

Following Table 1.1 lists various memory units used.

Table 1.1 Units of Computer Memory Measurements

Unit	Short Name	Full Name	Unit	Short Name	Full Name
1 Bit	Bit	Binary Digit	2^{10} i.e., 1024 GB	1 TB	Terra Byte
8 Bits	1 Byte	Byte	2^{10} i.e., 1024 TB	1 PB	Peta Byte
2^{10} i.e., 1024 Bytes	1 KB	Kilo Byte	2^{10} i.e., 1024 PB	1 EB	Exa Byte
2^{10} i.e., 1024 KB	1 MB	Mega Byte	2^{10} i.e., 1024 EB	1 ZB	Zetta Byte
2^{10} i.e., 1024 MB	1 GB	Giga Byte			

Since computer's main memory (primary memory) is temporary, secondary memory space is needed to store data and information permanently for later use. Some most common secondary storage media are the hard disk, CD-RWs, pen drive etc. The secondary memory devices are also known as **storage devices**.

1.2.4A Parts of Main Memory/Primary Memory

In the random-access memory (RAM), the memory cells can be accessed for information transfer from any desired random location. That is, the process of locating a word in memory is the same and requires an equal amount of memory, thus the name "random access".

The main drawback of RAM memory is that it is a volatile memory. That is, when the power goes off, the contents of RAM get erased.

The RAM chips in a computer can be of *two* basic types :

- (i) **Dynamic RAM (DRAM)**. These are made up of transistors and capacitors. The amount of time taken to produce data required from memory, from the start of access until the availability of data is called *memory access time*. Today's DRAM chips have access times ranging from *below 20 to 70 nanoseconds*.
- (ii) **Static RAM**. These are made up of flip-flops¹ and offer faster access times (about 10 nanoseconds) than DRAMs.

Static RAMs are thus used in specialized applications while dynamic RAMs are used in the primary storage sections of most computers.

MEMORY ACCESS TIME

The amount of time taken to produce data required from memory, from the start of access until the availability of data, is called *Memory Access Time*.

Read Only Memory (ROM)

As the name implies, a read-only memory (ROM) is a memory unit that performs the read operation only; it does not have a write capability. This implies that the binary information stored in a ROM is made permanent during the hardware production of the unit and cannot be altered by writing different words into it (hence non-volatile). Whereas a RAM is a general-purpose device whose contents can be altered during the computational process, a ROM is restricted to reading words that are permanently stored within the unit. ROMs are used for applications in which it is known that the information never needs to be altered, for example, a monitor program controlling a machine. These, however, are slower than RAM.

1. A flip-flop is a binary cell capable of storing one bit of information.

There are various types of ROM which are given below :

- (i) **PROM (programmable ROM)**. Also called **OTP (One Time Programmable)**. PROM is a user-programmable memory in which information is burnt using special equipment called a ROM burner.
- (ii) **EPROM (erasable programmable ROM)**. In EPROM, one can program the memory chip (through various mechanisms e.g., UV radiation) and erase it many times as needed. The UV-EPROM can take up to 20 minutes for erasing EPROM contents.
- (iii) **EEPROM (electrically erasable programmable ROM)**. In EEPROM, the EPROM is erased electrically which is faster. Also, with EEPROM, selective bytes can be erased unlike UV-EPROM which erases fully.
- (iv) **Flash EEPROM**. It is like EEPROM but is very fast comparatively (the erasure of the entire contents takes less than a second). Also, it erases fully and not selectively.
- (v) **Mask ROM**. Mask ROM refers to a kind of ROM in which the contents are programmed by the IC manufacturer. It is not a user-programmable ROM.

1.2.5 The Storage Unit

Computers need to store and retrieve data for processing. Since primary memory has a limited storage capacity and is not permanent, secondary storage devices are used to store large amount of data permanently. There are various types of secondary devices available these days.

To specify the storage capacity of storage devices, same units of memory are used, which are used for measuring primary memory. That is, we can represent the storage capacity of storage devices in terms of *kilo bytes (KBs)*, *mega bytes (MBs)*, *giga bytes (GBs)* and *tera bytes (TBs)* as we do for main memory.

Let us now talk about some most common storage devices.

Some most common storage devices	
❖ Hard disks] Magnetic Media
❖ CD ROMs	
❖ DVDs] Optical Media
❖ Pen drive	
] Flash memory

1. Hard Disks

The hard disk memories store information on one or more circular **platters** (or disks) which are continually spinning. These rotating disks are coated with a magnetic material and stacked with space between them. Information is recorded on the surface of rotating disks by magnetic heads as tiny magnetic spots.

The hard disks of today have storage capacity measured in giga bytes upto tera bytes.

2. Compact Disks (CDs)

The compact disks or CDs are optical media. The CDs are relatively cheap and have a storage capacity of upto 700 Mb. There are **three** main types of CDs :

- (i) **CD-ROM (Compact Disk-Read Only Memory)**. This is used only to store information and cannot be used to store data. It is mainly used for CD distribution e.g., encyclopedias, software, games, e-books etc.
- (ii) **CD-R (Compact Disk-Recordable)**. It is mainly used for CD-R and can be written or only once and disk can't be erased.
- (iii) **CD-RW (Compact Disk-Rewritable)**. CD-RW is an erasable disk you can write or multiple times.

3. DVDs

DVD is an optical storage device that looks the same as a compact disc but is able to hold about 15 times as much information and transfer it to the computer about 20 times as fast as a CD-ROM. A DVD, also called a **Super Density disk (SD)**, can hold upto 17 **gigabytes** of data or four hours of movies on a side. DVDs also come in *three* varieties.

- (i) **DVD-ROM**. This is read only DVDs *i.e.*, once recorded initially, you cannot write on it.
- (ii) **DVD-R (DVD-Recordable)**. DVD-R similar to CD-R's allow users to write on the disc once but read it many times.
- (iii) **DVD-RW (DVD-Rewritable)**. Most writable DVD drives are DVD-RW You can erase and read many times on them.

4. Flash Memory

A flash drive is a small, ultra-portable storage device with a '**solid state**' memory *i.e.*, it has no moving parts unlike magnetic storage devices, nor does it make use of lasers — unlike optical drives. Instead, it works in a similar way to RAM. The key difference is that data is retained in Flash memory even when the power is switched off. They are now fairly inexpensive, costing from ₹ 250/- upwards. Typical sizes range from 256 Mbytes up to 128 GB and beyond.

5. Blu Ray Disk

Blu-ray Disc (also known as **Blu-ray** or **BD**) is an optical disc storage media format. Its main uses are high-definition video and data storage. The disc has the same dimensions as a standard DVD or CD. While current optical disc technologies such as DVD, DVD ± R, DVD ± RW, and DVD-RAM rely on a red laser to read and write data, the new format uses a **blue-violet laser** instead, hence the name **Blu-ray**. The benefit of using a *blue-violet laser* (405 nm) is that it has a shorter wavelength than a *red laser* (650 nm), which makes it possible to focus the laser spot with even greater precision. This allows data to be packed more tightly and stored in less space, so it's possible to fit more data on the disc even though it's the same size as a CD/DVD. Blu Ray disks of today are capable of storing upto 128 GB of data.

Check Point

1.1

1. (i) Storage of 1 KB means the following number of bytes :
 - (a) 1000
 - (b) 964
 - (c) 1024
 - (d) 1064
- (ii) One Megabyte is equivalent to
 - (a) 210 bytes
 - (b) 220 bytes
 - (c) 230 bytes
 - (d) none of the above
2. What are the functional components of a digital computer ?
3. What are the components of CPU ? What is its role ? What is the function