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**Basics of Database**

**1. What is a Database?**

A **database** is a structured collection of data that can be easily accessed, managed, and updated. It stores information in a way that makes it easy to retrieve, organize, and analyze. Databases are used to store everything from personal data to complex business data.

**2. Types of Databases**

* **Relational Databases (RDBMS):** Store data in tables with rows and columns. Examples include MySQL, PostgreSQL, and Oracle.
* **NoSQL Databases:** Non-relational databases designed to handle unstructured or semi-structured data, such as MongoDB, Cassandra, or Redis.
* **In-memory Databases:** Store data in the computer’s RAM for faster access, like Redis or Memcached.
* **Graph Databases:** Store data in graph format, suitable for representing relationships (e.g., Neo4j).

**3. Database Management System (DBMS)**

A **DBMS** is software that manages databases and provides an interface for users to interact with the data. It ensures data integrity, security, and supports SQL queries.

* **Examples of DBMS:** MySQL, PostgreSQL, MongoDB, Oracle, Microsoft SQL Server.

**4. Tables and Structure**

In a **relational database**, data is organized in **tables**, which are made up of:

* **Rows (Records):** Each row represents a single, unique record or entity (e.g., a customer).
* **Columns (Fields):** Each column holds specific data attributes (e.g., name, email, age).

**5. Keys in Databases**

* **Primary Key:** A column (or a set of columns) that uniquely identifies each row in a table. It cannot contain null values.
* **Foreign Key:** A column in one table that references the primary key in another table, creating a relationship between the two tables.
* **Unique Key:** A column that ensures all values in that column are unique.
* **Composite Key:** A primary key composed of multiple columns.

**6. SQL (Structured Query Language)**

**SQL** is the standard language used to interact with relational databases. Here are some of the key SQL commands:

* **SELECT:** Retrieves data from one or more tables.
* SELECT \* FROM customers;
* **INSERT:** Adds new records into a table.
* INSERT INTO customers (name, age) VALUES ('John Doe', 30);
* **UPDATE:** Modifies existing data in a table.
* UPDATE customers SET age = 31 WHERE name = 'John Doe';
* **DELETE:** Removes data from a table.
* DELETE FROM customers WHERE name = 'John Doe';

**7. Normalization**

**Normalization** is the process of organizing data to minimize redundancy and dependency. It involves dividing a database into two or more tables and defining relationships between them.

* **First Normal Form (1NF):** No repeating groups or arrays in a table.
* **Second Normal Form (2NF):** Eliminate partial dependencies (ensure all non-key columns depend on the whole primary key).
* **Third Normal Form (3NF):** Eliminate transitive dependencies (non-key columns should not depend on other non-key columns).

**8. Transactions**

A **transaction** is a sequence of operations (e.g., insert, update, delete) performed as a single unit. Transactions ensure that the database remains in a consistent state, even in the event of a failure.

* **ACID Properties:**
  + **Atomicity:** All operations in a transaction are completed successfully or not at all.
  + **Consistency:** A transaction brings the database from one consistent state to another.
  + **Isolation:** Transactions do not interfere with each other.
  + **Durability:** Once a transaction is committed, it is permanent.

**9. Relationships Between Tables**

* **One-to-One:** One record in a table is related to one record in another table.
* **One-to-Many:** One record in a table can be related to multiple records in another table (e.g., one customer has many orders).
* **Many-to-Many:** Multiple records in one table are related to multiple records in another table (e.g., students and courses).

**10. Data Redundancy and Security**

* **Data Redundancy:** Unnecessary duplication of data. Avoided through proper normalization.
* **Data Security:** Protects data from unauthorized access, theft, or corruption using authentication, encryption, and access control.

**11. Cloud Databases**

**Cloud Databases** store data in the cloud, offering flexibility and scalability. Popular cloud databases include:

* **Amazon RDS (Relational Database Service)**
* **Google Cloud SQL**
* **Microsoft Azure SQL Database**