SPATIAL DATABASES

Lecture:
Entity Relationship Diagram

Nikolas Mitrou, Professor, ECE, NTUA
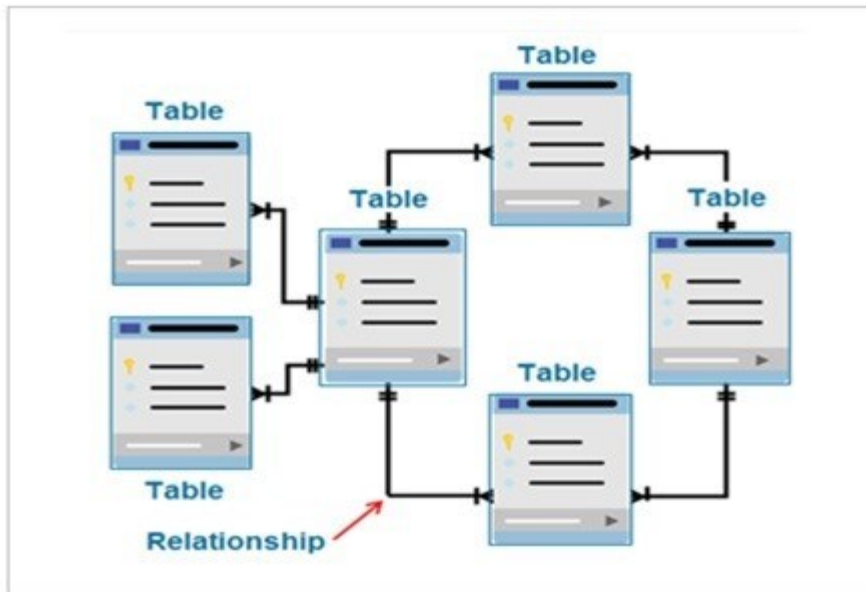**Anastasios Zafeiropoulos, Postdoc Researcher, ECE, NTUA**

Geospatial Information Systems Layering

- Layer 1 – Applications
- Layer 2 – Analysis and visualization services
- Layer 3 – Spatial data management (production, management, interlinking of spatial data)
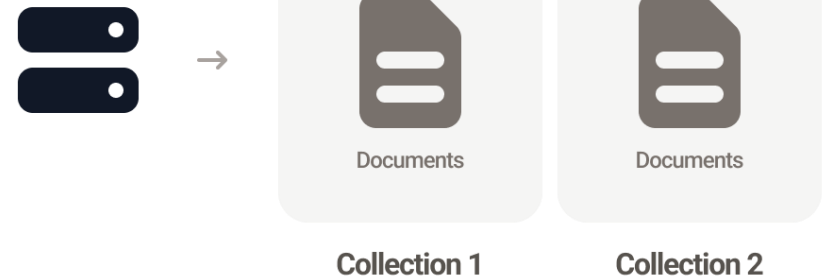- Layer 4 – Base Maps
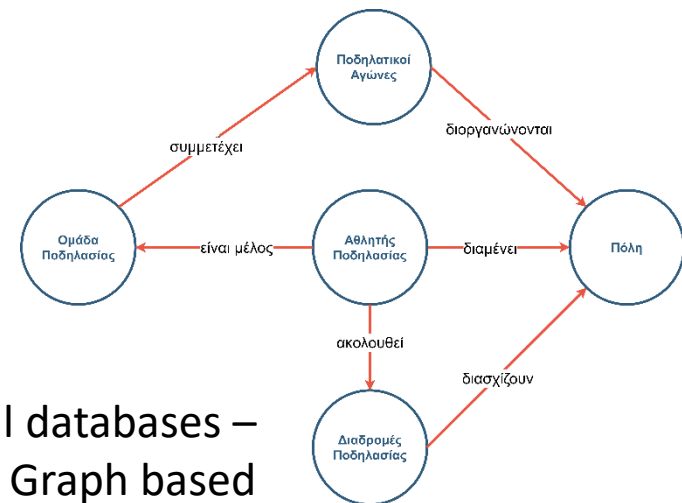
Classification of Spatial Databases

Relational Databases

Non relational databases – Documents based

Collection 1   Collection 2

Non relational databases – Graph based

Relational Databases

- Manage/Classify the data through **tables**
  - **tables** or **relations** (named as **relational**)
  - the **columns** refer to **attributes**
  - the **records** refer to different physical entities and span horizontally across the various columns
- Archiving and efficient searching is done with the help of **primary keys**.
- They relate the tables (and therefore the entities they represent) through common properties referred to as **foreign keys**.

