Venue _____

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

Family Name _____

First Name _____

End of Semester 1, 2019
COMP2006 Operating Systems

Curtin University

School of Electrical Engineering, Computing and Mathematical Sciences

EXAMINATION

End of Semester 1, 2019

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

Students may write notes in the margins of the exam paper 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

ATTEMPT ALL QUESTIONS IN THE SPACE PROVIDED

For Examiner Use Only

Q	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	

Total _____

Examination Cover Sheet

QUESTION ONE (total: 20 marks): Deadlock

a) **(4 marks).** The three overall strategies in handling deadlocks are (i) Ensure the system will never enter a deadlock state, (ii) Allow deadlocks, but device schemes to recover from them, and (iii) Pretend deadlock does not happen. Among the three strategies, which one requires the least overhead? Which one uses the most overhead? Explain your answers.

Answer:

b) **(3 marks).** Is the following statement **true** or **false**? Justify your answer.

Deadlocks can always be detected by finding a cycle in a resource allocation graph.

Answer:

c) **(4 marks).** Discuss two main factors to decide when to invoke a deadlock detection algorithm.

Answer:

d) **(Total: 9 marks).** Consider the following snapshot of a system that contains five processes {P0, P1, P2, P3, P4} and four types of resources {A, B, C, D}. The information about the system's total available resources, the maximum demand of each process, and the current allocation of resources are as shown.

Available			
A	B	C	D
8	5	9	7

Maximum Demand				
	A	B	C	D
P0	3	2	1	4
P1	0	2	5	2
P2	5	1	0	5
P3	1	5	3	0
P4	3	0	3	3

Current Allocation				
	A	B	C	D
P0	1	0	1	1
P1	0	1	2	1
P2	4	0	0	3
P3	1	2	1	0
P4	1	0	3	0

Answer the following questions using the banker's algorithm:

(i) **(2 marks).** Calculate the *Need* matrix.

(ii) **(3 marks).** Is the system in a safe state? If so, show its safe sequence. Otherwise state which processes are in deadlock.

(iii) **(4 marks).** Can a request of **one** instance of resource A by Process P0 be granted according to the banker's algorithm? Show the details for the decision.

Answer:

(i) Need matrix

	Needs			
	A	B	C	D
P0				
P1				
P2				
P3				
P4				

(ii) Is the system safe?

(iii) Process P0 requests for one instance of resource A:

END OF QUESTION ONE

QUESTION TWO (total: 41 marks): Memory Management

a) **(6 marks).** Describe the difference between a *logical* address and a *physical* address. Describe one way to convert / map a logical address into a physical address.

Answer:

b) **(6 marks).** Explain the differences between *compile time*, *load time*, and *execution time* bindings in terms of what happens in each binding when a process needs to be reloaded.

Answer:

c) **(6 marks).** Describe **compaction** and **paging**, two possible solutions to the external fragmentation problem. For each solution, state its main disadvantage.

Answer:

Compaction:

Paging:

d) **(Total: 4 marks).** A computer provides users with virtual addresses of 2^{32} bytes, and page size of 4096 bytes. The total physical memory is 2^{18} bytes.

(i) **(2 marks).** How many frames are there in the system?

(ii) **(2 marks).** How many pages are there in the system?

Note: $4096 = 2^{12}$

Answer:

(i)

(ii)

e) **(Total: 9 marks).** Consider a paging system where the page table is stored in cache memory. The hit ratio is 90% (meaning that the page table entry will be found in cache 90% of the time). Assume the normal memory access time is 100 nanoseconds.

(i) **(3 marks).** If checking the entry in the cache takes 10 nanoseconds, what is the effective (average) paged memory access time?

(ii) **(3 marks).** If swap-in and swap-out time each requires 20 milliseconds, and on average, 50% of the pages are dirty (e.g. modified, requiring both swap-in and swap-out), what is the effective page fault service time? You can ignore all processing times other than page swaps between memory and secondary storage.
Hint. You can solve this question from the information provided in part (ii) only.

(iii) **(3 marks).** If page faults occur once in 10000 references, what is the effective demand-paged memory access time?
Hint. You need solutions for part (i) and part (ii) to solve part (iii). If you don't have the solutions for part (i) and (ii), you can assume their solutions are respectively 200 nanoseconds and 20 milliseconds.

Answer:

(i)

(ii)

(iii)

f) **(4 marks).** Consider the following page reference string:

8, 3, 0, 9, 0, 1, 2, 8, 1, 2, 7, 8, 2, 3, 8, 1, 8, 7, 8, 7

How many page faults would occur for the **LRU** replacement algorithms, assuming five frames frames? Remember that all frames are initially empty, so your first unique pages will all cost one fault each.

Answer:

g) **(6 marks)**. For each of the following statement, explain why it is **true** or **false**.

The advantages of virtual memory are:

- To support for a higher degree of multiprogramming.
- To prevent processes not getting aborted for insufficient memory.
- To reduce I/O.

Answer:

-

-

-

END OF QUESTION TWO

QUESTION THREE (total: 27 marks): File, I/O, and disk

a) **(6 marks).** Contrast the differences among a *buffer*, a *cache*, and a *spool*. Describe one use of each of them.

Answer:

b) **(Total: 6 marks).** Consider a file currently consisting of 300 blocks. Assume that the file control block is already in memory.

(i) **(4 marks).** Calculate how many disk I/O operations are required for the linked allocation strategy if:

- One block is added after the last block.
- The third block from the beginning is removed.

(ii) **(2 marks).** Repeat part (i) for indexed allocation.

Justify you answers.

Answer:

(i)

-

-

(ii) Indexed allocation

-

-

c) **(3 marks).** Why do all file systems suffer from internal fragmentation?

Answer:

d) **(4 marks).** Describe the two main aspects of disk speed.

Answer:

e) **(4 marks)**. Disk requests come in the disk driver for cylinders 2, 40, 10, 22, 6, and 38, in that order. A seek takes 5 milliseconds per cylinder moved. Assuming the arm is initially at cylinder 21 (the previous request was at cylinder 9) for a disk with 100 cylinders, how much seek time is needed for C-LOOK? Explain your answer.

Answer:

f) **(4 marks).** Explain if the following statement is **true** or **false**: Data striping *always* increases the *disk transfer rate* for RAID systems.

Answer:

END OF QUESTION THREE

QUESTION FOUR (total: 12 marks): Protection and Security

a) **(4 marks).** Suppose you are designing an operating system for use in an environment with **all trusted users**. Give two main reasons to explain why providing protection in your system is still needed.

Answer:

b) **(4 marks)**. Access matrix can be implemented using a *global table*. Describe the content of the table, how this implementation work, and one drawback of such implementation.

Answer:

c) **(4 marks)**. Explain why access rights revocation in an access-list scheme is easier than in a capability scheme.

Answer:

END OF EXAMINATION