CHAPTER ONE :Introduction

Objectives:

- ✓ Define the discipline computer science
- ✓ Define the term computer
- ✓ Identify the several characteristics of computer that made them useful and popular
- ✓ Identify various classification of computers
- ✓ Application of Computers

1.1. Introduction to Information and Communication Technology

Information and Communication Technology (ICT) is an umbrella term that covers all technical means for processing and communicating information. While this technically encompasses pre-digital technologies, including paper-based writing, it is most often used to describe digital technologies including:

- ✓ Methods for communication (communication protocols, transmission techniques, communications equipment, media (communication)), as well as
- ✓ Techniques for storing and processing information (computing, data storage, etc.)

The term has gained popularity partially due to the convergence of information technology (IT) and telecommunication technology.

ICT allows users to participate in a rapidly changing world in which work and other activities are increasingly transformed by access to varied and developing technologies. By this definition, you could almost say ICT is technology's version of economic growth, to satisfy the needs and wants of the community over time.

ICT tools can be used to find, explore, analyze, exchange and present information responsibly and without discrimination. ICT can be employed to give users quick access to ideas and experiences from a wide range of people, communities and cultures.

1.1.1. Introducing Information Technology

- **Information Technology:**
  - is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware."
  - deals with the use of electronic computers and computer software to convert, store, protect, process, transmit, and securely retrieve information.
  - is the combination of computer and communication technologies
  - is a general term that describes any technology that helps to produce, manipulate, store, communicate, and/or disseminate information
- **Data Processing**

The difference between Data and Information

Data:

Think of data as a "raw material" - it needs to be processed before it can be turned into something useful, hence, the need for "data processing". Data comes in many forms - numbers, words, symbols. Data relates to transactions, events and facts. On its own - it is not very useful. Think of the data that is created when you buy a product from a retailer. This includes:

- Time and date of transaction (e.g. 10:05 Tuesday 23 December 2003)
- Transaction value (e.g. £55.00)
- Facts about what was bought (e.g. hairdryer, cosmetics pack, shaving foam) and how much was bought (quantities)
- How payment was made (e.g. credit card, credit card number and code)
- Which employee recorded the sale
- Whether any promotional discount applied

At its simplest, this data needs processing at the point of sale in order for the customer to receive a valid receipt. So, the data about the transaction is processed to create "information" - in this case a receipt. You can imagine that the same data would also be useful to the manager of the retail store. For example, a report showing total sales in the day, or which are the best-selling products. So, the data concerning all shop transactions in the day needs to be captured, and then processed into a management report.

Information:

The above example demonstrates what information is. Information is data that has been processed in such a way as to be meaningful to the person who receives it. Note the - "processed" and "meaningful": It is not enough for data simply to be processed; it has to be of use to someone - otherwise why bother?!

1.2. What is Computer Science?

Computer Science is a science concerned with information i.e. representation, storage, manipulation or processing and presentation of information. Like any other science, which uses some devices for the practical aspect, computer Science uses a special device called **COMPUTER**.

Computer science has different fields of specialization or sub-disciplines like other sciences.

There are seven sub-disciplines of computer science.

- **Software engineering**: – It is concerned about the development of a better quality software by applying scientific &basic engineering principles.
- **Computer engineering (Architecture)**: deals with studying, analyzing and designing of computer hardware (organization and interconnection of computer system components) and its working principle.
- **Automata theory**: Automata Theory Is The study of machines or devices which accept a certain inputs such that the out put or at least the probabilities of output s are determined by the input.
- **Formal Language Theory**: Embraces the study of programs of programming languages, which is important for the understanding, and construction of compilers.
- **Complexity theory**: concerned with the study and analysis of algorithms, which helps in measuring the efficiency of the algorithms.
- **Database Architecture**: involves the study and design of efficient methods for information storage, process & retrieval.
- **Artificial intelligence**: Is concerned with means by which Computers may perform tasks that would be characterized as intelligent if performed by human beings.

1.2.1. What is Computer?

A **computer** is an electronic device that accepts data, performs computations, and makes logical decisions according to instructions that have been given to it; then produces meaningful information in a form that is useful to humans. The name computer comes from a Latin word Computer, meaning, "to compute"

1.3. Characteristics of Computers

The characteristics of a computer show the capability and the potential of the computer for processing data. This saves time, space, money, labors etc. And they answer the questions why computers are used? Why have they become so popular?

- **Speed**

The ability of the computers to carry out their instructions in a very short period of time is one of the main reasons for their popularity. Computers can perform within a matter of seconds or minutes tasks that would be impossible for a person to complete by hand in lifetime.

