CS1122

Relational Databases

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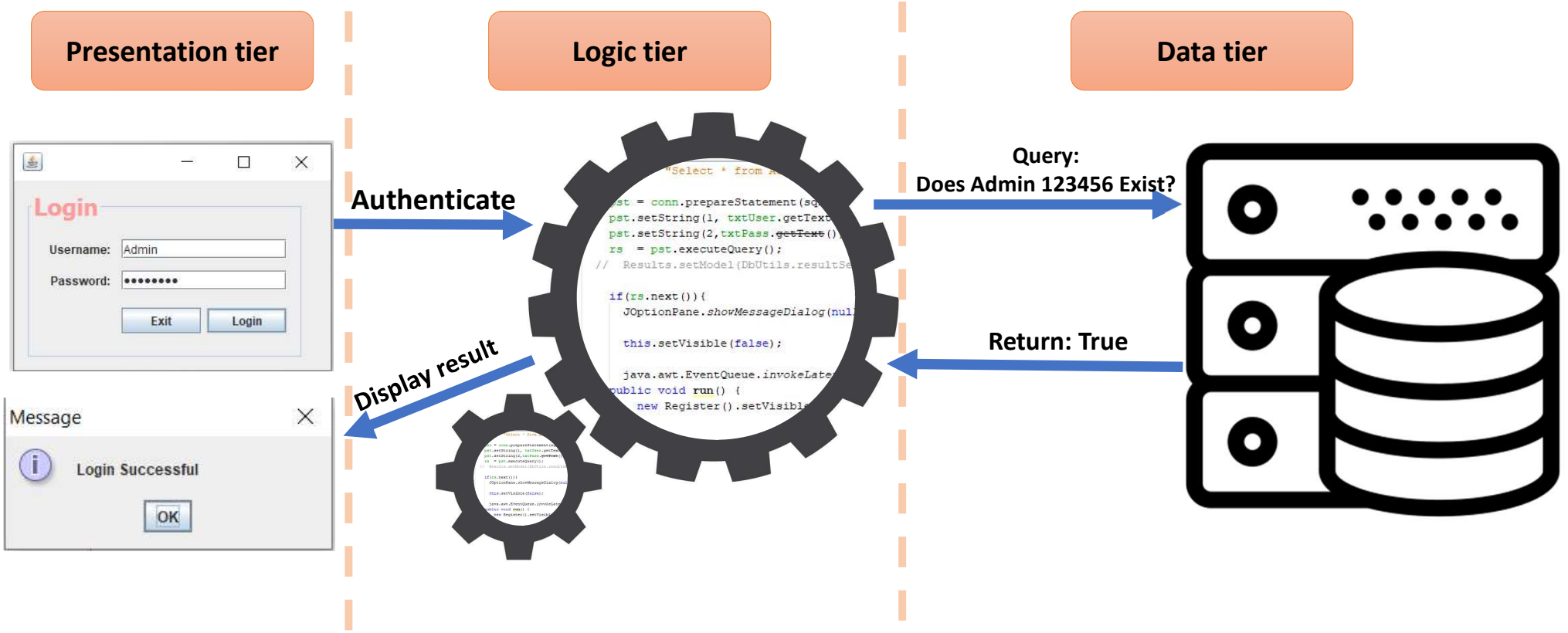
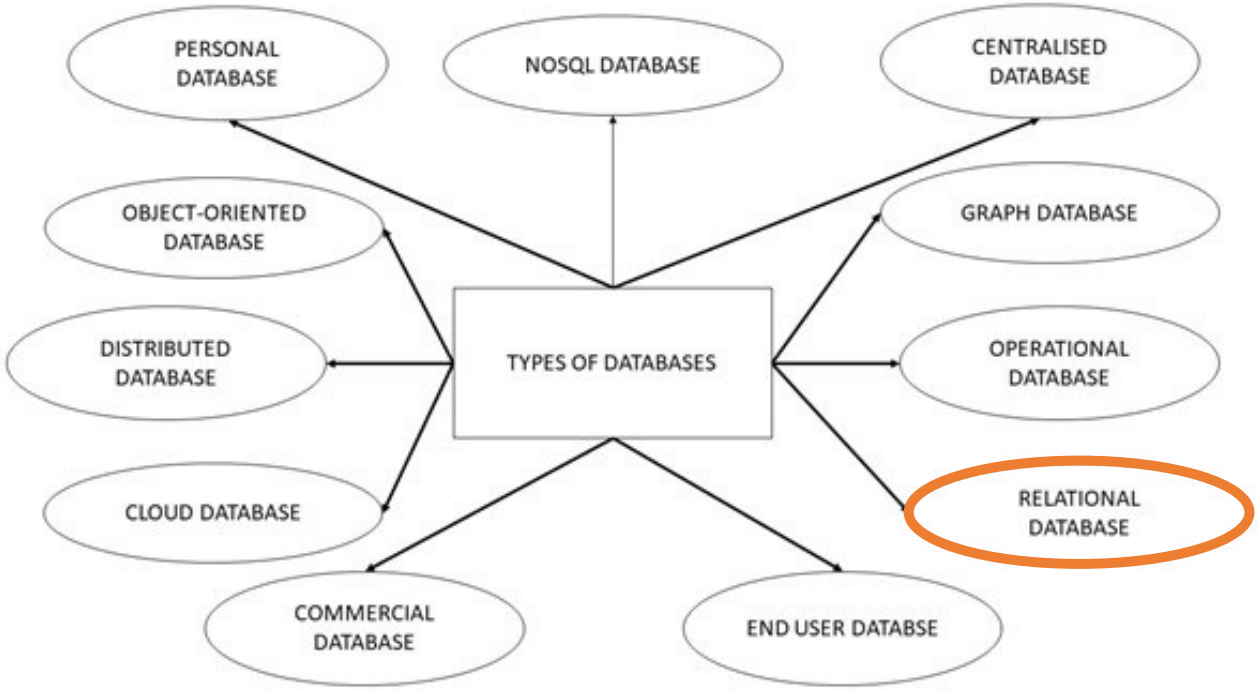
Software Architecture

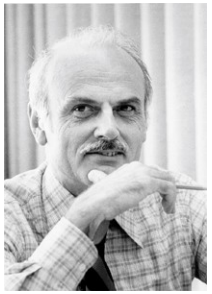


Databases

- A database is a **collection of data** in a defined **structure**.
- How that data is organized determines what type of database it is.



