1 CHAPTER

Computer Introduction

Objectives

After reading this chapter, students should be able to :

- Understand a computer system that has hardware and software components, which controls and makes them useful
- Know about various types of computer system.
- Learn about different types of line and free-hand lettering.

1.1 INTRODUCTION

Our lifestyles have undergone a sea change with the advancement in technology especially in the field of computers. Computers are an integral part of our lifestyles today. We can see computers at offices, homes, schools, colleges, hotels, shops etc. This advance in technology has made our lives easy and comfortable.

For instance, we can execute a number of activities using computer based systems—we can write a draft on word processor and email it, make calculations using an electronic spreadsheet and incorporate graphics, create a database of friends with their phone numbers, addresses and e-mail ids etc. It is an arduous process to perform these activities using existing traditional methods.

Computers can also simplify other tasks such as word processing, designing, web site development, database management etc. Therefore, a computer should be referred to as a 'data processor'.

Structure of the Chapter

1.2 COMPUTER

The term 'computer' is derived from the word 'compute', which means to calculate. A computer is an electronic machine devised for performing calculations and controlling operations that can be expressed either in logical or in numerical terms.

In simple words, a computer is an electronic device that performs diverse operations with the help of instructions to process the data in order to achieve desired results. Although the application domain of a computer depends totally on human creativity and imagination, it covers a huge area of applications including education, industries, government, medicine, scientific research, law, and even music and arts.

Computers are one of the most influential forces available in modern times. Harnessing the power of computers enables relatively limited and fallible human capacities for memory, logical decision making, reaction and perfection to be extended to almost infinite levels. Millions of complex calculations can be done in a mere fraction of time; difficult decisions can be made with unerring accuracy for comparatively little cost.

Computers are widely seen as instruments for future progress and as tools to achieve sustainability by way of improved access to information with the help of video-conferencing and e-mail. Indeed, computers have left such an impression on modern civilization that we call this era as the "information age".

1.2.1 Evolution of Computer Technology

The origin of computer technology took place in the 19th century. People desired to have a machine that would carry out mathematical calculations for them. The ABACUS is considered to have been the first computer in the world. It was used to perform simple measurements and calculations. ABACUS is available even today for school going children.

In the 17th century, a scientist named Pascal developed a machine that could perform mathematical calculations. This machine comprised of a number of gears. The movement of gear mechanism was used to perform some calculations. He named the machine PASCALINE.

George Boolean developed the famous Boolean Algebra based on binary numbers. De Morgan put forward theorems on logic gates. These theorems are known as De Morgan's Theorems. Lady Ada was the first computer programmer.

However, the concept of the modern computer was propounded by the scientist and mathematician Charles Babbage. He first wrote on the use of logic and loops in process execution. Based on the concept of logic and loops, Babbage envisaged two models for performing computations—Analytical Engine and Difference Engine.

In those days, electronics was not developed. Therefore, these models proposed by Babbage existed only on paper. However, the ideas given by Babbage were implemented after the invention of electronics. The real application of computers began in the late fifties. The computers were used in the United States for various applications such as census, defence, R&D, universities etc.

The need for a device to do calculations along with the growth in commerce and other human activities explains the evolution of computers. Having the right tool to perform these tasks has

always been important for human beings. In their quest to develop efficient computing devices, humankind developed many apparatuses. However, many centuries elapsed before technology was adequately advanced to develop computers.

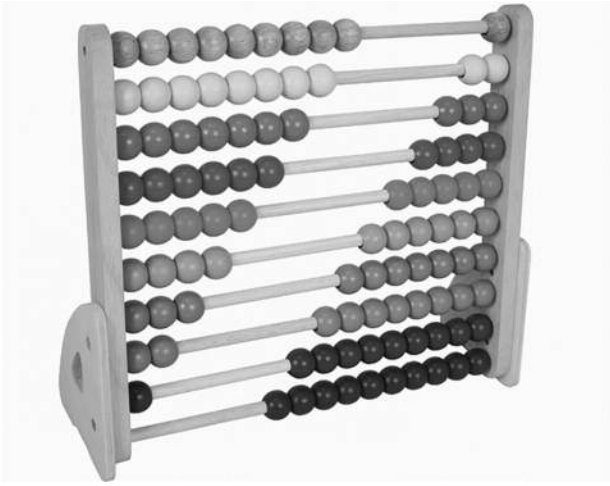

Fig. 1: Abacus

With the passage of time, humankind invented many computing devices, such as Napier bones and slide rule. It took many centuries, however, for the next significant advancement in computing devices.

In 1642, a French mathematician, Blaise Pascal, invented the first functional automatic calculator. This brass rectangular box, also called a Pascaline, used eight movable dials to add numbers up to eight figures long (Figure 2).

In the beginning, when the task was simply counting or adding, people used either their fingers or pebbles along lines in the sand.

In order to conveniently have the sand and pebbles all the time, people in Asia Minor built a counting device called abacus. This device allowed users to do calculations using a system of sliding beads arranged on a rack. The abacus was simple to operate and was used worldwide for centuries. In fact, it is still used in many countries (Figure 1).

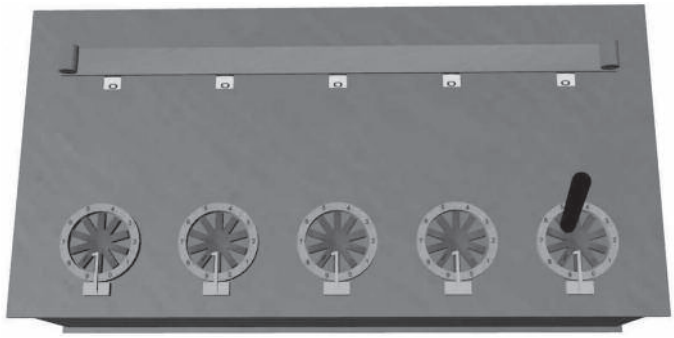

Fig. 2: Pascaline

In 1694, a German mathematician, Gottfried Wilhem von Leibniz, extended Pascal's design to perform multiplication, division and to find square root. This machine is known as the Stepped Reckoner. It was the first mass-produced calculating device, which was designed to perform multiplication by repeated addition. Like its predecessor, Leibniz's mechanical multiplier worked by a system of gears and dials. The only problem with this device was that it lacked mechanical precision in its construction and was not very reliable. The real beginning of computers as we know them today, however, lay with an English mathematics professor, Charles Babbage.

In 1946, John Eckert and John Mauchly of the Moore School of Engineering at the University of Pennsylvania developed the Electronic Numerical Integrator and Calculator (ENIAC). This computer used electronic vacuum tubes to make the internal parts of the computer. It embodied almost all the components and concepts of today's high-speed, electronic computers.

Later on, Eckert and Mauchly also proposed the development of the Electronic Discrete Variable Automatic Computer (EDVAC).

Fig. 3 : Hollerith's Tabulator

It was the first electronic computer to use the stored program concept introduced by John Von Neumann. It also had the capability of conditional transfer of control, that is, the computer could stop any time and then resume operations.

In 1949, at the Cambridge University, a team headed by Maurice Wilkes developed the Electronic Delay Storage Automatic Calculator (EDSAC), which was also based on John Von Neumann's stored program concept. This machine used mercury delay lines for memory and vacuum tubes for logic. The Eckert–Mauchly Corporation manufactured the Universal Automatic Computer (UNIVAC) in 1951 and its implementation marked the real beginning of the computer era.

In the 1960s, efforts to design and develop the fastest possible computer with the greatest capacity reached a turning point with the Livermore Advanced Research Computer (LARC), which had access time of less than 1 ìs (pronounced as microsecond) and the total capacity of 100,000,000 words.

In the 1980s, Very Large Scale Integration (VLSI) design, in which hundreds of thousands of transistors were placed on a single chip, became increasingly common. The "shrinking" trend

continued with the introduction of personal computers (PCs), which are programmable machines small enough and inexpensive enough to be purchased and used by individuals. Microprocessors equipped with the read-only memory (ROM), which stores constantly used and unchanging programs, performed an increased number of functions.

By the late 1980s, some PCs were run by microprocessors that were capable of handling 32 bits of data at a time and processing about 4,000,000 instructions per second. By the 1990s, PCs became part of everyday life. This transformation was the result of the invention of the microprocessor, a processor on a single integrated circuit (IC) chip. The trend continued leading to the development of smaller and smaller microprocessors with a proportionate increase in processing powers.

The computer technology continues to experience huge growth. Computer networking, electronic mail and electronic publishing are just a few applications that have grown in recent years. Advances in technologies continue to produce cheaper and more powerful computers, offering the promise that in the near future, computers or terminals will reside in most, if not all, homes, offices and schools.

1.3 DATA AND INFORMATION

We live in the information age. In the same way that the development of industry created the industrial age, the development of information technology systems, and especially the internet, has created the information age.

It has been a long-held belief by many philosophers that knowledge is power and that knowledge stems from understanding of information; information, in turn, is the assigning of meaning to data. To develop learners' understanding of information technology, we start by defining these three related concepts. The topics are hierarchical in that:

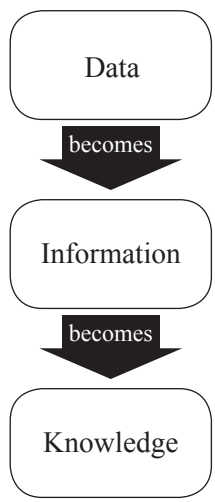

Fig. 4: Data and information

1.3.1 Data

Data refers to raw input that when processed or arranged makes meaningful output. Information is usually the processed outcome of data. In other words, data in a meaningful form becomes information. Information can be about facts, things, concepts, or anything relevant to the topic concerned.

1.3.2 What is data?

The concept of data as it is used in the syllabus is commonly referred to as 'raw' data — a collection of text, numbers and symbols with no meaning. Data therefore has to be processed, or provided with a context, before it can have meaning.

Example:

- 3, 6, 9, 12, 15, 18, 21
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

These are meaningless sets of data. They could be the first four answers in the 3 × table, a list of household pets and the heights of 15-year-old students but without a context we don't know.

1.3.3 What is Information?

It is important that students learn the concept of what 'information' is as used in information technology. Information is the result of processing data, usually by computer. This results in facts, which enables the processed data to be used in context and have meaning. Information is data that has meaning.

1.3.4 When does data become information?

Data on its own has no meaning. It only takes on meaning and becomes information when it is interpreted. Data consists of raw facts and figures. When that data is processed into sets according to context, it provides information.

Data refers to raw input that when processed or arranged makes meaningful output. Information is usually the processed outcome of data. When data is processed into information, it becomes interpretable and gains significance.

In IT, symbols, characters, images, or numbers are data. These are the inputs an IT system needs to process in order to produce a meaningful interpretation. In other words, data in a meaningful form becomes information. Information can be about facts, things, concepts, or anything relevant to the topic concerned. It may provide answers to questions like who, which, when, why, what, and how. If we put Information into an equation it would look like this:

Data + Meaning = Information

Example

Looking at the examples given for data:

- 3, 6, 9, 12, 15, 18, 21
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

Only when we assign a context or meaning does the data become information. It all becomes meaningful when we are told:

- 3, 6, 9 and 12 are the first four answers in the 3 × table
- cat, dog, gerbil, rabbit, cockatoo is a list of household pets
- 161.2, 175.3, 166.4, 164.7, 169.3 are the heights of 15-year-old students

1.4 DATA PROCESSING

The term Data Processing (DP) has also been used to refer to a department within an organization responsible for the operation of data processing applications. It is generally, "the collection and manipulation of items of data to produce meaningful information." In this sense it can be considered a subset of information processing, "the change (processing) of information in any manner detectable by an observer."

1.4.1 Definition of Computer

In basic term, a computer is an electronic device that processes data, converting it into information that is useful to people. Any computer regardless of its type is controlled by programmed instructions, which give the machine a purpose and tell it what to do.

Hence, a computer that represents data by measurable quantities, as voltages or, formerly, the rotation of gears, in order to solve a problem, rather than by expressing the data as numbers.

According to Wikipedia:

The word “Computer" was first used in a book called “the Young mans gleanings” in 1613. We can define computer as:

“A Computer is an electronic machine that can solve different problems, process data, store & retrieve data and perform calculations faster and efficiently than humans”.

Interesting Facts about Computers and its Operating Systems:

- The first digital computers were developed between 1940 to 1945.
- Konrad Zuse, In 1941 developed “Z3”, the first modern computing machine.
- Konrad Zuse is regarded as “the inventor of computers”.
- ENIAC (Electronic Numerical Integrator and Computer) was the first US-built electronic computer.
- ENIAC was developed by John Mauchly and J. Presper Eckert.
- The world’s first stored-program computer was “Manchester Baby” developed in 1948.
- The “Manchester Baby” was a small-scale experimental computer developed in Victoria university of Manchester.
- In the 1st generation of computers, Computers were built with vacuum tubes.
- In 1957, FORTRAN (Formula Translator) was introduced.
- Computers were built with Transistors in the 2nd generation of computers.
- In the 3rd generation of computers, Transistors were replaced with Integrated Circuits.
- In the 4th generation of computers, Microprocessors were used to build Computers.
- In 1981, IBM PC with Intel processors and MS-Dos were introduced.
- In 1984, Macintosh Computers were introduced.
- In 1985, Microsoft Windows GUI was introduced.
- In 1989, Intel 486 computers were introduced.
- In 1990, Windows 3.0 operating System for PCs was launched.
- In 1991, the World Wide Web was introduced to the general public.
- In 1991, Linux operating was developed.
- In 1993, Intel’s Pentium was introduced.

- In 1995, Windows 95 operating system was released.
- In June, 1996 Windows 4.0 operating system was released.
- On February 17, 2000, Windows 2000 was released.
- Windows XP was released on 25th October, 2001.
- On November 30th, 2006 Windows Vista was released.
- On July 22nd 2009, Windows 7 was introduced.
- On Windows 8, the successor of Windows 7 was released on October 28th, 2012.

1.5 BLOCK DIAGRAM OF COMPUTER SYSTEM

A computer can process data, pictures, sound and graphics. They can solve highly complicated problems quickly and accurately.

