be read or written corresponding to the main memory of the conventional computer

(ii) Read Only Memory (ROM) and

(iii) Programmable Read Only Memory (PROM).

In ROM chips, the data is 'burnt' into the chip at the time of manufacturing. It cannot be changed after that. These chips are used in systems where the data need not be changed. Even when power supply fails, the data remains in the memory. In case of PROM a user can program and even correct the data if necessary. The fourth generation of computers may be called the microcomputer generation.

The input-output devices used with the fourth generation computers are quite advanced. Among the advanced input-output devices employed in fourth generation computers are optical readers, by which whole documents can be fed into the computer; audio response terminals, by which an operator can vocally introduce data or instructions; and graphic display terminals, by which an operator can feed pictures into the computer.

The use of Very Large Integrated Circuits (VLIC) has made the fourth generation (micro)computers very compact, much less expensive, faster, more reliable and with a much greater data processing capacity than equivalent third generation computers.

Fig. 1.7 VLSI

The third generation computers made use of 'Integrated Circuits that had 10- 20 components on each chip, this was **Small Scale Integration (SSI).**

The Fourth Generation realized **Large Scale Integration (LSI)** which could fit hundreds of components on one chip and **Very Large Scale integration (VLSI)** which squeezed thousand of components on one chip. The Intel 4004 chip, located all the components of a computer (central processing unit, memory, input and output controls) on a single chip and microcomputers were introduced. Higher capacity storage media like magnetic disks were developed. Fourth generation languages emerged and applications software's started becoming popular.

Computer production became inexpensive and the era of Personal Computers (PCs) commenced. In 1981, IBM introduced its personal computer for use in office, home and schools. In direct competition, the Macintosh was introduced by Apple in 1984. Shared interactive systems and user friendly environments were the features of these computers.

As the computers started becoming more and more powerful, they could be linked together or networked to share not only data but also memory space and software. The networks could reach enormous proportions with local area networks. A global web of computer circuitry, the Internet, links the computers worldwide into a single network of information.

1.1.4. The Fifth Generation:

Defining the fifth generation computers is somewhat difficult because the field is still in its infancy. The computers of tomorrow would be characterized by Artificial Intelligence (At). An example of Al is Expert Systems. Computers could be developed which could think and reason in much the same way as humans. Computers would be able to accept spoken words as input (voice recognition).

Till the fourth generation of computers, the major stress was on improving the hardware

- from valves to transistors and then to integrated circuits - which resulted in the miniaturization and fast speed of computers. However, lack of thinking power in it forced the scientists to work further towards the fifth generation computers. The concept of “Artificial Intelligence” is being used in these computers and the Japanese call them “Knowledge Processors”. Automatic programming, computational logic, pattern recognition and control of robots (robotics), the processes needing skill and intelligence are examples of Artificial Intelligence. These computers, when developed, will be able to execute billions of instructions per second and will have unimaginable storage capacities. The present day high level languages will become obsolete on these machines and new computer languages and related software will be needed.

The fifth generation gives the highest priority to making systems that are easy and natural to use. Other objectives relate to the types of technological support needed to support “problem solving systems” according to the fifth generation committee. “In these systems”, the Committee adds, "Intelligence will be greatly improved to approach that of a human being. When compared to conventional systems, the man–machine interface will be closer to that of human behavior.”

Many advances in the science of computer design and technology are coming together to enable the creation of fifth generation computers. Two such advances are **parallel processing** where many CPUs work as one and advance in **superconductor technology** which allows the flow of electricity with little or no resistance, greatly improving the speed of information flow

1.5 CLASSIFICATION OF COMPUTERS

There is a computer in the car you drive. There could be a PC on your desk or yourstudy table at home. The weather report you get daily also involves computer, but all of them do not fall into the same category. They are different in terms of hardware, software, built, purpose and everything.

Initially computers were classified on the basis of their size, speed and cost, but now there are many more attributes attached to them.

Each and every computer must fall into one of the four categories described below:

1. Supercomputer
2. Mainframe computer
3. Minicomputer
4. Microcomputer

Whereas supercomputers are the most powerful and the largest, microcomputers are the smallest ones. Supercomputers are the most powerful computer available today. It is another thing that a microcomputer of the 21st century might be as powerful as of the

supercomputer of yore. Today technology is developing so fast that it has become

difficult to predict anything for the future.

Although all the above – mentioned (four) types of computers have been around for quite some time, the capabilities of each type have changed tremendously.

