Notes for 10/30/09

Pop quiz:

1. 32KB cache, 128B blocks, 4-way set-associative, 32-bit addresses
   a) Number of blocks?
   b) Number of sets?
   c) Number of tag bits?
2. True of false: TLB's are an alternative to multi-level page tables; an architecture will typically not use both.

RAID – Redundant Array of Inexpensive Disks
The purpose: get more fault tolerance and performance by using multiple commodity disks

- Level 0 – Striping
  - Not in original RAID paper; does not actually provide redundancy
  - Used for better throughput
  - Interleave data across disks on the block level
  - Data has to be at least the block size to see performance increase
  - Your total capacity is the capacity of the disks
- Level 1 – Mirroring
  - Every block is duplicated on both disks
  - Provides fault tolerance
  - Have better throughput for reads but not for writes
  - Your total capacity is half of the capacity of the disks
- Level 2 – Bit-level striping with Hamming code error-correcting code
  - Bitwise interleave
  - Spread bits across drives as well as Hamming codes on parity drives
  - When a single drive fails, we can use the Hamming codes to tell which one and correct the data
  - Your total capacity is over half of the capacity of the disks
- Level 3 – Bit-level striping with parity bit
  - Like level 2, except use just parity bits instead of Hamming code
  - Hamming code will tell us which disk has failed, but we typically already know this anyways
  - Parity bits can be used to replace data when we already know which disk has failed
  - And parity bits require less space than Hamming codes
  - So your total capacity is even better than with level 2
- Level 4 – Block-interleaved parity
  - Like level 3, except interleaved on the block level
  - This allows drives to act independently when only one block is requested
  - This increases parallelism
- Level 5 – Distributed block-interleaved parity
  - Distribute parity bits across all drives to prevent bottlenecking on the parity drive
  - So no dedicated parity drives
- Level 6 – Tolerate additional failures
  - Provide extra parity bits to tolerate more than one failure