

Operating Systems

Midterm Exam

1. (1.5 pts) Briefly explain what a system call is. Is there any hardware mechanism necessary for its implementation? Discuss how a system call differs from an API and why APIs are commonly used.

2. (1 pts) Order from lowest to highest access time the following elements of the memory hierarchy: a) cache, b) disc, c) main memory, d) registers. Propose typical sizes for each of the levels (approximate values).

3. (1 pts) In what ways can the Operating System regain control of the CPU? Briefly describe the motivation of each.

4. (1 pts) Let's write a new UNIX Shell, but instead of calling `fork()` first and then `exec()` to launch a task, we will make a small change: first call `exec()` and then `fork()`. What would the impact of this change be, if any?

5. (1.5 pts) Explain in a concise and orderly manner what the OS and hardware need to do in a context switch.

6. (1 pts) Consider a system with a **MLFQ** (*Multi-Level Feedback Queue*) scheduler with the following characteristics:

- Each second the priority of each process is boosted to the top (*boosting time* = 1seg).
- The *time allotment* (quantum length) of each of the different queues:
 - Q1 = ?
 - Q2 = 50 ms
 - Q3 = 100 ms

Being Q1 the highest priority queue, how much should its *time allotment* be so that, in practice, each process gets at least 1% of the CPU?

7. (3 pts) There are 3 jobs running in a system, each one with the following characteristics:

Job	Starting Time	Total CPU usage	I/O execution	I/O duration
A	0ms	60ms	every 15ms of CPU	10ms
B	5ms	50ms	no I/O	-
C	15ms	40ms	every 10ms of CPU	5ms

a) Draw the scheduling algorithm behavior for First-In First-Out (FIFO), Shortest First Time to Completion (STCF) and Round Robin (RR) with 10 ms of time slice. Note that STCF is preemptive and every time a process enters the ready state, the algorithm reevaluates.

b) Compute the **turnaround time** of each job in each algorithm. What is the average turnaround time of each algorithm?

c) Compute the **response time** of each job in each algorithm. What is the average response time of each algorithm?

d) What algorithm would you choose for a system with multiple users working in the Shell interactively and simultaneously? What algorithm would you choose in a supercomputing center in which several processes are running simultaneously for weather prediction? Explain your answers in detail.