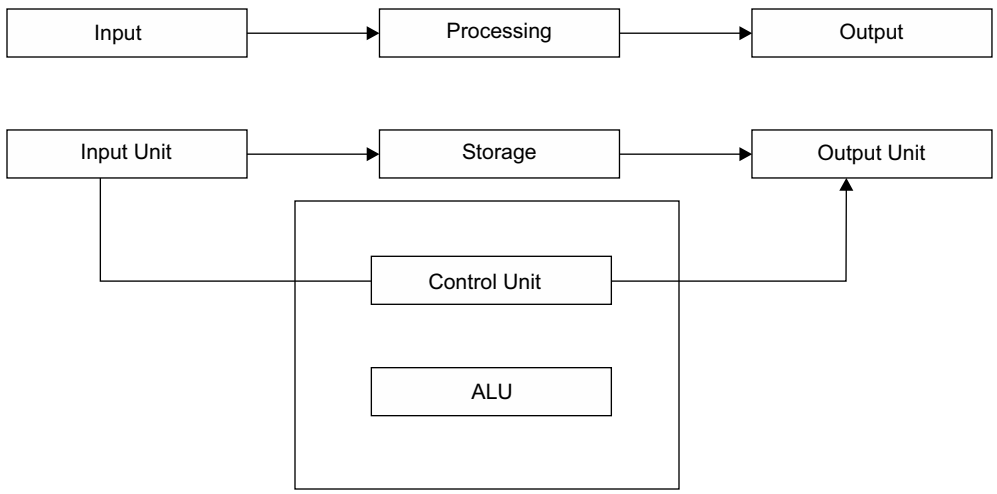

Fig. 5: Diagram of Computer System

A diagram (as shown in Fig. 5) performs basically five major computer operations or functions irrespective of their size and make. These are as given as follows:

- it accepts data or instructions by way of input,
- it stores data,
- it can process data as required by the user,
- it gives results in the form of output, and
- it controls all operations inside a computer.

A computer can process data, pictures, sound and graphics. They can solve highly complicated problems quickly and accurately.

1.5.1 Input Unit

This is the process of entering data and programs in to the computer system. Computers need to receive data and instruction in order to solve any problem. Therefore, we need to input the data and instructions into the computers. The input unit consists of one or more input devices. Keyboard is the one of the most commonly used input device. Other commonly used input devices are the mouse, floppy disk drive, magnetic tape, etc.

All the input devices perform the following functions.

- Accept the data and instructions from the outside world.
- Convert it to a form that the computer can understand.
- Supply the converted data to the computer system for further processing.

1.5.2 Storage Unit

The process of saving data and instructions permanently is known as storage. The storage unit of the computer holds data and instructions that are entered through the input unit, before they are processed. It preserves the intermediate and final results before these are sent to the output devices. It also saves the data for the later use. The various storage devices of a computer system are divided into two categories.

1. **Primary Storage:** Stores and provides very fast. This memory is generally used to hold the program being currently executed in the computer, the data being received from the input unit, the intermediate and final results of the program.

   The primary memory is temporary in nature. The data is lost, when the computer is switched off. In order to store the data permanently, the data has to be transferred to the secondary memory. The cost of the primary storage is more compared to the secondary storage. Therefore most computers have limited primary storage capacity.

2. **Secondary Storage:** Secondary storage is used like an archive. It stores several programs, documents, data bases etc. The programs that you run on the computer are first transferred to the primary memory before it is actually run. Whenever the results are saved, again they get stored in the secondary memory. The secondary memory is slower and cheaper than the primary memory. Some of the commonly used secondary memory devices are Hard disk, CD, etc.,

1.5.3 Memory Size

All digital computers use the binary system, i.e. 0's and 1's. Each character or a number is represented by an 8 bit code. The set of 8 bits is called a byte. A character occupies 1 byte space. A numeric occupies 2 byte space. Byte is the space occupied in the memory.

The size of the primary storage is specified in KB (Kilobytes) or MB (Megabyte). One KB is equal to 1024 bytes and one MB is equal to 1000KB. The size of the primary storage in a typical PC usually starts at 16MB. PCs having 32 MB, 48MB, 128 MB, 256MB memory are quite common.

1.5.4 Output Unit

An output device is any device used to send data from a computer to another device or user. Most computer data output that is meant for humans is in the form of audio or video. The output unit of a computer provides the information and results of a computation to outside world. Printers, Visual Display Unit (VDU) are the commonly used output devices. Other commonly used output devices are floppy disk drive, hard disk drive, and magnetic tape drive.

1.5.5 Processing Unit

The task of performing operations like arithmetic and logical operations is called processing. The Central Processing Unit (CPU) 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.

1.5.6 Functional Units

In order to carry out the operations the computer allocates the task between its various functional units. The computer system is divided into three separate units for its operation. They are:

1. **Arithmetic Logical Unit:** All calculations are performed in the Arithmetic Logic Unit (ALU) of the computer. It also does comparison and takes decision. The ALU can perform basic operations such as addition, subtraction, multiplication, division, etc and does logic operations viz, >, <, =, ‘etc.

   Whenever calculations are required, the control unit transfers the data from storage unit to ALU once the computations are done, the results are transferred to the storage unit by the control unit and then it is send to the output unit for displaying results.

2. **Control Unit:** It controls all other units in the computer. The control unit instructs the input unit, where to store the data after receiving it from the user. It controls the flow of data and instructions from the storage unit to ALU. It also controls the flow of results from the ALU to the storage unit. The control unit is generally referred as the central nervous system of the computer that control and synchronizes its working.

3. **Central Processing Unit (CPU):** The ALU and the CU of a computer system are jointly known as the central processing unit. The control unit and ALU of the computer are together known as the Central Processing Unit (CPU).

   The CPU is like brain performs the following functions:

- It performs all calculations.
- It takes all decisions.
- It controls all units of the computer.

A PC may have CPU-IC such as Intel 8088, 80286, 80386, 80486, Celeron, Pentium, Pentium Pro, Pentium II, Pentium III, Pentium IV, Dual Core, and AMD etc.

1.6 COMPONENTS OF A COMPUTER SYSTEM

A computer can be viewed as a system, which consists of a number of interrelated components that work together with the aim of converting data into information. In a computer system, processing is carried out electronically, usually with little or no intervention from the user.

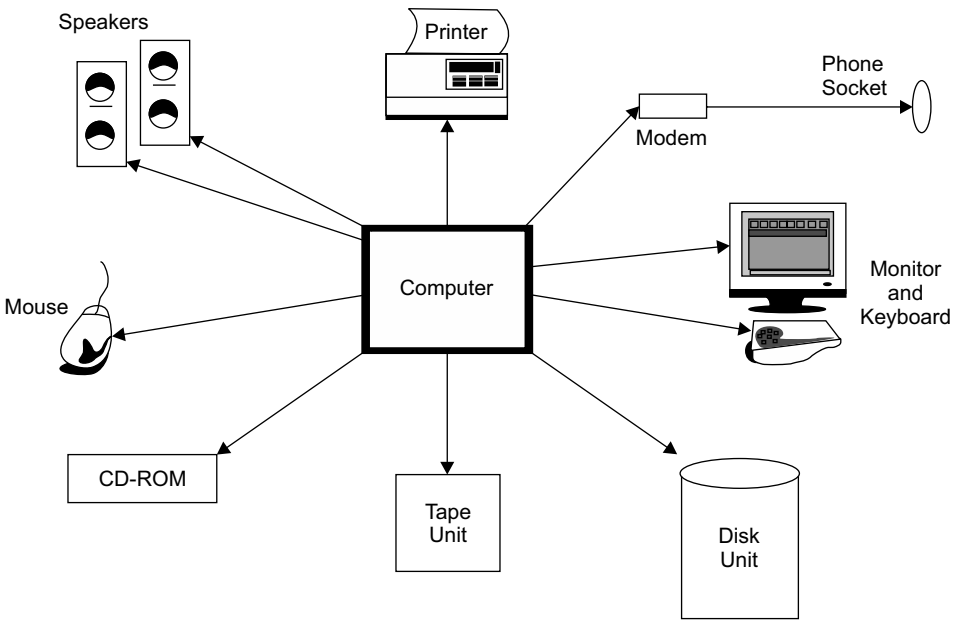

Fig. 6: Components of a computer

The general perception of people regarding the computer is that it is an "intelligent thinking machine". However, this is not true. Every computer needs to be instructed exactly what to do and how to do. The instructions given to computers are called programs.

Fig. 7: Typical Hardware and Peripherals in a Computer System

1.6.1 Speaker

A computer speaker is a hardware device that connects to a computer to generate sound. The signal used to produce the sound that comes from a computer speaker is created by the computer's sound card. The signal input connector is often a 3.5 mm jack plug (usually color-coded lime green per the PC 99 standard); RCA connectors are sometimes used, and a USB port may supply both signal and power (requiring additional circuitry, and only suitable for use with a computer).

Fig. 8: Speaker

Battery-powered wireless Bluetooth speakers require no connections at all. Most computers have speakers of low power and quality built in; when external speakers are connected they disable the built-in speakers. Altec Lansing claims to have created the computer speaker market in 1990.

1.6.2 Printer

A computer printer is a piece of hardware for a computer. It allows a user to print items on paper, such as letters and pictures. Mostly a printer prints under the control of a computer. Many can also work as a copying machine or with a digital camera to print directly without using a computer.

Fig. 9: Printer

1.6.3 Mouse

A computer mouse is a hand-held pointing device that detects two-dimensional motion relative to a surface. This motion is typically translated into the motion of a pointer on a display, which allows a smooth control of the graphical user interface. The first public demonstration of a mouse controlling a computer system was in 1968.

Fig. 10: Mouse

In addition to moving a cursor, computer mice have one or more buttons to allow operations such as selection of a menu item on a display. Mice often also feature other elements, such as touch surfaces and "wheels", which enable additional control and dimensional input

1.6.4 Monitor

Fig. 11: Monitor

A computer monitor is an output device which displays information in pictorial form. It usually comprises the display device, circuitry, casing, and power supply. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) with LED backlighting

having replaced cold-cathode fluorescent lamp (CCFL) backlighting. Older monitors used a cathode ray tube (CRT).

Monitors are connected to the computer via VGA, Digital Visual Interface (DVI), HDMI, DisplayPort, Thunderbolt, low-voltage differential signaling (LVDS) or other proprietary connectors and signals.

1.6.5 Desktop Computer

The desktop computer, also known as the PC, is principally intended for stand-alone use by an individual. These are the most-common type of micro-computers. These micro-computers typically consist of a system unit, a display monitor, a keyboard, an internal hard disk storage and other peripheral devices. The main reason behind the importance of the PCs is that they are not very expensive for the individuals or the small businesses. Some of the major PC manufacturers are APPLE, IBM, Dell and Hewlett-Packard (Figure 12).

Fig. 12: Desktop Computer

Features:

- A desktop computer is a personal computer.
- It is designed for regular use at a single location on or near a desk or table due to its size and power requirements.
- The most common configuration has a case that houses the power supply, motherboard (a printed circuit board with a microprocessor as the central processing unit (CPU), memory, bus, and other electronic components), disk storage (usually one or more hard disk drives, optical disc drives, and in early models a floppy disk drive);
- A keyboard and mouse for input; and a computer monitor, speakers, and, often, a printer for output. The case may be oriented horizontally or vertically and placed either underneath, beside, or on top of a desk.

Fig. 13: Speaker

1.6.6 Keyboard

A computer keyboard is an input device that allows a person to enter letters, numbers, and other symbols (these are called characters) into a computer. It is one of the most used input devices for computers. Using a keyboard to enter lots of data is called typing.

A keyboard contains many mechanical switches or push-buttons called "keys". When one of these are pushed, an electrical circuit is closed, and the keyboard sends a signal to the computer that tells it what letter, number or symbol it would like to be shown on the screen. The computer's CPU then shows the character on the screen, usually at the place where the cursor is.

Fig. 14: Keyboard

Besides entering characters, computer keyboards also have keys that change the symbol (such as shift or caps lock) or give the computer special commands (such as the arrow keys, CTRL and ALT). Different computer operating systems use different special keys, or use them differently. A keyboard can be joined to a computer using a wire, but can also be wireless (like those that use

Bluetooth). Most 21st century keyboards that use wires connect to a USB port on the computer, but older ones use a less versatile DIN connector port.

1.6.7 Tape Drive

Fig. 15: Tape Drive

A tape drive is a data storage device that reads and writes data on a magnetic tape. Magnetic tape data storage is typically used for offline, archival data storage. Tape media generally has a favorable unit cost and a long archival stability.

A tape drive provides sequential access storage, unlike a hard disk drive, which provides direct access storage. A disk drive can move to any position on the disk in a few milliseconds, but a tape drive must physically wind tape between reels to read any one particular piece of data. As a result, tape drives have very large average access times.

However, tape drives can stream data very quickly off a tape when the required position has been reached. For example, as of 2010 Linear Tape-Open (LTO) supported continuous data transfer rates of up to 140 MB/s, a rate comparable to hard disk drives.

1.6.8 CD-ROM

A CD-ROM is a pre-pressed optical compact disc which contains data. The name is an acronym which is short for "Compact Disc Read-Only Memory". Computers can read CD-ROMs, but cannot write to CD-ROMs, which are not writable or erasable.

During the 1990s, CD-ROMs were popularly used to distribute software and data for computers and video game consoles. Some CDs, called enhanced CDs, hold both computer data and audio with the latter capable of being played on a CD player, while data (such as software or digital video) is only usable on a computer (such as ISO 9660 format PC CD-ROMs).

The CD-ROM format was developed by Japanese company Denon in 1982. It was an extension of Compact Disc Digital Audio, and adapted the format to hold any form of digital data, with a storage capacity of 553 MiB. CD-ROM was then introduced by Denon and Sony at a Japanese computer show in 1984.

Fig. 16: CD-ROM

The Yellow Book is the technical standard that defines the format of CD-ROMs. One of a set of color-bound books that contain the technical specifications for all CD formats, the Yellow Book, standardized by Sony and Philips in 1983, has a capacity of 650 MiB

1.7 CLASSIFICATION OF COMPUTERS

These days, computers are available in many sizes and types. Some computers can fit in the palm of the hand, while some can occupy the entire room. Computers also differ based on their data-processing abilities.

1.7.1 Classification Based on Physical Size

Based on the physical size, performance and application areas, we can generally divide computers into four major categories: micro, mini, mainframe and supercomputers (Figure 17).

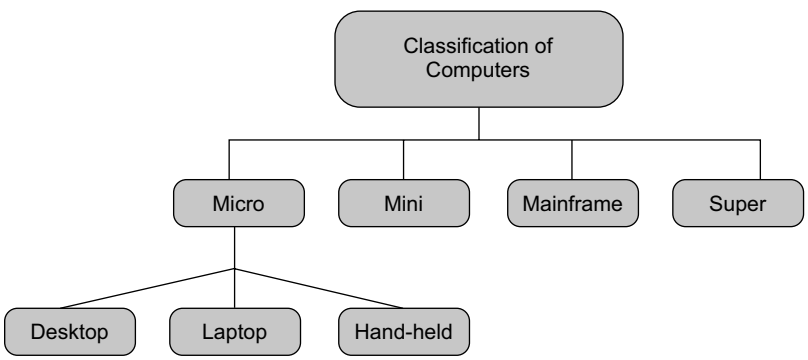

Fig. 17: Classification of Computers

Microcomputers

A microcomputer is a small, low-cost digital computer, which usually consists of a microprocessor, a storage unit, an input channel and an output channel, all of which may be on one chip inserted into one or several PC boards. The addition of power supply and connecting cables, appropriate

peripherals (keyboard, monitor, printer, disk drives and others), an operating system and other software programs can provide a complete microcomputer system. The micro-computer is generally the smallest of the computer family.

