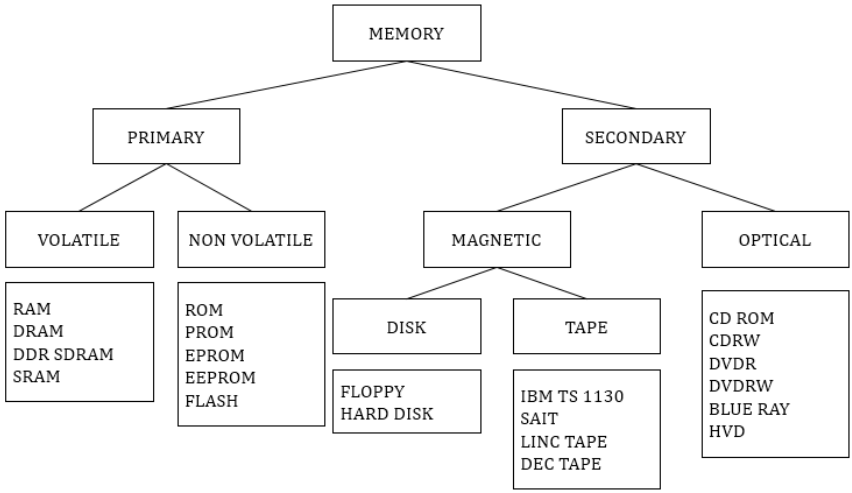
Module V

COMPUTER MEMORY



Memory refers to the physical devices used to store programs or sequences of instructions or data on a temporary or permanent basis for use in a computer or other digital electronic device. The term primary memory is used for the information in physical systems which are fast (i.e. RAM), as a distinction from secondary memory, which are physical devices for program and data storage which are slow to access but offer higher memory capacity. Primary memory stored on secondary memory is called "virtual memory".

Primary Memory

Primary storage (or main memory or internal memory), often referred to simply as memory, is the only one directly accessible to the CPU. The CPU continuously reads instructions stored there and executes them as required. Any data actively operated on is also stored there in uniform manner.

Secondary Memory

Secondary storage (also known as external memory or auxiliary storage), differs from primary storage in that it is not directly accessible by the CPU. The computer usually uses its input/output channels to access secondary storage and transfers the desired data using intermediate area in primary

storage. Secondary storage does not lose the data when the device is powered down—it is non-volatile. Per unit, it is typically also two orders of magnitude less expensive than primary storage. Consequently, modern computer systems typically have two orders of magnitude more secondary storage than primary storage and data are kept for a longer time there.

Volatile Memory

Volatile memory, also known as volatile storage, is computer memory that requires power to maintain the stored information, in other words it needs power to reach the computer memory. Volatile memory retains the information as long as power supply is on, but when power supply is off or interrupted the stored memory is lost; unlike non-volatile memory which does not require a maintained power supply. It has been less popularly known as temporary memory.

Non Volatile Memory

Non-volatile memory, nonvolatile memory, NVM or non-volatile storage is computer memory that can retain the stored information even when not powered. Examples of non-volatile memory include read-only memory, flash memory, ferroelectric RAM (F-RAM), most types of magnetic computer storage devices (e.g. hard disks, floppy disks, and magnetic tape), optical discs, and early computer storage methods such as paper tape and punched cards.

Magnetic Memory

Magnetic storage and magnetic recording are referring to the storage of data on a magnetized medium. Magnetic storage uses different patterns of magnetization in a magnetizable material to store data and is a form of non-volatile memory. The information is accessed using one or more read/write heads. Magnetic storage media, primarily hard disks, are widely used to store computer data as well as audio and video signals. In the field of computing, the term magnetic storage is preferred and in the field of audio and video production, the term magnetic recording is more commonly used. The distinction is less

technical and more a matter of preference. Other examples of magnetic storage media include floppy disks, magnetic recording tape, and magnetic stripes on credit cards.

Optical Memory

Mellon optical memory was an early form of computer memory invented at the Mellon Institute in the 1950s. The device used a combination of photo emissive and phosphorescent materials to produce a "light loop" between two surfaces. The presence or lack of light, detected by a photocell, represented a one or zero.

Disk Memory

Disk storage or disc storage is a general category of storage mechanisms, in which data are digitally recorded by various electronic, magnetic, optical, or mechanical methods on a surface layer deposited of one or more planar, round and rotating disks (or discs) (also referred to as the media). A disk drive is a device implementing such a storage mechanism with fixed or removable media; with removable media the device is usually distinguished from the media as in compact disc drive and the compact disc. Notable types are the hard disk drive (HDD) containing a non-removable disk, the floppy disk drive (FDD) and its removable floppy disk, and various optical disc drives and associated optical disc media.

