Chapter 2
**Computer
Memory**

Informatics Practices

Class XI (As per CBSE Board)

A Computer Memory - is just like a human brain,is used to store data and instructions. Computer memory is the storage space in the computer, where data is to be processed and instructions required for processing are stored.A collection of cells, each with a unique physical address.Most computers are byte-addressable.Cell at address 11111110 contains 10101010.

0	1	2	3	4	5	6	7	← Bit position
1	0	1	0	1	0	1	0	← Contents
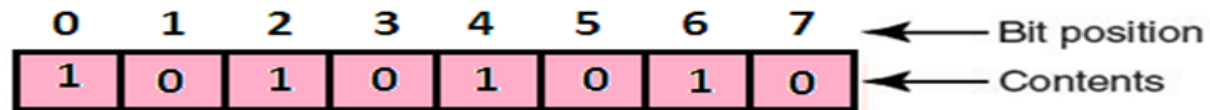
E.g. for memory size-> if the computer has 64k words, then this memory unit has 64 * 1024 = 65536 memory locations. The address of these locations varies from 0 to 65535.

Memory Units – **How much memory is required for a file/data/progam etc. is measured by memory units. Following are the 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

fppt.com

Memory is primarily of three types –

- Cache Memory
- Primary Memory/Main Memory
- Secondary Memory

Cache Memory - Cache memory is a very high speed semiconductor memory which can speed up the 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.
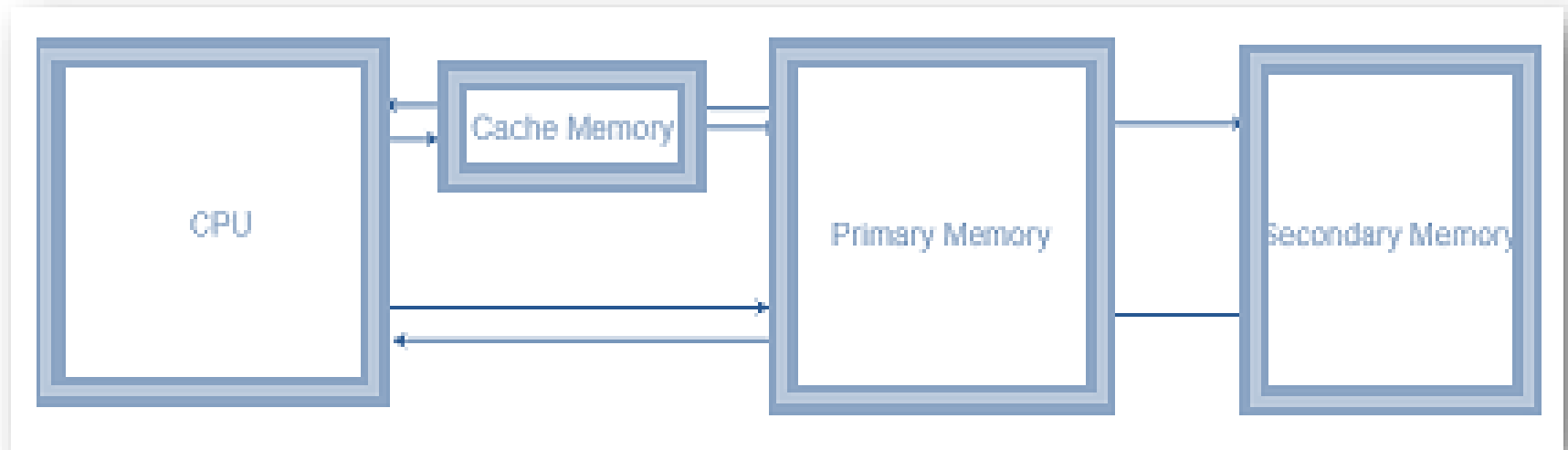
Types of memory

The advantages of cache memory are as follows –

- 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.

The disadvantages of cache memory are as follows –

- Cache memory has limited capacity.
- It is very expensive.

