CHAPTER-1

INTRODUCTION TO COMPUTERS

A **computer** is a machine for manipulating data according to a list of instructions.

Computers take numerous physical forms. Early electronic computers were the size of a large room, consuming as much power as several hundred modern personal computers. Today, computers can be made small enough to fit into a wrist watch and be powered from a watch battery. Society has come to recognize personal computers and their portable equivalent, the laptop computer, as icons of the information age; they are what most people think of as "a computer".

The ability to store and execute programs makes computers extremely versatile and distinguishes them from calculators. Any computer with a certain minimum capability is, in principle, capable of performing the same tasks that any other computer can perform. Therefore, computers with capability and complexity ranging from that of a personal digital assistant to a supercomputer are all able to perform the same computational tasks so long as time and storage capacity are not considerations.

1.1 History of computing

It is difficult to define any one device as the earliest computer. The very definition of a computer has changed and it is therefore impossible to identify the first computer. Many devices once called "computers" would no longer qualify as such by today's standards.

Originally, the term "computer" referred to a person who performed numerical calculations (a human computer), often with the aid of a mechanical calculating device. Examples of early mechanical computing devices included the abacus, the slide rule . The end of the Middle Ages saw a re-invigoration of European mathematics and engineering, and Wilhelm Schickard's 1623 device was the first of a number of mechanical calculators constructed by European engineers.

However, none of those devices fit the modern definition of a computer because they could not be programmed. In 1801, Joseph Marie Jacquard made an improvement to the textile loom that used a series of punched paper cards as a template to allow his loom to weave intricate patterns automatically. The resulting Jacquard loom was an important step in the development of computers because the use of punched cards to define woven patterns can be viewed as an early, albeit limited, form of programmability.

In 1837, Charles Babbage was the first to conceptualize and design a fully programmable mechanical computer that he called "The Analytical Engine".[2]

Due to limited finance, and an inability to resist tinkering with the design, Babbage never actually built his Analytical Engine.

Large-scale automated data processing of punched cards was performed for the US Census in 1890 by tabulating machines designed by Herman Hollerith and manufactured by the Computing Tabulating Recording Corporation, which later became IBM. By the end of the 19th century a number of technologies that would later prove useful in the realization of practical computers had begun to appear: the punched card, boolean algebra, the vacuum tube (thermionic valve) and the teleprinter.

During the first half of the 20th century, many scientific computing needs were met by increasingly sophisticated analog computers, which used a direct mechanical or electrical model of the problem as a basis for computation. However, these were not programmable and generally lacked the versatility and accuracy of modern digital computers.

A succession of steadily more powerful and flexible computing devices were constructed in the 1930s and 1940s, gradually adding the key features that are seen in modern computers. The use of digital electronics (largely invented by Claude Shannon in 1937) and more flexible programmability were vitally important steps, but defining one point along this road as "the first digital electronic computer" is difficult (Shannon 1940). Notable achievements include:

Nearly all modern computers implement some form of the stored program architecture, making it the single trait by which the word "computer" is now defined. By this standard, many earlier devices would no longer be called computers by today's definition, but are usually referred to as such in their historical context. While the technologies used in computers have changed dramatically since the first electronic, general-purpose computers of the 1940s, most still use the von Neumann architecture. The design made the universal computer a practical reality.

Vacuum tube-based computers were in use throughout the 1950s, but were largely replaced in the 1960s by transistor-based devices, which were smaller, faster, cheaper, used less power and were more reliable. These factors allowed computers to be produced on an unprecedented commercial scale. By the 1970s, the adoption of integrated circuit technology and the subsequent creation of microprocessors such as the Intel 4004 caused another leap in size, speed, cost and reliability. By the 1980s, computers had become sufficiently small and cheap to replace simple mechanical controls in domestic appliances such as washing machines. Around the same time, computers became widely accessible for personal use by individuals in the form of home computers or personal computer. In conjunction with the widespread growth of the Internet since the 1990s, personal computers are becoming as common as the television and the

telephone and almost all modern electronic devices contain a computer of some kind.

1.2 Stored program architecture

However, computers cannot "think" for themselves in the sense that they only solve problems in exactly the way they are programmed to. An intelligent human faced with the above addition task might soon realize that instead of actually adding up all the numbers one can simply use the equation

$$1 + 2 + 3 + \ldots + n = \frac{n(n+1)}{2}$$

and arrive at the correct answer (500,500) with little work.

1.3 How computers work

A general purpose computer has four main sections: the arithmetic and logic unit (ALU), the control unit, the memory, and the input and output devices (collectively termed I/O). These parts are interconnected by busses, often made of groups of wires.

The control unit, ALU, registers, and basic I/O (and often other hardware closely linked with these) are collectively known as a central processing unit (CPU). Early CPUs were comprised of many separate components but since the mid-1970s CPUs have typically been constructed on a single integrated circuit called a *microprocessor*.

1.3.1 Control unit

The control unit (often called a control system or central controller) directs the various components of a computer. It reads and interprets (decodes) instructions in the program one by one. The control system decodes each instruction and turns it into a series of control signals that operate the other parts of the computer. Control systems in advanced computers may change the order of some instructions so as to improve performance.

A key component common to all CPUs is the program counter, a special memory cell (a register) that keeps track of which location in memory the next instruction is to be read from.

1.3.2 Arithmetic/logic unit (ALU)

The ALU is capable of performing two classes of operations: Arithmetic and logic.

