# Chapter- 1
# Computer System

# Introduction

- A computer is an electronic device that can be programmed to accept data (input), process it and generate result (output).
- A computer along with additional hardware and software together is called a computer system.

**Data vs Information**

Data are raw numbers or other findings which, by themselves, are of limited value.

Information is data that has been converted into a meaningful and useful context

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# Functionalities of a computer

- Any digital computer performs five functions in gross term.

1. Take data as input
2. Stores data/instructions
3. Process those stored data
4. Generate the output
5. Control all above steps

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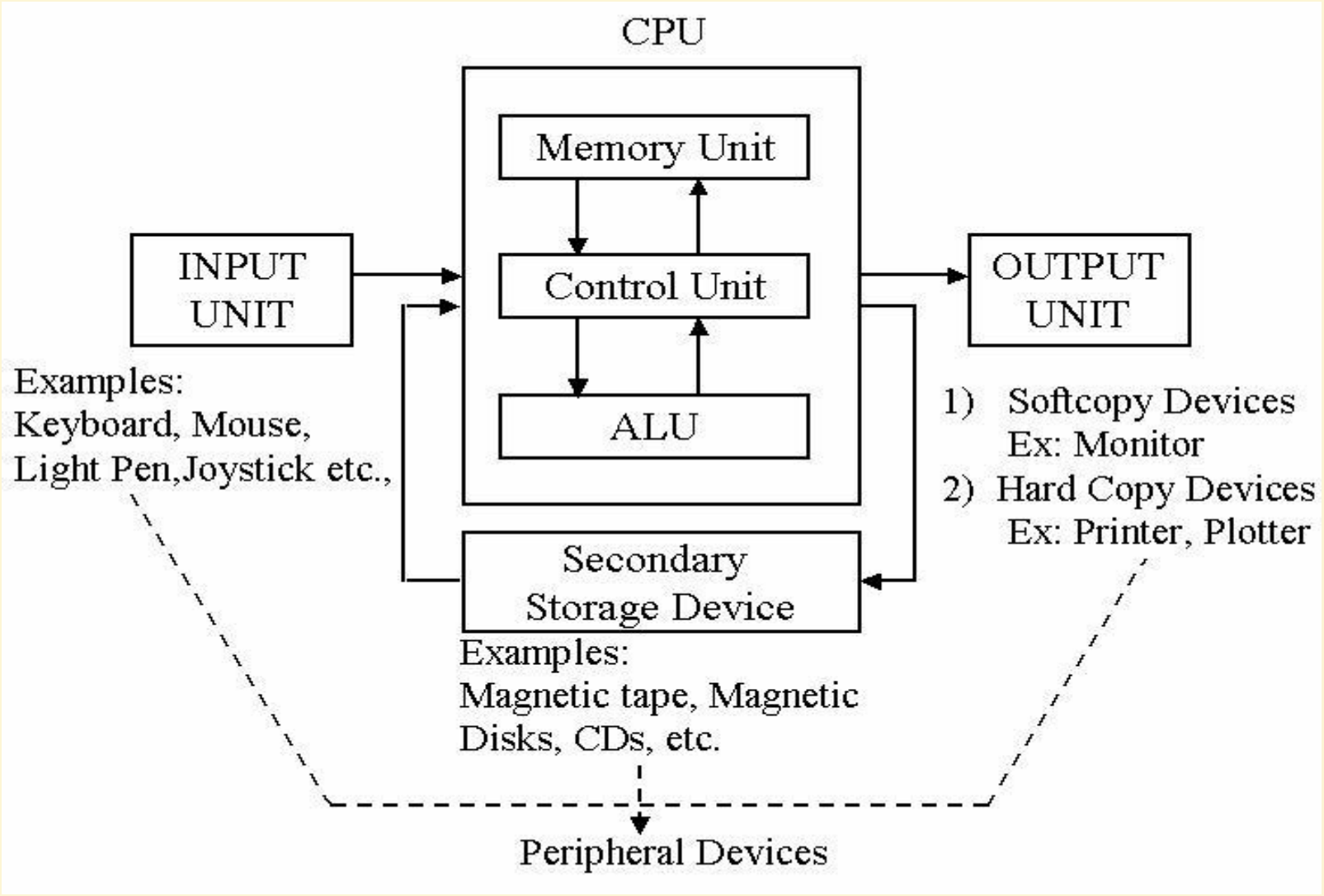
# COMPONENTS OF COMPUTER SYSTEM

