CMSC 412 Midterm #2 (Fall 2011)

Name _____ Signature _____

(1) This exam is closed book, closed notes, and closed neighbor. No calculators are permitted. Violation of any of these rules will be considered academic dishonestly.

(2) You have 70 minutes to complete this exam. If you finish early, you may turn in your exam at the front of the room and leave. However if you finish during the last ten minutes of the exam please remain seated until the end of the exam so you don't disturb others. Failure to follow this direction will result in points being deducted from your exam.

(3) Write all answers on the exam. If you need additional paper, I will provide it. Make sure your name is on any additional sheets.

(4) Partial credit will be given for most questions assuming I can figure out what you were doing.

(5) Please write neatly. Print your answers if your handwriting is hard to read. If you write something, and wish to cross it out, simply put an X through it. Please indicate if your answer continues onto another page.

Question	Possible	Score
1	**20**	
2	**20**	
3	**20**	
4	**20**	
5	**20**	
Total	**100**	

1.) (20 points) Define and explain the following terms:

a) Rotational Latency

b) Super page

c) Thrashing

d) inode

2.) (20 points) Memory Systems

a) (10 points) Consider an x86-32 like architecture with a hardware TLB (with an access time of 10 ns for a hit or miss), and a two level page directory and page table structure (both of which are pageable). The TLB has a hit rate of 99% and the memory access time to read any word of physical memory is 100ns (i.e. don't consider CPU caches). On average, 0.001% of all memory references result in a page fault which takes an average of 3ms to service. What is the effective access time for the virtual memory?

b) (10 points) Explain what the clock algorithm for page aging is and explain why it is often used instead of full LRU.

3.) (20 Points) Synchronization: Given an implementation of counting semaphores (semaphores whose values range from 0 to some positive integer), implement binary semaphores (semaphores whose value is either 0 or 1).

P_{binary}:

V_{binary}:

4.) (20 points) File Systems

a) (6 points) Explain why file systems often include a file name cache even if they have a file buffer cache.

b) (8 points) Consider a FAT file system (using 32 bit block numbers) and 4KB blocks. If you wanted to read 2^{20} byte of a file, what is the minimum **and maximum** number of disk reads required? Be sure to explain each step, don't just give numbers.

c) (6 points) What is the role of the cleaner in a log structured file system?

5.) (20 points) Project

a) (6 points) Explain why it is possible to use a single LDT for all user processes in the project once the paging code for project #4 is done.

b) (6 points) Why does the function `Alloc_Pageable_Page` need to know the virtual address where the page to be allocated will be mapped?

c) (8 points) Consider the Clone system call. It works like fork (i.e. it creates a new process with the same program as its parent). The difference is that it creates a kernel visible user mode thread (i.e. all of the text and data are shared with the parent). List the steps that would be involved in creating the user mode context to implement Clone. Make sure to describe how the page tables of the new process should be setup.