

Information Technology University of the Punjab
SE301T Operating Systems B – Spring 2025
Quiz 1 [CLO1] – February 24, 2025

Name: _____ **Solution** _____

Roll No.: _____

Time allowed: 40 minutes

Maximum Marks: 25

1. How many processes will be created by the following code? Explain how you reached your answer. [4]

```
1  int main() {  
2      fork();  
3      int rc = fork();  
4      if (rc == 0)  
5          fork();  
6      fork();  
7  }
```

At line 2: one parent (P) and one child (C1). Total processes: 2 (P, C1)

At line 3: P and C1 both run this fork, so P creates C2, and C1 creates GC1. So, total processes: 4 (P, C1, C2, GC1)

At line 5: Only C2 and GC1 run this line and create GC2 and GGC1 respectively. Total processes: 6 (P, C1, C2, GC1, GC2, GGC1)

At line 6: This line is run by all processes created before it. So, P creates C3, C1 creates GC3, C2 creates GC4, GC1 creates GGC2, GC2 creates GGC3, and GGC1 creates GGGC1. Total processes: 12 (P, C1, C2, C3, GC1, GC2, GC3, GC4, GGC1, GGC2, GGC3, GGGC1)

2. What is meant by limited direct execution? [2]

Limited direct execution is a technique by which the OS lets user programs run directly on the CPU for efficiency. However, the programs run at a lower privilege level, which means that there are certain tasks that they cannot perform themselves and need to ask the OS (via system calls) to perform such tasks. This ensures better control, isolation and security.

3. Which two approaches did we study that allow the kernel to regain control of the CPU? [3]

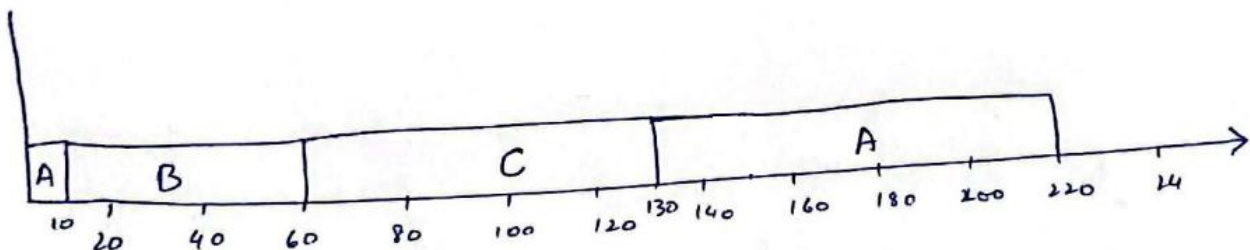
The two approaches are:

Cooperative approach: The processes themselves yield and let the kernel take control.

Non-cooperative approach: The processes are interrupted (by hardware, e.g. the CPU timer) periodically to transfer control to the OS.

4. Calculate the turnaround and response times in the case of STCF scheduling for the workload described by the following table: [4]

Job	Arrival time	Total runtime
A	0	100
B	10	50
C	20	70



$$\text{Turnaround time} = \frac{(220 - 0) + (60 - 10) + (130 - 20)}{3} = 126$$

$$\text{Response time} = \frac{(0 - 0) + (30 - 12) + (30 - 12)}{3} = 13.33$$

5. Write code that uses a pipe to send a message "Hello I am your child\n" from the child to the parent. [4]

```
int main() {
    int fd[2];
    char buffer[100];
    pipe(fd);
    int rc = fork();

    if (rc == 0) {
        // Child process
        close(fd[0]); // Close read end
        write(fd[1], "Hello, I am your child!", 23); // Write to pipe
        close(fd[1]); // Close write end
    } else {
        // Parent process
        close(fd[1]); // Close write end
        read(fd[0], buffer, sizeof(buffer)); // Read from pipe
        close(fd[0]); // Close read end
    }

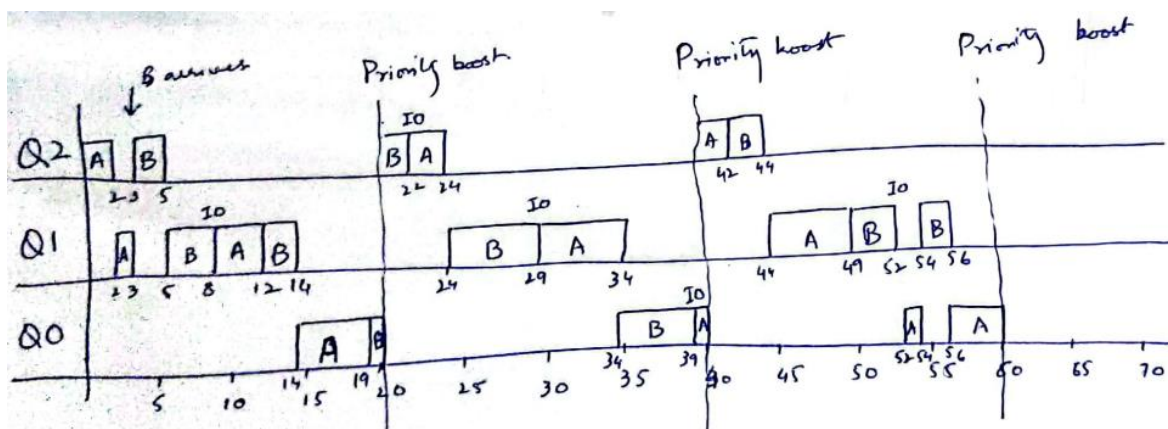
    return 0;
}
```

6. In round robin scheduling, what is the disadvantage of keeping the time slice too small? [2]

If the time slice is too small, the response time improves, but the percentage of time used by the context switch during the time slice duration is high. This is undesirable as, then, processes would get little time to execute their own instructions.

7. For the following workload, draw the timing diagram for an MLFQ scheduler that has three priority queues Q0, Q1 and Q2 with Q2 being the highest priority queue. Q1 and Q2 have allotment times of 5 ms and 2 ms respectively. Also, assume that the scheduler boosts the priorities of all processes after every 20 ms. [6]

Job	Arrival time	Total runtime	I/Os
A	0	50	Does not generate any I/O
B	3	30	2 ms I/O after every 5 ms



(Note: The timing diagram does not cover the complete runtimes of the processes, however, full marks are to be awarded to a student who has shown correct scheduling at least up till the second priority boost)