THE UNIVERSITY of ADELAIDE

Primary Examination

School of Computer Science
The University of Adelaide

Semester 2, 2017

OPERATING SYSTEMS
COMP SCI 3004, 7064

Official Reading Time:	10 mins
Writing Time:	120 mins
Total Duration:	130 mins

Questions	Time	Marks
Answer all **6** questions	120 mins	100 marks
		100 Total

Instructions

- Begin each answer on a new page
- Examination material must not be removed from the examination room
- Simple, Non-programmable Calculators Allowed

Materials

- 1 Blue book

DO NOT COMMENCE WRITING UNTIL INSTRUCTED TO DO SO

Question 1

Answer the following questions:

(a) An operating system manages each type of resource in the computer system by performing three tasks: monitoring the usage of the resource, allocating the resource and deallocating the resource. When the resource is memory, explain how these tasks are performed in memory management of paging.

[6 marks]

(b) Explain the purpose of demand paging. What are the pros and cons for admitting more processes to the memory?

[4 marks]

(c) Describe how the simplest operating system works under the two modes (kernel (0) vs user (1)) of operation.

[4 marks]

(d) Describe how to prevent deadocks for resource allocation in systems with each resource type containing only one instance.

[4 marks]

[Total for Question 1: 18 marks]

Question 2

Consider the following sets of processes, with the length of the CPU-burst time given in milliseconds:

Process	Arrival Time	Burst Time	Priority
P_1	0	6	4
P_2	2	3	2
P_3	4	6	1
P_4	1	4	3

For each of the following scheduling algorithms, determine the *average turnaround time* and *average waiting time* respectively. Show working (using a Gantt chart).

(a) First-Come-First-Served scheduling.

[4 marks]

(b) Shortest-Job-First scheduling (preemptive).

[4 marks]

(c) Priority scheduling, where a smaller priority number indicates a higher priority (preemptive).

[4 marks]

(d) Round-Robin scheduling (quantum=2).

[4 marks]

[Total for Question 2: 16 marks]

Question 3

Consider the following page reference string:

$$3, 1, 2, 3, 1, 4, 3, 5, 2, 5, 6, 2, 3, 5, 2, 6, 1.$$

How many page faults would occur for each of the following replacement algorithms in the three cases of **two**, **three** and **four** frames available. Note that this means your answers to the questions below will contain nine numbers in total. Also note that all frames are initially empty, so your first unique pages will all cost one fault each.

(a) FIFO replacement.

[6 marks]

(b) Optimal replacement.

[6 marks]

(c) LRU replacement.

[6 marks]

[Total for Question 3: 18 marks]

Question 4

Answer the following questions on file systems and mass storage:

(a) Consider a file system on a disk that has both logical and physical block sizes of 512 bytes. Assume that the information about each file is already in memory and the starting file address (block number) is Z. For each of the three allocation strategies (**contiguous**, **linked**, and **indexed**), how is the logical-to-physical address mapping accomplished in this system? (For the indexed allocation, assume that a file is always less than 512 blocks long.)

[9 marks]

(b) Suppose that a disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143, and the previous request was at cylinder 125. The queue of pending requests, in FIFO order, is 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130.

Starting from the current head position, what is the order of cylinder numbers that the disk arm moves to satisfy all the pending requests for the C-SCAN disk-scheduling algorithm? What is the total seek distance (in cylinders) the disk arm has moved?

[5 marks]

[Total for Question 4: 14 marks]

Question 5

Answer the following questions on protection and security:

(a) Discuss a means by which managers of systems connected to the Internet could have designed their systems to limit or eliminate the damage done by a worm. What are the drawbacks of making the change that you suggest?

[3 marks]

(b) Describe how to avoid buffer-overflow attacks by using special hardware support.

[5 marks]

(c) State the essential difference between symmetric and asymmetric encryption schemes, discuss their performances in computation cost and security provision, and list two different applications — one for each scheme.

[6 marks]

[Total for Question 5: 14 marks]

Question 6 **20 marks**

The Third Readers-Writers Problem: A large database is to be shared among many concurrent processes — *readers* and *writers* — wishing to read and write (update) it respectively. It is acceptable to have multiple processes reading the database in the same time, but if one process is writing the database, no other processes may have any access (read or write) to the database. When no process is accessing the database, processes waiting for accessing the database are served in their arrival order, hence neither readers nor writers will suffer from starvation. This differs from readers prior to writers (the first reader-writer problem) and writers prior to readers (the second reader-writer problem).

Write a program (pseudo code) to coordinate the readers and writers, assuming semaphores preserve first-in first-out ordering when blocking and releasing processes.

[20 marks]

[Total for Question 6: 20 marks]