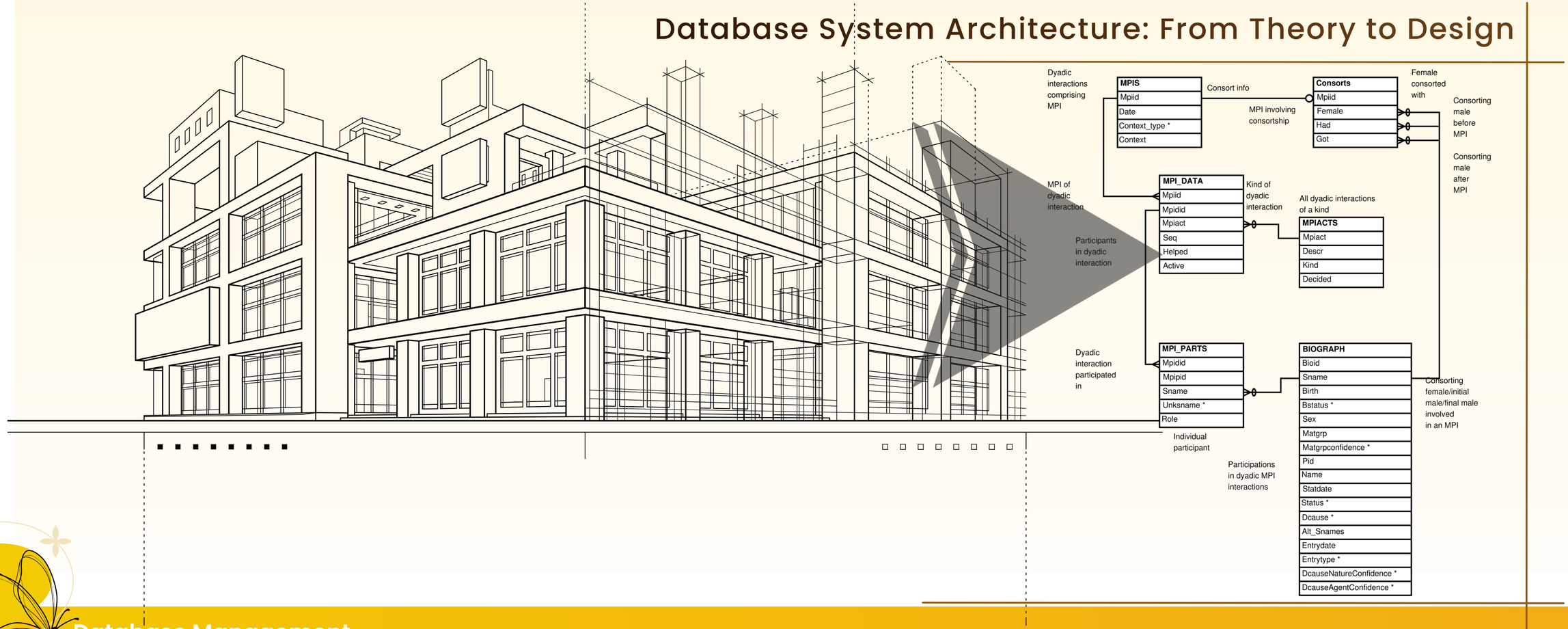
Database System Architecture

Database System Architecture: From Theory to Design



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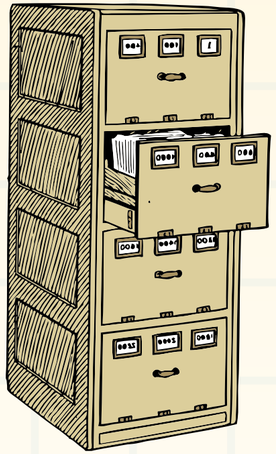
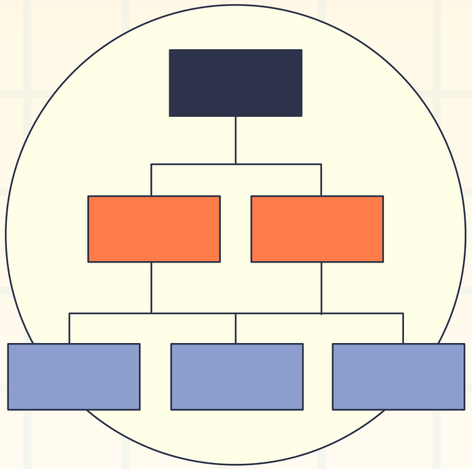
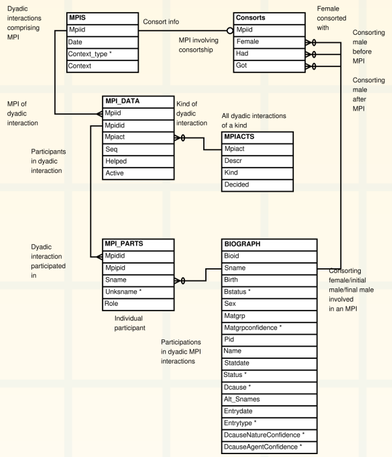
Data Model Evolution







