Data Storage

A computer usually uses three types of storage.

1. Internal Storage/Main Storage/Primary Storage: includes Read Only Memory (ROM), Random Access Memory (RAM) and DVD-RAM.
2. Main Backing Storage/Secondary Storage: includes Hard Disk Drive (HDD) and Solid State Drives (SSDs)
3. Offline Storage/External Storage (Type of Backing Storage): includes Digital Versatile Disk (DVDs), Compact Disks (CDs), Blu-ray, USB flash memory, Removable Disks

It is really important to know the difference between a storage device and a storage medium. The storage device is the machine that stores data such as hard disk drive while the storage medium (plural is media) is the material on which the device stores data such as rotating disks (platters) in hard disk.

Internal Storage/Main Storage/Primary Storage

Main storage (or computer memory) is divided into Read Only Memory (ROM) and Random Access Memory (RAM).

- **ROM** is memory that cannot be changed by a program or user. ROM retains its memory even after the computer is turned off. For example, ROM stores the instructions for the computer to start up when it is turned on again. It is also called as non-volatile memory and usually it is programmed by manufacturer.
- **RAM** is a fast **temporary (volatile)** type of memory in which programs, applications and data are stored. If a computer loses power, all data stored in its RAM is lost.

DVD-RAM

Stands for "Digital Versatile Disc Random Access Memory." DVD-RAMs are writable DVDs that can be erased and rewritten like DVD-RW and DVD+RW discs. It is called DVD RAM because just like normal RAM it data and programs can be written and read as many times as want.

DVD-RAM discs can be rewritten far more times than either DVD-RW or DVD+RW, the other two rewritable DVD formats. DVD-RAM drives can usually read both DVD Video discs and DVD-ROM discs, as well as any type of CD. Like other rewriteable DVD formats.

Storage capacity and file size

Storage capacities and file sizes are measured (from lowest to highest) in:

- bits
- bytes
- kilobytes (KB)
- megabytes (MB)
- gigabytes (GB)
- terabytes (TB)
- petabytes (PB)

Relationship between measurements

The table below outlines the relationship between bits (smallest) and terabytes (largest):

Size	Equal to
8 bits	1 byte
1024 bytes	1 kilobyte
1024 kilobytes	1 megabyte
1024 megabytes	1 gigabyte
1024 gigabytes	1 terabyte

The size of a file and a storage device's capacity will always be written in its simplest form. For example, an operating system would report a 1 terabyte hard disk's size as 1TB **not** as 1024 GB, although both are correct.

Example file sizes

The table below lists files commonly found on a computer and their typical file size (compressed):

File	File size
Photo	3MB
Song	5MB
Film	1-1.5GB

A file's size can be influenced by a number of factors but ultimately the more information a file stores, the larger it will be.

Backing Storage/Secondary Storage

The Hard Disk Drive or Hard Drive

A **hard disk drive** (**HDD**) is used for storing (writing) and retrieving (reading) digital information using rapidly rotating disks (platters) coated with magnetic material. An HDD retains its data even when powered off. Data is read in a random-access manner, meaning individual blocks of data can be stored or retrieved in any order rather than sequentially. An HDD consists of one or more rigid ("hard") rapidly rotating disks (platters) with magnetic heads arranged on a moving actuator arm to read and write data to the surfaces.

The Hard Disk

The main internal backing storage is a computer's hard disk. It is a main storage medium in computers and laptops. A hard disk is a **direct access medium**. A hard disk stores:

- the operating system
- software applications or programs
- the majority of your data files

Hard disks spin at very high speeds (around 7,200 RPM - revolutions per minute) within a sealed unit inside the computer. Hard disks store large amounts of data - 200 GB to 1TB is common in desktop

computers. The data stored on a hard disk is retained until deleted, but it needs to be loaded into RAM before it can be used.

Sometimes an external hard disk is used to increase the backing storage capacity of a computer system. The external hard disk is not located inside the CPU box and it is connected via USB port to the computer system.

Advantages:
- It can store large amount of data up to TeraBytes(TBs) and (PetaBytes) PBs
- Access to the hard disk is faster than optical discs.
- There is no limit to the number of times it can rewrite data.

Disadvantages:
- Vulnerable to mechanical shocks.

Solid State Drive (SSD)

Solid state storage is backing storage which is made up of Integrated Circuits (ICs) or chips. The chip is the medium at which data is stored. There is a little separate drive required to read from and write to solid state storage. This drive is called as Solid State Derive or SSD.

The current predominant SSD technology is flash memory or memory stick which is non-volatile. Data can be erased or written on it easily. Flash memory is used in as fixed storage in PDAs, mobile phones, cameras and some portable MP3/MP4 players.

Another example of SSD technology is Digital Storage Cards (DSCs). These cards are used as removable storage for PDAs, mobile phones, cameras, camcorders and audio recorders. These are flat and small cards and are inserted into a very small slot which is called as DSC reader/writer.

Advantages:
- These are extremely small and portable.
- They can store large amount of data.
- Unlike disk media, they have no moving parts which makes them robust.
- While transferring data they generate no noise and low power consumption

Disadvantages:
- They are more expensive as compared to other forms of backing storage
- Flash based devices have a relatively limited number of write cycles which means the data is written comparatively slowly on flash drives.

