

**MASSEY UNIVERSITY
ALBANY CAMPUS**

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

Semester One - June 2006

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) How and when is a CPU switched from user mode into supervisor mode? *[2 marks]*
- (b) Briefly describe how an Operating System can make use of a dual core CPU. *[2 marks]*
- (c) What are the main differences between a monolithic operating system and a microkernel operating system? *[3 marks]*
- (d) Name four hardware devices that may cause interrupts. *[2 marks]*
- (e) Give an instruction that is not allowed in user mode. *[1 mark]*
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2. (a) What is busy waiting and why should it be avoided? *[2 marks]*
- (b) How many Xs would the following code print when run under a UNIX OS?
- ```
for (i=0;i<3;i++) {
 j=fork()
 if(j==0)
 printf("X");
}
```
- [3 marks]*
- (c) Briefly explain the difference between a process and a thread. *[2 marks]*
- (d) Give three reasons for using concurrent programming. *[3 marks]*

3. (a) The EXT3 file system is a logging file system, explain what this means?

[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>0</sub> | 0                       | 10                    |
| P <sub>1</sub> | 5                       | 15                    |
| P <sub>2</sub> | 10                      | 20                    |
| P <sub>3</sub> | 20                      | 20                    |

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) What is the 'load' of a system, how is it calculated and what can it be used for?

[2 marks]

4. (a) A system has 3 resource types, A, B and C. There are 5 instances of A, 2 instances of B and 2 instances of C. At a certain point in time, the resources are being used as follows:

| Process        | Allocation |   |   | Maximum |   |   |
|----------------|------------|---|---|---------|---|---|
|                | A          | B | C | A       | B | C |
| p <sub>1</sub> | 0          | 0 | 1 | 1       | 0 | 2 |
| p <sub>2</sub> | 1          | 1 | 0 | 1       | 2 | 1 |
| p <sub>3</sub> | 2          | 1 | 0 | 3       | 1 | 2 |

Use the bankers algorithm to show if this system is in a safe state or not. If it is in a safe state, give a safe sequence. If it is unsafe, identify the resource types that would be involved in the resulting deadlock.

*[3 marks]*

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

*[2 marks]*

- (c) Briefly describe how monitors are implemented in Java.

*[3 marks]*

- (d) What is a race condition?

*[2 marks]*

5. (a) Briefly describe the Readers-Writers problem and give a pseudocode solution to this problem.

*[6 marks]*

- (b) Briefly describe how the bankers algorithm can be used for deadlock detection.

*[3 marks]*

- (c) How do most commercial operating systems handle deadlock?

*[1 mark]*

6. (a) The following sequence of requests for pages is made,

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

If there are four 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]*

- (b) What is Belady's anomaly?

*[2 marks]*

- (c) Explain the purpose of the 'modified' bit in a page table entry.

*[2 marks]*

- (d) A system with two level paging and a Translation Lookaside Buffer (TLB) has an effective access time of 120ns, if the memory access time is 80ns and the TLB access time is 20ns, what is the TLB hit rate?

*[3 marks]*

7. (a) RAID level 5 suffers from bad performance for random writes, explain why?

*[2 marks]*

- (b) 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 11 direct blocks, one single indirect block and one double indirect block.

- i) How many blocks (including index blocks) would a 4MB file use?

*[2 marks]*

- ii) What is the maximum possible size for a file?

*[2 marks]*

- (c) Briefly describe how malloc allocates memory, assume that the OS can only allocate memory in 4K pages.

*[4 marks]*

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