Types of memory

Primary Memory (Main Memory) - Primary memory holds only those data & instructions on which the computer is currently working. It has a limited capacity and data is lost when power is switched off. It is generally made up of semiconductor device. These memories are not as fast as registers. The data and instruction required to be processed resides in the main memory.

It is divided into two subcategories RAM and ROM.

ROM vs RAM

Computer Memory

Types of memory

Primary Memory (Main Memory) – Difference between RAM & ROM

BASIS FOR COMPARISON	RAM	ROM
Basic	It is a read-write memory.	It is read only memory.
Use	store data to be currently processed	required for booting of computer
Volatility	It is a volatile memory.	It is a nonvolatile memory.
Stands for	Random Access Memory.	Read Only Memory.
Modification	Data in RAM can be modified.	Data in ROM can't be modified.
Capacity	RAM sizes from 64 MB to 8GB.	smaller than RAM.
Cost	RAM is a costlier memory.	cheaper than RAM.
Type	Types of RAM are static RAM and dynamic RAM.	Types of ROM are PROM, EPROM, EEPROM.

fppt.c

Types of memory

Primary Memory (Main Memory) – Types of RAM

BASIS FOR COMPARISON	SRAM(STATIC RAM)	DRAM(DYNAMIC RAM)
Speed	Faster	Slower
Size	Small	Large
Cost	Expensive	Cheap
Used in	Cache memory	Main memory
Density	Less dense	Highly dense
Construction	Complex and uses transistors and latches.	Simple and uses capacitors and very few transistors.
Single block requires	6 transistors	Only one transistor.
Charge leakage property	Not present	Present hence require power refresh circuitry
Power consumption	Low	High

fppt.com

Types of memory

Primary Memory (Main Memory) – Types of ROM

MROM (Masked ROM)-The very first ROMs were hard-wired devices that contained a pre-programmed set of data or instructions & are known as masked ROMs & are inexpensive.

PROM (Programmable Read Only Memory)-PROM is read-only .The user buys a blank PROM and enters the desired contents using a PROM program. Inside the PROM chip, there are small fuses which are burnt open during programming. It can be programmed only once and is not erasable.

EPROM (Erasable and Programmable Read Only Memory)-EPROM can be erased by exposing it to ultra-violet light for a duration of up to 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.

EEPROM (Electrically Erasable and Programmable Read Only Memory)-EEPROM is programmed and erased electrically. It can be erased and reprogrammed about ten thousand times. Both erasing and programming take about 4 to 10 ms (millisecond). In EEPROM, any location can be selectively erased and programmed.

Types of memory

Secondary Memory

This type of memory is also known as external memory or non-volatile. These are slower than the main memory. These are used for storing data/information permanently. CPU directly does not access these memories, instead they are accessed via input-output routines. For example Tape, disk, CD-ROM, DVD,pen drive etc.
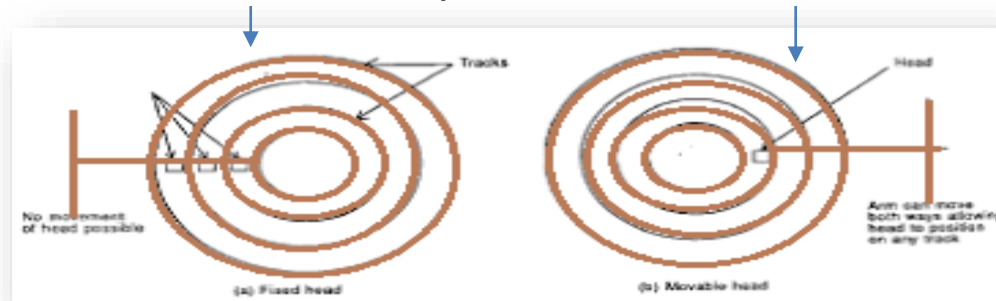
Magnetic Tape

