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THE APPLICATION OF DATABASE MODELS.

Temirova Gulfiya Ravshan kizi,
Qarshi State Technical University,
Computer engineering student

Annotation. *Database models are the foundational structures that define how data is stored, organized, and manipulated within a database system. Different database models, such as the hierarchical, network, relational, and NoSQL models, serve distinct purposes and are applied across various industries based on the nature of the data and specific system requirements. The hierarchical model is useful in applications with a strict parent-child relationship, while the relational model, with its tables and relationships, is the most widely used in business and enterprise systems. The network model offers more flexibility than the hierarchical model by allowing complex relationships, and the NoSQL model supports large-scale, unstructured, or semi-structured data, making it essential for big data and real-time applications. This article explores the practical applications of these database models, examining their strengths, limitations, and how they contribute to efficient data management in sectors such as finance, healthcare, e-commerce, and social media.*

Keywords: *Database Models, Relational Model, Hierarchical Model, Network Model, NoSQL, Data Management, Big Data, Data Organization, Scalability, Application, Structured Data.*

Аннотация. *Модели баз данных являются основополагающими структурами, которые определяют, как данные хранятся, организуются и обрабатываются в системе баз данных. Различные модели баз данных, такие как иерархическая, сетевая, реляционная и NoSQL, служат различным целям и применяются в различных отраслях в зависимости от характера данных и конкретных системных требований. Иерархическая модель полезна в приложениях со строгими родительско-дочерними отношениями, в то время*

как реляционная модель с ее таблицами и отношениями наиболее широко используется в бизнес- и корпоративных системах. Сетевая модель обеспечивает большую гибкость, чем иерархическая модель, допуская сложные отношения, а модель NoSQL поддерживает крупномасштабные, неструктурированные или полуструктурированные данные, что делает ее необходимой для больших данных и приложений реального времени. В этой статье рассматриваются практические применения этих моделей баз данных, их сильные стороны, ограничения и то, как они способствуют эффективному управлению данными в таких секторах, как финансы, здравоохранение, электронная коммерция и социальные сети.

Ключевые слова. *Ключевые слова: Модели баз данных, Реляционная модель, Иерархическая модель, Сетевая модель, NoSQL, Управление данными, Большие данные, Организация данных, Масштабируемость, Приложение, Структурированные данные.*

In today's data-driven world, efficient data storage, management, and retrieval are critical for businesses, organizations, and even individuals. Database models provide the framework for organizing and managing data. These models define how data is structured, how relationships between different data elements are represented, and how data is accessed or manipulated. Over time, various database models have emerged, each designed to address specific types of data, use cases, and technological advancements. This article explores the most widely used database models—hierarchical, network, relational, and NoSQL—and discusses their applications across industries such as healthcare, e-commerce, finance, and social media.

A database model is an abstract representation of how data is structured and how the relationships between data elements are managed. It provides the blueprint for organizing data, ensuring that it is stored in an efficient, accessible, and secure manner. Database models are essential for managing both small and large-scale data systems, and they evolve to meet the demands of changing technology and business requirements. The choice of database model influences the performance, scalability,

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and flexibility of the database system, as well as the ease with which data can be manipulated and accessed.

The hierarchical model organizes data in a tree-like structure where each record has a single parent and can have multiple child records. This model is often compared to a family tree, where one entity (the parent) can have several related entities (the children). Hierarchical databases were widely used in early mainframe systems and are still useful in applications where data has a clear hierarchical structure, such as file systems, organizational charts, and inventory management systems.

In the early days of computing, hierarchical databases were used by industries that needed structured, parent-child data relationships. They were especially useful in banking applications and enterprise resource planning (ERP) systems where data entities are clearly defined and follow a strict hierarchy. However, the rigid nature of the model can be limiting when complex relationships are required.

Examples: IBM's Information Management System (IMS) is a well-known hierarchical database.

The network model is an extension of the hierarchical model and allows for more complex relationships between data entities. It allows each record to have multiple parent and child records, creating a graph-like structure where data entities are connected in many-to-many relationships. The network model is more flexible than the hierarchical model, making it suitable for applications that require more intricate data relationships.

The network model is commonly used in large-scale systems that need to handle complex relationships. For example, in telecommunications or transportation industries, the model can represent relationships between different systems, such as customers, products, services, and geographic locations.

Examples**.** The Integrated Data Store (IDS) by Cullinet and the Conference on Data Systems Languages (CODASYL) database standards are examples of network databases.