Relational Database:
ER Diagram and Relational Model
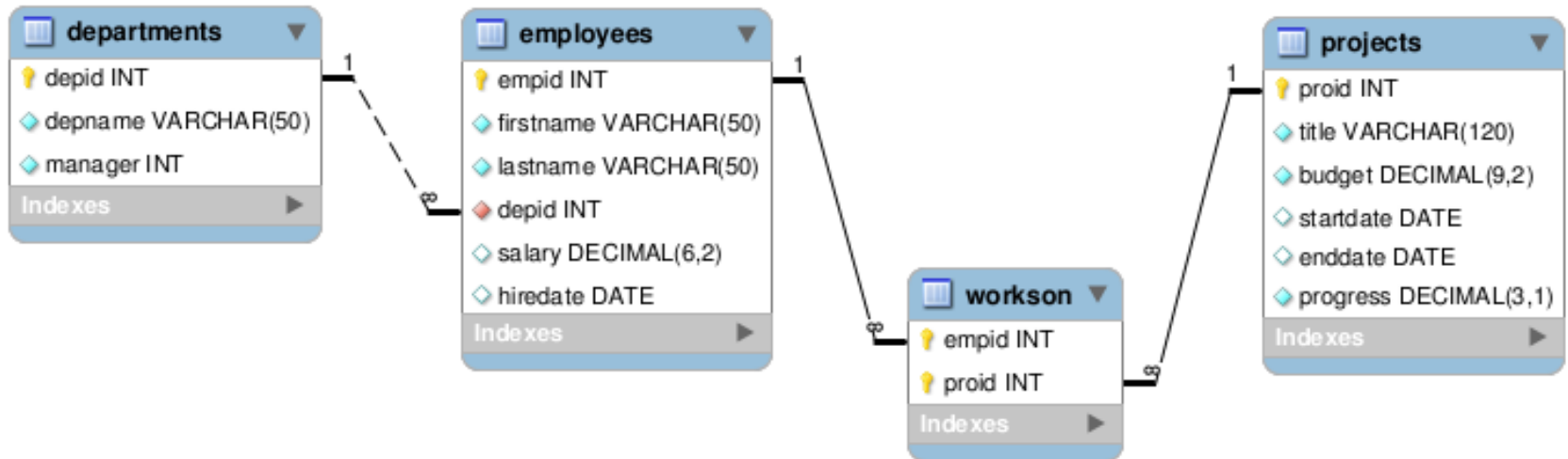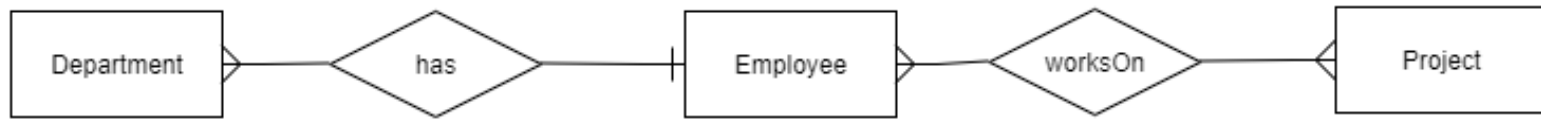
Data Models

