Name:

Operating Systems (COP 6611)
Spring 2009
Midterm Exam

Closed books, notes, cell phones, PDAs, iPods, laptops, etc. No headphones, please. You may use a simple calculator (but it is unlikely you will need it).

You have 75 minutes to solve 6 problems, totaling 100 points. As with any exam, you should read through the questions first and start with those that you are most comfortable with. If you believe that you cannot answer a question without making some assumptions, state those assumptions in your answer.

Partial credit will be offered for meaningful progress towards solving the problems.

In recognition of and in the spirit of the academic code of honor, I certify that I will neither give nor receive unpermitted aid on this exam.

Signature:_____

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Total	

1. **(30 points)** Explain in detail the consistency model of the distributed file system you studied (GFS or AFS). Present the consistency model chosen and how it was achieved through design. Clarity of presentation matters, so take your time to formulate your answer clearly.

2. **(10 points)** Show (using pseudocode) that mutexes and counting semaphores are equivalent.

3. **(15 points)** Assume you are given a uniprocessor system with one gigabyte of memory and a 300 gigabyte disk. The OS on the machine has a demand paged virtual memory system with a local page replacement policy and a multi-level feedback queue (MLFQ) CPU scheduler. On the system there are two compute-intensive jobs running: Job-A and Job-B. Job-A has a working set of 50 gigabytes while Job-B has a working set of 100 megabytes. Assume you left the system to run for a while until it reached a steady state with both jobs running.
    a. Which job would you expect to have a higher CPU scheduling priority from the MLFQ scheduler?
    b. Assume you add a second CPU to system, how would this affect the priorities of the jobs?
    c. Assume you switch from a local to a global page replacement policy, how does this change affect the priorities of the jobs?

    Justify your answer and state any assumptions you make.

4. **(15 points)** Consider the organization of a UNIX file as represented by the inode. Assume there are 13 direct block pointers and a singly, doubly and triply indirect pointer in each inode. Further, assume that the system block size and the disk sector size are both 4K. If the disk block pointer is 32 bits, then:
    a. What is the maximum file size supported by this system?
    b. Assuming no information other than the file inode is already in main memory, how many disk accesses are required to access the byte in position $5Y^3+100$, where Y=1024?

5. (15 points)

a. Define the term “deadlock”. There are four conditions that must hold before deadlock is possible. Name them.
b. Outline an algorithm that detects whether there is a deadlock. The algorithm should be able to cope with multiple types of resources, each type having a limited number of units available.
c. When should the algorithm be invoked? The answer to this question may depend on system characteristics such as the rate of resource requests, the granularity of resources, and the expected rate of deadlock. List three possible choices and discuss the criteria you would use to choose among them.

6. (**15 points**) Suppose an instruction takes 1 nanosecond to execute (on average), a page fault takes 20 microseconds of processor time, and it takes 300 microseconds of disk time to read or write a single page. Suppose that on average, 1/2 of the pages are modified. What is the average number of instructions between page faults that would cause the disk to be busy doing page transfers all the time?