Massey University
ALBANY CAMPUS

EXAMINATION FOR 159.335
OPERATING SYSTEMS AND CONCURRENT PROGRAMMING
Semester One − 2001

Time Allowed: THREE (3) Hours

INSTRUCTIONS

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

This final examination contributes 70% to the final assessment.
Calculators are permitted.

Turn over to pg.2 ...

1. (a) What is a file system?

[2 marks]

(b) Why do most CPUs have two modes of operation, user mode and supervisor mode? When is the mode changed?

[3 marks]

(c) Briefly explain the difference between a thread and a process.

[2 marks]

(d) Briefly explain how an Operating System boots from a hard disk.

[3 marks]

2. (a) Explain how interrupts are used with a buffer to handle keyboard input.

[3 marks]

(b) What is Inter Process Communication (IPC)?

[2 marks]

(c) Draw a diagram to illustrate the life cycle of a typical process.

[2 marks]

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

[3 marks]

Turn over to pg. 3 ...

3. (a) What is the bounded buffer problem?

[2 marks]

(c) What is a pipe? Briefly describe the popen system call.

[3 marks]

(d) The following processes are to be scheduled

Process	Arrival Time(ms)	Burst Time(ms)
P_1	5	5
P_2	6	3
P_3	10	1

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

(i) FCFS
(ii) SJF
(iii) SRTF

Comment on these results.

[5 marks]

Turn over to pg. 4 ...

4. (a) Why is it possible for a program which has been thoroughly tested to still contain a race condition?

[2 marks]

(b) Describe the testandset instruction and show how it can be used to protect a critical section within an operation system.

[3 marks]

(c) The following is an attempted solution to the Readers/Writers problem

```
semaphore writemutex=1, readmutex=1;


Write() {
  wait(writemutex);
    perform writing
  signal(writemutex);
}

Read() {
  wait(readmutex);
  wait(writemutex);
     perform reading
  signal(writemutex);
  signal(readmutex);
}
```

(i) Is mutual exclusion of Readers and Writers provided by this solution.

[1 mark]

(ii) Explain why this solution is not satisfactory.

[2 marks]

(iii) Comment on the use of the writemutex semaphore

[2 marks]

Turn over to pg. 5...

5. (a) A network application is allowed a maximum of 5 simultaneously open incoming connections and a maximum of 2 simultaneously open outgoing connections. The application has 3 threads.
Thread 1 uses up to 4 incoming connections and 1 outgoing connection.
Thread 2 uses up to 2 incoming connections and 2 outgoing connections.
Thread 3 uses up to 2 incoming connections and 1 outgoing connection.

At a certain point in time
Thread 1 is using 1 incoming connection and 1 outgoing connection.
Thread 2 is using 2 incoming connections and no outgoing connections.
Thread 3 is using 1 incoming connection and 1 outgoing connection.

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) Thread 1 stops using its incoming connection; is the system in a safe state? Prove using the safety algorithm.

[3 marks]

(b) Briefly describe the difference between deadlock prevention and deadlock avoidance.

[2 marks]

6. (a) A machine uses two level paging; it has a main memory access time of 10ns and a TLB with an access time of 2ns. What TLB hit rate is needed to give an effective memory access time of 14ns.

[3 marks]

(b) Briefly describe all the control bits stored in a page table entry.

[3 marks]

(c) A file system uses 4K blocks and the unix method of combined indexing. The first 11 entries in an i−node are directly accessed, the 12^{th} is a single indirect block and the 13^{th} is a double indirect block.

(i) Explain how a 98K file is stored in this file system.

[2 marks]

(ii) What is the maximum size of a file using this system? State any assumptions you make.

[2 marks]

Turn over to pg. 6...

7. Give brief definitions of the following terms.

(a) Working Set
(b) Logging Filesystem
(c) Copy on Write
(d) Dynamic Linking
(e) Semaphore

[10 marks]

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