Practice

1. Consider the following snapshot of a system:

	Allocation				Max			
	A	B	C	D	A	B	C	D
T0	2	1	0	6	6	3	2	7
T1	3	3	1	3	5	4	1	5
T2	2	3	1	2	6	6	1	4
T3	1	2	3	4	4	3	4	5
T4	3	0	3	0	7	2	6	1

What are the contents of the Need matrix?

2. Consider the following snapshot of a system:

	Allocation			Max			Available		
	A	B	C	A	B	C	A	B	C
T0	0	1	0	7	5	3	3	3	2
T1	2	2	0	3	2	2			
T2	3	0	2	9	0	2			
T3	2	1	1	2	2	2			
T4	0	0	2	4	3	3			

Answer the following questions using the banker's algorithm:

a. What are the contents of the Need Matrix?
b. Is the system in a safe state?
c. If a request from thread T_0 arrivers for (1,0,0) can be request be granted immediately?

Practice

3. Consider the following snapshot of a system:

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
T0	0	0	1	2	0	0	1	2	1	5	2	0
T1	1	0	0	0	1	7	5	0				
T2	1	3	5	4	2	3	5	6				
T3	0	6	3	2	0	6	5	2				
T4	0	0	1	4	0	6	5	6				

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?
c. If a request from thread T_1 arrives for (0,4,2,0), can the request be granted immediately?

Practice

4. Consider the following snapshot of a system:

	Allocation				Max			
	A	B	C	D	A	B	C	D
T0	3	0	1	4	5	1	1	7
T1	2	2	1	0	3	2	1	1
T2	3	1	2	1	3	3	2	1
T3	0	5	1	0	4	6	1	2
T4	4	2	1	2	6	3	2	5

Using the banker's algorithm, determine whether or not each of the following states is unsafe. If the state is safe, illustrate the order in which the threads may complete. Otherwise, illustrate why the state is unsafe.

a. Available = (0, 3, 0, 1)
b. Available = (1, 0, 0, 2)

Practice

5. Consider the following snapshot of a system:

	Allocation				Max			
	A	B	C	D	A	B	C	D
T0	1	2	0	2	4	3	1	6
T1	0	1	1	2	2	4	2	4
T2	1	2	4	0	3	6	5	1
T3	1	2	0	1	2	6	2	3
T4	1	0	0	1	3	1	1	2

Using the banker's algorithm, determine whether or not each of the following states is unsafe. If the state is safe, illustrate the order in which the threads may complete. Otherwise, illustrate why the state is unsafe.

a. Available = (2, 2, 2, 3)
b. Available = (4, 4, 1, 1)
c. Available = (3, 0, 1, 4)
d. Available = (1, 5, 2, 2)

Practice

6. Consider the following snapshot of a system:

	Allocation				Max				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
T0	3	1	4	1	6	4	7	3	2	2	2	4
T1	2	1	0	2	4	2	3	2				
T2	2	4	1	3	2	5	3	3				
T3	4	1	1	0	6	3	3	2				
T4	2	2	2	1	5	6	7	5				

Answer the following questions using the banker's algorithm:

a. Illustrate that the system is in a safe state by demonstrating an order in which the threads may complete.
b. If a request from thread T_4 arrives for (2, 2, 2, 4), can the request be granted immediately?
c. If a request from thread T_2 arrives for (0, 1, 1, 0), can the request be granted immediately?
d. If a request from thread T_3 arrives for (2, 2, 1, 2), can the request be granted immediately?

Question 1

The content of the matrix Need is defined to be Max – Allocation:

	Need			
	A	B	C	D
T0	4	2	2	1
T1	2	1	0	2
T2	4	3	0	2
T3	3	1	1	1
T4	4	2	3	1

Question 2

a/ The content of the matrix Need is defined to be Max – Allocation:

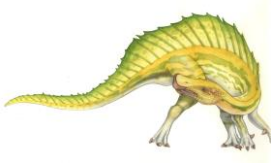
	Need		
	A	B	C
T0	7	4	3
T1	1	0	2
T2	6	0	0
T3	0	1	1
T4	4	3	1

The system is in a safe state since the sequence < T1, T3, T4, T2, T0> satisfies safety criteria.

b/ Check that Request $\leq$ $Need_0$ (that is, (1,0,0) $\leq$ (7,4,3) $\Rightarrow$ true
Check that Request $\leq$ Available (that is, (1,0,0) $\leq$ (3,3,2) $\Rightarrow$ true

	Allocation			Need			Available		
	A	B	C	A	B	C	A	B	C
T0	1	1	0	6	4	3	2	3	2
T1	2	2	0	1	0	2			
T2	3	0	2	6	0	0			
T3	2	1	1	0	1	1			
T4	0	0	2	4	3	1			

Executing safety algorithm shows that sequence <T1, T3, T4, T2, T0> satisfies safety requirement.



