Question Paper

Exam Date & Time: 02-May-2024 (02:30 PM - 05:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

SIXTH SEMESTER B.TECH. (INFORMATION TECHNOLOGY) DEGREE EXAMINATIONS - APRIL / MAY 2024 SUBJECT: ICT 3254/ICT_3254 - DISTRIBUTED SYSTEMS

Marks: 50

Duration: 180 mins.

Answer all the questions.

1A)	Illustrate how RPC technology facilitates seamless interaction between a centralized Financial Transaction Processing System (FTPS) server and client systems located at various branches in a financial institution. Identify and describe the specific RPC components and communication processes involved in this scenario.	(5)
1B)	A user arrives at a railway station that they have never visited before, carrying a smartphone that is capable of wireless networking. Describe how the user could be provided with information about the local services and amenities at that station, without entering the station's name or attributes. What technical challenges must be overcome?	
1C)	A server creates a port that it uses to receive requests from clients. Discuss the characteristics of inter-process communication concerning the relationship between client and server.	(2)
2A)	 Three computers, A, B, and C communicate using a protocol that implements Lamport logical clocks (they include their clock time stamp in messages). At the beginning of time, all three computers begin with their logical clock set to zero. Later, the following sequence of events occurs: A sends message M1 to B C sends message M2 to B B receives M2 before M1 B replies message M3 to C first, and then message M4 to A After receiving message M3, C sends message M5 to A After receiving message M5, A sends message M6 to B After receiving message M6, B sends message M7 to A The last message A received is M4 Illustrate with a time-line diagram and proper stepwise explanation of Lamport timestamp algorithm for the above-mentioned scenario. 	(5)
2B)	Discuss the significance of session semantics, caching and coherency mechanisms, and conflict resolution strategies in maintaining a reliable Andrew File System.	(3)
2C)	In a laboratory experiment, a digital clock is observed to lose 2 seconds every 24 hours. Calculate the drift rate of the digital clock in seconds per hour.	(2)
3A)	Model and illustrate how multicast synchronization works in the Ricart and Agrawala algorithm with a simple example involving three processes: P1, P2, and P3.	(5)
3B)	Discuss the advantages of organizing names hierarchically and provide examples of hierarchical namespace implementations in widely used name services.	(3)
3C)	Consider two processes, P1 and P2, in a distributed system, and examine and write how the strict consistency model applies to their read and write operations on memory location x.	(2)
4A)	What is the key techniques key for masking faults using redundancy. Model the same with proper examples. Consider Figure of Q4. What happens if one of the signals that passes through devices A, B, and C, is faulty.	(5)

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(A)	В	C

concurrency control.

5A)

5B)

5C)

- 4B) In a gossip system, a front end has the vector timestamp (3, 5, 7) representing the data it has (3)received from members of a group of three replica managers. The three replica managers have vector timestamps (5, 2, 8), (4, 5, 6) and (4, 5, 8), respectively. Which replica manager(s) could immediately satisfy a query from the front end, and what would the resultant timestamp of the front end be? Which could incorporate an update from the front end immediately? 4C) Explain the differences between backward and forward validation in the context of optimistic
 - (2)

Consider the following transactions for Two-Phase Commit (2PC) protocol to coordinate the commit (5) process.

- Transaction T1 initiates a nested transaction T2 within its scope. T2 performs a series of read and write operations on different accounts at different branches.
- The nested transaction T2 involves multiple sub-operations that must all succeed or fail together to maintain transactional consistency.
- After T2 completes its operations, T1 continues with its own operations, potentially accessing or updating additional data across distributed nodes.
- Both T1 and T2 must commit their changes atomically to ensure data integrity and . consistency across the banking system.

Describe the algorithmic process of nested transactions within the context of the Two-Phase Commit (2PC) protocol for the above scenario. How does the 2PC protocol handle the commit process for nested transactions? Explain time-out actions for the participants.

Consider hierarchic locks as illustrated in Figure. What locks must be set when an appointment is (3)assigned to a time slot in week w, day d, at time t? In what order should these locks be set? Does the order in which they are released matter? What locks must be set when the time slots for every day in week w are viewed? Can this be done when the locks for assigning an appointment to a time slot are already set?



Describe the methods used in the Chubby API within Google's distributed system to ensure (2)consistency management.

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