- **Model:** abstract representation of the real world.
- **Object based models**
  - Entity – Relationship
- **Record based models**
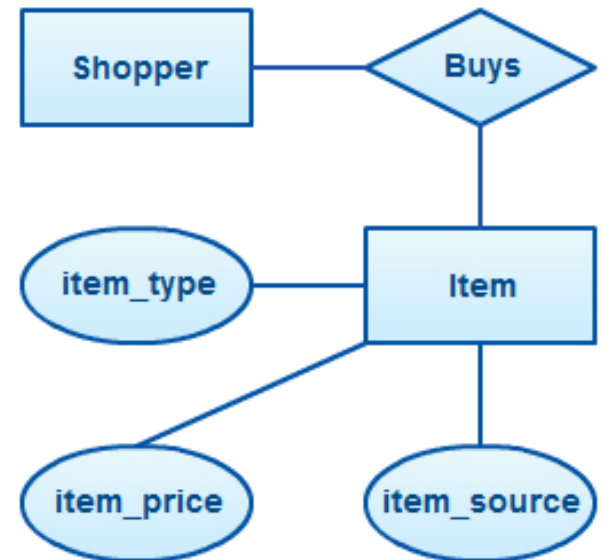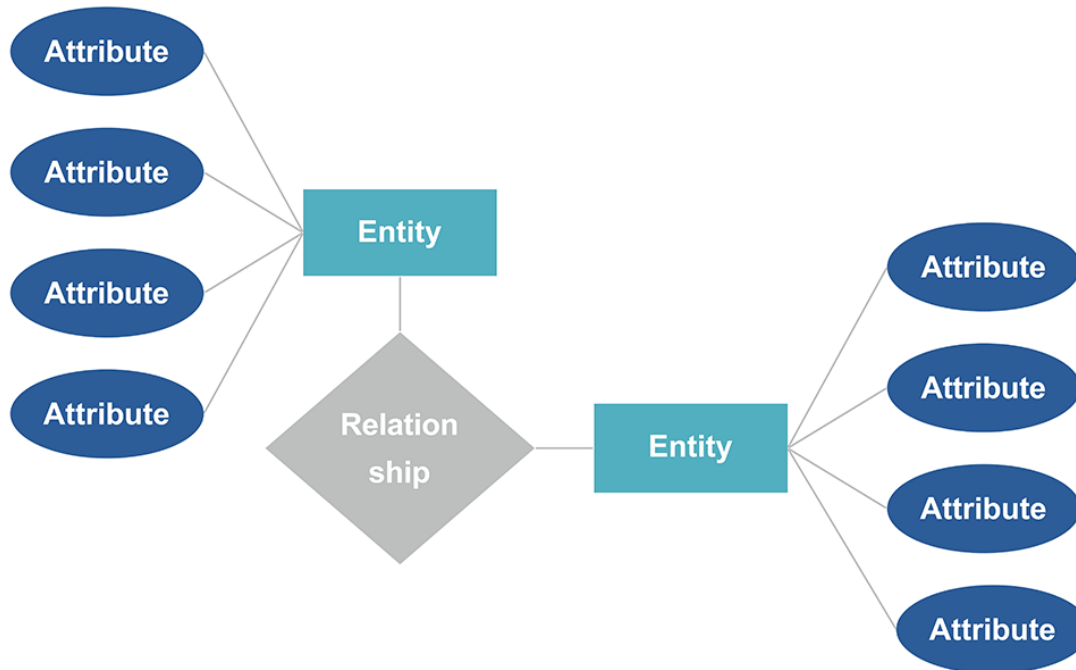 - Relational model

Entity Relationship (ER) Model

- The **entity-relationship model** is based on the notion that the real world consists of **entities** with attributes and **relationships** between the entities.

- It was developed to facilitate the design of a database by allowing the definition of a **schema** that represents the overall logical structure of the database.
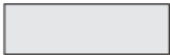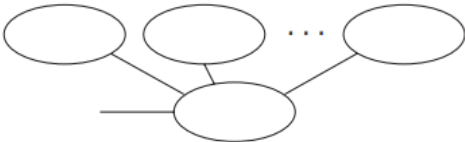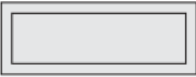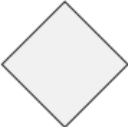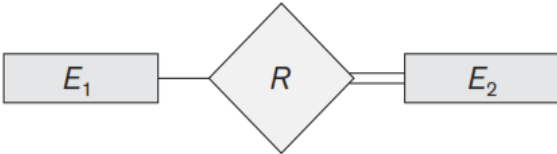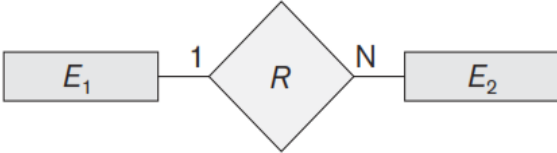
Entity Relationship (ER) Model

