Operating Systems, Spring 2019

Homework Assignment #3

Due midnight Thursday, May 2, 2019

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

5. 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.