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# Central processing unit

- It is the electronic circuitry of a computer that carries out the actual processing and usually referred as the brain of the computer. It is commonly called microprocessor also.
- Physically, a CPU can be placed on one or more microchips called integrated circuits (IC). The Ics comprise semiconductor materials.
- While processing, the CPU stores the data as well as instructions in its local memory called registers. Registers are part of the CPU chip and they are limited in size and number. Different registers are used for storing data, instructions or intermediate results.

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# Main components of CPU

- Arithmetic Logic Unit (ALU)
- Control Unit (CU).

- ALU performs all the arithmetic and logic operations that need to be done as per the instruction in a program.
- CU controls sequential instruction execution, interprets instructions and guides data flow through the computer's memory, ALU and input or output devices.

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# Input Devices

- The devices through which control signals are sent to a computer are termed as input devices.
- These devices convert the input data into a digital form that is acceptable by the computer system.
- Data entered through input device is temporarily stored in the main memory (also called RAM) of the computer system. For permanent storage and future use, the data as well as instructions are stored permanently in additional storage locations called secondary memory.
- Examples: keyboard, mouse, scanner, touch screen, etc.,

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# Output Devices

- The device that receives data from a computer system for display, physical production, etc., is called output device.
- It converts digital information into human understandable form.

- Examples: Monitor, projector, headphone, speaker, printer, etc.

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# Computer Memory

- A computer system needs memory to store the data and instructions for processing.
- Memory is a collection of cells, each with a unique physical address most computers are byte-addressable cell at address 11111110 contains 10101010

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# Memory Units

| UNIT | STORAGE | ABBREVIATION |
|---|---|---|
| Bit | Binary Digit, Single 1 or 0 | B |
| Nibble | 4 bits | - |
| Byte/Octet | 8 bits | B |
| Kilobyte | 1024 bytes | KB |
| Megabyte | 1024 KB | MB |
| Gigabyte | 1024 MB | GB |
| Terabyte | 1024 GB | TB |
| Petabyte | 1024 TB | PB |
| Exabyte | 1024 PB | EB |
| Zettabyte | 1024 EB | ZB |
| Yottabyte | 1024 ZB | YB |

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# Types of Memory

- ***Primary Memory***
  Primary memory is an essential component of a computer system. Program and data are loaded into the primary memory before processing. The CPU interacts directly with the primary memory to perform read or write operation.

- It is of two types viz. (i) Random Access Memory (RAM) and (ii) Read Only Memory (ROM).

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# MEMORY (CONTD.)

| RAM | ROM |
|---|---|
| RAM stands for Random Access Memory. | ROM stands for Read Only Memory. |
| It allows both read and write operations. | It allows only read operation. |
| It is volatile in nature i.e. data are lost when power supply is switched off. | It is non-volatile in nature and used for permanent storage. |
| It is used when IO operation is performed, known as buffering. | It is not used for buffering purpose. |
| It usually has higher memory space than ROM. | It usually has less memory space than RAM. |
| The second operation after booting the computer is performed in RAM. | The first operation in computer system is performed in ROM (during booting process). |
| It is used to store data/instructions while they are being processed, waiting to be processed and after being processed before it is provided to output components. | It is used to store program that are required for the operation of electronic devices. |

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# Memory (contd.)

