COP 4600 – Midterm Examination - 2

Date: October 28, 2013

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

Instructions:

* This exam is open book and open notes. Allotted time is 75 minutes.
* Note that the points add up to 100 + 10 bonus points.

# Problem 1 (10 pts)

Consider a logical address with a page size of 8 KB. How many bits must be used to represent the page offset in the logical address? Explain why (1 sentence).

# Problem 2 (25 points)

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

4,6,7,3,0,2,3,1,0,2,3,1,7,6,3,6,3,1,0,2

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

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## b) Repeat for the FIFO policy.

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## c) Repeat for the optimal algorithm

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## d) Calculate and compare the hit ratios. Comment on the results.

# 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:

712

5000

## List the actions which will happen if the operating system allocates frame 10 to another process B

1

2

3

4

5

6

## List the actions which will happen if the operating system allocates frame 11 to another process B

1

2

3

4

5

6

## List the actions which will happen if the process A writes into page 2?

1

2

3

4

5

6

# Problem 4 (15 pts)

Suppose a program is operating with execution-time binding with a relocation register. The physical address generated is 300. The relocation register is set to 100. What is the corresponding logical address? Explain why.

# Problem 5 (10 pts)

An address generated by a CPU is referred to as a \_\_\_\_.

A) physical address

B) logical address

C) post relocation register address

D) Memory-Management Unit (MMU) generated address

The mapping of a logical address to a physical address is done in hardware by the \_\_\_\_\_\_\_\_.

A) memory-management-unit (MMU)

B) memory address register

C) relocation register

D) dynamic loading register

# Problem 6 (10 points)

How many philosophers may eat simultaneously in the Dining Philosophers problem **with 17 philosophers**? Explain why (3 sentences, maybe drawing).

# Problem 7 (20 points)

Create a model of the formation of a methane molecule CH4 using semaphores. Methane is made of one carbon atom and four hydrogen atoms . You need to implement three types of processes:

-one process for each hydrogen atom (assume that they are created regularly).

-one process for each carbon atom (assume that they are created regularly)

-a single process for the chemical bonding.

The hydrogen and carbon atoms wait until there are four hydrogen and one carbon atom available. Then, they are combined into a methane molecule and terminate their individual life as an atom. Show the pseudocode for the three types of processes.