# Data Models, Architecture, and Languages

CS157A

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# Outline

- Data Models, Schema, and Instances
- Three Schema Architecture
- Database Languages and Interfaces

# Data Models

- A **data model** is a collections of concepts used to describe the structure of a database. That is, the basic data types, relationships, and constraints that hold on the data.
- A data model usual also comes with a set of **basic operations** that can be applied to the data. Like storage, retrieval, update.
- Additionally, it might say things about **dynamic aspects** of the database and about what **user-defined operations** possible.

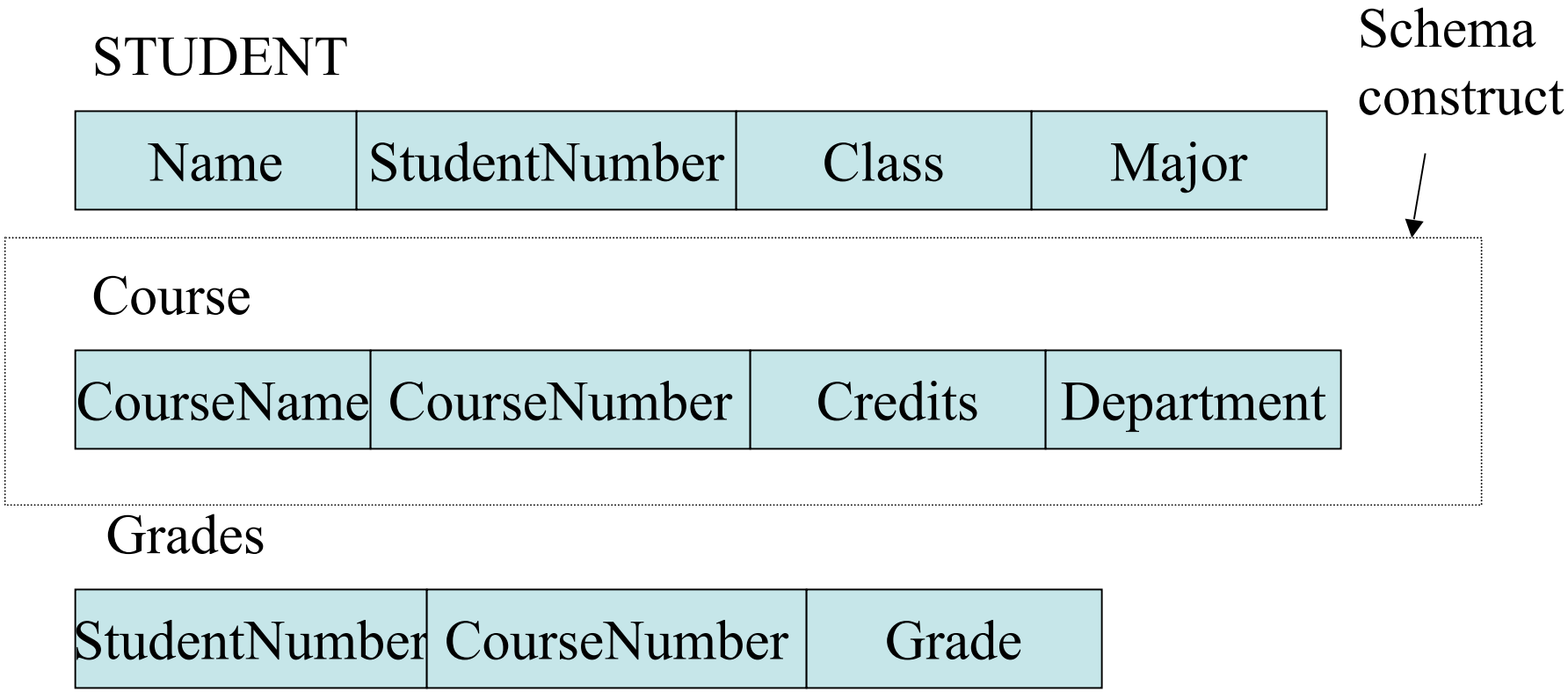
# Types of Data Models

- **Conceptual Data Models** - a high level model close to how the user will perceive the data.(Entity Relationship model. Might have notion of entity, attribute, and relationship)
- **Physical Data Models** - a low-level model which provides details about how the data is actually stored.
- **Representational Data Models** - mid-level models which expose the end user to some of the internals. (Relational Data Model, Network Data Model, and Hierarchal Data Model).
- **Object Data Models -** an OO model.

