

Introduction to RDBMS

A Relational Database Management System (RDBMS) is a type of database management system that stores data in the form of related tables. Each table is a collection of rows and columns, where each row represents a record and each column represents an attribute of the record. RDBMSs use Structured Query Language (SQL) for accessing and managing data. Examples include MySQL, PostgreSQL, Oracle Database, and Microsoft SQL Server.

Key Concepts of RDBMS

- Table: Basic storage structure, consisting of rows and columns.
- Record: A row in a table.
- Field: A column in a table.
- Primary Key: A unique identifier for each record in a table.
- Foreign Key: A field in one table that refers to the primary key in another table.
- Normalization: The process of organizing data to reduce redundancy.
- Schema: The structure that defines the organization of data in a database.

Advantages of RDBMS

- Data Integrity: Ensures accuracy and consistency.
- Data Security: Provides access control and authentication.
- Scalability: Handles large volumes of data efficiently.
- Flexibility: Allows complex queries and data manipulation.
- Concurrency: Supports multiple users simultaneously.

SQL - Structured Query Language

SQL is the standard language used to interact with RDBMS. It includes:

- DDL (Data Definition Language): CREATE, ALTER, DROP
- DML (Data Manipulation Language): SELECT, INSERT, UPDATE, DELETE
- DCL (Data Control Language): GRANT, REVOKE
- TCL (Transaction Control Language): COMMIT, ROLLBACK, SAVEPOINT

Database Normalization

Normalization is a technique to organize data efficiently. Types:

- 1NF (First Normal Form): Eliminate repeating groups.
- 2NF (Second Normal Form): Eliminate partial dependency.
- 3NF (Third Normal Form): Eliminate transitive dependency.
- BCNF (Boyce-Codd Normal Form): Advanced version of 3NF.

ER Model and Relational Schema

- Entity-Relationship (ER) Model: Graphical representation of entities and their relationships.
- Entities: Objects or concepts (e.g., Student, Course).
- Relationships: Associations among entities.
- Relational Schema: Maps ER diagram to database tables.

Transactions and Concurrency Control

- Transaction: A sequence of operations performed as a single unit.
- ACID Properties: Atomicity, Consistency, Isolation, Durability.
- Concurrency Control: Techniques like locking, timestamp ordering to manage simultaneous operations.

RDBMS Architecture

Three levels:

- Internal Level: Physical storage of data.
- Conceptual Level: Logical view of the entire database.
- External Level: User-specific views.

RDBMS Components: Query Processor, Storage Manager, Transaction Manager.

Popular RDBMS Software

- MySQL: Open-source, widely used.
- PostgreSQL: Advanced open-source RDBMS.
- Oracle: High performance, enterprise-grade.
- MS SQL Server: Microsoft's RDBMS with rich features.

Future Trends in RDBMS

- Cloud Databases: Scalable, cost-effective solutions.
- AI Integration: Automating query optimization.
- Distributed Databases: For large-scale applications.
- NoSQL Hybrids: Combining relational and non-relational features.

RDBMS remains a foundational technology in data management, essential for modern software applications.