Announcements

- Program #0
  - Due on Friday
  - Limit should return 0 when called with correct parameters
  - Calling limit resets the counter, so a Limit(0,4) will be killed on the 5th system call after Limit.
- Reading
  - Today: Processes - Chapter 3 (ch 4, 6th Ed)
  - Thursday: Threads - Chapter 4 (ch 5, 6th Ed)

Hardware Protection

- Need to protect programs from each other
- Processor has modes
  - user mode and supervisor (monitor, privileged)
  - operations permitted in user mode are a subset of supervisor mode
- Memory Protection
  - control access to memory
  - only part of the memory is available
    - can be done with base/bound registers
- I/O Protection
  - I/O devices can only be accessed in supervisor mode
- Processor Protection
  - Periodic timer returns processor to supervisor mode

Operating System Structure

- Simple Structure (or no structure)
  - any part of the system may use the functionality of the rest of the system
  - MS-DOS (user programs can call low level I/O routines)
- Layered Structure
  - layer n can only see the functionality that layer n-1 exports
  - provides good abstraction from the lower level details
    - new hardware can be added if it provides the interface required of a particular layer
  - system call interface is an example of layering
  - can be slow if there are too many layers
- Hybrid Approach
  - most real systems fall somewhere in the middle

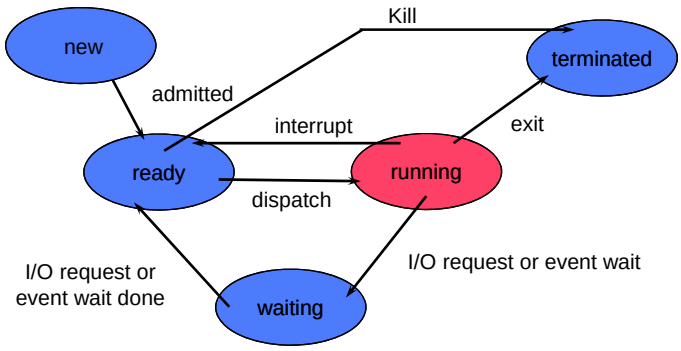
Policy vs. Mechanism

- Policy - what to do
  - users should not be able to read other users files
- Mechanism- how to accomplish the goal
  - file protection properties are checked on open system call
- Want to be able to change policy without having to change mechanism
  - change default file protection
- Extreme examples of each:
  - micro-kernel OS - all mechanism, no policy
  - MACOS - policy and mechanism are bound together

Multi-programming

- Systems that permit more than one process at once
  - virtually all computers today
- Permits more efficient use of resources
  - while one process is waiting another can run
- Provides natural abstraction of different activities
  - windowing system
  - editor
  - mail daemon
- Preemptive vs. non-preemptive muti-programming
  - preemptive means that a process can be forced off the processor by the OS
  - provides processor protection

Process State Transitions



Components of a Process

- Memory Segments
  - Program - often called the text segment
  - Data - global variables
  - Stack - contains activation records
- Processor Registers
  - program counter - next instruction to execute
  - general purpose CPU registers
  - processor status word
    - results of compare operations
  - floating point registers

Process Control Block

- Stores all of the information about a process
- PCB contains
  - process state: new, ready, etc.
  - processor registers
  - Memory Management Information
    - page tables, and limit registers for segments
  - CPU scheduling information
    - process priority
    - pointers to process queues
  - Accounting information
    - time used (and limits)
    - files used
    - program owner
  - I/O status information
    - list of open files
    - pending I/O operations