LEHMAN COLLEGE
OF THE
CITY UNIVERSITY OF NEW YORK
Department of Computer Science

CMP 426/CMP 697 Exam 2

Date: November 20, 2018

Name: ____

Instructions:

- Answer all questions on this exam paper.
- Please make sure your writing and diagrams are legible. Answer all questions within the space provided on the paper. Be concise!
- Please read each question very carefully and answer the question clearly to the point. Make sure that your answers are neatly written, legible, and readable.
- This is a CLOSED book exam!

Question	Points Assigned	Points Obtained
	30	
	27	
	25	
	25	
Total	105	

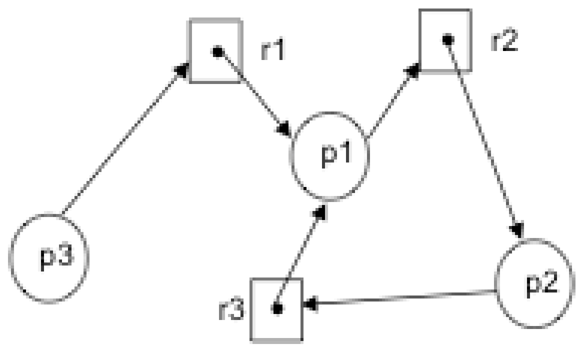
1. **(30 points) Deadlocks**
   Consider the following information about a system:
   – There are two resources named R1 and R2.
   – There are two instances of each resource.
   – There are four processes named P1 through P4.
   There are some resource instances already allocated to processes, as follows:
   – one instance of R1 held by P2, another held by P3
   – one instance of R2 held by P1, another held by P4
   Some processes have requested additional resources, as follows:
   – P1 wants one instance of R1
   – P3 wants one instance of R2
   (Use the above information to answer questions A), and B) below.

   A) (7 points) Draw the resource allocation graph for this system. Use the style of diagram from the lecture notes.

   B) (6 points) Is this the above system deadlocked? If so, state which processes are involved. If not, give an execution sequence that eventually ends, showing resource acquisition and release at each step.

C) (5 points) For the following resource allocation graph, find out whether there is a deadlock.

a.



Consider the following system with four processes (P0, P1, P2, and P3) and resource types A, B and C. Given that all resource instances are of the same type and using the definitions presented in the discussion of the Banker's Algorithm, answer these questions for each system:

	Max			Allocation			Available		
	A	B	C	A	B	C	A	B	C
P0	0	0	1	0	0	1	1	5	2
P1	1	7	5	1	0	0			
P2	2	3	5	1	3	5			
P3	0	6	5	0	6	3			

D) (4 points) Determine the values in the Need matrix for each process in the system.

E) (8 points) Determine whether each of the systems is safe or unsafe. If the system is in a safe state, list a sequence of requests and releases that will make it possible for all processes to run to completion. If the system is in an unsafe state, show how it is possible for deadlock to occur.

2) (27 Points) CPU Scheduling.

Given the following information:

Process	Arrival Time	Burst Time
P0	0	8
P1	1	4
P2	2	3
P3	3	2
P4	4	4

Draw a Gantt chart for each of the following scheduling algorithms and compute the average waiting time for each process. Use the above information to answer Question A), B), C, and D)

A). (6 points) First-Come First-Served (FCFS)

B). (6 points) Shortest Job First (SJF)

C). (6 points) Round Robin (using a time quantum of 4)

D). (6 points) For the round robin algorithm above, compute the waiting time for each process (not the average).

E). (6 points) A short quantum allows a scheduler to cycle through more processes more quickly than with a long quantum. What is the downside of this?

3) (23 Points) Process Synchronization

A). (5 points) What is a counting semaphore?

B). (6 points) Explain what is meant by *starvation* in the context of a solution to the mutual exclusion problem.

C). (8 Points) What is a critical section? What are the three requirements for correctly solving a critical section problem?

D). (6 Points) Explain the key drawback of spinlocks with busy-waiting compared to binary semaphores with sleeping.

4) (25 points) Memory Management

A). (7 points) What is swapping and when is it used?

B). (6 points) What is fragmentation? What is the difference between external and internal fragmentation?

C). (6 pts) List three algorithms for managing memory with contiguous segmented allocation. Do these algorithms require compaction to work?

HAPPY THANKSGIVING!