CSE 351: The Hardware/Software Interface

Section 10

Final review

Non-inclusive topic list

- Caches
- Exceptional control flow
- Processes
- Virtual memory
- Dynamic memory allocation
- Garbage collection
- Memory perils and pitfalls
- C versus Java

Caches

- What purpose do they serve?
- How do direct-mapped, set-associative, and fully-associative caches work?
- What are temporal and spatial locality and how do they affect evictions and miss rates?
- When do cold misses, conflict misses, and capacity misses occur?

Exceptional control flow

- Asynchronous exceptions
  - Interrupt signals such as SIGINT (caused by Ctrl+C)
- Synchronous exceptions
  - Traps (e.g. system calls such as `open` and `read`)
  - Faults (e.g. division by zero)
  - Aborts (e.g. memory error in hardware causes a crash)

Processes

- A process is a running instance of a program
- Each process has the illusion of exclusive use of the CPU and memory
  - How does the OS provide this illusion?
- How are `fork()`, `exec()`, and `wait()` used to spawn and manage processes?
  - Bonus points (not really): What do children become if we don’t reap them?

Virtual memory

- What problem does virtual memory solve?
- How does virtual address to physical address translation work, and what are the components involved in the process?
- How does protection and sharing of pages between processes work?

Dynamic memory allocation

- How does dynamic memory allocation using an explicit free list work?
- How do `malloc` and `free` (`mm_malloc` and `mm_free` in lab 5 terms) interact with the heap?
- When does memory fragmentation occur?

Garbage collection

- Why is garbage collection in C not an easy proposition?
- At a high level, how does garbage collection in Java work?

Memory perils and pitfalls

- Be able to identify:
  - Bad (invalid) pointers
  - Reads of uninitialized memory
  - Double frees
  - Memory leaks

C versus Java

- Pointers versus references: What's the difference?
- How are the compilation processes of C and Java code different?
- What general design differences are there between the two languages?
  - Strings, classes, inheritance, casting, etc.

Questions?

- Ask any exam- or lab-related questions
- Fill out course evaluations in last ten minutes