Entity Relationship Diagram

Entity Relationship (ER) Model

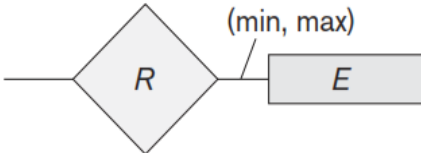| Symbol	Meaning
□	Entity
▣	Weak Entity
◇	Relationship
◈	Indentifying Relationship
⬭	Attribute
⬭	Key Attribute
⬭	Multivalued Attribute

Symbol	Meaning
(ovals)	Composite Attribute
(dashed oval)	Derived Attribute
E_1 — R = E_2	Total Participation of E_2 in R
E_1 —1— R —N— E_2	Cardinality Ratio 1: N for E_1:E_2 in R
R —(min, max)— E	Structural Constraint (min, max) on Participation of E in R

Entity Relationship (ER) Model

- **Entity:** a "thing" or "object" of the world that is distinct from other objects, an abstract concept
  - Simple and complex properties/attributes
  - Single-valued and multi-valued properties
  - Derived property
  - Primary key (set of attributes that uniquely identifies a record)
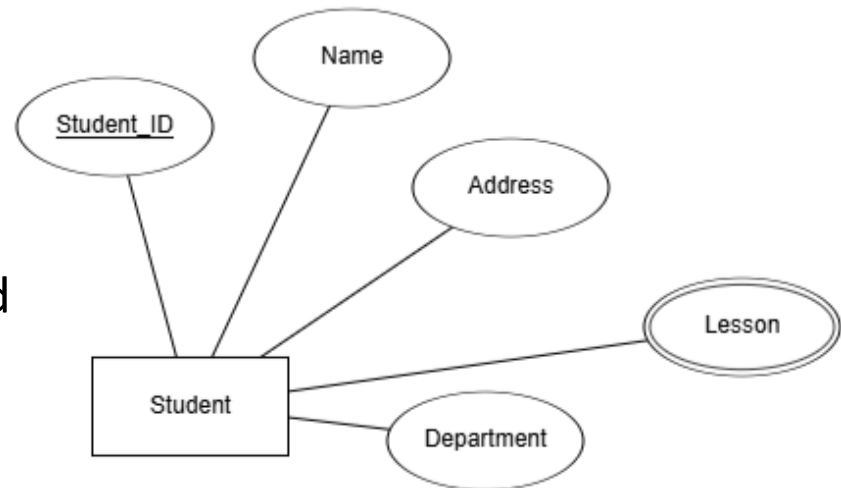
Entity Relationship (ER) Model

- **Relationship:** a relationship between two or more entities, which represents a corresponding relationship of objects in the real world.

- A relationship has descriptive properties.
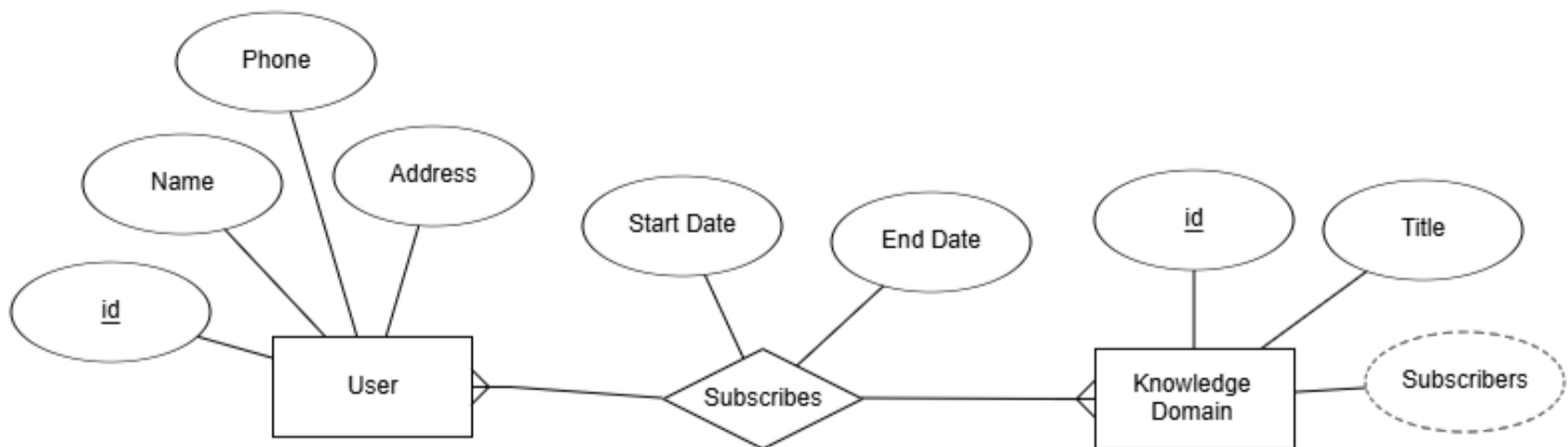
Relationship Degrees

- **One-to-one**: an entity in A is associated with at most one entity in B and vice versa.