Originally, these were designed for individual users only, but nowadays they have become powerful tools for many businesses that, when networked together, can serve more than one user. IBM-PC Pentium 100, IBM-PC Pentium 200 and Apple Macintosh are some of the examples of micro computers. Micro computers include desktop, laptop and hand-held models such as Personal Digital Assistants (PDAs).

Features of Micro Computers

- They use very little power, require little air conditioning and does not require special wiring, raised floors.
- They are stable and reliable. Personal Computers:
- They are the one of the latest type of micro computers. They are called so because they are designed for personal use of individuals or small business units, office automation units or professionals.

Personal computers can be used for basic programming, fun and games, business and professional applications, telecommunications; data base management, accounting, and word processing.

Laptop

A laptop is a portable computer that a user can carry around. Since the laptop resembles a notebook, it is also known as the notebook computer. Laptops are small computers enclosing all the basic features of a normal desktop computer.

The biggest advantage of laptops is that they are lightweight and one can use them anywhere and at anytime, especially when one is travelling. Moreover, they do not need any external power supply as a rechargeable battery is completely self-contained in them. However, they are expensive as compared to desktop computers (Figure 18).

Fig. 18: Laptop

Hand-held Computers

A hand-held computer such as a PDA is a portable computer that can conveniently be stored in a pocket (of sufficient size) and used while the user is holding it. PDAs are essentially small portable computers and are slightly bigger than the common calculators. A PDA user generally uses a pen or electronic stylus, instead of a keyboard for input.

As shown in Figure 19, the monitor is very small and is the only apparent form of output. Since these computers can be easily fitted on the top of the palm, they are also known as palmtop computers. Hand-held computers usually have no disk drive; rather, they use small cards to store programs and data.

However, they can be connected to a printer or a disk drive to generate output or store data. They have limited memory and are less powerful as compared to desktop computers. Some examples of hand-held computers are Apple Newton, Casio Cassiopeia and Franklin eBookMan.

Fig. 19: Personal Digital Assistant

Minicomputers

A minicomputer is a small digital computer, which normally is able to process and store less data than a mainframe but more than a microcomputer, while doing so less rapidly than a mainframe but more rapidly than a microcomputer. It is about the size of a two-drawer filing cabinet. Generally, these computers are used as desktop devices that are often connected to a mainframe in order to perform the auxiliary operations (Figure 20).

A minicomputer (sometimes called a mid-range computer) is designed to meet the computing needs of several people simultaneously in a small-to medium-sized business environment. It is capable of supporting from four to about 200 simultaneous users. It serves as a centralized storehouse for a cluster of workstations or as a network server.

Minicomputers are usually multi-user systems so these are used in interactive applications in industries, research organizations, colleges and universities. They are also used for real-time controls and engineering design work. Some of the widely used minicomputers are PDP 11, IBM (8000 series) and VAX 7500.

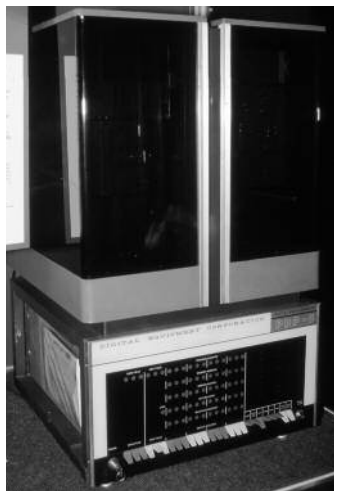

Fig. 20: Minicomputer

Characteristics

- They can accept and transfer data from I/O devices at the maximum speed of 4 million bytes per second.
- Can support up to a maximum of 20 terminals.
- They usually employ microprocessors in the CPU for data storage and data manipulation.
- They have faster processing speed.
- In most mini computers, data and instructions are stored in fixed word locations. They have main memory ranging from 256 kb to 12 Mb and word length of 16/32 bits and are designed for 4 to 8 users in time sharing models.

Mainframes

Mainframe computers are used in large organisation such as insurance companies and banks, where many people frequently need to use the same data. In a traditional mainframe environment, each user accesses the mainframe's resources through a device called a terminal. A mainframe is an ultra-high performance computer made for high-volume, processor-intensive computing. It consists of a high-end computer processor, with related peripheral devices, capable of supporting large volumes of data processing, high-performance online transaction processing, and extensive data storage and retrieval. Normally, it is able to process and store more data than a minicomputer and far more than a microcomputer.

Moreover, it is designed to perform at a faster rate than a minicomputer and at even more faster rate than a microcomputer. Mainframes are the second largest (in capability and size) of the computer family, the largest being the supercomputers.

However, mainframes can usually execute many programs simultaneously at a high speed, whereas supercomputers are designed for a single process (Figure 21).

Fig. 21: Mainframe

The mainframe allows its users to maintain a large amount of data storage at a centralized location and to access and process this data from different computers located at different locations. It is typically used by large businesses and for scientific purposes.

Some examples of the mainframe are IBM's ES000, VAX 8000 and CDC 6600.

Supercomputers

Supercomputers are the special-purpose machines, which are especially designed to maximize the numbers of floating point operations per second (FLOPS). Any computer below one gigaflop per second is not considered a supercomputer.

Fig. 22: Supercomputer

A supercomputer has the highest processing speed at a given time for solving scientific and engineering problems. Essentially, it contains a number of CPUs that operate in parallel to make it faster. Its processing speed lies in the range 400–10,000 MFLOPS (millions of floating point

operations per second). Due to this feature, supercomputers help in many applications including information retrieval and computer-aided designing (Figure 22).

A supercomputer can process a great deal of data and make extensive calculations very quickly. It can resolve complex mathematical equations in a few hours, which would have taken many years when performed using a paper and pencil or using a hand calculator. It is the fastest, costliest and most powerful computer available today.

Typically, supercomputers are used to solve multivariant mathematical problems of existent physical processes, such as aerodynamics, metrology and plasma physics. They are also required by the military strategists to simulate defence scenarios. Cinematic specialists use them to produce sophisticated movie animations.

Scientists build complex models and simulate them in a supercomputer. However, a supercomputer has limited broad-spectrum use because of its price and limited market. The largest commercial uses of supercomputers are in the entertainment/advertising industry. CRAY-3, Cyber 205 and PARAM are some well-known supercomputers.

Typical Laptop Microcomputer

Next in the line is the minicomputer as shown in Figure 23. These are also small general-purpose computers having the capability to serve a number of users simultaneously. They are generally more powerful and expensive than the microcomputers. In size, they range from desktops to a size of a small file cabinet.

A typical microcomputer has a keyboard for input and user diskettes and floppy disk drives to enter data and programs and to receive processed outputs. They use magnetic tape and floppy discs as secondary storage devices. A visual display unit and/or character printer is used to prepare output in a human readable form. All micro computers are byte addressable machines. They use micro processor chips viz.

Fig. 23: Typical Laptop Microcomputer

1.7.2 Classification Based on Functions and Purpose

Computers differ based on their data processing abilities. They are classified according to purpose, data handling and functionality. According to purpose, computers are either general purpose or specific purpose. General purpose computers are designed to perform a range of tasks. They have the ability to store numerous programs, but lack in speed and efficiency. Specific purpose computers are designed to handle a specific problem or to perform a specific task. A set of instructions is built into the machine.

According to data handling, computers are analog, digital or hybrid. Analog computers work on the principle of measuring, in which the measurements obtained are translated into data. Modern analog computers usually employ electrical parameters, such as voltages, resistances or currents, to represent the quantities being manipulated. Such computers do not deal directly with the numbers. They measure continuous physical magnitudes.

Digital computers are those that operate with information, numerical or otherwise, represented in a digital form. Such computers process data into a digital value (in 0s and 1s). They give the results with more accuracy and at a faster rate.

Hybrid computers incorporate the measuring feature of an analog computer and counting feature of a digital computer. For computational purposes, these computers use analog components and for storage, digital memories are used. Let us discuss one by one:

Analog Computer

An analog computer (spelt analogue in British English) is a form of computer that uses continuous physical phenomena such as electrical, mechanical, or hydraulic quantities to model the problem being solved.

Fig. 24: Analog Computer

An analog computer is a computer which is used to process analog data. Analog computers store data in a continuous form of physical quantities and perform calculations with the help of measures. It is quite different from the digital computer, which makes use of symbolic numbers to represent results.

Analog computers are excellent for situations which require data to be measured directly without converting into numerals or codes. Analog computers, although available and used in industrial and scientific applications like control systems and aircraft, have been largely replaced by digital computers due to the wide range of complexities involved. In contrast, digital computers represent varying quantities symbolically, as their numerical values change. As an analog computer does not use discrete values, but rather continuous values, processes cannot be reliably repeated with exact equivalence, as they can with Turing machines. Unlike digital signal processing, analog computers do not suffer from the quantization noise, but are limited by analog noise.

Analog computers were widely used in scientific and industrial applications where digital computers of the time lacked sufficient performance. Analog computers can have a very wide range of complexity. Slide rules and monograms are the simplest, while naval gunfire control computers and large hybrid digital/analog computers were among the most complicated. Systems for process control and protective relays used analog computation to perform control and protective functions.

The advent of digital computing made simple analog computers obsolete as early as the 1950s and 1960s, although analog computers remained in use in some specific applications, like the flight computer in aircraft, and for teaching control systems in universities. More complex applications, such as synthetic aperture radar, remained the domain of analog computing well into the 1980s, since digital computers were insufficient for the task.

Analog Computer can be explained as:

- Analog computers were the earliest computer machines developed and were the among the most complicated machines for analog computation and process control.
- Analog data is not discrete, but rather is of a continuous nature.
- Examples of such data are pressure, temperature, voltage, speed and weight. An analog computer makes use of continuous values and not discrete values. Because of this, processes with an analog computer cannot be repeated for exact equivalent results.
- Unlike digital computers, analog computers are immune to quantization noise.
- Some of the common computing elements found in analog computers are function generators, integrators, comparators and multipliers.
- Depending on the application, other specialized components can also be used. Programming on an analog computer involves transformation of the problematic equations into the analog computer circuit.
- There are certain advantages associated with analog computers. Real-time operation and simultaneous computation is possible with the help of analog computers.
- Analog computers can also provide the insight of the problems and errors in case of analog issues for users.

Digital Computer

A computer that performs calculations and logical operations with quantities represented as digits, usually in the binary number system

Digital computer, any of a class of devices capable of solving problems by processing information in discrete form. It operates on data, including magnitudes, letters, and symbols, that are expressed in binary code—i.e., using only the two digits 0 and 1.

Fig. 25: Digital Computer

By counting, comparing, and manipulating these digits or their combinations according to a set of instructions held in its memory, a digital computer can perform such tasks as to control industrial processes and regulate the operations of machines; analyze and organize vast amounts of business data; and simulate the behaviour of dynamic systems (e.g., global weather patterns and chemical reactions) in scientific research.

Functional Elements

A typical digital computer system has four basic functional elements:

(1) input-output equipment,

(2) main memory,

(3) control unit, and

(4) arithmetic-logic unit.

Any of a number of devices is used to enter data and program instructions into a computer and to gain access to the results of the processing operation.

Common input devices include keyboards and optical scanners; output devices include printers and monitors. The information received by a computer from its input unit is stored in the main memory or, if not for immediate use, in an auxiliary storage device.

The control unit selects and calls up instructions from the memory in appropriate sequence and relays the proper commands to the appropriate unit. It also synchronizes the varied operating speeds of the input and output devices to that of the arithmetic-logic unit (ALU) so as to ensure the proper movement of data through the entire computer system.

The ALU performs the arithmetic and logic algorithms selected to process the incoming data at extremely high speeds—in many cases in nanoseconds (billionths of a second). The main memory, control unit, and ALU together make up the central processing unit (CPU) of most digital

computer systems, while the input-output devices and auxiliary storage units constitute peripheral equipment.

Development of the Digital Computer

- Blaise Pascal of France and Gottfried Wilhelm Leibniz of Germany invented mechanical digital calculating machines during the 17th century.
- The English inventor Charles Babbage, however, is generally credited with having conceived the first automatic digital computer.
- During the 1830s Babbage devised his so-called Analytical Engine, a mechanical device designed to combine basic arithmetic operations with decisions based on its own computations. Babbage's plans embodied most of the fundamental elements of the modern digital computer (Fig. 26).
- For example, they called for sequential control—i.e., program control that included branching, looping, and both arithmetic and storage units with automatic printout. Babbage's device, however, was never completed and was forgotten until his writings were rediscovered over a century later.
- Using vacuum tubes (Fig. 27), the ENIAC could perform 300 multiplications per second. However, the fact that it weighed 30 tons and occupied the space of a three bedroom house was the major disadvantage of this computer.
- In the mid 1940s, John Von Neumann published a paper where he gave the concept of stored program and using binary number system for computation purposes.
- This idea was incorporated into a new computer called the EDVAC and then the EDSAC. Later in time, the UNIVAC came into existence.

Fig. 26: Digital Computer

1.8 GENERATION OF COMPUTERS

Computer production started in the 1940s when the first electronic computer was created. Since then, the improvements and enhancements in the field of electronics had considerable influence on the design of computers thus leading to what is known today as Generation of Computers.

1.8.1 First Generation

The computers in this generation used machine code as programming language. The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms.

Dr. John Vincent Atanasoff and Clifford Berry created the first electronic computer. They called it the Atanasoff-Berry Computer (ABC). The ABC used vacuum tubes for storage and arithmetic and logical functions.

Fig. 27: Vacuum tubes

This work was observed by John W. Mauchly, who in 1940-41 teamed up with J. Presper Eckert Jr., and organized the construction of the ENIAC. The ENIAC, shown in Figure 28, was the first general purpose computer to be put fully in operation.

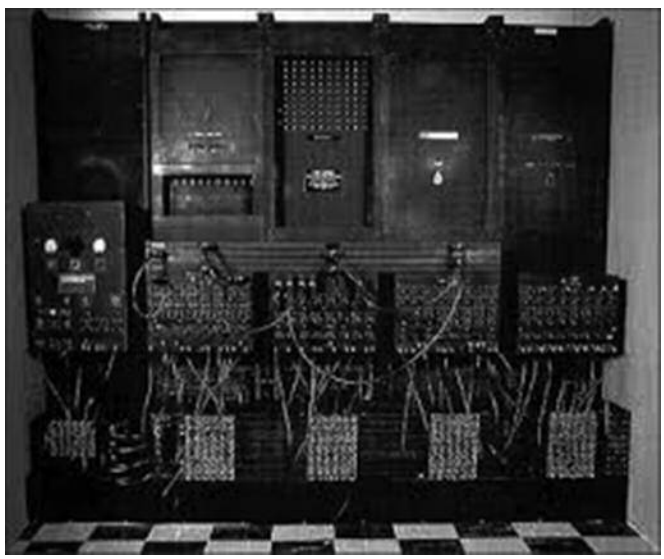

Fig. 28: ENIAC

Characteristics:

- These computers were based on vacuum tube technology.
- These were the fastest computing devices of their times (computation time was in milliseconds).
- These computers were very large and required a lot of space for installation.
- Since thousands of vacuum tubes were used, they generated a large amount of heat. Therefore, air conditioning was essential. These were non-portable and very slow equipments.
- They lacked in versatility and speed. They were very expensive to operate and used a large amount of electricity.
- These machines were unreliable and prone to frequent hardware failures. Hence, constant maintenance was required.
- Since machine language was used, these computers were difficult to program and use.
- Each individual component had to be assembled manually. Hence, commercial appeal of these computers was poor.

