RAID & FILE ORGANIZATION

Database Management System

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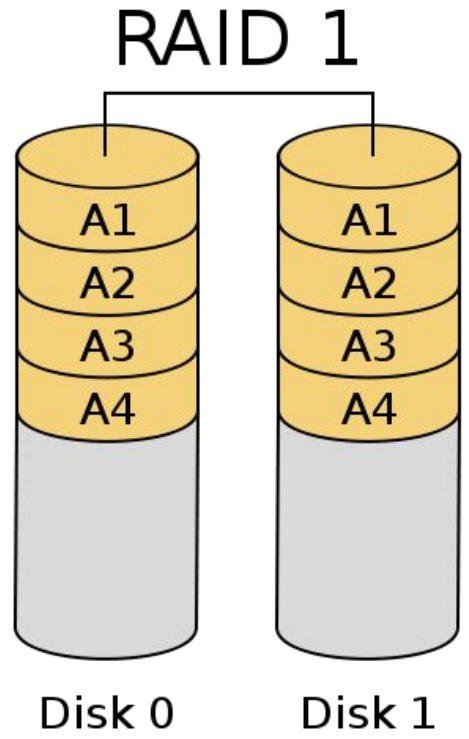
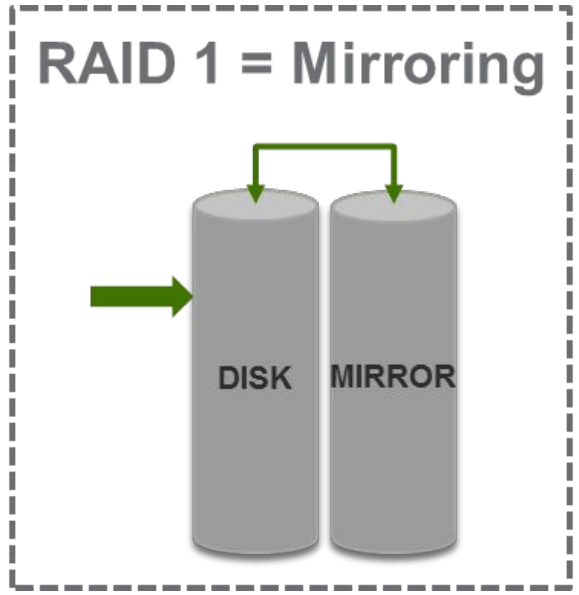
RAID

- Redundant Arrays of Independent Disk
- Technique proposed to achieve improved performance & reliability
- A technology to connect multiple secondary storage devices and use them as a single storage media.
- RAID consists of an array of disks in which multiple disks are connected together to achieve different goals.
- Various categories of RAID schemes:
  - RAID level 0 (stripping)
  - RAID level 1 (mirroring)
  - RAID level 2
  - RAID level 3
  - RAID level 4
  - RAID level 5
  - RAID level 6

RAID - Redundancy

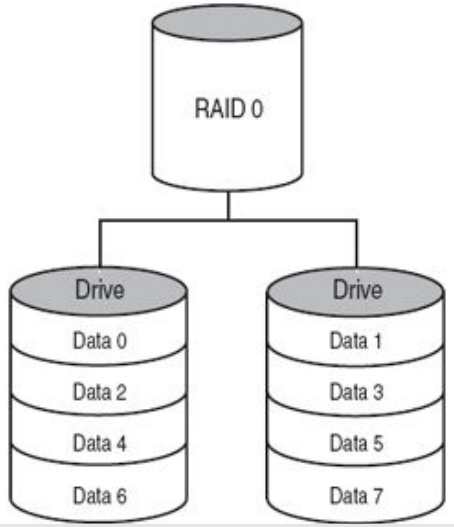
- A.k.a Mirroring / Shadowing
- Data backed up in other disks
- Failure in one disk won't lead to loss of data
- One logical disk consists of 'n' physical disks (commonly 2)
- Every write is carried on 'n' disks
- In failure of one disk, data can be retrieved from other disk
- Data lost chances occur only when 2nd disk fails before first failed disk is repaired.
- MTTF depends on MTTF of individual disk and mean time to repair a failed disk and restore data on it.