Relational Databases

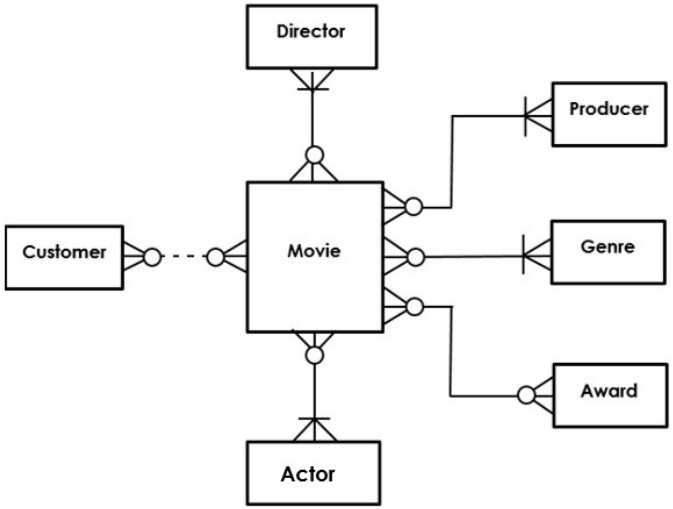


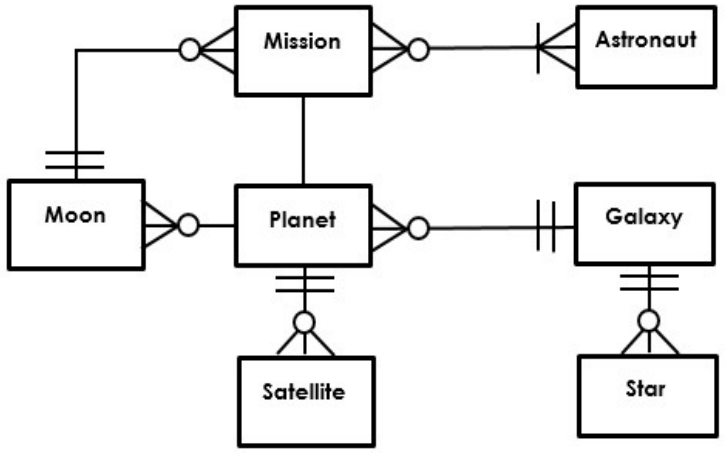
Edgar Frank Codd, Born August 19, 1923, Portland, UK; A researcher at I. B.M.; recipient of the 1981 ACM Turing Award, applying his knowledge of mathematical logic, was able to **introduce an abstract model for database management**: principles of relational databases.

Peter Chen Born January 3, 1947, Taichung City, Taiwan; The originator of the Entity-Relationship Model (ER Model) which serves as the foundation and the Meta model for information systems. He **invented the concepts and symbols for the ER Model**. His modeling ides has been widely used to depict the data in a relational database.

Database – An example

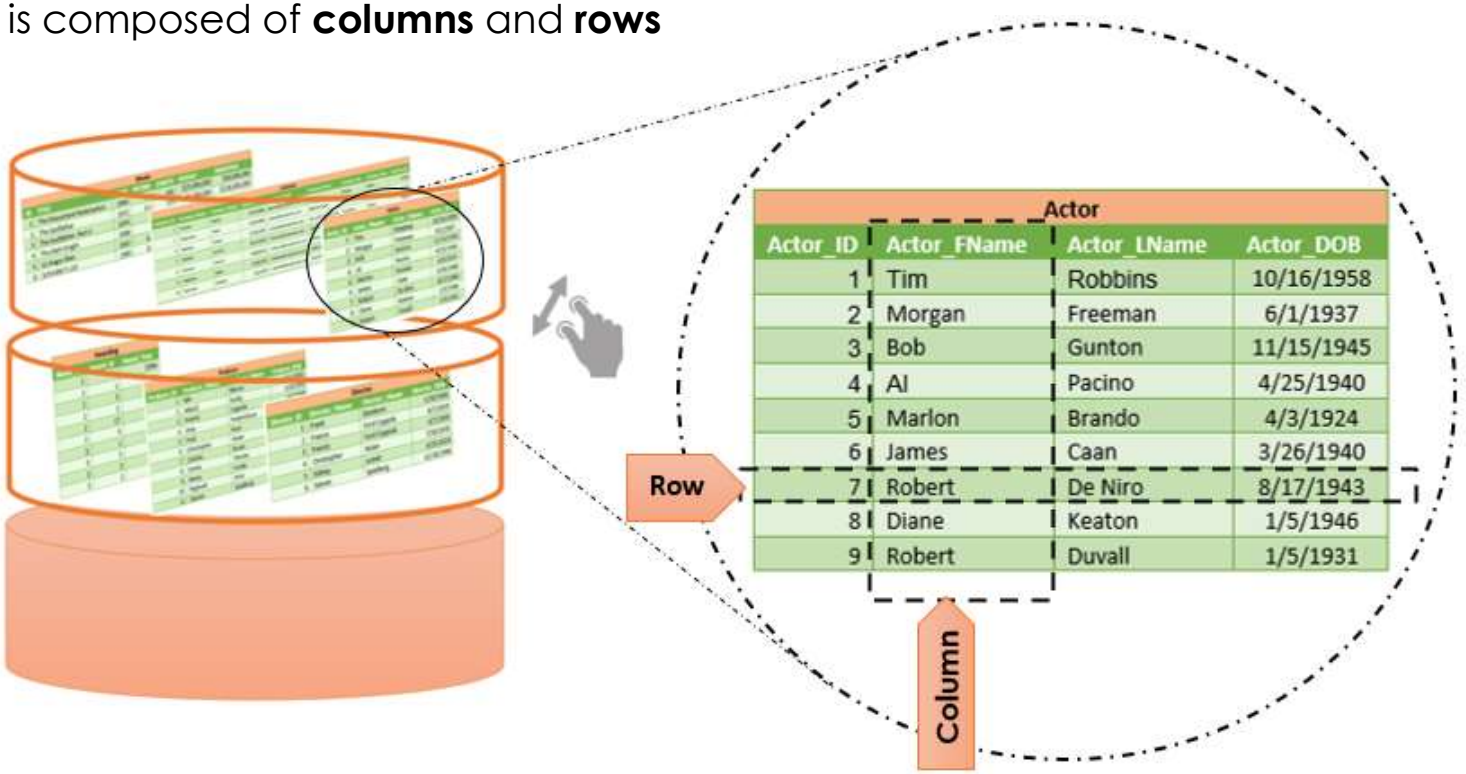
- This diagram is an example of an **entity relationship diagram** (ERD).
- Depicts how the relational database is structured.