Tape Memory

Memory Tapes is a recording alias of New Jersey-based Dayve Hawk, former frontman of Philadelphia-based Hail Social. After initially releasing material under the names Memory Cassette and Weird Tapes., and on signing to something in Construction to release a Memory Cassette EP (also on Acephale), Memory Tapes' first LP, Seek Magic was released in September 2009, through the labels Something In Construction, Sincerely Yours, Acéphale.

RAM

Random access memory (RAM) is a form of computer data storage. A random access device allows stored data to be

accessed in any order in very nearly the same amount of time for any storage location or size of memory device. A device such as a magnetic tape requires increasing time to access data stored on parts of the tape that are far from the ends. Memory devices (such as floppy discs, CDs and DVDs) can access the storage data only in a predetermined order, because of mechanical design limitations; the time to access a given part of the device varies significantly due to its physical location.

DRAM

Dynamic random-access memory (DRAM) is a type of random-access memory that stores each bit of data in a separate capacitor within an integrated circuit. The capacitor can be either charged or discharged; these two states are taken to represent the two values of a bit, conventionally called 0 and 1. Since capacitors leak charge, the information eventually fades unless the capacitor charge is refreshed periodically. Because of this refresh requirement, it is a dynamic memory as opposed to SRAM and other static memory.

DDR SDRAM

Double data rate synchronous dynamic random-access memory (DDR SDRAM) is a class of memory integrated circuits used in computers. DDR SDRAM (sometimes referred to as DDR1 SDRAM) has been superseded by DDR2 SDRAM and DDR3 SDRAM, neither of which are either forward or backward compatible with DDR SDRAM, meaning that DDR2 or DDR3 memory modules will not work in DDR equipped motherboards, and vice versa.

SRAM

Static random-access memory (SRAM) is a type of semiconductor memory that uses bistable latching circuitry to store each bit. The term static differentiates it from dynamic RAM (DRAM) which must be periodically refreshed. SRAM exhibits data remanence, but is still volatile in the conventional sense that data is eventually lost when the memory is not powered.

ROM

Read-only memory (ROM) is a class of storage medium used in computers and other electronic devices. Data stored in ROM cannot be modified, or can be modified only slowly or with difficulty, so it is mainly used to distribute firmware (software that is very closely tied to specific hardware, and unlikely to need frequent updates).

PROM

A programmable read-only memory (PROM) or field programmable read-only memory (FPROM) or one-time programmable non-volatile memory (OTP NVM) is a form of digital memory where the setting of each bit is locked by a fuse or antifuse. Such PROMs are used to store programs permanently. The key difference from a strict ROM is that the programming is applied after the device is constructed.

EPROM

An EPROM (rarely EROM), or erasable programmable read only memory, is a type of memory chip that retains its data when its power supply is switched off. In other words, it is non-volatile. It is an array of floating-gate transistors individually programmed by an electronic device that supplies higher voltages than those normally used in digital circuits. Once programmed, an EPROM can be erased by exposing it to strong ultraviolet light source (such as from a mercury-vapor light). EPROMs are easily recognizable by the transparent fused quartz window in the top of the package, through which the Silicon chip is visible, and which permits exposure to UV light during erasing.

EEPROM

EEPROM (also written E^2PROM and pronounced "e-e-prom," "double-e prom," "e-squared," or simply "e-prom") stands for Electrically Erasable Programmable Read-Only Memory and is a type of non-volatile memory used in computers and other electronic devices to store small amounts of data that must be

saved when power is removed, e.g., calibration tables or device configuration.

Flash Memory
Flash memory is a non-volatile computer storage chip that can be electrically erased and reprogrammed. It was developed from EEPROM (electrically erasable programmable read-only memory) and must be erased in fairly large blocks before these can be rewritten with new data. The high density NAND type must also be programmed and read in (smaller) blocks, or pages, while the NOR type allows a single machine word (byte) to be written or read independently.

