

DS1105 DATABASE MANAGEMENT SYSTEMS

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Lesson Learning Outcomes

By the end of this lesson, students will be able to:

- Define the three schema levels.
- Describe logical & physical data independence.
- List DBMS languages and interfaces.

Content

- Three Schema Architecture: External, Conceptual, Internal
- Data Independence: Logical & Physical
- DBMS Languages: DDL, SDL, VDL, DML

Three Schema Architecture

- ❑ It describes how the data is represented or viewed by the user in the database.
- ❑ This architecture is also known as the **three-level architecture**.
- ❑ The three-schema architecture divides the database into three level to create a separation between the physical database and the user application.

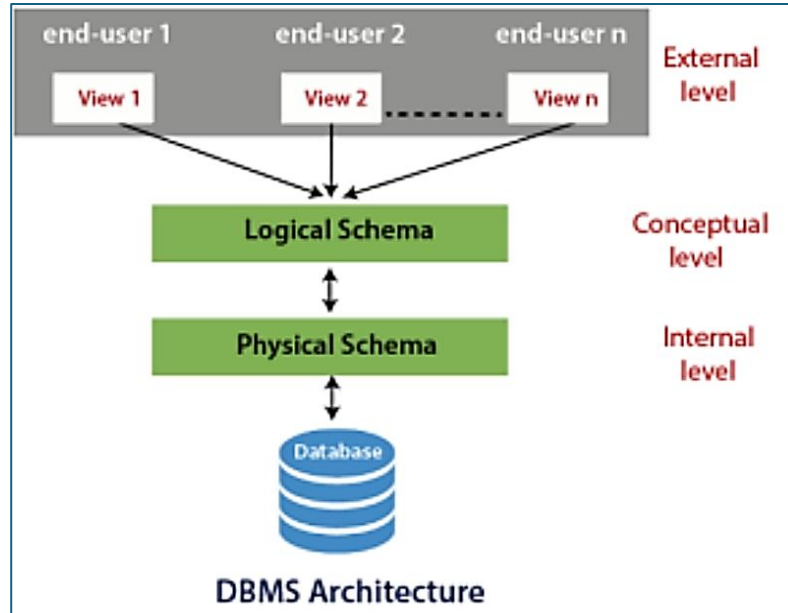
Three Schema Architecture

- ❑ In simple words, this architecture hides the details of physical storage from the user.
- ❑ The database administrator (DBA) should be able to change the structure of database storage without affecting the user's view.

Three Schema Architecture

- ❑ This architecture contains three layers or levels of the database management system:

1. External level
2. Conceptual level
3. Internal level



1. External or View level

- ❑ The highest level of database abstraction
- ❑ Describes the actual view of data that is relevant to the user
- ❑ Provides different views of the same database for a specific user or a group of users
- ❑ An external view provides a powerful and flexible security mechanism by hiding the parts of the database from the user

2. Conceptual or Logical level

- ❑ Describes the structure of the whole database
- ❑ Acts as a **middle layer** between the physical storage and the user view
- ❑ It explains what data to be stored in the database,
 - what relationship exists among those data, and
 - what the data types are

2. Conceptual or Logical level

- ❑ There is only one conceptual schema per database.
- ❑ Database administrator and the programmers work at this level.
- ❑ This level does not provide any access or storage details but concentrates on the relational model of the database.
- ❑ The conceptual schema also includes features that specify the checks to retain integrity and consistency.

3. Internal or Physical level

- ❑ The lowest level of database abstraction
- ❑ Describes how the data is **actually stored** in the database and provides methods to access data from the database
- ❑ It allows viewing the physical representation of the database on the computer system.

3. Internal or Physical level

- ❑ The interface between the conceptual schema and the internal schema identifies how an element in the conceptual schema is stored and how it may be accessed.
- ❑ If there is any change in the internal or physical schema, it needs to be addressed in the interface between the conceptual and internal schema.

3. Internal or Physical level

- ❑ But there is no need to change the interface of a conceptual and external schema.
- ❑ It means that the changes in physical storage devices, such as hard disks, and the files organized on storage devices, are transparent to application programs and users.

Data Independence

- ❑ The three-schema architecture can be used to explain the concept of data independence further
- ❑ This can be defined as the capacity to change the schema at one level of a database system without having to change the schema at the next higher level.
- ❑ There are two types of data independence,
 1. Logical data independence
 2. Physical data independence

Logical data independence

- ❑ Logical data independence is the capacity to change the conceptual schema without having to change external schemas or application programs.
- ❑ We may change the conceptual schema
 - to expand the database (by adding a record type or data item),
 - to change constraints, or
 - to reduce the database (by removing a record type or data item).
- ❑ In the last case (by removing a record type or data item), external schemas that refer only to the remaining data should not be affected

Logical data independence

For example, the external schema of “TRANSCRIPT” should not be affected by changing the
GRADE_REPORT file
(or record type)

TRANSCRIPT					
Student_name	Student_transcript				
	Course_number	Grade	Semester	Year	Section_id
Smith	CS1310	C	Fall	08	119
	MATH2410	B	Fall	08	112
Brown	MATH2410	A	Fall	07	85
	CS1310	A	Fall	07	92
	CS3320	B	Spring	08	102
	CS3380	A	Fall	08	135

(a)

GRADE_REPORT				
Student_number	Student_name	Section_identifier	Course_number	Grade
17	Smith	112	MATH2410	B
17	Smith	119	CS1310	C
8	Brown	85	MATH2410	A
8	Brown	92	CS1310	A
8	Brown	102	CS3320	B
8	Brown	135	CS3380	A

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Physical data independence

- ❑ Physical data independence is the capacity to change the internal schema without having to change the conceptual schema.
- ❑ Hence, the external schemas need not be changed as well.
- ❑ Changes to the internal schema may be needed because some physical files were reorganized.
- ❑ For example, by creating additional access structures to improve the performance of retrieval or update.
- ❑ If the same data as before remains in the database, we should not have to change the conceptual schema.

DATABASE LANGUAGES AND INTERFACES

DBMS Languages (database schemas)

- ❑ Data Definition Language (DDL), is used by the DBA and by database designers to define both conceptual and external schemas.
- ❑ Storage Definition Language (SDL), is used to specify the internal schema.
- ❑ View Definition Language (VDL), to specify user views and their mappings to the conceptual schema.
 - ❑ SQL is used in the role of VDL to define user or application views as results of predefined queries

DBMS Languages (manipulate database)

- ❑ Typical manipulations include retrieval, insertion, deletion, and modification of the data.
- ❑ The DBMS provides a set of operations or a language called the Data Manipulation Language (DML) for these purposes.

DBMS Interfaces – Homework

- ❑ User-friendly interfaces provided by a DBMS may include the following:
 - Menu-Based Interfaces for Web Clients or Browsing
 - Forms-Based Interfaces
 - Graphical User Interfaces.
 - Natural Language Interfaces.
 - Speech Input and Output.
 - Interfaces for Parametric Users.
 - Interfaces for the DBA.

Summary

- Three schemas separate the user view, logical design, and physical storage.
- Data independence ensures schema changes don't affect higher levels.
- DBMS provides languages and interfaces to manage and use databases.

THANK YOU