CSCI4333 Database Design & Implement

Lecture Three – E-R Model

Instructor: Dr. Yifeng Gao

The E-R Model

The Entity-Relationship Model

The **E-R** (entity-relationship) data model views the real world as a set of basic **objects** (entities) and **relationships** among these objects.

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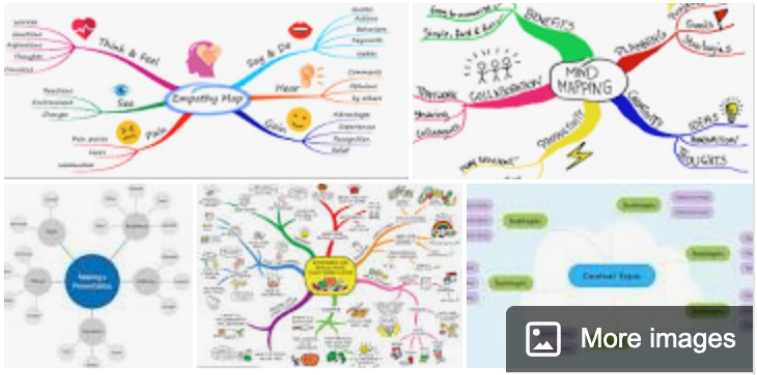
It is intended primarily for the DB design process by allowing the specification of an **enterprise scheme**. This represents the overall logical structure of the DB.

The E-R Model

In Other Words:

E-R Model is very similar to **Mind Map**



Mind map

A mind map is a diagram used to visually organize information. A mind map is hierarchical and shows relationships among pieces of the whole. Wikipedia

Images from Google

Entities and Entity Sets

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• An entity may be **concrete** or **abstract**

- Person
- Book
- Holiday
- Disease

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  - **Ex:** a computer science professor might take an art class in another department

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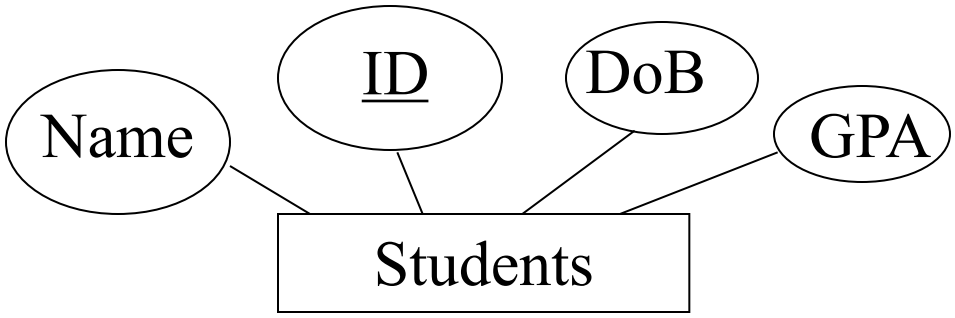

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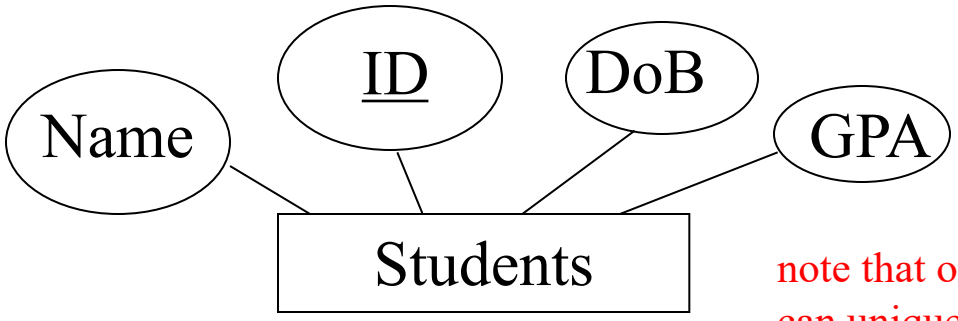

note that one of the attributes is underlined, means it can uniquely define a student.

we will explain why later.