ISSN 3060-4567

The relational model, developed by Edgar F. Codd in the 1970s, represents data in tables (or relations), where each table consists of rows (records) and columns (attributes). Data can be retrieved and manipulated using Structured Query Language (SQL), making relational databases highly flexible and efficient for managing structured data. The relational model is the most widely used database model today due to its simplicity, scalability, and ease of use.

Relational databases are widely used in business applications where data is structured in tables and requires complex queries. Examples include customer relationship management (CRM) systems, inventory management systems, financial applications, and enterprise resource planning (ERP) systems. These systems rely on the relational model to store transactional data, customer information, and business operations.

Examples**:** Popular relational database management systems (RDBMS) include MySQL, PostgreSQL, Oracle, and Microsoft SQL Server.

NoSQL (Not Only SQL) databases are designed for handling unstructured or semi-structured data. Unlike relational databases, which store data in tables with predefined schemas, NoSQL databases allow for flexible data storage. They are highly scalable and designed for distributed computing environments. NoSQL databases support a variety of data models, including key-value stores, document-based databases, column-family stores, and graph databases.

NoSQL databases are particularly useful in applications involving large volumes of unstructured data, real-time data processing, and horizontal scalability. They are commonly used in big data applications, web-scale applications, social media platforms, and content management systems. For example, they are popular in IoT applications, where devices generate continuous streams of data.

Examples: Some well-known NoSQL databases include MongoDB (document-based), Cassandra (column-family store), Redis (key-value store), and Neo4j (graph database).

Applications of Database Models in Various Industries.

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The healthcare industry relies on various database models for managing patient records, medical histories, prescriptions, and billing information. Relational databases are often used for Electronic Health Records (EHR), as they provide structured data storage and allow for complex queries and reporting. NoSQL databases may also be used for managing large sets of unstructured data from medical imaging or sensor devices.

A hospital might use a relational database to store patient demographics and treatment history, while a NoSQL database could store real-time data from wearable health devices.

In e-commerce, databases are essential for managing product catalogs, customer orders, inventories, and payment information.

Relational databases are widely used for managing structured data, such as product prices and customer data. However, NoSQL databases can be used for handling product reviews, customer interactions, and other unstructured data generated by users.

An online retailer like Amazon may use a relational database for transaction processing and a NoSQL database to store product recommendations based on user preferences.

Financial institutions rely on databases to manage transactions, customer accounts, and risk analysis.

Relational databases are widely used for transaction processing due to their ability to handle large volumes of structured data with high consistency. In recent years, NoSQL databases have been gaining traction in handling real-time data streams for stock market analysis and financial forecasting.

A bank may use a relational database for transaction records, but employ a NoSQL database to track real-time stock market data for predictive modeling.

Social media platforms rely on databases to store user profiles, posts, interactions, and multimedia content.

These platforms often use a combination of relational databases (for structured data like user accounts) and NoSQL databases (for unstructured data such as

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comments, likes, and media files). NoSQL databases like MongoDB and Cassandra are ideal for handling the massive scale and dynamic nature of social media data.

Facebook uses a combination of relational and NoSQL databases to store user data, interactions, photos, and videos across its platform.

Challenges and Considerations in Choosing a Database Model**.**

Choosing the right database model depends on several factors, including the nature of the data, the scale of the application, and the required level of performance. Some of the challenges and considerations include:

While relational databases can scale vertically, NoSQL databases are designed for horizontal scaling, which is essential for handling large-scale applications.

Relational databases work best for structured data with a defined schema. NoSQL databases are better suited for unstructured or semi-structured data, making them ideal for big data applications.

Relational databases prioritize consistency, ensuring that data is always accurate and up to date. NoSQL databases, on the other hand, may favor availability and partition tolerance, making them suitable for applications requiring high availability and fault tolerance.

Relational databases are easier to maintain for smaller applications with structured data, but NoSQL databases may require more complex management as the data grows.

Database models play a crucial role in organizing and managing data efficiently across different industries. From traditional relational models to the more flexible NoSQL models, each database system has its strengths and is designed to address specific needs.

As data continues to grow in volume, complexity, and velocity, selecting the right database model will remain critical to ensuring efficient data management and decision-making.

With the continued rise of big data, real-time applications, and cloud computing, the role of NoSQL databases will only increase, but relational databases

will continue to be a staple for structured data management in industries that require rigorous consistency and complex querying capabilities.

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