Its speed is measured by the amount of time it took to perform or carry out a basic operation.And its speed measured in terms of micro second (10-6 one millionths), nano second (10-9 one billionths), and Pico second (10-12 one trillionths). Hence a computer with speed 1 microsecond can perform 1 million instructions in just 1 second. (For example in one second this computer can perform the following tasks:

- ✓ Compute the grade point average for 3000 students
- ✓ Calculate the total number of all books used by students in a university

- **Accuracy**

Now a days computers are being used in life-and-death situations (For example, jet pilots rely on computer computations for guidance, Hospitals rely on patient-monitoring systems in critical –care units) which needs almost hundred percent accuracy. From this we can understand that computer is accurate and consistent. Unless there is an error in the input data or unreliable program, computers processes very accurately.

- **Durability and reliability**

Generally, reliablility is the measurment of the performance of a computer, which 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. Moreover, computers have the built-in diagnostic capabilities, which help in continuous monitoring of the system.

- **Versatility**

Computers are quite versatile in nature. They can perform multiple tasks simultaneously with equal ease. For example, at one moment it can be used to prepare a letter , the other moment it can be used to play music and in between you can print a document as well. All this work is possible by changing the program (sequence of instructions for computers). In brief, we can say that a computer can perform various tasks by reducing the task to a series of logical steps.

- **Diligence**

A computer is free from tiredness, lack of concentration, fatigue, etc. It can work for hours without creating any error. If millions of calculations are to be performed, a computer will perform every calculation with the same accuracy. Due to this capability it overpowers human being in routine type of work.

- **Storage Capability**

Computers can store large amounts of data and it can recall the required information almost instantaneously. The memory of the computer is relatively small and it can hold only a certain amount of information, therefore, the data is stored on storage devices such as magnetic tape or disks. Small sections of the data can be accessed very quickly and brought into the storage devices, as and when required, for processing. In order to explain the idea of storage capacity, we can take an example of CD-ROM and a hard disk. A single CD-ROM can store up to 700 MB of data while a hard disk can have a capacity of around 80GB (1GB=1024 MB).

Note: Even if the above main characteristics of computers are increasing with time, the cost and size of computers are decreasing.

1.4. Types of computers

There are different types of Computers. Their difference is depending on different categories of characteristics.

- **Classification by the method of operation (processing)**

They are classified into three:

I. Analog Computers

Analog computers operate by measuring. They deal with continues variables; they don't compute directly with numbers, rather, they operate by measuring physical magnitude such as pressure, temperature, voltage, current etc.

Examples

- Thermometer, Voltmeter, Speedometer
- Gasoline pomp – Contains an analog Computer that converts the flow of pumped fuel into two measurements the price of the delivered gas and the quantity of pumped fuel.

Note: They are special purpose computers.

Analog computers have limited accuracy

II. Digital Computers

Digital computers deal with discrete variables; they operate by counting rather than measuring. They operate directly up on numbers (or digits) that represent numbers, letters, or other special symbols.

Examples:

- Abacus
- Desk & pocket computers
- The general purpose computers

Digital computers have higher accuracy and speed than the analog ones.

III. Hybrid Computers

The best features of analog and digital computers can be combined into a single device to form a hybrid computer. A hybrid computer processes the information by collecting input data with analog method, convert it into digital quantities, processes the digital values and convert the output from digital to analog form.

Example:

In hospital insensitive-care unit analog devices may measure a patient's heart function, temperature and other vital signs. These measurements may then be converted into numbers and supplied to a digital component in the system. This component is used to monitor the patient's vital signs and to send an immediate signal to the nurse's station. If any abnormal readings are detected.

- **Classification by purpose of application**

Computers can be applied or used for different purposes. Based upon their application, they are classified as special purpose or general-purpose computers

I. Special purpose computers

They are designed to solve a single type of problem, that is their components and function are uniquely adapted to a specific situation involving specific application.
Example:

- The public telephone box
- Traffic control system
- Ticket machines (used in grocery, super market etc.)
- Pocket calculators
- Counters etc..

Most analog computers are special purpose computers.

II. General-purpose computers

They are designed to solve variety of problems through the use of "store program concept". A program or set of instructions designed to solve a problem is read and stored into the memory and then executed by the computer one by one. The same computer can be applied to solve another set of problem using different program. General purpose computers are more flexible and versatile.
Examples

- Micro computers
- Mini computers
- Super computers etc.