Relational Database structure

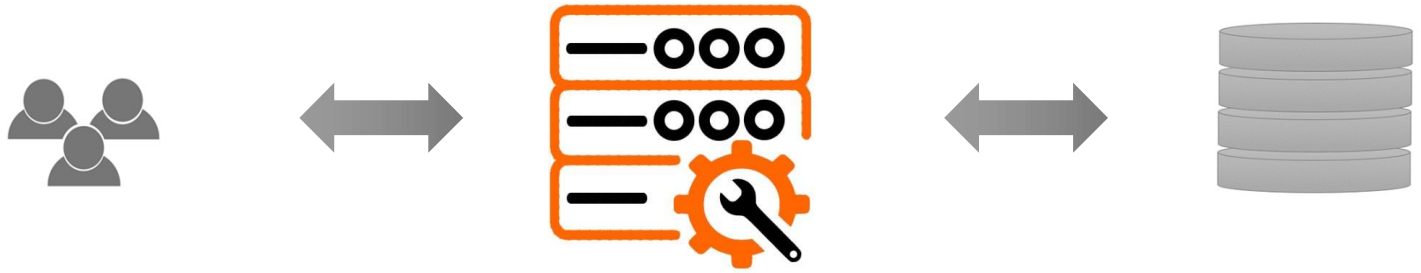
- ✓ A database is composed of interrelated **tables**.
- ✓ A table is composed of **columns** and **rows**



Database management System (DBMS)

The **Database Management System** (DBMS) is the software package used to:

- ✓ Define the database structure.
- ✓ Manipulate the data.
- ✓ Data retrieval.
- ✓ Administration.



End-users or Applications **DBMS** **Database**

Popular Database management Systems

Data vs Information

- **Data** is a raw single unit that contains facts and raw numbers which has not yet been interpreted or put into context.
- **Information** is an interpreted collection of useful data.

Movie						
ID	TITLE	YEAR	RATING	LENGTH	BUDGET	BOXOFFICE
1	The Shawshank Redemption	1994	9.2	142	$25,000,000	$58,000,000
2	The Godfather	1972	9.1	175	$6,000,000	$136,000,000
3	The Godfather: Part II	1974	9	202	$13,000,000	$88,000,000
4	The Dark Knight	2008	9	152	$180,000,000	$1,000,000
5	12 Angry Men	1957	8.9	96	$340,000	$2,000,000
6	Schindler's List	1993	8.9	195	$25,000,000	$322,000,000

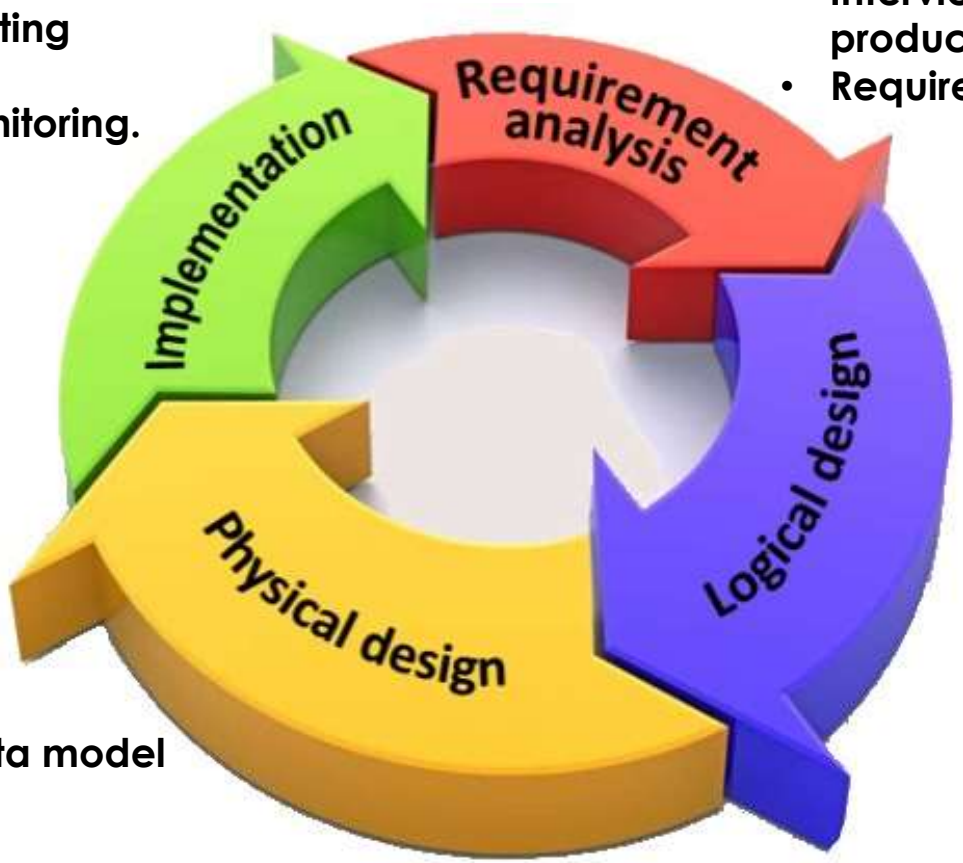
Data: Movies ID, Movie title, Year, Rating, Length, Budget, etc.