File System (1960s)
Rigid,Record-based

Hierarchical/Network (1970s)
Parent-Child,Complex

Relational Model (TheHero)
Table-based,SQL,Standard

OO/NoSQL
Unstructured Data

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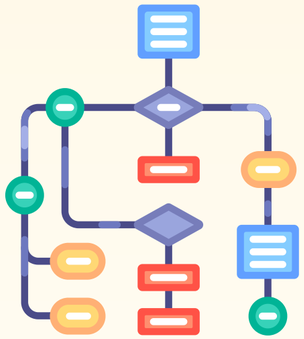
The Three-Level Architecture (ANSI-SPARC)

Levels of Data Abstraction

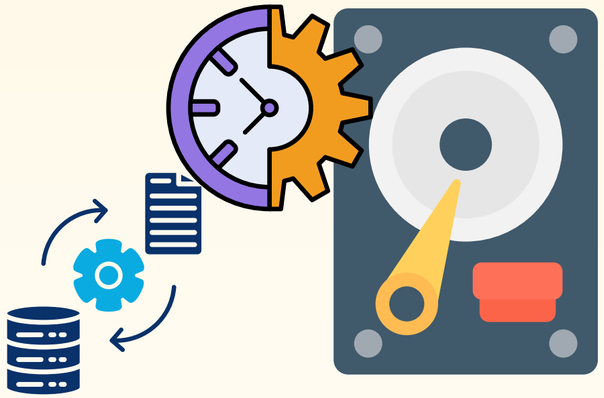
External Model

High Abstraction



Conceptual Model

Designer's View



Internal & Physical Models

Low Abstraction

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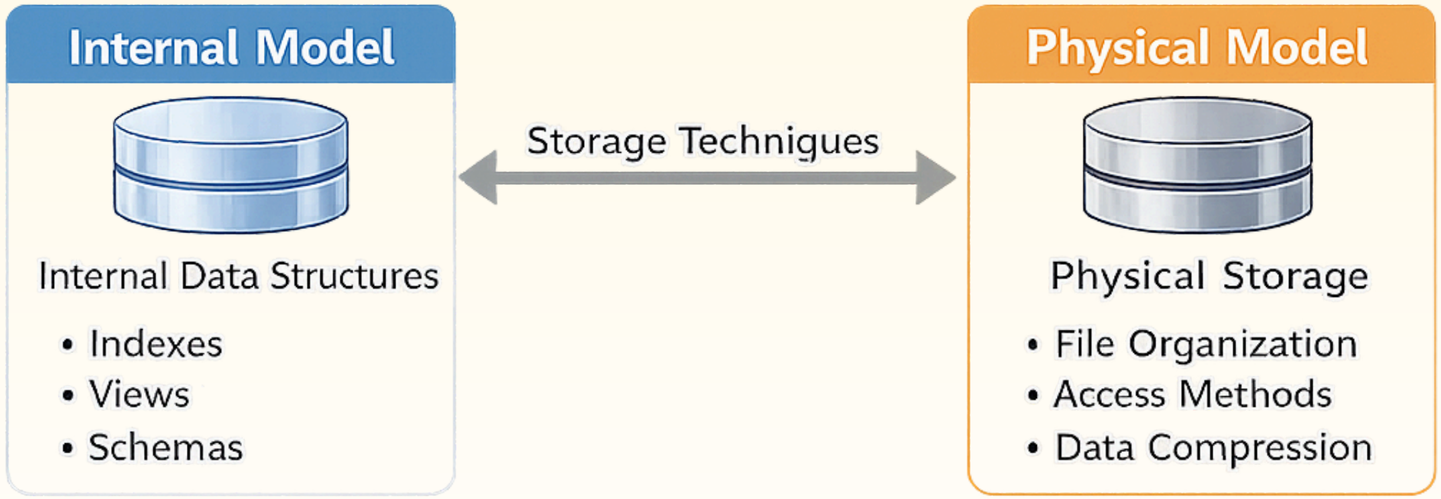
The Three-Level Architecture(ANSI-SPARC)

Internal & Physical Models

The Internal and Physical Models focus on the internal structure of the dafabase. They deal with how data is stored, erganized, and accessed efficiently.



