McGill University
Computer Science and Engineering
Final Exam

COMP-310 and ECSE-427
Operating Systems

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Exam Date: December 13, 2006
2PM in RPHYS

Student Name:_____
Student ID: _____

Instructions

1. Closed Book Exam
2. Calculators are not permitted
3. Attempt all questions since part marks will be given
4. Answer all questions on the exam sheet. Enough space has been provided. If more space is required you can write on the back of the exam pages.
5. Ask questions if you do not understand something.

Marking

	Value	Grade
Question 1	10%	
Question 2	10%	
Question 3	20%	
Question 4	20%	
Question 5	20%	
Question 6	20%	
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Total	100 %	

Question 1: Memory Management

Discuss, in a paragraph or two (you can use drawings if you find it helpful), how a pure paging system functions. This is not a virtual memory system. It is simply a paging system. It incorporates and TLB and cache. Also, since page numbers do not match page table index numbers, this system uses a hash function to locate the cell the page number refers to.

To answer this question correctly, do the following:

- Discuss how the above paging system operates
- Answer these questions:
    - How does a paging system advantage us if it is not a virtual memory system?
    - Why do the page numbers not match the page table's index?
    - What would the formula be for the hash function? Is you function a 1:1 map? If not, what should your function / algorithm do?

Question 2: Virtual Memory

Suppose that your replacement policy (in a virtual memory paging system) is to examine each page regularly (a timer is set that triggers this operation on an interval) and to discard the page if it has not been used since the last examination (regardless of a need for a page or not by another process).

To answer this question correctly, do the following:

- What would you gain and what would you lose by using this policy rather than LRU?
- Show an example with a list of page numbers and times of entry into memory to support your claims.
- Give a formula that expresses the rate at which this procedure should be invoked so that it would operate optimally (I am not asking for a proof, just a formula that supports your claims).

Question 3: File Systems

Answer the following questions concisely in at most 5 sentences:

A. Can you simulate a multilevel directory structure with a single-level directory structure assuming your FAT could support file names of infinite length? How? Or Why not?

B. Consider a file 100 blocks long. Assume all the data-structures the OS requires are already loaded in memory and do not need to be accessed from storage. Assume further that the disk is full at the head of the file but that there is free space at the tail of the file. Assume, in addition, that disk access is carried out by block. In other words, a single I/O operation on the disk is measured in a block.

How many disk access operations would be needed to add a block to the middle of the file if the file was stored: (i) contiguously, (ii) linked? Justify your answer.

Question 4: Disk Drives

Suppose that a disk drive has 5,000 blocks numbered 0 to 4999. The drive is currently services a request at block 143, and the previous request was at block 125. The queue of pending requests, in FIFO order, is:

86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130.

Start from the current head position, what is the total distance (in blocks) that the disk arm moves to satisfy all the pending requests for each of the following disk-scheduling algorithms?

A. FCFS
B. SSTF
C. C-SCAN

Question 5: Security

Many operating systems provide automated backup and recovery software. Operating system administrators often have the responsibility to design a backup / recovery policy. These policies contain the following elements: the frequency backups should occur, the amount of data to be backed-up, how long the data should be kept in storage, should their be different rules for daily – weekly – monthly – yearly backups, and what are these different rules.

What policy would be most appropriate in each of the following systems? Justify!

- A batch-processing payroll system that runs every Thursday
- An on-line banking system for handling customer transactions
- A patient billing system in a hospital
- An airline reservation system in which customers make reservations on-line for flights as much as one year in advance
- A timesharing programming development system used by a group of 100 programmers

Question 6: Security

In the early Unix systems, passwords were kept as ASCII text files. People quickly realized that this was not good. Describe a better way of managing passwords. Keep in mind that users would like to be able to change their passwords. System operators would also like to change user passwords. We also would like to ensure privacy, meaning that the super user cannot see the user's passwords even if they wanted to. The computer needs to access the passwords to perform validation.