Supercomputers are highly sophisticated computers used for very special tasks like scientific researches, etc. Mainframes are large and expensive and are designed to meet the needs of a large organization. Minicomputers, although smaller than mainframes, are still big enough to cater to a medium sized organization or a small-scale business. PCs or microcomputers cater solely to individuals. Microcomputers could be PCs

or desktops or laptops or even notebooks. The computers around us, like those in microwave ovens, washing machines, automobiles, etc., are embedded computers, which are special-purpose and are generally used to perform control functions.

Supercomputers

These are the most powerful computers designed till now. They are made to process huge amounts of data. Many users can access them at the same time.

They are primarily used for mathematically intensive scientific researches such as in aerospace, satellite, chemical, electronics, petroleum and nuclear power industries. Supercomputers are used in weather forecasts. It would not have been possible to warn the people around the coastal areas about the advent of a hurricane but for a supercomputer. It is because of supercomputers alone that such a large-scale devastation can be controlled well in time saving human lives as well as financial and infrastructural resources. Supercomputers are also found in public, private and government research centers such as universities, government labs and R&D departments of organizations.

One main area where supercomputers are used is in the nuclear field, especially when nuclear fissionable material approaches a critical mass, and researchers are required to know what is happening at every nanosecond of the nuclear chain reaction. A supercomputer can monitor the actions and reactions of million of atoms when they interact.

Supercomputers were used to find out the pollution in Los Angeles. The model comprised of more than 5,00,000 variables including geographic elevation, temperature, airborne chemicals, etc., and it was required to create an accurate simulation of the Los Angeles Basin to decide upon various strategies to be used to control air pollution. This would have taken months with less powerful computers, but supercomputers did it in just half an hour.

The first supercomputer was built in the 1960's for the US Department of Defense. That was supposed to be the fastest and most powerful computer of that time. Millions of dollars are being spent on R&D of the technology enhancement of supercomputers.

The main feature of a supercomputer is multiprocessing, which enables the computer to perform a large number of operations simultaneously. The first supercomputer had 4 CPUs. Today's supercomputers have hundreds of processors. The speed of the supercomputer is measured in Nanoseconds and Gigaflops. A Nanosecond

equals 10^{-9}th of a second and a Gigaflop is 1 billion floating-point arithmetic operation per second. A supercomputer can perform up to 128 Gigaflops.

Market and R&D leaders of supercomputers include IBM, Silicon Graphics, Cray Research Corporation, Fuifits, Intel, Thinking Machines, etc.

Thinking Machines has produced a supercomputer called Connection Machine, which has over 64,000 processors. Its price is about $5million. Supercomputers are priced from $2million to $20million and they consume electricity enough to light about 100 homes.

Mainframes

Mainframe computers are used where many people in a large organization need frequent access to the same information, which is usually organized information of one or more large databases.

After UNIVAC-I was sold in 1951, the mainframes caught the attention of the computer industry. IBM, the computer giant, captured the mainframes market in the late 1950's and made their name and money in the mainframe market. A mainframe computer system is generally made up of several computers, called terminals, in addition to the mainframe or host processor. A terminal is a keyboard and a screen wired to the mainframe. It does not necessarily have its own CPU or storage it just has input and output devices that function as the windows of the computer placed elsewhere. The host processor is responsible for controlling rest of the processors, operations and the peripheral devices attached to it. A front-end processor is the one that handles communication to and from all the remote terminals connected to the computer system. At times, a backend processor is also used to the handle data retrieval operation. Although the host computer is capable of doing all the operations by itself, it is still better to have two processors to share the load, thereby saving time and increasing speed.

The mainframe computer has a processor that handles input, controls the database and output needs of the terminals attached to it. Each user has access to the contents of the database. It is difficult to store such massive amount of data and it would also be too slow. Many modern mainframes have multiprocessing capabilities. However, they are generally limited to 8 or less processors. They are slower than supercomputers and their speed is measured in megaflops and not in gigaflops.

Mainframes can cost anything above $35,000. It used to be common for mainframe computers to occupy an entire room or even an entire floor of a high-rise building. Typically, they were placed inside glass offices with

special air conditioning support to keep them cool, and on raised floors to accommodate all the wiring needed to tie the systems together. This setup is not used anymore. Mainframes today, look more like a file cabinet although they still need the same type of environment.

A mainframes can support up to several hundred users simultaneously. It does so by keeping a number of programs in primary memory and by rapidly switching back and forth between programs. These operations are so fast that users do not even come to know that it is working on others tasks. This property of processing many tasks concurrently for multiple users is called “multiprogramming”.

No one really knows from where the term 'mainframe' originated. Earlier IBM documents define the term frame as an integral part of a computer: “the housing …. hardware support structures, …. and all the parts and components therein”. It was only when computers of various sizes and shapes came into existence, that the big computers began to be referred to as main frames and eventually became one word 'mainframe'.

