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**Sri Sivasubramaniya Nadar College of Engineering, Kalavakkam – 603 110**

(An Autonomous Institution, Affiliated to Anna University, Chennai)

**Computer Science and Engineering**

**Continuous Assessment Test - III**


**Answer Key**

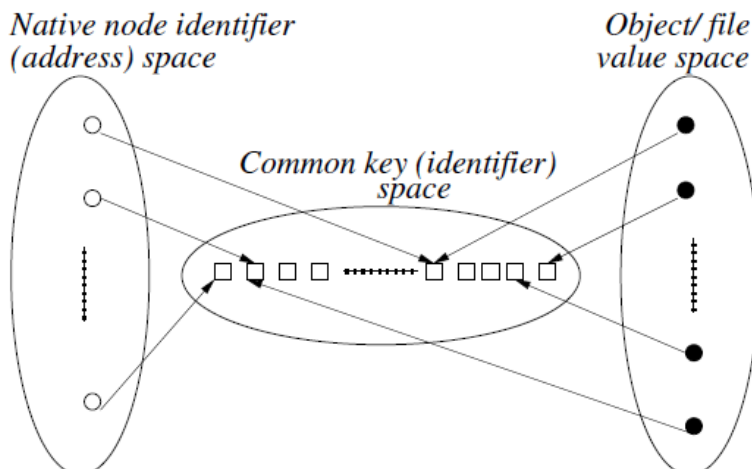
<b>Degree &amp; Branch</b>	BE - CSE				<b>Semester</b>	7
<b>Subject Code &amp; Name</b>	UCS1701- Distributed Systems				<b>Regulation:</b>	<b>2018</b>
<b>Academic Year</b>	2023-2024 ODD	<b>Batch</b>	2020-2024	<b>Date</b>	<b>03.11.2023</b>	<b>FN / AN</b>
<b>Time: 08:10 - 09:40 a.m (90 Minutes)</b>	<b>Answer All Questions</b>				<b>Maximum: 50 Marks</b>	

**Part – A (6×2 = 12 Marks)**

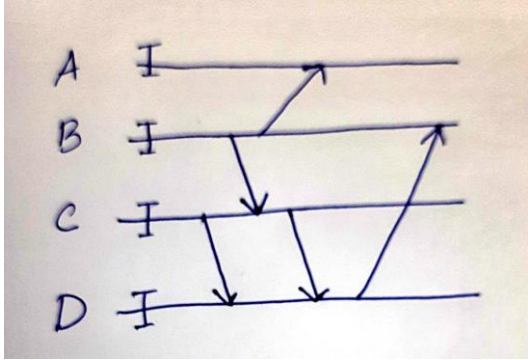
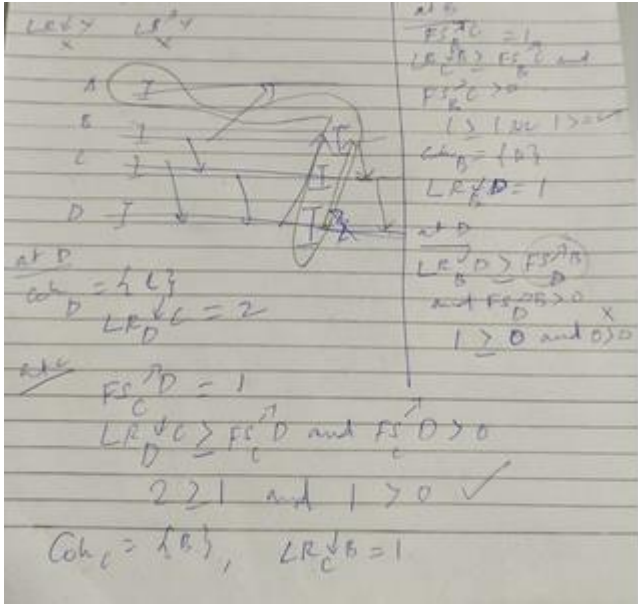
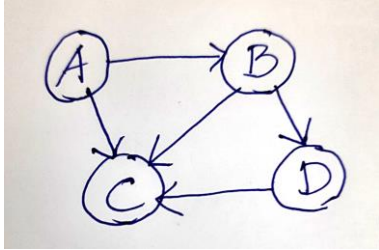
K2	1. If the source is faulty, outline the effect of consensus. If the source is faulty, it is difficult to arrive at consensus due to source sending the incorrect values or subset or all processes.	CO4	1.4.1 2.2.3
K1	2. Define Orphan Messages in distributed systems. Received being recorded and send event is not recorded due to rollback recovery.	CO4	2.2.3
K1	3. What is the difference between a P2P and Client Server system. Client-server networks have a dedicated server and specialized clients, whereas peer-to-peer networks allow any node to operate as both a client and a server. In a client-server model, the server gives the client services.	CO5	1.4.1 2.2.3
K1	4. Define the term Overlay Networks. Virtual network on top of physical network formed in P2P is called overlay network.	CO	1.4.1 2.2.3
K1	5. Mention any two applications of P2P systems. Skype Bittorrent Distributed Databases and Computation. Oceanstore	CO5	2.1.1
K1	6. What is local indexing and in which type of overlay it is used? Local indexing is used in P2P to store and access the data in the local node and unstructured overlay is used in local indexing.	CO5	2.1.1