E-R diagrams Continued

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relationship has following components:

- **diamonds** representing **relationship** sets.
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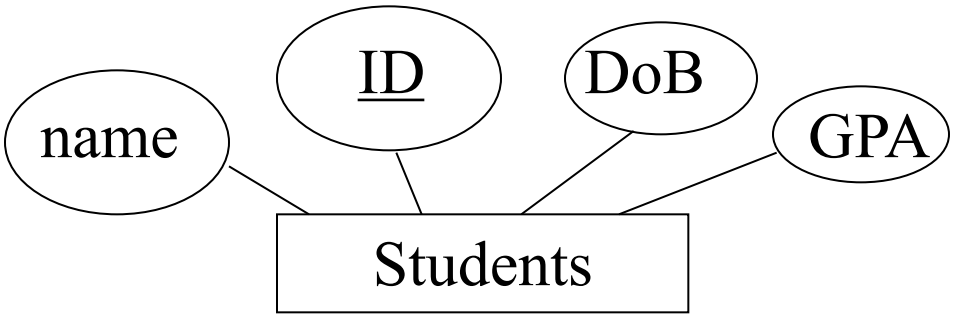

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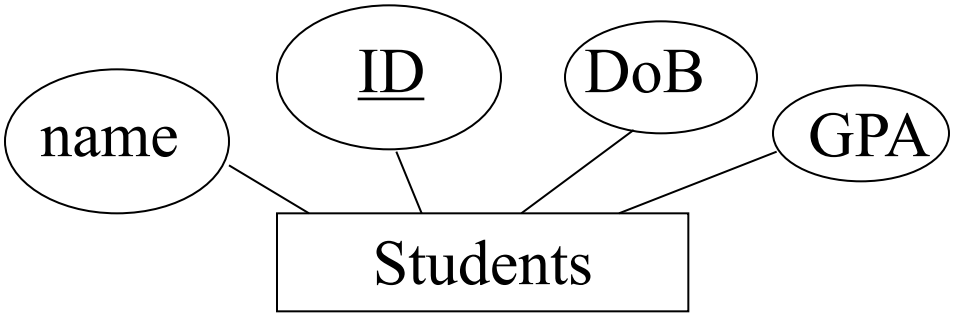

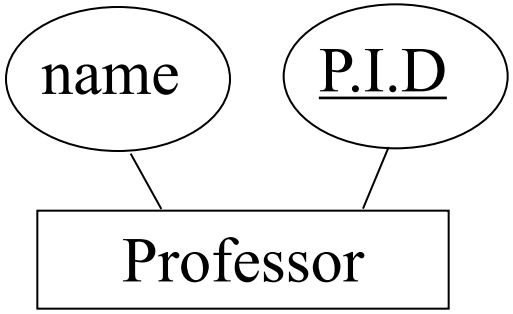

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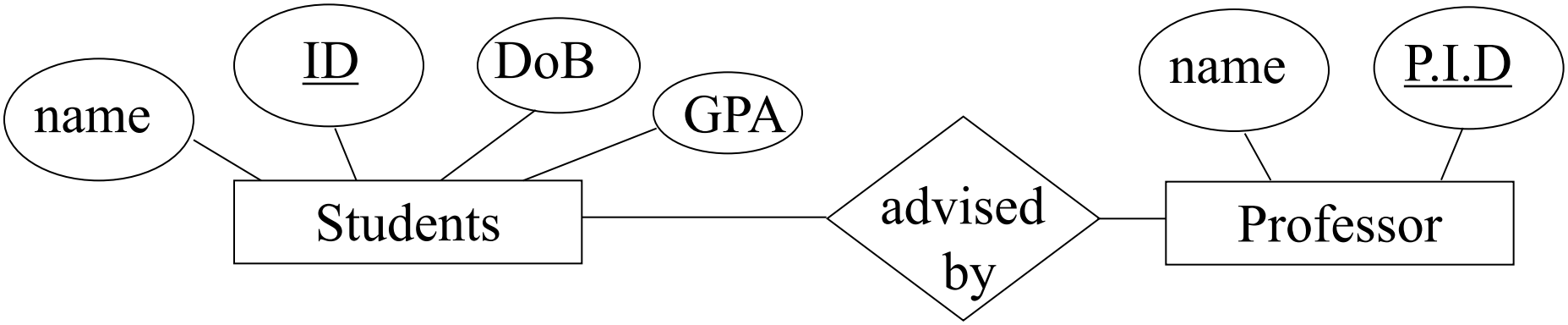

