

**MASSEY UNIVERSITY  
ALBANY CAMPUS**

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

**Semester One – June 2008**

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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 Process Management? *[2 marks]*
- (b) Briefly describe how an Operating System can make use of a quad core CPU. *[3 marks]*
- (c) Give three reasons for using concurrent programming. *[3 marks]*
- (d) Briefly describe the sequence of events that occurs after a mouse button is pressed generating an interrupt? *[2 marks]*

2. (a) What is a spinlock? *[3 marks]*
- (b) What could the following code print when run under a UNIX OS?

```
for (i=0; i<2; i++) {  
    j=fork()  
    if (j==0)  
        printf ("%x", i);  
    fflush (stdout);  
}
```

Would the output always be the same, why?

*[4 marks]*

- (c) A process has 4 threads and a semaphore used as a mutex by the threads is initialised to 1. The mutex protects a single critical section. At some point during the execution of the process, the semaphore has a value of 0. What is happening in this process? *[3 marks]*

3. (a) Draw a diagram to illustrate the expected distribution of burst times for a typical set of processes.

[2 marks]

(b) The following processes are to be scheduled

<i>Process</i>	<i>Arrival Time(ms)</i>	<i>Burst Time(ms)</i>
P <sub>1</sub>	0	20
P <sub>2</sub>	10	15
P <sub>3</sub>	20	10
P <sub>4</sub>	40	10

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]

(c) Describe an algorithm that would give the worst possible average waiting time.

[2 marks]

4. (a) Give entry and exit code that could be used to protect a critical section using the **testandset** instruction.

[3 marks]

(b) What will happen if a semaphore that is used for IPC is initialised to one instead of zero?

[2 marks]

(c) What is "busy waiting" and why should it be avoided?

[2 marks]

(d) What is a monitor and what are condition variables?

[3 marks]

5. Four teams of builders are working on a construction project and sharing tools (5 saws and 4 drills).

Team 1 needs to use 2 saws and 2 drills.

Team 2 needs to use 3 saws and 2 drills.

Team 3 needs to use 4 saws and 4 drills.

Team 4 needs to use 4 saws and 1 drill.

At a certain point in time

Team 1 is using 1 drill.

Team 2 is using 1 saw.

Team 3 is using 2 saws and 1 drill.

Team 4 is using 1 drill.

(a) Draw a Resource Allocation Graph for this system.

*[ 2 marks]*

(b) Is this system in a safe state? Prove using the bankers algorithm.

*[ 4 marks]*

(c) If the system is safe, give a safe sequence.

If it is not safe, which teams will be involved in the deadlock?

*[2 marks]*

(d) Describe how deadlock prevention could be used in this situation.

*[2 marks]*

6. (a) Briefly describe how the buddy system may be used for memory allocation.

*[3 marks]*

- (b) The following sequence of requests for pages is made,

0,1,4,1,0,3,4,2,0,1,4

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]*

- (c) What are the advantages and disadvantages of dynamic linking at execution time over dynamic linking at load time?

*[2 marks]*

- (d) Draw a diagram to show a Memory Management Unit with two level paging and a **translation lookaside buffer**.

*[2 marks]*

7. (a) A machine uses 4 disks in a RAID 5 array. Each disk holds 500GB and can transfer data at 100MB/s. What is the capacity of the array and its peak read performance? *[2 marks]*
- (b) Describe a workload for which a RAID 5 array will perform badly. *[2 marks]*
- (c) A file system uses the UNIX method of combined indexing. It has a block size of 4KB 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 40MB file use? *[2 marks]*
- ii) What is the maximum possible size for a file? *[2 marks]*
- (d) How does a logging filesystem allow a machine to restart faster after a power outage? *[2 marks]*

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