IT Department

Entity-Relationship (ER) Model

Soma Soleiman Zadeh

Database Systems I (IT 215)

Fall 2025 - 2026

Week 3

October 20, 2025

Outline

- **Entity-Relationship** Model (**E-R** Diagram)
- **Entity** and **Attributes**
- **Relationships** and **Cardinality of Relationships**

Data Model Types in Database Systems

- **Relational Model** ← The most widely used data model
- **Entity-Relationship (ER) Model**
- Network Model
- Object-Oriented Data Model
- Object-Relational Data Model
- Hierarchical Data Model
- …

Entity-Relationship Model (ER Diagram)

- An **Entity Relationship Diagram** (ER diagram) is a visual representation of different **entities** in a database and how they **relate** to each other.
- **ER diagrams use a defined set of symbols**, including rectangles, ovals and diamonds, and link them with connecting lines.
- E-R Diagram is independent of any DBMS,
  - Valid regardless of the DBMS chosen.

Components of ER Diagram

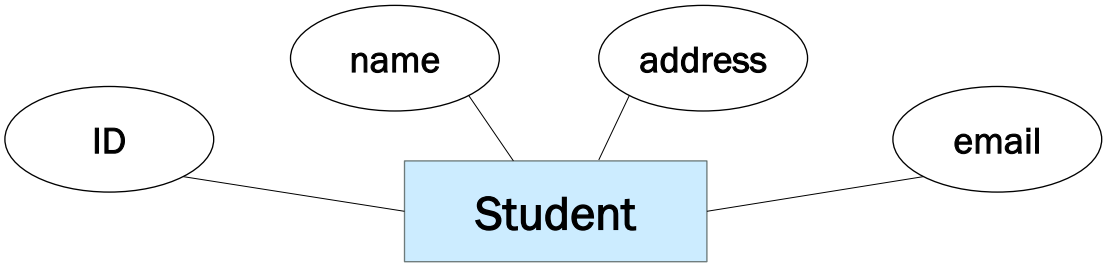
- ER Model consists of **Entities**, **Attributes**, and **Relationships** among Entities in a Database System.
- Symbols used in ER Diagram:
  - **Entity –** rectangle
  - **Attribute –** oval
  - **Relationship –** diamond
  - **Link -** line

Entity

- **Entity:** An entity is an object or concept; you want to store information about, such as a **particular person**, **house**, **employee**, **company** or **course**.
- Each entity type is shown as a **rectangle**, labeled with the name of the entity.

Attributes

- **Attribute** is a property or characteristic of an entity (or a relationship type).
- Each attribute of an entity is represented by an **oval**, with a line to the rectangle representing its entity.



Attribute Values

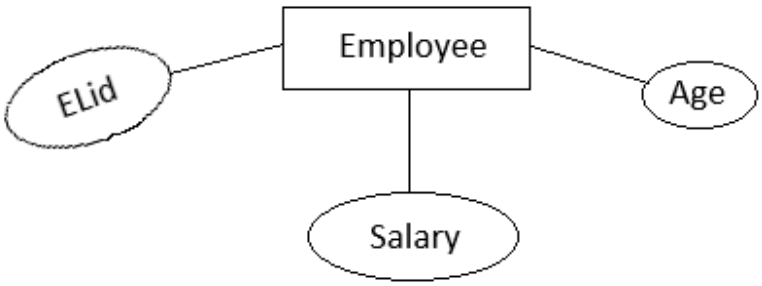
- Normally, an entity instance will have a value for each of its attributes.
- **Attribute Domain:** A set of allowed values for each attribute.
- For the **Student** entity, the domain of the **age** attribute might be the set of integer values between 15 and 40.
- **Null Values** → The undefined values with "No Value“ of attributes.

Types of Attributes

- **There are different classifications of attributes:**
  - **Simple** and **Composite** Attributes
  - **Single-valued** and **Multi-valued** Attributes
  - **Derived** Attributes
  - **Key** Attributes

