

CS323 – Midterm Preparation Exercises
Week 8
11 April 2019

Question 1: Operating system structure

Describe what happens when a timer interrupt occurs and causes a process switch. For each step make clear whether it is performed by the hardware or the software.

Question 2: Linux shell

Describe what happens in the Linux shell in terms of system calls to implement the following shell command line:

```
ls -x | grep junk > a.txt
```

Question 3: fork()

How many times does the following program print the text “Whatsup”?

```
void fork_test() {
    if (fork() != 0) {
        if (fork() != 0)
            fork();
        else
            printf("hello 1\n");
    } else {
        if(fork() != 0)
            printf("hello\n");
        else
            fork();
    }
    printf("Whatsup\n");
}
```

Question 4: Process scheduling

Describe on a timeline the order of execution of the following five processes, with arrival and execution times as shown in the table, using the following scheduling algorithms:

- 1) FCFS
- 2) SJF
- 3) RR with a time quantum of 1.

Process	Arrival time	Execution time
A	0	3
B	1	5
C	3	2
D	9	5
E	12	5

Question 5: Fragmentation

- A. Define external fragmentation and internal fragmentation, and explain what the difference is between the two.
- B. Which of the two occurs in the following memory systems: base-and-bounds, segmentation, paging, segmentation with paging.

Question 6: Synchronization

Some monkeys are trying to cross a ravine. There are monkeys on the east side of the ravine that want to cross over to the west side, and there are monkeys on the west side that want to cross over to the east side. A single rope traverses the ravine, which the monkeys can use to make the crossing in either direction.

Up to five monkeys can hang on the rope at any one time. If there are more than five, then the rope will break, and all monkeys on the rope will fall to their death. Also, if eastward-moving

monkeys encounter westward-moving monkeys on the rope, or vice versa, all monkeys on the rope will fall to their death.

- The monkeys can see what other monkeys are doing.
- Assume that monkeys are threads. The monkey threads invoke two methods `WaitUntilSafeToCross (Destination dst)` and `DoneWithCrossing (Destination dst)`, where `Destination` is either `EAST=0` or `WEST=1`.
- Write the code for these methods using Pthreads primitives, making sure that no monkeys fall to their death, and, of course, avoiding the trivial solution in which no monkey ever traverses the ravine.

Your solution must guarantee:

1. At most 5 monkeys execute `CrossRavine` simultaneously
2. All monkeys executing `CrossRavine` are heading in the same direction

Question 7: Demand paging

A computer has 4 frames. A process makes references to the following pages:

1, 2, 3, 4, 1, 5, 3, 2, 1, 2

How many page faults occur with:

- 1) FIFO
- 2) second chance
- 3) LRU?