- ***Cache Memory*** is a special very high-speed memory. It is used to speed up and synchronizing with high-speed CPU. Cache memory is costlier than main memory or disk memory but economical than CPU registers.
- Cache memory is an extremely fast memory type that acts as a buffer between RAM and the CPU.

- It holds frequently requested data and instructions so that they are immediately available to the CPU when needed. When the CPU needs some data, it first examines the cache. In case the requirement is met, it is read from the cache, otherwise the primary memory is accessed.

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# MEMORY (CONTD.)

- ***Secondary Memory*** is a memory which permanently store the data or instructions for future use. The secondary memory is non-volatile and has larger storage capacity than primary memory. It is slower and cheaper than the main memory. But, it cannot be accessed directly by the CPU. Contents of secondary storage need to be first brought into the main memory for the CPU to access.
- Examples: Hard Disk Drive (HDD), CD/ DVD, Memory Card, SSD etc.,

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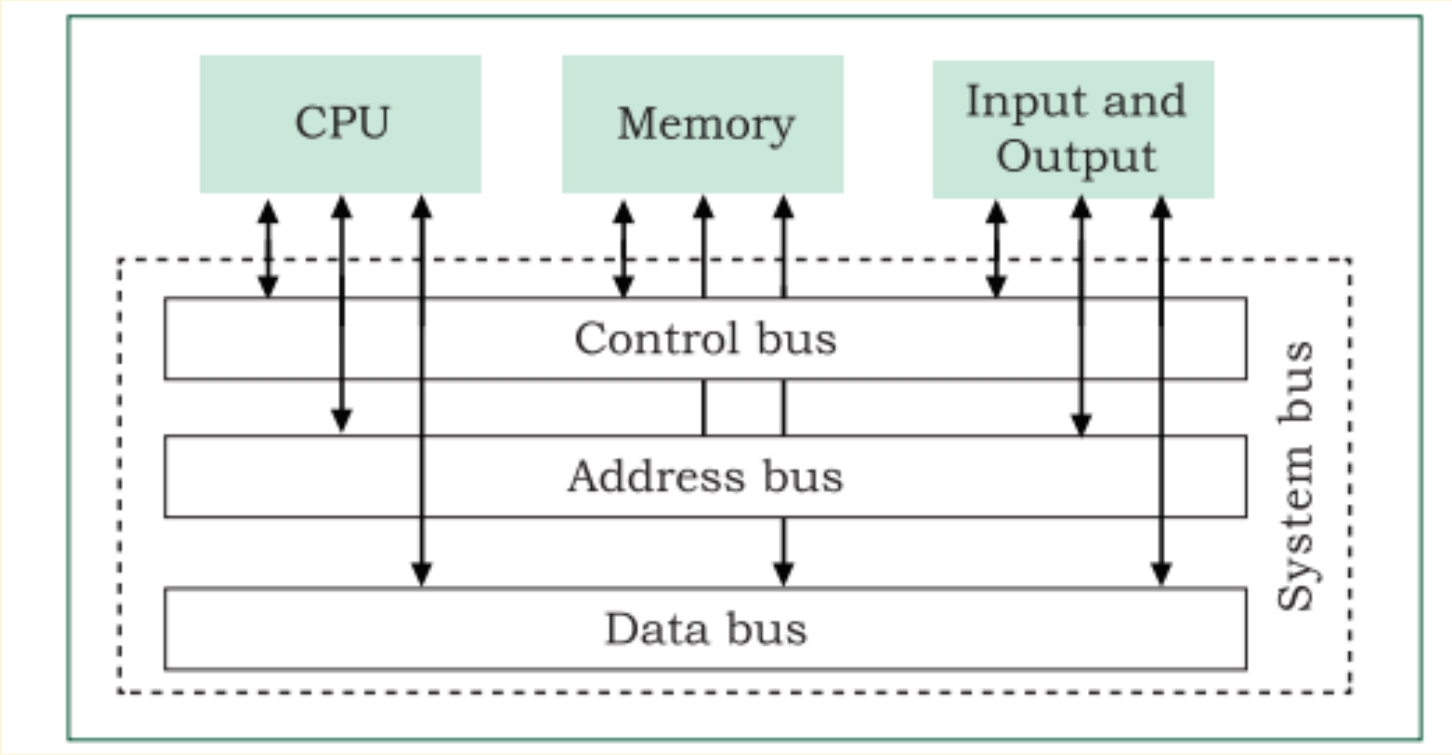
# Data transfer between CPU and memory