1.8.2 Second Generation

The main disadvantage of the first generation computers was the fact that the vacuum tubes, owing to their short life, had to be replaced frequently and they generated a lot of heat. These computers took up a lot of space and programming them was a tedious task because programs had to be written in machine language. In the 1950s, these disadvantages led to the creation of computers, which were much smaller and faster.

In addition to this, programming in these computers was easy because they understood high-level programming languages. These languages were more English like and easy to understand. The computers in this generation used solid state components such as the transistors developed by the Bell Laboratories. Some computers of this generation are LEO mark III, ATLAS and the IBM 7000 series, shown in Figure 29.

Fig. 29: IBM 7000 series

Characteristics :

- These machines were based on transistor technology.
- These were smaller as compared to the first-generation computers.
- The computational time of these computers was reduced to microseconds from milliseconds.
- These were more reliable and less prone to hardware failure. Hence, they required less frequent maintenance. These were more portable and generated less amount of heat.
- Assembly language was used to program computers. Hence, programming became more time-efficient and less cumbersome.
- Second-generation computers still required air conditioning.
- Manual assembly of individual components into a functioning unit was still required.

1.8.3 Third Generation

The second-generation computers were well suited to do either scientific or non-scientific applications but not both. Thus, in 1964, IBM announced the System 360 family of mainframes, where each processor had a set of large built-in instructions. The period of third generation was from 1965-1971. The computers of third generation used Integrated Circuits (ICs) in place of transistors. A single IC has many transistors, resistors, and capacitors along with the associated circuitry.

The IC was invented by Jack Kilby. This development made computers smaller in size, reliable, and efficient. In this generation remote processing, time-sharing, multiprogramming operating system were used. High-level languages (FORTRAN-II TO IV, COBOL, PASCAL PL/1, BASIC, ALGOL-68 etc.) were used during this generation.

Some of these instructions could be used effectively for scientific calculation while the others were more suited for record-keeping applications. The computers in this generation used the technology of Integrated Circuits (IC). Since the ICs were small in size, there was a further reduction in size of these computers. A typical IC is shown in Figure 30. These computers were based on IC technology.

Characteristics:

- These were able to reduce the computational time from microseconds to nanoseconds.
- These were easily portable and more reliable than the second-generation computers.
- These devices consumed less power and generated less heat. In some cases, air conditioning was still required. The size of these computers was smaller as compared to previous-generation computers.
- Since hardware rarely failed, the maintenance cost was quite low. Extensive use of high-level languages became possible.
- Manual assembling of individual components was not required, so it reduced the large requirement of labour and cost. However, highly sophisticated technologies were required for the manufacturing of IC chips.
- Commercial production became easier and cheaper.

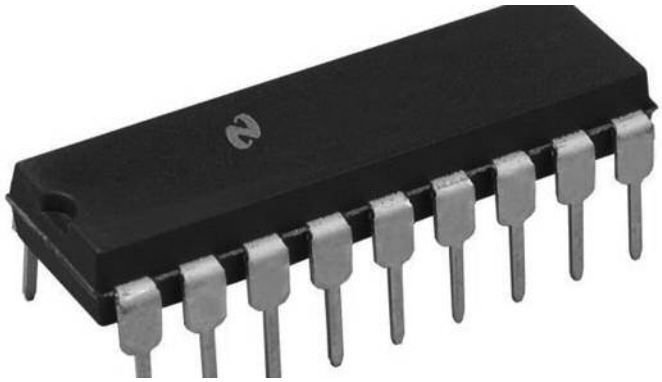

Fig. 30: Integrated circuit

The main features of the third generation are:

- IC used
- More reliable in comparison to previous two generations
- Smaller size
- Generated less heat
- Faster
- Lesser maintenance
- Costly
- AC required
- Consumed lesser electricity
- Supported high-level language

1.8.4 Fourth Generation (Early 1970s to till Date): Microprocessors

As the technology advanced, the size of the ICs reduced and more and more components could be packed into smaller chips. They were called Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) chips, as in Figure 31. Since the computers in this generation used these chips, their size was greatly reduced. The speed at which they operated increased and their cost decreased. The computers of today are said to be of the fourth generation.

The fourth generation is an extension of third generation technology. Although, the technology of this generation is still based on the IC, these have been made readily available to us because of the development of the microprocessor (circuits containing millions of transistors). The Intel 4004 chip, which was developed in 1971, took the IC one step further by locating all the components of a computer (CPU, memory and I/O controls) on a minuscule chip.

A microprocessor is built on to a single piece of silicon, known as chip. It is about 0.5 cm along one side and no more than 0.05 cm thick.

Fig. 31: VLSI

The fourth-generation computers led to an era of Large Scale Integration (LSI) and VLSI technology. LSI technology allowed thousands of transistors to be constructed on one small slice of silicon material, whereas VLSI squeezed hundreds of thousands of components on to a single chip. Ultra Large Scale Integration (ULSI) increased that number to the millions. This way computers became smaller and cheaper than ever before.

The fourth-generation computers became more powerful, compact, reliable and affordable. As a result, it gave rise to the PC revolution. During this period, magnetic core memories were substituted by semiconductor memories, which resulted in faster random access main memories. Moreover, secondary memories such as hard disks became economical, smaller and bigger in capacity.

The other significant development of this era was that these computers could be linked together to form networks, which eventually led to the development of the Internet. This generation also saw the development of the Graphical User Interfaces (GUIs), mouse and hand-held devices.

Characteristics :

- These computers are microprocessor-based systems.
- These are very small in size and the cheapest among all the other generation computers.
- These are portable and quite reliable and generate negligible amount of heat, hence do not require air conditioning. Hardware failure is negligible so minimum maintenance is required.
- The production cost is very low. The GUI and pointing devices enabled users to learn to use the computer quickly.
- Interconnection of computers led to better communication and resource sharing.

1.8.5 Fifth Generation

It had been predicted that by early 21st century, computers should be able to behave like human making interaction more human like. They would be able to think and act on their own. This situation is very well depicted in the motion picture Terminator II where the computers acts on their own, based on their own judgment.

Characteristics

- ULSI technology.
- Development of true artificial intelligence.
- Development of Natural language processing.
- Advancement in Parallel Processing.
- Advancement in Superconductor technology.
- More user-friendly interfaces with multimedia features.
- Availability of very powerful and compact computers at cheaper rates.

1.9 APPLICATIONS OF COMPUTERS

In the last few decades, computer technology has revolutionized the businesses and other aspects of human life all over the world. Practically, every company, large or small, is now directly or indirectly dependent on computers for data processing. Computer systems also help in the efficient operation of railway and airway reservation, hospital records, accounts, electronic banking and so on. Computers not only save time, but also save paper work. Some of the areas where computers are being used are listed below.

1.9.1 Business

A computer has high speed of calculation, diligence, accuracy, reliability, or versatility which has made it an integrated part in all business organizations. This is one of the important uses of the computer. Initially, computers were used for batch processing jobs, where one does not require the immediate response from the computer.

Currently, computers are mainly used for real-time applications (like at the sales counter) that require immediate response from the computer. There are various concerns for which computers are used such as in business forecasting, to prepare pay bills and personal records, in banking operations and data storage, in various types of life insurance business, and as an aid to management.

Businesses are also using the networking of computers, where a number of computers are connected together to share the data and the information.

Use of an e-mail and the Internet has changed the ways of doing business.

Computer is used in business organizations for:

- Payroll calculations
- Budgeting

- Sales analysis
- Financial forecasting
- Managing employee database
- Maintenance of stocks, etc.

Fig. 32: Computer used in business.

1.9.2 Publishing

Computers have created a field known as Desktop Publishing (DTP). In DTP, with the help of a computer and a laser printer one can perform the publishing job all by oneself. Many of the tasks requiring long manual hours, such as making a table of contents and an index, can be automatically performed using the computers and DTP software.

1.9.3 Banking

Fig. 33: Banking

In the field of banking and finance, computers are extensively used. People can use the Automated Teller Machine (ATM) services 24 hours a day in order to deposit and withdraw cash. When the different branches of the bank are connected through the computer networks, the inter-branch transactions, such as drawing cheques and making drafts, can be performed by the computers without any delay .

Today, banking is almost totally dependent on computers. Banks provide the following facilities:

- Online accounting facility, which includes checking current balance, making deposits and overdrafts, checking interest charges, shares, and trustee records.
- ATM machines which are completely automated are making it even easier for customers to deal with banks.

1.9.4 Insurance

Insurance companies are keeping all records up-to-date with the help of computers. Insurance companies, finance houses, and stock broking firms are widely using computers for their concerns. Insurance companies are maintaining a database of all clients with information showing:

Fig. 34: Insurance

- Procedure to continue with policies
- Starting date of the policies
- Next due installment of a policy
- Maturity date
- Interests due
- Survival benefits
- Bonus

1.9.5 Education

The computer helps in providing a lot of facilities in the education system. Computers have also revolutionized the whole process of education. Currently, the classrooms, libraries and museums are utilizing computers to make the education much more interesting. Unlike recorded television

shows, computer-aided education (CAE) and computer-based training (CBT) packages are making learning much more interactive.

- The computer provides a tool in the education system known as CBE (Computer Based Education).
- CBE involves control, delivery, and evaluation of learning.
- Computer education is rapidly increasing the graph of number of computer students.
- There are a number of methods in which educational institutions can use a computer to educate the students.
- It is used to prepare a database about performance of a student and analysis is carried out on this basis.

Fig. 35: Computer helps to provide education.

1.9.6 Marketing

In marketing, uses of the computer are following:

- **Advertising** − With computers, advertising professionals create art and graphics, write and revise copy, and print and disseminate ads with the goal of selling more products.
- **Home Shopping** − Home shopping has been made possible through the use of computerized catalogues that provide access to product information and permit direct entry of orders to be filled by the customers.

Fig. 36: Marketing

1.9.7 Healthcare

Computers have become an important part in hospitals, labs, and dispensaries. They are being used in hospitals to keep the record of patients and medicines. It is also used in scanning and diagnosing different diseases. ECG, EEG, ultrasounds and CT scans, etc. are also done by computerized machines. Hence, there has been an increasing use of computers in the field of medicine. Now, doctors are using computers right from diagnosing the illness to monitoring a patient's status during complex surgery.

Fig. 37: Doctors are using computers.

By using automated imaging techniques, doctors are able to look inside a person's body and can study each organ in detail (such as CAT scans or MRI scans), which was not possible few years ago. There are several examples of special-purpose computers that can operate within the human body such as a cochlear implant, a special kind of hearing aid that makes it possible for deaf people to hear.

Following are some major fields of health care in which computers are used.

- **Diagnostic System** − Computers are used to collect data and identify the cause of illness.
- **Lab-diagnostic System** − All tests can be done and the reports are prepared by computer.
- **Patient Monitoring System** − These are used to check the patient's signs for abnormality such as in Cardiac Arrest, ECG, etc.
- **Pharma Information System** − Computer is used to check drug labels, expiry dates, harmful side effects, etc.
- **Surgery** − Nowadays, computers are also used in performing surgery.

1.9.8 Engineering Design

Computers are widely used for Engineering purpose. One of the major areas is CAD (Computer Aided Design) that provides creation and modification of images. The architects and engineers are extensively using computers in designing and drawings. Computers can create objects that can be viewed from all the three dimensions.

By using techniques like virtual reality, architects can explore houses that have been designed but not built. The manufacturing factories are using computerized robotic arms in order to perform hazardous jobs.

Besides, computer-aided manufacturing (CAM) can be used in designing the product, ordering the parts and planning production. Thus, computers help in coordinating the entire manufacturing process.

Fig. 38: Computers are widely used for Engineering purpose.

Some of the fields are:

- **Structural Engineering** − Requires stress and strain analysis for design of ships, buildings, budgets, airplanes, etc.
- **Industrial Engineering** − Computers deal with design, implementation, and improvement of integrated systems of people, materials, and equipment.
- **Architectural Engineering** − Computers help in planning towns, designing buildings, determining a range of buildings on a site using both 2D and 3D drawings.

1.9.9 Military

Computers are largely used in defence. Modern tanks, missiles, weapons, etc. Military also employs computerized control systems.

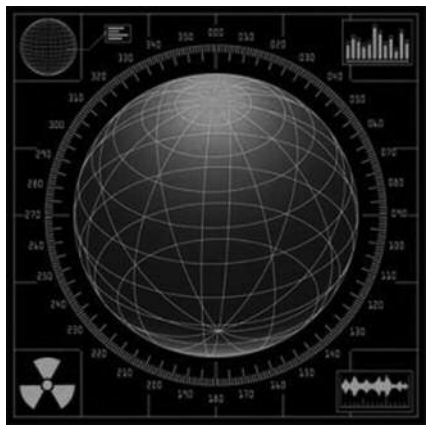

Fig.39: Computers are largely used in defence.

Some military areas where a computer has been used are:

- Missile Control
- Military Communication
- Military Operation and Planning
- Smart Weapons

1.9.10 Communication

Communication is a way to convey a message, an idea, a picture, or speech that is received and understood clearly and correctly by the person for whom it is meant. E-mail or electronic mail is one of the communication media in which computers are used.

Fig. 40: Conveying message through computer.

Through an e-mail, messages and reports are passed from one person to one or more persons with the aid of computers and telephone lines. The advantage of this service is that while transferring the messages it saves time, avoids wastage of paper, and so on.

Moreover, the person who is receiving the messages can read the messages whenever he is free and can save it, reply it, forward it or delete it from the computer.

Some main areas in this category are:

- E-mail
- Chatting
- Usenet
- FTP
- Telnet
- Video-conferencing

1.9.11 Government

Computers play an important role in government services. Some major fields in this category are −

- Budgets
- Sales tax department
- Income tax department
- Computation of male/female ratio
- Computerization of voters lists
- Computerization of PAN card
- Weather forecasting

Fig. 41: Computer used in government services.

1.10 INPUT AND OUTPUT DEVICES

A personal computer would be useless if you could not interact with it because the machine could not receive instructions or deliver the results of its work. Input devices accept data and instructions from the user or from another computer system. Output devices return processed data to the user or the another computer system.