mass auxiliary storage device

CARTRIDGE
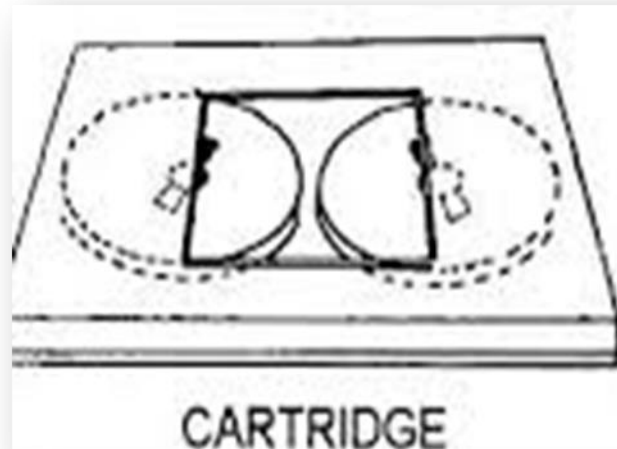
Secondary Storage Devices

Hard disk

Fixed Head HDD / Movable head HDD

A hard disk is a set of stacked disks. Each disk has data recorded electromagnetically in concentric circles, or tracks, on the disk
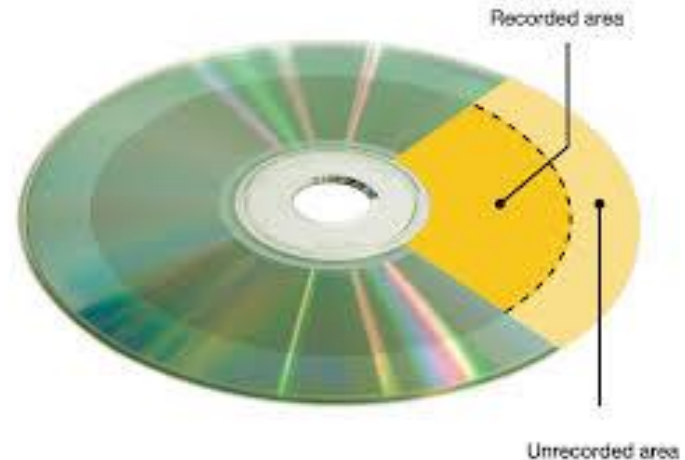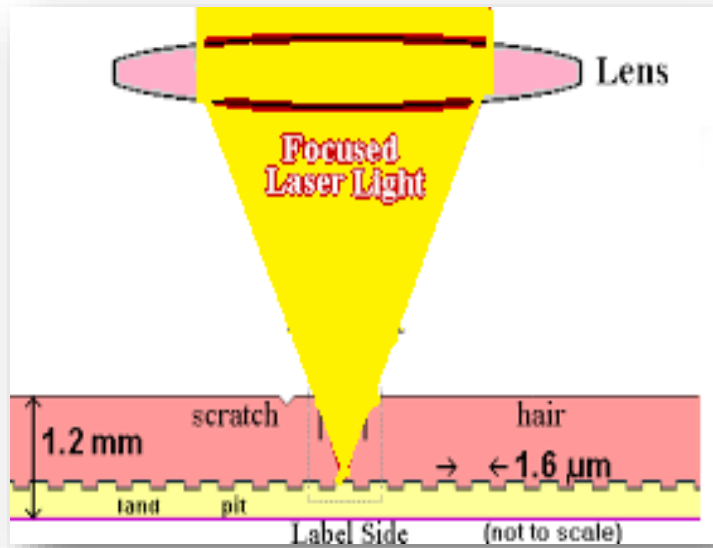
Hard Drive Types

1. Parallel Advanced Technology Attachment (PATA)
2. Serial ATA (SATA)
3. Small Computer System Interface (SCSI)
4. Solid State Drives (SSD)

Upto 12 TB sized HDD is available in the market

Secondary Storage Devices

A Compact disc read-only memory (CD-ROM)- is a storage device that can be read but not written to. The surface of a CD is made of a polycarbonate layer with molded spiral tracks on the top. The data are stored on the CD as a series of minute grooves which are known as 'pits' encoded on these spiral tracks. The areas between the 'pits' are known as 'lands'. A CD burner is used to write (burn) the data on a CD.A sensor reads data through light(laser) reflection.