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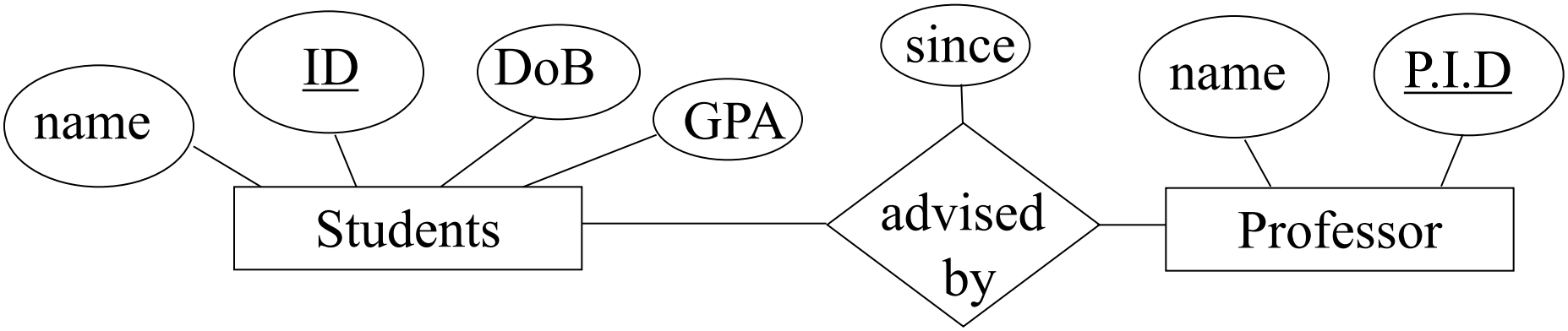

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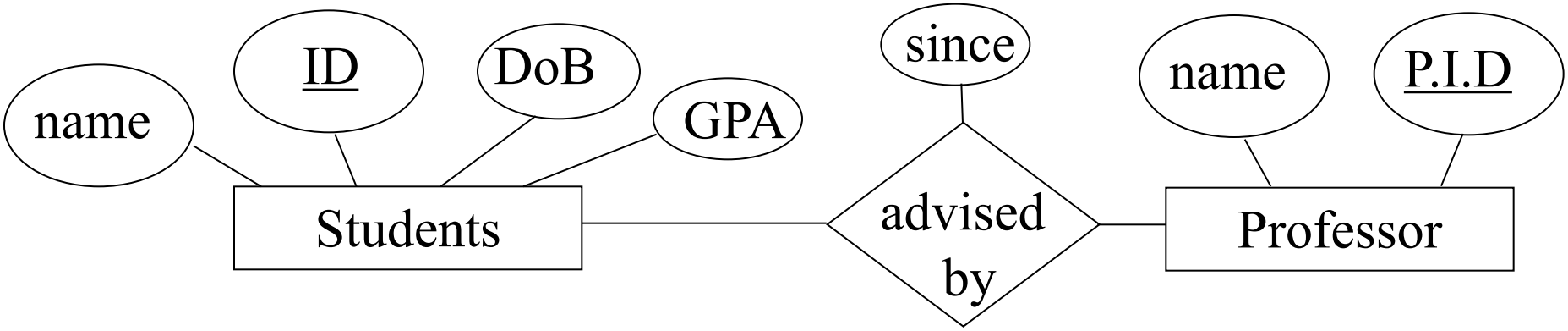
The "since" attribute in this example is called a **descriptive attribute**, since it describes the mapping from A to B



Entities and Entity Sets Continued

Name	State	Established
Yellow Stone	WY	1872
Great Smoky Mountain	TN	1934
Acadia	ME	1916
Mount Rainer	WA	1899

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An entity is represented by a set of **attributes**

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An entity is represented by a set of **attributes**

Name, State, Established for "**National Park**" entity.