- **One-to-many**: an entity in A is associated with any number of entities in B. An entity in B is associated with at most one entity in A.

- **Many-to-one**: an entity in A is associated with at most one entity in B. An entity in B is associated with any number of entities in A.

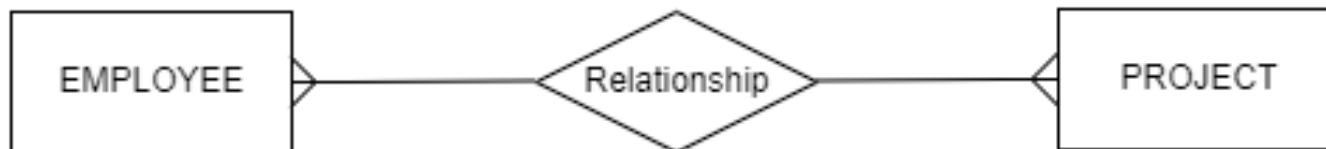- **Many-to-many**: an entity in A is associated with any number of entities in B and vice versa.

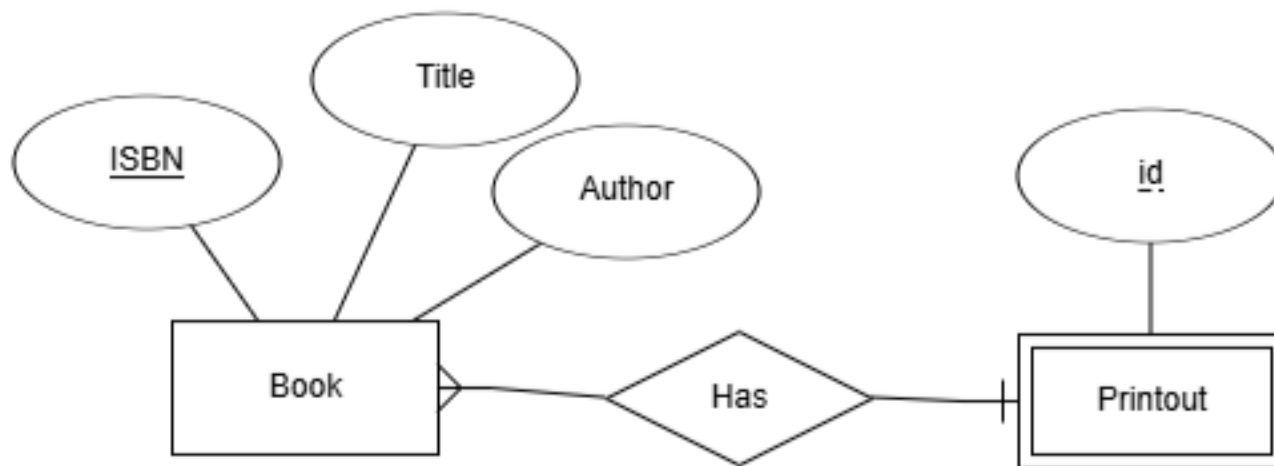# **Relationship Degrees**

One to One

