

Performance Tuning

Hardware Tuning: Choice of RAID Level

- To use RAID 1 or RAID 5?
 - Depends on ratio of reads and writes
 - RAID 5 requires 2 block reads and 2 block writes to write out one data block
- If an application requires r reads and w writes per second
 - RAID 1 requires $r + 2w$ I/O operations per second (How?)
 - RAID 5 requires: $r + 4w$ I/O operations per second (How?)

RAID Levels

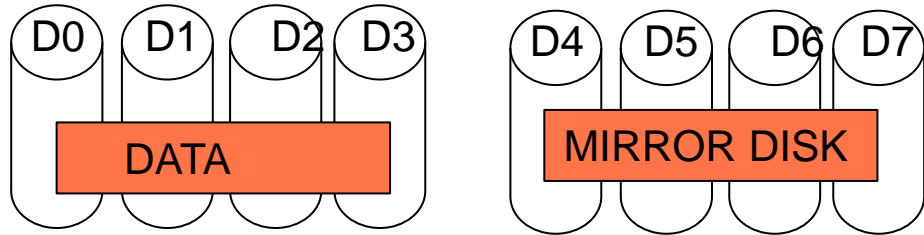
RAID Level 1 (Mirroring)

Example: You need 8TB of storage and there are available of 2TB disks.

How many disks will be needed for this storage system in RAID 1?

RAID Level 1: Mirrored disks with block striping

- Offers best write performance.
- Popular for applications such as storing log files in a database system.

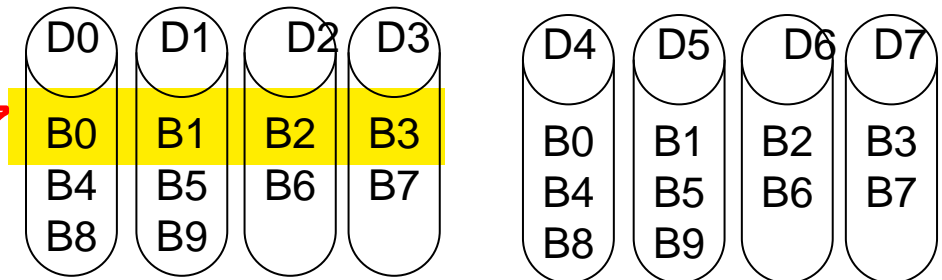


Question 35-1: If an application requires r reads and w writes per second, RAID 1 requires $r + 2w$ I/O operations per second (**How?**)

You have to store student relation file (B0, B1, B2, B3, B4, B5, B6, B7, B8, B9) into the storage system of RAID 1.

How?

Block-level striping
(for parallel access)



RAID Levels (Cont.)

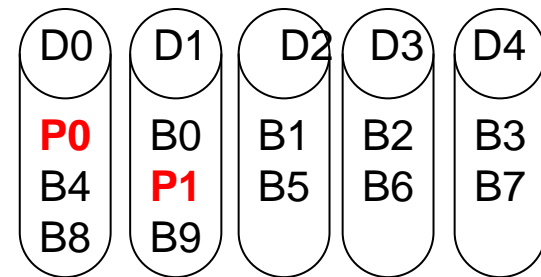
RAID Level 5: Block-Interleaved Distributed Parity;

- partitions data and parity among all $N + 1$ disks.
- E.g., with 5 disks, parity block P_k for blocks $4k, 4k+1, 4k+2, 4k+3$ is stored in disk $k \bmod 5$.
- For $k=0$, blocks B_0, B_1, B_2, B_3 , parity block P_0 is stored in disk $(0 \bmod 5 = 0)$ D0 disk.
- For $k=1$, blocks B_4, B_5, B_6, B_7 , parity block P_1 is stored in disk $(1 \bmod 5 = 1)$ D1 disk.

RAID Level 5 (Block striping distributed parity)

Example: You need 8TB of storage and there are available of 2TB disks.

How many disks will be needed for this storage system in RAID 5?



RAID Levels (Cont.)

RAID Level 5 (Block striping distributed parity)

Parity blocks: Parity block stores XOR of bits from corresponding blocks of each disk

How is recovery performed single disk failure?

- To recover data for a block, compute XOR of bits from all other blocks in the set including the parity block

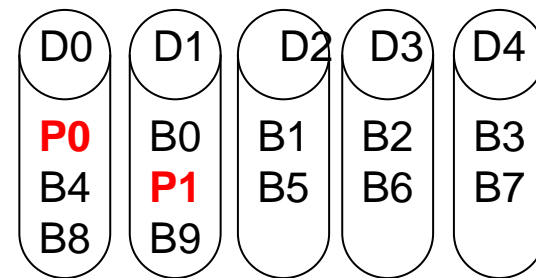
What will happen if two disks failed simultaneously?

How is update block B3 performed?

- READ B3, P0 into memory
- Update B3 to B'3 and compute P'0 using B3 and B'3
- WRITE B'3, P'0 to disk.

Example: You need 8TB of storage and there are available of 2TB disks.

How many disks will be needed for this storage system in RAID 5?



Question 35-2:

If an application requires r reads and w writes per second, RAID 5 requires: $r + 4w$ I/O operations per second (**How?**)

RAID Levels (Cont.)

RAID Level 5 (Block striping distributed parity)

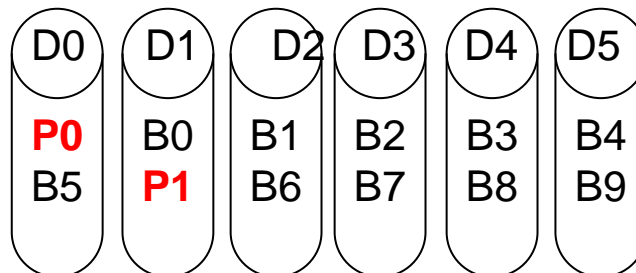
Example: You have been given six disks of 2TB each.

- a. What are the effective storage capacity in RAID 1, RAID 5?

Effective storage capacity in RAID 1 = 6TB

Effective storage capacity in RAID 5 = 10TB

- b. Show the storage of blocks B0, B1, B2, B3, B4, B5, B6, B7, B8, B9 into 6 disks using RAID5.



Hardware Tuning: Choice of RAID Level

- For reasonably large r and w , this requires lots of disks to handle workload
 - RAID 5 may require more disks than RAID 1 to handle load!
 - Apparent saving of number of disks by RAID 5 (by using parity, as opposed to the mirroring done by RAID 1) may be illusory!
- Thumb rule: RAID 5 is fine when writes are rare and data is very large, but RAID 1 is preferable otherwise
 - If you need more disks to handle I/O load, just mirror them since disk capacities these days are enormous!