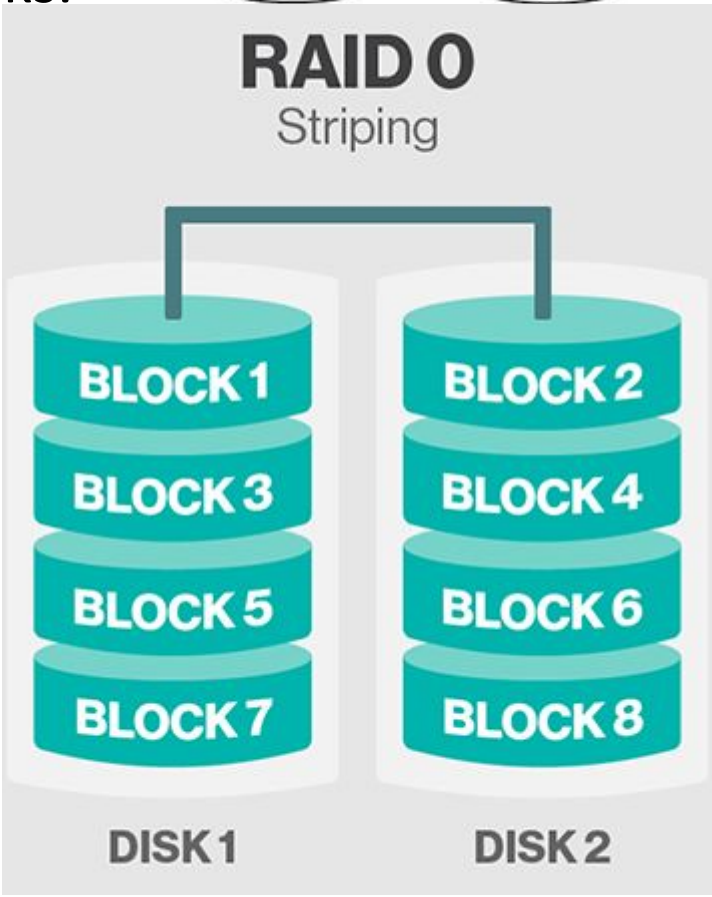


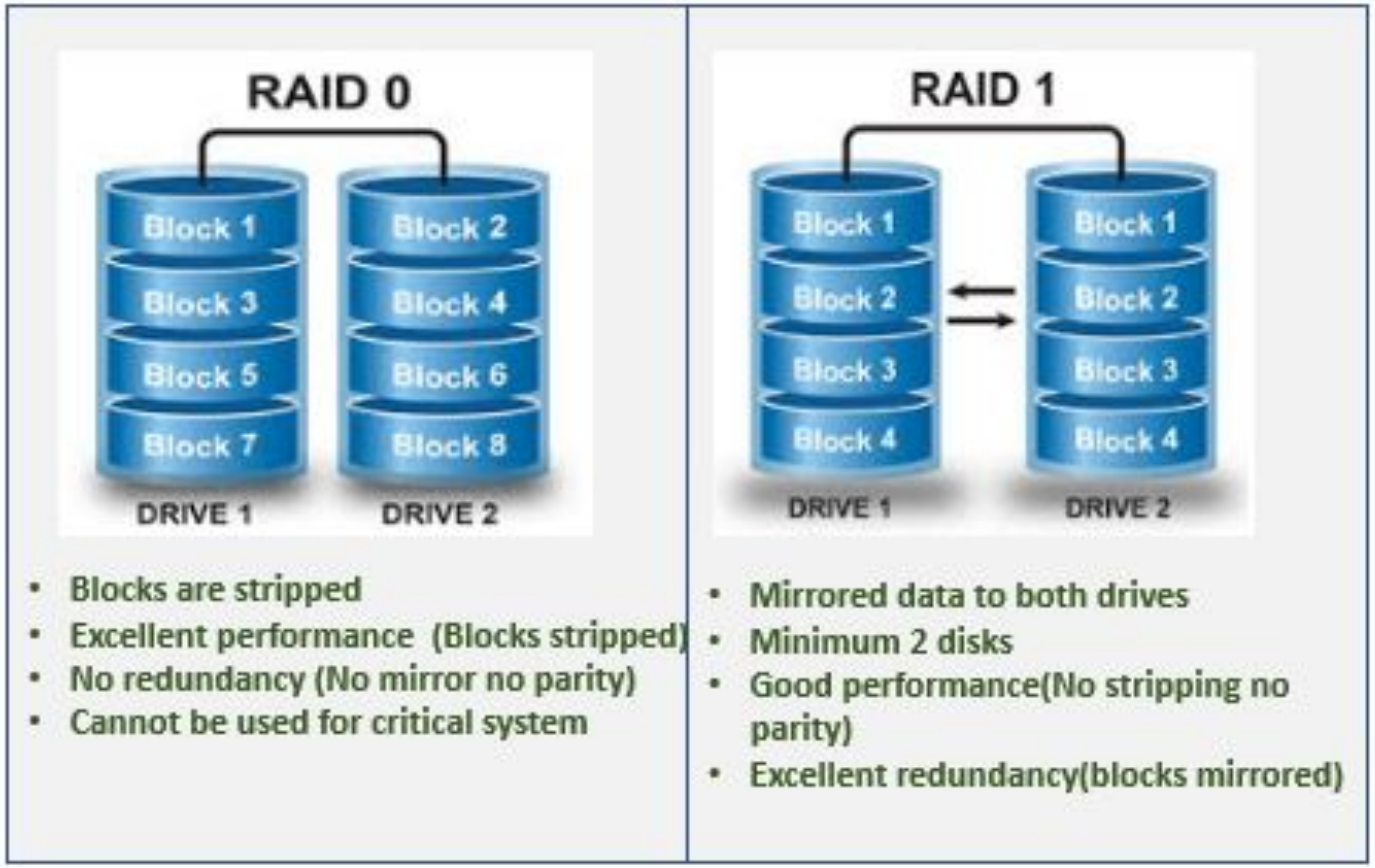


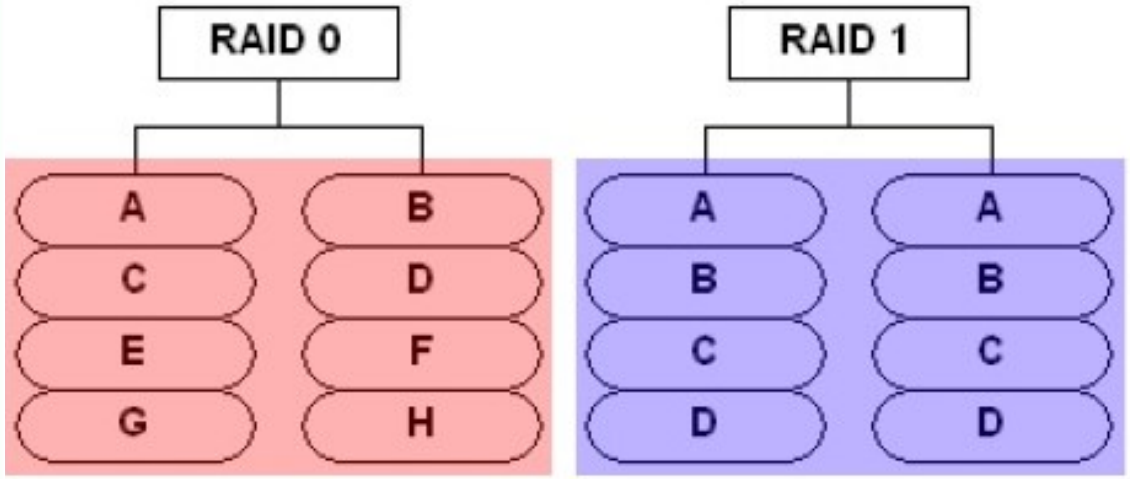
RAID – Parallelism

- A.k.a Stripping
- In Redundancy, rate of read request is higher (wait for data in same disk)
- To improve transfer rate, data stripping is done to multiple disks.
- Data stripping consists of splitting bits of each byte across multiple disk, such stripping is called bit-level stripping.
- Every disk participates in every access.
- Array of disks can be treated as a single disk with high sized sectors.
- Number of access that can be processed per second is about the same as on a single disk, but each access can read ‘n’ times (eight times) as many data in same time.
- Bit level stripping can be generalized to a no. of disks that is a multiple of 8.









MIRRORING provides high reliability but is time expensive.

STRIPPING provides high data transfer rate but does not improve reliability.

File organization

- Database consists of tables, views, index, procedures, functions etc.
- The tables and views are logical form of viewing the data.
- But the actual data are stored in the physical memory. In the physical memory devices, these data cannot be stored as it is. They are converted to binary format.
- Each memory devices will have many data blocks, each of which will be capable of storing certain amount of data.

  In a database we have lots of data. Each data is grouped into related groups called tables. Each table will have lots of related records. Any user will see these records in the form of tables in the screen. But these records are stored as files in the memory. Usually one file will contain all the records of a table.

- To access these files, we need to store them in certain order so that it will be easy to fetch the records. It is same as indexes in the books.
- A file is organized logically as a sequence of records. Records are mapped onto disk blocks.