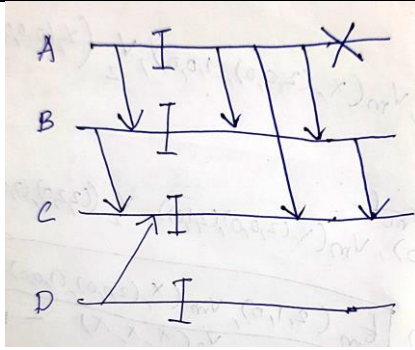
**Part – B (3×6 = 18 Marks)**

K3	<p>7. Consider a Distributed System with three processes. Apply <b>Asynchronous Recovery Algorithm</b> for the occurrence of a crash at Process 2.</p>  <p>RCVDi ← j (CkPti) &lt;= SENTj → i (CkPtj)</p>	CO4	1.4.1 2.2.3 13.2.1
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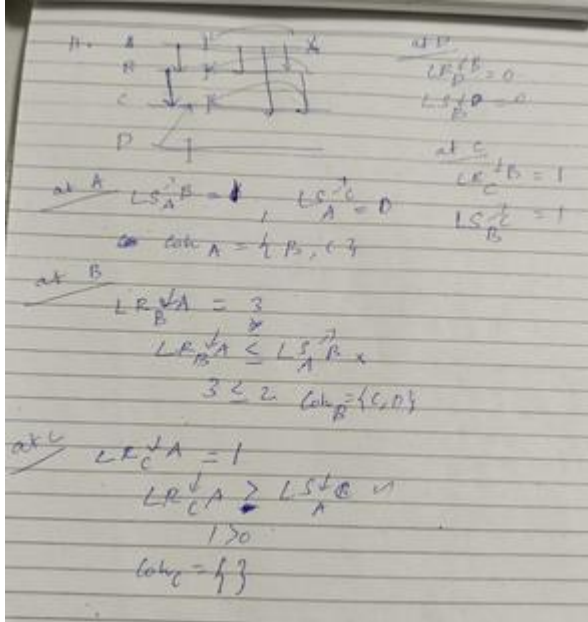
K2	<p>8. Discuss Distributed indexing of P2P systems in detail.</p> <p>Data identified by indexing, which allows physical data independence from apps.</p> <p><b>Centralized indexing</b>, e.g., versions of Napster, DNS</p> <p><b>Distributed indexing</b>. Indexes to data scattered across peers. Access data through mechanisms such as Distributed Hash Tables (DHT). These differ in hash mapping, search algorithms, diameter for lookup, fault tolerance, churn resilience.</p> <h3>Simple Distributed Hash Table scheme</h3>  <p>Mappings from node address space and object space in a simple DHT.</p> <ul style="list-style-type: none"><li>• Highly deterministic placement of files/data allows fast lookup.</li><li>• But file insertions/deletions under churn incurs some cost.</li><li>• Attribute search, range search, keyword search etc. not possible.</li></ul> <p><b>Local indexing.</b> Each peer indexes only the local objects. Remote objects need to be searched for. Typical DHT uses at key space. Used commonly in unstructured overlays (E.g., Gnutella) along with flooding search or random walk search.</p> <p>Another classification</p> <p><b>Semantic indexing</b> - human readable, e.g., filename, keyword, database key. Supports keyword searches, range searches, approximate searches.</p> <p><b>Semantic-free indexing.</b> Not human readable. Corresponds to index obtained by use of hash function.</p>	CO5	1.4.1										
K2	<p>9. Explain Lamport's Bakery Algorithm with a suitable example.</p> <ul style="list-style-type: none"><li>• Without atomic operation assumptions</li><li>• Introduce an array of N Booleans: <i>choosing</i>, initially all values False.</li></ul> <pre>lock(i){     choosing[i] = True     num[i] = MAX(num[0], num[1], ..., num[N-1]) + 1     choosing[i] = False     for(p = 0; p &lt; N; ++p){         while (choosing[p]);         while (num[p] != 0 and (num[p],p)&lt;(num[i],i));     } }</pre> <p>critical section</p> <pre>unlock(i){     num[i] = 0; }</pre> <p>doorway</p> <p>check p&lt;i</p> <table><tr><td>P1</td><td>P2</td><td>P3</td><td>P4</td><td>P5</td></tr><tr><td>0</td><td>3</td><td>0</td><td>2</td><td>2</td></tr></table> <p>(a, b) &lt; (c, d) which is equivalent to: (a &lt; c) or ((a == c) and (b &lt; d))</p>	P1	P2	P3	P4	P5	0	3	0	2	2	CO5	1.4.1 2.1.1
P1	P2	P3	P4	P5									
0	3	0	2	2									

