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UNIVERSITY OF TORONTO
Faculty of Arts and Science

Scarborough

February 2017 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 Midterm 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] Draw 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] Briefly Explain Linux 2.6 scheduling algorithm

check week3 slides

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

This exam continues on the following page

Question 3. Virtual Memory [11 MARKS]

A system has a 32-bit virtual address space and uses a two-level page table. 9 bits are used to index the top-level page table, and 11 bits are used to index the second-level page table.

Part (a) [2 MARKS] How large are the pages (in bytes)?

32 - 9 - 11 = 12 bits for offset. Page size = $2^1 2$ = 4096 bytes.

Part (b) [2 MARKS] How many virtual pages can the process have?

$2^2 0$ (2^9 second-level page tables each map $2^1 1$ virtual pages)

Part (c) [2 MARKS] What is the size (in bytes) of an entry in the second-level page table, assuming the second-level page table is stored in a single physical page frame?

A page frame is $2^1 2$ bytes. There are 11 bits to index the second level page table =¿ $2^1 1$ entries. Thus there can only be 2 bytes per entry (just divide total size by number of entries).

Part (d) [2 MARKS] If each page table entry includes valid, reference, and dirty bits in addition to the page frame number, what is the maximum number of physical page frames in the system?

A 2 byte entry has 16 bits of information. 3 are used for status information, leaving 13 to record the page frame number. Thus $2^1 3$ = 8192 physical frames.

Part (e) [3 MARKS] Assuming the page size is fixed, how can the address translation scheme be altered to support more physical page frames?

Use 10 bits to index each level. Now the second level page table only has $2^1 0$ entries and they can be 4 bytes in length. This gives 32 bits in total, 29 for page frame number =¿ $2^2 9$

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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