

**MASSEY UNIVERSITY  
ALBANY CAMPUS**

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

**Semester Two - November 2006**

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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 why and how user processes are prevented from executing certain machine instructions. *[3 marks]*
- (c) Give three reasons for using concurrent programming. *[3 marks]*
- (d) Briefly describe the sequence of events that occurs after the mouse is moved causing an interrupt. *[2 marks]*
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2. (a) What is the difference between a buffer and a cache? *[2 marks]*
- (b) Consider the following C code written for a UNIX OS:
- ```
for (i=0; i<4; i++) {  
    j=fork ();  
    if (j!=0)  
        printf ("%d", i);  
}
```
- i) How many characters will be printed?  
ii) How many threes will be printed? *[3 marks]*
- (c) When does a process enter the wait queue? *[1 mark]*
- (d) When does a process enter the ready queue? *[2 marks]*
- (e) Briefly explain how a timer is used to keep the operating system in control. *[2 marks]*

3. (a) Draw a diagram to illustrate a typical distribution of process burst times. Give an example of a process that may have very large burst times.

[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                       | 25                    |
| P <sub>1</sub> | 10                      | 5                     |
| P <sub>2</sub> | 10                      | 10                    |
| P <sub>3</sub> | 20                      | 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) Why is average waiting time a better measure of scheduler performance than average turnaround time?

[2 marks]

4. (a) A construction project employs three teams of workers, the teams share 2 diggers, 5 shovels and 2 cement mixers.

Team 1 needs to use 2 diggers, 3 shovels and 2 cement mixers.

Team 2 needs to use 1 digger, 3 shovels and 1 cement mixer.

Team 3 needs to use 1 digger, 2 shovels and 1 cement mixer.

At a certain point in time:

Team 1 is using 1 digger and 2 shovels.

Team 2 is using 1 shovel and 1 cement mixer.

Team 3 is using 1 digger and 1 cement mixer.

- i) Draw a table showing the allocated and needed resources at this point in time.
- ii) What resources are available?
- 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 will happen if a semaphore that is used for IPC is initialised to one instead of zero?

*[2 marks]*

- (c) Show how the 'testandset' instruction can be used to protect a critical section.

*[2 marks]*

5. (a) The following is the reader code for a solution to the readers/writers problem.

```
wait(mutex);
readcount = readcount + 1;
if (readcount == 1) wait(norw);
signal(mutex);
...
reading is performed
...
wait(mutex);
readcount = readcount - 1;
if (readcount == 0) signal(norw);
signal(mutex);
```

- i) How are the semaphores norw and mutex initialised?

*[1 mark]*

- ii) Give the code for the writer.

*[1 mark]*

- iii) Briefly explain how this solution works.

*[3 marks]*

- iv) Three processes perform reading and writing as follows:

Process 1 wants to read for 30ms starting at time  $t=0$   
Process 2 wants to write for 25ms starting at time  $t=10$   
Process 3 wants to read for 15ms starting at time  $t=20$   
Process 1 wants to read for 20ms starting at time  $t=40$

Draw a diagram to show what each process does over time.

*[3 marks]*

- (b) Draw a resource allocation graph to illustrate deadlock in the dining philosophers problem with five philosophers.

*[2 marks]*

6. (a) What is a page table entry? Explain the purpose of two of the bits that are stored in a page table entry along with the frame number. *[4 marks]*
- (b) Draw a diagram to illustrate a two level paging scheme. *[2 marks]*
- (c) What is a Translation Lookaside buffer (TLB)? Redraw your diagram from part b to include a TLB. *[2 marks]*
- (d) What is thrashing? *[2 marks]*
7. (a) Draw a diagram to show how 4 disks can be used as a RAID 5 array. *[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 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]*
- (c) Briefly describe one method for managing free space in a filesystem. *[2 marks]*
- (d) How does a logging filesystem allow a machine to restart faster after a power outage? *[2 marks]*

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