UNIT – I

CHAPTER

INTRODUCTION TO COMPUTERS

1.1 INTRODUCTION

We are familiar with the word 'compute' which means to calculate. The term computer is derived from the word 'compute'.

1.1.1 Definition

Computer is an electronic machine devised for performing calculations and controlling operations that can be expressed either in logical or numerical terms.

Computers are one of the most influential forces available in modern times. Millions of complex calculations can be done in a mere fraction of time. Computers have left such an impression on modern civilization that we call this era as the **information age**.

1.2 BASIC OPERATIONS OF A COMPUTER

1. **Input** It is the process of capturing the information or it is the raw data or information.
2. **Process** It is the transformation process to convert the input into output.
3. **Output** It is the result which comes from the transformation process or it is the outcome of a process.
4. **Storage** It is the process of saving the data, information and instruction, so that they can be retrieved whenever required.

Fig. 1.1 *Basic Computer*

1.3 CHARACTERISTICS OF COMPUTERS

The important characteristics of computers are:

1. **Speed** Computers process data at extremely fast rate–millions of instructions per second. 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.
2. **Accuracy** Computers are very accurate in their computations. The level of accuracy depends on the instructions and the type of machine being used. Faulty instructions may lead to faulty results.
3. **Diligence** A computer does not suffer from the human traits of tiredness and lack of concentration. It performs all the operations with same speed and accuracy.
4. **Reliability** It is the measurement of performance of a computer, which is measured against some predetermined standard for operation without any failure. Computers are very reliable because at the hardware level they do not require any human intervention between its processing operations.
5. **Storage Capability** Computers can store large amounts of data. The main memory can store a small amount of data. The secondary memory like hard disk can store a large volume of data.
6. **Versatility** Computers can perform multiple tasks simultaneously with great ease. Hence they are very versatile in nature.
7. **Resource Sharing** Computers today have the capability to connect with each other. This has made the sharing of costly resources, like printers, possible. Data and information can also be shared among groups of computers.

1.4 EVOLUTION OF COMPUTERS

In the beginning, when the task was simply counting, people used either their fingers or pebbles along lines in the sand. The computer was born not for entertainment or emailing but out of a need to solve a serious number crunching crisis.

Attempts by humans to develop a tool to manipulate data go back as far as 2600 BC when the Chinese came up with the **abacus**. It was also known as the "SOROBAN". It had a sliding rack with which simple calculations such as addition and subtraction could be performed.

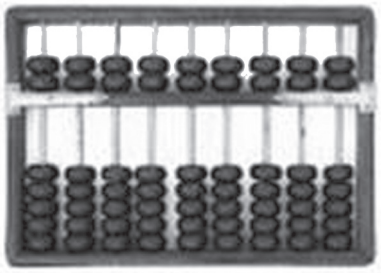

Fig. 1.2 *Abacus*

With the passage of time, many computing devices such as Napier bones and slide rule were invented.

In 1642, a French mathematician, Blaise Pascal invented the first functional automatic **calculator.** It was called as **Pascaline** and used eight movable dials toad sums eight figures long.

Fig. 1.3 *Pascaline*

In 1694, German mathematician, Gottfried Wilhem von Leibniz extended Pascal's design to perform multiplication, division and to find square root. This machine was called as **Stepped Reckoner.**

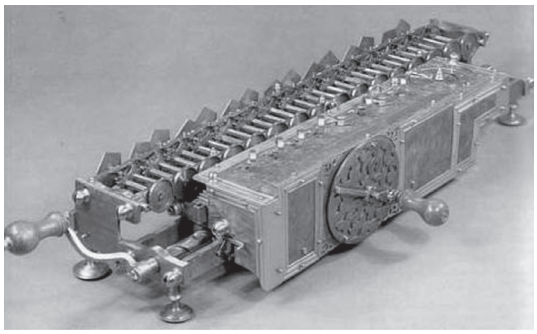

Fig. 1.4 *Stepped Reckoner*

The real beginning of computers lay with an English mathematician, Charles Babbage. In 1822, he proposed a machine to perform differential equations called a **Difference Engine.** Difference engines are strictly calculators. They crunch numbers; the only way they know how–is by repeated addition according to the method of finite differences. They cannot be used for general arithmetical calculations.

