CHAPTER 1
Overview of Computers and the Computer System

1.1 Overview of Computers

1.1.1 What is a computer?

An electronic system that can be instructed to accept, process, store, and present data and information. It 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"

1.1.2 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?

1. **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.

Processing speed is measured in Hertz, a unit used in the definition of frequency. i.e Its speed is measured by the amount of time it took to perform or carry out a basic operation. Common units are 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 value of all books used by students in a university,…

Remark: is usually the concern of CPU.

2. **Accuracy:** Now days computers are being used 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 the computer processes with a very accurate.

3. **Capacity**: The ability of computers to store and process vast amounts of data continues to grow. A computer operating at 200 MHz can move data from one location to another at a rate excess of 1.2 billions characters (symbols) per second.

Remark: is usually the concern of Memory: RAM, Hard Disk.

4. **Versatility:** Because of technological advancements in the computer industry, most computers today are considered to be general-purpose computers That is both their computation and input/output processing capabilities are such that they can be used for almost any type of application. For example, the same computer that is used to handle engineering company's mathematics, and design computations can also be efficiently used by the company to track inventory, process payroll, project earnings, and fulfill all its reporting needs.

Today's computers are versatile in what they can do; computers and their components part being used in application never before envisioned. For example; in home appliances (washing machines, ovens) home entertainment centers, traffic lights, automobiles, banking, assembly plants, space probes, art, music, education, hospitals, and agriculture, to name few. The versatility of the computers and its use in a wide array of application are limited only by the imagination of the human mind.

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

Durability and Reliability: are durable and extremely reliable devices. They can operate error-free over long periods of time.

1.1.3 Application of Computers

Why we use Computers?
The following are some of the capability of Computers, which are reasons to use them.
- ✓ 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:

Examples: 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:

Example : 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,…

Scientific – Engineering and Research Applications

- ☐ Using computers for scientific research, complex mathematical calculations, design work, and analysis and control of physical system

Banking and Services: eg. 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…

Communication: Basic need for most human activities

Tarditional- telephone, fax, mail...

In the new information era- e-mail, internet, video conferencing

The new communication technology enables people located in different places to work together as if they were in the same office. Big multinational companies are already exploiting this technology to achieve better use of the resources of their seperate offices. In this way projects can be shared between officeswith the application of the best expertise, and around the clock

Related Iessues:On-line services, Internet distance learning, E-business, Teleworking...

1.1.4 Generation of Computers

Although computer professionals do not agree on exact dates or specifics, computer developments are often categorized by generations. Actually there are four generations and major characteristics that distinguish these generations are the following;

- ✔ Dominant type of electronic circuit elements used.
- ✔ Major secondary storage media used.
- ✔ Computer language used.
- ✔ Types or characteristic of operating system used.
- ✔ Memory access time (time to store or retrieve a word or data from memory).

Computer generations are usually categorized by dramatic improvement in the hardware, typically refold or better increases in speed and reliability.

First Generation (1950s)

- ✓ Used vacuum tubes as components for the electronic circuit.
- ✓ Punched cards were the main source of inputs, and magnetic grams were used for internal storage.
- ✓ Operate in a speed of milliseconds (thousands of a second) and could handle more than 10,000 additions each second.
- ✓ Most applications were scientific calculations.

Has lot limitations.

Second Generations (Early 1960s)

- ✓ Transistors were the main circuit components. (Transistors are a solid state device made from silicon which is smaller, cheaper, faster, dissipate less energy and more reliable than vacuum tube but work in the same way with the vacuum tube.)
- ✓ Invented by Bell Labs.
- ✓ Magnetic tapes (similar with home tape caste), used for main storage,
- ✓ Operate in microseconds (millionths of a second) with more than 200,000 additions possible each second.
- ✓ Business applications become more commonplace, with large data files stored on magnetic tape and disk.
- ✓ High-level languages COBOL and FORTRAN were introduced during this period. Batch operating systems are used that permitted rapid processing of magnetic tape files.

