Data Reliability Techniques

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RAID 0 and RAID 1

• RAID 0 has no additional redundancy (misnomer) – it uses an array of disks and stripes (interleaves) data across the arrays to improve parallelism and throughput

• RAID 1 mirrors or shadows every disk – every write happens to two disks

• Reads to the mirror may happen only when the primary disk fails – or, you may try to read both together and the quicker response is accepted

• Expensive solution: high reliability at twice the cost
RAID 3

• Data is bit-interleaved across several disks and a separate disk maintains parity information for a set of bits

• For example: with 8 disks, bit 0 is in disk-0, bit 1 is in disk-1, ..., bit 7 is in disk-7; disk-8 maintains parity for all 8 bits

• For any read, 8 disks must be accessed (as we usually read more than a byte at a time) and for any write, 9 disks must be accessed as parity has to be re-calculated

• High throughput for a single request, low cost for redundancy (overhead: 12.5%), low task-level parallelism
RAID 4 and RAID 5

• Data is block interleaved – this allows us to get all our data from a single disk on a read – in case of a disk error, read all 9 disks

• Block interleaving reduces throughput for a single request (as only a single disk drive is servicing the request), but improves task-level parallelism as other disk drives are free to service other requests

• On a write, we access the disk that stores the data and the parity disk – parity information can be updated simply by checking if the new data differs from the old data
RAID 5

- If we have a single disk for parity, multiple writes can not happen in parallel (as all writes must update parity info)

- RAID 5 distributes the parity block to allow simultaneous writes
RAID Summary

- RAID 1-5 can tolerate a single fault – mirroring (RAID 1) has a 100% overhead, while parity (RAID 3, 4, 5) has modest overhead

- Can tolerate multiple faults by having multiple check functions – each additional check can cost an additional disk (RAID 6)

- RAID 6 and RAID 2 (memory-style ECC) are not commercially employed