COP 4600 – Final examination

Date: Dec 9, 2013

**Name: ………………………………………………………………………………………………………….**

Instructions:

* This exam is open book and open notes. Allotted time is 180 minutes.
* Note that the points add up to 100 + 20 bonus points.

# Problem 1 (10 pts)

1. Explain what is an access matrix in computer protection. (2 sentences)
2. The simplest approach to implement an access matrix is to just store it in an Excel spreadsheet in a file. Give two reasons why this is a bad idea. (2 sentences)
3. Describe how the Unix system is approximating the functionality of an access matrix. (3 sentences)

# Problem 2 (20 points)

A process contains eight virtual pages on disk and is assigned a fixed allocation of four page frames in the main memory.

## a) Show the successive pages residing in the four frames using the LRU (least recently used) policy.

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| 2 | 4 | 6 | 1 | 3 | 2 | 4 | 6 | 1 | 3 | 2 | 4 | 6 | 1 | 3 | 2 | 4 | 6 | 1 | 3 |

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* How many page table hits were there? …………………..
* How many misses? …………………..
* How many misses were unavoidable? …………………..
* Explain the result (1 sentence)

## c) Repeat for the optimal algorithm

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| 2 | 4 | 6 | 1 | 3 | 2 | 4 | 6 | 1 | 3 | 2 | 4 | 6 | 1 | 3 | 2 | 4 | 6 | 1 | 3 |

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* How many page table hits were there? …………………..
* How many misses? …………………..
* How many misses were unavoidable? ………………..
* Explain the result (1 sentence)

# Problem 3 (20 pts)

Suppose the page table for a process A currently executing on the processor looks like the following. All numbers are decimal, everything is numbered starting from zero, and all addresses are memory byte addresses. The page size is **4096** bytes.

|  |  |  |  |
| --- | --- | --- | --- |
| Virtual page number | Valid bit  (1 =valid) | Modify bit  (1 = modified) | Page frame number |
| 0 | 1 | 0 | 10 |
| 1 | 1 | 1 | 11 |
| 2 | 0 | 0 | - |
| 3 | 1 | 0 | 3 |
| 4 | 0 | 0 | - |
| 5 | 1 | 1 | 1 |

## What **physical address**, if any, would each of the following **virtual addresses** correspond to:

77

12328

10000

## What **virtual address**, if any, would each of the following **physical addresses** correspond to:

40970

70

# Problem 4 (20 pts)

A type of hard disk has a failure probability of 0.05 / year. We equate “failure” with “data loss”.

1. What is the failure probability of 2 disks assembled in a RAID-0 configuration?
2. What is the failure probability of 2 disks assembled in a RAID-1 configuration?
3. Is the failure probability of a RAID-5 configuration with 4 disks higher or lower than the same 4 disks arranged in two RAID-1 pairings? Explain.

# Problem 5 (10 pts)

* What are the problems associated with linked allocation of disk space routines?
* Which disadvantage is solved by the file allocation table?

# Problem 6 (10 pts)

A page fault must be preceded by a TLB miss, but a TLB miss does not necessarily mean a page fault. True or false? Explain why (2-3 sentences)

# Problem 7 (10 pts)

Assume a system has a TLB hit ratio of 99%. It requires 10 nanoseconds to access the TLB, and 90 nanoseconds to access main memory. What is the effective memory access time in nanoseconds for this system?

# Problem 8 (20 pts)

You have a hard drive with 150 tracks. Assume that the disk head’s last movement was from 90 to 100 and is currently on track 100. Consider the following series of disk track requests:

10, 30, 50, 90, 102, 120

Trace the following disk scheduling algorithms and for each of them:

1. draw a small bar graph of the distances the head must travel for each request (starting from beginning, so the second one will be longer, the third one even longer)
2. calculate the average distance the head must travel (numerical value required, don’t leave it as an expression)

# SSTF

# SCAN

# C-LOOK