

**MASSEY UNIVERSITY
ALBANY CAMPUS**

**EXAMINATION FOR
159.335 Operating Systems and
Concurrent Programming**

Semester One - June 2007

Time allowed: **THREE (3)** hours

Attempt **ALL SEVEN (7)** questions.

This examination contributes 70% to the final assessment.

Questions are of equal value

Calculators are permitted - no restrictions

1. (a) What is a Device Driver? *[2 marks]*
- (b) What two modes of operation does a CPU require to support a modern operating system? How is the mode changed? *[3 marks]*
- (c) Name three hardware devices that may generate interrupts. *[3 marks]*
- (d) What is the difference between logical memory and physical memory? *[2 marks]*
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2. (a) What is busy waiting and why should it be avoided? *[2 marks]*
- (b) Consider the following C code written for a UNIX OS:
- ```
for(int i=0;i<4;i++) {
 int j=fork();
 if(j==0)
 printf("X");
 fflush(stdout);
}
```
- i) Draw a process tree to illustrate the execution of this code.  
ii) How many Xs will be printed? *[3 marks]*
- (c) When does a process move from the running state to the ready state? *[2 marks]*
- (d) Briefly explain the role of the operating system loader in booting an OS. *[2 marks]*
- (e) What does the return value from the UNIX fork system call signify? *[1 mark]*

3. (a) The following processes are to be scheduled

| <i>Process</i> | <i>Arrival Time(ms)</i> | <i>Burst Time(ms)</i> |
|----------------|-------------------------|-----------------------|
| P <sub>0</sub> | 0                       | 20                    |
| P <sub>1</sub> | 10                      | 5                     |
| P <sub>2</sub> | 20                      | 10                    |
| P <sub>3</sub> | 20                      | 5                     |

Draw scheduling diagrams and calculate the average waiting time and response time for these processes when using the following algorithms.

- (i) FCFS
- (ii) SJF
- (iii) SRTF
- (iv) RR with  $q=10$

Comment on your results.

**[6 marks]**

(b) What is starvation and which scheduling algorithms may suffer from it?  
How is the problem of starvation usually solved?

**[4 marks]**

4. (a) A sushi restaurant employs three people to make sushi, they share 1 chopping board, 2 knives and 1 rolling mat.

Person 1 needs to use 1 knife, and 1 rolling mat.

Person 2 needs to use 1 knife, and 1 chopping board.

Person 3 needs to use 1 knife, 1 rolling mat and 1 chopping board.

At a certain point in time:

Person 1 is using 1 rolling mat.

Person 2 is not using anything.

Person 3 is using 1 knife and 1 chopping board.

- i) Draw a resource allocation graph to illustrate the state of the system. (show future claims as dashed lines)
- ii) Draw a table to illustrate maximum, used, needed, and available resources in the system.
- iii) Use the bankers algorithm to find out if this system is in a safe state.
- iv) If it is in a safe state, give a safe sequence, if not, identify the resources involved in the resulting deadlock.

*[6 marks]*

- (b) What could happen if a semaphore that is used for mutual exclusion is initialised to two instead of one?

*[2 marks]*

- (c) What is the main disadvantage of using spinlocks to protect critical sections?

*[2 marks]*

5. (a) Consider a critical section protected by the following:

```
wait (mutex);
... Critical section
signal (mutex);
```

What could happen if the wait and signal calls are accidentally swapped.

*[2 marks]*

- (b) What is the 'load' of a system, how is it calculated?

*[2 marks]*

- (c) What is multilevel feedback queue scheduling?

*[2 marks]*

- (d) What is a monitor and what limitations of semaphores are they designed to remove?

How is IPC performed when using monitors?

*[4 marks]*

6. (a) Briefly explain the difference between static and dynamic linking.

*[2 marks]*

- (b) What is the difference between internal and external fragmentation?

*[2 marks]*

- (c) The following sequence of requests for pages is made:

3,2,1,4,1,2,3,1,5,4,2,1,3

If there are three frames, how many page faults occur when using the following page replacement algorithms?

- i) First In First Out.
- ii) Least Recently Used.
- iii) Optimal.

*[3 marks]*

- (d) A system with two level paging and a Translation Lookaside Buffer (TLB) has an effective access time of 100ns, if the memory access time is 90ns and the TLB access time is 5ns, what is the TLB hit rate?

*[3 marks]*

7. (a) Draw a diagram to show how 5 disks can be used as a RAID 5 array. Raid 5 is inefficient if disk access involves many random writes, why is this? *[4 marks]*
- (b) A file system uses the UNIX method of combined indexing. It has a block size of 8KB and block numbers are 32 bits. An inode contains 12 direct blocks, one single indirect block and one double indirect block.
- i) How many blocks (including index blocks) would a 400MB file use? *[2 marks]*
- ii) What is the maximum possible size for a file? *[2 marks]*
- (c) What is a logging filesystem? What is logged? *[2 marks]*

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