Operating Systems, Spring 2022

Homework Assignment #3

Due midnight Thursday, April 21, 2022

Instructions

1. If any question is unclear, please ask for a clarification.

2. You are required to do all the homework assignments on Linux.

3. You are required to give your TA a demo of your program.

4. For the program that you write, you are required to include a Makefile so that your TA can compile your program by issuing the command "`make clean dep all`" from a shell. Otherwise, the program part of your homework will not be graded—meaning that you will receive zero marks.

5. Unless stated otherwise, you are required to work on the homework assignment individually.

6. Neither late nor copied homework will be accepted.

Part I (50%)

1. (10%) Explain what memory-mapped I/O is and how it works.

2. (10%) Explain what DMA is and how it works.

3. Consider the following set of processes, with the length of the CPU-burst time given in milliseconds:

Process	Burst Time	Priority
P_1	8	4
P_2	1	1
P_3	2	3
P_4	1	5
P_5	6	2

The processes are assumed to have arrived in the order P_1, P_2, P_3, P_4, P_5, all at time 0.

(a) (5%) Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a non-preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling.

(b) (5%) What is the turnaround time of each process for each of the scheduling algorithms in part 3a?

    (c) (5%) What is the waiting time of each process for each of the scheduling algorithms in part 3a?

    (d) (5%) Which of the schedulers in part 3a results in the minimal waiting time (over all processes)?

4. (10%) A UNIX process has two parts—the user part and the kernel part. Is the kernel part like a subroutine and a coroutine? Why?

Part II (50%)

Write a monitor in C++ to simulate the dining philosopher problem mentioned in the textbook using the conditional variables provided by the Pthreads API. Make sure that your implementation is able to handle 5 philosophers and is free of the race condition.

Grading Policy

The grading policy for this homework assignment is as follows:

- The points for each problem in Part I are as marked.

- 50 points for Part II.

Gentle Reminder

Once again, as mentioned in the instructions, neither late nor copied homework will be accepted.