Information: The movie with the highest budget. → **The Dark Knight**
Average budget for all movies. → **$41,556,666.67**
The count of movies with ratings above 9 → **4 movies**

Database Development Life Cycle

- Creating and updating database.
- Operation and monitoring.
- Modifications.

- Interviewing both the producers and users of data.
- Requirement specification.



- Conceptual data modeling.
- Normalization

- Transformation of data model Into relational tables

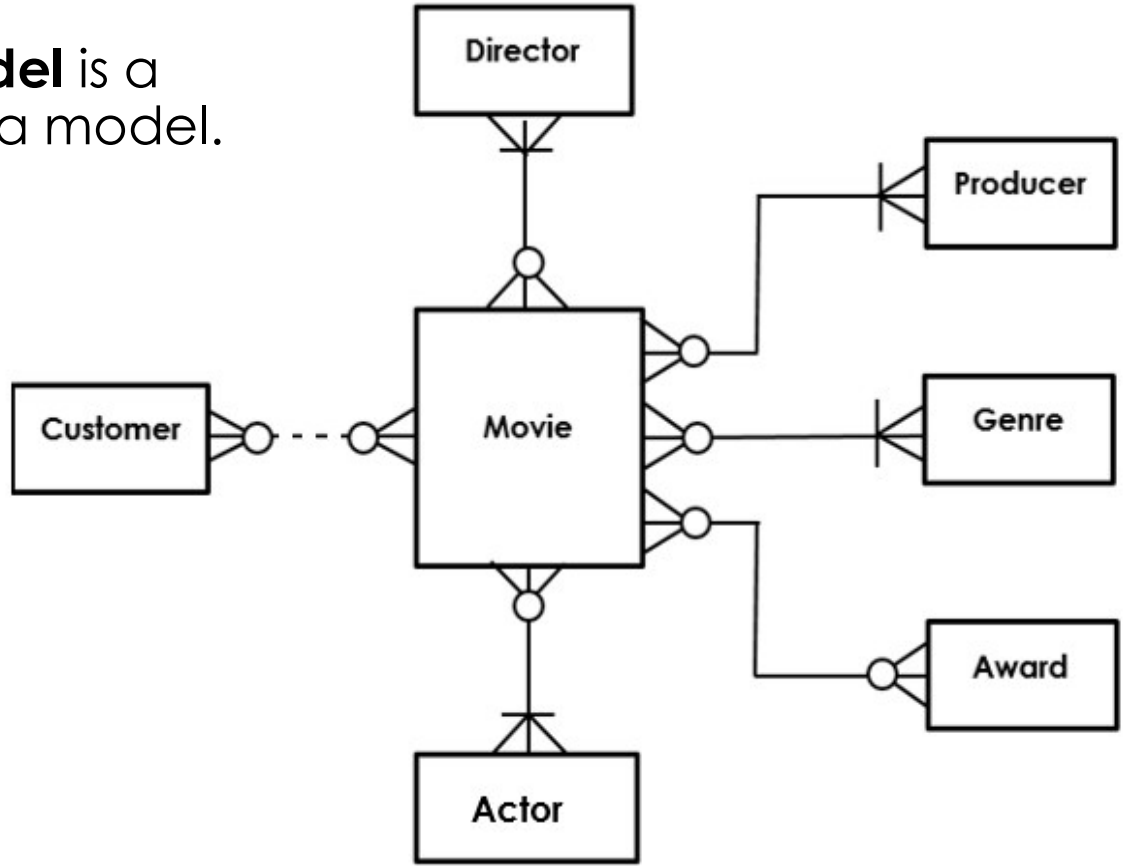
Requirement Specification – Example

1. A professor teaches zero, one or many classes and a class is taught by one professor.
2. A course may generate zero, one or many classes and a class comes from one course.
3. A class is held in one room but a room has many classes.