The most common input device is the keyboard, which accepts letters, numbers, and commands from the user. Another important type of input device is the mouse which lets you select options from on-screen menus. You use a mouse by moving it across a flat surface and pressing its buttons.

In these notes, we take a brief look at the functions of the different hardware components. In addition, we describe the some of the essential software required for the operation of a computer system.

A computer has two major internal components that are of particular interest to us, namely its processor and its memory. There will also be a power supply unit (not shown) to provide power for the system.

Hence, the term device is used to describe any piece of hardware that we connect to a computer such as a keyboard, monitor, disk drive, printer and so on. Such devices are also sometimes described as peripheral devices or simply peripherals. They may be classified as Input/Output (I/O) devices and storage devices.

The devices which are used to give data and instructions to the computer are called Input Devices. Various types of input devices can be used with the computer depending upon the type of data you want to enter in the computer, e.g., keyboard, mouse, joystick, light pen, etc.

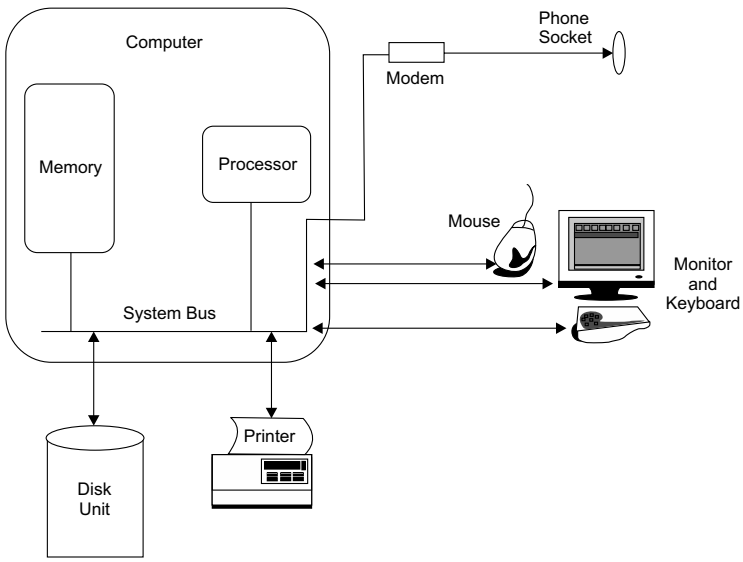

Fig. 42 : Input and Output Devices

As the name suggests, I/O devices are responsible for communicating with the computer, providing input for the computer to process and arranging to display output for computer users. The keyboard and mouse are commonly used input devices.

The monitor is the commonest output device, followed by the printer for hardcopy (permanent) output. Storage devices are used to store information in a computer system. The memory is used to store information inside the computer while the computer is switched on. Disk storage is the commonest form of external storage, followed by the tape storage.

External storage devices can store information indefinitely or more realistically, for some number of years. A very important component of a computer system is the system bus. This is used to transfer information between all system components.

1.10.1 Graphics Input Devices

An input device consists of external devices—that is, outside of the computer's CPU—that provide information and instructions to the computer.

Keyboard

A keyboard is an input device, partially modeled after the typewriter keyboard, which uses an arrangement of buttons or keys, which act as electronic switches. A keyboard typically has characters engraved or printed on the keys and each press of a key typically corresponds to a single written symbol.

However, to produce some symbols requires pressing and holding several keys simultaneously or in sequence. While most keyboard keys produce letters, numbers or signs (characters), other keys or simultaneous key presses can produce actions or computer commands.

Mouse

A mouse is a pointing device that functions by detecting two-dimensional motion relative to its supporting surface. Physically, a mouse consists of an object held under one of the user's hands, with one or more buttons. It sometimes features other elements, such as "wheels", which allow the user to perform various system-dependent operations, or extra buttons or features can add more control or dimensional input.

The mouse's motion typically translates into the motion of a pointer on a display, which allows for fine control of a Graphical User Interface. Generally mouse can be divided into two categories: Mechanical mouse and Optical mouse .

Trackball

A trackball is a pointing device consisting of a ball housed in a socket containing sensors to detect rotation of the ball about two axes—like an upside-down mouse with an exposed protruding ball. The user rolls the ball with the thumb, fingers, or the palm of the hand to move a cursor.

Large tracker balls are common on CAD workstations for easy precision. Before the advent of the touch pad, small trackballs were common on portable computers, where there may be no desk space on which to run a mouse.

Fig. 43 : Trackball

Some small thumb balls clip onto the side of the keyboard and have integral buttons with the same function as mouse buttons.
The trackball was invented by Tom Cranston and Fred Longstaff as part of the Royal Canadian Navy's DATAR system in 1952, eleven years before the mouse was invented.

Touchpad

A touchpad is a pointing device consisting of specialized surface that can translate the motion and position of a user's fingers to a relative position on screen. These are common features of laptop computers and also used as a substitute for a computer mouse where desk space is scarce. Touchpads

vary in size but are rarely made larger than 40 square centimeters (about 6 square inches). These can also be found on personal digital assistants (PDAs) and some portable media players.

Graphics Tablet

A graphics tablet (or digitizing tablet, graphics pad, drawing tablet) is a computer input device that allows one to hand-draw images and graphics, similar to the way one draws images with a pencil and paper. These tablets may also be used to capture data of handwritten signatures.

A graphics tablet (also called pen pad) consists of a flat surface upon which the user may "draw" an image using an attached stylus, a pen-like drawing apparatus. The image generally does not appear on the tablet itself but, rather, is displayed on the computer monitor. Some tablets, however, come as a functioning secondary computer screen that you can interact with directly using the stylus.

Touch screen

Touchscreen is a display which can detect the presence and location of a touch within the display area. This term generally refers to touch or contact to the display of the device by a finger or hand. Touch screens can also sense other passive objects, such as a stylus.

However, if the object sensed is active, as with a light pen, the term touchscreen is generally not applicable. The ability to interact directly with a display typically indicates the presence of a touchscreen.

Joystick

A joystick is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer.

Fig. 44 : Joystick

A popular variation of the joystick used on modern video game consoles is the analog stick. Joystick is mainly used in video games.

Light Pen

A light pen is a computer input device in the form of a light-sensitive wand used in conjunction with a computer's CRT TV set or monitor. It allows the user to point to displayed objects, or draw on the screen, in a similar way to a touch screen but with greater positional accuracy. A light pen can work with any CRT-based display, but not with LCD screens projectors and other display devices.

Fig. 45 : Light Pen

A light pen is fairly simple to implement. The light pen works by sensing the sudden small change in brightness of a point on the screen when the electron gun refreshes that spot. By noting exactly where the scanning has reached at that moment, the X,Y position of the pen can be resolved. This is usually

achieved by the light pen causing an interrupt, at which point the scan position can be read from a special register, or computed from a counter or timer. The pen position is updated on every refresh of the screen.

Webcams

Webcams are video capturing devices connected to computers or computer networks, often using USB or, if they connect to networks, ethernet or Wi-Fi. They are well-known for their low manufacturing costs and flexible applications.

Fig. 46 : Webcams

Barcode Reader

A barcode reader (or barcode scanner) is an electronic device for reading printed barcodes. Like a flatbed scanner, it consists of a light source, a lens and a light sensor translating optical impulses into electrical ones.

Additionally, nearly all barcode readers contain decoder circuitry analyzing the barcode's image data provided by the sensor and sending the barcode's content to the scanner's output port. Scanning methods are distinguished by the amount of operator manipulation required:

- **Pen type readers:** requires the operator to swipe the pen over the code.
- **Semi-automatic handheld readers:** The operator need not swipe, but must at least position the reader near the label
- **Fix-mount readers for automatic reading:** The reading is performed laterally passing the label over the reader. No operator is required, but the position of the code target must coincide with the imaging capability of the reader.
- **Reader gates for automatic scanning:** The position of the code must be just under the gate for short time, enabling the scanner sweep to capture the code target successfully.

3D Scanner

A 3D scanner is a device that analyzes a real-world object or environment to collect data on its shape and possibly its appearance (i.e. color). The collected data can then be used to construct digital, three dimensional models useful for a wide variety of applications. These devices are used extensively by the entertainment industry in the production of movies and video games.

Other common applications of this technology include industrial design, orthotics and prosthetics, reverse engineering and prototyping, quality control/inspection and documentation of cultural artifacts.

Many different technologies can be used to build these 3D scanning devices; each technology comes with its own limitations, advantages and costs. It should be remembered that many limitations in the kind of objects that can be digitized are still present: For example, optical technologies encounter many difficulties with shiny, mirroring or transparent objects.

1.11 MEMORY OF COMPUTER

The term "memory", meaning "primary storage" or "main memory", is often associated with addressable semiconductor memory, i.e. integrated circuits consisting of silicon-based transistors, used for example as primary storage but also other purposes in computers and other digital electronic devices. There are two main kinds of semiconductor memory, volatile and non-volatile.

Computer memory is any physical device capable of storing information temporarily or permanently. For example, Random Access Memory (RAM), is a volatile memory that stores information on an integrated circuit used by the operating system, software, and hardware.

Examples of non-volatile memory are flash memory (used as secondary memory) and ROM, PROM, EPROM and EEPROM memory (used for storing firmware such as BIOS). Examples of volatile memory are primary storage, which is typically dynamic random-access memory (DRAM), and fast CPU cache memory, which is typically static random-access memory (SRAM) that is fast but energy-consuming, offering lower memory areal density than DRAM.

1.11.1 Random Access Memory (RAM)

The most common type of memory is called as Random Access Memory (RAM). As a result, the term memory is typically used to mean RAM. RAM is like an electronic scratch pad inside the computer. It holds data and program instructions while the CPU works with them. When a program is launched, it is loaded into and run from memory. As the programs need data, it is loaded into memory for fast access. As new data is entered into the computer, it is also stored in memory—but only temporarily. When the computer is off, main memory is empty, when it is on it is capable of receiving and holding a copy of the software instructions, and data necessary for processing.

Because the main memory is a volatile form of storage that depends on electric power can go off during processing, users save their work frequently on to non volatile secondary storage devices such as diskettes or hard disk.

The main memory is used for the following purposes:

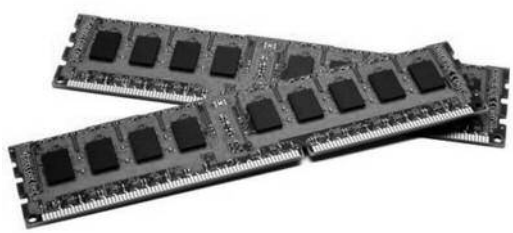

Fig. 47 : Random access memory

1. Storage of the copy of the main software program that controls the general operation of the computer. This copy is loaded on to the main memory when the computer is turned on, and it stays there as long as the computer is on.
2. Temporary storage of a copy of application program instruction, to be received by CPU for interpretation and processing or execution.
3. Temporary storage of data that has been input from the key board, until instructions call for the data to be transferred in to CPU for processing.
4. Temporary storage of data, which is required for further processing or transferred as output to output devices such as screen, a printer, a disk storage device.

1.11.2 Read-Only Memory (ROM)

Unlike RAM, read-only memory permanently stores its data, even when the computer is shut off. ROM is called non-volatile memory used in computers and other electronic devices. Data stored in ROM can only be modified slowly, with difficulty, or not at all, so it is mainly used to store firmware (software that is closely tied to specific hardware, and unlikely to need frequent updates) or application software in plug-in cartridges.

Strictly, read-only memory refers to memory that is hard-wired, such as diode matrix and the later mask ROM (MROM), which cannot be changed after manufacture. Although discrete circuits can be altered in principle, integrated circuits (ICs) cannot, and are useless if the data is bad or requires an update. That such memory can never be changed is a disadvantage in many applications, as bugs and security issues cannot be fixed, and new features cannot be added.

More recently, ROM has come to include memory that is read-only in normal operation, but can still be reprogrammed in some way. Erasable programmable read-only memory (EPROM) and electrically erasable programmable read-only memory (EEPROM) can be erased and re-programmed, but usually this can only be done at relatively slow speeds, may require special equipment to achieve, and is typically only possible a certain number of times.

1.11.3 PROM

A programmable read-only memory (PROM) or field programmable read-only memory (FPROM) or one-time programmable non-volatile memory (OTP NVM) is a form of digital memory where the setting of each bit is locked by a fuse or antifuse. It is one type of ROM (read-only memory). The data in them is permanent and cannot be changed.

PROMs are used in digital electronic devices to store permanent data, usually low level programs such as firmware (microcode). The key difference from a standard ROM is that the data is written into a ROM during manufacture, while with a PROM the data is programmed into them after manufacture.

Thus, ROMs tend to be used only for large production runs with well-verified data, while PROMs are used to allow companies to test on a subset of the devices in an order before burning data into all of them.

PROMs are manufactured blank and, depending on the technology, can be programmed at wafer, final test, or in system. Blank PROM chips are programmed by plugging them into a device called a PROM programmer.

The availability of this technology allows companies to keep a supply of blank PROMs in stock, and program them at the last minute to avoid large volume commitment. These types of memories are frequently used in microcontrollers, video game consoles, mobile phones, radio-frequency identification (RFID) tags, implantable medical devices, high-definition multimedia interfaces (HDMI) and in many other consumer and automotive electronics products

1.11.4 EPROM

An EPROM (rarely EROM), or erasable programmable read-only memory, is a type of memory chip that retains its data when its power supply is switched off. Computer memory that can retrieve

stored data after a power supply has been turned off and back on is called non-volatile. It is an array of floating-gate transistors individually programmed by an electronic device that supplies higher voltages than those normally used in digital circuits.

Once programmed, an EPROM can be erased by exposing it to strong ultraviolet light source (such as from a mercury-vapor light). EPROMs are easily recognizable by the transparent fused quartz window in the top of the package, through which the silicon chip is visible, and which permits exposure to ultraviolet light during erasing.

1.12 SECONDARY MEMORY DEVICES

Secondary memory (or secondary storage) is the slowest and cheapest form of memory. It cannot be processed directly by the CPU. It must first be copied into primary storage (also known as RAM).

Secondary memory devices include magnetic disks like hard drives and floppy disks ; optical disks such as CDs and CDROMs; and magnetic tapes, which were the first forms of secondary memory.

- A **USB flash drive,** usually portable and rewritable, is a type of flash memory storage device that plugs into a computer's USB port. Flash drives are more expensive than hard drives with the same storage capacity.
- **Floppy disks** are a storage medium made of a thin magnetic disk. They were widely used from the 1970s to the early 2000s. On the 3 1⁄2-inch microfloppy, common from the late 1980s onward, storage capabilities ranged from the standard 1.44 MB to 200 MB on some versions.
- A **CD-R**, a type of recordable CD, is an optical secondary storage device invented by Sony and Philips. It is also known as a WORM — write once read many — medium.
- A **DVD-R**, a type of recordable DVD, has a storage capacity of usually 4.1 GB. There is also an 8.54-GB dual-layer version, called DVD-R DL.
- **Magnetic tape** has been in use for more than 50 years. Modern magnetic tape is packaged in cartridges or cassettes and is used for storing data backups, particularly in corporate settings. The average amount of storage is 5 MB to 140 MB for every standard-length reel, which is 2,400 feet.

