Curtin University

School of Electrical Engineering, Computing and Mathematical Sciences

Discipline of Computing - Curtin University

COMP2006 Operating Systems

Final Assessment - Semester 1/2020

Total Mark: 100

Time allowed: 4 hours (start to finish)

Test mode: Online test, open-book: you are allowed to access your hand-written notes, lecture slides, textbooks, and printed and electronic materials in your possession. However, you are **NOT allowed to simply copy and paste solutions** from your open sources. Doing so will be considered academic misconduct.

CONDITIONS

- The assessment must be completed by yourself only. No one else should do this assessment for you. Any attempts to compromise the system are strictly prohibited. Any breaches of this policy will be considered cheating and appropriate action will be taken as per University policy.
- You are prohibited from communicating with people other than the unit coordinator/lecturer and the tutors during the test.
- You are prohibited from providing information about your work and your assessment to others during and outside your assessment within two days. Some students may sit in the assessment after you.
- You must complete and submit the "Student Declaration Form".
- Some students sitting the assessment can be invited to an online interview as confirmation check to confirm the authorship of the submitted final assessment. In the interview, students will be asked to explain their answers and demonstrate their knowledge for randomly selected questions. Students will be shown the questions, as well as their written answers.

INSTRUCTION

- This assessment consists of four questions: QUESTION ONE to QUESTION FOUR of different types, with a total of 100 marks. **Attempt ALL questions**.
- You can submit your answers multiple times during the assessment, but only the last submission would be used for marking.

QUESTION ONE (total: 21 marks): Deadlock

Q1 a) (3 marks). Give one example to show that deadlock can occur in a system that has only single process with a single resource.

Q1 b) (4 marks). Give two reasons why a system in an unsafe state does not necessarily imply that the system will deadlock.

Q1 c) (Total: 4 marks). One method of recovering from deadlock is to kill one or more of the lowest-priority processes that are involved in the deadlock. The processes are then restarted and allowed to compete for resources.

(i) **(2 marks).** What potential problem might develop in a system using such an algorithm?

(ii) **(2 marks).** How would you solve this problem?

Q1 d) (Total: 10 marks). Consider the following snapshot of a system that contains four processes {P1, P2, P3, P4} and five types of resources {A, B, C, D, E}. The information about the system's total resources, the maximum demand of each process, and the current allocation of resources are as shown.

	Total resources			
A	B	C	D	E
8	5	9	7	4

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

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

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

(ii) **(3 marks).** Show that the system is in a safe state.

(iii) **(5 marks).** Can a request of instance of resource B and one instance of resource E by Process P1 be granted according to the banker's algorithm? Show the details for the decision.

END OF QUESTION ONE

QUESTION TWO (total: 44 marks): Memory Management

Q2 a) (3 marks). Explain if the following statement is **True** or **False**:
For a constant number of bits in a virtual address, the size of a single page table decreases with larger page size.

Q2 b) (3 marks). Explain if the following statement is **True or False:**
A user-level process should not be allowed to modify its own page table entries.

Q2 c) (3 marks). Explain if the following statement is **True** or **False**:
Two processes reading from the same physical address will access the same contents.

Q2 d) (3 marks). Explain if the following statement is **True** or **False**:
Translation Lookaside Buffer (TLB) gives more benefits when it is used in a system with 2-level page tables than with single-level page tables.

Q2 e) (4 marks). Consider a paging system. If swap-in and swap-out time each requires 20 milliseconds, and on average 30% of the pages have NOT been modified, what is the effective page fault service time?

You can ignore all processing times other than page swaps between memory and secondary storage. Show your calculation to get partial marks.

Q2 f) (3 marks). Explain if the following statement is **True** or **False**:
For a system with a physical address of 32 bits and a page size of 4KB, the 18 most significant bits of the 32 bits identify frame number for the physical address.

Q2 g). (2 marks). Explain if the following statement is **True** or **False**:
To reduce internal fragmentation, the size of a page in paging system must be increased.

Q2 h). (3 marks). A computer with an 8-KB page, a 256MB main memory, and a 64-GB virtual address space uses an inverted page table to implement its virtual memory. How many entries are there in the inverted tables?

Q2 i). (3 marks). Consider a system in which each page is of size 4-KB. Compute the virtual page number and offset for each of the following virtual addresses; note the addresses are shown in decimal.

- 20000
- 32768

Q2 j). (5 marks). Consider a computer system with a virtual-memory space of 2^{32} bytes and 2^{18} bytes of physical memory. The virtual memory is implemented by paging, and the page size is 2048 bytes. Consider a user process generates a virtual address 12345678 (in hexadecimal). If the page table for the process contains frame number 34 (in hexadecimal) at entry 0001 0010 0011 0100 0101 0 (in binary), what is the corresponding physical address of the virtual address 12345678 (in hexadecimal)? Explain your answer.

Q2 k). (4 marks). On a simple paged-system, associative registers hold the most active page entries, and the full page-table is stored in main memory. If references satisfied by the associative registers take 90 ns and references through the main memory page table take 190 ns, what must the hit ratio be to achieve an effective access time of 120 ns?

Q2 l). 4 marks. Consider the following page reference string:

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

How many page faults would occur for the **LRU** replacement algorithms, assuming three frames? Show the contents of the three frames.

Remember that all frames are initially empty, so your first unique pages will all cost one fault each.

Q2 m). (4 marks). Consider the following page reference string:

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

For $\Delta = 6$ with t equal to the time between the 15^{th} and 16^{th} references, what is the working set WS(t)?

END OF QUESTION TWO

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

Q3 a) (3 marks). Explain if the following statement is **True** or **False**:
The average rotation time for a random read in a disk with a 7200 RPM is expected to be around 8.3 ms.

Q3 b) (4 marks) Disk requests come in the disk driver for cylinders 10, 22, 2, 40, 6, and 38, in that order. A seek takes 6 msec per cylinder moved. Assuming the arm is initially at cylinder 20, and moving toward larger cylinder number for a disk with 64 cylinders (0 to 63), how much seek time is needed for C-SCAN algorithm.

Q3 c) **(Total: 5 marks).** Consider a file currently consisting of 50 blocks. Assume that the file control block is already in memory.

(i) **(3 marks).** Calculate how many disk I/O operations are required for linked allocation strategy to insert one block after the third block from the beginning of the list.

(ii) **(2 marks).** Consider a block size 512 bytes, and a 16 bit pointer in the system. What is the maximum size of a file that is supported in such system?

Q3 d) **(6 marks).** Between Polling I/O and Interrupt driven I/O, which of them is more suitable for the following types of systems? Justify your answer.

- A system dedicated to controlling a single I/O device.

- A workstation running a heavily used web server.

Q3 e) **(3 marks).** Explain if the following statement is **true** or **false**:
Data striping *always* increases the *disk transfer rate* for RAID systems.

Q3 f) **(3 marks).** Explain if the following statement is **true** or **false**:
Contiguous allocation method ensures that only one access is needed to get a disk block using direct access.

Q3 g) (3 marks). Explain if the following statement is **true** or **false**:
The extent-based system requires more overhead than the linked allocation scheme.

END OF QUESTION THREE

QUESTION FOUR (total: 8 marks): Protection and Security

Q4 a) (4 marks). Discuss one advantage and disadvantage of allowing the operating system to access the full range of real addresses in a computer system **at all times**.

Q4 b) (4 marks). The Linux systems administrator cannot determine the password of a user who has lost his or her password. Explain the reason and describe how the user can regain access to the computer.

END OF EXAM PAPER