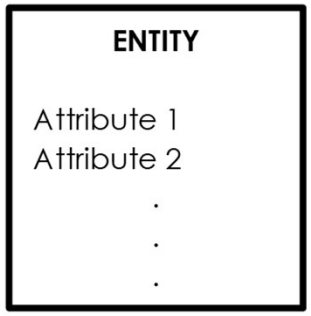
ER Model – Logical Data Model

The **Entity Relationship Model** is a high-level conceptual data model. Composed of:

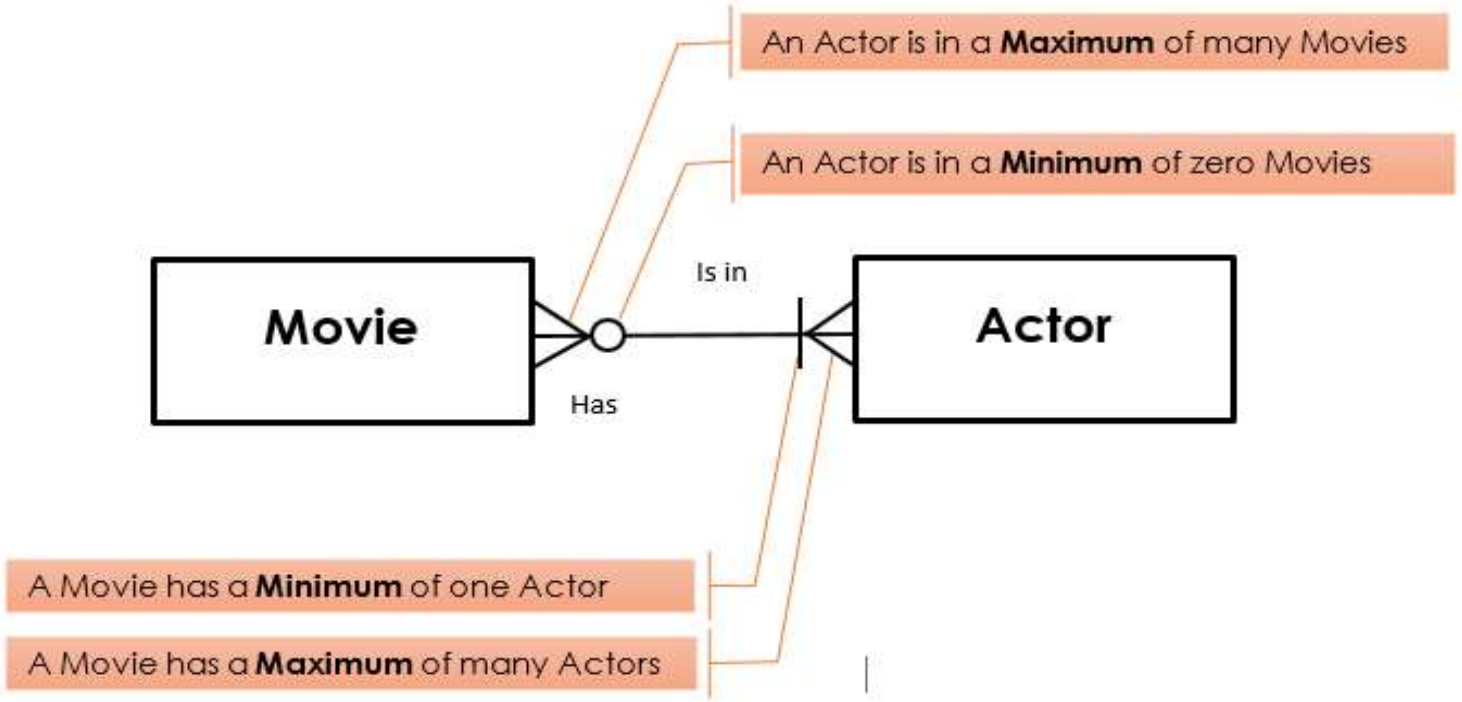
- ✓**Entities**
- ✓**Attributes**
- ✓**Relationships**
- ✓**Cardinality Symbols**



ER Model Ingredients:

	A rectangle for an Entity composed of attributes
	Solid line for a relationship
	Vertical line for a cardinality of "1"
	Circle for a cardinality of "0"
	Crow's feet for a cardinality of "many"

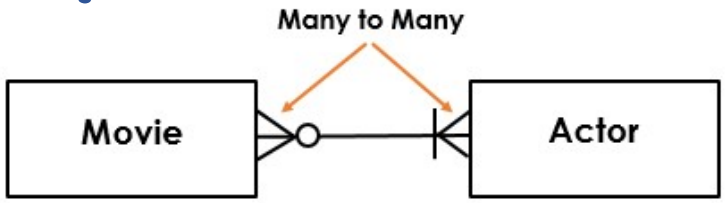
Movie-Actor Relationship

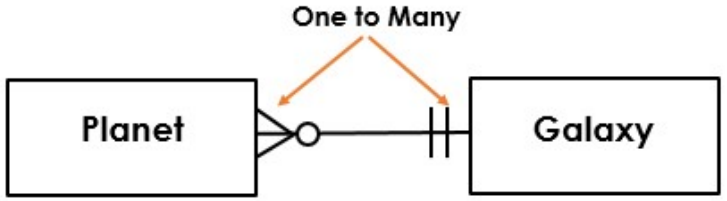


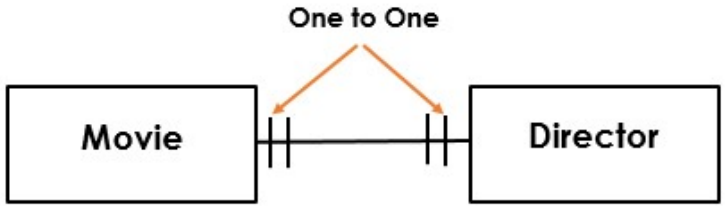
Types of relationships

There are three types of relationships:

- Many to many
- One to many
- One to one

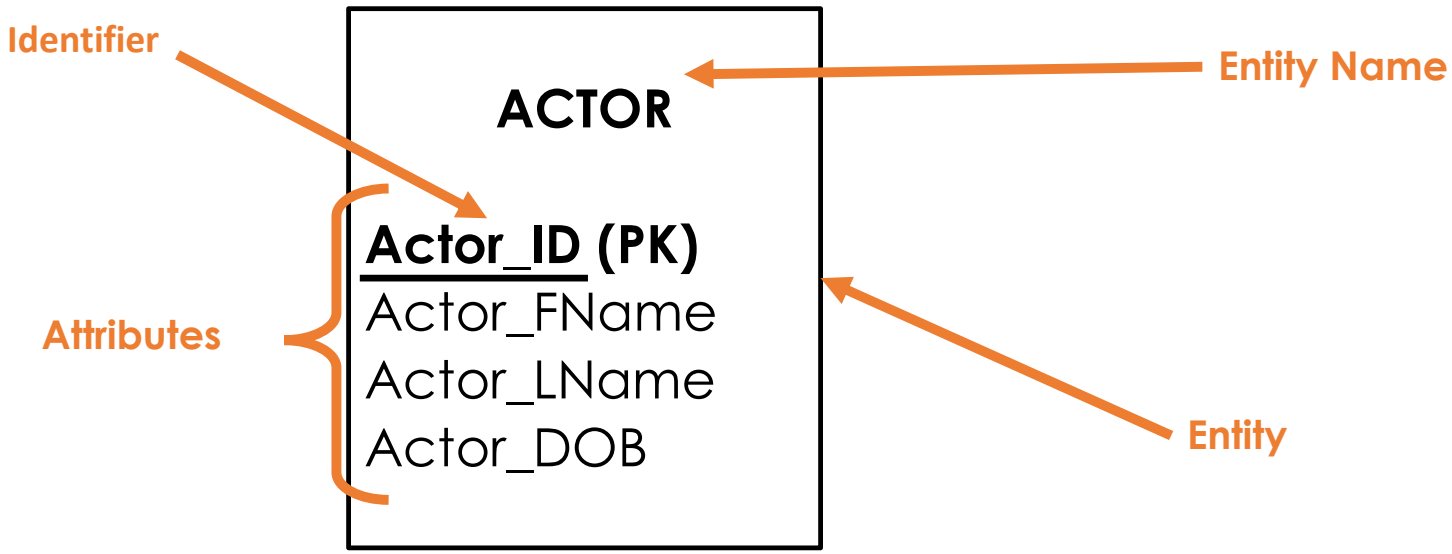






Entity and Attributes

- ✓ **Entity**: A person, business, organization, place, thing or event about which we want to store data.
- ✓ **ATTRIBUTE**: An attribute is a single unit of information that describes something about an entity.



Entity Instance

An entity instance is a **single occurrence** of an entity.

Instances of the entity Actor.

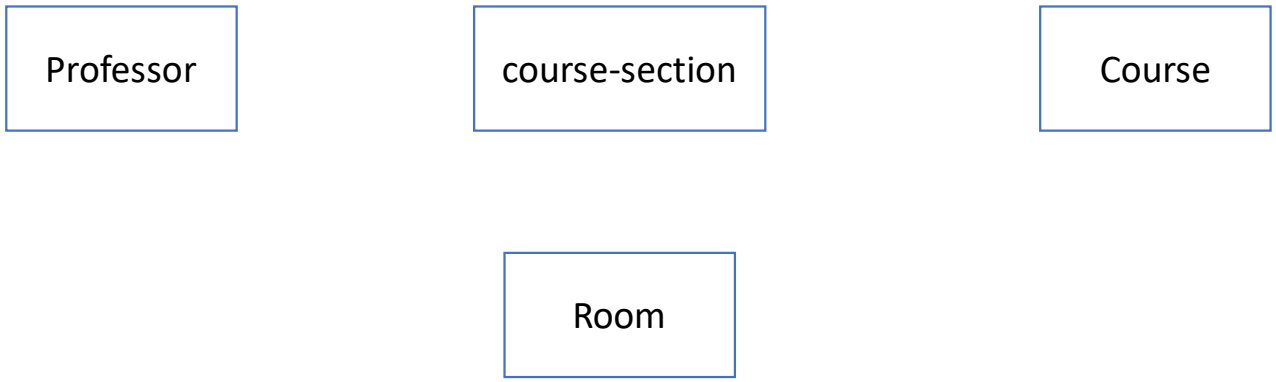
1	Tim	Robbins	10/16/1958
2	Morgan	Freeman	6/1/1937
3	Bob	Gunton	11/15/1945
4	Al	Pacino	4/25/1940

From requirement specification to Logical Model – ERD

1. A professor teaches zero, one or many classes and a class is taught by one professor.
2. A course may generate zero, one or many classes and a class comes from one course.
3. A class is held in one room, but a room has zero or many classes.

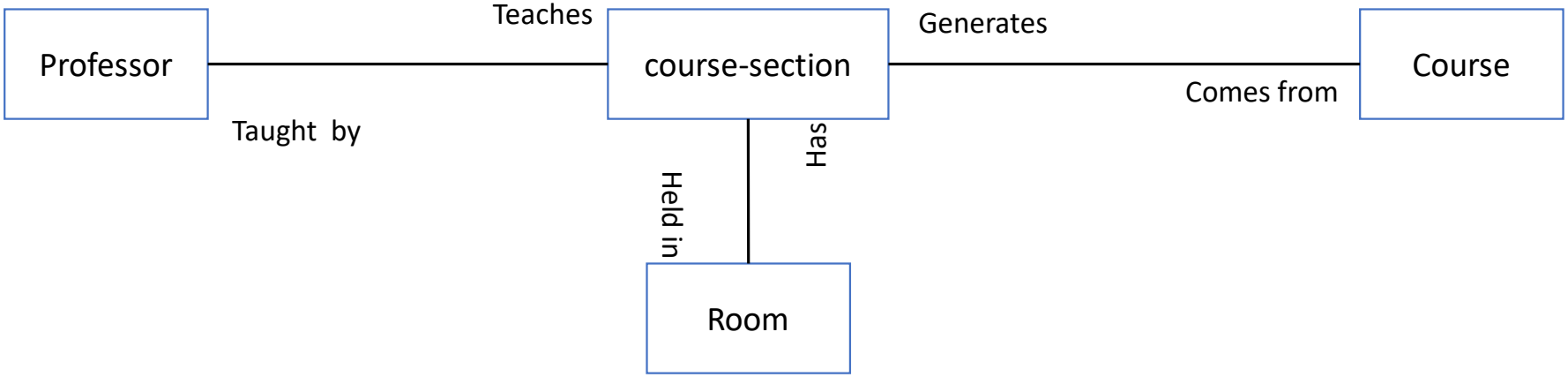
Requirement specification to ERD
>>> Entities