The set of arithmetic operations that a particular ALU supports may be limited to adding and subtracting or might include multiplying or dividing, trigonometry functions (sine, cosine, etc) and square roots. Some can only operate on whole numbers (integers) whilst others use floating point to represent real numbers.

1.3.3 Memory

A computer's memory may be viewed as a list of cells into which numbers may be placed or read. Each cell has a numbered "address" and can store a single number. The computer may be instructed to "put the number 123 into the cell numbered 1357" or to "add the number that is in cell 1357 to the number that is in cell 2468 and put the answer into cell 1595". The information stored in memory may represent practically anything. Letters, numbers, even computer instructions may be placed into memory with equal ease.

Computer main memory comes in two principal varieties: random access memory or RAM and read-only memory or ROM. RAM can be read and written to anytime the CPU commands it, but ROM is pre-loaded with data and software that never changes, so the CPU can only read from it. ROM is typically used to store the computer's initial start-up instructions. In general, the contents of RAM is erased when the power to the computer is turned off while ROM retains its data indefinitely.

1.3.4 Input/output (I/O)

I/O is the means by which a computer receives information from the outside world and sends results back. Devices that provide input or output to the computer are called peripherals. On a typical personal computer, peripherals include inputs like the keyboard and mouse, and outputs such as the display and printer. Hard disks, floppy disks and optical discs serve as both inputs and outputs. Computer networking is another form of I/O.

1.4 THE COMPUTER GENERATIONS

With the development in electronics, growth of computer has also been very fast. In the beginning computers were using tubes and were of very big size. Then transistors came and size reduced. With the invention if Integrated circuit (IC's) computers reduced to the size of modern PC's. We can divide the development of computers in five generations.

1.4.1 FIRST GENERATION COMPUTERS (1951-1959)

1. Vacuum tubes were used in these computers .
2. Size very large almost as big as size of a normal room.
3. Input data was fed through punched cards.
4. magnetic tapes for storing the data.

5. Single user
6. Used machine /assembly language,

1.4.2 SECOND GENERATION COMPUTERS (1959-1965)

1. Transistors were used in these computers .
2. Size not very large.
3. Input data was fed through punched cards.
4. Magnetic tapes for storing the data.
5. Multiple user
6. Development of FORTRAN-IV, COBOL, Basic, & PL/I languages.

1.4.3 THIRD GENERATION COMPUTERS (1965-1971)

1. Integrated Circuits (IC's) were used in these computers .
2. Monitor and keyboards were attached for I/O unit..
3. Magnetic disc for storing the data.
4. Multiple user/multi tasking with the help of sophisticated softwares.
5. Development of sophisticated OS and languages..

1.4.4 FOURTH GENERATION COMPUTERS (1971-present)

Significant distinction for fourth generation is the development of Large Scale Integration (LSI) and Very large Scale Integration (VLSI) . LSI placed several thousand transistors into a single chip. VLSI placed several hundred thousand transistors into a single chip. These developments were followed by creation of microprocessors.

1. Miniaturization of computers, PC's, Laptops
2. Further refinements off Input/output devices.
3. Introduction of microcomputers.
4. Sophistication of Operating System s, capable of virtual storage.

1.4.5 FIFTH GENERATION COMPUTERS (Future)

Super computers advanced in artificial intelligence would be capable of billions of calculations per second. Computers will be able to 'think' and 'reason'.

1.5 CATAGORIES OF COMPUTERS

Computers can be classified into two categories:

(a) Classification according to the logic used

(b) Classification according to size

1.5.1. Classification according to the logic used

There are three types of computer categorization according to logic. Analog, digital and hybrid computers.

Analog computers recognize data as a continuous measurement of a physical property. Their output is usually in the form of reading on dials or graphs. Voltage, pressure, speed and temperature are some physical properties that can be measured in this way. Examples are, patrol service station, speedometer of automobile etc.

Digital computers are high speed programmable devices that performs mathematical calculations, compare values, and store results. Examples are Personal Computers, main frame computers.

Hybrid computers combine the best features of analog and digital computers. They are usually used for special problems in which input data derived from measurements is converted into digits and processed by computers.

1.5.2. Classification according to size

Computers can be divided into following categories according to size.

(i) **Super Computer** : A **supercomputer** is a computer that leads the world in terms of processing capacity, particularly speed of calculation, at the time of its introduction. The term "Super Computing" was first used by *New_York_World* newspaper in 1920 to refer to large custom-built tabulators IBM made for Columbia University.

(ii) **MainFrame** Computers :A main frame computer is usually slower, less powerful and less expensive than super computers. It can be connected with more than 1000 terminals and works on time sharing basis.

(iii) **Mini Computers** : Minicomputer is a largely obsolete term for a class of multi-user computers which make up the middle range of the computing spectrum, in between the largest multi-user systems (traditionally, mainframe computers) and the smallest single-user systems (microcomputers or personal computers). More modern terms for such machines include midrange systems (common in IBM parlance), workstations (common in Sun Microsystems and general UNIX/Linux parlance), and servers.

(iv) **Micro Computers** : Although there is no rigid definition, a m**icrocomputer** (sometimes shortened to **micro**) is most often taken to mean a computer with a microprocessor (µP) as its CPU. Another general characteristic of these computers is that they occupy physically small amounts of space. Although the terms are not synonymous, many microcomputers are also personal computers (in the generic sense) and vice versa. The microcomputer came after the minicomputer, most notably replacing the many distinct components

that made up the minicomputer's CPU with a single integrated microprocessor chip.