**Part – C (2×10 = 20 Marks)**

	<p>10. Apply <b>synchronous checkpointing</b> algorithm for the given scenario in which D initiates the algorithm.</p>  <p>last_label_rcvdY[X] &gt;= last_label_sentX[Y] &gt; 0</p> 	CO4	1.4.1 2.2.3 13.2.1
(OR)			
K3	<p>11. Consider the following topology,</p>  <p>Apply <b>synchronous Recovery</b> algorithm for the given scenario.</p>	CO4	1.4.1 2.2.3 13.2.1

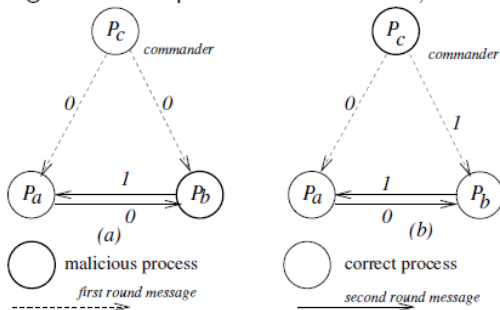


$RCVD_i \leftarrow j (CkPti) \Leftarrow SENT_j \rightarrow i (CkPtj)$



12. Apply Byzantine consensus for a distributed System with 4 processes including the source. Discuss the effect of Byzantine Agreement for an Asynchronous distributed systems

Agreement impossible when  $f = 1, n = 3$ .

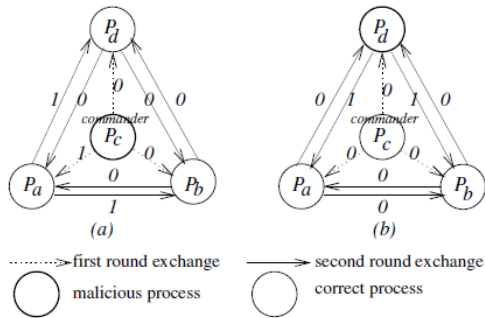


- Taking simple majority decision does not help because loyal commander  $P_a$  cannot distinguish between the possible scenarios (a) and (b);
- hence does not know which action to take.
- Proof using induction that problem solvable if  $f \leq \lfloor \frac{n-1}{3} \rfloor$ . See text.

CO4

1.4.1  
2.2.3  
13.2.1

## Consensus Solvable when $f = 1, n = 4$



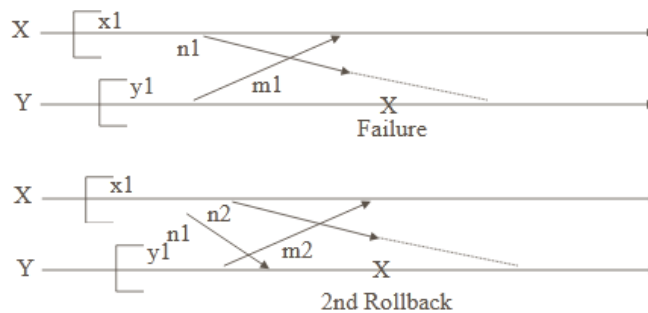
- There is no ambiguity at any loyal commander, when taking majority decision
- Majority decision is over 2nd round messages, and 1st round message received directly from commander-in-chief process.

Byzantine Agreement for an Asynchronous distributed systems: It is difficult to arrive at consensus in Asynchronous system as there is no time bound. There is no guarantee to achieve consensus immediately but consensus can arrive later point in time.

(OR)

13. Construct a Live locks scenario for two given processes A & B. Simulate 3 three cycles of rollbacks due to live locks.

### Livelocks



- Y crashes before receiving n1. Y rolls back to Y1 -> X to x1.
- Y recovers, receives n1 and sends m2.
- X recovers, sends n2 but has no record of sending n1
- Hence, Y is forced to rollback second time. X also rolls back as it has received m2 but Y has no record of m2.
- Above sequence can repeat indefinitely, causing a livelock.

K3

CO4

1.4.1  
2.2.3  
13.2.1

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Prepared By	Reviewed By	Approved By
Course Coordinator	PAC Team	HOD

