Relational Database Model

Introduction

A relational database model organizes data into one or more tables (or "relations") of rows and columns, with a unique key identifying each row. Here's a breakdown of the key concepts and components:

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Key Concepts

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1. Table (Relation): A table is a collection of related data entries consisting of rows and columns. Each table has a unique name.

2. Row (Tuple or Record): A single entry in a table, representing a set of related data. Each row in a table should be unique.

3. Column (Attribute or Field): A column represents a single piece of data in a table. Each column has a unique name within the table and a specific data type.

4. Primary Key: A column or a combination of columns that uniquely identifies each row in a table. Primary keys must contain unique values and cannot contain null values.

5. Foreign Key: A column or a set of columns in one table that refers to the primary key in another table. Foreign keys are used to establish and enforce a link between the data in the two tables.

6. Index: A database object that improves the speed of data retrieval operations on a table at the cost of additional storage and maintenance overhead.

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Relationships

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- One-to-One: A single row in one table is linked to a single row in another table.
- One-to-Many: A single row in one table is linked to multiple rows in another table.
- Many-to-Many: Multiple rows in one table are linked to multiple rows in another table. This is typically implemented using a junction table.

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SQL

SQL (Structured Query Language)

SQL is the language used to manage and manipulate relational databases. Common SQL operations include:

- SELECT: Retrieve data from one or more tables.
- INSERT: Add new rows to a table.
- UPDATE: Modify existing rows in a table.
- DELETE: Remove rows from a table.
- CREATE TABLE: Define a new table and its columns.
- ALTER TABLE: Modify an existing table structure.
- DROP TABLE: Delete a table and its data.

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Example

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Consider a simple example with two tables: Customers and Orders.

Customers Table

CustomerID	Name	Email
1	John Smith	john@example.com
2	Jane Doe	jane@example.com

Orders Table

OrderID	CustomerID	OrderDate
101	1	2024-07-01
102	2	2024-07-02

In this example:

- The Customers table has a primary key CustomerID.

- The Orders table has a primary key OrderID and a foreign key CustomerID that references CustomerID in the Customers table, establishing a one-to-many relationship.

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Example SQL Queries

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- Retrieve all customers:

```
SELECT * FROM Customers;
```

- Insert a new order:

```
INSERT INTO Orders (OrderID, CustomerID, OrderDate)
VALUES (103, 1, '2024-07-03');
```

- Update a customer's email:

```
UPDATE Customers
SET Email = 'newemail@example.com'
WHERE CustomerID = 1;
```

- Delete an order:

```
DELETE FROM Orders
WHERE OrderID = 101;
```

The relational database model is widely used due to its simplicity, flexibility, and ability to handle large volumes of data efficiently.