DPP

Operating System

Deadlock

Q1 Consider a system with 3 processes A, B and C. All 3 processes require 6 resources each to execute. The minimum number of resources the system should have such that deadlock can never occur, is _____?

Q2 Consider a system with 5 processes that share 15 instances of the same resource type. Each process can request a maximum of k instances. Resource instances can be requested and released only one at a time. The largest value of k that will always avoid deadlock is ____?

Q3 Consider the following process scenario with 5 processes P1, P2, P3, P4 and P5; and 4 types of recourses A, B, C and D. The system has total 3, 14, 11 and 12 instances of resources A, B, C and D respectively.

Process	Allocation				Max			
	A	B	C	D	A	B	C	D
P1	0	0	0	2	0	3	1	2
P2	1	0	0	0	1	7	5	0
P3	1	3	5	4	2	3	5	6
P4	0	6	3	2	0	6	5	4
P5	0	0	1	4	0	6	5	6

Here allocation denotes the total allocated instances of each resource type. And Max denotes the maximum required instances of each resource type. Which of the following is true regarding the deadlock avoidance?

(A) The system is in unsafe state

(B) The system is in safe state and safe sequence is <P1, P2, P3, P4, P5>

(C) The system is in safe state and safe sequence is <P1, P3, P2, P4, P5>

(D) The system is in safe state and safe sequence is <P1, P4, P3, P2, P5>

Q4 Consider the following scenario:

Process	Max	Allocation
P1	5	0
P2	4	0
P3	6	0
P4	2	0

Minimum number of available resources required to have system deadlock free is ___?

Q5 Consider the following scenario:

Process	Max	Allocation
P1	4	1
P2	8	3
P3	3	1
P4	4	0

Minimum number of not allocated available resources required to have system deadlock free is _____?

Q6 A computer has 23 tape drives, with n number of processes competing for them. Each process may need 5 drives. The maximum value of n for the system to be deadlock free is _____?

Answer Key

Q1	16
Q2	3
Q3	(C, D)
Q4	14
Q5	11
Q6	5

Hints & Solutions

Q1 Text Solution:

Minimum number of resources to avoid deadlock = 3 (6 – 1) + 1

= 16

Q2 Text Solution:

To avoid deadlock

15 > = 5 (k – 1) + 1

k < = 3.8

Maximum value of k = 3

Q3 Text Solution:

Among total 3 instances of resource A, 2 are already allocated, hence available is = 1

Among total 14 instances of resource B, 9 are already allocated, hence available is = 5

Among total 11 instances of resource C, 9 are already allocated, hence available is = 2

Among total 12 instances of resource D, 12 are already allocated, hence available is = 0

So current available = 1, 5, 2, 0

Let us calculate need matrix now, which is = max – allocation

Process	Allocation				Max				Need			
	A	B	C	D	A	B	C	D	A	B	C	D
P1	0	0	0	2	0	3	1	2	0	3	1	0
P2	1	0	0	0	1	7	5	0	0	7	5	0
P3	1	3	5	4	2	3	5	6	1	0	0	2
P4	0	6	3	2	0	6	5	4	0	0	2	2
P5	0	0	1	4	0	6	5	6	0	6	4	2

For process P1, the its need <= available, hence once after P1 completes, available resources = available + allocation of P1 = (1, 5, 2, 0) + (0, 0, 0, 2) = 1, 5, 2, 2

Now any of the processes P3 or P3 can run because their need <= available

Hence after P3 itself the available resources = available + allocation of P3 = (1, 5, 2, 2) + (1, 3, 5, 4) = (2, 8, 7, 6)

Now all processes have their need <= available

Hence the system is in safe state.

Among given options, <P1, P3, P2, P4, P5> and <P1, P4, P3, P2, P5> are correct safe sequences.

But after P1, P2 can not be executed.

Q4 Text Solution:

Minimum number of available resources required to have system deadlock free = (5 - 1)+ (4 - 1)+(6 -1)+(2-1) + 1

= 4 + 3 + 5 + 1 + 1

= 14

Q5 Text Solution:

Minimum number of available resources required to have system deadlock free = (4 - 1 - 1) + (8 - 3 -1) + (3 - 1 -1) + (4 - 0 -1) + 1

= 2 + 4 + 1 + 3 + 1

= 11

Q6 Text Solution:

23 > = n (5 – 1) + 1

n < = 5.5

Maximum value of n = 5