Offline Storage/External Storage/ Optical Storage

An optical disc (optical storage medium) is a revolving disc on which data is read and write by the help of optical storage drive. Optical disk is direct access medium

Optical storage device or optical storage drive writes and reads data from optically reflective medium (optical storage medium) by using a LASER.

CD (Compact Disc)

It can store up to 700MB of data. CDs can be used for multimedia applications such as encyclopedias and can store pictures, sounds and video clips or anything else that will fit.

There are several formats on the market, such as:

- **CD-ROM** - read only, the data is written to them before they are sold.
- **CD-R** - meaning CD-Recordable, the user can write data to the CD once or fill it over time using multi-session (writing to the same disc on separate occasions) until all capacity of CD is occupied with data and programs. Once a piece of data is written then it cannot be erased.
- **CD-RW** - meaning CD-ReWritable, the CD can be written and re-written to. Unlike multi-session discs, existing data can be overwritten. Data can be written and deleted again and again as per requirement.

DVD (Digital Versatile Disc)

DVDs are the same physical size as CDs but hold much more data - a single sided disc can hold up to 4.7 GB or 4.4 GiB. DVDs are commonly used for storing video.

There are several formats on the market, such as:

- **DVD-ROMs** - read only, the data is written to them before they are sold.
- **DVD-R** - meaning DVD-Recordable, the user can write data to the DVD once or fill it over time using multi-session.
- **DVD-RW** - meaning DVD-ReWritable, the DVD can be written and re-written to. Unlike multi-session discs, existing data can be overwritten.

There are also dual layer and double sided formats for DVDs that can store data up to 17.1 GB.

Blu-ray-Disc (BD)

Blu-ray is an optical disc format designed to display high definition video and store large amounts of data. While a CD can hold 700 MB of data and a basic DVD can hold 4.7 GB of data, a single Blu-ray disc can hold up to 25 GB of data. Even a double sided, dual layer DVD (which are not common) can only hold 17 GB of data. Dual-layer Blu-ray discs will be able to store 50 GB of data. That is equivalent to 4 hours of HDTV.

Advantages:

- Large storage capacity
- Higher rate of data transfer

Disadvantages:

- The only disadvantage is cost. The cost of Blu-ray-Disc is much higher than DVD and CD.

Magnetic tape

Principally used for backup of important files from the hard disk and for the long term storage and archiving of data. A tape drive has head similar to hard drive for read/write purpose. A magnetic tape is serial access medium.

Advantage

- they are small, robust, portable and provide low cost storage per GB

Disadvantages

- they are very slow to write to and read from
- serial access means all the data on the tape must be read before you can access the data you need

Accessing Data on a Medium

The way of reading/writing data on a medium is called as accessing data on a medium. There are two ways of access:

1. **Direct Access:** It is an accessing method in which data is written/read directly to correct point of the medium. These mediums are Magnetic Disk or Optical Disk Storage.
2. **Serial Access:** It is an accessing method in which data is written/read one after another from the physical start of the medium. Example of such medium is Magnetic Tape.

Question 1

A family has purchased a computer system with the following specification:

Processor speed 2200 MHz
RAM 512 Megabyte
Hard disk drive 120 Gigabytes
CD ROM
DVD writer
Modem 56k
Monitor 17"

(a) The computer has been purchased for buying goods and services over the Internet. Explain how each of these items of hardware would be used for this purpose.

Hard disk drive ....

....

....

RAM ....

....

....

DVD writer ....

....

....

Question 2

Kamil is setting up a new computer system to record television programmes. He wants to be able to record, view and then erase programmes that he does not want to keep. He has chosen to use DVD-RAM as an optical storage medium.

Explain to Kamil why it is better to use DVD-RAM rather than DVD+RW or DVD-RW.

1 ....

....

2 ....

.... [2]

Question 3

Define the term backing storage and explain why computers need backing storage?

Question 4

(a) Name a storage device used by large organisations with large volumes of data where speed of access is not important.

(b) Describe two applications where it could be used.

(c) What kind of data access does it provide?

Question 5

ROM and RAM are two types of memory found in computers.

(a) What do the letters ROM stand for?

(b) What do the letters RAM stand for?

(c) What is the main difference between RAM and ROM?

(d) Complete the following statements with 'RAM', 'ROM', 'backing storage'.

i .... stores a copy of your work when the computer is switched off .

ii .... stores application programs and data while the computer is running.

iii .... stores programs that must be available as soon as the computer is switched on.

Question 6

Complete the following sentences by using the correct words from this list: eight, gigabytes, memory, RAM

(a) A byte is a unit of computer …………… and it consists of …………… bits.

(b) A school computer may have two ………………….. of ………………….. .

Question 7

Indicate which of the following statements are true or false:

(a) ROM stands for Read-Only Memory.

(b) Data can be saved in ROM.

(c) The internal memory of a computer can store software and data.

(d) Data that changes is normally held in ROM.

(e) Data on magnetic tape has to be read serially.

(f) An airline booking system would probably use hard disk drive as backing storage.

(g) A CD-ROM is an optical disk.

Question 7

A company produces animation effects using computers rather than producing them manually. Each image takes about 400 kilobytes of storage. 25 images per second are produced. How much memory would be needed to store a 30-minute animation?