

Introduction to Databases

Introduction to Databases – Study Notes

1. What Is a Database?

Concept	Description
Definition	An organized collection of data that can be stored, retrieved, and manipulateded electronically.
Purpose	To provide efficient, reliable, and secure access to information for applications, users, and systems. • Structured storage
Key	• Persistent (data remains after power loss)
Characteristics	• Supports multiple concurrent users • Enforces data integrity and security

2. Core Database Concepts

Term	Meaning
Table (Relation)	A set of rows (records) and columns (fields) that stores data of a single entity type.
Row (Record/tuple)	One complete entry in a table; contains a value for each column.
Column (Attribute)	A named data element that defines the type of information stored (e.g., CustomerID, Name).
Primary Key	A column (or combination) that uniquely identifies each row in a table.
Foreign Key	A column that creates a link between two tables by referencing the primary key of another table.
Index	A data structure (often B-tree) that speeds up search and retrieval operations.
Schema	The logical design of the database: tables, columns, relationships, constraints, and other objects.
Transaction	A unit of work that must be atomic , consistent , isolated , and durable (ACID).

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Term	Meaning
Normalization	Process of organizing data to reduce redundancy and improve integrity (1NF, 2NF, 3NF, BCNF, etc.).

3. Types of Databases

Category	Typical Use Cases	Examples
Relational DBMS (RDBMS)	Structured data, complex queries, strong ACID guarantees	MySQL, PostgreSQL, Oracle, Microsoft SQL Server
NoSQL	Large scale, flexible schema, high velocity data	MongoDB (document), Cassandra (wide column), Redis (key-value), Neo4j (graph)
In-Memory DBMS	Real-time analytics, caching	SAP HANA, Redis
NewSQL	Combines SQL interface with NoSQL scalability	CockroachDB, Google Spanner
Time Series DB	Sensor data, monitoring logs	InfluxDB, TimescaleDB
Graph DB	Social networks, recommendation engines	Neo4j, Amazon Neptune

4. Database Architecture Layers

1. External Level (View)

- What individual users or applications see.
- Can have multiple logical views of the same data.

2. Conceptual Level (Logical Schema)

- Whole logical structure of the database (tables, relationships, constraints).
- Independent of physical storage details.

3. Internal Level (Physical Schema)

- How data is actually stored on disk (files, indexes, storage structures).

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- Optimizations for performance and space.
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5. Basic SQL Commands (RDBMS)

Category	Command	Example
Data Definition Language (DDL)	CREATE TABLE, ALTER TABLE, DROP TABLE	CREATE TABLE Customers (CustomerID INT PRIMARY KEY, Name VARCHAR(100));
Data Manipulation Language (DML)	INSERT, UPDATE, DELETE,	