CS492 Spring 2020 – Homework 2

No handwritten submissions will be accepted or graded. Your submission must be a pdf (not doc, docx, tex, html, rtf and any other format, but **pdf**) file with the typed solutions to the 5 problems included in this document.

This is an individual assignment. Individual assignments, as the word indicate, are to be done INDIVIDUALLY. Any sign of collaboration will result in a 0 and being reported to the Honor Board.

Problem 1. (10 pts)

Does the busy waiting solution using the turn variable (Fig. 2-23 in the book) solves the mutual exclusion problem when two processes are running on a shared-memory multiprocessor, that is, two CPUs sharing a common memory?

Problem 2. (20 pts)

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.

   a) Round robin.
   b) Priority scheduling.
   c) First-come, first-served (run in order 10, 6, 2, 4, 8).
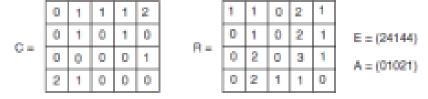   d) Shortest job first.

For (a), assume that the system is multiprogrammed, and that each job gets its fair share of the CPU. For (b) through (d), assume that only one job at a time runs, until it finishes. All jobs are completely CPU bound.

Problem 3. (20 pts)

A soft real-time system has four periodic events with periods of 50, 100, 200, and 250 msec each. Suppose that the four events require 35, 20, 10, and x msec of CPU time, respectively. What is the largest value of x for which the system is schedulable?

Problem 4. (25 pts)

Consider the following state of a system with four processes, P1, P2, P3, and P4, and five types of resources, RS1, RS2, RS3, RS4, and RS5:

$$C = \begin{bmatrix} 0 & 1 & 1 & 1 & 2 \\ 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 2 & 1 & 0 & 0 & 0 \end{bmatrix} \quad R = \begin{bmatrix} 1 & 1 & 0 & 2 & 1 \\ 0 & 1 & 0 & 2 & 1 \\ 0 & 2 & 0 & 3 & 1 \\ 0 & 2 & 1 & 1 & 0 \end{bmatrix}$$

$$E = (2\,4\,1\,4\,4)$$
$$A = (0\,1\,0\,2\,1)$$

Using the deadlock detection algorithm described in Section 6.4.2, show that there is a deadlock in the system. Identify the processes that are deadlocked.

Problem 5. (25 pts)

A system has four processes and five allocable resources. The current and maximum needs are as follows:

	Allocated	Maximum	Available
Process A	1 0 2 1 1	1 1 2 1 2	0 0 x 1 1
Process B	2 0 1 1 0	2 2 2 1 0	
Process C	1 1 0 1 0	2 1 3 1 0	
Process D	1 1 1 1 0	1 1 2 2 1	

What is the smallest value of x for which this is a safe state? Show your calculations using the Banker's Algorithm.