MASSEY UNIVERSITY
ALBANY CAMPUS

EXAMINATION FOR
159.335 Operating Systems and Concurrent Programming

Semester Two - November 2005

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) Draw a diagram to illustrate the overall structure of a monolithic Operating System.

[3 marks]

(b) What is Symmetric Multiprocessing (SMP)?

[2 marks]

(c) What is a Device Driver?

[3 marks]

(d) Why does an interrupt usually cause the CPU to be put into supervisor mode?

[2 marks]

2. (a) What mechanism can threads use for communication that is not always available to processes?

[2 marks]

(b) What could the following code print when run under a UNIX OS?

```
for(i=0;i<3;i++) {
  printf("%d %d\n",i,fork());
}
```

Assume the PID of this process is 100.

[3 marks]

(c) Draw a diagram to illustrate how the state of a process changes throughout its lifetime.

[2 marks]

(d) A process has 5 threads and a semaphore used by the threads is initialised to 0. At some point during the execution of the process, the semaphore has a value of -5. What does this imply about the state of the process?

[3 marks]

3. (a) What is the "Burst Time" for a process?

[2 marks]

(b) The following processes are to be scheduled

Process	*Arrival Time(ms)*	*Burst Time(ms)*
P_0	0	20
P_1	10	15
P_2	20	10
P_3	30	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) What is starvation? Give a scheduling algorithm that could suffer from starvation.

[2 marks]

4. (a) Briefly describe Peterson's algorithm for mutual exclusion.

[3 marks]

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

[2 marks]

(c) Why are semaphores better than simple "Sleep" and "Wakeup" system calls for performing IPC.

[2 marks]

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

[3 marks]

5. (a) A Restaurant has four frying pans, two woks and three saucepans. Four chefs are cooking.

Chef 1 needs to use two frying pans, two woks and two saucepans.
Chef 2 needs to use two frying pans and one wok.
Chef 3 needs to use two frying pans and two saucepans.
Chef 4 needs to use three frying pans, two woks and two saucepans.

At a certain point in time
Chef 1 is using a frying pan and a saucepan.
Chef 2 is using a frying pan.
Chef 3 is using a saucepan.
Chef 4 is using a frying pan and a wok.

i) Draw a Resource Allocation Graph for this system.

[2 marks]

ii) Is this system in a safe state? Prove using the safety algorithm.

[3 marks]

iii) One of the saucepans is broken and cannot be used. Is the system in a safe state? Prove.

[2 marks]

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

[3 marks]

6. (a) What is a page fault? What does an operating system usually do when a page fault occurs.

[2 marks]

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

1,3,2,4,1,6,3,1,2,4,2,1,3

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]

(c) Draw diagram to illustrate how CPU utilisation changes as the degree of multiprogramming increases. Where does thrashing occur on the diagram?

[2 marks]

(d) Draw a diagram to show a Memory Management Unit with two level paging and a Translation Lookaside Buffer?

[3 marks]

7. (a) Briefly describe the differences between RAID levels 0,1 and 5.

[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 11 direct blocks, one single indirect block and one double indirect block.

i) How many blocks (including index blocks) would a 2MB file use?

[2 marks]

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

[2 marks]

(c) What is a Logging File System?

[2 marks]

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