Quiz Assignment-V Solutions: Distributed Systems (Week-5)

Q. 1 A state in which a process has finished its computation and will not restart any action unless it receives a message is called as

A. Partially terminated state
B. Locally terminated state
C. Globally terminated state
D. Terminating state

Ans: Locally terminated state

Explanation: A distributed computation is globally terminated if every process is locally terminated and there is no message in transit between any processes.

“Locally terminated” state is a state in which a process has finished its computation and will not restart any action unless it receives a message.

Q. 2 In spanning-tree-based termination detection algorithm of Topor, the best case message complexity is _____and worst case complexity of the algorithm is_____,where N is the number of processes and M is the number of computation messages exchanged

A. O(N), O(M)
B. O(N), O(N*M)
C. $O(N^2)$, $O(N^2)$
D. O(M), O(N)

Ans: O(N), O(N*M)

Explanation: The best case message complexity of the algorithm is O(N), where N is the number of processes in the computation, which occurs when all nodes send all computation messages in the first round.

The worst case complexity of the algorithm is O(N*M), where M is the number of computation messages exchanged, which occurs when only computation message is exchanged every time the algorithm is executed.

Q. 3 Consider the following statements about termination detection (TD) algorithm

Statement 1: Execution of a termination detection algorithm cannot indefinitely delay the underlying computation.

Statement 2: The termination detection algorithm required addition of new communication channels between processes.

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

Ans: Statement 1 is true and statement 2 is false

Explanation: A termination detection (TD) algorithm must ensure the following:

1. Execution of a TD algorithm cannot indefinitely delay the underlying computation.

2. The termination detection algorithm must not require addition of new communication channels between processes.

Q. 4 Find out the correct relation between the different message ordering paradigms, where SYNC, FIFO, A and CO denote the set of all possible executions ordered by synchronous order, FIFO order, non- FIFO order and causal order respectively.

A. SYNC $\subset$ FIFO$\subset$ A$\subset$ CO
B. SYNC $\subset$ FIFO$\subset$ CO$\subset$ A
C. SYNC $\subset$ CO$\subset$ FIFO$\subset$ A
D. A $\subset$ FIFO$\subset$ CO$\subset$ SYNCH

Ans: SYNC$\subset$ CO$\subset$ FIFO$\subset$ A

Q. 5 Consider the dijkstra's self-stabilizing token ring system.

A legitimate state must satisfy the following constraints:

1) There must be at least one privilege in the system (liveness or no deadlock).

2) Every move from a legal state must again put the system into a legal state (closure).

3) During an infinite execution, each machine should enjoy a privilege an infinite number of times (no starvation).

4) Given any two legal states, there is a series of moves that change one legal state to the other (reachability).

A. All constraints are false
B. All constraints are true
C. Constraint 1&2 are true and Constraint 3&4 are false
D. Constraint 1&2 are false and Constraint 3&4 are true

Ans: All constraints are true

Explanation: A legitimate state must satisfy the following constraints:

1. There must be at least one privilege in the system (liveness or no deadlock).

2. Every move from a legal state must again put the system into a legal state (closure).

3. During an infinite execution, each machine should enjoy a privilege an infinite number of times (no starvation).

4. Given any two legal states, there is a series of moves that change one legal state to the other (reachability).

Q. 6 As proven by Ghosh, the minimum number of states required in a self-stabilizing ring is:

A. One state
B. Two states
C. Three states
D. Four states

Ans: Three states

Explanation: Dijkstra offered three solutions for a directed ring with n machines, 0, 1, ……, n−1, each having K states, (i) $K \geq n$, (ii) $K = 4$, (iii) $K = 3$.

It was later proven by Ghosh that a minimum of three states is required in a self-stabilizing ring.

Q. 7 Consider the following statements about three phase distributed algorithm

Statement 1: The three phase distributed algorithm is closely structured along the lines of Lamport's algorithm for mutual exclusion.

Statement 2: This algorithm uses $3(n - 1)$ messages for $n - 1$ destinations.

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

Ans: Both statements are true

Explanation: The 3 phase algorithm is closely structured along the lines of Lamport's algorithm for mutual exclusion. This algorithm uses three phases and 3(n − 1) messages for n − 1 destinations

Q. 8 Consider the following table of Application-Level Multicast Algorithms:

Algorithm	Paradigm
(P) Communication history-based algorithms	(i) Pinwheel
(Q) Privilege-based	(ii) Propagation tree
(R) Moving sequencer	(iii) RST algorithm
(S) Fixed sequencer	(iv) Totem

Match the algorithm to the correct example

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

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

Q. 9 Consider the following properties of different multicast algorithms:

Statement 1: Privilege-based multicast algorithms provide (i) causal ordering if closed groups are assumed, and (ii) total ordering.

Statement 2: Moving sequencer algorithms, which work with open groups, provide total ordering.

Statement 3: Fixed sequencer algorithms provide total ordering.

A. Only statement 1&2 are true
B. Only statement 1&3 are true
C. All statements are false
D. All statements are true

Ans: All statements are true