One to Many

Many to One

Many to Many
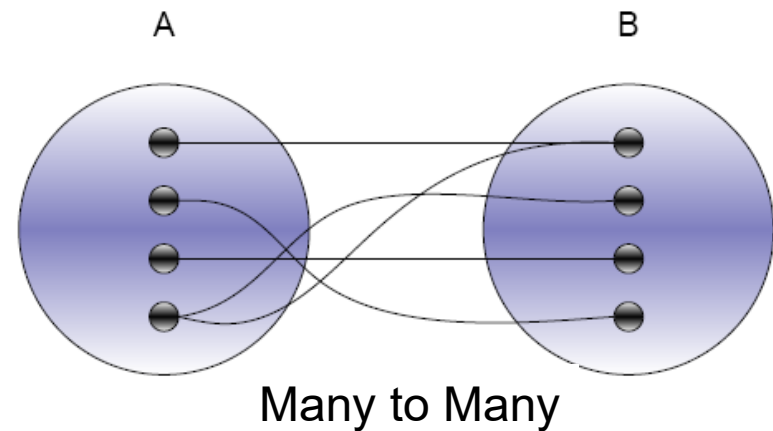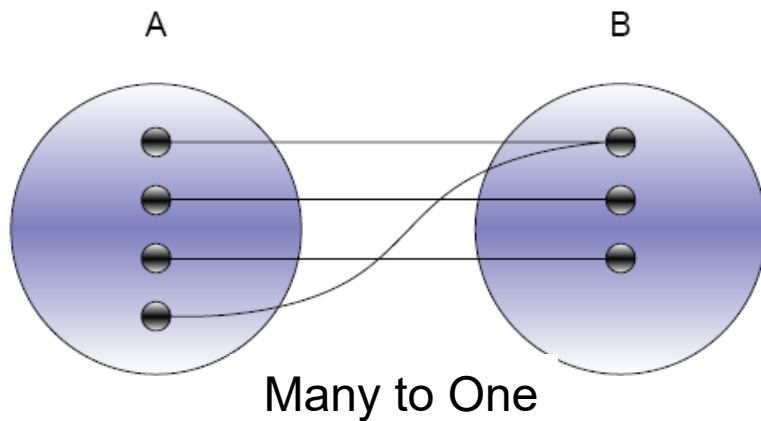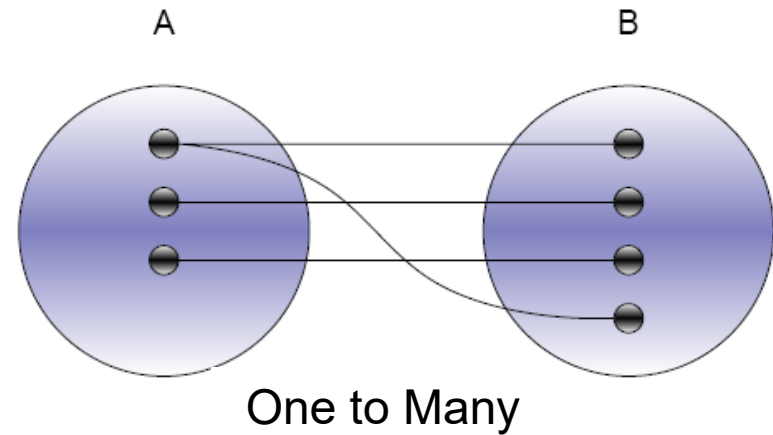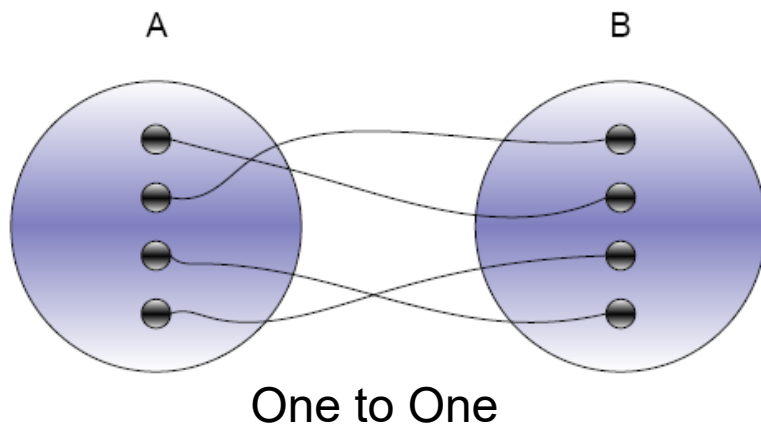
Relationship Degrees

Weak Entities

Weak entities are the entities whose instances are identified only through an identifying relationship with a strong entity.

Constraints in Relationships

Constraints express the minimum and maximum instances of the second entity in which the first entity can participate.