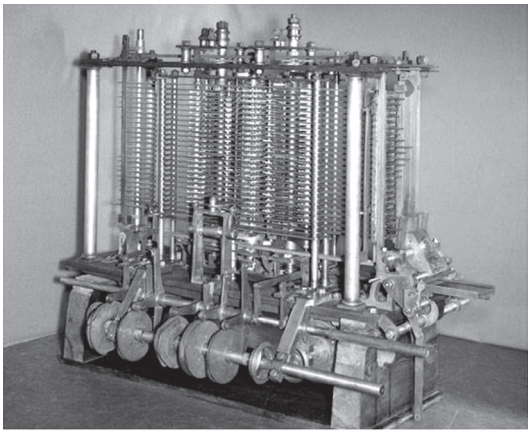

Fig. 1.5 *Difference Engine*

In 1833, he constructed another machine called as **Analytical Engine**. The basic design of this engine included input devices in the form of perforated cards containing operating instructions and a store for memory of 1,000 numbers up to 50 decimals digits long.

The start of World War–II produced a substantial need for computer capacity, especially for the military purposes. One such machine was the Mark I, which was built as a partnership between Harvard Aiken and IBM in 1944.

In 1946, John Eckert and John Mauchly of the Moore School of Engineering at the University of Pennsylvania developed ENIAC (Electronic Numerical Integrator and Calculator). Later, they proposed the development of EDVAC (Electronic Discrete Variable Automatic Computer).

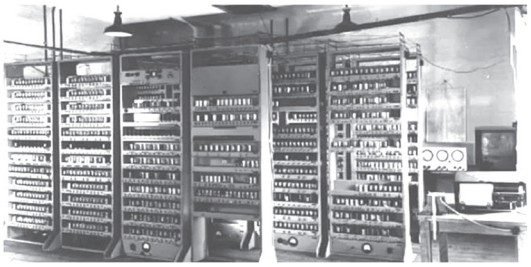

Fig. 1.6 *EDSAC*

In 1949, at the Cambridge University, a team headed by Maurice Wilkes developed EDSAC (Electronic Delay Storage Automatic Calculator).

In 1951, Eckert-Mauchly Corporation manufactured UNIVAC (Universal Automatic Computer) during 1946 to 1951. It was the first commercially available electronic digital computer, developed by J. Presper Eckret and John Mauchly. It contained thousands of vacuum tubes that utilized punched cards and switches for inputting data and punched cards for outputting and storing data.

In the 1960s, efforts to design and develop the fastest possible computer with the greatest capacity reached a turning point with the LARC machine, which had access time of less than 1 micro second and a total capacity of 100,000,000 words.

During the 1970s, many business organizations adopted computers for their offices. The entire computer assemblies became available on tiny "chips" knows as Integrated Circuits (IC).

Fig. 1.7 *UNIVAC*

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. Personal Computers (PCs) were introduced during this period. By the late 1980s, PCs were run by microprocessors, handling 32 bits of data at a time, and could process about 4,000,000 instructions per second.

By the 1990s, personal computers became part of everyday life. 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 some of the applications that have grown in recent years. Advances in technologies continue to produce cheaper and more powerful computers.

1.5 GENERATION OF COMPUTERS

The history of computer development is explained with reference to the different generations of computing devices. A generation refers to the state of improvement in the development of a product. This term is also used in the different advancements of computer technology. With each new generation, the circuitry has gotten smaller and more advanced. As a result of miniaturization, speed, power and memory of computers have proportionally increased.

According to the technology used, there are five generations of computers. They are:

1.5.1 First Generation (1940–56): Vacuum Tubes

The first generation computers were vacuum tubes based machines. They used vacuum tubes for circuitry and magnetic drums for memory. First generation computers relied on binary-coded language to perform operations.

