

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

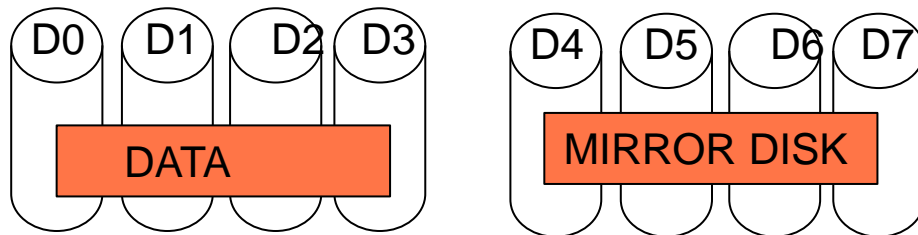
RAID Level 1 (Mirroring)

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?

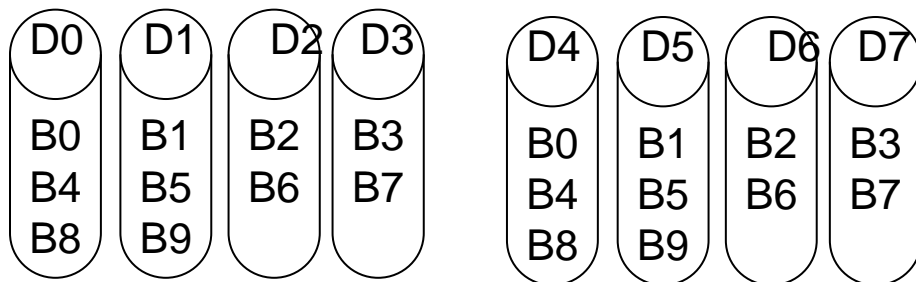
RAID Level 1: Mirrored disks with block striping

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



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?



RAID Levels (Cont.)

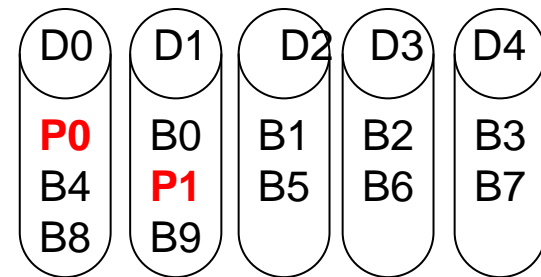
RAID Level 5: Block-Interleaved Distributed Parity;

- 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

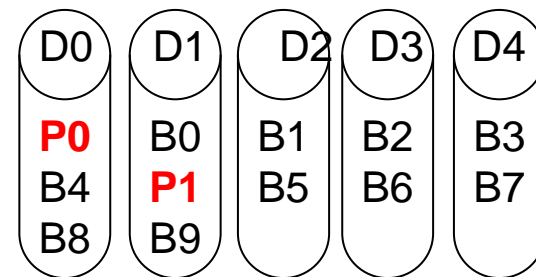
What will happen if two disks failed simultaneously?

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)

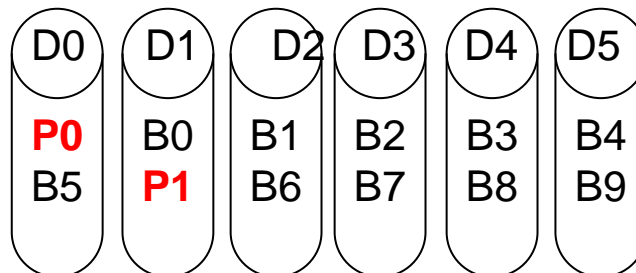
Example: You have been given six disks of 2TB each.

- 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!