Midterm Review

CS 416: Operating Systems Design

Department of Computer Science

Rutgers University

Reminders

- Write name on all answer books.
- Closed book. Closed notes. No calculators, cell phones, laptops, etc.
- No questions during the exam. If in doubt, make an assumption and write it down.
- Be concise. Write just enough to answer questions.
- Cheating will be punished severely!

Architecture

- Caching? How does it work, Types of caches, types of misses
- Exceptions, traps, interrupts, signals (How are they created, what happens under each of these situations)

Processes and Threads

- Stack. Activation records. What is stored there?

- Heap. What is stored there?
- Address space. What is it?
- Process context. Thread context. What do they comprise?
- PCB. TCB. Where are they stored? What do they store?
- Fork(), exec()
- Context switching. Steps involved in Context Switching
- Thread states. Transitions between states.
- User-level and kernel-level threads. Pros and cons?

Synchronization

- Critical section.
  - Software Solution: CS conditions (Mutual Exclusion, Progress, Bounded Waiting)
  - Test_and_Set(), Compare_and_swap()
  - Locks. Semaphores. Condition Variables. Monitors (You need to know how the atomic operations inside each of these are implemented).
- Understanding of Classic problems in synchronization
  - Readers-Writers(All versions), Dining Philosopher, Producer Consumer, etc.
- Spinning vs. blocking. Tradeoff?

Deadlocks

- Deadlock. Necessary conditions?
  - ME, Hold and Wait, No Preemption, Circular Wait
- Deadlock Prevention?
- Deadlock Avoidance
  - Resource Allocation Graph (Single Resource)
  - Banker's algorithm.

- I could give you a synchronization code and ask you to look for deadlocks .

Virtual Memory

- Paging. Segmentation. How do they work? Pros and cons?
- Translation Lookaside Buffer (TLB). What is it used for ? How does it work?
- Translation from logical (virtual) to physical address. How?
- Page tables. Where are they stored? What can we do to reduce their size?
- Single Level, Multi-level paging, Inverted Page Tables (Pros and Cons)
- Copy-on-write

Virtual Memory

- Page replacement policies: FIFO, LRU, Optimal, 2nd chance, Nth chance.
  - I could give you a sequence of page accesses and ask you for counting the number of page faults, check for belady's anomaly, etc.
- Understanding Locality.
  - I could give you a program and ask you to optimize it for reducing the page faults
- Working set. Thrashing. Swapping.

CPU Scheduling

- Metrics: throughput, utilization, waiting-time, turnaround, response time

- Policies: FCFS, SJF, RR, Priorities, MLFQ, Lottery scheduling. Pros and cons.

(Source: Wikipedia)

Scheduling algorithm	CPU Utilization	Throughput	Response time
First In First Out	Low	Low	Medium
Shortest Job First	Medium	**High**	Medium
Priority based scheduling	Medium	Low	High
Round-robin scheduling	**High**	Medium	**Low**
Multilevel Queue scheduling	**High**	**High**	Medium

Some Examples?

- Third Readers Writers problem
  - No Starvation! How do you design this ?