Review

Questions
- What are two functions of an OS?
- What “layer” is above the OS?
- What “layer” is below the OS?

Questions
- When is it appropriate for OS to “waste” resources?
- How might the growth in networks influence OS design?

True or False
- Unix is a “simple structure” OS
- Micro Kernels are faster than other OS structures
- Virtual Machines are faster than other OS structures

Processes
- “A program in execution”
- Modern computers allow several at once – “pseudoparallelism”
Processes

- "A program in execution"

- "more" than a program: `ls`, `tcsh`
- "less" than a program: `gcc` `blah.c`
  (`cpp`, `cc1`, `cc2`, `ln` ...)
- "A sequential stream of execution in it's own address space"

Design Technique: State Machines

- Process states
- Move from state to state based on events
  - Reactive system
- Can be mechanically converted into a program
- Other example:
  - string parsing, pre-processor

Unix Process Creation

- System call: `fork()`
  - creates (nearly) identical copy of process
  - return value different for child/parent
- System call: `exec()`
  - over-write with new process memory
- (Hey, you, show demos!)

Process Scheduler

- All services are processes
- Small scheduler handles interrupts, stopping and starting processes

Process Control Block

- Each process has a PCB
  - state
  - program counter
  - registers
  - memory management
  - ...
- OS keeps a table of PCB’s, one per process
- (Hey! Simple Operating System, “system.h”)
Question

- Usually the PCB is in OS memory only.
- Assume we put the PCB into a processes address space.
- What problems might this cause?

Interrupt Handling

- Stores program counter (hardware)
- Loads new program counter (hardware)
  - jump to interrupt service procedure
- Save PCB information (assembly)
- Set up new stack (assembly)
- Set "waiting" process to "ready" (C)
- Re-schedule (probably awakened process) (C)
- If new process, called a context-switch

Context Switch

- Pure overhead
- So … fast, fast, fast
  - typically 1 to 1000 microseconds
- Sometimes special hardware to speed up

- How to decide when to switch context to another process is process scheduling