Example: ENIAC, EDVAC and UNIVAC.

Fig. 1.8 *Vacuum Tube*

Characteristics of Ist Generation Computers:

- Based on vacuum tube technology.
- Since they were very large, they required a lot of space for installation.
- Non-portable and very slow in processing.
- Very expensive and consumed large amount of electricity.

- ❖ They generated large amount of heat. Hence air-conditioning was must.
- ❖ Magnetic drums were used for memory.
- ❖ Computers were difficult to program since they used machine language.
- ❖ Punch cards and paper tapes were used as inputs and output was displayed on printouts.
- ❖ They lacked versatility and speed.
- ❖ Computation time was in milliseconds.

1.5.2 Second Generation Computers (1956–63): Transistors

The second generation computers used transistors, which were superior to vacuum tubes.

A transistor is made up of semiconductor material like germanium and silicon. Since transistor is a small device, the size of the computers was reduced. The programming language used was assembly language.

Assembly language used mnemonics for instructions rather than number. For example: ADD, Mul etc.

Example: PDP – 8, IBM 1401 and IBM 7090.

Fig. 1.9 *Transistor*

Characteristics of IInd Generation Computers:

- ❖ Based on transistor technology.
- ❖ Magnetic cores were used as primary memory and magnetic disk as secondary storage device.
- ❖ The size was smaller compared to first generation computers.
- ❖ The speed was increased.
- ❖ Assembly language was used.
- ❖ More portable and generated less heat.
- ❖ Punch cards were used for input and printouts for output.
- ❖ Computation time was in microseconds.

1.5.3 Third Generation Computers (1964-Early 1970s): Integrated Circuits

The development of Integrated Circuits was the major advancement during this period. This development made computers smaller in size, reliable and efficient. Users used keyboards for interacting with computers. Computers were cheaper during this period.

Example: NCR 395 and B6500.

Characteristics of IIIrd Generation Computers:

- ❖ Based on Integrated Circuits (IC) technology.
- ❖ Portable, reliable and small in size.
- ❖ Consumed less power and hence generated less heat.

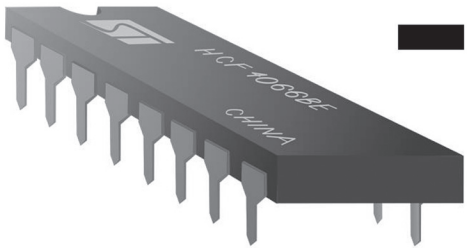

Fig. 1.10 *Integrated Circuits*

- Extensive use of high level language was possible.
- Keyboards and monitors were used for input and output, respectively.
- Computation time was reduced from microsecond to nanoseconds.

1.5.4 Fourth Generation Computers (Early 1970s–till date): Microprocessors

The fourth generation computers led to an era of Large Scale Integration (LSI) and Very Large Scale Integration (VLSI) technology.

LSI technology allowed thousands of transistors to be constructed on one small slice of silicon material. VLSI technology allowed hundreds of thousands of components on to a single chip. Because of this, computers became smaller and cheaper.

Personal Computer (PC) revolution took place during this period. Secondary memories such as hard disk became economical and bigger in size. Networking of computers was possible during this period. This led to the development of internet. Graphical User Interface (GUI), mouse and hand held devices were developed during this period.

Fig. 1.11 *Microprocessor*

Characteristics of IVth Generation Computers:

- Based on microprocessors.
- Very cheap and small in size.
- No air-conditioning needed since they generate less heat.
- Minimum maintenance required.
- Portable and reliable.

They support graphical user interface (GUI) and hand held devices to make input/output task more easily and efficiently.

They allow interconnection between themselves to from a network. Network enables data communication and resource sharing.

1.5.5 Fifth Generation Computers (Present and Beyond): Artificial Intelligence

The process of developing fifth generation computers is still in the development stage. The scientists are trying to develop human–like computers that would be capable of thinking and reaching a decision depending on the situations.

