ORDRE DES INGÉNIEURS DU QUÉBEC

NOVEMBER 2017

All documentation allowed
Calculators: Authorized models only
Exam duration: 3 hours

14-IF-A5 Operating systems

QUESTION 1 [20 points]

Concepts of operating systems

(a) [4 points]

What is an operation system?

(b) [6 points]

What is a Kernel and what are its main functions?

(c) [4 points]

What is an interrupt?

(d) [6 points]

Name and describe different types of memory.

QUESTION 2 [20 points]

Processes, threads and synchronisation

(a) [4 points]

Consider the following code:

```
for (i=0 ; fork() ; i++) {
    if (i==5) {break ;}
    printf(''PID : %d, i = %d\n'', getpid(), i) ;
}
```

Suppose that the initial process ID is 1234 and the PID always increments by 1 when a new process is created. Suppose that no new other processes are created during the lifespan of the process.

(i) What are the possible outputs of this program?
(ii) During the lifespan of the process, how many times is the function fork() called ?

(b) [2 points]

What is busy waiting?

(c) [4 points]

What is a context and a context switching?

(d) [4 points]

What is a critical section? Give a simple example.

(e) [6 points]

List 6 of the attributes that an operating system maintains to keep track of information about a process.

QUESTION 3 [20 points]

Scheduler

(a) [6 points]

Describe the following scheduling types: short term, medium term and long term scheduling.

(b) [4 points]

What are turnaround time and response time?

(c) [10 points]

Consider the following processes:

Process	Starting time (ms)	Duration(ms)
A	0	22
B	6	14
C	10	4
D	20	6
E	24	12

For each of the following scheduling algorithms, you have to:

1. Draw the Gantt chart
2. Calculate the average waiting time

(i) Shortest job first, no preemption
(ii) Shortest job first, with preemption
(iii) Round-Robin scheduler with a quantum of 8 ms. A new process is inserted at the beginning of the queue (a new process will be executed before processes already in queue)

QUESTION 4 [20 points]

Deadlock

(a) [2 points]

When is a system in a safe state?

(b) [10 points]

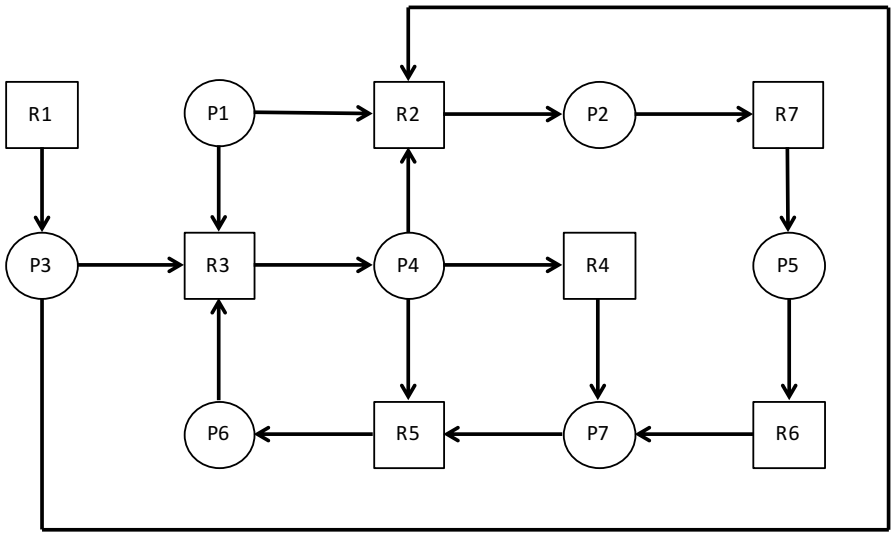
Consider the following situation:

	Allocation			Need			Available		
	A	B	C	A	B	C	A	B	C
P1	1	1	1	2	5	1	3	2	4
P2	1	3	1	4	3	1			
P3	4	2	0	0	9	8			
P4	4	2	2	2	1	4			
P5	0	1	0	2	3	8			

Use the banker algorithm to check if the system is in a safe state and specify the safe execution sequence if one exists.

(b) [8 points]

Consider the following resource-allocation graph. Assume that there is only one instance of each resource.



i) Give resources held by each process in the system.
ii) Is the system deadlocked? If yes, which processes are involved?
iii) Draw the wait-for graph corresponding to the allocation-graph.

QUESTION 5 [20 points]

Memory management

(a) [8 points]

Describe four memory allocation algorithms.

(b) [4 points]

What are temporal locality and spatial locality?

(c) [4 points]

Give some pros and cons for increasing the page size.

(d) [4 points]

Define both internal and external fragmentation.