Data are transferred between different components of a computer system using physical wires called *bus*.

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# TYPES OF BUS

- Data bus to transfer data between different components,
- Address bus to transfer addresses between CPU and main memory.
- Control bus to communicate control signals between different components of a computer.
- To write data into memory, the CPU places the data on the data bus, which is then written to the specific address provided through the address bus.
- In case of read operation, the CPU specifies the address, and the data is placed on the data bus by a dedicated hardware, called memory controller. The memory controller manages the flow of data into and out of the computer's main memory.

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# MICROPROCESSORS

- Microprocessor is a small-sized electronic component inside a computer that carries out various tasks involved in data processing as well as arithmetic and logical operations.
- Microprocessors have evolved over time in terms of their increased processing capability, decreasing physical size and reduced cost.

Generations of microprocessor

| Generation | Era | Chip type | Word size | Maximum memory size | Clock speed | Cores | Example* |
|---|---|---|---|---|---|---|---|
| First | 1971-73 | LSI | 4 / 8 bit | 1 KB | 108 KHz-200 KHz | Single | Intel 8080 |
| Second | 1974-78 | LSI | 8 bit | 1 MB | Upto 2 MHz | Single | Motorola 6800 Intel 8085 |
| Third | 1979-80 | VLSI | 16 bit | 16 MB | 4 MHz - 6 MHz | Single | Intel 8086 |
| Fourth | 1981-95 | VLSI | 32 bit | 4 GB | Upto 133 MHz | Single | Intel 80386 Motorola 68030 |
| Fifth | 1995 till date | SLSI | 64 bit | 64 GB | 533 MHz - 34 GHz | Multicore | Pentium, Celeron, Xeon |



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# Microprocessor Specifications

- ***Word Size***
  Word size is the maximum number of bits that a microprocessor can process at a time. Earlier, a word was of 8 bits, as it was the maximum limit at that time. At present, the minimum word size is 16 bits and maximum word size is 64 bits.
- ***Memory Size***
  Depending upon the word size, the size of RAM varies. Initially, RAM was very small (4MB) due to 4/8 bits word size. As word size increased to 64 bits, it has become feasible to use RAM of size upto 16 Exabytes (EB).
- ***Clock Speed***
  Computers have an internal clock that generates pulses (signals) at regular intervals of time. Clock speed simply means the number of pulses generated per second by the clock inside a computer. The clock speed indicates the speed at which the computer can execute instructions. Earlier, it was measured in Hertz (Hz), now in Gigahertz(GHz).

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# CONTD.

- ***Cores***
  Core is a basic computation unit of the CPU. Earlier processors had only one computation unit, thereby capable of performing only one task at a time. CPU with two, four, and eight cores is called dual-core, quad-core and octa-core processor, respectively.
- **Microcontrollers**
  The microcontroller is a small computing device which has a CPU, a fixed amount of RAM, ROM and other peripherals all embedded on a single chip as compared to microprocessor that has only a CPU on the chip. Because of the very small size of the microcontroller, it is embedded in another device or system to perform a specific functionality.

