Quiz Assignment-IV Solutions: Distributed Systems (Week-4)

Q. 1 In wait for graph (WFG), a directed edge from node P1 to node P2 indicates that:

A. P1 is blocked and is waiting for P2 to release some resource
B. P2 is blocked and is waiting for P1 to release some resource
C. P1 is blocked and is waiting for P2 to leave the system
D. P2 is blocked and is waiting for P1 to leave the system

Ans: A) P1 is blocked and is waiting for P2 to release some resource

Explanation: The state of the system can be modeled by directed graph, called a wait for graph (WFG). In a WFG , nodes are processes and there is a directed edge from node P1 to node P2 if P1 is blocked and is waiting for P2 to release some resource.

Q. 2 In the wait for graph, if there exists a directed cycle or knot:

A. then a deadlock does not exist
B. then a deadlock exists
C. then the system is in a safe state
D. either b or c

Ans: B) then a deadlock exists

Explanation: A system is deadlocked if and only if there exists a directed cycle or knot in the WFG.

Q. 3 Consider the following statements:

A deadlock detection algorithm must satisfy the following two conditions:

Condition 1: Progress (No false deadlocks): The algorithm should not report deadlocks which do not exist.

Condition 2: Safety (No undetected deadlocks): The algorithm must detect all existing deadlocks in finite time.

A. Both conditions are true
B. Both conditions are false
C. Only condition 1 is true
D. Only condition 1 is true

Ans: B) Both conditions are false

Explanation: A deadlock detection algorithm must satisfy the following two conditions:

(i)Progress (No undetected deadlocks): The algorithm must detect all existing deadlocks in finite time. In other words, after all wait-for dependencies for a deadlock have formed, the algorithm should not wait for any more events to occur to detect the deadlock.

(ii)Safety (No false deadlocks): The algorithm should not report deadlocks which do not exist (called phantom or false deadlocks).

Q. 4 Consider the following regarding the models of deadlock:

Model of Deadlock	Design Paradigm
(P) Single Resource Model	(i) No assumptions are made regarding the underlying structure of resource requests.
(Q) AND Model	(ii) Presence of a knot indicates a deadlock.
(R) OR Model	(iii) The out degree of a node in the WFG can be more than 1.
(S) Unrestricted model,	(iv) Maximum out-degree of a node in a WFG can be 1

Match the deadlock models to the design paradigms they are based on.

A. (P): (i), Q: (ii), R: (iii), (S): (iv)
B. (P): (iv), Q: (iii), R: (ii), (S): (i)
C. (P): (iii), Q: (iv), R: (i), (S): (ii)
D. (P): (ii), Q: (iv), R: (i), (S): (iii)

Ans: B) (P): (iv), Q: (iii), R: (ii), (S): (i)

Explanation:

The Single Resource Model: In the single resource model, a process can have at most one outstanding request for only one unit of a resource. Since the maximum out-degree of a node in a WFG for the single resource model can be 1, the presence of a cycle in the WFG shall indicate that there is a deadlock.

The AND Model: In the AND model, a process can request for more than one resource simultaneously and the request is satisfied only after all the requested resources are granted to the process. The out degree of a node in the WFG for AND model can be more than 1.

OR Model: In the OR model, the presence of a knot indicates a deadlock.

Unrestricted Model: In the unrestricted model, no assumptions are made regarding the underlying structure of resource requests. Only one assumption that the deadlock is stable is made and hence it is the most general model.

Q. 5 Consider the following statements related to distributed deadlock detection algorithms:

Statement 1: In path-pushing algorithms, distributed deadlocks are detected by maintaining an explicit global WFG. The basic idea is to build a global WFG for each site of the distributed system.

Statement 2: In an edge-chasing algorithm, the presence of a cycle in a distributed graph structure is be verified by propagating special messages called probes, along the edges of the graph. These probe messages are different than the request and reply messages.

A. Both statements are true
B. Both statements are false
C. Only statement 1 is true
D. Only statement 2 is true

Ans: A) Both statements are true

Q. 6 Consider the following statements related to consistency models:

(i) Strict consistency (SC): Only Write operations issued by the same processor and to the same memory location must be seen by others in that order.

(ii) PRAM memory: Only Write operations issued by the same processor are seen by others in the order they were issued, but Writes from different processors may be seen by other processors in different orders.

(iii) Slow Memory: Any Read to a location (variable) is required to return the value written by the most recent Write to that location (variable) as per a global time reference.

A. All are True
B. All are False
C. Only (i) and (iii) are true
D. Only (ii) is true

Ans: D) Only (ii) is true

Explanations: (i) Strict consistency (SC): Any Read to a location (variable) is required to return the value written by the most recent Write to that location (variable) as per a global time reference.

(ii) PRAM memory: Only Write operations issued by the same processor are seen by others in the order they were issued, but Writes from different processors may be seen by other processors in different orders.

(iii) Slow Memory: Only Write operations issued by the same processor and to the same memory location must be seen by others in that order.

Q. 7 Choose the correct consistency model that defines the following conditions:

I. All Writes are propagated to other processes, and all Writes done elsewhere are brought locally, at a sync instruction.
II. Accesses to sync variables are sequentially consistent
III. Access to sync variable is not permitted unless all Writes elsewhere have completed
IV. No data access is allowed until all previous synchronization variable accesses have been performed

A. Weak consistency
B. Causal consistency
C. Processor consistency
D. Program consistency

Ans: A) Weak consistency

Q. 8 The space complexity is the ____________registers and time complexity is ________time for n-process bakery algorithm of shared memory mutual exclusion

A. Upper bound of n, $O(n^2)$
B. Upper bound of n, O(n)
C. Lower bound of n, O(n)
D. Lower bound of n, $O(n^2)$

Ans: C) Lower bound of n, O(n)

Explanation: For Bakery algorithm

Space complexity: lower bound of n registers

Time complexity: O(n) time

Q. 9 In GHS algorithm for Minimum Spanning Tree (MST), an edge adjacent to the fragment with smallest weight and that does not create a cycle is called as:

A. Weight outgoing edge (WOE)
B. Least weight outgoing edge (LWOE)
C. Link outgoing weight edge (LOWE)
D. Minimum weight outgoing edge (MWOE)

Ans: D) Minimum weight outgoing edge (MWOE)

Explanation: Minimum weight outgoing edge (MWOE) An edge adjacent to the fragment with smallest weight and that does not create a cycle.

Q. 10 The GHS algorithm computes the minimum spanning tree using ____________messages for a graph of N nodes and E edges

A. Atleast 2|E|
B. Atleast 5N logN
C. Atmost 3NlogN + 2|E|
D. Atmost 5N logN + 2|E|

Ans: D) At most 5N logN + 2|E|

Explanation: The upper bound of GHS algorithm is 5N logN + 2|E|

Q. 11 Consider the following properties of minimum spanning tree (MST):

MST Property 1: Given a fragment of an MST, let e be a minimum-weight outgoing edge of the fragment. Then joining e and its adjacent non-fragment node to the fragment yields another fragment of an MST.

MST Property 2: If all the edges of a connected graph have same weights, then the MST is unique.

A. Both are true
B. Both are false
C. Only property 1 is true
D. Only property 2 is true

Ans: C) Only property 1 is true

Explanation: MST Property 1: Given a fragment of an MST, let e be a minimum-weight outgoing edge of the fragment. Then joining e and its adjacent non-fragment node to the fragment yields another fragment of an MST.

MST Property 2: If all the edges of a connected graph have different weights, then the MST is unique.