# 2023

## 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, 2** and **any four** questions from the rest.

1. Answer **any five** questions : 2×5

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

  (b) What is binding by types in the context of process migration?

  (c) What are the two call semantics used in SUN RPC?

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

    [2,5,1,3], [1,3,0,2], [1,5,2,31], [1,3,0,1]

    (i) [2,5,1,3]      (ii) [1,3,0,2]      (iii) [1,5,2,3]      (iv) [1,3,0,1].

  (e) How do you differentiate between semantic transparency and syntactic transparency?

  (f) Why token-based algorithms are said to be inherently safe?

  (g) What is the disadvantage if cache are maintained in the client nodes to improve efficiency?

2. Comment on the correctness of the statements below and justify your opinion (**any five**) : 4×5

  (a) In diffusion computation model, a process that diffuses a query never knows whether the communication will be an engaging or non-engaging query for the recipient.

  (b) A state recording is consistent if and only if every message that has been recorded as sent is also recorded as received in the destination.

  (c) An horizontal straight line 'Cut' parallel to the timeline reflects global state recording.

  (d) Symmetric algorithms have high message complexity, and is subject to a single point of failure.

  (e) Given, the timestamps for two events A and B are T(A) and T(B), respectively, using the Lamport's logical clock, T(A) < T(B) implies that event A occurred before event B.

  (f) In the context of the Chandy-Lamport's state-recording algorithm,– a node within degree 0 in a directed graph topology cannot act as the 'Initiator Node' for Chandy-Lamport's state-recording algorithm.

  (g) Building a common address space for an entire distributed system accessible to any client node, may be implemented by mounting the file systems of different nodes, important for individual client, in the respective client rites.

**Please Turn Over**

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

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

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

   (d) Define pre-emptive and non pre-emptive process migrations.

                                      2+4+2+2

4. (a) What is the role of IDL (interface definition language) in RPC?

   (b) "Call by Reference is best suitable for RPC." — Comment on correctness of the statement and justify your opinion.

   (c) What is an Orphan Call in RPC?

   (d) How a client process is bound with the expertor of a remote procedure in case of SUN RPC?

                                      1+4+2+3

5. (a) What are the drawbacks of the centralized deadlock detection algorithm?

   (b) Describe Mitchell-Merritt algorithm for deadlock detection in a distributed environment. Illustrate the same with an example.

                                      3+7

6. (a) What is inverted tree topology?

   (b) Describe Raymond's algorithm to ensure mutual exclusion of processes run from multiple nodes in a distributed system.

   (c) 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?

   (d) Compare performances of symmetric algorithms vis-à-vis token-based algorithms for mutual exclusion.

                                      1+5+1+3

7. (a) What are forward and backward intersections?

   (b) The following events occur in a system of four processes :

| process  p1 | process  p2 | process  p3 | process  p4 |
|---|---|---|---|
| event  e1; | event  e4; | event  e6; | event  e9; |
| send message to p2; | receive message from p3; | send message to p2; | event  e10; |
| event  e2; | receive message from p1; | event  e7; | |
| event  e3; | event  e5; | receive message from p2; | |
| | send message to p3; | event  e8; | |

     (i) Draw an event trace diagram for the system.

     (ii) List the event precedence in the system for every pair of events between which such precedence exists.

     (iii) List the concurrent pair of events.

                                        2+(4+2+2)

8. (a) How do you define a vector clock for a distributed environment with N nodes?

   (b) Explain how the problem of concurrent event detection in Lamport's clocking can be solved by vector clocking.

   (c) Explain how the use of stubs helps in making an RPC mechanism transparent.

   (d) Why resource migration is often considered as the most critical challenge for migrating a process?

1+3+3+3

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