Memory organisation

→ The memory is organized in the form of a cell, each cell is able to be identified with a unique number called address. Each cell is able to recognize control signals such as "read" and "write", generated by CPU when it wants to read or write address. Whenever CPU executes the program there is a need to transfer the instruction from the memory to CPU because the program is available in memory. To access the instruction CPU generates the memory request.

→ "Memory request" contains the address along with the control signals.

→ "word size:- It is the maximum number of bits that a CPU can process at a time and it depends upon the processor.
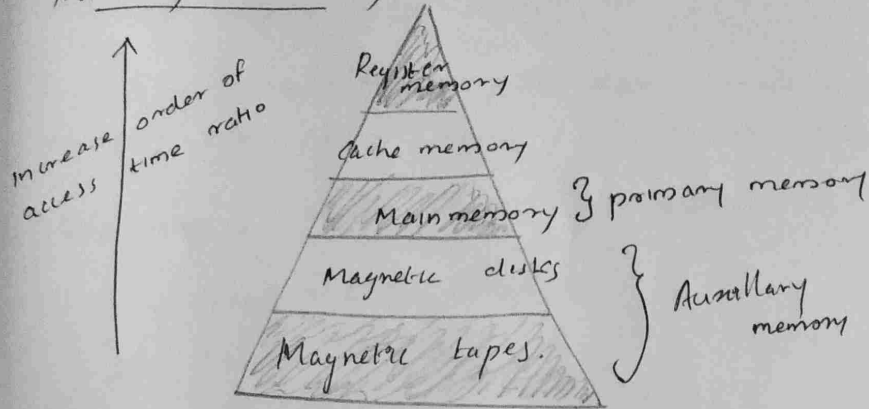
→ Memory unit is the collection of storage units or devices together. The memory units stores the binary information in the form of bits. Generally memory/storage is classified into 2 categories:

- Volatile memory: This loses its data, when power is switched off.

- Non volatile memory: This is permanent storage. And doesn't lose any data when power is switched off.

Memory hierarchy

Increase order of access time ratio

- Register memory
- Cache memory
- Main memory } primary memory
- Magnetic disks } Auxillary memory
- Magnetic tapes.

o "Auxillary memory" access time is generally 1000 times that of the main memory, hence it is at the bottom of hierarchy.

o The "main memory" occupies the central position because it is equipped to communicate directly with CPU & with auxillary devices through I/O.

o The "cache memory" is used to store program data which is currently being executed in the CPU.

Magnetic tapes ←→ I/o processor ←→ Main memory

Magnetic disk
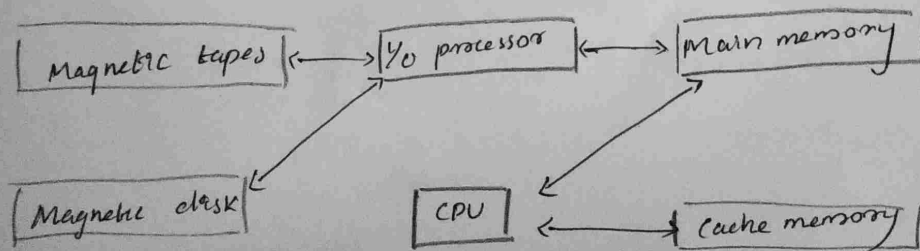
CPU ←→ Cache memory

Memory Mapping.
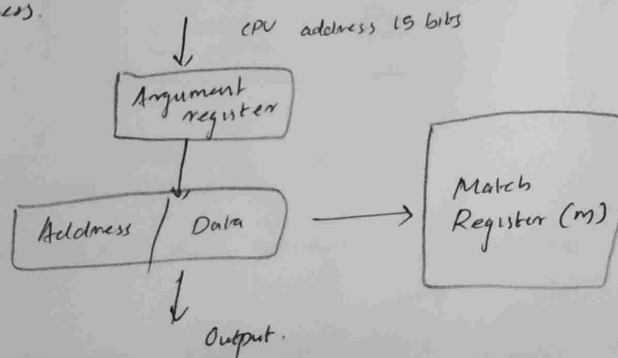
→ The transformation of data from main memory to cache memory is called mapping.

o There are 3 main types of mapping.

