

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/ Backlog), April-May 2015

B. Tech in Computer Science Engineering, Semester VI

Roll No.....

CSE 605: Distributed Systems

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark)

10



- i. What can we know if we use Lamport clocks?
A) if, and only if, $L(a) < L(b)$ then a happened before b
B) if, but not only if, $L(a) < L(b)$ then a happened before b
C) if, but not only if, a happened before b then $L(a) < L(b)$
D) if $L(a) = L(b)$ then $a = b$
- ii. What is the difference between a Lamport clock and a vector clock?
A) nothing, two names for the same thing
B) Lamport clocks are more efficient since they require smaller messages
C) only the vector clock gives a complete description of the "happened before order"
D) only the Lamport clock gives a complete description of the "happened before order"
- iii. What is the advantage of a bully algorithm compared to a ring-based algorithm?
A) nodes can easily change priority in-between elections
B) better worst case number of messages
C) better turnaround time
D) two nodes will never be elected even if we have an unreliable failure detector
- iv. What is significant for an asynchronous system?
A) that all operations will take equal amount of time
B) that our internal clock has a bounded drift
C) that the time to perform an operation does not have an upper bound
D) that messages might not be delivered
- v. CORBA is a _____.
A) Hardware B) Software C) Middleware D) Firmware
- vi. The major reasons for replication are _____.
A) Reliability B) Availability C) Scalability D) Performance
- vii. _____ is used to decrease network traffic.
A) Batch mode RPC
B) Broadcast RPC
C) Callback RPC
D) Nothing
- viii. How are FIFO, causal and total order multicast related?



	A) a total order is also a FIFO order B) a FIFO order is also a total order C) a causal order is also a FIFO order D) a causal order is also a total order	
ix.	What do we know if we record a snapshot using the algorithm by Chandy and Lamport? A) the execution passed through the state described by the snapshot B) a non-stable predicate that is true for the snapshot has also been true during the execution C) if the algorithm terminates then the execution will also terminate D) there is a linearization from the original state to the final state that passes through the snapshot	
x.	What is the difference when an error is reported for an at-least-once and at-most-once remote procedure call? A) in the at-most-once case, the remote call will not have been executed B) nothing, in either case we don't know if the remote call has been executed C) in the at-least-once case, the remote call will not have been executed at all D) in the at-least-once case, the call could have been executed more than once	
Q.2	Short answer type questions (4 questions @ 2.5 marks)	10
i.	Define distributed system? What are significant advantages of Distributed Systems?	
ii.	What is a logical clock? Discuss its significance in a distributed system,	
iii.	How does a DFS differ from a file system used for a centralized system?	
iv.	How does two-phase locking help in recovery of crashed objects in distributed transaction?	
Q.3A	Describe some of the ways in which conventional email is vulnerable to eavesdropping, masquerading, tampering, replay, denial of service. Suggest methods by which email could be protected against each of these forms of attack.	05
Q.3B	What are Vector clocks? What are the advantages of Vector clock over Lamport's clock?	05
Q.4A	What is the problem of distributed deadlock detection? Compare merits and demerits of Centralized, Distributed and Hierarchical control organizations for distributed deadlock detection?	05
Q.4B	You're building a transactional database and have some options in how to implement the concurrency control. What would the pros and cons be to implement an optimistic concurrency control scheme? When would it be most useful?	05
Q.5	Ricart and Agrawala's is a fully distributed mutual exclusion algorithm making use of multicast and Lamport clocks. It guarantees that requests to enter a critical section are granted according to the happens before order that is defined by timestamps read from the logical Lamport clock. The algorithm assumes reliable and in-order delivery.	10

In a certain system, each process typically uses a critical section many times, by re-entering almost immediately after exit and before another process requires that critical section.

- (a) How many messages does the Ricart and Agrawala algorithm require per access to the critical section, in this case, if N is the number of nodes in this distributed system?
- (b) Describe how you would modify the algorithm in order to improve its performance in this case. Explain any additional states or actions of your protocol.