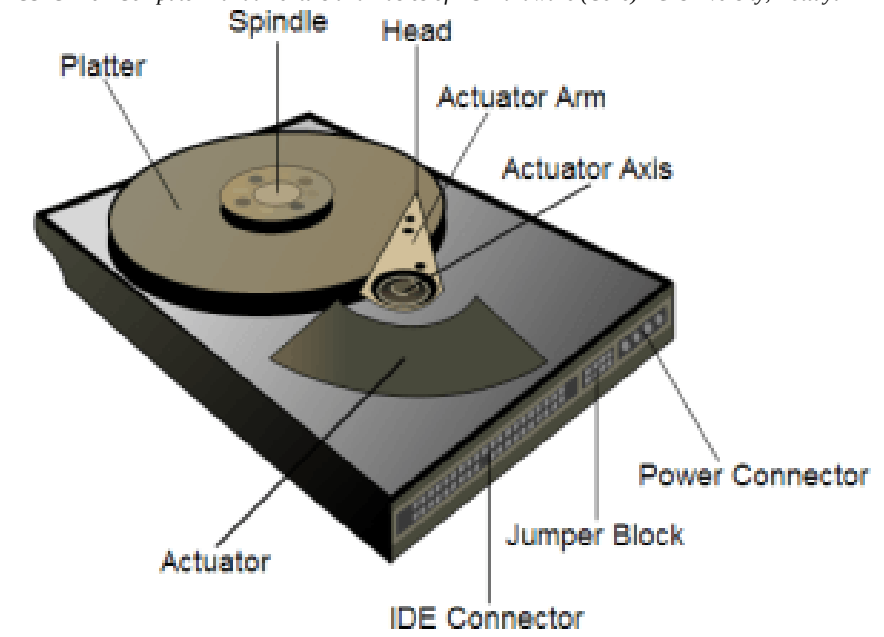
Floppy Disk
A floppy disk, or diskette, is a disk storage medium composed of a disk of thin and flexible magnetic storage medium, sealed in a rectangular plastic carrier lined with fabric that removes dust particles. They are read and written by a floppy disk drive (FDD).

HARD DISK
The Hard Disk Drive abbreviated as HDD is the main and largest storage device of the computer. It involves electronic circuitry and moving parts to store data by using the magnetic polarities. The data the hard disk drives store is permanent and is present even if the computer is turned off.

The American data storage companies **Seagate Technologies** and **Western Digital**, **Hitachi** and **Toshiba** are the leading producers of hard disk drives.

Construction
After it was introduced in 1956, the internal construction of HDDs hasn't changed much except that it is manufactured in various form factors (dimensions).

It basically consists of hard drive **platters** (disk shaped magnetic material) inside air sealed casing.



From the inside, one side of the casing is the electronics control board called **disk controller**. There is also a motor which spins the platters at 3600 or 7200 rpm beneath the board.

The arm present over the platter in the corner holds the read (or) write heads and has extremely fast moving patterns.

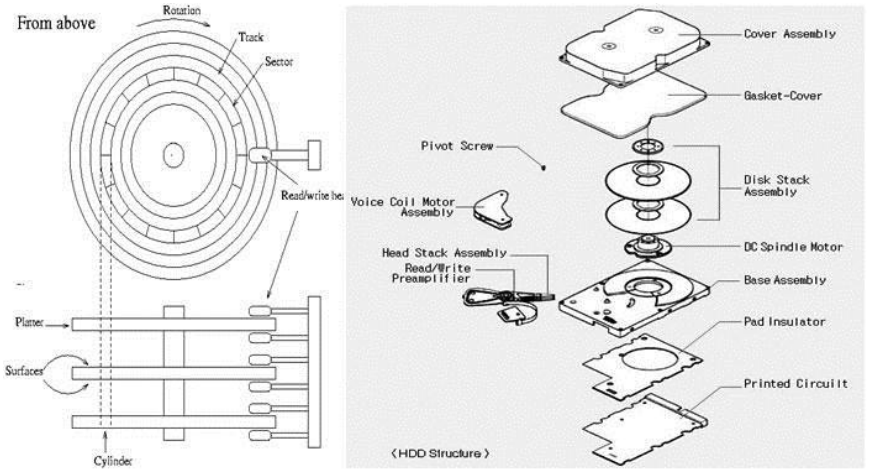
Connection Architecture

These hard drives are connected to the motherboard using the power cable and either of the ATA, SATA or SCSI cables via the back end ports. The exact cable to b used will depend on the type of HDD and usually included with the HDD.

