



Unit-2

computer Hardware & software

Computer Hardware

Computer hardware is the physical component of any computer system.

A computer hardware may come in many states such as electrical, electronic, mechanical, optical, magnetic etc.

Here are some of the popular examples of computer hardware. Or you can say that, here are the list of some items that come in the category of computer hardware:

- Microprocessors
- Hard Disks
- Integrated Circuits (ICs)
- Optical Disks
- Floppy Disks
- Mouse
- Monitor
- Printer etc.

Hardware

Hardware refers to the physical elements of a computer. This is also sometimes called the machinery or the equipment of the computer. Examples of hardware in a computer are the keyboard, the monitor, the mouse and the central processing unit. However, most of a computer's hardware cannot be seen; in other words, it is not an external element of the computer, but rather an internal one, surrounded by the computer's casing (tower). A computer's hardware is comprised of many different parts, but perhaps the most important of these is the motherboard. The motherboard is made up of even more parts that power and control the computer.

In contrast to software, hardware is a physical entity. Hardware and software are interconnected, without software, the hardware of a computer would have no function. However, without the creation of hardware to perform tasks directed by software via the central processing unit, software would be useless.

Hardware is limited to specifically designed tasks that are, taken independently, very simple.

Software implements algorithms (problem solutions) that allow the computer to complete much more complex tasks.

Computer Input Devices

Input devices are all those computer components that are used to enter/feed information into the computer system.

In other words, input devices are devices used in computers that bring data into a computer.



Unit-2

computer Hardware & software

The prime purpose of input devices are to translate data and information from human-readable format into electrical impulses.

List of Popular Input Devices

Some of the major or popular input devices are given below:

- Keyboard
- Mouse
- Scanner
- Optical Mark Reader (OMR)
- Light Pen
- Trackball
- Magnetic Ink Character Recognition (MICR)
- Bar code reader (BCR)
- Optical Bar Code Reader (OBR)
- Optical Character Recognition (OCR)
- Voice Input Systems
- Digital Camera

Now let's briefly describe all the above listed popular input devices.

Keyboard

It is the most popular input device used to feed data/programs into the computer system. Keyboard contains keys such as alphabets (a to z), digits (0 to 9), special characters, function keys, navigation/arrows keys, and many more keys etc.

In keyboard that is attached to a computer system when a key is pressed then an electric signal is produced detected by an electronic circuit called keyboard encoder.

Mouse

Mouse is the second most popular input device attached to computer.

It is a pointing device. You can also say that it is an electromechanical hand-held device.

Mouse is used in many ways such as:

- to scroll
- to select
- to draw sketches or diagrams etc.
- to perform right-click (pop-up menu)
- to change Windows position
- and many more



Unit-2

computer Hardware & software

Scanner

Now-a-days, it is also an important and popular input device, as it is able to enter information directly into the computer without typing. Therefore scanner provides faster and "as it is" data entry or accurate data entry and exact data entry.

Magnetic ink character recognition (MICR)

Magnetic ink character recognition (MICR) is a technology used to verify the legitimacy of originality of paper documents, especially checks.

Special link, which is sensitive to magnetic fields, is used in the printing of certain characters to the original documents.

Information can be encoded in the magnetic characters. The use of MICR can enhance security and minimise the losses caused by some types of crime.

Optical Mark Reader (OMR)

OMR stands for Optical Mark Reading or Optical Mark Reader. OMR is a system that gathers information by using a hardware device that detects a reflection or an absence of reflection from a card or piece of paper.

OMR enables the processing of hundreds or thousands of documents every hour automatically.

Trackball

Trackball is similar to the upside-down design of the mouse.

The user moves the ball directly, while the device itself remains stationary. The user spins the ball in various directions to effect the screen movements.

Light pen

This is an input device which is used to draw lines or figures on a computer screen. It is touched to the CRT screen where it can detect raster on the screen as it passes.

Optical character reader (OCR)

It is a device which detects alphanumeric characters printed or written on a paper. The text which is to be scanned is illuminated by a low frequency light source.

The light is absorbed by the dark areas but reflected from the bright areas. The reflected light is received by the photocells.