Minicomputers

The advent of minicomputers or minis as they are sometimes called started in the 1960’s when DEC (Digital Equipment Corporation) began shipping its PDP series computers. The press named them minicomputers because of their small size as compared to other prevailing computers.

The easiest way to describe minicomputers is by saying that they lie somewhere in between mainframes and microcomputers. They can handle a great amount of data like mainframes. They can also support a number of terminals just as mainframes do. Although they are designed for hundreds of terminals, they differ in speed, i.e. minicomputers are slower than mainframes and they cannot support as many terminals as mainframes can. They have less storage capacity and their printers too are slow. They are meant for smaller organizations, which can neither afford mainframes nor do they require such big computers. The cost ranges from $18,000 to $50,000. The major manufactures of minicomputers are DEC, Data General, IBM and Hewlett Packard.

Workstations and Microcomputers

When working on minicomputers and mainframes through terminals, users can just control the input and output of the computer. Whereas a single user computer gives you the power of controlling the total processing cycle i.e. input and output, processing and storage. You can select your own programs and do not need to be dependent on mainframes or minis for storage. They are designed to meet the needs of an individual

and thus are also called as Personal Computers. PC and microcomputers are interchangeable as far as meaning is concerned.

When we talk about computers today, we generally mean a PC or a microcomputer. Microcomputers have a great impact on the computer industry. Till 1975, they did not even exist, and in 1995 the sale of PCs was as high as $16 billion. Microcomputers are the fastest growing segment of the computer industry. One of the sources of the PC's popularity is the rate at which improvements are being made in the technology. As the technology is growing, microprocessor, memory, chips and storage devices keep getting faster and better and bigger.

Today, a typical PC has 8 times as much RAM, 150 times more storage capacity and a microprocessor that is at least 100 times faster than a PC 10 years earlier. Analysts believe that the pace of this growth will be the same for another 20 years.

In 1981, IBM called its first microcomputer the IBM-PC. Within a few years there were many more companies in the race to design a computer compatible to IBM-PC. Thus the term IBM-PC became the name of a family of computer that included IBMs and IBM compatibles. The vast majority of computers falls in this family except Apple Macintosh, which is another family of microcomputers made by Apple Computer. It is appropriate to say that Macintosh is a personal computer but not a PC. Presently IBM commands over about 28 percent of the market where as Apple holds about 8 percent of market share.

A few years ago, Apple Computers, IBM and Motorola joined to develop the Power PC chip, which enables Apple Computer to run IBM applications and vice versa. Most Apple Macintosh computers and compatibles are based on this chip.

A single computer can actually fall into the category of either a microcomputer or a workstation. A workstation is a powerful desktop computer designed to meet the computing needs of engineers, architects and other professionals, who need graphic display. Workstations are generally used for CAD (Computer Aided Design) applications. For this type of complex programs the computer needs great processing power and much storage. They are also used as services for LANs (Local Area Networks). Workstations are sometimes called "Supermicros". Although they look like desktops, the chip inside is different. Most workstations use RISC (Reduce Instruction Set Computer) microprocessors. RISC processors are used in special purpose applications, where speed is critical.

Presently the boundary between workstations and PCs is becoming less distinct. Today's PCs are better than workstations of the past. Pentium-pro has multiprocessing capabilities.

Most microcomputers support multitasking (enabling the user to switch between the tasks). Multitasking saves a lot of time. The user can open another activity while one task is being processed. For example while the computer is downloading one thing in the browser, the user can open another window for writing a mail or a calculator to perform some calculation.

One style of PC is the desktop. This type of computer is small enough to fit on a desk but is too big to carry around. There are a number of models available in the desktop category. The cabinets come in flat (horizontal) and vertical (tower model) depending upon the space management of the user.

Laptop Computers

The first portable computers were known as "luggable". They weighed about 28 pounds. As the size reduced further the term also changed to "laptop". Laptops weigh about 10 to 12 pounds. The name was probably given because laptops are kept on the laps while users are on the move (in a car, an airplane or train).

Notebook Computers

As the name suggests, their size is about 8.5 by 11 by 2 inches, and can easily fit inside a briefcase. They were initially called laptops too, but gradually as the size decreased even further they started being called notebooks. They can be operated on batteries also. They are fully functional microcomputers. They can have input devices Hard Disk Drives, Floppy Disk Drives, a CD-ROM, a modem and an in-built mouse.

