| CS 4760 | Operating Systems | Test 2 |
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| Name: | Spring 2009 | Max Pts: 51 |

**Important**: This is an open book test. You can use any books, notes, or paper but no electronic device. *Do not log into the computer during the test, or use any electronic or communications device. Switch off your cell phones.* Any calculations and rough work can be done on the back side of the test pages. If there is a syntax error in any program segment, just write it down and you will get full credit for the problem. You will lose five points for not writing your name.

1. [6 pt] When we compile a program on one operating system, we cannot typically execute it under a different operating system, even on the same machine. For example, an executable program generated on a machine running Linux will not run under Windows. What is the reason for that?

2. [6 pt] How do you control degree of multiprogramming in an operating system? Why is it necessary to do so?

3. [8 pt] One way to fix the deadlock problem is by denying circular wait. This can be achieved by creating a total order on all resources and allocating resources in order. Illustrate with an example why it cannot be achieved by creating a partial order on resources.

4. [6 pt] Compare chain based method and indirect addressing method for linking. Name one advantage for each of them.

5. [15pt] Assume that you have the following jobs to be executed with one processor:

| Process | Burst time | Arrival time |
|---|---|---|
| $p_0$ | 2 | 7 |
| $p_1$ | 7 | 9 |
| $p_2$ | 9 | 1 |
| $p_3$ | 8 | 2 |
| $p_4$ | 2 | 0 |

Give the average wait time and average turnaround time for each process using the following algorithms. Is the CPU idle at any time in the given algorithms?

(a) First in first out

(b) Shortest job next (no preemption)

(c) Shortest remaining time next

(d) Round robin, with a quantum of 4

(e) Round robin, with a quantum of 3 plus context switch time of 1

6. [10 pt] Consider a system with the following set of processes and states:

$$P = \{p_0, p_1\},\ S = \{s_0, s_1, s_2, s_3\}$$

State changes due to processes are:

$$\begin{array}{ll} p_0(s_0) = \{s_1\} & p_1(s_0) = \{s_2, s_3\} \\ p_0(s_1) = \{s_2\} & p_1(s_1) = \{s_2\} \\ p_0(s_2) = \{s_1\} & p_1(s_2) = \Omega \\ p_0(s_3) = \{s_1, s_2\} & p_1(s_3) = \{s_1\} \end{array}$$

Draw the corresponding state change diagram. Is the system safe? Is it deadlocked? Is there a knot in the system?