Venue _____

Student Number |__|__|__|__|__|__|__|__|

Family Name _____

First Name _____

End of Semester 1, 2017
COMP2006 Operating Systems

Curtin University

Department of Computing

EXAMINATION

End of Semester 1, 2017

COMP2006 Operating Systems

This paper is for Bentley Campus, Miri Sarawak Campus and Sri Lanka Inst Info Tech students

This is a CLOSED BOOK examination

Examination paper IS NOT to be released to student

Examination Duration 2 hours

Reading Time 10 minutes

Notes in the margins of exam paper may be written by Students during reading time

Total Marks 100

Supplied by the University

none

Supplied by the Student

Materials

none

Calculator

No calculators are permitted in this exam

Instructions to Students

This paper consists of four (4) questions with the following breakdown of marks:

Question One: 20 marks

Question Two: 42 marks

Question Three: 25 marks

Question Four: 13 marks

For Examiner Use Only

Q	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
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17	
18	

Total _____

Examination Cover Sheet

QUESTION ONE (total: 20 marks): Deadlock

a) **(2 marks).** Describe the use of a wait-for-graph.

Answer:

b) **(Total: 8 marks).** Consider the following three processes: P1, P2 and P3, and two semaphores: mutex1 and mutex2. Assume mutex1 and mutex2 are initialized to 1.

P1:	**P2:**	**P3:**
wait (mutex1)	wait (mutex2)	wait (mutex1)
wait (mutex2)	wait (mutex1)	wait (mutex2)
signal (mutex1)	signal (mutex1)	signal (mutex2)
signal (mutex2)	signal (mutex2)	signal (mutex1)

(i) **(4 marks).** Describe a situation when there is a deadlock. List what processes are in this deadlock.

(ii) **(4 marks).** If only processes P1 and P3 existed, would there be a deadlock? Why or why not?

Answer:

(i)

(ii)

c) **(Total: 10 marks).** Consider banker's algorithm and the following snapshot of a system:

Maximum				
	A	B	C	D
P_0	3	2	1	3
P_1	0	2	6	2
P_2	5	1	0	5
P_3	1	5	3	0
P_4	7	0	3	3

Allocation				
	A	B	C	D
P_0	1	0	1	1
P_1	0	1	2	1
P_2	4	0	0	3
P_3	1	2	1	0
P_4	1	0	3	0

(i) **(6 marks).** Show that the system in a safe state, if the system ***initially*** (**not at the snapshot**) has the following available instances of each resource.

Available			
A	B	C	D
8	5	9	7

(ii) **(4 marks).** Can a request of one instance of A by Process P_0 be granted safely according to Banker's algorithm? Justify your answer.

Answer:

(i) System safe.

(ii)

END OF QUESTION ONE

QUESTION TWO (total: 42 marks): Memory Management

a) **(6 marks).** Explain each of the following terms:

- Virtual Address
- Thrashing
- TLB

Answer:

- Virtual Address:

- Thrashing:

- TLB:

b) **(6 marks).** One motivation for page-based memory management is the concern about memory fragmentation. What is the "fragmentation" problem in this context? Why does it occur? Does it solve an external or internal fragmentation?

Answer:

c) **(4 marks).** Describe one main advantage and one main disadvantage of using an Inverted Page Table as compared to a page table.

Answer:

d) **(Total: 8 marks)**. While virtual memory systems allow processes to execute with only part of their address space in memory at a given time, it creates the possibility of a page fault.

(i) **(2 marks)**. What is a page fault?

(ii) **(6 marks).** What are the 6 (six) main steps involved in servicing a page fault, i.e., after page fault is detected?

Answer:

(i)

(ii) 6 (six) steps:

e) **(Total: 6 marks)**. Suppose you have a virtual memory system where addresses are 22 bits and the page size is 4096 (i.e. 2^{12}) bytes.

(i) **(4 marks)**. How many bits of a virtual address are used to determine the virtual page number and how many bits are used to determine the offset?

(ii) **(2 marks)**. How many elements would a page table need to have?

Answer:

(i)

(ii)

f) **(6 marks).** Consider an OS that supports a paged virtual memory. Assume each page has 2000 bytes, and the paging device is a disk that rotates at 6000 RPM and transfers 1 million bytes per second. What is the average time (in millisecond) to transfer 1 page from memory to the disk?

Answer:

g) **(Total: 6 marks).** Consider a reference string 1, 2, 3, 4, 2, 5, 7, 2, 3, 2, 1, 7, 8.

(i) **(3 marks).** How many page faults would there be using FIFO replacement and 4 page frames?

(ii) **(3 marks).** How many faults with LRU and 4 page frames?

Answer:

(i)

(ii)

END OF QUESTION TWO

QUESTION THREE (total: 25 marks): File, I/O, and disk

a) **(3 marks).** One file system design decision is to choose between "structured" or "unstructured" files. Explain what is meant by each of these terms. Which approach is used in the Linux file system?

Answer:

b) **(5 marks).** A file system has a total of 2 million blocks of size 4KB, 500.000 of which are not used, and each block number is stored using 32 bits. Which method (to store the free list) requires less amount of storage: a bit map method or a link list? Assume each node pointer in the link list uses 32 bits.

Answer:

c) **(4 marks).** How many disk accesses are necessary for direct access to byte 20680 using linked allocation and assuming each disk block is 4 KB in size? Show your computation to get partial marks. **Note: 4 KB = 4096 bytes.**
Answer:

d) **(Total: 6 marks).** Disk Scheduling

Disk requests come into the disk driver for cylinders 10, 22, 20, 2, 40, 6, and 38, in that order. Assume that the disk has 100 cylinders.

A seek takes 5 msec per cylinder moved. Compute the average seek time for the request sequence given above for

(i) **(3 marks).** First-come, First-served.

(ii) **(3 marks).** Shortest Seek Time First (SSTF).

In both cases, the arm is initially at cylinder 20.

Answer:

(i) First-come, First-served.

(ii) SSTF

e) **(Total: 7 marks).** Consider a system with 8 disks and the following RAID options:

- RAID 0
- RAID 1
- RAID 5

(i) **(3 marks).** For each level, how much usable storage does the system receive?

(ii) **(4 marks).** Which levels improve reliability? Describe why each of your selected level improves reliability.

Answer:

(i) RAID 0:

RAID 1:

RAID 5:

(ii)

END OF QUESTION THREE

QUESTION FOUR (total: 13 marks): Protection and Security

a) **(5 marks).** Explain the difference between policy and mechanism in a context of system protection. Give an example of each.

Answer:

b) **(4 marks).** What is the *confinement* problem? Can the problem be prevented? Justify your answer.

Answer:

c) **(4 marks).** What are the four levels of security measures that are necessary for system protection?

Answer:

END OF EXAMINATION PAPER