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Q1) List the characteristics of distributed System.

:- 1. Resource sharing - shared resources like files, printers, etc.

2. Concurrency - Multiple processes run concurrently across nodes.

3. Scalability - System scales horizontally by adding more nodes.

4. Fault Tolerance - Continues functioning despite failures.

5. Transparency - Hides complexity from users (eg, access, location, replication).

6. Heterogeneity - Can use different hardware / OS.

7. No Global clock - Each node / process has its own local clock.

8. Independent Failures - Components can fail independently.

Q2). Explain the characteristics of synchronous execution

:- • Bounded Delays - Time taken for execution and message delivery is known.

• Global clock Assumption - Process can synchronize actions using time.

• Deterministic Behaviour - Due to known delay and clock synchronizations

• Blocking Communication - Sender / reciever wait until - Sender / reciever wait until message exchange completes.

Q3. Explain how communication happened between the processes of distributed network.

~~Q4. write a formula for how any process, numbered pi, sends are~~

:- Message parsing - processes communicate via send / receive primitives.

• Protocol used - TCP/IP, RPC, or higher - level message queues.

• Types:-
  • Synchronous: Sender waits for acknowledgement.
  • Asynchronous: Non-blocking, fire-and-forget
  • Reliability - Often ensured via acknowledgments or retries.

Q4. write a formula for how any process numbered Pi, sends message to other process in synchronous message parsing system:

:- For a process pi sending a message to Pj:

Send (Pi, Pj, m)

where:
• Pi is the sender
• Pj is the reciever
• m is the message

Q5- write a formula for how any process numbered i, receives a message from other processes in a synchronous message

- passing system:
- For process p_i receiving a message from p_j:

Recv(p_i, p_j, m)

where;
- p_i is the receiver
- p_j is the sender
- m is the message

Ⓠ6 What is condition for happen before casual precedence relation within the same process?

:→ In the same process, event a happened before, event b if:

$$a \rightarrow b$$

when a occurs before b in the execution of the same process.

Ⓠ7 Illustrate how does a process p_i update its vector clock in distributed environments?

:— ① Internal Event:-

$$VC[i] = VC[i] + 1$$

② Send Event:-

$$VC[i] = VC[i] + 1$$
Send (VC) with message

③ Receive Event from p_j:

$$VC[i] = max(VC[i], VC_j[i]) \text{ for all } i$$
$$VC[i] = VC[i] + 1$$

Q8. Illustrate how does a process pi update its Lamport clock in distributed environment

1. Internal Event or Send:

$$LC = LC + 1$$

2. Send Event:

$$LC = LC + 1$$
$$send(LC) \text{ with message}$$

3. Receive Event From Pj:

$$LC = max(LC, LC_j) + 1$$