Personal Digital Assistants (PDA)

These are the smallest portable computers and are no bigger than chequebooks. They are also called palmtops. They are not as powerful as notebooks and laptops. They are used for some special applications like keeping record of phone numbers, dates,agendas and calculations. They can be connected to large computers to exchange data. They also come with an electronic pen, called stylus, that lets users write on a touch-sensitive screen. The latest PDA's can use infrared light to communicate with nearby computers. They may also have built-in capabilities for fax, cellular telephony and e- mails.

These are meant for the people who want to avoid carrying a lot of weight and do not need the full collection of applications while away from home or office. These computers use inexpensive batteries. They do not have any disk drivers. They use the PC card, a card of the size of a credit card, to store programs and data. Notebook and desktop computers also have

now adopted these PC cards. PC cards are some version of smart cards (small cards developed in France). They were earlier used to pay highway tolls, make STD calls, pay bills etc. A smart card has a microprocessor and a memory chip.

Embedded Computers

Have you ever noticed that computers surrounds you everywhere? Be it your car, your kitchen, bathroom, entertainment or anywhere else. You start using computers the time you get up in the morning and keep using it till you go off to sleep. Such computers as these, which work inside other machines, are called embedded computers.

Cars use embedded computer to control the engine. Alarm clocks use these computers to wake you up.

VCR and TVs also use embedded computers for a variety of functions. The users do not even realize, while using these equipment, that they are using embedded computers.

1.6 COMPUTER APPLICATIONS

Today computers find widespread applications in all activities of the modern world. Some of the major application areas include:

1. Scientific, Engineering and Research:

This is the major area where computers find vast applications. They are used in areas which require lot of experiments, mathematical calculations,weather forecasting, and complex mathematical and engineering applications. Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM) help in designing robotics, automobile manufacturing, automatic process control devices etc.

2. Business:

Record keeping, budgets, reports, inventory, payroll, invoicing, accounts are all the areas of business and industry where computers are used to a great extent. Database management is one of the major area where computers are used on a large scale. The areas of application here include banking, airline reservations, etc. where large amounts of data need to be updated, edited, sorted, searched from large databases.

3. Medicine:

Computerized systems are now in widespread use in monitoring patient data like , pulse rate, blood pressure etc. resulting in faster and accurate diagnosis. Modern day medical equipment are highly computerized today. Computers are also widely used in medical research.

4. Information:

This is the age of information. Television, Satellite communication, Internet, networks are all based on computers.

5. Education:

The use of computers in education is increasing day by day. The students develop the habit of thinking more logically and are able to formulate problem solving techniques. CDs on a variety of subjects are available to impart education. On line training programs for students are also becoming popular day by day. All the major encyclopedias, dictionaries and books are now available in the digital form and therefore are easily accessible to the student of today. Creativity in drawing, painting, designing, decoration, music etc. can be well developed with computers.

6. Games and Entertainment:

Computer games are popular with children and adults alike. Computers are nowadays also used in entertainment areas like movies, sports, advertising etc.

1.7 LIMITATIONS OF COMPUTERS

Until now we have discussed the good points of computers like making work easier, reducing the response time, facilitating the daily activities, dealing with large amounts of data and many more, but there are some bad effects too attached to computers. Some of the disadvantages include the following:

1. They are manufactured using hazardous chemicals that can harm the health of users, as also contributing to pollution.
2. They are failure prone. A failure in a nuclear power station, or airplane etc. can endanger many lives and resources.
3. Discarded computers are real junk and consume lots of space.
4. They are always a threat to personal privacy.
5. Working longer on computers gives the user back pain, nerve injuries etc.
6. Because of the automation brought about by computers, unemployment is on the rise.

Check your Progress 1

1. Define computer?

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2. What is a computer code?

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3. What are the basic operations of a computer?

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4. What are the characteristics of Computer?

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1.8 LET US SUM UP

1. A computer is a fast and accurate data processing system which accepts data, performs various operations on the data, has the capacity to store data and process the data with the set of instructions given to it.

