2022

COMPUTER SCIENCE

Paper : CSMC-202

(Advanced Operating Systems)

Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer ***Question Nos.*** **1** and **2** and ***any four*** questions from the rest.

1. Answer ***any five*** out of the following : 2×5

(a) Define access transparency and name transparency for a distributed system.

(b) State the condition for termination detection in a distributed system.

(c) Arrange the time stamps taken using the Lamport's logical clock model [<3,8>, <3,5>, <2,7>, <5,1>].

(d) Which of the following is the smallest time stamp according to Vector clock model?

[2, 5, 1, 3], [1, 3, 0, 2], [1, 5, 2, 3], [1, 3, 1, 2]

(A) [2, 5, 1, 3], (B) [1, 3, 0, 2], (C) [1, 5, 2, 3], (D) [1, 3, 1, 2]

(e) Which of the following defines Lamport's second implementation rule for clock, where C(X) is clock for node X and ∂ is arbitrary delay for transmission?

(A) If A is the event of sending message m from node S and B is the event of receiving the same message m at D, then C(D): = max(C(D), C(S)+∂)

(B) If A is the event of sending message m from node S and B is the event of receiving the same message m at D, then C(D): = min(C(D), C(S)+∂)

(C) If A is the event of sending message m from node S and B is the event of receiving the same message m at D, then C(D): = max(C(D)+∂, C(S))

(D) If A is the event of sending message m from node S and B is the event of receiving the same message m at D, then C(D): = min(C(D)+∂, C(S)+∂)

(f) Which of the following is true for the Ricart-Agrawala algorithm for mutual exclusion?

(A) This is not a symmetric algorithm.

(B) A process currently in CS that receives requests, store them in a local queue

C) A process currently in CS that receives requests, store them in a local stack

(D) A process currently in CS that receives requests, store them in a local list.

(g) Name the IDL for SUN RPC environment. What compiler is used for IDL in SUN RPC?

2. Comment on the correctness of the following statements and justify your opinion. 4×5
Answer ***any five*** :

(a) "Chandy-Lamport's state recording algorithm guarantees snapshot recording for any node X in the system and the set of channels incident on X."

(b) "It's easier to achieve semantic transparency than syntactic transparency for a distributed system."

(c) "In case of SUN RPC, there is no system-wide binding mechanism is designed maintaining distribution transparancy."

(d) "Recording Global State for a distributed system is impossible."

(e) For RPC, "Call by Reference is the best suitable."

(f) "In consistent state recording (CSR), for every message that is recorded as sent, the corresponding state recording in the receiver node must reflect that the message has been received."

(g) "Migration of resources is a greater concern than address-space migration."

3. (a) In Chandy-Lamport's state recording algorithm, on receipt of the first marker from A, the recipient process B records state of the channel CH_{AB} through which it received the first marker as empty. However, apparently and new message may be placed on the channel by A. Do you consider the algorithm to be correct in this context? Justify your opinion.

(b) State the assumptions of Chandy-Lamport's state recording algorithm.

(c) Comment if the following statement is correct : "Chandy-Lamport's state recording algorithm fails for a system if more than one node in the system exist for which indegree is 0". Justify your opinion. 4+2+4

4. (a) Describe a token-based algorithm to ensure mutual exclusion of processes run from multiple nodes in a distributed system connected using a hierarchical topology.

(b) What would be the worst-case complexity for the above algorithm for a system with N processes running in that many nodes in the system?

(c) For mutual exclusion compare performances of symmetric algorithms with token-based algorithm. 6+1+3

5. (a) Define cut of a system.

(b) What are forward and backward intersections?

(c) The following events occur in a system of three processes :

process p1	**process p2**	**process p3**
event e1;	event e4;	event e6;
send message to p2;	receive message from p3;	send message to p2;
event e2;	receive message from p1;	event e7;
event e3;	event e5;	receive message from p2;
send message to p3;	event e8;	

(i) Draw a valid timing diagram (event trace diagram) for the system.

(ii) Show the event precedence in the system.

(iii) List the concurrent events. 2+2+6

6. (a) State at least two different motivations behind process migration.

(b) Describe the sender-initiate process migration approach.

(c) What is stability? What is done to improve the stability of the system for sender-initiated process migration?

(d) Define preemptive and non-preemptive process migrations. 2+4+2+2

7. (a) Discuss the role of RPC run-time towards implementing RPC mechanism.

(b) Discuss the process of binding in RPC using binding agent.

(c) Suggest the appropriate call semantics to be used (among may-be, last-of-many, at-least-once or exactly-once) for the following application :

(i) To update an employee phone number in the employee database.

(ii) To increase the salary of an employee by 10% of the basic salary. 2+4+4

8. (a) Define correctness of control algorithms for a distributed system.

(b) What is fairness in the context of designing a mutual exclusion algorithm?

(c) Prove that the set of vector clock stamps in a distributed system forms a Partially Ordered set (PO-set) for $\leq$ relation using its properties.

(d) What are the drawbacks of the Ho-Ramamurthy deadlock detection algorithm? 2+2+4+2