Database Management System – 5 (Three Schema architecture)

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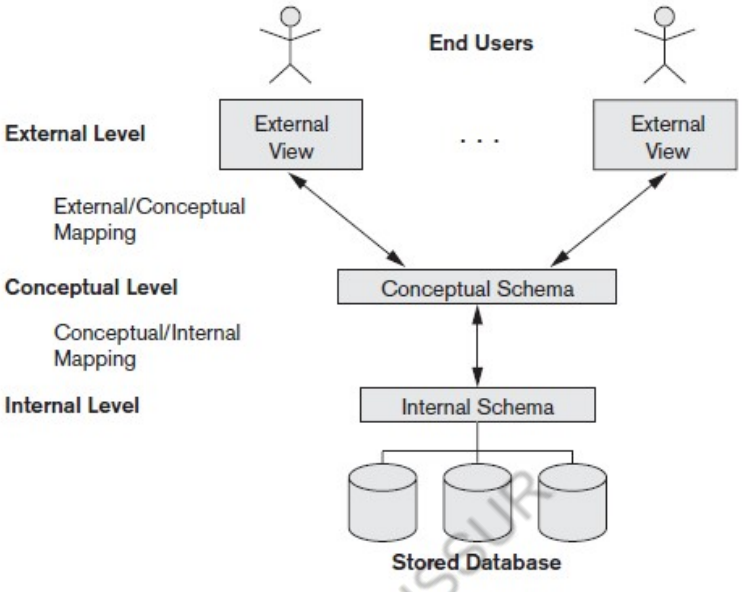
Four important characteristics of the database approach

1. *Self-describing nature of a database system (**catalog**)*
2. *Insulation between programs and data, and data abstraction (**program-data** and **program-operation independence**)*
3. *Support of **multiple views** of the data*
4. Sharing of data and multiuser transaction processing

Three Schema Architecture



Three-Schema Architecture

- Defines DBMS schemas at ***three*** levels:
  - **Internal schema**
  - At the internal level
  - To describe physical storage structures and access paths
    - Uses a **physical** data model
  - **Conceptual schema**
  - At the conceptual level
  - To describe the structure and constraints for the whole database for a community of users
    - Uses a **conceptual** or an **implementation** data model
  - **External schemas**
  - At the external level
  - To describe the various user views.
    - Usually uses the same data model as the conceptual schema

Three-Schema Architecture

- Mappings among schema levels are needed to transform requests and data
  - Programs refer to an external schema
  - Programs are mapped to the internal schema for execution
  - Data extracted from the internal DBMS level is reformatted to match the user's external view

Data Independence

- **Logical Data Independence**
- **Physical Data Independence**
- **Logical Data Independence**
  - Capacity to *change the conceptual schema* without having to change the external schemas and their associated application programs

Logical Data Independence

GRADE_REPORT

Student_number	Section_identifier	Grade
17	112	B
17	119	C
8	85	A
8	92	A
8	102	B
8	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

Data Independence

- **Physical Data Independence:**
  - Capacity to *change the internal schema* without having to change the conceptual schema
  - For example, the internal schema may be changed when certain file structures are reorganized or new indexes are created to improve database performance

Physical Data Independence

- Providing an *access path* to improve retrieval speed of SECTION records by semester and year should not require a query such as list all sections offered in fall 2008 to be changed

SECTION

Section_identifier	Course_number	Semester	Year	Instructor
85	MATH2410	Fall	07	King
92	CS1310	Fall	07	Anderson
102	CS3320	Spring	08	Knuth
112	MATH2410	Fall	08	Chang
119	CS1310	Fall	08	Anderson
135	CS3380	Fall	08	Stone

Data Independence

- When a schema at a lower level is changed, only the **mappings** between this schema and higher-level schemas need to be changed
- Higher-level schemas are **unchanged**
  - Application programs need not be changed

Reference

- Elmasri R. and S. Navathe, Database Systems: Models, Languages, Design and Application Programming, Pearson Education 6th edition and 7th edition

Thank you