1. A professor teaches zero, one or many course-sections and a course-section is taught by one professor.
2. A course may generate zero, one or many course-sections and a course-section comes from one course.
3. A course-section is held in one room, but a room has zero or many course-sections.



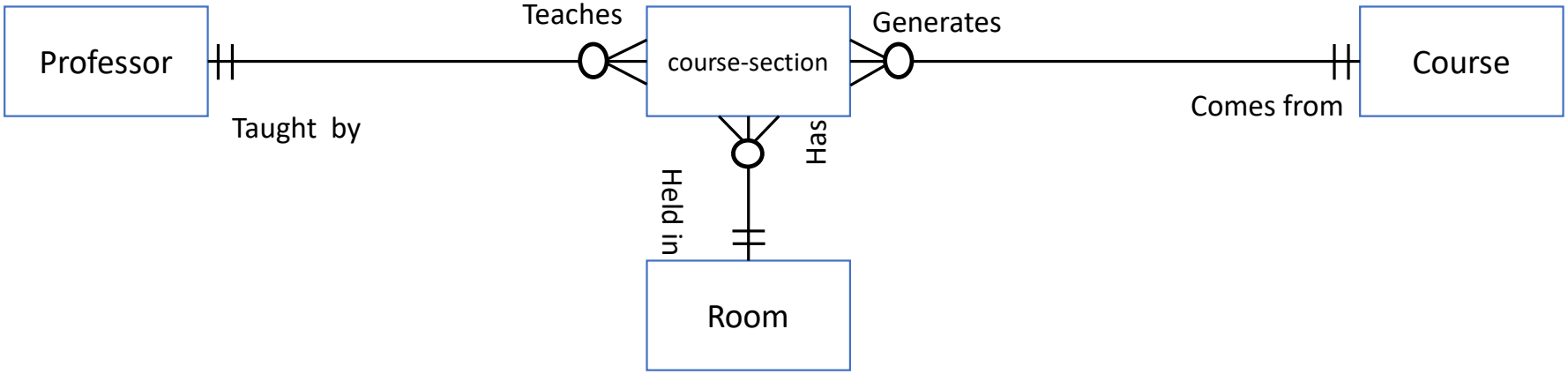
Requirement specification to ERD
>>> Relationships

1. A professor teaches zero, one or many course-sections and a course-section is taught by one professor.
2. A course may generate zero, one or many course-sections and a course-section comes from one course.
3. A course-section is held in one room, but a room has zero or many course-sections.