Third Generation (Late 1960s, Early 1970s)

✓ Characterized by solid-state logic and integrated circuit (IC). (A single, self-contained transistor is called discrete component. In early 1960 electronic equipment composed of discrete components transistors, capacitors, resistors, …. They are manufactured separately

✓ Packed in their own containers and soldered (wired together) on a circuit board. So the entire manufacturing process was cumbersome and expensive. Do to these and other problems in 1958 the achievement that revolutionized electronics started the era of microelectronics: the invention of integrated circuit

✓ Computer storage switched from magnetic cores to integrated circuit boards that provide modularity (expandable storage) and compatibility (interchangeable equipment New input/output methods such as optical scanning and plotters.

✓ Software become more important with sophisticated operating systems, improved programming languages

Fourth Generation (Late 1970s, Early 1989s)

✓ Greatly expanded storage capabilities and improved circuitry.
✓ Has a large-scale integrated circuits (LSI) which has several hundred thousands transistors placed on one tiny silicon chip.
✓ Computer memory operates at speeds of nano seconds (billionths of a second) with large computers capable of adding 15 million numbers per second.
✓ The introduction and popularity of networking

The fifth one is in progress and no border line with the fourth one. An architecture, which makes use of the changes in technology and allows a simple and natural methodology for solving problems, is being sought. These computers will have intelligent processors i.e., processors which can draw inferences. Users will also be able to interact with them in natural languages such as English.

Summary of generation of computers	1st	2nd	3rd	4th
Circuit element	Vacuum tube	Transistor	IC	LSI /VLSI
SSD	Punched card	Magnetic Tape	Magnetic disk	Mass storage device
Language	Machine & assembly	Fortran, COBOL etc	Structured language	Application oriented
Operating system	Operator control	Batch system	Application oriented	Time sharing

Memory Access time	1ms	10μs	10ns	1ns

1.1.5 Types of Computers

Computers come in four sizes:

a. Microcomputers

A relatively compact type of computer, the most common of all, easily outsells all other types of computers annually for use in business and at home.

Different types of Microcomputers:

Desktop Computers, Notebook Computers/Laptop Computers, Tablet PCs, Personal Digital Assistants, Palm PCs

b. Midrange(Mini) computers

A computer uses to interconnect people and large sets of information. More powerful than a microcomputer, the minicomputer is usually dedicated to performing specific functions.

c. Mainframes

d. Supercomputers

The most powerful of all computers, supercomputers were designed to solve problems consisting of long and difficult calculations.

1.2 The Computer System

Objectives: What a computer system is and how it works to process data

1.2.1 Computer Hardware

System is a group of components, consisting of subsystems or procedures that work in a coordination fashion to achieve some objective. A computer system composed of components that are classified either as **Computer hardware** or **Computer software**.

Computer hardware is the physical part of the computer that you see, you use to and the parts you can touch. The computer and its associated equipment. The hardware part of a computer system is composed of a number of interacting physical parts based on the need of the information flow.

The Central Processing Unit

In order to able to do its tasks the CPU needs to temporarily store some data to remember the location of the last instruction to store instruction and data temporarily while execution in other words, the CPU needs a small internal memory called registers.

The Arithmetic Logical Unit (ALU): It performs the arithmetic calculations of addition, subtraction, multiplication and division and comparisons and it is used to keep track of and execute instruction.

All modern digital computers can do is addition; multiplication is merely a continuous addition; subtraction is the addition of the complements of the number to be subtracted; division is the addition of complements.

Registers are paths or conduits that connect the Arithmetic Logical Unit to the main memory. When an instruction loaded from main memory, it is placed first in the register to wait instructions from the control unit. Data are also stored in registers prior to execution in the ALU.

The Control Unit: As the name implies, it performs all the control functions of the computer. It retrieves the instruction from memory. Translates those instructions into computer functions and sends signals to other computer hardware units to carry out those functions. It is also responsible for determining the next instruction to be executed by the computer.

Main Memory or Primary Memory or RAM

Is that the memory which is directly accessible by the control unit and ALU; Usually referred as Random Access Memory (RAM), because each memory location can be accessed without having to work sequentially through hundreds or even thousands of memory locations called addresses; Each memory location can be referred by its memory location (address). Holds instructions and data elements which are currently used by the computer.

The data in the main memory while be lost when the power is off;

Parts of the CPU may also contain Read Only Memory (ROM).

This type of memory is integrated into the circuitry of the computer and cannot be altered without altering the computer circuitry;

Used to store programs and data those are used frequently and permanently

Due to high price of a primary storage memory of a computer system, the need to have other type of storage to hold large amount of data in a less expensive and yet accessible manner is evident. Hence secondary storage device were created with this need in mind.