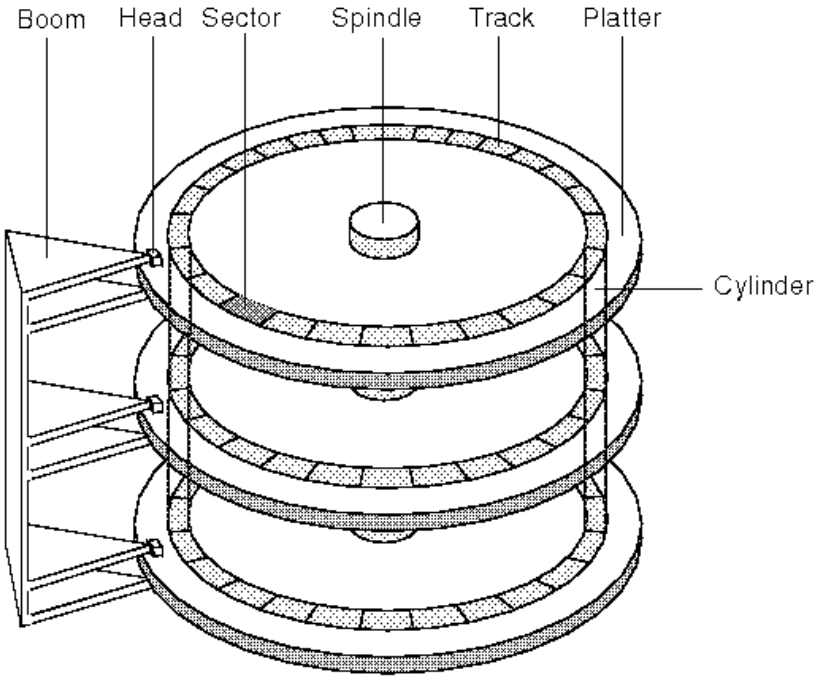
Working

Actually the files on the hard drive are all scattered on the platter in **sectors** and **tracks**. (Tracks are concentric circles, and the pie-shaped wedges present on each track are called sectors. **Cylinders** are concepts in old hard disk drives where more than one platters were used on a single HDD. Now a day's only single platter HDDs are available in the market). Also the data flow

control from and into the Hard Drive is controlled by the operating system.



Hard Disk-Sector, Track, Cylinder, Head



Anatomy of a regular hard disk

It decides how the components have to move within the drive to perform a specific operation and relies on the disk controller to implement it by controlling the hardware.

Initially, the operating system based on its analysis over the hard drives **File Allocation Table (FAT)** communicates with the disk controller.

The read (or) write head present on the arm has to move onto different sectors to check for required files or areas available for storage.

And this movement of the arm is taken care of by the **disk controller** based on the instructions the operating system provides it. All of the information is then stored or written magnetically.

For instance, if the computer plans to read information present in the hard drive, it considers the magnetic polarities on the platter. These magnetic polarities are interpreted as 1's and 0's and read by the computer.

CDROM

A CD-ROM an acronym of "Compact Disc Read-only memory" is a pre-pressed compact disc that contains data accessible to, but not writable by, a computer for data storage and music playback. The 1985 "Yellow Book" standard developed by Sony and Philips adapted the format to hold any form of binary data.

CD R

A CD-R (Compact Disc-Recordable) is a variation of the Compact Disc invented by Philips and Sony. CD-R is a Write Once Read Many (WORM) optical medium, although the whole disk does not have to be entirely written in the same session. CD-R retains a high level of compatibility with standard CD readers, unlike CD-RW which can be re-written, but is not capable of playing on many readers.

CDRW

A CD-RW (Compact Disc-Rewritable) is a rewritable optical disc. It was introduced in 1997, and was known as "CD-Writable" during development. It was preceded by the CD-MO(Magneto-Optic), which was never commercially released.

DVDR

A DVD recorder (also known as a DVDR, mainly outside of the UK and Ireland), is an optical disc recorder that uses Optical disc recording technologies to digitally record analog signal or digital signals onto blank writable DVD media. Such devices are available as either installable drives for computers or as standalone components for use in television studios or home theater systems

DVDRW

A DVD-RW disc is a rewritable optical disc with equal storage capacity to a DVD-R, typically 4.7 GB. The format was developed by Pioneer in November 1999 and has been approved by the DVD Forum. The smaller Mini DVD-RW holds 1.46 GB, with a diameter of 8 cm.

BLU- RAY

Blu-ray Disc (BD) is an optical disc storage medium designed to supersede the DVD format. The plastic disc is 120 mm in diameter and 1.2 mm thick, the same size as DVDs and CDs. Conventional (pre-BD-XL) Blu-ray Discs contain 25 GB per layer, with dual layer discs (50 GB) being the industry standard for feature-length video discs. Triple layer discs (100 GB) and quadruple layers (128 GB) are available for BD-XL re-writer drives.

HVD

High-Definition Versatile Disc (HVD) is an Asian standard of advanced high-definition technology originally developed in China by AMLogic Inc., for high-definition video. The format resolutions support 720p, 1080i, or 1080p on version 1 discs. Version 2 of the format added high-resolution beyond the

standard fare of HD for use on non-TV monitors that support higher resolutions, up to 1080p.

