ELEC 263 COMPUTER ARCHITECTURE AND ORGANIZATION

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CHAPTER 12:
MEMORY ORGANIZATION

12-3 Auxiliary Memory

- Common used secondary memory is magnetic disks and magnetic tapes.
- Other devices (magnetic drums, bubble memory, CD, DVD, flash disks, etc.)
- The important characteristics of those storage devices are
  - Access mode
  - Access time
  - Transfer rate
  - Capacity
  - Cost.
- Access time
  - Average time needed to reach storage location and obtain contents.

- Access time = seek time + transfer time

- Seek time:
  - Transfer time: time required to transfer data to-from device.

- Secondary storage devices are organized into records (blocks). Reading or writing is always done with entire record.
- Transfer rate

- The number of characters or words the device can transfer in one second.

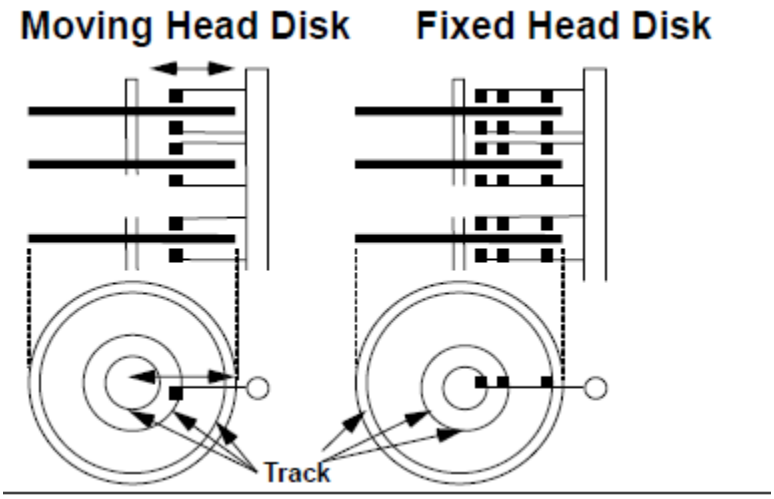
MAGNETIC DISKS

- Circular plate constructed of metal or plastic coated with magnetized material.
- Both sides of disks are used and severatemsl sysl disks may be stacked with read-write heads available for each surface.
- All disks rotate together at high speed
- Bits are stored in tracks which are concentric circles
- Tracks are divided into sections called sectors

- Some disk systems use single read-write head moveable to different tracks using mechanical assembly
- Others use multiple read-write heads positioned on each track (faster , more expensive).

- Addressing used to specify disk number, surface, track number, and sector within track.
- After head positioned at track, must wait to synchronize with sector
- Then reading data will start as same speed of rotation

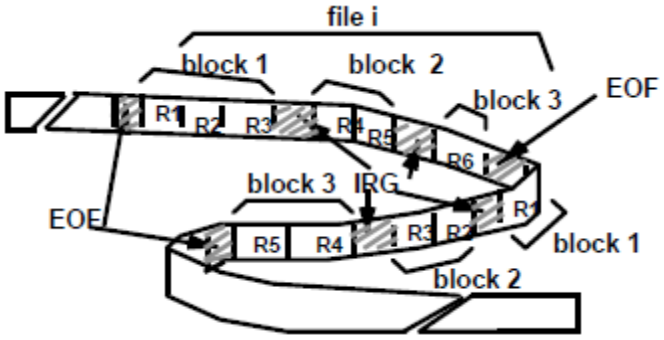
- Hard disks are permanently attached to unit and cannot move. Floppy disks are removable ones. With 2 sizes 5.25 and 3.5



MAGNETIC TAPES

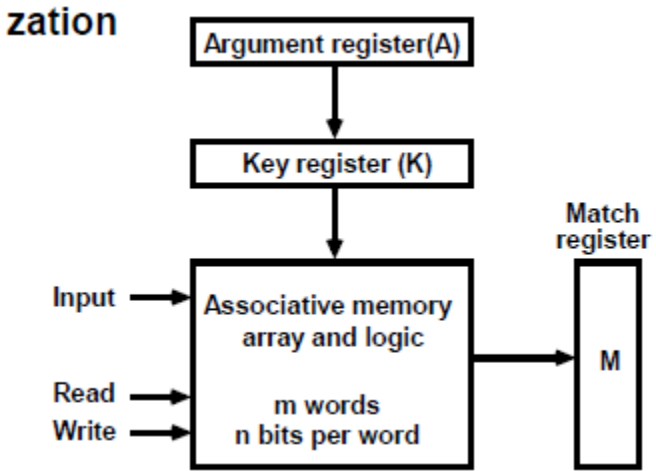
- Strip of plastic coated with magnetic recording material.
- Bits are recorded as magnetic spots along several parallel tracks(7 to 9 tracks to form character with parity).