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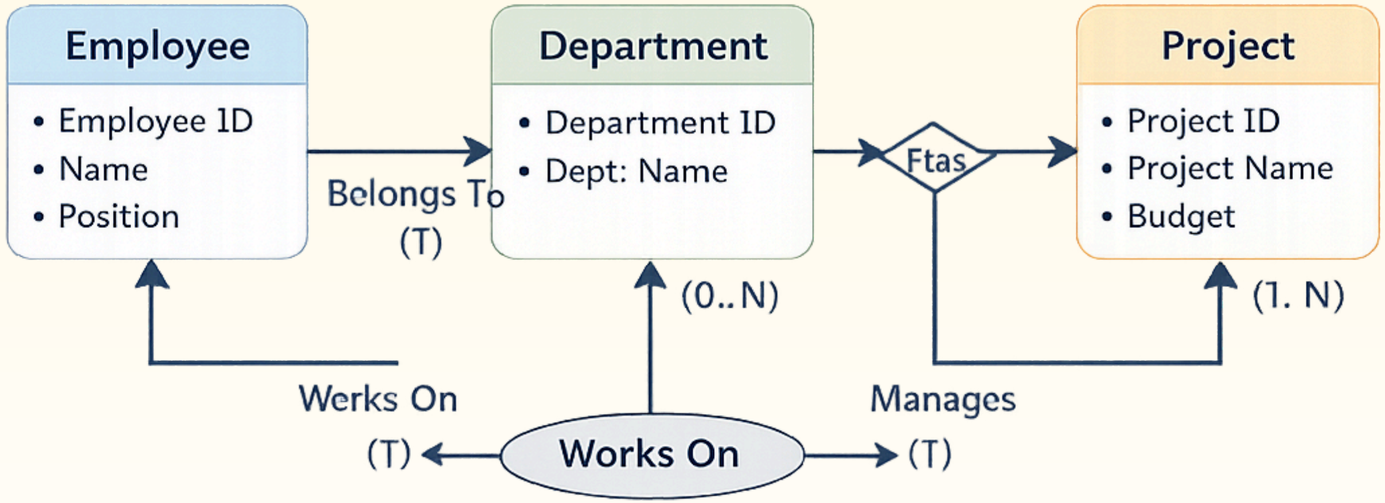
The Three-Level Architecture(ANSI-SPARC)

Conceptual Model

The Conceptual Model defines the overall database structure at a high level. It emphasizes the enttities, their attributes, and the relationships between them.



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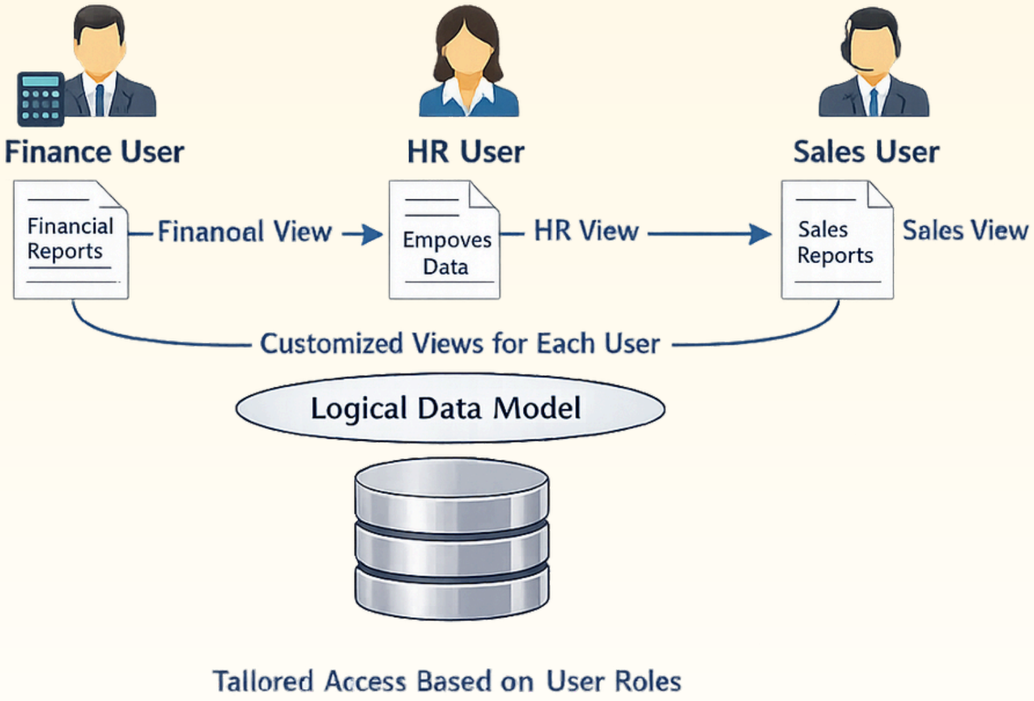
The Three-Level Architecture(ANSI-SPARC)