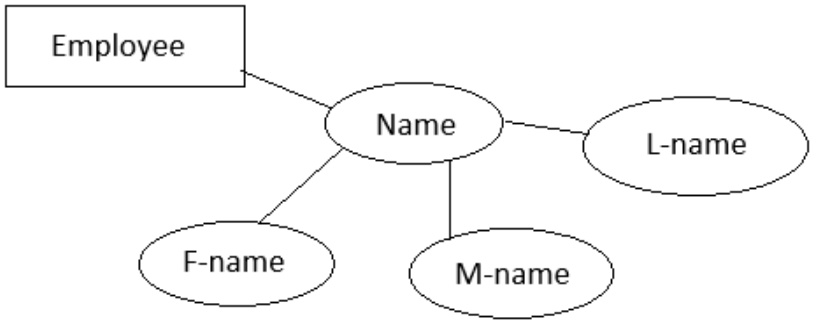
Simple Attributes

- **Simple Attribute:** contains a single value and cannot be divided into more attributes.
- E.g.: Gender, Salary



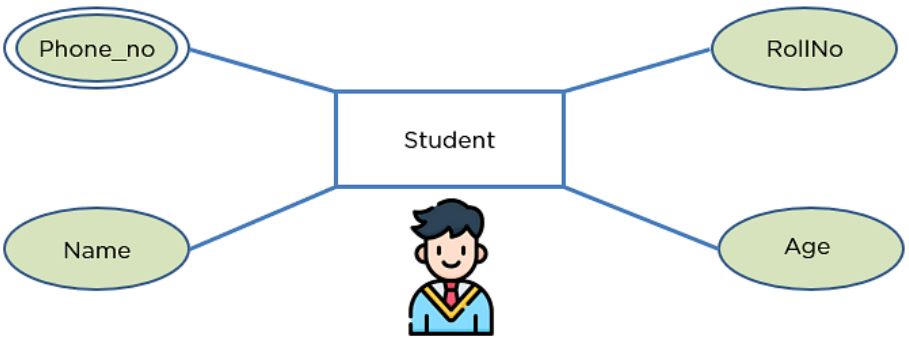
Composite Attributes

- **Composite Attribute:** Those attributes that can be further divided into more simple attributes.
- E.g.: Name



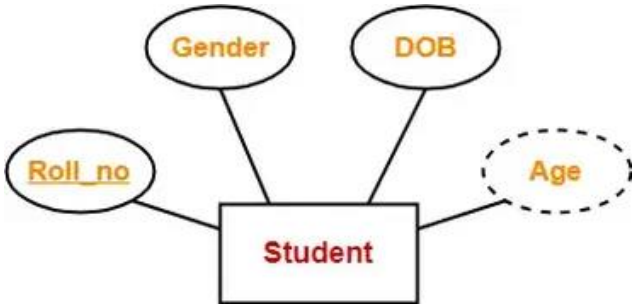
Multi-valued Attributes

- **Multi-valued Attribute:** Some attributes that may have multiple values for an entity instance.



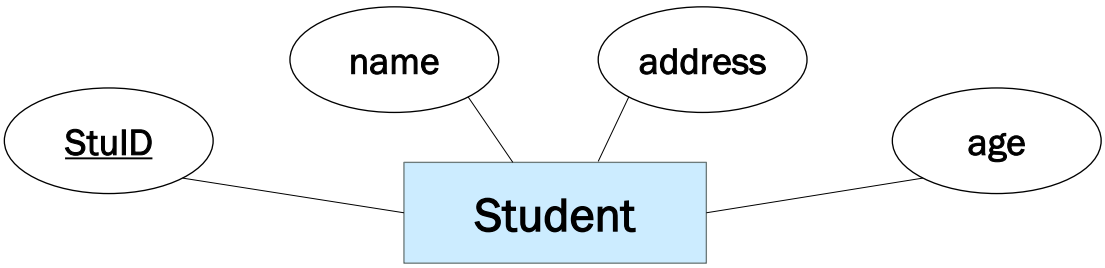
Derived Attributes

- **Derived Attribute:** Attributes that are not to be stored, but whose values are to be calculated or obtained from other attributes.
- E.g.: **Age** is a derived attribute, if we already have **dateOfBirth** attribute.



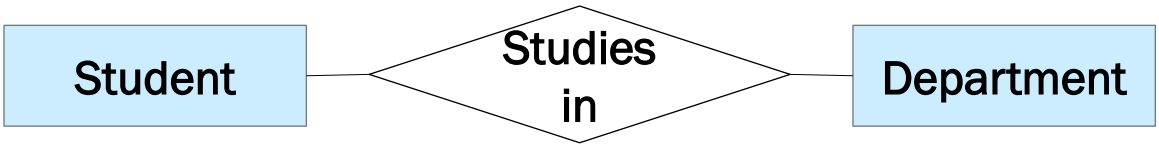
Key Attribute

- **Key Attribute:** Key attribute uniquely identifies an entity in an entity set.
- E.g.: Student_ID, Employee_ID



Relationships

- A **relationship** is an association among several entities.
- It is represented by a **diamond**, with lines to each of the entities involved.