File organization

- Blocks are of fixed size but records size vary.
- Storing the files in certain order is called file organization. The main objective of file organization is:
  - Optimal selection of records i.e.; records should be accessed as fast as possible.
  - Any insert, update or delete transaction on records should be easy, quick and should not harm other records.
  - No duplicate records should be induced as a result of insert, update or delete
  - Records should be stored efficiently so that cost of storage is minimal.

File organization

- Some of the file organizations are:
  1. Sequential File Organization
  2. Heap File Organization
  3. Hash/Direct File Organization
  4. Indexed Sequential Access Method
  5. B+ Tree File Organization
  6. Cluster File Organization

File organization

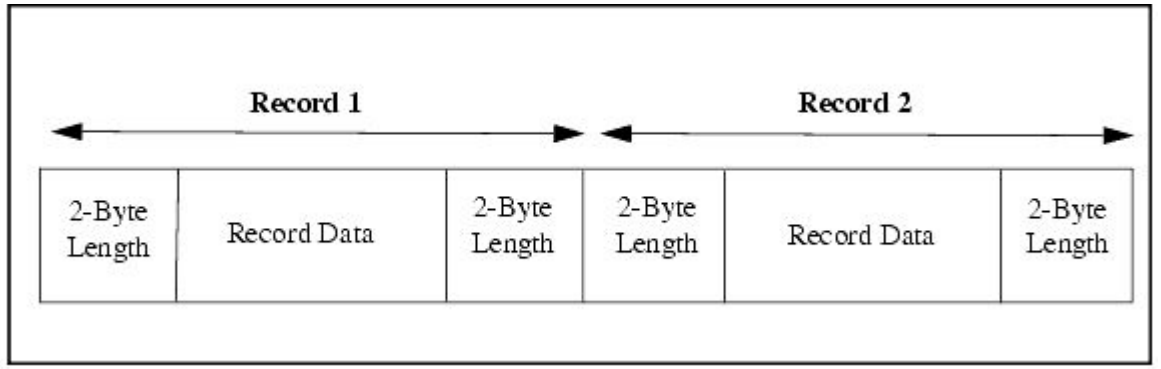
	Sequential	Heap/Direct	Hash
Method of storing	Sequential (ordered) files Records are ordered by the value of a specified field.	Heap (unordered) files Records are placed on disk in no particular order.	Hash files Records are placed on disk according to a hash function
Types	Pile file and sorted file Method	-	Static and dynamic hashing
Design	Simple Design	Simplest	Medium
Storage Cost	Cheap (magnetic tapes)	Cheap	Medium
Advantage	Fast and efficient when there is large volumes of data, Report generation, statistical calculations etc.	Best suited for bulk insertion, and small files/tables	Faster Access No Need to Sort Handles multiple transactions Suitable for Online transactions

File organization

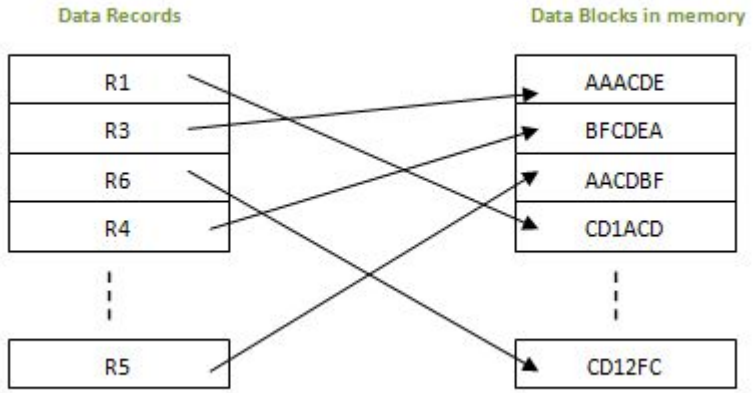
Heap file organization

In the below figure, we can see a sample of heap file organization for EMPLOYEE relation which consists of 8 records stored in 3 contiguous blocks, each blocks can contains at most 3 records.

	Name	EID	Address	Birthdate	Salary
block 1	Adams John	....	...	...	...
	Melinda, Perkin				
	Raymond, Wong				
block 2	Alan, Delon				
	Bill, Clinton				
	Nancy, Davies				
block 3	Jay, Shana				
	Son, Nguyen				



Sequential file organization



Hash file organization

File organization

- Assignment: Detailed notes on following:

1. Sequential File Organization
2. Heap File Organization
3. Hash/Direct File Organization
4. Indexed Sequential Access Method
5. B+ Tree File Organization
6. Cluster File Organization

Thank you!