External Model

The External Level represents the user's view of the database. Each user sees a tailored, specifle view based on their needs and access rights.



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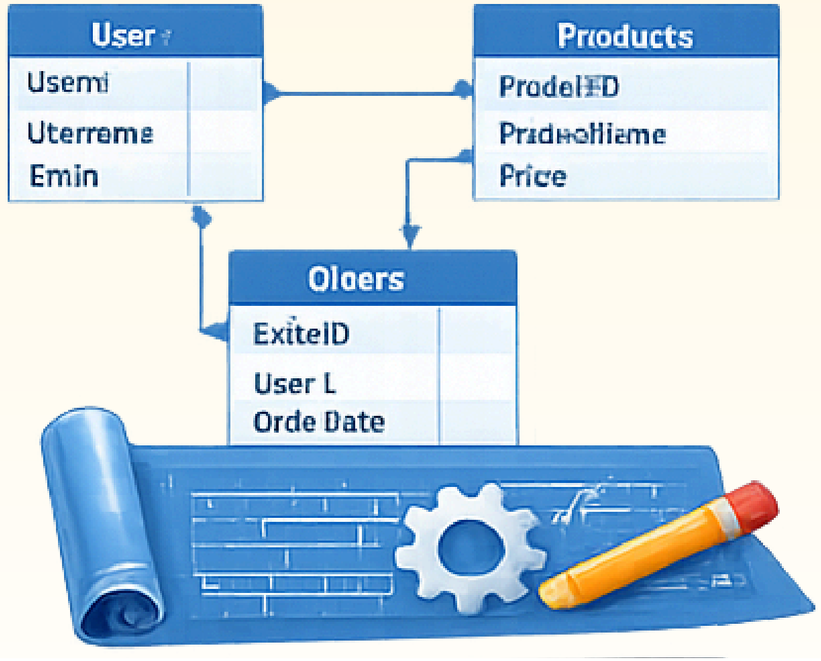
Database Schema

A Database Schema is the logical structure that defines the overall organization of a database system. It describes the fundamental structure of the entire database. The schema specifies database tables, fields or attributes, and data types. It also clearly defines the relationships among different data elements. A database schema is created during the database design phase. Its purpose is to provide a structured framework for storing and managing data systematically. In general, the schema does not change frequently unless the database structure is redesigned. Therefore, the database schema can be considered a blueprint of the database system. It serves as a critical foundation for database development, usage, and long-term maintenance.



