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UNIT–III
Transaction Management

Transaction Management – Definition

- A transaction is a logical unit of work that consists of one or more database operations executed as a single unit.

Properties of Transactions (ACID)

- Atomicity
- Consistency
- Isolation
- Durability

Types of Transactions

- Read-only Transactions
- Read-Write Transactions
- Distributed Transactions
- Nested Transactions
- Long-duration Transactions

Distributed Concurrency Control

- Ensures correctness of concurrent transactions in distributed databases while maintaining consistency and isolation.

Serializability

- A schedule is serializable if its outcome is equivalent to some serial execution of transactions.
- Types:
- – Conflict Serializability
- – View Serializability

Concurrency Control Mechanisms

- Lock-based Protocols
- Timestamp-based Protocols
- Optimistic Protocols
- Multiversion Concurrency Control

Lock-Based Algorithms

- Binary Locks
- Shared/Exclusive Locks
- Two-Phase Locking (2PL)
- Strict 2PL

Timestamp-Based Concurrency Control

- Each transaction receives a unique timestamp.
- Operations are executed according to timestamp order.

Timestamp Ordering Algorithm

- Read Timestamp (RTS)
- Write Timestamp (WTS)
- Validation of read/write requests using timestamps.

Optimistic Concurrency Control

- Assumes conflicts are rare.
- Phases:
- 1. Read Phase
- 2. Validation Phase
- 3. Write Phase

Optimistic Concurrency Control Algorithm

- Transactions execute without locking.
- Validation checks conflicts before commit.
- Rollback occurs if validation fails.

Deadlock Management

- Deadlock occurs when transactions wait indefinitely for each other's resources.

Deadlock Prevention

- Wait-Die Scheme
- Wound-Wait Scheme
- Resource Ordering

Deadlock Detection & Recovery

- Wait-for Graph
- Cycle Detection
- Transaction Rollback
- Resource Preemption

Advantages and Challenges

- Advantages:
- – Improved consistency
- – Better resource sharing
- Challenges:
- – Communication overhead
- – Deadlock handling
- – Synchronization complexity

Conclusion

- Transaction management and concurrency control ensure reliable, consistent, and efficient distributed database operations.