**Chapter 6**

**1. Measures of Query Cost:**

* **Definition:**
  + Query cost refers to the resources and time required to execute a database query.
* **Measures:**
  + *Response Time:* The time taken to receive the first tuple of the query result.
  + *Processing Time:* The time taken to execute the query once it starts.
  + *Disk Accesses:* The number of times the system reads from or writes to the disk.
  + *CPU Time:* The time the CPU spends processing the query.
  + *Communication Cost:* The cost associated with transmitting data between different components.

**2. Selection Operation, Sorting, and Join Operation:**

* **Selection Operation:**
  + *Definition:* Choosing specific rows from a table based on a given condition.
  + *Cost Factors:* Depends on the selectivity of the condition and the size of the table.
* **Sorting Operation:**
  + *Definition:* Arranging data in a specified order.
  + *Cost Factors:* Depends on the number of records to be sorted and the available memory.
* **Join Operation:**
  + *Definition:* Combining rows from two or more tables based on a related column.
  + *Cost Factors:* Depends on the size of the tables and the efficiency of the join algorithm (e.g., nested loop join, hash join).

**3. Transaction Concept:**

* **Definition:**
  + A transaction is a sequence of one or more operations performed as a single logical unit of work.
* **ACID Properties:**
  + *Atomicity:* All or nothing; a transaction is either fully completed or fully rolled back.
  + *Consistency:* A transaction brings the database from one valid state to another.
  + *Isolation:* The execution of one transaction is isolated from the execution of others.
  + *Durability:* Once a transaction is committed, its effects persist.

**4. Components of Transaction Management:**

* *Transaction Manager:* Coordinates and manages the execution of transactions.
* *Transaction Log:* Records all changes made by transactions for recovery purposes.
* *Concurrency Control Manager:* Ensures proper isolation of transactions.
* *Recovery Manager:* Manages the database recovery process after a failure.
* *Lock Manager:* Manages locks to control access to data during transactions.

**5. Concurrency and Recovery System:**

* **Concurrency Control:**
  + *Definition:* Managing simultaneous execution of transactions to ensure database consistency.
  + *Methods:* Locking, timestamps, validation.
* **Recovery System:**
  + *Definition:* Restoring the database to a consistent state after a failure.
  + *Methods:* Log-based recovery, shadow-paging.

**6. Different Concurrency Control Protocols:**

* *Timestamps:* Assigns a unique timestamp to each transaction and uses them to determine order and concurrency.
* *Locking:* Controls access to data by acquiring and releasing locks.

**7. Validation:**

* *Definition:* Checking the correctness of a transaction before committing.
* *Use:* Ensures that a transaction, when committed, will not violate integrity constraints.

**8. Multiple Granularity:**

* *Definition:* Allowing different levels of locking, from fine to coarse, depending on the application needs.
* *Benefits:* Enhances concurrency by allowing multiple transactions to lock different parts of a resource simultaneously.

**9. Deadlock Handling:**

* *Definition:* A situation where two or more transactions are unable to proceed because each is waiting for the other to release a lock.
* *Methods:* Timeout, detection, prevention.

**10. Different Crash Recovery Methods:**

* *Log-Based Recovery:* Uses a transaction log to roll forward committed transactions and roll back uncommitted ones.
* *Shadow-Paging:* Maintains a shadow copy of the database that is updated and switched after a transaction commits.
* *Buffer Management:* Controls the transfer of data between the disk and memory buffer to optimize query performance.
* *Remote Backup System:* Regularly copies and stores database backups at a remote location for disaster recovery.