1.12.1 Memory Tree

In computer science a T-tree is a type of binary tree data structure that is used by main-memory databases, such as Datablitz, EXtremeDB, MySQL Cluster, Oracle TimesTen and MobileLite.

A T-tree is a balanced index tree data structure optimized for cases where both the index and the actual data are fully kept in memory, just as a B-tree is an index structure optimized for storage on block oriented secondary storage devices like hard disks. T-trees seek to gain the performance benefits of in-memory tree structures such as AVL trees while avoiding the large storage space overhead which is common to them.

T-trees do not keep copies of the indexed data fields within the index tree nodes themselves. Instead, they take advantage of the fact that the actual data is always in main memory together with the index so that they just contain pointers to the actual data fields.

The 'T' in T-tree refers to the shape of the node data structures in the original paper which first described this type of index.

1.12.2 CPU-Types

A few years ago, choosing a processor was pretty straightforward. AMD and Intel each produced two series of processors, a mainstream line and a budget line. Each company used only one processor socket, and there was a limited range of processor speeds available. If you wanted an Intel processor, you might have a dozen mainstream models and a half-dozen budget models to choose among. The same was true of AMD

Now-a-days, choosing a processor isn't as simple. AMD and Intel now make literally scores of different processor models. Each company now offers several lines of processors, which differ in clock speed, L2 cache, socket type, host-bus speed, special features supported, and other characteristics. Even the model names are confusing. AMD, for example, has offered at least five different processor models under the same name Athlon 64 3200+.

An Intel Celeron model number that ends in J fits Socket 775, and the same model number without the J designates the same processor for Socket 478. A Pentium 4 processor model number that ends in J says nothing about the socket type it is designed for, but indicates that the processor supports the execute-disable bit feature. And so on. AMD and Intel each offer the three categories of processors described in the following sections.

1.12.3 Budget Processors

Budget processors give up a bit of performance in exchange for a lower price. At any given time, AMD or Intel's fastest available budget processor is likely to have about 85% of the performance of their slowest mainstream model.

Budget processors are more than sufficient for routine computing tasks. (After all, today's budget processor was yesterday's mainstream processor and last week's performance processor.) Budget processors are often the best choice for a system upgrade, because their lower clock speeds and power consumption make it more likely that they'll be compatible with an older motherboard.

1.12.4 AMD Sempron

The various models of the AMD Sempron processor sell in the $50 to $125 range, and are targeted at the budget through low-end mainstream segment. The Sempron replaced the discontinued Socket A Duron processor in 2004, and the obsolescent Socket A Athlon XP processor in 2005.

Various Sempron models are available in the obsolescent Socket A and in the same Socket 754 used by some Athlon 64 models.

AMD actually packages two different processors under the Sempron name. A Socket A Sempron, also called a K7 Sempron, is in fact a re-badged Athlon XP processor. A Socket 754 Sempron, shown in Figure 48 is also called a K8 Sempron, and is really a cut-down Athlon 64 model running at a lower clock speed with a smaller L2 cache and a single-channel memory controller rather than the dual-channel memory controller of the Athlon 64. Early Sempron models

had no support for 64-bit processing.

Recent Sempron models include 64-bit support, although the practicality of running 64bit software on a Sempron is questionable. Still, like the Athlon 64, the Sempron also runs 32-bit software very efficiently, so you can think of the 64-bit support as future-proofing.

Fig. 48: AMD Sempron processor (image courtesy of AMD, Inc.)

1.12.5 Intel Celeron

For many years, the Intel Celeron processor was the poor stepsister, offering too little performance at too high a price. Cynical observers believed that the only reason Intel sold any Celeron processors at all was that system makers wanted the Intel name on their boxes without having to pay the higher price for an Intel mainstream processor. That all changed when Intel introduced their Celeron D models, which are now available for Socket 478 and Socket 775 motherboards. While Celeron D models are still slower than Semprons dollar-for-dollar, the disparity is nowhere near as large as in years past.

Celeron D processors, which sell in the $60 to $125 range, are very credible upgrade processors for anyone who owns a Socket 478 or Socket 775 motherboard. Like the Sempron, Celeron models are available with 64-bit support, although again the practicality of running 64-bit software on an entry-level processor is questionable.

Once again, it's important to verify the compatibility of your motherboard with the specific Celeron you intend to install, and you may need to upgrade the BIOS to recognize the Celeron.

1.12.6 Mainstream Processors

Mainstream processors typically cost $125 to $250 although the fastest models sell for $500 or more and offer anything up to about twice the overall performance of the slowest budget processors. A mainstream processor may be a good upgrade choice if you need more performance than a budget processor offers and are willing to pay the additional cost.

However, depending on your motherboard, a mainstream processor may not be an option even if you are willing to pay the extra cost. Mainstream processors consume considerably more power than most budget processors, often too much to be used on older motherboards.

1.12.7 AMD Athlon 64

The AMD Athlon 64 processor, shown in Figure 49, is available in Socket 754 and Socket 939 variants. As its name indicates, the Athlon 64 supports 64-bit software, although only a tiny percentage of Athlon 64 owners run 64-bit software. Fortunately, the Athlon 64 is equally at home running the 32-bit operating systems and applications software that most of us use.

Fig. 49: AMD Athlon 64 processor (image courtesy of AMD, Inc.)

Like the Sempron, the Athlon 64 has a memory controller built onto the processor die, rather than depending on a memory controller that's part of the chipset. The upside of this design decision is that Athlon 64 memory performance is excellent. The downside is that supporting a new type of memory, such as DDR2, requires a processor redesign.

Socket 754 models have a single-channel PC3200 DDR-SDRAM memory controller versus the dual-channel controller in Socket 939 models, so Socket 939 models running at the same clock speed and with the same size L2 cache offer somewhat higher performance.

For example, AMD designates a Socket 754 Newcastle-core Athlon 64 with 512 KB of L2 cache running at 2.2 GHz a 3200+ model, while the same processor in Socket 939 is designated an Athlon 64 3400+.

1.12.8 Intel Pentium 4

The Pentium 4, shown in Figure 50, is Intel's flagship processor, and is available in Socket 478 and Socket 775. Unlike AMD which sometimes uses the same Athlon 64 model number to designate four or more different processors with different clock speeds, L2 cache sizes, and sockets Intel uses a numbering scheme that identifies each model unambiguously. Older Pentium 4 models, which are available only in Socket 478, are identified by clock speed and sometimes a supplemental letter to indicate FSB speed and/or core type.

For example, a Socket 478 Northwood-core Pentium 4 processor operating at a core speed of 2.8 GHz with the 400 MHz FSB is designated a Pentium 4/2.8. The same processor with the 533 MHz FSB is designated a Pentium 4/2.8B, and with the 800 MHz FSB it's designated a Pentium 4/2.8C. A 2.8 GHz Prescott-core Pentium 4 processor is designated a Pentium 4/2.8E.

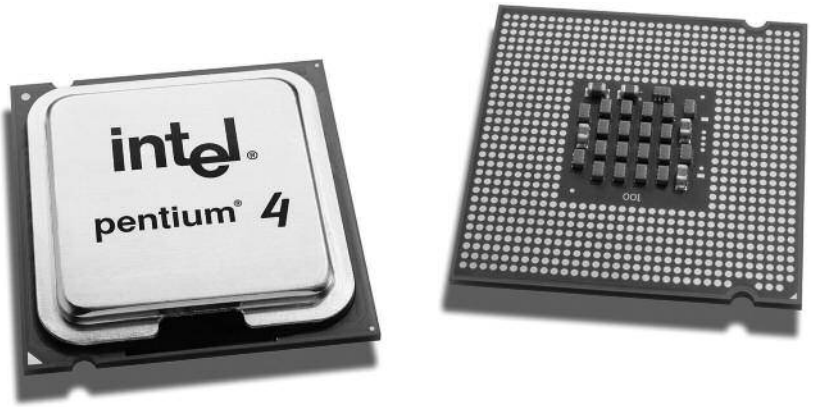

Fig. 50: Intel Pentium 4 600 series processor (image courtesy of Intel Corporation)

Socket 775 Pentium 4 models belong to one of two series. All 500-series processors use the Prescott-core and have 1 MB of L2 cache. All 600-series processors use the Prescott 2M core and have 2 MB of L2 cache.

Intel uses the second number of the model number to indicate relative clock speed. For example, a Pentium 4/530 has a clock speed of 3 GHz, as does a Pentium 4/630. The 540/640 models run at 3.2 GHz, the 550/650 models at 3.4 GHz, the 560/660 models at 3.6 GHz, and so on. A "J" following a 500-series model number (for example, 560J) indicates that the processor supports the XDB feature, but not EM64T 64-bit support.

1.12.9 Dual-core processors

By early 2005, AMD and Intel had both pushed their processor cores to about the fastest possible speeds, and it had become clear that the only practical way to increase processor performance significantly was to use two processors.

Although it's possible to build systems with two physical processors, doing that introduces many complexities, not least a doubling of the already-high power consumption and heat production. AMD, later followed by Intel, chose to go dual-core.

Combining two cores in one processor isn't exactly the same thing as doubling the speed of one processor. For one thing, there is overhead involved in managing the two cores that doesn't exist for a single processor. Also, in a single-tasking environment, a program thread runs no faster on a dual-core processor than it would on a single-core processor, so doubling the number of cores by no means doubles application performance.

But in a multitasking environment, where many programs and their threads are competing for processor time, the availability of a second processor core means that one thread can run on one core while a second thread runs on the second core. The upshot is that a dual-core processor

typically provides 25% to 75% higher performance than a similar single-core processor if you multitask heavily. Dual-core performance for a single application is essentially unchanged unless the application is designed to support threading, which many processor-intensive applications are.

Even if you were running only unthreaded applications, though, you'd see some performance benefit from a dual-core processor. This is true because an operating system, such as Windows XP, that supports dual-core processors automatically allocates different processes to each core.

1.12.10 AMD Athlon 64 X2

The AMD Athlon 64 X2, shown in Figure 51, has several things going for it, including high performance, relatively low power requirements and heat production, and compatibility with most existing Socket 939 motherboards.

Alas, while Intel has priced its least expensive dual-core processors in the sub-$250 range, the least expensive AMD dual-core models initially sold in the $800 range, which is out of the question for most upgraders. Fortunately, by late 2005 AMD had begun to ship more reasonably priced dual-core models, although availability is limited.

Fig. 51: AMD Athlon 64 X2

1.12.11 Intel Pentium D

The announcement of AMD's Athlon 64 X2 dual-core processor caught Intel unprepared. Under the gun, Intel took a cruder approach to making a dual-core processor. Rather than build an integrated dual-core processor as AMD had with its Athlon 64 X2 processors, Intel essentially slapped two slower Pentium 4 cores on one substrate and called it the Pentium D dual-core processor.

The 800-series 90 nm Smithfield-core Pentium D, shown in Figure 52, is a stop-gap kludge for Intel, designed to counter the AMD Athlon 64 X2 until Intel can bring to market its real answer, the dual-core 65 nm Presler-core processor, which is likely to be designated the 900-series Pentium D. The Presler-based dual-core processors will be fully integrated, compatible with existing dual-core Intel-compatible motherboards, and feature reduced power consumption, lower heat output, twice as much L2 cache, and considerably higher performance.

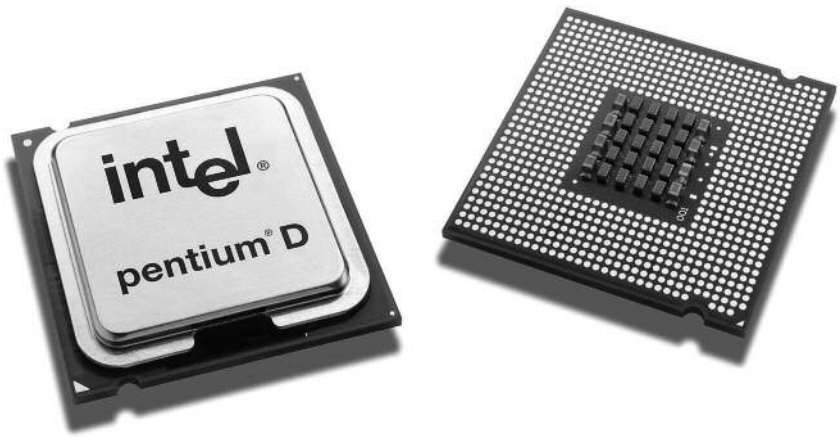

Fig. 52: Intel Pentium D dual-core processor (image courtesy of Intel Corporation)

Reading the foregoing, you might think we had only contempt for the 800-series Pentium D processors. In fact, nothing could be further from the truth. They're a kludge, yes, but they're a reasonably cheap, very effective kludge, assuming that you have a motherboard that supports them.

We extensively tested an early sample of the least expensive 800-series Pentium D, the 820. The 820 runs at 2.8 GHz, and under light, mostly single-tasking use, the 820 "feels" pretty much like a 2.8 GHz Prescott-core Pentium 4. As we added more and more processes, the difference became clear. Instead of bogging down, as the single-core Prescott would have done, the Pentium D provided snappy response to the foreground process.

1.13 LEVELS OF PROGRAMMING LANGUAGE

- Microcode
- Machine code
- Assembly Language
- Low-level Programming Language
- High-level Programming Language

1.13.1 Microcode

Microcode is a computer hardware technique that imposes an interpreter between the CPU hardware and the programmer-visible instruction set architecture of the computer. As such, the microcode is a layer of hardware-level instructions that implement higher-level machine code instructions or internal state machine sequencing in many digital processing elements.

Microcode is used in general-purpose central processing units, although in current desktop CPUs it is only a fallback path for cases that the faster hardwired control unit cannot handle.

Microcode typically resides in special high-speed memory and translates machine instructions, state machine data or other input into sequences of detailed circuit-level operations. It separates

the machine instructions from the underlying electronics so that instructions can be designed and altered more freely.

It also facilitates the building of complex multi-step instructions, while reducing the complexity of computer circuits. Writing microcode is often called microprogramming and the microcode in a particular processor implementation is sometimes called a microprogram.

- Machine-specific code that directs the individual components of a CPU's data-path to perform small-scale operations.
- **CPU:** central processing unit of a computer, typically consisting of:
  1. Control unit
  2. Arithmetic/logical unit (ALU)
  3. Registers – high-speed memory locations to store temporary results and control information. Foremost among these is the program counter, which points to the next instruction to be executed.
- The CPU is connected to I/O devices and main memory by parallel channels called buses Machine-specific code that directs the individual components of a CPU's data-path to perform small-scale operations.
- Data-path: the ALU, its inputs and outputs.
- People who build computers program in micro-code. The programs that you write are converted (as explained later) into machine code.
- Every machine code instruction tells the CPU to execute a certain microprogram, written in micro-code.
- Often these programs are implemented in hardware.

