CS307 Operating System Exercises Spring 2019

Exercise 3: Deadlocks

Due date: Apr. 15, 2019

1. Suppose there are 2 copies of resource A, 3 copies of resource B, and 3 copies of resource C. Suppose further that process 1 holds one unit of resources B and C and is waiting for a unit of A; that process 2 is holding a unit of A and waiting on a unit of B; and that process 3 is holding one unit of A, two units of B, and one unit of C. Draw the resource allocation graph. Is the system in a deadlocked state? Why or why not?

2. Consider the following system snapshot using data structures in the Banker's algorithm, with resources A, B, C, and D, and process P0 to P4:

	Max				Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D	A	B	C	D
P0	6	0	1	2	4	0	0	1								
P1	1	7	5	0	1	1	0	0								
P2	2	3	5	6	1	2	5	4								
P3	1	6	5	3	0	6	3	3								
P4	1	6	5	6	0	2	1	2								
													3	2	1	1

Using Banker's algorithm, answer the following questions.

a. How many resources of type A, B, C, and D are there?
b. What are the contents of the Need matrix?
c. Is the system in a safe state? Why?
d. If a request from process P4 arrives for additional resources of (1,2,0,0,), can the Banker's algorithm grant the request immediately? Show the new system state and other criteria.

3. Consider a system with four processes P1, P2, P3, and P4, and two resources, R1, and R2, respectively.
   Each resource has two instances. Furthermore:
   - P1 allocates an instance of R2, and requests an instance of R1.
   - P2 allocates an instance of R1, and doesn't need any other resource.
   - P3 allocates an instance of R1 and requires an instance of R2.
   - P4 allocates an instance of R2, and doesn't need any other resource

   a. Draw the resource allocation graph.
   b. Is there a cycle in the graph? If yes name it.
   c. Is the system in deadlock? If yes, explain why. If not, give a possible sequence of executions after which every process completes.

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

	Allocated	Maximum	Available
Process A	1 0 2 1 1	1 1 2 1 3	0 0 1 X 2
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?