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# DATA AND ITS TYPES

- ***Structured Data***
  Data which follows a strict record structure and is easy to comprehend is called structured data. Such data with pre-specified tabular format may be stored in a data file to access in the future. Examples: online tickets booking, sales transactions, etc.,
- ***Unstructured Data***
  Data which are not organised in a pre-defined record format is called unstructured data. Examples: audio and video files, graphics, text documents, social media posts, satellite images, etc.
- ***Semi-structured Data***
  Data which have no well-defined structure but maintains internal tags or markings to separate data elements are called semi-structured data. Examples: email document, HTML page.

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# Data Capturing, Storage and Retrieval

- ***Data Capturing***
  It involves the process of gathering data from different sources in the digital form.
- ***Data Storage***
  It is the process of storing the captured data for processing later.
- ***Data Retrieval***
  It involves fetching data from the storage devices, for its processing as per the user requirement.

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# Data Deletion and Recovery

- Deleting digitally stored data means changing the details of data at bit level, which can be very time consuming. Therefore, when any data is simply deleted, its address entry is marked as free, and that much space is shown as empty to the user, without actually deleting the data.
- **Data recovery** is a process of retrieving deleted, corrupted and lost data from secondary storage devices.

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# Software

- The software comprises a set of instructions which on execution deliver the desired outcome. In other words, each software is written for some computational purpose.
- **Need of Software**
  The sole purpose of a software is to make the computer hardware useful and operational.

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# Types of software

- **Application software:** It handles specialized/ common tasks a user wants to perform, such as banking, hotel management, any data processing, word processing etc.
- **System software:** controls the basic functions of a computer and hides the complexity of computer system from user and application software. E.g. Operating System, Compiler, Interpret etc.
- **Utility software:** Which helps to manage, maintain and control computer resources. E.g. are antivirus software, backup software and disk tools.

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# SOFTWARE

- **System software:**
- **Operating system**
  An Operating System (OS) is a system program that controls and manages the computer resources (resource manager) so that application software can run on it.
  Example: Microsoft Windows, Solaris, Linux, MAC OS,Ubuntu, Apple's i-Phone OS etc.
- ***System Utilities***
  Software used for maintenance and confguration of the computer system is called system utility. Some system utilities are shipped with the operating system for example disk defragmentation tool, formatting utility, system restore utility, etc
- ***Device Drivers***
  As the name signifes, the purpose of a device driver is to ensure proper functioning of a particular device.

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# HOW OPERATING SYSTEM WORKS

In any computer or mobile device, the operating system can be termed as the back bone when it comes to software. This is because it has to be there before other programs can be run. It works as a middleman (interface) between machine and user. At the simplest level, an operating system does two things:

- It manages the hardware resources of the computer system. These resources include such things as the processor, memory, disk space, etc.
- It provides a stable, consistent way for applications to deal with the hardware without having to know all the details of the hardware.

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# FUNCTIONS OF OPERATING SYSTEM

- Processor management:
  Loads, schedules and execute process/programs.
- Memory management:
  Allocates /De-allocation of memory for program execution.
- Device management:
  Communicate and controls various I/O devices.
- Storage management:
  Manages and controls the storage device to provide space to program for execution & data save.
- Application interface:
  API/drivers provide a way for applications to make use of hardware subsystems.
- User interface:
  structure for interaction between a user and the computer.

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# Types of OS interfaces

- ***Command-based Interface***
  Command-based interface requires a user to enter the commands to perform different tasks like creating, opening, editing or deleting a file, etc. Command based interface is often less interactive and usually allows a user to run a single program at a time. Examples: MS-DOS and Unix.
- ***Graphical User Interface***
  Graphical User Interface (GUI) lets users run programs or give instructions to the computer in the form of icons, menus and other visual options. Examples: Microsoft Windows, Ubuntu, Fedora and Macintosh, among others.
- ***Touch-based Interface***
  Using the touchscreen, a user provides inputs to the operating system, which are interpreted by the OS as commands like opening an app, closing an app, dialing a number, scrolling across apps, etc. Examples: Android and iOS.
- ***Voice-based Interface***
  Modern computers have been designed to address the needs of all types of users including people with special needs and people who want to interact with computers or smartphones while doing some other task.
- ***Gesture-based Interface***
  Some smartphones based on Android and iOS as well as laptops let users interact with the devices using gestures like waving, tilting, eye motion and shaking. This technology is evolving faster and it has promising potential for application in gaming, medicine and other areas.

