15-213 Recitation 11 - 4/9/01

Outline

- More Cacheing
- Virtual Memory

Reminders

- Lab 4 – Due 4/11, 11:59 PM
- Exam 2 – 4/17, DH 2210

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More Cacheing

- Performance Analysis
  - What good's a cache if you don't use it?
- Miss Rate, Hit Time, Miss Penalty
- Types of Misses:
  - Compulsory, Capacity, Conflict

Virtual Memory

- A transparent system for mapping memory spaces
- Enables both versatility *and* security
- Virtual Memory and Caches are two separate things, but they draw on the same ideas

Virtual Memory

- Physical Memory is thought of as a bunch of "pages" (equal sized blocks)
- The Page Table provides mapping between virtual and physical address spaces
  - Who creates this?
    - The OS
- The processor works with virtual addresses

Address Translation

- Processor asks for word from memory
  - Hardware maps virtual address to physical address [Page Table lookup]
    - Page Fault?
      - Ask the operating system
  - Memory receives request as physical address
  - Everybody's happy

Address Translation

- Sounds great!
  - Not really.
    - Page Table resides in memory
    - Processor runs at ~1GHz; Memory runs at ~8ns (120MHz)
    - Since the Page Table resides in main memory, we'd spend 10 clock cycles on every instruction
  - Solution?
    - A Cache (Translation Lookaside Buffer)

Virtual Memory: Reasons

- Why go through all this pain?
  - Versatility
    - Processes can act like they own the place
    - Enables multi-tasking operating systems
    - Dynamically allocate portions of memory to processes as needed (i.e., `malloc`)
  - Security
    - Processes can't always act like they own the place