Lens
Focused Laser Light
1.2 mm
scratch   hair
→ ←1.6 μm
land   pit
Label Side   (not to scale)

Recorded area
Unrecorded area

Secondary Storage Devices

DVD - Short for digital versatile disc or digital video disc, a DVD or DVD-ROM is a disc capable of storing a significant amount more data than a standard compact disc. DVD-ROM drives that utilize these discs were first sold in 1997.Works similar to cd but store data densely due to it's faster speed.

DVDs have differing capacities.

- One of the most common DVDs is the single-sided, single-layer disc, capable of holding 4.7 GB.
- The single-sided, double-layer disc is capable of holding between 8.5-8.7 GB.
- The double-sided, single-layer disc is capable of holding 9.4 GB.
- Although rare, the double-sided, double-layer disc is capable of holding up to 17.08 GB.

fppt.com

Secondary Storage Devices

Pen drive -   is small storage device shaped like a pen with built-in data storage that connects to a computer by a USB port. It is based on old EEPROMS technology that allows writing and erasure processes. When a pen drive is connected to a USB port, it activates. Otherwise, it lies dormant. Pen drives are used to store data. These flash drives vary in storage capacity (64 MB to 128 GB) and are removable and rewritable.

How data are deleted from

RAM – Data once stored in ram are not removed but are replaced with new one or become inaccessible ,due to their label(address) are detached from current program.

ROM – Deletion depends on rom type.(Read previous slide)

Magnetic tape - If the tape technology uses magnetic servo tracks, they also will be destroyed and the tape will be rendered useless. Note, however, that degaussing has to be performed properly. The tapes need to be exposed to a strong enough magnetic field for the correct amount of time to completely destroy the data

How data are deleted from

Hard disk – When we format a hard drive or delete a partition, we are only deleting the file system, making the data invisible, or no longer actively indexed, but not gone.

CDRW/DVDRW – Through crystal rearrangement.

Pen drive/flash memory - The electrons in the cells of a flash-memory chip can be returned to normal ("1") by the application of an electric field, a higher-voltage charge. Flash memory uses in-circuit wiring to apply the electric field either to the entire chip or to predetermined sections known as blocks. This erases the targeted area of the chip, which can then be rewritten.

How data are recovered from RAM –

1. We can't (in practice). RAM needs to be constantly refreshed to keep "remembering", when the computer is turned off the charge leaks out after a minute or so.

2. Freeze the chip, pop it into another computer, and run the linux command dd to copy the raw data to disk.

After we have the raw data, copy it to a new partition using dd again and run an undelete program on the partition. Undelete should pull out any files that fall under a recognizable format (ex pictures, etc...). The rest could be further processed but not easily unless we know what you're looking for.

How data are recovered from

ROM – It depends on the type of ROM being used.

Magnetic tape - The procedure for recovering data from magnetic tapes is very specialised and there are few organisations capable of successfully achieving this(through their specilised tool) and it depends on the condition of tape also.

Hard disk – If hdd circuit is damaged then it will be replaced and data will be recovered,this procedure is easy but if data loss from disk track then it become harder to recover.if files are removed due to command given mistakenly or formatted mistakenly and no data then after over written then these can be recovered from recua like software or we can approach hdd repair & recovery company for the same ,they work in specialized environment ,specialist open hdd and recover data bitwise that is too much harder process.

How data are recovered from

Pen drive – When the data are loss due to file system corruption or accidently deleted and not over written,then data recovery software can be used to recover the loss data. These software works at hardware level and read each memory cell for recovery.

Security issue

RAM– RAM is used to store sensitive non-persistent information in a lot of cases. Encryption keys would be a common example.Sometimes it is possible to remove RAM and place it into another device to dump the contents.

ROM - Customs Roms are open-source and they have all chance to steal data. But the developers stick to Their ethics and refrain from such practices. Also security teams watch what kind of additions are made to the source codes.

Hard disk -Once our computer becomes infected with malware, a cybercriminal can hijack our computer and do almost anything they wish. A lot of malware these days is programmed to seek out valuable or sensitive data and send it back to the criminals.