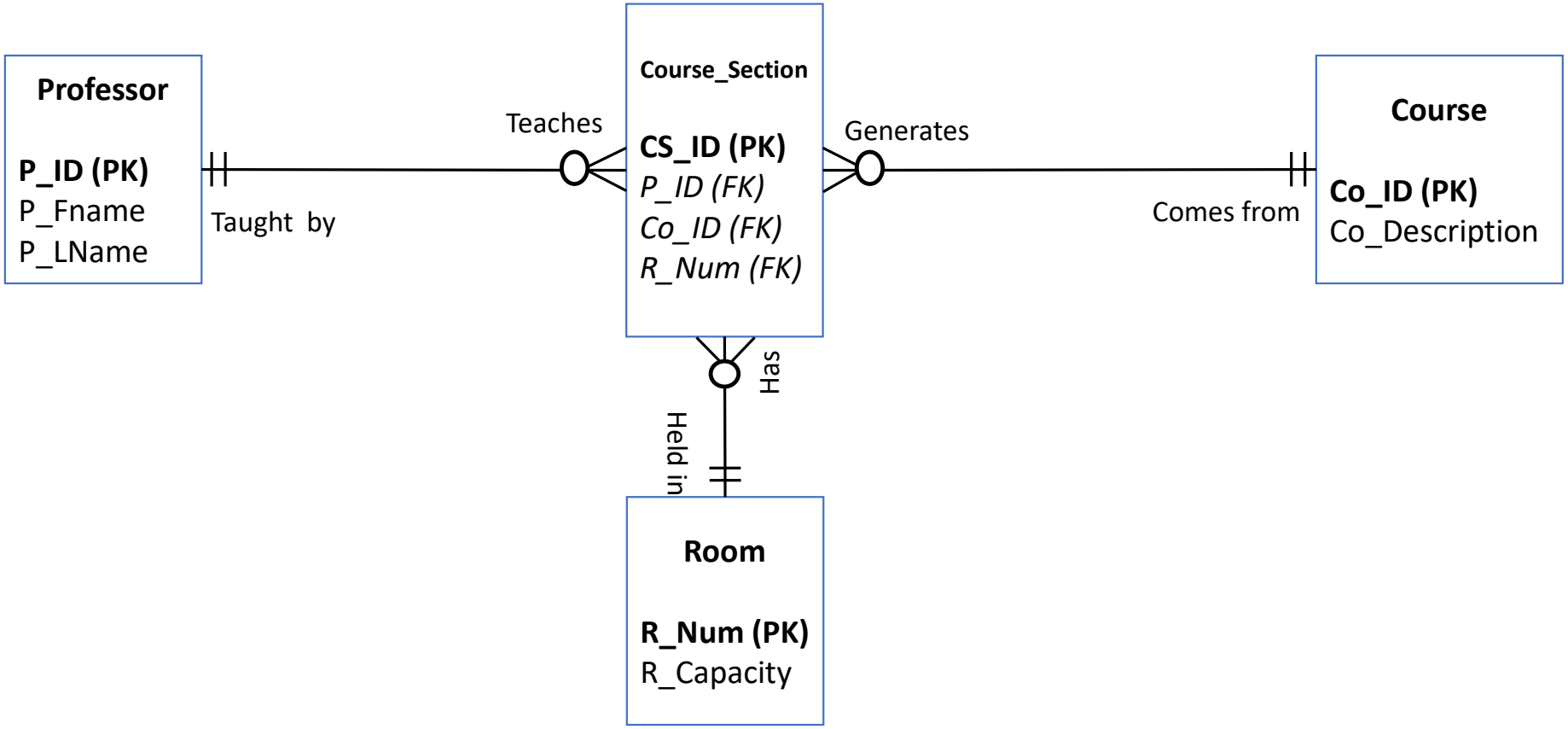


Requirement specification to ERD
>>> Cardinalities

1. A professor teaches zero, one or many course-sections and a course-section is taught by one professor.
2. A course may generate zero, one or many course-sections and a course-section comes from one course.
3. A course-section is held in one room, but a room has zero or many course-sections.



Requirement specification to ERD
>>> Attributes and Constraints

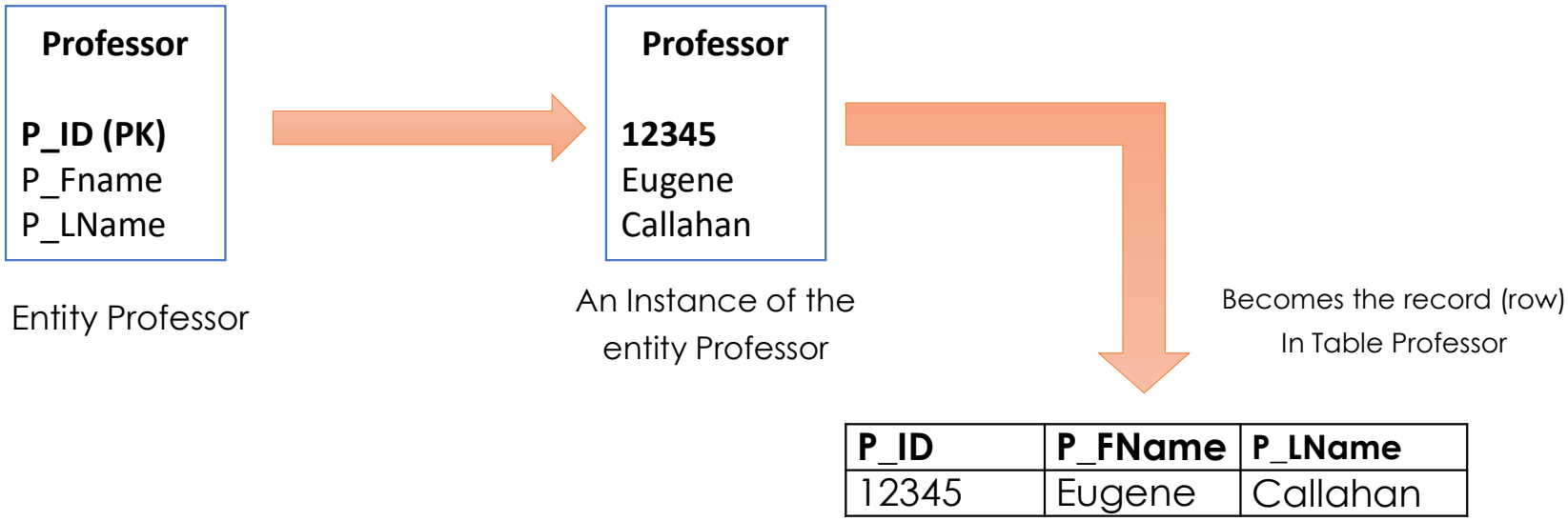


Logical to Physical Model

Translates a logical model into physical tables and constraints.

Logical Model	**Physical Model**
Entity	Table
Attribute	Column or field
Entity instance	Row in a table (record)
Relationship	A shared column in both related tables

Logical to Physical Model



Logical to Physical Model

Professor

P_ID (PK)
P_FName
P_LName

P_ID (PK)	P_FName	P_LName
Number(5)	Varchar(25)	Varchar(25)

Course

Co_ID (PK)
Co_Description

Co_ID (PK)	Co_Description
Varchar(5)	Varchar(200)

Room

R_Num (PK)
R_Capacity

R_Num (PK)	R_Capacity
Varchar(4)	Number(3)

PK

Course_Section

CS_ID
Co_ID (FK)
P_ID (FK)
R_Num (FK)

Composite PK

CS_ID	*Co_ID (FK)*	*P_ID (FK)*	*R_Num (FK)*
Varchar(4)	Varchar(25)	Number(5)	Varchar(3)

Implementation

- **DDL:** DATA DEFINITION.
- **DML:** DATA MANIPULATION.
- **DQL:** DATA QUERY.
- **DCL:** DATA CONTROL.

Implementation

- SQLITE3 Database Management System

- Oracle APEX Management System