Input Unit

Is the unit used to enter data into the computer so that it can be processed.

It converts information from a form suitable to human beings to one understandable by the computer.

Examples of input devices:

Keyboard (which is the most widely used input devices)

Disk derives (floppy and hard-disk derives)

Mouse, Scanner

Light pen (a photo cell to choose a displayed response to request further information).

Voice synthesizer

CD-ROM Drive, etc.

It is intensively used by U.S. banking industry to input information on checking account transactions. It has been in use since the 1950s, allows checks and deposit slips to be read both by people and by machines. The machines, called magnetic ink

OUTPUT UNIT

Used to retrieve information out of a computer so that it can be examined, analyzed or distributed to others.

Convert the result of the only-machine understandable form to a form understandable by human beings.

Examples

The Visual Display Unit (VDU) or monitor or screen

Printers (dot matrix, desy wheel, laser printers)

Plotters

Voice (audio) response unit

Disk drives

We have seen that there are different components of a computer and each performs a specific function. But to perform a given task in synchronized form there should be some 2 Optical Recognition Systems **Interconnecting Components in a Macro Computer and Information Movement in a Computer System.**

An electronic circuit which produces communication path between the different components of a computer system along which data are transferred is Bus. The bus, which communicates the different parts of the CPU is called Internal Bus. And the bus, which communicates the CPU with memory and peripheral devices is called External Bus. The size of the bus determines the speed of efficiency of the computer.

Address Bus: - is a unidirectional bus over which digital information is transferred to identify either a particular memory location or particular I/O address.

Data Bus: - a bus system which interconnects the CPU, memory and all the peripheral Input / Output devices of a computer system for the purpose of exchanging data.

Control Bus: - a bus used to select and enable an area of main storage and transmit signals required to regulate the computer operation.

Secondary Storage:- secondary storage or auxiliary storage, can take many forms, which have traditionally included punched cards, papers tape, magnetic tape, magnetic disk and magnetic drum.

Magnetic Tapes

Magnetic tapes are a particularly popular form of secondary storage because of their high data density (the number of bytes of instruction per inch of tape) and their convenience in handling. Magnetic tapes are approximately one - half inch wide are made of Mylar – based plastic film which can be magnetized. Data are stored on a magnetic tape by running the tape over the electromagnetic called read/write head which magnetizes small spots on the tape. Seven-track tapes store information as bytes of information, where each byte consists of a six-bit code and a one-bit parity bit. Nine-track tape use an eight-bit and a parity bit. **Random Processing Medias**

Magnetic disks

Magnetic disks are metals or plastic platters coated with ferrous oxide, an easily magnetizable material. Magnetic disks allow for random access of information and overcome the slow access time commonly found in tape files.

1.2.2 Computer Software

The computer hardware is an electronic device which has the potential of performing the task of solving a problem. However one has to give precise instructions to the hardware in order to solve problem.

The finite set of instructions (steps) that the computer follow to perform a given job is called a **program**.

Any program to be executed first it should reside / loaded/ in the memory.

Software:- is a collection of programs and routines that support the operations of performing a task using a computer. Software also includes documentations, rules and operational procedures. Software makes the interface between the user and the electronic components of the computer.

Computer software is classified into two

    1. System software

    2. Application software

3.2. 1.SYSTEM SOFTWARE

☐ Constitutes those programs which facilitates the work of the computer hardware.

☐ It organizes and manages the machine's resources handles the input/output devices.

☐ It controls the hardware by performing functions that users shouldn't have to or are unable to handle.

☐ System programs make complex hardware more users friendly.

☐ It acts as intermediate between the user and the hardware.

☐IIt enables the computer understand programming languages i.e. it serves as means of communication between user and a computer.

The important categories of system software are:

    a) Operating System

    B) Language Software

a) Operating system

Operating system coordinates the activity between the user and the computer. An operating system has huge tasks/ functions. These include:

Controlling operations (control program)

☐ Coordinates, or supervises the activity of the computer system.

☐ Decides where programs and data should be stored in the computer memory.

☐ Handles communications among the computer components, applications software and the user.

☐ Controls the saving and retrieving of files to and from disks in the disk drive.