Optical Bar Code Reader (OBR)

It stands for optical bar code reader which is used for reading bar-coded data. It is scans a set of vertical bars of different width for specific data and is used to read tags.

Bar code reading is done by a light pen or scanner connected to computer.



Unit-2

computer Hardware & software

Optical Character Recognition (OCR)

OCR is the recognition of printed or written text characters by a computer. This involves photo scanning of the text character-by-character, analysis of the scanned-in image, and then translation of the character image into character codes, such as ASCII, commonly used in data processing.

In OCR processing, the scanned-in image or bitmap is analysed for light and dark areas in order to identify each alphabetic letter or numeric digit. When a character is recognised, it is converted into an ASCII code.

Special circuit boards and computer chips designed expressly for OCR are used to speed up the recognition process.

OCR is being used by libraries to digitise and preserve their Holdings. OCR is also used to process checks and credit card slips and sort the mail.

Billions of magazines and letters are sorted every day by OCR machines, considerably speeding up mail delivery.

Bar code reader (BCR)

This device reads bar codes and converts them into electrical pulses to be processed by a computer. A bar code is nothing but data coded in form of light and dark bars.

Voice Input Systems

This devices converts spoken words to M/C language. A microphone is used to convert human speech into electric signals.

The signal pattern is then transmitted to a computer when it is compared to a dictionary of patterns that have been previously placed in a storage unit of computer. When a close match is found, the word is recognized.

Digital Camera

It converts graphics directly into digital form. It looks like an ordinary camera, but no film is used therein, instead a CCD (changed coupled divide) electronic chip is used.

When light falls on the chip through the lens, it converts light waves into electrical waves.

Computer Memory

Computer Memory

Area where the program instruction and data are retained for processing is called memory, like human brain, computer also requires some space to store data and instruction for addressing their processing.

CPU does not have the capacity to store programs or large set of data permanently. It contains only basic instruction needed to operate the computer. Therefore memory is required.



Unit-2

computer Hardware & software

Types of Computer Memory

Memories primarily is of two types as given here:

1. Internal Memory

- Random Access Memory (RAM)
 - Static RAM (SRAM)
 - Dynamic RAM (DRAM)
- Read Only Memory (ROM)
 - Masked Read Only Memory (MROM)
 - Programmable Read Only Memory (PROM)
 - Erasable and Programmable Read Only Memory (EPROM)
 - Electrically Erasable and Programmable Read Only Memory (EEPROM)
- Sequential Access Memory
- Cache Memory
- Virtual Memory

2. External Memory

- External Hard Drives
- Solid State Drive (SSD)
- USB Flash Drive etc.

Random Access Memory (RAM)

A RAM constitutes the internal memory of the CPU for storing data, program and program result. It is read/write memory. It is called Random Access Memory (RAM).

Since access time in RAM is independent of the address to the word that is, each storage location inside the memory is as easy to reach as other location and takes the same amount of time. We can reach into the memory at random and extremely fast but can also be quite expensive.

RAM is volatile, that is data stored in it is lost when we switch off or turn off the computer or if there is a power Failure. Hence, a backup un-interruptible power system (UPS) is often used with computers.

RAM is a small, both in terms of its physical size and in the amount of data that can hold.

Types of RAM

RAM is of two types:

1. Static RAM (SRAM)
2. Dynamic Ram (DRAM)

Static RAM (SRAM)

The word static indicates that the memory retains its contents as long as power remains applied.

However, data is lost when the power gets down due to volatile nature.

Static RAM chips use a matrix of 6 transistors and no capacitors.



Unit-2

computer Hardware & software

Transistors do not require power to prevent leakage, so static RAM need not have to be refreshed on a regular basis. Because of the extra space in the matrix, static RAM uses more chips than dynamic RAM for the same amount of storage space, thus making the manufacturing costs higher.

Static RAM is used as cache memory needs to be very fast and small.

Dynamic Ram (DRAM)

Dynamic RAM, unlike static RAM, must be continually replaced in order for it to maintain the data. This is done by placing the memory on a refresh circuit that rewrites the data several hundred times per second.

Dynamic RAM is used for most system memory because it is cheap and small.

