CSC415 OPERATING SYSTEM PRINCIPLES

Homework 1

1. What is the difference between symmetric multiprocessing and asymmetric multiprocessing? (10 Points)

   In the symmetric multiprocessing every CPU run the same copy of the OS. In the asymmetric multiprocessing the processes and responsibilities are split and have master/slave relationship, a boss processor controls the system. It schedules and allocates tasks to work processors.

2. Why do user programs have to make system calls rather than just executing the code for the system calls themselves? (10 Points)

   System calls provide layer between the hardware and the user program/process. It also protects system from errant users.

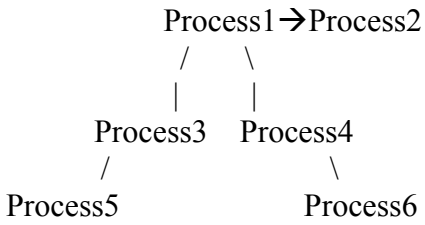
3. What are the four sections in the address space of a process? What is the Process Control Block? (10 Points)

- Text section contains program code
- Data section contains global variables
- Heap contains the memory dynamically allocated during process run time
- Process stack contains temporary data such as function parameters, local variables
  Process control block contains all the other information about the process
- Process state
- Program counter: the counter indicates the address of the next instruction to be executed
- CPU registers
- CPU scheduling information: process priority, pointers to scheduling queues, etc.
- Memory-management information: page tables, segment tables, etc.
- I/O status information: I/O devices allocated to the process, open files, etc.

4. Assuming there are no errors, how many NEW processes will the following code create? Why? (10 Points)

```
if (!fork())
        fork();
else {
        fork();
        fork();
}
```

   There will be 6 processes at the end of the code.



5. Describe the actions taken by a kernel to context-switch between processes? (10 Points)

   Switching CPU to another process requires performing a state save of the current process and a state restore of a different process

   •Context of a process is represented in the PCB
   E.g., value of CPU registers, process state, memory-management information, etc.
   •When a context switch occurs, kernel saves the context of the old process in its PCB and loads the saved context of the new process to run

6. What are the two models for Inter-Process Communication? What are their differences? (10 Points)
   Shared Memory Model:
   - The shared-memory region resides in the address space of the process crating the shared-memory segment
   - Other cooperating processes must attach it to their address space
   - Cooperating processes exchange information by reading and writing data to the shared region
   - The communication is under the control of these processes, not the OS
   - The processes must also ensure the synchronization of their actions when they access shared memory

   Message Passing Model:
- Cooperating processes use the message-passing facility provided by OS to communicate
- A message-passing facility provides two operations
  - send
  - receive
- A link must be established between two processes

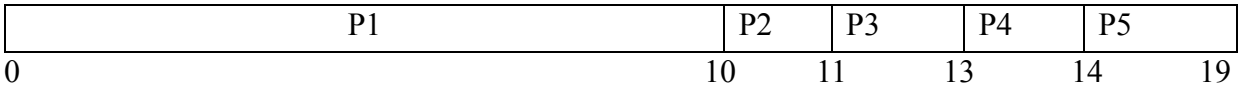
7. Consider the following set of processes, with the length of the CPU-burst time given in milliseconds: (40 Points)

Process	Burst Time	Priority
*P*1	10	3
*P*2	1	1
*P*3	2	3
*P*4	1	4
*P*5	5	2

   The processes are assumed to have arrived in the order P1, P2, P3, P4, P5, all at time 0.

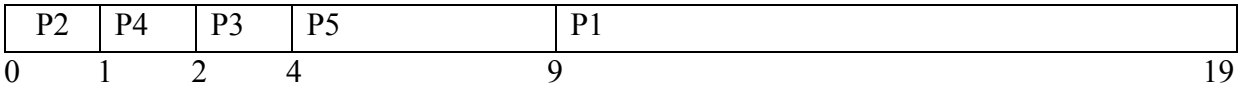
a. Draw four Gantt charts illustrating the execution of these processes using FCFS, SJF, a non-preemptive priority (a smaller priority number implies a higher priority), and RR (quantum = 1) scheduling.
b. What is the turnaround time of each process for each of the scheduling algorithms in Part a?
c. What is the waiting time of each process for each of the scheduling algorithms Part a?
d. What is the average waiting time for each of the scheduling algorithms in Part a?

FCFS



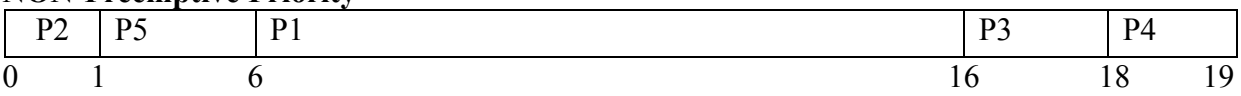
Process	Turnaround Time	Waiting Time
P1	10	0
P2	11	10
P3	13	11
P4	14	13
P5	19	14
AVG Time		9.6ms

SJF



Process	Turnaround Time	Waiting Time
P1	19	9
P2	1	0
P3	4	2
P4	2	1
P5	9	4
AVG Time		3.2ms

NON-Preemptive Priority



Process	Turnaround Time	Waiting Time
P1	16	6
P2	1	0
P3	18	16
P4	19	18
P5	6	1
AVG Time		8.2ms

RR

P1	**P2**	**P3**	**P4**	**P5**	**P1**	**P3**	**P5**	**P1**	**P5**	**P1**	**P5**	**P1**	**P5**	**P1**	**P1**	**P1**	**P1**	**P1**

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

Process	Turnaround Time	Waiting Time
P1	19	9
P2	2	1
P3	7	5
P4	4	3
P5	14	9
AVG Time		5.4ms