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UNIVERSITY OF TORONTO
Faculty of Arts and Science

St George Campus

June 2016 EXAMINATIONS

CSCC 69H
Instructor — Sina Meraji
Duration — 2 hours

Student Number: |_|_|_|_|_|_|_|_|_|

Last (Family) Name(s): ______________________________

First (Given) Name(s): ______________________________

Do ***not*** *turn this page until you have received the signal to start.*
(In the meantime, please fill out the identification section above, and read the instructions below *carefully*.)

This final examination consists of 4 questions on 8 pages (including this one). *When you receive the signal to start, please make sure that your copy of the examination is complete.*

If you need more space for one of your solutions, use the last pages of the exam and indicate clearly the part of your work that should be marked.

In your written answers, be as specific as possible and explain your reasoning. Clear, concise answers will be given higher marks than vague, wordy answers. **Marks will be deducted for incorrect statements in an answer.** Please make your handwriting legible!

Marking Guide

1: ______/19

2: ______/12

3: ______/11

4: ______/ 8

TOTAL: ______/50

Question 1. Short Questions [19 MARKS]

Part (a) [4 MARKS] Drew the process state diagram?

check slide 14 from the first week

Part (b) [4 MARKS] Explain the OS bootstrapping process?

check slide 6 from the second week

Part (c) [4 MARKS] Explain two algorithms for implementing exact Least Recently Used(LRU) page eviction algorithm briefly. What are the drawbacks of each algorithm

Option 1: Time stamp every reference Evict page with oldest time stamp Problems: Need to make PTE large enough to hold meaningful time stamp (may double size of page tables, TLBs) Need to examine every page on eviction to find one with oldest time stamp Option 2: Keep pages in a stack. On reference, move the page to the top of the stack. On eviction, replace page at bottom. Problems: Need costly software operation to manipulate stack on EVERY memory reference!

Part (d) [4 MARKS] Briefly explain the memory paging algorithm

I hope you all know this :)

Part (e) [3 MARKS] how does Brinch monitors work?

Signal() immediately switches from the caller to a waiting thread Need another queue for the signaler, if signaler was not done using the monitor

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Question 2. Synchronization Problem [12 MARKS]

9 philosophers are sitting on a round table to eat. A philosopher needs two forks to eat. come up with a deadlock free solution for dining philosophers using semaphores so they can all eat with no starvation(dining philosopher problem)

Please check the slides

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Question 3. Virtual Memory [11 MARKS]

Suppose that a machine has 48-bit virtual addresses and 32-bit physical addresses

Part (a) [4 MARKS] if pages are 4KB, how many entries are in the page table if it has only a single level?explain

We need one entry for each page, or $2^{2}4 = 1610241024$ entries, since there are $36 = 48 \; 12$ bits in the page number field.

Part (b) [4 MARKS] suppose the same system has a TLB with 32 entries. Furthermore, suppose that a program contains instructions that fit into one page and it sequentially reads long integer elements from an array that spans thousands of pages. How effective the TLB be for this case?

Instruction addresses will hit 100% in the TLB. The data pages will have a 100 hit rate until the program has moved onto the next data page. Since a 4-KB page contains 1,024 long integers, there will be one TLB miss and one extra memory access for every 1,024 data references

Part (c) [3 MARKS] Give a simple example of a page reference sequence where the first page selected for replacement will be different for the clock and LRU page replacement algorithms. Assume that a process is allocated 3 frames, and the reference string contains page numbers from the set 0,1,2,3.

The sequence: 0, 1, 2, 1, 2, 0, 3. In LRU, page 1 will be replaced by page 3. In clock, page 1 will be replaced, since all pages will be marked and the cursor is at page 0.

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Question 4. Scheduling [8 marks]

Five batch jobs A through E, arrive at a computer center at almost the same time. They have estimated running times of 10, 6, 2, 4, and 8 minutes. Their (externally determined) priorities are 3, 5, 2, 1, and 4, respectively, with 5 being the highest priority. For each of the following scheduling algorithms, determine the mean process turnaround time. Ignore process switching overhead.
(a) Round robin.
(b) Priority scheduling.
(c) First-come, first-served (run in order 10,6,2,4,8).
(d) Shortest job first.

For (a), assume that the system is multiprogrammed, and that each job gets its fair share of the CPU. For (b) through (d) assume that only one job at a time runs, until it finishes. All jobs are completely CPU bound.

For round robin, during the first 10 minutes each job gets 1/5 of the CPU. At the end of 10 minutes, C finishes. During the next 8 minutes, each job gets 1/4 of the CPU, after which time D finishes. Then each of the three remaining jobs gets 1/3 of the CPU for 6 minutes, until B finishes, and so on. The finishing times for the five jobs are 10, 18, 24, 28, and 30, for an average of 22 minutes. For priority scheduling, B is run first. After 6 minutes it is finished. The other jobs finish at 14, 24, 26, and 30, for an average of 18.8 minutes. If the jobs run in the order A through E, they finish at 10, 16, 18, 22, and 30, for an average of 19.2 minutes. Finally, shortest job first yields finishing times of 2, 6, 12, 20, and 30, for an average of 14 minutes

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