All dynamic rams are made up of memory cells. These cells are composed of one capacitor and one transistor.

Read Only Memory (ROM)

ROOM stands for read only memory. The memory from which we can only read but cannot write on it.

This type of memory is non-volatile. The information is stored permanently in such memories during manufacture.

A ROM, stores such instruction as are required to start computer when electricity is first turned on, this operation is referred to as bootstrap.

ROM chip are not only used in the computer but also in other electronic items like washing machine and microwave oven.

Types of ROM

Let's briefly the following list of ROM available in computer:

1. Masked Read Only Memory (MROM)
2. Programmable Read Only Memory (PROM)
3. Erasable and Programmable Read Only Memory (EPROM)
4. Electrically Erasable and Programmable Read Only Memory (EEPROM)

Masked Read Only Memory (MROM)

The very first ROMs were hardware devices that contained a pre-programmed set of data or instructions. This kind of ROMs are known as masked ROMs. It is inexpensive ROM.

Programmable Read Only Memory (PROM)

PROM is read only memory that can be modified only once by a user. The user buys a blank PROM and enters the desired contents using a PROM programmer.

Inside the PROM, there are small fuses which are burnt open during programming. It can be programmed only once and it's not erasable.



Unit-2

computer Hardware & software

Erasable and Programmable Read Only Memory (EPROM)

The EPROM can be erased by exposing it to ultra-violet light for a duration of upto 40 minutes.

Usually, an EPROM eraser achieves this function. during programming, an electrical charge is trapped in an insulated Gate region.

The charge is retained for more than 10 years because the charge has no leakage path. For erasing this charge, ultraviolet light is passed through a quartz crystal window (lid). This exposure to ultraviolet light dissipates the charge. During normal use the quartz lid is sealed with a sticker.

Electrically Erasable and Programmable Read Only Memory (EEPROM)

The EEPROM is programmed and erased electrically. It can be erased and re-programmed about ten thousand times.

Both erasing and programming take about 4 to 10 milliseconds. In EEPROM, any location can be selectively erased and programmed.

EEPROMs can be erased 1 byte at a time, rather than erasing the entire chip. Hence, the process of reprogramming is flexible but slow.

Sequential Access Memory

Sequential access means the system must search the storage device from the beginning of the memory address until it finds the required piece of data.

Memory device which supports such access is called a sequential access memory or serial Access Memory.

Magnetic tape is an example of serial Access Memory.

Cache Memory

Cache memory is a very high speed semiconductor memory which can speed up CPU. It acts as a buffer between the CPU and the main memory.

It is used to hold those parts of data and program which are most frequently used by the CPU. The parts of data and programs, are transferred from disk to cache memory by operating system, from where CPU can access them.

Cache memory, lies in between CPU and the main memory.

It is also called CPU memory, that a computer microprocessor can access more quickly than it can access regular RAM.

This memory is typically integrated directly with the CPU chip or placed on a separate chip that has a separate bus interconnect with the CPU.

Cache memory saves time and increases efficiency because the most recently processing data is stored in it which takes the fetching easier.



Unit-2

computer Hardware & software

Functions of Cache Memory

The basic purpose of cache memory is to store program instructions that are frequently Re-referenced by software during operation. Fast access to these instructions increases the overall speed of the software program.

The main function of cache memory is to speed up the working mechanism of computer.

Advantages of Cache Memory

Cache memory is faster than main memory.

It consumes less access time as compared to main memory.

It stores the program that can be executed within a short period of time.

It stores data for temporary use.

Disadvantages of Cache Memory

Cache memory has limited capacity.

Cache memory is very expensive.

Virtual Memory

It is a technique that allows the execution of processes which are not completely available in memory. The main visible advantage of this scheme is that programs can be larger than physical memory.

Virtual memory is the separation of user logical memory from physical memory. This separation allows an extremely large virtual memory to be provided for programmers when only a smaller physical memory is available.

Following are the situations, when entire program is not required to be loaded fully in main memory.

User written error handling routines are used only when an error occurred in the data or computation.

Certain options and features of a program may be used rarely.

Many tables are assigned a fixed amount of address space even though only a small amount of the table is actually used.