Transition to Relational Model

- The ER diagram is converted to a relational model by implementing simple steps

- The main points are:

  – Convert entities to relations (tables)

  – Represent relationships using foreign keys
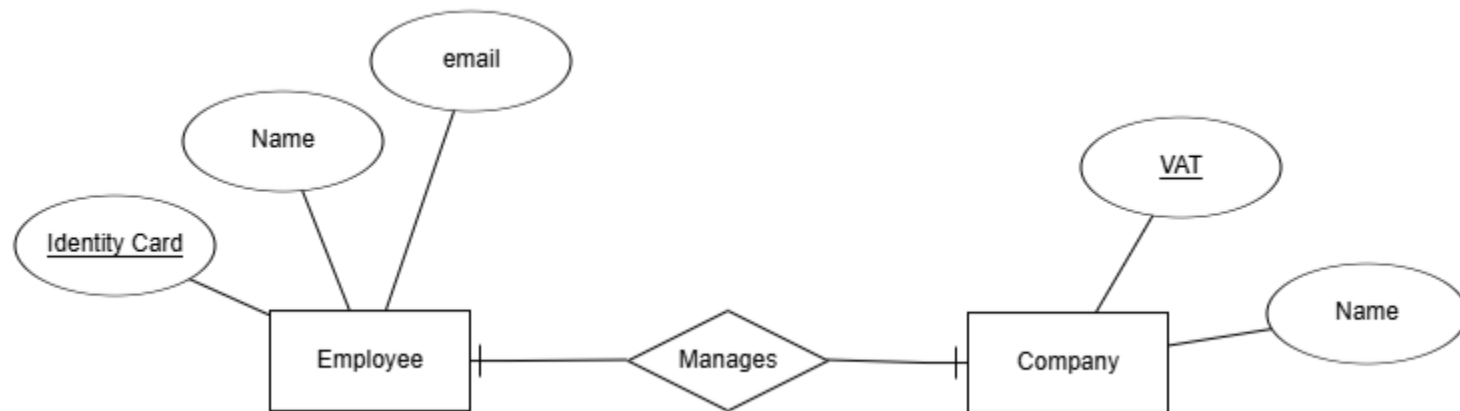
Transition to Relational Model

- **Strong Entities**
  - For each strong entity we create a relation (table) with all the attributes of the entity.
  - We select the primary key and underline it. If the primary key is a complex attribute, all the simple attributes are underlined.
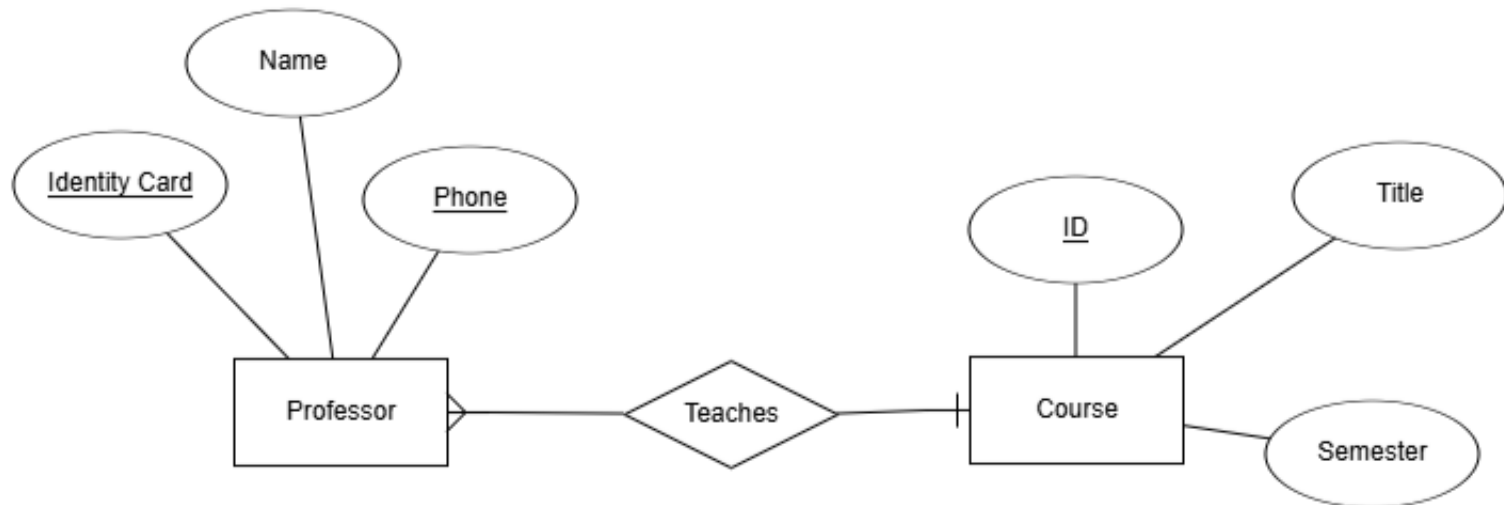
Transition to Relational Model