On the other hand, some microprocessors are:

- programmable, e.g., many digital signal processing chips that mobile telephones use, FPGAs, or reconfigurable – they can actually rewire themselves.

1.13.2 Machine code / Assembly Language

"Machine code or machine language is a system of instructions and data executed directly by a computer's central processing unit." Basically, assembler code is the language and it is translated to object code (the native code that the CPU runs) by an assembler (analogous to a compiler).

- Machine code instructions still depend on the computer's architecture, but the variation isn't as great; many CPUs manufactured around the same time or by the same company will use the same machine code sets, in fact.
- Assembly language is a symbolic presentation of machine code so that people (very dedicated people with lots of free time) can read programs written in it.
- Most assemblers (programs that convert assembly code to machine code) support labelling and macros to make assembly language programming easier. Some recent assemblers support looping control structures, simple data structures and even types!

1.13.3 Low-level Programming Language

A low-level programming language is a programming language that provides little or no abstraction from a computer's instruction set architecture—commands or functions in the language map closely to processor instructions.

- Formerly known as high-level programming languages. – e.g.: FORTRAN, COBOL, BASIC, arguably C
- These languages have looping constructs, procedures, functions, some typing – the trappings of modern programming languages. Big improvement over assembly language.

1.13.4 High-level Programming Language

language such as C, FORTRAN, or Pascal that enables a programmer to write programs that are more or less independent of a particular type of computer. Such languages are considered high-level because they are closer to human languages and further from machine languages.

- e.g.: Java, Python, ML, Prolog, MATLAB, etc.
- These are very convenient, but also very far removed from the computer they are running on.
- Type checking
- Easier to debug
- You may never even see a memory address.
  - As a result, they typically aren't as efficient.
  - They still may not be portable: implementation dependence. Java has had some problems with this.

1.13.5 Compilation

A compiled language is a programming language whose implementations are typically compilers (translators that generate machine code from source code), and not interpreters (step-by-step executors of source code, where no pre-runtime translation takes place). The term is somewhat vague:

- A compiler is a program that converts a program written at one of the higher levels
- into an equivalent program at some lower level.
- Some people have even tried to use C as a target language for Java, ML or Prolog compilers.
- Not always the next level down, though.
- Native code compilers compile the code all the way down into the machine code level.

Advantages

- Compile once, run target many times
- Compiler can optimize the speed of the target, even if the optimization itself takes a long time.
- Actually, most compilers define their own intermediate code levels, and perform optimizations

at the source level, the intermediate level, and at the target level. Which level is best depends on the optimization.

Disadvantage

- debugging requires much more
- software support
- typically through annotated object code and IDE extensions.

1.13.6 Interpreted Code

An interpreted language is a type of programming language for which most of its implementations execute instructions directly and freely, without previously compiling a program into machine-language instructions. ... Java and C# are compiled into bytecode, the virtual-machine-friendly interpreted language.

- Code that isn't compiled before execution is interpreted.
- Some programming languages have both compilers and interpreters.
- Not a black-and-white distinction either – it's very rare for an interpreter to perform no compilation whatsoever
- A byte compiler translates source code into a more compact form by coding keywords and hashing variables names and other strings.

Advantages:

- Creates the impression that your computer actually runs on a high-level language
- Easier to provide feedback for debugging because execution proceeds from (something close to) source code
- Easier to rapidly prototype and often easier to add code while running code.

Disadvantages:

– Slower

– Independent executions repeat much of the same work.

Inside your Interpreter

- The fetch-execute cycle
  - initialize the program counter
  - loop
- fetch instruction pointed to by PC
- increment the PC
- decode the instruction

- fetch data from memory, as necessary
- execute the instruction
- store the result
  - end loop
- The idea that an imperative program is sitting around executing your precious ML code is anathema to functional programmers.
- But we can think of it functionally: then it's called the read-eval-print loop, a recursive program that repeatedly:
  - initializes the evaluation environment
  - reads an expression
  - evaluates the expression, and then
  - prints the expression

1.14 PROGRAMMING OVERVIEW

Before getting into computer programming, let us first understand computer programs and what they do. A computer program is a sequence of instructions written using a Computer Programming Language to perform a specified task by the computer.

The two important terms that we have used in the above definition are:

- Sequence of instructions
- Computer Programming Language

To understand these terms, consider a situation when someone asks you about how to go to a nearby KFC. What exactly do you do to tell him the way to go to KFC? You will use Human Language to tell the way to go to KFC, something as follows:

- First go straight, after half kilometer,
- take left from the red light and then
- drive around one kilometer and you will find KFC at the right.

Here, you have used English Language to give several steps to be taken to reach KFC. If they are followed in the following sequence, then you will reach KFC −

1. Go straight
2. Drive half kilometer
3. Take left
4. Drive around one kilometer
5. Search for KFC at your right side

Now, try to map the situation with a computer program. The above sequence of instructions is actually a Human Program written in English Language, which instructs on how to reach KFC from a given starting point. This same sequence could have been given in Spanish, Hindi, Arabic, or any other human language, provided the person seeking direction knows any of these languages.

Now, let's go back and try to understand a computer program, which is a sequence of instructions written in a Computer Language to perform a specified task by the computer. Following is a simple program written in Python programming Language −

```
print "Hello, World!"
```

The above computer program instructs the computer to print "Hello, World!" on the computer screen. A computer program is also called a computer software, which can range from two lines to millions of lines of instructions. Computer program instructions are also called program source code and computer programming is also called program coding.

A computer without a computer program is just a dump box; it is programs that make computers active. As we have developed so many languages to communicate among ourselves, computer scientists have developed several computer-programming languages to provide instructions to the computer (i.e., to write computer programs). We will see several computer programming languages in the subsequent chapters. If you understood what a computer program is, then we will say: the act of writing computer programs is called computer programming. As we mentioned earlier, there are hundreds of programming languages, which can be used to write computer programs and following are a few of them −

- Java C
- C++
- Python
- PHP
- Perl
- Ruby

1.14.1 Uses of Computer Programs

Today computer programs are being used in almost every field, household, agriculture, medical, entertainment, defense, communication, etc. Listed below are a few applications of computer programs:

- MS Word, MS Excel, Adobe Photoshop, Internet Explorer, Chrome, etc., are examples of computer programs.
- Computer programs are being used to develop graphics and special effects in movie making.
- Computer programs are being used to perform Ultrasounds, X-Rays, and other medical examinations.
- Computer programs are being used in our mobile phones for SMS, Chat, and voice communication.

1.14.2 Computer Programmer

Someone who can write computer programs or in other words, someone who can do computer programming is called a Computer Programmer. Based on computer programming language expertise, we can name a computer programmers as follows −

- C Programmer
- C++ Programmer
- Java Programmer
- Python Programmer
- PHP Programmer
- Perl Programmer
- Ruby Programmer
- Algorithm

From programming point of view, an algorithm is a step-by-step procedure to resolve any problem. An algorithm is an effective method expressed as a finite set of well-defined instructions.

Thus, a computer programmer lists down all the steps required to resolve a problem before writing the actual code. Following is a simple example of an algorithm to find out the largest number from a given list of numbers −

1. Get a list of numbers L1, L2, L3....LN
2. Assume L1 is the largest, Largest = L1
3. Take next number Li from the list and do the following
4. If Largest is less than Li
5. Largest = Li
6. If Li is last number from the list then
7. Print value stored in Largest and come out
8. Else repeat same process starting from step 3

The above algorithm has been written in a crude way to help beginners understand the concept. You will come across more standardized ways of writing computer algorithms as you move on to advanced levels of computer programming.

We assume you are well aware of English Language, which is a well-known Human Interface Language. English has a predefined grammar, which needs to be followed to write English statements in a correct way. Likewise, most of the Human Interface Languages (Hindi, English, Spanish, French, etc.) are made of several elements like verbs, nouns, adjectives, adverbs, propositions, and conjunctions, etc.

Similar to Human Interface Languages, Computer Programming Languages are also made of several elements. We will take you through the basics of those elements and make you comfortable to use them in various programming languages.

These basic elements include:

- Programming Environment
- Basic Syntax
- Data Types
- Variables
- Keywords

- Basic Operators
- Decision Making
- Loops
- Numbers
- Characters
- Arrays
- Strings
- Functions
- File I/O

1.15 SOFTWARE

Computer software, or simply software, is a generic term that refers to a collection of data or computer instructions that tell the computer how to work, in contrast to the physical hardware from which the system is built, that actually performs the work . Software can be broadly divided into two categories application software and system software.

1.15.1 System Software

System software is computer software designed to provide a platform to other software. Examples of system software include operating systems, computational science software, game engines, industrial automation, and software as a service applications. In contrast to system software, software that allows users to do things like create text documents, play games, listen to music, or surf the web is called application software.

In the early days of computing most application software was custom-written by computer users to fit their specific hardware and requirements. In contrast, system software was usually supplied by the manufacturer of the computer hardware and was intended to be used by most or all users of that system.

The line where the distinction should be drawn is not always clear. Many operating systems bundle application software. Such software is not considered system software when it can be uninstalled usually without affecting the functioning of other software. Exceptions could be e.g. web browsers such as Internet Explorer where Microsoft argued in court that it was system software that could not be uninstalled. Later examples are Chrome OS and Firefox OS where the browser functions as the only user interface and the only way to run programs (and other web browsers can not be installed in their place), then they can well be argued to be (part of) the operating system and hence system software.

Another borderline example is cloud-based software. This software provides services to a software client (usually a web browser or a JavaScript application running in the web browser), not to the user directly, and is therefore systems software. It is also developed using system programming methodologies and systems programming languages. Yet from the perspective of functionality there is little difference between a word processing application and word processing web application.

1.15.2 Application Software

Application software is a program or group of programs designed for end users. These programs are divided into two classes: system software and application software. While system software consists of low-level programs that interact with computers at a basic level, application software resides above system software and includes applications such as database programs, word processors and spreadsheets. Application software may be bundled with system software or published alone. Application software may simply be referred to as an application.

Different types of application software include:

- **Application Suite:** It has multiple applications bundled together. Related functions, features and user interfaces interact with each other.
- **Enterprise Software:** It addresses an organization's needs and data flow in a huge distributed environment
- **Enterprise Infrastructure Software:** It provides capabilities required to support enterprise software systems
- **Information Worker Software:** It addresses individual needs required to manage and create information for individual projects within departments
- **Content Access Software:** It used to access content and addresses a desire for published digital content and entertainment
- **Educational Software:** It provides content intended for use by students
- **Media Development Software:** It addresses individual needs to generate and print electronic media for others to consume

1.16 SUM UP

- Computers are an integral part of our lifestyles today and are found at offices, homes, schools, colleges, hotels, shops etc. This advance in technology has made our lives easy and comfortable. For instance, we can execute a number of activities using computer based systems—we can write a draft on word processor and email it, make calculations using an electronic spreadsheet and incorporate graphics, create a database of friends with their phone numbers, addresses and e-mail ids etc.
- The computer comprises of technologically advanced hardware put together to work at great speed. To accomplish its various tasks, the computer is made of different parts, each serving a particular purpose in conjunction with other parts. In other words, a ‘computer’ is an ensemble of different machines that you will be using to accomplish your job.
- A computer is primarily made of the Central Processing Unit (usually referred to as the computer), the monitor, the keyboard and the mouse. Other pieces of hardware, commonly referred to as peripherals, can enhance or improve your experience with the computer.
- Computers are one of the most influential forces available in modern times. Harnessing the

power of computers enables relatively limited and fallible human capacities for memory, logical decision making, reaction and perfection to be extended to almost infinite levels.

- The origin of computer technology took place in the 19th century. People desired to have a machine that would carry out mathematical calculations for them. The ABACUS is considered to have been the first computer in the world. It was used to perform simple measurements and calculations. ABACUS is available even today for school going children.
- In the 17th century, a scientist named Pascal developed a machine that could perform mathematical calculations. This machine comprised of a number of gears. The movement of gear mechanism was used to perform some calculations. He named the machine PASCALINE.
- In 1694, a German mathematician, Gottfried Wilhem von Leibniz, extended Pascal's design to perform multiplication, division and to find square root. This machine is known as the Stepped Reckoner. It was the first mass-produced calculating device, which was designed to perform multiplication by repeated addition. Like its predecessor, Leibniz's mechanical multiplier worked by a system of gears and dials.
- The real beginning of computers as we know them today, however, lay with an English mathematics professor, Charles Babbage.
- In 1822, he proposed a machine to perform differential equations, called a Difference Engine. Powered by steam and as large as a locomotive, the machine would have a stored program and could perform calculations and print the results automatically.
- In 1889, Herman Hollerith, who worked for the US Census Bureau, also applied Jacquard's loom concept to computing. Unlike Babbage's idea of using perforated cards to instruct the machine, Hollerith's method used cards to store the data, which he fed into a machine that compiled the results mechanically.
- In the 1960s, efforts to design and develop the fastest possible computer with the greatest capacity reached a turning point with the Livermore Advanced Research Computer (LARC), which had access time of less than 1 ìs (pronounced as microsecond) and the total capacity of 100,000,000 words.
- During this period, the major computer manufacturers began to offer a range of capabilities and prices, as well as accessories such as card feeders, page printers and cathode ray tube displays.
- During the 1970s, the trend shifted towards a larger range of applications for cheaper computer systems. During this period, many business organizations adopted computers for their offices. The vacuum deposition of transistors became the norm and entire computer assemblies became available on tiny "chips".
- In the 1980s, Very Large Scale Integration (VLSI) design, in which hundreds of thousands of transistors were placed on a single chip, became increasingly common.
- Characteristics of computers, which make them an essential part of every emerging technology and such a desirable tool in human development.
- Computers can store large amounts of data and can recall the required information almost

instantaneously. The main memory of the computer is relatively small and it can hold only a certain amount of data; therefore, the data are stored on secondary storage devices such as magnetic tape or disks. Small sections of data can be accessed very quickly from these storage devices and brought into the main memory, as and when required, for processing.