- Read-write heads are positioned on each track.
- Magnetic tape units can be started stopped, forward moved, or reverse moved or rewound.
- Data are recorded in records (number of characters) followed by gaps between record for synchronization.
- At start and end of each record there is ID bit patterns.
- Records are identified by reading ID bit patterns.



12-4 Associative Memory

- Accessed by the content of the data rather than by an address. Also called Content Addressable Memory (CAM).
- When word is written to CAM, no address is needed; next available unused storage location is located. When word is read from CAM, the content of word or part of it is specified, the memory locates all words which give match and marks them for reading.
- Associative memories are expensive and used for application where time search is critical.

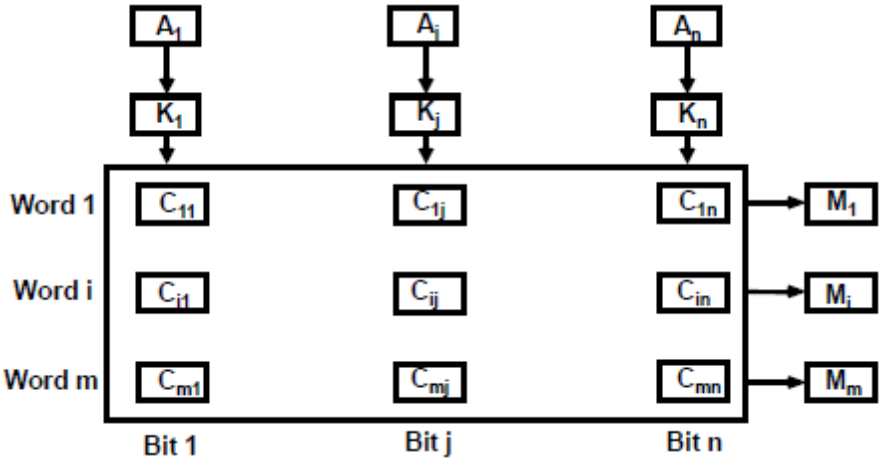


HARDWARE ORANIZATION

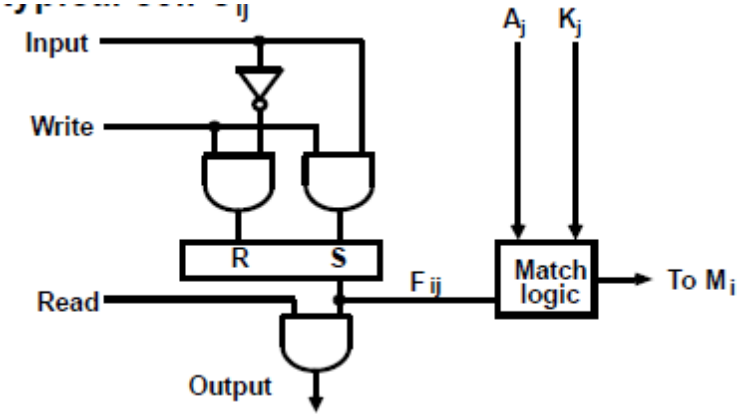
- Consists of memory array of m words each of n bits, argument register A and key register K each of n bits.
- Match register M has m bits, one for each memory word
- Each word of memory is compared in parallel with content of argument register and set corresponding bit in match register. Those bits set in match register indicate their words has match.
- Key register provides mask to select particular bits in argument word to be included in match or not. 1 means corresponding bit in argument register is in match and 0 means not.

- Example

A	101	111100	
K	111	000000	
W1	100	111100	NO MATCH
W2	101	000001	MATCH



- Previous figure shows CAM memory of m words by n cells per word and next figure shows internal organization of single cell.



MATCHING LOGIC

- The match logic for each word can be derived from comparison algorithm of two binary numbers.

1. K is neglected

   Word i is equal to argument A if $A_j = F_{ij}$ for j=1 ,2, 3, …,n

   $$x_j = A_j F_{ij} + A'_j F'_{ij}$$

   for word i to be equal to argument A we must have all x_i variables equal 1. The Boolean function for that will be

   $$M_i = x_1 x_2 x_3 x_4 \ldots\ldots x_n$$

2. K is included

   Requirement will be

   $x_i + K'_j = x_i$ if $K_j=1$
   $= 1$ if $K_j=0$

   Then match logic will be

   $$M_i = (x_1 + K'_1)(x_2 + K'_2)(x_3 + K'_3) \ldots\ldots (x_n + K'_n)$$

   The function now can be expressed in detail as

   $$M_i = \prod(A_j F_{ij} + A'_j F'_{ij} + K'_j) \text{ for j=1 to n}$$