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# TYPE OF OPERATING SYSTEM

- **Single-User, Single Task Operating System:**
  These operating systems work on single task & single user at a time. E.g. DOS
- **Single-User, Multi-Task Operating System:**
  These operating systems works on more than one task and process them concurrently at a time. E.g. windows 95 or later version of windows
- **Multiuser Operating System:**
  In these OS, multiple users are allowed to access the same data or information at a time via a **network**. E.g. Unix,Linux,Windows7.
- **Multiprocessing Operating System:**
  Here, a single process runs on two or more processors. All the processing and their management takes place in a parallel way, hence this OS are also called as **Parallel Processing**. E.g. Linux, UNIX and Windows 7.
- **Embedded Operating System:**
  These are embedded in a device, which is located in ROM. E.g. OS of microwaves, washing machine.
- **Distributed Operating System:**
  In these OS, the computers work in co-operation with each other.

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# PROGRAMMING SOFTWARES

- **Language processor/Programming Language:**
  As the computer understand machine language(0/1) where as Humans understand High level/Human Lang.
- Language Processors does the conversion task(high level to machine lang). These are of 3 types Language processors

  * Assembler  * Compiler  * Interpreter

- Compilers:
  It convert high-level language code to machine code in one session. It takes time because it have to translate high-level code to lower-level machine language all at once and then save the executable object code to memory.

- Interpreters:
  It translates code like a compiler but reads the code and immediately executes that code, and therefore it is initially faster than a compiler.

- Assemblers:
  It translates an assembly language program into machine language.

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# Software (contd.)

**Application software:**

- General Purpose application software:
  These are ready to use software for daily use purpose e.g. word processor, spread sheet, presention, DBMS etc.
- Specific Purpose application software:
  Softwares which are designed for specific task e.g. Payroll, Hotel Mgmt, Hospital Mgmt, Stock Mgmt etc.

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# Software (contd.)

**Utility software:**
that assist OS in carrying out certain specialized tasks are called utility software.

- Antivirus - An anti-virus scans the system for any virus and if detected, gets rid of it by deleting or isolating it.
- Compression tools - Compression tools are utilities that assist operating systems in shortening files so that they take less space.
- Disk Cleanup - Disk cleanup tools assist users in freeing up disk space.
- Disk Defragmenter - Disk defragmenter is a disk management utility that increases file access speeds by rearranging fragmented files on contiguous locations.
- Backup - Backup utility enables backing up of files, folders, databases or complete disks.
- File management tools - Utility software providing regular file management tasks like browse, search, update, preview, etc. are called file management tools.

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# QA SESSION

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# ASSIGNMENT NEED TO BE DONE IN NOTEBOOK

- What is the need of RAM? How does it differ from ROM?
- How do different components of the computer communicate with each other?
- Draw the block diagram of a computer system. Briefly write about the functionality of each component.
- What is the primary role of system bus? Why is data bus is bidirectional while address bus is unidirectional?
- Mention the different types of data that you deal with while browsing the Internet.
- Categorize the following data as structured, semi structured and unstructured:
  - Newspaper
  - Cricket Match Score
  - HTML Page
  - Patient records in a hospital
- Name the input or output device used to do the following:
  a) To output audio
  b) To enter textual data
  c) To make hard copy of a text fle
  d) To display the data or information
  e) To enter audio-based command
  f) To build 3D models
  g) To assist a visually-impaired individual in entering data
- Identify the category (system, application, programming tool) of the following software:
  a) Compiler
  b) Assembler
  c) Ubuntu
  d) Text editor

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