    1 → Associative Mapping

    2 → Direct Mapping

    3 → Set associative Mapping

1. Associative mapping.

• The associative memory stores both memory and data. The address value of 15 bits is 5 digit octal numbers and data is of 12 bits word in 4 digit octal number. A CPU address of 15 bits is placed in "argument register" and the associative memory is searched for matching address.

```
              ↓ CPU address 15 bits
        ┌──────────────┐
        │  Argument    │
        │   register   │
        └──────────────┘
              ↓
    ┌──────────────────┐            ┌──────────────┐
    │ Address │  Data  │ ────────→  │   Match      │
    └──────────────────┘            │ Register (m) │
              ↓                     └──────────────┘
           Output.
```

2. Direct mapping

• The CPU address of 15-bits is divided into 2 fields. in this the 9 least significant bits constitute the "index" field and the remaining 6 bits

constitute the "tag" field. The number of bits in index field is equal to the number of address bits required to access cache memory.

3. Set Associative mapping.

6 bits 9 bits

Tag	index

- The disadvantage of direct mapping is that two words with same index address can't reside in cache memory at the same time. This problem can be overcome by set associative mapping.

In this we can store 2 or more words of memory under the same index address. Each data word is stored together with its tag and this forms a set
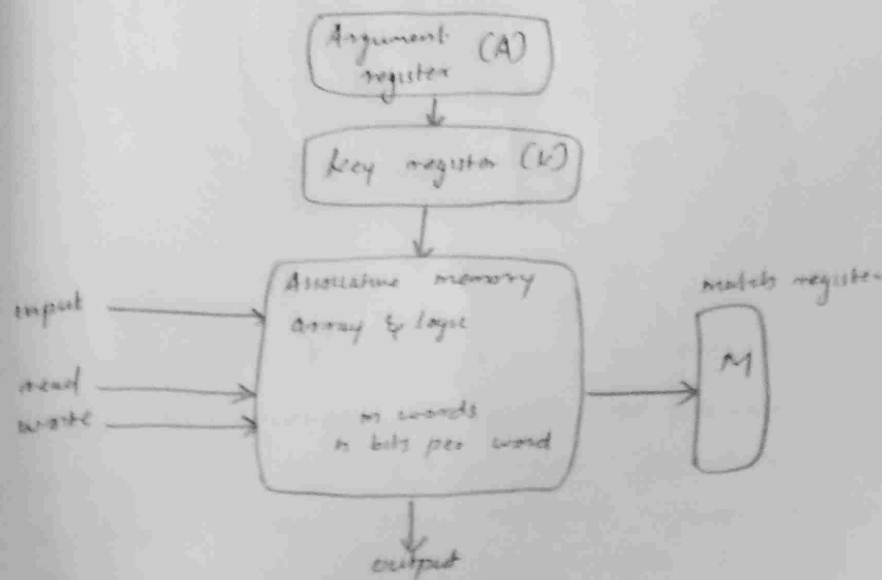

Tag   Data   address

Associative memory

- It is also known as content addressable memory (CAM).

- It is a memory chip in which each bit position can be compared. In this the content is compared in each bit cell which allows very fast table lookup. Since the entire chip can be compared, contenters are randomly stored

without considering addressing scheme
These chips have less storage capacity than
regular memory chips.

```
┌─────────────────┐
│ Argument (A)    │
│ register        │
└─────────────────┘
        │
        ▼
┌─────────────────┐
│ key register (k)│
└─────────────────┘
        │
        ▼
```

input ─────────────▶ ┌─────────────────────┐   match register
                     │ Associative memory │
read ──────────────▶ │ array & logic   │ ──────────▶ ┌───┐
write ─────────────▶ │   │   │ M │
                     │   m words   │   └───┘
                     │   n bits per word   │
                     └─────────────────────┘
                              │
                              ▼
                           output

Cache memory

- The data or contents of the main memory that
  are used again & again by CPU, are stored in
  the cache memory so that we can easily access
  that data in shorter time.