# Schemas, Instances, and DB State

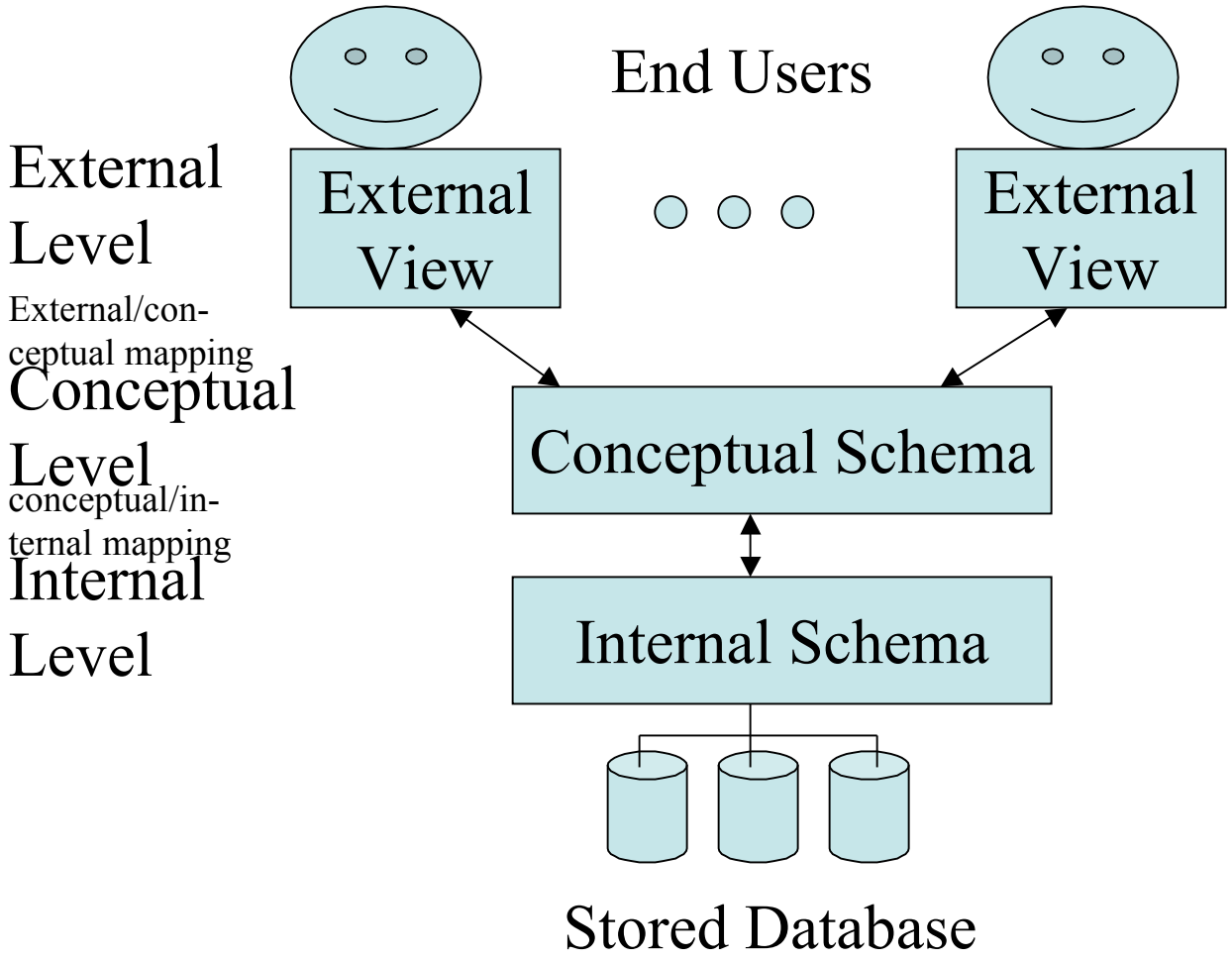
- In any data model need to distinguish between the description of the database and the database itself.
- The former is called the **database schema** and the latter is called the **database instance**.
- Sometimes say: instance is the **extension** of the schema; the schema is the **intention** of instance.
- As the database changes with time the **database instance** changes, but the schema usually stays the same. (Can change but usually more slowly, called **schema evolution.**)
- The current instance is called the **database state.**

# Example Schema Diagram




Data associated with this schema would be the instance. Before first started with some first **population** of data, the database is in its **initial state**. This state evolves to the **current state**.

# Three-Schema Architecture



# Data Independence

- One motivation for the three schema architecture is in terms of **data independence**.
- **Data independence** is the capacity to change one level without having to change the next higher level. This split into:
  - **Logical data independence -** can change the conceptual schema without needing to change existing external views (just need to change the mapping)
  - **Physical data independence -** can change the way the data is stored without having to change the conceptual schema (just need to change the mapping)

# DBMS Languages

- After designing the database, the next step is to implement it according to the three schema architecture.
- Usually, one has a **data definition language** (DDL) is used to specify the three levels.
- Sometimes this language though is split into three languages: the **storage definition language** (SDL), the DDL, and the **view definition language** (VDL).
- To add and modify data in the database a **data manipulation language** (DML) is used. There are high (set at a time) and low level (record at a time) variants of DMLs. One can also have a **query language** which is used to retrieve data from the database.

# DBMS Interfaces

- Menu and Web-Based Interfaces
- Forms-Based Interfaces
- Graphical User Interfaces
- Natural Language Interfaces
- Interfaces for Parametric Users
- Interfaces for DBAs.