Paper “RAID”

- Redundant array of independent disks
- What are the two main goals of RAID?
- What is Amdahl’s Law?
- What are downsides of redundant disks?
Paper “RAID”

- Seek time, rotational latency, data transfer time
- *What are techniques to reduce these times?*
- DMA (Figure 2)

```
+---------------------------------+------------------+
| RAID 0                          | RAID 1           |
| striping block 1 block 2 block 3 | mirroring block 1 block 2 |
| block 4 block 5 block 6 block 7 | block 4 block 4  |
+---------------------------------+------------------+
```

Paper “RAID”

- Fine-grained vs. coarse-grained interleaving
- “Hot spots”; concentrated/distributed patterns
- Load balancing
Paper “RAID”

(a) RAID 0: non-redundant striping.
(b) RAID 1: mirrored disks.
(c) RAID 2: memory-style error-correcting codes.
(d) RAID 3: bit-interleaved parity.
(e) RAID 4: block-interleaved parity.
(f) RAID 5: block-interleaved distributed parity.
(g) RAID 6: P + Q redundancy.

Paper “RAID”

- Reliability and correlated disk failures
- Buffering/caching
- Floating parity
- On-line spare disks

- Thoughts on RAID? Pros/cons?
- Do Google, Microsoft, Facebook, etc. use RAID?
Paper “Differential RAID”

- SSD vs. HD
- SLC vs. MLC
- Bit error rate (BER)
- Correlated failures
- Age differential: low vs. high differential?
- Diff-Raid technique 1: distribute parity unevenly (why?)
- Diff-Raid technique 2: reshuffle parity on drive replacements (why?)

Paper “Differential RAID”

- Pages & blocks; erase operations
- Wear-leveling algorithms
- RAID-5 load balancing & reliability
- *Diff-RAID: why focus on parity distribution?*
- Uneven parity distribution
- “Aging older devices faster”
- *Thoughts on Diff-RAID? Pros/cons?*