Characteristics of Vth Generation Computers:

- **Mega Chips**: Fifth generation computers will use Super Large Scale integrated Chips (SLSI) which will result in the production of a microprocessor having millions of electronic components on a single chip.

- **Parallel Processing**: Computers will process more than one instruction at a time using multiple central processing units.
- **Artificial Intelligence (AI):** It refers to a technology that tries to simulate and reproduce human behavior, including thinking, speaking and reasoning. It also includes other technologies like expert systems, natural language processing, speech recognition etc.

1.6 CLASSIFICATION OF COMPUTERS

1.6.1 Based on Operating Principles

Analog Computers: The analog computers represent data in the form of continuous electrical signals having a specific magnitude. These computers are very fast in their operation and allow several other operations to be carried out at the same time.

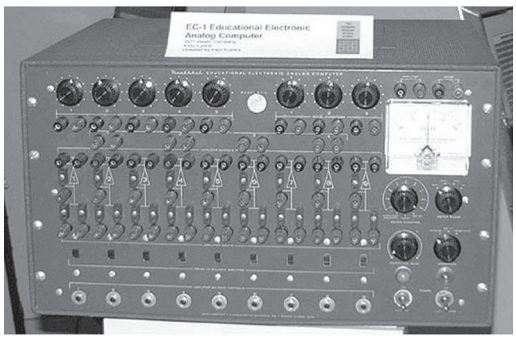

Fig. 1.12 *Analog Computer*

The results produced by these computers are not very accurate. They are powerful tools to solve differential equations. The electrical circuit employed in modern analog computers is generally an Operational Amplifier (Op-Amp). It is made up of semiconductor integrated circuits.

Digital Computers: The digital computers are also known as the digital information processing system. It is a type of computer that stores and processes data in the digital form. Digital computers are generally faster and more reliable than the analog computer systems and provide more accurate results.

Hybrid Computers: The hybrid computer is a combination of analog computer and digital computer because it encompasses the best features of both these computers. The hardware components are mixture of analog and digital components.

Fig. 1.13 *Hybrid Computer*

The hybrid computers are very fast, efficient and reliable. In these computers, data is generally measured and processed in the form of electrical signals and is stored with the help of digital components.

1.6.2 Based on Applications

General-purpose computers: They are designed in such a manner that they can work in all environments. The general–purpose computers are versatile and can store a number of programs meant for performing distinct tasks. These computers are not efficient and consume a large amount of time in generating results.

Special purpose computers: They are designed in such a manner that they can perform only specified tasks. The special purpose computers are not versatile and their speed and memory size is dependent on the task that is to be performed. These computers are less expensive, efficient and consume less amount of time in generating the results.

Based on Size and Capability: Computers are classified into four different categories based on size, performance and application areas. They are:

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

1. Micro Computers: A micro computer 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. These were designed for individual users, but nowadays they have become powerful tools for many businesses when networked together.

Examples: IBM – PC Pentium 100, IBM-PC Pentium 200 and Apple Macintosh.

Micro computers can be classified into three categories. They are:

(i) Desktop Computer
(ii) Laptop Computer
(iii) Hand-held computer

(i) **Desktop Computer:** It is also known as Personal Computer (PC) or stand-alone computer. It consists of a system unit, a display monitor, a keyboard, internal hard disk storage, and other peripheral devices. It is not very expensive. Example: Apple, IBM, Dell, Hewllet Packard (HP).

Fig. 1.14 *Personal Computer*

Fig. 1.15 *Laptop*

(ii) **Laptop Computer:** A laptop is a portable computer, i.e., the user can carry it around. It is also called as notebook computers since it looks like a note book. It has all the basic features of a normal desktop computer. It does not need an external power supply as a rechargeable battery is completely self-contained in them.

(iii) **Hand-Held Computer:** It is also called as Personal-Digital Assistant (PDA). A PDA user uses a pen or electronic stylus, instead of keyboard for input. Since these computers can be easily fitted on the palm, they are also knows as palmtop computers. They don't have any disk drives; instead they use small cards to store programs and data.