Question 3

a/ The content of the matrix Need is defined to be Max – Allocation:

	Need			
	A	B	C	D
T0	0	0	0	0
T1	0	7	5	0
T2	1	0	0	2
T3	0	0	2	0
T4	0	6	4	2

b/ The system is in a safe state since the sequence < *T0*, *T2*, *T3*, *T4*, *T1*> satisfies safety criteria.

c/ Check that Request ≤ $Need_1$ (that is, (0,4,2,0) ≤ (0,7,5,0) ⇒ true
Check that Request ≤ Available (that is, (0,4,2,0) ≤ (1,5,2,0) ⇒ true

	Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
T0	0	0	1	2	0	0	0	0	1	1	0	0
T1	1	4	2	0	0	3	3	0				
T2	1	3	5	4	1	0	0	2				
T3	0	6	3	2	0	0	2	0				
T4	0	0	1	4	0	6	4	2				

Executing safety algorithm shows that sequence < *T0*, *T2*, *T3*, *T4*, *T1* > satisfies safety requirement

Question 4

a/ The content of the matrix Need is defined to be Max – Allocation:

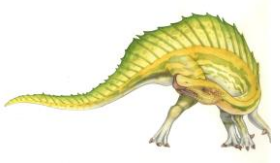
	Need				Available			
	A	B	C	D	A	B	C	D
T0	2	1	0	3	0	3	0	1
T1	1	0	0	1				
T2	0	2	0	0				
T3	4	1	0	2				
T4	2	1	1	3				

The system is in a safe state since the sequence < T2,T4,T0,T1,T3> satisfies safety criteria.

b/ The content of the matrix Need is defined to be Max – Allocation:

	Need				Available			
	A	B	C	D	A	B	C	D
T0	2	1	0	3	1	0	0	2
T1	1	0	0	1				
T2	0	2	0	0				
T3	4	1	0	2				
T4	2	1	1	3				

The system is in a safe state since the sequence < T1,T2,T3,T4,T0> satisfies safety criteria.



Question 5

a/ The content of the matrix Need is defined to be Max – Allocation:

	Need				Available			
	A	B	C	D	A	B	C	D
T0	3	1	1	4	2	2	2	3
T1	2	3	1	2				
T2	2	4	1	1				
T3	1	4	2	2				
T4	2	1	1	1				

The system is in a safe state since the sequence < T4, T0, T1, T2, T3> satisfies safety criteria.

b/ The content of the matrix Need is defined to be Max – Allocation:

	Need				Available			
	A	B	C	D	A	B	C	D
T0	3	1	1	4	4	4	1	1
T1	1	0	0	1				
T2	0	2	0	0				
T3	4	1	0	2				
T4	2	1	1	1				

The system is in a safe state since the sequence < T2, T3, T4, T0, T1> satisfies safety criteria.

Question 5

c/ The content of the matrix Need is defined to be Max – Allocation:

	Need				Available			
	A	B	C	D	A	B	C	D
T0	3	1	1	4	3	0	1	4
T1	2	3	1	2				
T2	2	4	1	1				
T3	1	4	2	2				
T4	2	1	1	1				

The system is in a unsafe state because there are not have any sequence satisfies safety criteria.

d/ The content of the matrix Need is defined to be Max – Allocation:

	Need				Available			
	A	B	C	D	A	B	C	D
T0	3	1	1	4	1	5	2	2
T1	1	0	0	1				
T2	0	2	0	0				
T3	4	1	0	2				
T4	2	1	1	1				

The system is in a safe state since the sequence < T3, T4, T0, T1, T2> satisfies safety criteria.

Question 6

a/ The content of the matrix Need is defined to be Max – Allocation:

	Need			
	A	B	C	D
T0	3	3	3	2
T1	2	1	3	0
T2	0	1	2	0
T3	2	2	2	2
T4	3	4	5	4

The system is in a safe state since the sequence < T2, T3, T4, T0 ,T1> satisfies safety criteria. So the request can be granted.

b/ Check that Request $\leq$ $Need_4$ (that is, (2,2,2,4) $\leq$ (3,4,5,4) $\Rightarrow$ true
Check that Request $\leq$ Available (that is, (2,2,2,4) $\leq$ (2,2,2,4) $\Rightarrow$ true

	Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
T0	3	1	4	1	3	3	3	2	0	0	0	0
T1	2	1	0	2	2	1	3	0				
T2	2	4	1	3	0	1	2	0				
T3	4	1	1	0	2	2	2	2				
T4	4	4	4	5	1	2	3	0				

Executing safety algorithm shows that there are not have any sequence satisfies safety requirement. The system is in unsafe state, so the request can not be granted.

Question 6

c/ Check that Request ≤ $Need_2$ (that is, (0,1,1,0) ≤ (0,1,2,0) ⇒ true
Check that Request ≤ Available (that is, (0,1,1,0) ≤ (2,2,2,4) ⇒ true

	Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
T0	3	1	4	1	3	3	3	2	2	1	1	4
T1	2	1	0	2	2	1	3	0				
T2	2	5	2	3	0	0	1	0				
T3	4	1	1	0	2	2	2	2				
T4	2	2	2	1	3	4	5	4				

Executing safety algorithm shows that sequence <T1, T2, T3 ,T0, T4> satisfies safety requirement. So the request can be granted.

d/ Check that Request ≤ $Need_3$ (that is, (2,2,1,2) ≤ (2,2,2,2) ⇒ true
Check that Request ≤ Available (that is, (2,2,1,2) ≤ (2,2,2,4) ⇒ true

	Allocation				Need				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
T0	3	1	4	1	3	3	3	2	0	0	1	2
T1	2	1	0	2	2	1	3	0				
T2	2	4	1	3	0	1	2	0				
T3	6	3	2	2	0	0	1	0				
T4	2	2	2	1	3	4	5	4				

Executing safety algorithm shows that sequence <T3, T0, T1, T2 ,T4> satisfies safety requirement.