ZIP DISK

The Zip drive is a medium-capacity removable disk storage system that was introduced by Iomega in late 1994. Originally, Zip disks launched with capacities of 100 MB, but later versions increased this to first 250 MB and then 750 MB.

MEMORY UNITS

Memory unit is the amount of data that can be stored in the storage unit. This storage capacity is expressed in terms of Bytes.

The following table explains the main memory storage units –

Sl.No.	Unit & Description
1	**Bit (Binary Digit)** A binary digit is logical 0 and 1 representing a passive or an active state of a component in an electric circuit.
2	**Nibble** A group of 4 bits is called nibble.
3	**Byte** A group of 8 bits is called byte. A byte is the smallest unit, which can represent a data item or a character.
4	**Word** A computer word, like a byte, is a group of fixed number of bits processed as a unit, which varies from computer to computer but is fixed for each computer. The length of a computer word is called word-size or word length. It may be as small as 8 bits or may be as long as 96 bits. A computer stores the information in the form of computer words.

The following table lists some higher storage units –

S.No.	Unit & Description
1	**Kilobyte (KB)** 1 KB = 1024 Bytes
2	**Megabyte (MB)** 1 MB = 1024 KB
3	**GigaByte (GB)** 1 GB = 1024 MB
4	**TeraByte (TB)** 1 TB = 1024 GB
5	**PetaByte (PB)** 1 PB = 1024 TB

SIMM (single in-line memory module)

A SIMM (single in-line memory module) is a module containing one or several random access memory (RAM) chips on a small circuit board with pins that connect to the computer motherboard. Since the more RAM your computer has, the less frequently it will need to access your secondary storage (for example, hard disk or CD-ROM), PC owners sometimes expand RAM by installing additional SIMMs.

SIMMs typically come with a 32 data bit (36 bits counting parity bits) path to the computer that requires a 72-pin connector. SIMMs usually come in memory chip multiples of four megabytes.

The memory chips on a SIMM are typically dynamic RAM (DRAM) chips. An improved form of RAM called Synchronous DRAM (SDRAM) can also be used. Since SDRAM provides a 64 data bit path, it requires at least two SIMMs or a dual in-line memory module (DIMM).

DIMM (dual in-line memory module)

A DIMM (dual in-line memory module) is a double SIMM (single in-line memory module). Like a SIMM, it's a module containing one or several random access memory (RAM) chips on a small circuit board with pins that connect it to the computer motherboard.

A SIMM typically has a 32 data bit (36 bits counting parity bits) path to the computer that requires a 72-pin connector. For synchronous dynamic RAM (SDRAM) chips, which have a 64 data bit connection to the computer, SIMMs must be installed in in-line pairs (since each supports a 32 bit path).

A single DIMM can be used instead. A DIMM has a 168-pin connector and supports 64-bit data transfer. It is considered likely that future computers will standardize on the DIMM.

RIMM (Rambus inline memory module)

In a computer, a RIMM is a memory module developed by Kingston Technology Corp. that takes up less space inside the computer than the older DIMM module and has different pin characteristics.

A RIMM has a 184-pin connector and an SO-RIMM module has a 160-pin connector. An SO-RIMM is smaller and is used in systems that require smaller form factors. While RIMM is commonly believed to stand for "Rambus inline memory module," Kingston Technology has trademarked "RIMM" and uses only that term.

A RIMM module consists of RDRAM chips that are attached using a thin layer of solder, a metal alloy that, when melted, fuses metals to each other. Solder balls on each chip create a metal pathway used to conduct electricity.

Model Questions

Part A: Answer in One or Two Sentences

1. What is NV memory?
2. Compare RAM and ROM.
3. What DDR?
4. What is the use of platters in disk drives?
5. Expand FAT.
6. What is the use of HVD?
7. Compare nibble and byte.
8. Distinguish between volatile and non-volatile memories.
9. What is tape memory?
10. What is flash memory?
11. Compare tracks, sectors and cylinders in a HDD.
12. What is the difference between CDROM and CDRW?
13. What is BLU Ray disk?

Part B: Short Essay Type Questions

1. Make a comparison between primary and secondary memory.
2. Briefly explain different magnetic memories.
3. Explain different types of optical memories.
4. Explain some of DDR memories.
5. Compare DVDR and DVDRW.
6. What are DIMM, RIMM and SIMM?

Part C: Long Essay Type Questions

1. Explain different types of computer memories.
2. Explain different types of electronic memories.
3. Explain the construction and working of a hard disk drive.
4. Explain
    - i. ROM
    - ii. PROM
    - iii. EPROM
    - iv. EEPROM