Fig. 1.16 *PDA*

2. **Mini computers:** A mini computer is designed to meet the computing needs for a small to medium sized business operations. It is capable of supporting 4 to 200 simultaneous users. It serves as a centralized storehouse for a cluster of workstations. A mini computer is a type of computer that possesses most of the features and capabilities of a large computer but is smaller in physical size.

A mini computer fills the space between the mainframe and micro computer, and is smaller than the former but larger than the latter. Mini computers are mainly used as small or midrange servers operating business and scientific applications. A mini computer may also be called a mid-range computer.

Examples: PDP 11, IBM 8000 series and VAX 7500

3. **Mainframe Computers:** 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. It performs at a faster rate and is second largest among the computer family. Large amount of information can be stored at a centralized location.

It is a very large and expensive computer capable of supporting hundreds, or even thousands of users simultaneously. In the hierarchy that starts with a simple microprocessor (in watches, for example) at the bottom and moves to supercomputers at the top, mainframes are just below super computers. In some ways, mainframes are more powerful than super computers because they support more simultaneous programs. But super computers can execute a single program faster than a mainframe. The distinction between small mainframes and mini computers is vague, depending really on how the manufacturer wants to market its machines.

Fig. 1.17 *Mainframe Computer*

Examples: IBM ES000, VAX 8000 and CDC 6600.

4. **Super Computers:** They are the special purpose machines which are specially designed to maximize the number of floating point operations per second (FLOPS). A super computer has the highest processing speed at a given time for solving scientific and engineering problems.

Fig. 1.18 *Super Computer*

It contains a number of CPUs that operate in parallel. A super computer can process at a faster rate in terms of nanoseconds. It is the fastest, costliest and the most powerful computer available today. Systems with massive numbers of processors generally take one of the two paths: in one approach (e.g., in distributed computing), a large number of discrete computers (e.g., laptops) are distributed across a network (e.g., the Internet) and devote some or all of their time to solve a common problem; each individual computer (client) receives and completes many small tasks, reporting the results to a central server which integrates the task results from all the clients into the overall solution. In another approach, a large number of dedicated processors are placed in a close proximity to each other (e.g., in a computer cluster), this saves considerable time moving data around and makes it possible for the processors to work together (rather than on separate tasks), for example, in mesh and hypercube architectures.

The use of multi-core processors combined with centralization is an emerging trend; one can think of this as a small cluster (the multi core processor in a smart phone, tablet, laptop, etc.) that both depends upon and contributes to the cloud.

Examples: CRAY-3, Cyber 205 and PARAM.

1.7 APPLICATION OF COMPUTERS

Computer systems help in information processing. They also help in the efficient operations of railway and airway reservation, electronic banking etc. Some of the areas where computers are being used are:

- **Science:** Scientists use computers to develop theories, to analyze and test the data. They are used to generate detailed studies on natural calamities like earthquakes, pollution, etc.
- **Education:** Computers are used in classroom teaching and in library for learning purposes. Computer Aided Education (CAE) and Computer Based Training (CBT) packages are making learning more interactive.
- **Medicine and Health Care**: Doctors use computers for diagnosing the illness, surgeries and monitoring the patients.
- **Engineering/Architecture/Manufacturing**: The architects and engineers are extensively using computers in designing and drawings. Computer Aided Manufacturing (CAM) is used in designing products, ordering parts, and planning production.

- **Entertainment:** Computers are used extensively in entertainment industry. Special effects, animations etc., are done using computers.
- **Communication**: E-mail is one of the communication media in which computer is used. Communication among the clients is possible through networking of the systems.
- **Business Application**: Computers are used in decision making in any business process. They help in preparing pay bills and maintaining personal records of the employees.
- **Banking**: computers are being increasingly used for online banking. The users or customers can transfer and receive money by using computers and internet.
- **Publishing:** In Desktop Publishing, with the help of computers, one can perform publishing job like typing the manuscripts of the books, creating table of contents etc., and developing publications at a shorter duration.