CS2302 Operating System Exercises Spring 2022

Exercise 3: Deadlocks

Due Time: Apr. 4, 2022

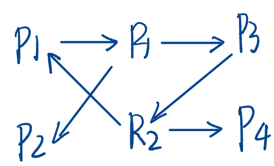
1. A computer system has 8 printers that are shared by K process. Each of the processes can take no more than 3 printers. K=1 V K=2 V K=3 V K=4 X If each of the process ask for 1 printer while already has two printer, a deadlock may be caused.
   a. What is the minimum value of K that may cause the system deadlock? Why?
   b. Is there a minimum value of K that must cause the system deadlock? Why?
   No.

2. Consider the following snapshot of a system:

	Allocation				Max				Available				Need			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
P0	0	0	1	2	0	0	1	2	~~2~~	~~1~~	~~0~~	~~0~~	0	0	0	0
P1	2	0	0	0	2	7	5	0	2	1	1	2	0	7	5	0
P2	0	0	3	4	6	6	5	6					2	0	0	2
P3	2	3	5	4	4	3	5	6					0	3	2	0
P4	0	3	3	2	0	6	5	2								

   Answer the following questions using the banker's algorithm:
   a. What is the content of the matrix Need?
   b. Is the system in a safe state? Why or why not? Yes, P0→P3→P4→P2
   c. If a request from process P2 arrives for (0,2,0,0), can the request be granted immediately? Briefly Explain. No, because P2 needs 2 R2, but there only 1 R2

3. Consider a system with four processes P1, P2, P3, and P4, and two kinds of resources, R1, and R2, respectively. Each kind of resource has two instances. Furthermore:



   - P1 is allocated with an instance of R2, and requests an instance of R1.
   - P2 is allocated with an instance of R1, but doesn't need any more resource.
   - P3 is allocated with an instance of R1, and requests an instance of R2.
   - P4 is allocated with an instance of R2, but doesn't need any more resource

   a. Draw the resource allocation graph.
   b. Is there a cycle in the graph? If yes name it. P1→R1→P3→R2→P1
   c. Is the system in deadlock? If yes, explain why. If not, give a possible sequence of executions after which every process completes.
   NO, P2→P1→P3→P4

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?

Exercise 3 Solutions

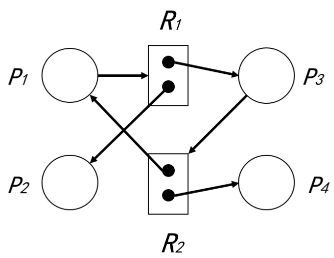
1. a. 4
   b. No
2. a.

	Allocation				Max				Available			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
P0	0	0	1	2	0	0	1	2	0	0	0	0
P1	2	0	0	0	2	7	5	0	0	7	5	0
P2	0	0	3	4	6	6	5	6	6	6	2	2
P3	2	3	5	4	4	3	5	6	2	0	0	2
P4	0	3	3	2	0	6	5	2	0	3	2	0

（b）The system is in a safe state as the processes can be finished in the sequence <P0,P3,P4,P1,P2>

（c）No, it can’t. Process P2 requires two R2, while there is only one free R2.

3. a. Draw the resource allocation graph.



   b. P1 R1 P3 R2 P1
   c. No. There is a cycle, but no deadlock. P2 and P4 have all resources for completing. P2 P4, P1, P3

4. The need matrix is as follows:

	R1	R2	R3	R4	R5
A	0	1	0	0	2
B	0	2	1	0	0
C	1	0	3	0	0
D	0	0	1	1	1

Suppose that we are in a safe state. Process D must run first, because we have no other choice. To make process D run, the number X of R4 should be no less than 1. Since process A, B, and C do not need any more instance of resource R4, the constraint of X is X>=1.

So if and only if X>=1, the state is safe. Then the smallest value of X is 1.