- whenever the CPU needs to access memory,
  it first checks the cache memory. If the data
  is not found in cache memory then the CPU
  moves onto the main memory. It also
  transfers blocks of recent data into the
  cache and keeps on deleting the old data
  in cache to accomodate the new one.
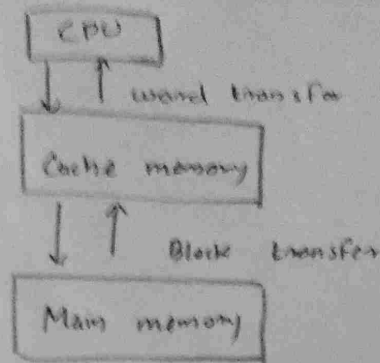
Virtual memory

- It is imaginary memory; it gives you the illusion of a memory arrangement that's not physically there.
- Virtual memory give programmer the illusion that they have a very large memory even though the computer has a small main memory.
- It makes the task of programming easier because the programmer no longer needs to worry about the amount of physical memory available.
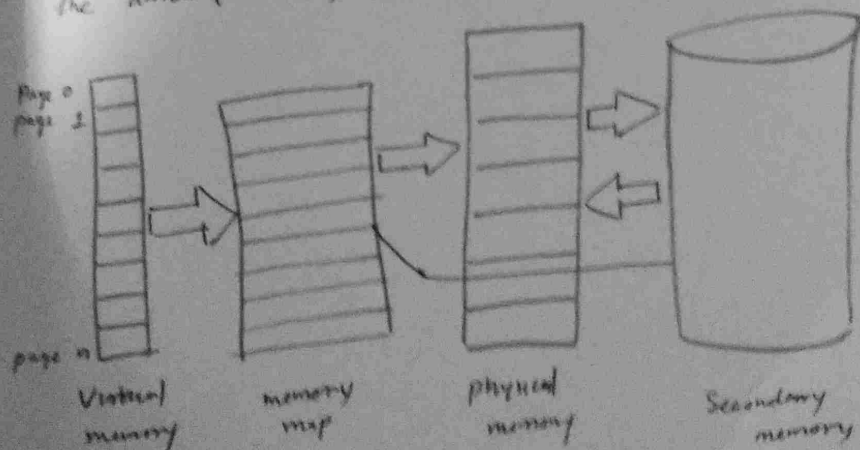
Virtual memory | memory map | physical memory | Secondary memory

Peripheral devices

→ They are the devices which provides input / output functions for a computer & serves as an auxillary computer device with out computing - intensive functionality.

- A peripheral device is a device that is connected to a computer system but is not part of the core computer system architecture.

Classifications of peripheral devices.

1. input devices:-
   - It converts incoming data & instructions into a pattern of electrical signals in binary code that are comprehensible to a digital computer.
   - eg:- keyboard, mouse, scanner, microphone etc.

2. Output devices :-
   - It generally translatting the digitized signals into a form intelligible to the user. The output device is also performed for sending data from one computer system to another.
   - egs- Monitor, headphones, printers etc.

3. Storage devices:-
   - They are used to store data in the system which is required for performing any operation in the system.
   - The storage device is one of the most requirest requirement devices and also provide better compatability.

• eg:- Hard disk, magnetic tape etc...

→ Advantages of peripheral devices:-

→ It is helpful for taking input very easily.

→ It is also provided a specific output.

→ It has a storage device for storing information or data.

→ It also improves the efficiency of the system.