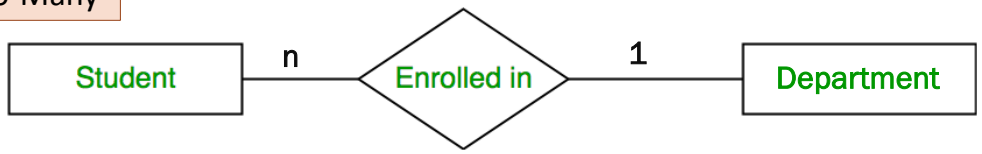
Cardinality of Relationships

- **Cardinality of Relationship:** The number of times an entity of an entity set participates in a relationship set is known as **cardinality**.
- There are 3 different types of cardinality:
  - One-to-One
  - One-to-Many
  - Many-to-Many

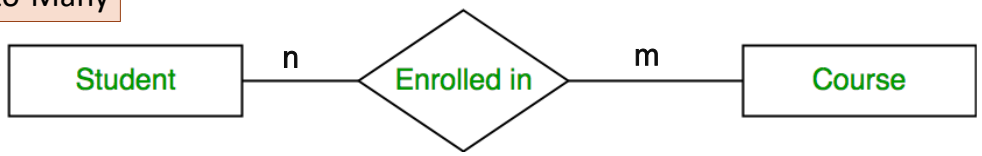
Cardinality of Relationships

One-to-One

One-to-Many



Many-to-Many



An Example of ER Diagram

- **ER diagram** for the **University** database, containing the following entities (with at least three attributes per each entity) and relationships (and the cardinality of each relationship).
- **Entities:** Student, Course, Department, Teacher
- **Relationships:**

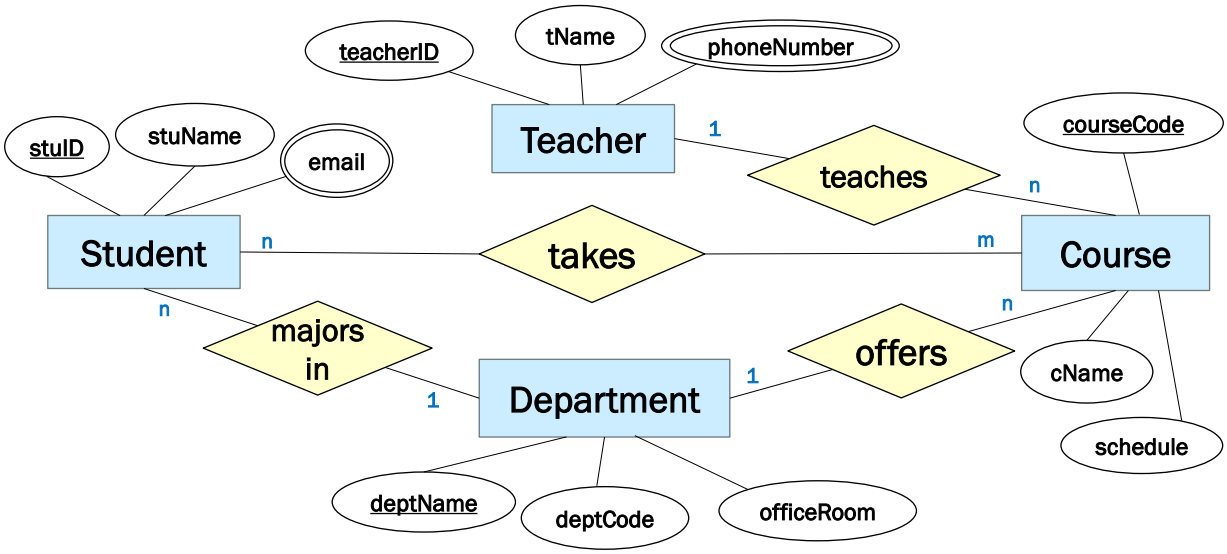
  Student **takes** Course

  Department **offers** Course

  Student **majors** in Department

  Teacher **teaches** Course

An Example of ER Diagram



Class Work

- Draw the **ER diagram** for a **Restaurant** database.
  - At least **four entity**,
  - Attributes,
  - At least **three relationships**,
  - **Cardinality** of all relationships.