TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI
VICTORIA
UNIVERSITY OF WELLINGTON

EXAMINATIONS — 2009
MID-YEAR

COMP305

OPERATING SYSTEMS

Time allowed: THREE HOURS

Instructions: The examination contains 5 questions, you must answer all questions

Each question is worth 30 marks.

The exam consists of 150 marks in total.

Paper foreign to English language dictionaries are allowed.

Electronic dictionaries and programmable calculators are not allowed.

Question 1 Processes, Threading and Synchronisation [30 marks]

(a) Provide a short explanation for each of the following terms:

i. [2 Marks] A Process,

ii. [2 Marks] A Kernel Thread, and

iii. [2 Marks] A Context Switch.

(b) [5 Marks] Outline a typical sequence of steps an OS goes through during a **FORK** system call.

(b) Provide:

i. [2 Marks] An advantage that user level threads have over processes, and

ii. [2 Marks] A major disadvantage of user level threads.

(c) Briefly outline:

i. [2 Marks] a programming scenario that suits the use of kernel threads, and

ii. [3 Marks] how kernel threads would be used in your scenario.

(d) Synchronisation

i. [2 Marks] What is a critical section (CS)?

ii. [3 Marks] State and briefly explain the three necessary and sufficient conditions for a solution to the CS problem.

iii. [3 Marks] Consider a two-process concurrency scheme that uses strict alternation. For each of the criteria outlined in question (d) ii. indicate if that criteria is satisfied and if it is not satisfied explain why not.

Question 2 Scheduling **[30 marks]**

(a) [2 Marks] What is the optimal CPU scheduling algorithm, and why is it not normally possible to implement.

(b) [4 Marks] Explain, with the aid of an annotated, where the scheduling opportunities lie during the lifecycle of a process.

(c) Consider the following table of processes and their arrival times:

Process	Arrival Time	CPU Burst
1	0	4
2	3	4
3	4	3
4	9	2

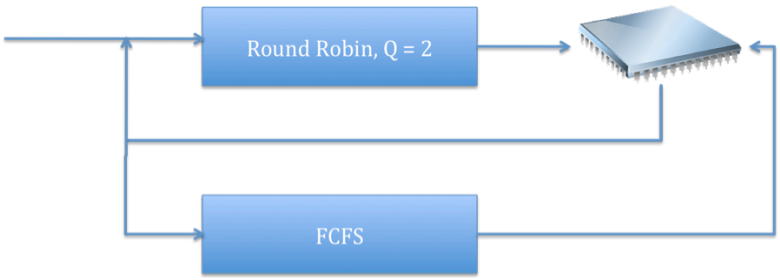
Table 1: Process arrival and burst times.

Draw a Gantt chart for the:

i. [4 Marks] FCFS scheduler. What is the average waiting time.

ii. [2 Marks] non pre-emptive SRTF scheduler. What is the average waiting time.

(d) Imagine we have a multi-level feedback queue with 2 queues. The highest priority queue is a RR scheduler with a quantum of 2. The second priority queue runs as a FCFS queue.



Processes start in the RR queue and are demoted to the FCFS queue if they exceed their quantum. Processes in the RR queue are always prioritised over the FCFS queue. Use the processes from Table 1.

i. [8 Marks] Show the state of the queues at time intervals of 2 from time 0 to the finish.

ii. [2 Marks] What is the average waiting time?

(e) Disk Scheduling

i. [2 Marks] What physical limitation of Hard Drives is disk scheduling intended to minimise?

ii. [4 Marks] For the following cylinder sequence 87, 6, 158, 49, 487, 576, 588, 267, 12, what is the total head movement for the **scan** scheduling algorithm with start position 300 and seeking initially in increasing cylinder number.

iii. [2 Marks] What is the problem with the scan algorithm? Suggest a remedy.

Question 3 Memory Management **[30 marks]**

(a) [3 Marks] Explain the difference between compile time, load time and execution time binding, specifically talk about the memory addresses assigned to the program.

(b) [2 Marks] Summarise the difference between logical and physical addresses.

(c) [6 Marks] What is a Translation Lookaside Buffer (TLB)? Outline how the TLB works using a diagram describing what happens in the event of a 'hit' and a 'miss'.

(d) [5 Marks] Show, with the aid of a diagram, logical to physical address binding using a Hashed page table.

(e) [4 Marks]What is segmentation and what benefit does it provide?

(f) [5 Marks] Describe the process of logical to physical address translation when using segmentation.

(g) [5 Marks] How is segmentation different from paging in terms of addressing and translation between logical and physical addresses

Question 4 File Systems **[30 marks]**

(a) [3 Marks] Describe the role that a Virtual File System plays in a system.

(b) [5 Marks] Outline, using a diagram, a typical sequence of steps an OS goes through during a **Open** file system call.

(c) [4 Marks] What is meant by a **linked** file allocation scheme?

(d) [2 Marks] What is the primary drawback of linked file allocation schemes for hard drives?

(e) [5 Marks] Describe the structure of a unix inode.

(f) [4 Marks] Given a block size of 1K, how many disk reads are needed to seek to a position 15K into a file. Note, there is no caching.

(g) [3 Marks] Draw a graph structured directory and explain how we can traverse this structure without suffering from cycles.

(h) [4 Marks] Summarise the principle of a log structured file system.

Question 6 Security **[30 marks]**

(a) [4 Marks] Define the principle of **least privilege**, give an example of a possible threat and show how the principle of least privilege can be applied.

(b) [4 Marks] Explain what Access Rights are and describe how they relate to Domains.

(c) [6 Marks] Describe an access control list and a capability list and provide one drawback of each.

(d) [16 Marks] Consider the following access control matrix. The matrix describes the access rights for a simple system containing three domains (Administrators, Programmers, and Guests), three files and an executable program.

	File A	*File B*	*File C*	*Program P*
D1 (Admin)	*W*	*RW **	*R**	*Ex*
D2 (Programmer)	*RW*	*R*		*Ex*
D3 (Guest)	*W*			

i. [2 Marks] Which entities can *Read* File A?

ii. [2 Marks] How could a Guest gain the appropriate *Read* privilege for File C?

iii. [4 marks] Specify the access control lists to implement this access control matrix.

iv. [4 Marks] If the Read right for File B has limited copy semantics, what would the matrix look like if the right is transferred from an Admin (D1) to a Guest (D3)

v. [4 Marks] Imagine a new file (File D) was added to the system, allowing only the admin to have initial Write privileges. Is it possible for the admin to hand over the Write privilege to a Programmer such that the Programmer is now the only domain to have write priviilge on File D? Justify your answer.

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