The ability of the execute a program that is only partially in memory would counter many benefits.

Less number of input/output (I/O) would be needed to load or swap each user program into memory.

A program would no longer be constrained by the amount of physical memory that is available.

Each user program could take less physical memory, more programs could be run the same time, with a corresponding increase in CPU utilisation and through output.



Unit-2

computer Hardware & software

External Memory (Secondary memory)

Secondary memory is much larger in size than main memory but it is slower. It normally stores system programs, instruction and data files. It is also known as auxiliary memory. It can also be used as an overflow/virtual memory in case the main memory capacity has been exceeded.

Secondary memory cannot be accessed directly by a processor. First the data/information of auxiliary memory is transferred to the main memory and then that information can be accessed by the CPU.

Characteristics of Auxiliary Memory

Here are the characteristics of auxiliary memory:

- **Non volatile memory** - Data is not lost when power is cut off.
- **Reusable** - The data stage in the secondary storage on permanent basis until it is not overwritten or deleted by the user.
- **Reliable** - Data in secondary storage is safe because of high physical stability of secondary storage device.
- **Convenience** - With the help of a computer software, authorised people can locate and access the data quickly.
- **Capacity** - Secondary storage can store large volumes of data in sets of multiple disks.
- **Cost** - It is much lesser expensive to store data on a tape or disk than primary memory.

We can also say that secondary memory is the other type of memory which is required to store the data permanently for a long time.

Types of Secondary Storage Device

There are various types of secondary storage device available to store data for the future use. These device allow to read or write anywhere in memory.

Commonly used secondary storage devices are:

- magnetic tape
- magnetic disk
- and optical disk etc.

Magnetic Tape

It is similar to audio tape containing a plastic strip coated with magnetic material. The data is encoded on the magnetic material in the form of electric current. Conduction state (ON) represent ONE (1) and non conduction state (OFF) represent ZERO (0).

The type of data encoding is called binary data storage. Magnetic tape are with large storage capacity and inexpensive, it can store data from 60 MB to 24 GB.



Unit-2

computer Hardware & software

Magnetic Disk

These are Direct Access storage media, where the accessing of a data is much faster because there is no need to go through call previous data for reaching a specific data.

In this type of storage devices, there is present a round diskette (round disk) of plastic material coated with magnetic ink on which data encoding is done.

The magnetic disk commonly of three types, that are:

- floppy disk
- hard disk
- Winchester disk

Optical Disk

The data can be read from and write to the optical disk by laser beam. These disks are able to store large amount of data into GB. These are available as CD-ROM, WORM (write once read only) erasable optical disks.

In CD-ROM data can be stored once and read only. These are called compact disks read only memory. These can store data from 600 MB to 1GB. A special device called CD-ROM player is used to read the data from CD-ROM.

External Hard Drive

All those drives or devices that are used to store information outside a computer. This device may or may not be attached to the computer. For example, in laptop a hard disk drive of 500GB, 1TB or 2TB etc. is attached to store any information permanently inside this drive. Now-a-day, many peoples also uses external hard disk drive or HDD to store any critical or extra information into that drive.

Solid State Drive (SSD)

Solid State Drive (SSD) is a non-volatile storage device, that uses integrated circuit assemblies as memory to store any information persistently.

USB Flash Drive

USB flash drive is a solid state device, that is it has no moving parts. In USB flash drive, the information is stored electronically using millions of small gates that have a value of zero (0) and one (1).

In simple sentence, it is a device that is used to store information. It includes a flash memory and an Integrated Universal Serial Bus (USB) interface.

