HW3  Problem Set

DUE DATE: Mon Feb 26 2018 11:55 PM. No late submissions accepted, since we want to share the solution. Submit PDF file using Canvas.

Problem 1 (4+4+4+8 =20 points) Specify true or false, or fill in the blank

a. Processes \{P0, P1, …, Pn-1\} are coordinating their accesses to a critical section where they make changes to common variables. It is OK for one of the processes to disregard the protocol for accessing critical sections and just directly access the critical section. □ True □ False

b. For a process, the following is a valid transition: Ready → Blocked  True __ False __

c. Threads within the same process do not share the same: □ Text segment (instructions). □ Data segment □ Stack □ Open files. (Choose one)

d. Consider the code below.

```
main(int argc, char **argv) {
    int i;
    for (i=0; i < 2; i++) {
        fork();
        printf("hello\n");
    }
}
```

   a. What will be the total number of processes? Answer: __

      (Hint complete the diagram below. Label each process with a number (just for counting. It is not necessarily the PID).

   b. How many times “hello” message will be printed? Answer: __________
Problem 2 (20 points) We had seen the exponential averaging used to predict the length of the next CPU burst. In a certain system the actual CPU burst time $t_i$ and the initial guess $\tau_i$ are given as in the table below. If the value of $\alpha$ is chosen to be 0.5, find the successive guesses.

<table>
<thead>
<tr>
<th>CPU burst time $t_i$</th>
<th>6</th>
<th>10</th>
<th>8</th>
<th>4</th>
<th>10</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guess $\tau_i$</td>
<td>12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Problem 3 (20 points) A system is running five I/O-bound tasks and one CPU-bound task. The I/O-bound tasks issue an I/O operation once for every millisecond of CPU computing and that each I/O operation takes 5 milliseconds to complete. Also assume that the context switching overhead is 0.1 millisecond (which does not count as the CPU being utilized) and that all processes are long-running tasks. Assume that each task uses a different IO device. What is the CPU utilization for a round-robin scheduler when:

1. The time quantum is 1 millisecond
2. The time quantum is 10 milliseconds

Answer:

* The time quantum is 1 millisecond:

* The time quantum is 10 milliseconds:
Problem 4 (40 points) The processes in the table below are being scheduled using FCFS, Shortest Remaining time (preemptive, no round robin) and round-robin scheduling algorithm with preemption. Obtain a Gantt chart for each case.

For the last scheduling algorithm, each process is assigned a numerical priority, with a higher number indicating a higher priority. In addition to the processes listed below, the system also has an idle task (which consumes no CPU resources and is identified as $P_{idle}$). This task has priority 0 and is scheduled whenever the system has no other available processes to run. The length of a time quantum is 10 units. If a process is preempted by a higher-priority process, the preempted process is placed at the end of the queue. (A process is not preempted by a process with the same priority, unless the time slice expires. A process cannot be preempted by a lower priority process, even if the time slice expires.

a. Show the scheduling order of the processes using a Gantt chart for each of FCFS, Shortest Remaining time (preemptive) and Robin Robin with Priority (preemptive) as specified above.

Answer the following only for Robin Robin with Priority (preemptive)

b. What is the turnaround time for each process?

c. What is the total waiting time for each process (including initial and in the Ready Queue)?

d. What is the CPU utilization rate?

### Thread Schedule

<table>
<thead>
<tr>
<th>Thread</th>
<th>Priority</th>
<th>Burst</th>
<th>Arrival</th>
</tr>
</thead>
<tbody>
<tr>
<td>$P_1$</td>
<td>40</td>
<td>20</td>
<td>0</td>
</tr>
<tr>
<td>$P_2$</td>
<td>30</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>$P_3$</td>
<td>30</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>$P_4$</td>
<td>35</td>
<td>15</td>
<td>60</td>
</tr>
</tbody>
</table>

Answer:

a) Gantt Charts
   i. FCFS
   ii. Shortest Remaining time (preemptive)
   iii. Robin Robin with Priority (preemptive)

b) Turnaround time:

c) Waiting time

d) CPU util=