Operating Systems and Concurrency
Midterm 1
Fall, 2011
100 Points

Notes
1. Tear off this sheet and use it to **keep your answers covered at all times**.
2. Turn the exam over and write your name next to the staple. Do **not** put your name anywhere else on the exam.
3. To receive full credit, show **all** your work.
4. You are graded not only on the correct answer, but also the most efficient answer.
5. Read all the questions before you begin.
6. The use of calculators is **not** allowed.
7. You may have one 8½ × 11 sheet of notes for use on the test.
8. If you have questions about the test, please come and ask me.
1. (24 points) Answer each of the following questions by circling T (true) or F (false).
   a. T or F: A loosely coupled system and a distributed system are the same things.
   b. T or F: A DMA transfer slows down the CPU because the CPU has to handle the storing of data from the I/O device into memory.
   c. T or F: On a hard disk, seek time is the time it takes to get the desired sector under the disk head.
   d. T or F: Perhaps, the most important kernel function is interpreting commands (the command interpreter).
   e. T or F: The function of the dispatcher is to load jobs that are ready to execute into memory.
   f. T or F: For two processes to communicate, a direct communication link must exist between them.
   g. T or F: One advantage of a kernel thread is that the operating system is able to schedule it.
   h. T or F: Java threads are mapped one-to-one to kernel threads.
   i. T or F: When doing shortest job first scheduling, the process that gets the CPU next is the one whose next CPU burst is the shortest.
   j. T or F: The round robin scheduling algorithm is fair.
   k. T or F: If a machine has a swap instruction, it is possible to use it to implement mutual exclusion.
   l. T or F: Using P’s and V’s are nice because the user cannot inadvertently cause deadlock.

2. (5 points) List five primary components of an operating system.
   a. 
   b. 
   c. 
   d. 
   e. 

3. (5 points) When is batch processing the preferred strategy for work to be done by the computer? When is timesharing the preferred strategy?
4. (5 points) Distinguish between concurrent processes and simultaneous processes.

5. (5 points) Briefly explain how a multiprogramming system’s dispatcher relies on interrupts to manage the processor.

6. (6 points) What is an interrupt service routine (ISR)? How does the operating system know where to find the ISR for a particular device?

7. (5 points) Why would a Java thread ever voluntarily give up the CPU by calling the yield() method? After all, it may never get the CPU back.
8. (5 points) Describe how a counting semaphore can be implemented using only binary semaphores and ordinary machine instructions.

9. (20 points) 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. Note, b through d are non-preemptive, and all jobs are completely CPU bound.
   a. Round robin (1 minute quantum)
   
   b. Priority scheduling

   c. First-come, first-served (run in order 10, 6, 2, 4, 8)

   d. Shortest job first
10. (20 points) Suppose that a university wants to show off how politically correct it is by applying the U.S. Supreme Court’s “Separate but equal is inherently unequal” doctrine to gender as well as race, ending its long-standing practice of gender-segregated bathrooms on campus. However, as a concession to tradition, it decrees that when a woman is in a bathroom, other women may enter, but no men, and vice versa. A sign with a sliding marker on the door of each bathroom indicates which of three possible states it is currently in:

a. Empty
b. Women present
c. Men present

In your favorite language, write the following functions: `womanWantsToEnter` and `manLeaves`. You may use whatever counters you like. P’s and V’s must be used for synchronization. Make sure you describe the variables and semaphores you use.