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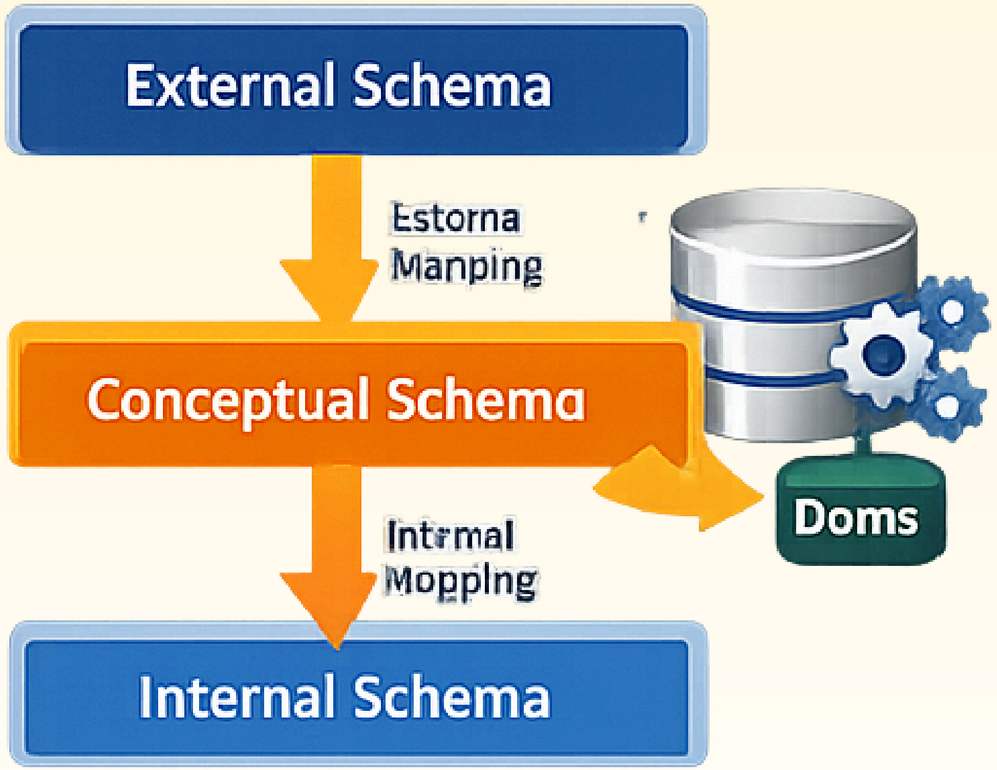
Schema Mapping

Schema mapping is the process of converting data definitions between different schema levels in a database system. It plays a crucial role in database architecture by enabling communication and transformation among schema layers. Through schema mapping, data can be translated from one level of abstraction to another without altering its meaning. This process supports data independence, which allows changes at one schema level without affecting other levels.

External-to-conceptual mapping defines how user views are related to the overall logical structure of the database. It ensures that different users can access the same underlying data through customized views.Conceptual-to-internal mapping, on the other hand, specifies how the logical structure is stored physically in the database.This mapping determines file structures, access paths, and storage techniques used by the system.

Schema mapping is fully managed by the Database Management System (DBMS). As a result, users and application programs are shielded from the complexity of data storage and structure. This mechanism enhances flexibility, maintainability, and efficiency in database systems.



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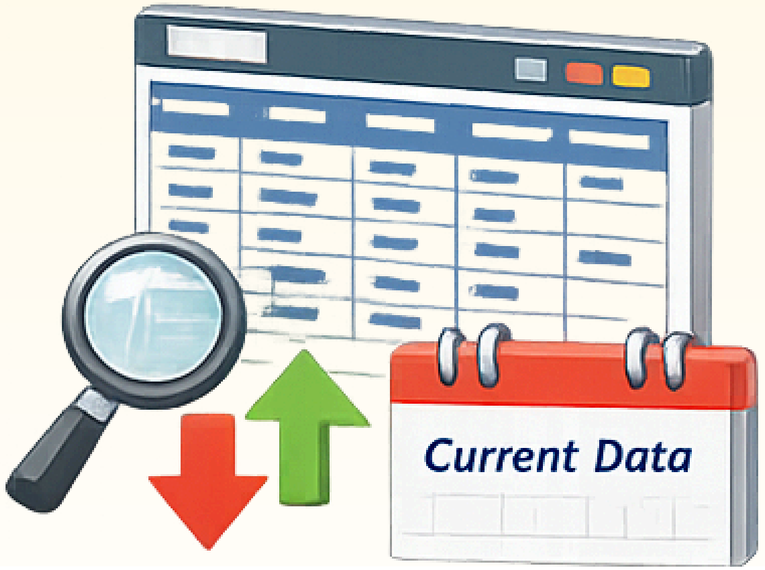
Database Instance

A database instance refers to the actual data stored in a database at a specific point in time. It represents the current state of the database, reflecting all records that exist at that moment. Unlike a database schema, which defines the structure, an instance contains real data values. The content of a database instance changes frequently as a result of database operations. Operations such as inserting, updating, or deleting records directly affect the database instance. Each transaction modifies the instance while the overall schema remains unchanged. Therefore, a database instance can be viewed as a dynamic component of the database system. It captures a snapshot of the database at a particular moment in time. Understanding the concept of database instance helps distinguish between data structure and data content. This distinction is fundamental to effective database design and management.



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Data Independence

External Schema

Conceptual Schema

Logical Data Independence

Internal Schema

Physical Data Independence

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