2. The data is the information provided by the user to the computer and the set of instructions to perform the operation on data is the computer pro- gram.
3. The hardware of the computer is the physical parts of the machine like monitor, keyboard, disks etc. whereas the software is the various programs, procedures and other documentation which is used to operate the hardware efficiently.
4. Classification of computers done on the basis of the logic used in their design as analog and digital computers. Analog computers recognize data as a continuous movement of a physical property. Digital computers recognize data a series of discrete signals representing high or low voltage state of electricity. Hybrid computers are a combination of analog and digital computers. Digital computers are further classified according to their speed and capacity of memory and size as micro computers, notebook or laptops, Mini computers, Main frames and Super computers.
5. The typical characteristics of the computer are its superfast speed, the accuracy of each and every calculation, and its consistent efficiency. It has tremendous storage capacity and can store large volumes of data. It is versatile in the sense that it can be used in a vast range of applications from complex scientific problems to a child's game. A system is a group of integrated elements which are logically related to achieve the goal of the system each element performs a specific task assigned to it.
6. A computer system is made up of:
7. **Input Unit:** which accepts input data The Central Processing Unit: This is made up of the Control unit, the Arithmetic and Logic Unit and the Primary Storage Unit. This unit controls the entire computer system.
8. **Output Unit:** This unit gives the results of the computation to the user. The evolution or development of computers is characterized by generations of computers.
9. The first generation had very large and complex machines which made use of the vacuum tube technology. Invention of transistors in the second generation reduced the size of the computers and the

concept of stored program emerged, as well as higher level languages were introduced. The third generation was characterized by Integrated Circuits and commercial production of computers. The fourth generation saw the invention of microcomputers with Very Large Scale Integration, Networking and introduction of personal computers. The fifth or the present generation has seen advances in parallel processing and superconductor technologies.

10. Computers today, find applications in vast and varying fields like scientific, engineering and research, medicine and business, education and games, entertainment. The computers however have a serious drawback that they can only do what they are programmed to do since they have no brain. They cannot arrive at a conclusion without going through all intermediate steps.

1.9 KEYWORDS

1. **Hardware**
2. The physical parts of a computer -
3. CPU
4. Central processing unit; the brain of the computer; controls the other elements of the computer
5. Disk Drive
6. A peripheral device that reads and/or writes information on a disk
7. Hard Drive
8. A device (usually within the computer case) that reads and writes information, including the operating system, program files, and data files
9. Keyboard
10. A peripheral used to input data by pressing keys
11. Modem
12. A peripheral device used to connect one computer to another over a phone line
13. Monitor
14. A device used to display information visually
15. Mouse
16. A peripheral device used to point to items on a monitor
17. NIC
18. Network interface card; a board inserted in a computer that provides a physical connection to a network

19. Printer
20. A peripheral device that converts output from a computer into a printed image
21. **Software**
    - Instructions executed by a computer -
22. Applications
23. Complete, self-contained programs that perform a specific function (ie. spreadsheets, databases)
24. Bit
25. A computer's most basic unit of information
26. Boot
27. The process of loading or initializing an operating system on a computer; usually occurs as soon as a computer is turned on
28. Browser
29. A program used to view World Wide Web pages, such as Netscape Navigator or Internet Explorer
30. Bug
31. A part of a program that usually causes the computer to malfunction; often remedied in patches or updates to the program
32. Byte
33. Small unit of data storage; 8 bits; usually holds one character
34. Click
35. Occurs when a user presses a button on a mouse which in turn, generates a command to the computer
36. Database
37. A large structured set of data; a file that contains numerous records that contain numerous fields
38. Diskette
39. A small flexible disk used for storing computer data
40. Double Click
41. Occurs when a user presses a button on the mouse twice in quick succession; this generates a command to the computer
42. Download
43. Transferring data from another computer to your computer

1.10 ANSWER TO CHECK YOUR PROGRESS

Refer 1 for Answer to check your progress- 1 Q. 1 …

Computer is a fast operating electronic device, which automatically accepts and store input data, process them and produces results under the direction of step by step program.

Refer 1 for Answer to check your progress- 1 Q. 2 …

The decimal digits represented by a group of four or more binary digits called code group.

Refer 1 for Answer to check your progress- 1 Q. 3…

The basic operations of the computer are
Input,
Process
Storing
Controlling and
Output

Refer 1 for Answer to check your progress- 1 Q. 4 …

The characteristics of the computers are
Speed
Accuracy
Automation
Endurance
Versatility
Storage
Cost reduction etc

1.11 SOME USEFUL BOOKS

- Computer Fundamentals, by Dr. Rajendra Devraj, Dist Solapur. Maharashtra.
- Microsoft Office 2010: On Johnson, Steve Pearson Education, New Delhi India, Demand.
- Microsoft Office 2010 for Schwartz. Steve Pearson Education, New Delhi India, Windows: Visual Quick.

Text Books

1 “Computer Fundamentals” by Goel, Anita, Pearson Education, New Delhi.

1.12 TERMINAL QUESTIONS

1. Define the terms: data, program, hardware and software.
2. List and explain in brief the characteristics of computers.
3. Define a System. What constitutes a computer system?
4. Write short notes on Fourth Generation of Computers, Limitations of computers.
5. Explain the classification of computers on the basis of their capacity to access memory and size.
6. List the applications of computers