☐ It performs all its controlling tasks without the involvement or awareness of the user.

ii. I

Input/output Management

☐ The I/O manager coordinates the computers communication with outside world, flow of data to the display screen and other output devices (printers/ plotters) and from the key board or other input devices.

☐ Handles the flow of data to and from the disk drives (file management).

☐ Handles the process of preparing a disk for use, the copying, renaming, erasing task of a file.

iii. Command Processing (command Interpreter):

It interprets the commands or what you enter using the keyboard or other input devices.

☐ If you write an internal command it carries out the function of that command if it is external command or other executable file it searches for the corresponding file in the default (current disk) or the user specified disk, loads the file into memory and transfers control to that program. Once this program is terminated, control returns to command.com and the program for that command or file is discarded from memory.

Types of Operating Systems

Operating systems can be classified by:

☐ The number of programs they can handle at a time and

☐ The number of users they serve at once at one or different stations (i.e. terminals or micro-computers connected to a central computer).

Single tasking operating systems: With single tasking operating systems only one program can be run on a computer at a time.

☐ In order to run another program, one must remove the first program loaded in the computers main memory and load the other one(i.e. it can't handle two or more programs at a time)

☐ These types of operating systems are single user or can serve only one user at a time.

ii. Multi User Operating System : It supports a number of work stations connected to a central system.

☐ A number of users can use the resources of one high capacity computer by the help

of terminals.

iii. **Real Time Operating System**: A real time is a system that is capable of processing data so quickly that the results are available to influence the activity currently taking place.

Example: - Air plane seat reservations and computer controlled plant.

- Its primary characteristics is that it responds to an event within a well defined time.

B) Language Software

- Are software which are used by programmers to develop application softwares and translate programs to machine code.

- Language software is a generic name consisting of various programs that serve as editors & translators to develop programs in a number of programming languages.

- Includes:- Translators, general purpose routines and utilities & high level languages

◆ Translator:- is a program that converts one or more languages to another language. Three types of translators are assemblers, Compilers & interpreters.

◆ Assemblers:- is a program that translates assembly languages into machine code.

◆ Compiler:- is a program that translates a high level language into machine code. (Pascal, Fortran Cobol)

◆ Interpreter:- is a program that translates each instruction of high level language & executes the instruction before translating the next instruction.

◆ The general-purpose routine and utilities include programs which are used to handle file processing, editing and debugging.

◆ High level language software are software which have their own compilers to detect syntax errors of the users program code. Example Cobol, Fortran, Pascal. Etc.

2. APPLICATION SOFTWARE

☐Is a software that is designed to perform tasks for the specific area or areas. But for use in more than one installation.

☐ Are usually called application packages as they may include a number of programs along with operating instruction, documentation and so forth.

☐ Depending on their function or task they are categorized in to the following.

1.Word Processors/ Word processing

- is a computerized typewriter which permits the electronic creation, editing, formatting, filing and printing text.
- Is the most common application of microcomputers.
- Until recently, word processing could be done only dedicated word processors. A dedicated word processor is a computer that denies its users the opportunity to execute any other program. Example: WordStar, WordPerfect, Microsoft word,…

2. Spreadsheet

- is an electronic worksheet display on the VDU.
- Until recently, financial analysis and other mathematical calculation were done by entering numbers on pages of an accountants ruled ledger pad.
- You can quickly create a model of a situation on a spreadsheet by entering labels, numbers & formulas.
- Using the programs built-in function you can perform complicated calculations such as net percent value, internal rates of return, and monthly payments on a loan. Example: Lotus 1-2-3, Microsoft Excel, Quatropro

3. Database Management System.

Allow you to store information on a computer, retrieve it when you need it and update it when necessary. You can do this with index cards, but database

management programs do them more quickly and easily.

Example: You can store large mailing list, inventory record or billing and collect information in lists stored in files and manipulate this information, one file at a time with database management program. You can record or create a database about employee information as

Name, sex, Marital status, salary, Date of Birth, **Date of employment, Post, Department Level of education, Field of study etc.**

Then you can ask the computer the following question

- How many female workers are there?

- List employees with a salary of birr 500 and above

- List those employees who are department head and have Bachelor degree or higher and so on.

Example: Dbase IV, FoxPro, Microsoft Access.