Relational Models

by Sophia

WHAT'S COVERED

In this lesson, you will explore milestones in the development of the relational data models created in the mid-1970s, in three parts. Specifically, this lesson will cover:

1. Historical Background

The **relational database** model was developed in the 1970s, with the goal of overcoming some of the limitations of the hierarchical and network models. The simplicity of the relational model made it quite easy to use, which is a big reason why it is still so commonly used today.

The relational model's foundation was based on mathematical set theory and the idea of representing data as independent relations. A **relation**, which you know as a table, is just a structure that has rows and columns. Each row is called a **tuple** (a record), and each column represents an **attribute** (a field). This model was viewed as a technical breakthrough for database users and designers.

IN CONTEXT

When the model was created in the 1970s, both the hierarchical and network models could not keep up with the data needs of companies and governments. The older models were in need of an overhaul. All database types started to grow because computing power grew exponentially once the personal computer (PC) hit the market. With new operating systems and new hardware capabilities, many different sizes and kinds of companies were able to start using relational databases. By the 1990s, databases started being the cornerstone of business, commerce, and computer systems.

Here are the core events that led us to today, and to the PostgreSQL that you will be using later in this course to practice working with a relational database.

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- 1970: Edgar F. Codd publishes “A Relational Model of Data for Large Shared Data Banks.”
- 1974: IBM releases System R, the first relational database management system (RDBMS).
- 1979: Oracle Corporation releases Oracle 1, the first commercially available RDBMS.
- 1982: Microsoft releases SQL Server, the first RDBMS for the Windows platform.
- 1983: Sybase releases Sybase SQL Server, a competitor to Microsoft SQL Server.
- 1986: Ingres releases Ingres, an open-source RDBMS.
- 1992: The SQL standard is released.
- 1998: MySQL is released, a popular open-source RDBMS.
- 2000: PostgreSQL is released, a popular open-source RDBMS.

TERMS TO KNOW

Relational Database

Relational databases are databases that store data in tables. Each table is a collection of rows and columns, and each row represents a single record.

Relation

Also known as a table, a row-and-column structure for holding data in a relational database.

Tuple

Also known as a record, one row in a relation (table) containing all the data for one item.

Attribute

A single piece of information within a record, also known as a field.

2. Model Features

Relational data models were implemented through a complex relational database management system (**RDBMS**). The RDBMS helps hide the complexities of the relational model from the user, so that the user sees only the relational database as a collection of tables where the data is stored. All of the underlying physical features of the model are completely hidden.

The relationships between tables in a relational model can be set up as one-to-one or one-to-many. For example, if one table holds orders and another holds order items, there's a one-to-many relationship because one order can have many ordered items, but an ordered item can belong to only one order. An example of a one-to-one relationship might be between an employee and their Social Security number.

Many-to-many relationships are broken down into multiple one-to-many relationships, with a relational table representing the transition between the many-to-many relationships. The relational table has complete data and structural independence. This means that how the data is physically stored in the database does not matter to the developer or end user.

The relational data model is where you start to see the use of **Structured Query Language** (SQL) with the data manipulation language (DML) and data definition language (DDL) statements that originated from the earlier

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network model. Recall that the network model was too complex, requiring programmers to create the code to run even the simplest reports. SQL, in contrast, is intuitive and easy to use because it is based on simple English-language words.

Advantages of the relational database model:	• It is simple and easy to understand. • It is flexible and can represent a wide variety of data relationships. • It is efficient for storing and retrieving data. • It is scalable and can be used to manage large amounts of data.
Disadvantages of the relational database model:	• It can be difficult to implement complex data relationships. • It can be difficult to optimize queries for performance. • It can be difficult to manage data security.

THINK ABOUT IT

When you execute a SELECT statement in SQL, you do not have to know how it is gathering the data and processing it behind the scenes. As an end user, you need only specify what must be done, without having to define how it is done. The use of SQL with the relational model made it a lot easier to retrieve data than in any other database that preceded it.

TERMS TO KNOW

RDBMS

Relational database management system.

Structured Query Language

A programming language that allows data to be retrieved and manipulated in a relational database.

3. Parts of a Relational Database

From a user perspective, a SQL-based relational database consists of three parts.

- The **end-user interface** is the part where you can interact with the data through the SQL code. For the SQL you will practice in this course, this is through the web interface. For others, this is through a program or a command line. There are many different types of user interfaces that can be used to connect to the same database.
- The second part is the collection of tables that the end user interacts with. Each of those tables is independent of one another, and the rows in the tables are related to each other through some common values in common attributes. This is where all the data is stored in a database.

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- The last part is the SQL engine. This is the part that is mostly hidden away from the end user. The **SQL engine** is part of the database management software that runs all of the SQL queries and data requests.

You should also know the core parts of the collection of tables and how they are used:

Tables	**Tables** (also called relations) are the basic unit of data storage in a relational database. They are organized into rows and columns, each representing a single record. The columns in a table represent the attributes (also called fields) of the record, and the rows represent the values of the attributes.
Columns	**Columns** are the individual attributes of a table. They are usually of the same data type and can contain various data, such as numbers, text, and dates.
Rows	**Rows** are the individual records in a table. They contain the values of all the columns in the table.
Primary Key	A **primary key** is a column or a combination of columns uniquely identifying each row in a table. The primary key cannot contain duplicate values. In a one-to-many relationship, the primary key is on the "one" side.
Foreign Key	A **foreign key** is a column or a combination of columns that refers to the primary key of another table. The foreign key must contain the same values as the primary key of the other table. In a one-to-many relationship, the foreign key is on the "many" side.
Indexes	An **index** is a data structure that speeds up the retrieval of data from a database, much like the index at the back of a book makes it easier to find specific topics in the book. Indexes are created on columns that are frequently used in queries.
Constraints	A **constraint** is a rule that restricts the values that can be stored in a column or a table. Constraints are used to ensure the integrity of the data in a database.

Columns

The individual attributes of a table, also called fields. They are usually of the same data type and can contain various data, such as numbers, text, and dates.

Constraints

A rule that restricts the values that can be stored in a column or a table. Constraints are used to ensure the integrity of the data in a database.

End-User Interface

Where ordinary database users interact with the data.

Foreign Key

A column or a combination of columns that refers to the primary key of another table.

Indexes

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Primary Key

A primary key is a column or a combination of columns uniquely identifying each row in a table. The primary key cannot contain duplicate values.

Rows

The individual records in a table. They contain the values of all the columns in the table.

SQL Engine

The software that runs the database and is normally not accessible by end users.

Tables

The basic unit of data storage in a relational database. They are organized into rows and columns, each representing a single record. The columns in a table represent the attributes of the record, and the rows represent the values of the attributes.

SUMMARY

Because the **historical background** of the hierarchical and network data models raised issues of complexity and difficulty in searching out answers in the data, the relational data model was developed in the 1970s. It had **model features** that made it easier to trace relationships between data, provided consistent data structure, and allowed for easier queries into the data. These improvements are possible because of the main **parts of the relational database**: an end-user interface, the collection of data tables, and the SQL engine for interpreting queries.

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TERMS TO KNOW

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