- Computers are quite versatile in nature. It can perform multiple tasks simultaneously with equal ease. For example, at one moment it can be used to draft a letter, another moment it can be used to play music and in between, one can print a document as well. All this work is possible by changing the program (computer instructions).
- The history of computer development is often discussed with reference to the different generations of computing devices. In computer terminology, the word generation is described as a stage of technological development or innovation.
- A major technological development that fundamentally changed the way computers operate, resulting in increasingly smaller, cheaper, more powerful, and more efficient and reliable devices, characterizes each generation of computers. According to the type of "processor" installed in a machine, there are five generations of computers.
- One of the major developments of this generation includes the progress from machine language to assembly language. Assembly language uses mnemonics (abbreviations) for instructions rather than numbers, for example, ADD for addition and MULT for multiplication. As a result, programming became less cumbersome. Early high-level programming languages such as COBOL and FORTRAN also came into existence in this period.
- Computers with one processor access and execute only one instruction at a time. This is called serial processing. However, fifth-generation computers will use multiple processors and perform parallel processing, thereby accessing several instructions at once and working on them at the same time.
- A microcomputer is a small, low-cost digital computer, which usually consists of a microprocessor, a storage unit, an input channel and an output channel, all of which may be on one chip inserted into one or several PC boards.
- The desktop computer, also known as the PC, is principally intended for stand-alone use by an individual.
- A laptop is a portable computer that a user can carry around. Since the laptop resembles a notebook, it is also known as the notebook computer. Laptops are small computers enclosing all the basic features of a normal desktop computer.
- A hand-held computer such as a PDA is a portable computer that can conveniently be stored in a pocket (of sufficient size) and used while the user is holding it. PDAs are essentially small portable computers and are slightly bigger than the common calculators. A PDA user generally uses a pen or electronic stylus, instead of a keyboard for input.
- A minicomputer (sometimes called a mid-range computer) is designed to meet the computing needs of several people simultaneously in a small-to medium-sized business environment. It is capable of supporting from four to about 200 simultaneous users. It serves as a centralized

storehouse for a cluster of workstations or as a network server.

- A mainframe is an ultra-high performance computer made for high-volume, processor-intensive computing. It consists of a high-end computer processor, with related peripheral devices, capable of supporting large volumes of data processing, high-performance online transaction processing, and extensive data storage and retrieval.
- Supercomputers are the special-purpose machines, which are especially designed to maximize the numbers of floating point operations per second (FLOPS). Any computer below one gigaflop per second is not considered a supercomputer. A supercomputer has the highest processing speed at a given time for solving scientific and engineering problems.
- The CPU, also known as a processor, is the brain of the computer system that processes data (input) and converts it into meaningful information (output). It is referred to as the administrative section of the computer system that interprets the data and instructions, coordinates the operations, and supervises the instructions.
- The CPU works with data in discrete form, that is, either 1 or 0. It counts, lists, compares and rearranges the binary digits of data in accordance with the detailed program instructions stored within the memory. Eventually, the results of these operations are translated into characters, numbers and symbols that can be understood by the user. The CPU itself has three parts:
- Arithmetic Logic Unit (ALU) performs the arithmetic (add, subtract) and logical operations (and, or) on the data made available to it. Whenever an arithmetic or logical operation is to be performed, the required data are transferred from the memory unit to the ALU, the operation is performed and the result is returned to the memory unit. Before the completion of the processing, data may need to be transferred back and forth several times between these two sections.
- Control Unit checks the correctness of the sequence of operations. It fetches the program instructions from the memory unit, interprets them and ensures correct execution of the program. It also controls the I/O devices and directs the overall functioning of the other units of the computer.
- An input unit accepts instructions and data from the user with the help of input devices such as keyboard, mouse, light pen, etc. Since the data and instructions entered through different input devices will be in different form, the input unit converts them into the form that the computer can understand. After this, the input unit supplies the converted instructions and data to the computer for further processing.
- Computers have also revolutionized the whole process of education. Currently, the classrooms, libraries and museums are utilizing computers to make the education much more interesting. Unlike recorded television shows, computer-aided education (CAE) and computer-based training (CBT) packages are making learning much more interactive.
- Computers are finding greater use in the entertainment industry. They are used to control the images and sounds. The special effects, which mesmerize the audience, would not have been possible without the computers. In addition, computerized animation and colourful graphics have modernized the film industry.

- E-mail or electronic mail is one of the communication media in which computers are used. Through an e-mail, messages and reports are passed from one person to one or more persons with the aid of computers and telephone lines. The advantage of this service is that while transferring the messages it saves time, avoids wastage of paper, and so on. Moreover, the person who is receiving the messages can read the messages whenever he is free and can save it, reply it, forward it or delete it from the computer.
- Business Application is one of the important uses of the computer. Initially, computers were used for batch processing jobs, where one does not require the immediate response from the computer. Currently, computers are mainly used for real-time applications (like at the sales counter) that require immediate response from the computer. There are various concerns for which computers are used such as in business forecasting, to prepare pay bills and personal records, in banking operations and data storage, in various types of life insurance business, and as an aid to management.

QUESTIONS AND ANSWERS

A. Very Short Answer Type of Questions

1. Which one is the computer's own language?

Ans. Low level language which is written in binary.

2. What is the meaning of URL?

Ans. Uniform resource locator.

3. When Microprocessor was invented?

Ans. In 1971.

4. What is UNIX?

Ans. Operating System.

5. What is the meaning of Fat?

Ans. File allocation table.

6. What is Adobe Photoshop?

Ans. Photo Editing Software.

7. What is Windows?

Ans. Operating System by Microsoft

8. What is Laptop?

Ans. Small portable computer.

9. Who invented punch card?

Ans. Joseph Marie Jacquard.

10. What is SIMM?

Ans. Single Inline Memory Module.

11. What is the short name of binary math?

Ans. bit.

12. What is ROM?

Ans. Read Only Memory.

13. What is RAM?

Ans. Random Access Memory.

14. Which is the first computer in Bangladesh?

Ans. IBM-1620 series.

15. What does BIOS means?

Ans. Basic Input Output System.

16. Which one is the brain of computer?

Ans. Microprocessor.

17. Who is the father of modern computer?

Ans. Charles Babbage.

B. Short Questions and Answers

1. What are the Basic Elements of Computer System?

Ans. Basic elements of a computer system are mouse, keyboard, monitor, memory, CPU, motherboard, Hard Disk, Speakers, Modem, power supply and processor.

2. What is Mouse?

Ans. Mouse is used for operating the system. Nowadays, optical mouse is more popular as compared to simple mouse.

3. What is Keyboard?

Ans. Keyboard is used to input data in to the system so that the system gives output to the user. Therefore, the keyboard is an integral part of the input system. A computer is essentially incomplete without a keyboard.

4. Why hard disk is used?

Ans. Hard disk is used to store data permanently on computer.

5. What is the use of modem?

Ans. Modem is used to connecting to the Internet. Two types of modems are widely used. One is known as software modems and the other is known as hardware modems.

C. Long Answer Type Questions

1. What are the advantages of computers?

Ans. Compared to traditional systems, computers offer many noteworthy advantages. This is one reason that traditional systems are being replaced rapidly by computer-based systems. The main advantages offered by computers are as follows:

1. They allow people across the globe to communicate with each other, no matter at what time, via the use of e-mail.
2. They allow people to look up information directly, instead of the use of searching through books.
3. Back-up copies of work can be made easily, without having to re-write everything.
4. People can work from home, and spend more time with their families because of this.
5. People with disabilities whom can't write, can get software that allows them to speak and it types it on the screen.

2. Discuss the characteristics of computers.

Ans. Some of the characteristics of computers, which make them an essential part of every emerging technology and such a desirable tool in human development.

- **Speed:** The computers process data at an extremely fast rate, at millions or billions of instructions per second. A computer can perform a huge task in a few seconds that otherwise a normal human being may take days or even years to complete. The speed of a computer is calculated in MHz (mega hertz), that is, one million instructions per second. At present, a powerful computer can perform billions of operations in just one second.
- **Accuracy:** Besides the efficiency, the computers are also very accurate. The level of accuracy depends on the instructions and the type of machines being used. Since the computer is capable of doing only what it is instructed to do, faulty instructions for data processing may lead to faulty results. This is known as Garbage In Garbage Out (GIGO).
- **Diligence:** Computer, being a machine, does not suffer from the human traits of tiredness and lack of concentration. If four million calculations have to be performed, then the computer will perform the last four-millionth calculations with the same accuracy and speed as the first calculation.
- **Reliability:** Generally, reliability is the measurement of the performance of a computer, which is measured against some predetermined standard for operation without any failure. The major reason behind the reliability of the computers is that, at hardware level, it does not require any human intervention between its processing operations.
- **Storage Capability:** Computers can store large amounts of data and can recall the required information almost instantaneously. The main memory of the computer is relatively small and it can hold only a certain amount of data; therefore, the data are stored on secondary storage devices such as magnetic tape or disks.
- **Versatility:** Computers are quite versatile in nature. It can perform multiple tasks simultaneously with equal ease. For example, at one moment it can be used to draft a letter,

another moment it can be used to play music and in between, one can print a document as well. All this work is possible by changing the program (computer instructions).

- **Resource Sharing:** In the initial stages of development, computers used to be isolated machines. With the tremendous growth in computer technologies, computers today have the capability to connect with each other. This has made the sharing of costly resources like printers possible. Apart from device sharing, data and information can also be shared among groups of computers, thus creating a large information and knowledge base.

3. What are the limitations of a Computer?

Ans. A computer has many limitations, some of them are:

- A computer can only perform what it is programmed to do.
- The computer needs well-defined instructions to perform any operation. Hence, computers are unable to give any conclusion without going through intermediate steps.
- A computer's use is limited in areas where qualitative considerations are important. For instance, it can make plans based on situations and information, but it cannot foresee whether they will succeed.

Although processing has become less tedious with the development of computers, it is still a time-consuming and expensive job. Sometimes, a program works properly for some period and then suddenly produces an error. This happens because of a rare combination of events or due to an error in the instruction provided by the user.

4. Briefly explain the Nature of Information.

Ans. The nature of information traces the evolution of the term "information" from its general linguistic use into the mainstream of modern science, proposing an entirely new definition of information as a mass-energy phenomenon. It demonstrates that information is in all cases a form phenomenon, both form and information are mass-energy, rather than abstract, phenomena, mind can be viewed as a mass-energy form-manipulating process, and form constitutes a mechanism immanent in the physical universe via which mass-energy systems can communicate informationally and control their own energetic activities. This is indeed the Information Age, but information has had a central role in our existence since the beginning. Biologists tell us that one of the hallmarks of life is the ability of an organism to adapt to its surroundings. But, in order to adapt, it must first respond to the conditions of those surroundings.

Thus, it is fundamental that all living things are sensitive to external stimuli. When a pin pricks your skin, a sharp pain results. The sudden appearance of a large object in your visual foreground produces the startle response—adrenalin surges in your body and your body prepares to respond to the potential threat. These are some simple examples of this essential characteristic of living things.

5. What is Digital Information Technology?

Ans. Electronic digital information technology is the latest generation of information technologies. But, it represents a different brand of information technology. Previously, new information technologies have often competed with and replaced existing ones. The telephone replaced

the telegraph for obvious reasons. Television has relegated radio to a subordinate niche. Digital information technology is different because it is a form of technology that extends other technologies.

In short, digital information technology has the capability to imitate other technologies. Electronic printed documents mimic conventional typeset ones. Digital audio recordings reproduce sounds like their analog counterparts.

6. Discuss the basic Computer Functioning.

Ans. A computer can be defined as an electronic device that accepts data from an input device, processes it, stores it in a disk and finally displays it on an output device such as a monitor. To understand the basic rudiments of the functioning of the computer refer to the basic block diagram of a computer. This flow of information holds true for all types of computers such as Personal Computers, Laptops, Palmtops etc. In other words, the fundamental principle of working is the same.

7. Discuss the applications of Computers.

Ans. Computers are everywhere and business and industry are using them. We can list of thousands of it's modern uses, were the power to computers ever shut off, Business and industry would almost instantly grind to halt. Without computers, the modern co-operation could not even. "Computers have become so deeply embedded in information processing and communication systems that almost no activity could be possible without them" Computer is now playing a vital role in the lives of people today.

8. Explain the advantages of the use of Computers in Education.

Ans. Computers are useful tools in different field of applications. Computers are very much useful in the field of engineering and architecture specially in the aspects of design and calculations. These machines are also beneficial in their application in the field of business and economics as it allows users to store and retrieve large amount of data in a less amount of time. The use of computers in learning provide both advantages and disadvantages in the learning processes. Computers are advantageous in the sense that these machines teach more effectively in technical sense, they can reach and teach more students and kept students more focus with the subject.

The use of computer technology in learning allows the teacher to individualized the learning instructions as well as the technology grants the students the autonomy and making them to learn with their own.

The Internet access will also allow the students to get different educational resources from all over the world, thus making the world like a classroom of learning. It enables him or her to access different ideas as well as learnings and knowledge coming from abroad.

In teaching kids or young learners, the use of computers in the teaching processes is very much advantageous. The use of computer machines could catch the attention of the kids, making them attentive as well as participative in teaching and learning activities.

Hence, the use of computer technology in education makes us prepared for the future. Computers as used in education allows the learners to learn modern tools and knowledge that will make him or her ready for the possible technological changes in the future.

REVIEW EXERCISE

A. Descriptive Questions

1. Differentiate between minicomputer and microcomputer.
2. What do you understand by the fourth generation of computer systems?
3. What is a computer?
4. What is the difference between primary and secondary storage devices?
5. What is the process of processor clock?
6. What operations are performed by ALU?
7. What is the difference between processor clock and clock rate?
8. What is the most popular use for home computer?

B. Multiple Choice Questions

1. The input unit of a computer
   (a) feeds the data in CPU (b) retrieves the data from CPU
   (c) directs all other units (d) all of these
2. The heart of any computer is
   (a) CPU (b) Memory
   (c) I/O unit (d) Disks
3. The control unit of computer
   (a) performs ALU operations on the data (b) controls the operation of the output devices
   (c) is a device for manually operating the computer
   (d) directs the other unit of computer.
4. Which of the following is responsible for coordinating various operating using timing signals?
   (a) ALU (b) control unit
   (c) memory unit (d) I/O unit
5. How many units in a single bus structure communicate at a time?
   (a) one (b) two
   (c) three (d) four
6. A single bus structure is primarily found in
   (a) main frames (b) super computers
   (c) high performance machines (d) mini-and-micro computers

C. True and False

1. A single clock cycle toggles between a logical zero and a logical one state. (T/F)
2. CPU Performance Decomposed into six Components. (T/F)
3. The clock rate of a CPU is normally determined by the frequency of an oscillator crystal. (T/F)
4. ALU includes storage places for input operands. (T/F)
5. A computer system is made up of a number of software devices. (T/F)

D. Fill in the Blanks

1. These storage devices use the ……. (–ve and +ve) for the data and/or instruction storage.
2. Each clock pulse, the signal lines inside the CPU need ……. to settle to their new state.
3. The purpose of buses is to reduce the number of ……. needed for communication.
4. ……. data stored is lost as soon as power is switched off.
5. ……. memory is also known as primary memory.

ANSWERS

B. Multiple Choice Question

1. (a) 2. (a) 3. (d) 4. (b) 5. (b) 6. (d)

C. True and False

1. True 2. False 3. True 4. True 5. False

D. Fill in the Blanks

1. electronic charges
2. time
3. pathways
4. RAM
5. Main