- One to One Relationship
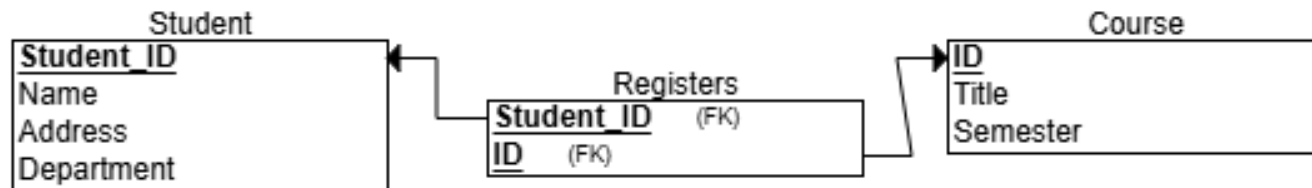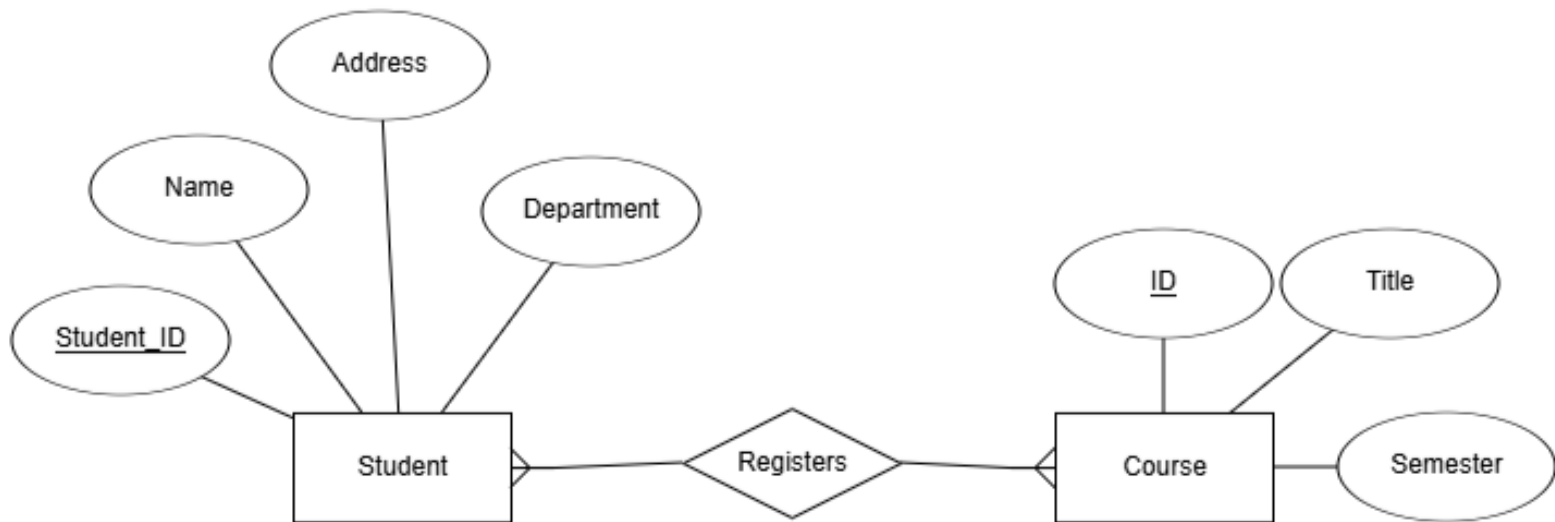
Transition to Relational Model

- One to Many Relationship

Transition to Relational Model

- Many to Many Relationship

Online tool for the design of ER diagrams

- https://erdplus.com/