Q.6A You are to design a distributed database system for an online ticket booking system for an airline. There will be more than one copy of the database for reliability and fault tolerance. Explain some of the problems (in distributed systems) you would have solve during the development of this system. In particular what problems have to be solved they are special for the domain (an online ticket booking system) 05

Q.6B Explain the following sentence: "Consistency, availability, and performance tend to contradictory forces in a distributed file system." 05

OR

Q.6B Consider a simple server that carries out client requests without accessing other servers. Explain why it is generally not possible to set a limit on the time taken by such a server to respond to a client request. What would need be done to make the server able to execute requests within a bounded time? Prove your approach is practical or not. 05

Q.7A What do you mean by distributed objects? Explain the concept of remote method invocation with a suitable example. 05

Q.7B Explain the difference between linearizability and sequential consistency, and why the latter is more practical to implement, in general. 05

OR

Q.7B In distributed systems where messages are asynchronous and failures can be Byzantine. Consider the following scenario: a client sends the same command to each of n servers and then waits for the servers to execute the command and send back the result. Ideally, the client should receive n matching results, but remember that f servers may be malicious. Additionally, messages are asynchronous, so they can be delayed for an indefinite amount of time. Show that $n \geq 3f + 1$ must hold for the client to always be able to identify the correct result. 05

Q.8 Suppose you are running a large distributed online shop with clients in different countries. To minimize the costs associated with hosting your system, you decided to adopt a cloud-based solution: you rent a number of machines from a global cloud service provider. The provider's machines can host arbitrary software that you supply. There are thousands of them, and they are located virtually all over the world. Moreover, the provider supports dynamic on-demand acquisition and relinquishment of machines, that is, at any time you can start additional instances of your software on arbitrary provider's machines. 10

that are currently available or you can dispose of any no longer needed running instances. Billing the additional resources is done automatically by the provider. Normally, you rent a few machines in different parts of the world. However, occasionally the number of machines is insufficient to serve your clients' requests. Typically this happens when certain shop items become popular or before major holidays, but you are not always able to predict such situations. The great majority of requests during such bursts are requests for browsing your shop and particular items.

Your goal is to minimize the costs incurred by hosting your system and not to lose clients due to a degraded performance during request bursts.

- a) Propose a logical organization of the software comprising your system.
- b) Propose a physical distribution of the software across the provider's machines.
- c) Describe the mechanisms and algorithms you would employ to handle request bursts. (Such as mutual exclusion, deadlock, synchronization, etc.)

Q.9A In a multi-user game, the players move figures around a common scene. The state of the game is replicated at the players' workstations and at a server, which contains services controlling the game overall, such as collision detection. Updates are multicast to all replicas. 10

- (i) The figures may throw projectiles at one another and a hit debilitates the unfortunate recipient for a limited time. What type of update ordering is required here? And Why? (Hint: consider the 'throw', 'collide' and 'revive' events)
- (ii) The game incorporates magic devices which may be picked up by a player to assist them. What type of ordering should be applied to the pick-up-device operation? And Why?

Q.9B Consider the following scheme to reduce message traffic in distributed deadlock detection : Transactions are assigned unique priorities, and an antagonistic conflict occurs when a transaction waits for a data object that is locked by a lower priority transaction. A deadlock detection is initiated only when an antagonistic conflict occurs. When a waiting transaction receives a probe that is initiated by a lower priority transaction, the probe is discarded. 10

- (a) Determine the number of messages exchanged to detect a deadlock in the best case.
- (b) Determine the number of messages exchanged to detect a deadlock in the worst case.
- (c) Determine the number of messages exchanged to detect a deadlock in the average case.
- (d) Determine the saving (as per percentage) in the average number of messages exchanged under this message traffic reduction scheme, as compared to when no such scheme is used.

OR

Q.9B Discuss the impact of message loss on the various deadlock detection algorithm discussed in the class. 10