CSE 421/521 – Operating Systems
Fall 2012 - Homework Assignment #2

The due date is: October 9th, Tuesday, before the class (9:30am). Late submission is **not** allowed. **No soft copies, paper submission only!**

Problem 1:

Consider a preemptive priority scheduling algorithm based on dynamically changing priorities. Larger priority numbers imply higher priority. When a process is waiting for the CPU (in the ready queue, but not running), its priority changes at a rate α; when it is running, its priority changes at a rate β. All processes are given a priority of 0 when they enter the ready queue. The parameters α and β can be set to give many different scheduling algorithms.

   a. What is the algorithm that results from $\beta > \alpha > 0$?

   b. What is the algorithm that results from $\alpha < \beta < 0$?

Problem 2:

Consider a system running ten I/O-bound tasks and one CPU-bound task. Assume that the I/O-bound tasks issue an I/O operation once for every millisecond of CPU computing and that each I/O operation takes 10 milliseconds to complete. Also assume that the context switching overhead is 0.1 millisecond and that all processes are long-running tasks. What is the CPU utilization for a round-robin scheduler when:

   a. The time quantum is 1 millisecond

   b. The time quantum is 10 milliseconds

Problem 3:

Which of the following scheduling algorithms could result in starvation? Explain the reasoning.
         a. First-come, first-served
         b. Shortest job first
         c. Round robin
         d. Priority

Problem 4:

Write a bounded-buffer monitor in which the buffers (portions) are embedded within the monitor itself.

Problem 5:

Consider the deadlock situation that could occur in the dining-philosophers problem when the philosophers obtain the chopsticks one at a time. Discuss how the four necessary conditions for deadlock indeed hold in this setting. Discuss how deadlocks could be avoided by eliminating any one of the four conditions.

Problem 6:

Consider the dining-philosophers problem where the chopsticks are placed at the center of the table and any two of them could be used by a philosopher. Assume that requests for chopsticks are made one at a time. Describe a simple rule for determining whether a particular request could be satisfied without causing deadlock given the current allocation of chopsticks to philosophers.

Problem 7:

Show that, if the `wait()` and `signal()` semaphore operations are not executed atomically, then mutual exclusion may be violated.

Problem 8:

Write a monitor that implements an *alarm clock* that enables a calling program to delay itself for a specified number of time units (*ticks*). You may assume the existence of a real hardware clock that invokes a procedure *tick* in your monitor at regular intervals.