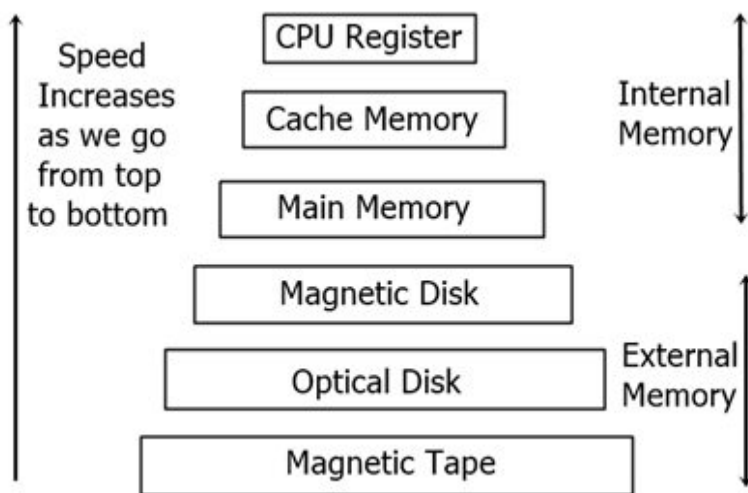
USB flash drive are smaller in size or pocket-friendly, that is you can handle or carry USB flash drive in your pocket. It means that, you can carry all the information just in your pocket using USB flash drive.

Memory Hierarchy

Now let's see the photo or diagram of memory hierarchy with its characteristics.

Unit-2

computer Hardware & software



Above diagram represents the hierarchy of a computer memory.

Here are the characteristics of memory hierarchy when we move from top to bottom:

- Storage capacity increases
- Cost per bit of storage decreases
- Frequency of memory access by CPU decreases
- Access time by CPU increases

Central Processing Unit (CPU)

CPU stands for central Processing Unit. It works same as our brain works in the body or you can say that it is the brain of any computer system, that is responsible in controlling all the other components attached to the computer system such as keyboard, mouse, memory, and printer etc.

The CPU of a small computer has a single microprocessor, whereas the CPU of any large computer may contain multiple microprocessor.

Note - Microprocessor does one specific job. A microprocessor contains a CU and ALU. CU stands for control unit and ALU stand for arithmetic and logic unit.

When main memory is added to microprocessor then it becomes CPU. Therefore, here are the major sections of a CPU:

- (CU) control unit
- ALU (Arithmetic and logical unit)
- Primary memory

Now let's briefly describe about the above major sections of a CPU.



Unit-2

computer Hardware & software

Primary memory

It is the main part of any computer system, as this is the main memory that keeps necessary [operating system](#) such as MS-DOS or Windows.

Primary memory or main memory holds data which is currently manipulated by central Processing Unit as you all known that this memory is present inside the CPU, therefore you can also says that this is the internal memory or RAM. RAM stands for Random Access Memory.

Control unit (CU)

This section of CPU is used to control the entire working of a computer system. This unit also controls the transfer of data between memory and input/output devices or I/O devices.

Arithmetic logic unit (ALU)

All calculations are performed in this section of unit. ALU is also used to make all the decisions inside computer system.

All ALUs are designed to perform all the basic arithmetic operations and logical operations which are:

- addition
- subtraction
- multiplication
- division
- less than
- greater than
- equal to

Computer Output Devices

Output devices are devices which are used to bring out the information from the computer.

The output device translates processed data from a machine coded form into a form that can be read by the end-user.

List of Popular Output Devices

The most common output devices that are in use as follows:

1. Monitors
2. Printers
3. Plotters
4. Projectors
5. Speakers

Now let's describe all the above listed popular output devices available for a computer system.



Unit-2

computer Hardware & software

Monitors

This is also known as display screen, however, usually refers to the entire box, whereas display screen can mean just the screen. In addition, the term monitor often implies graphics capabilities.

Printer

Printer is a device that prints text or illustrations on paper.

There are many different types of printers available in the market such as:

- Daisy wheel
- Dot Matrix
- Laser
- Ink-jet
- Thermal
- Line printer etc.

Plotter

A plotter is a computer hardware device similar to a printer that uses a pen, pencil, marker or other writing tool to make a design.

Often these printers are used in schematics, CAD, and other print Jobs.

Projector

An output device that can take the display of a computer screen and project a large version of it onto a flat surface.

Projectors are often used in meetings and presentations to help make sure everyone in the room can view the presentation. Projectors used with computers are small devices that are really much larger than a toaster and typically weight a few pounds.

Speaker

An output device connected to a computer's sound card that outputs sounds generated by the computer.

The speakers with sub-woofer are the most commonly used device in the personal computers.