- **Classification by physical size, price, capacity and performance**

At this stage, by a computer, we mean a general-purpose digital computer. There is a wide variety of general purpose digital computers on the market place today, in terms of physical size, price, capacity, and performance. They are then classified as follows by their capacity and size:

- **Super computers**:

Super computers are the fastest, largest and most potential types of computer. They have speed of hundreds of millions of operation per second, a primary memory capacity of about 80 million characters, a secondary memory of capacity of about 20 times its primary memory.

- They are multi-user systems in intercontinental range.
- They can carry out enormously complex scientific calculations.

They are used to process huge amount of data and are commonly used in space technology centers, meteorology stations,astronomical observatories, inter continental communications, airline organizations.

- **Mainframe computers**:

Smaller than super computers in size and capacity, lower in speed & memory capacity than the super computers. However they are multi-user systems and handle hundreds of users, usually used in large organizations.

- **Mini computers**

Have relatively lower speed, can handle multi-users, are smaller in size than the mainframe computers. They use terminals for inputs and output. Mini computers are used in small organizations.

- **Micro computers**:

Micro computer (personal or desktop computer) is a computer whose CPU is microprocessor. Microprocessor is a processor all of whose components are on a single integrated-circuit chip. Since its CPU is integrated in a single circuit, it can serve only a single user at a time. Most of home and personal office computers are microcomputers. The relative performance and usage of personal computer is relatively increased with a very high rate.

1.5. Application of Computers

- **Why we use Computers?**

The following are some of the capability of Computers, which are reasons to use Computers.

- Store and process large amount of information with high speed and accuracy;
- Transmit information across continents via communication channels;
- Simulate events;
- Perform complex mathematical computations and make comparisons;
- Monitor ongoing industrial operations;
- Perform repetitive processes with great ease, speed, and reliability;

Therefore, computers are applicable for any functions or process that requires these abilities. The main areas of computer applications can be listed as follows:

- **Learning Aids:**

Example: learning toys, programs range from simple arithmetic to calculus, from English grammar to creative writing and foreign language, and from basic graphics to engineering design models,)

- **Entertainment**:

Examples : Games

- **Commercial or business applications**

Computers are needed to perform business operations that require handling large amounts of data. Several computer applications are available to assist business in working with large volumes of data.

Examples are:

- ✓ Text processing
- ✓ Accounting and Finance management
- ✓ Inventory control
- ✓ Database management
- ✓ Statistical Analysis

- **Scientific – engineering and research applications**

Using computers for scientific research, complex mathematical calculations, design work, and analysis and control of physical systems.

Examples are:

- ✓ Space technology
- ✓ Meteorological observatory systems
- ✓ Astronomical investigations
- ✓ Design of machines and
- ✓ Control of manufacturing process

- **Information Utilities**

Information utilities companies use large computers that store huge amount of information about many different subjects. These computer systems and their vast amount of data are available for personal use. For example: information utilities can allow a computer user to read the daily news , research published works, send a letter to a friend, play games, make airline reservations, obtain the latest stock market quotations, and perform many other activities.

Example: Internet.

- **Electronic Banking and Service:**

Example: Teller Machine (customers are issued cards that permit them to use other banks teller machine's)

Online banking (A bank customer can use his/ her computer to check account balances, transfer funds, pay bills)

- **Shopping from Home**

Individual may now shop by computer in the comfort of their home.

- **Household Control**

A growing number of the newer houses hold devices are computers controlled. For example: Security systems, refrigerators, microwave ovens, washers, stereos, and televisions. This computer controlled home security system monitors movements,

broken glass, unlawful entry without a security code, and so on, and alerts the local police department.

- **Weather and Environment**

Computer equipment may show temperature ranges , precipitation levels and wind flow and can used in weather forecasting. Computer can also helped in overcoming environmental hazards.

- **Transportation**

Computers have affected almost every kind of transportation. Many aircraft can fly under the control of the computer; in this situation, the captain simply serves as a manger by telling the computer what to do. In Cars, computers have provided functional controls such as spark and fuel control.

- **Medical and Health Care**

Computers have long been used by hospitals for routine record keeping. Today, however, many people owe their lives to the computer. Computers are used in hospitals as sensors (device that detect changes in blood pressure, heart rate, temperature), testing (scan the body and provide 3-D figure), patient treatment.

- **Routine and Dangerous Tasks**

Computers are used in routine tasks. And they can perform task in environments to dangerous for human workers.

- **Consultant (Expert system)**

An Expert system is a computer program, which can solve problems from a specific knowledge base. These systems don't replace expert humans because the knowledge base of expert system is given from the skilled specialist.

Example: Mycin (a medical diagnostic program by using sophisticated decision making process).