Entities and Entity Sets Continued

Name	State	Established
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Every entity is described by a set of (attribute, data value) pairs.

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Name: Yellow Stone
State: WY
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Quick Question

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Draw the E-R Model for this table

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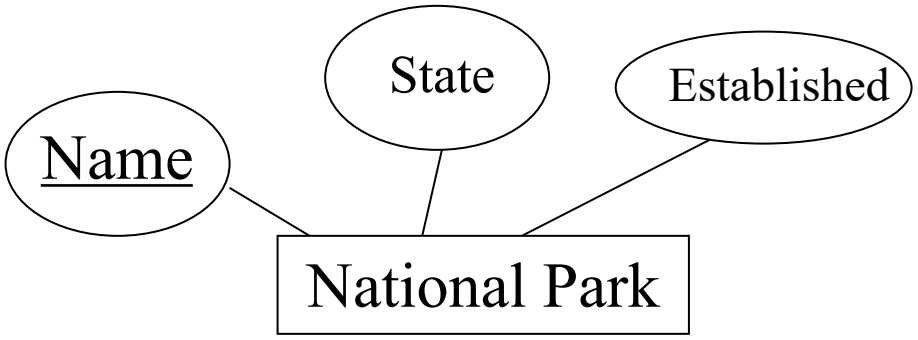

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- **rectangles** representing name of the entity set.
- **ellipses** representing attributes of the entity set.
- **lines** linking attributes to entity sets
- **underline** attributes which can uniquely define an entity

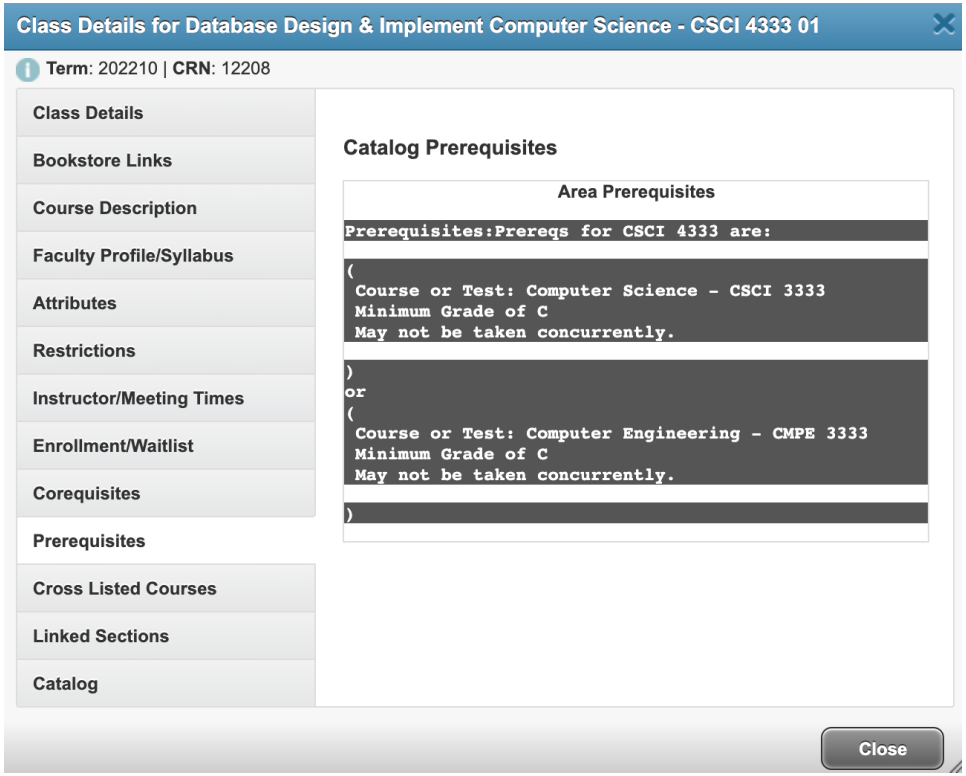
Relationship Continued

Visitor	National Park Name	First Visit
Michael	Yellow Stone	2001
Ana	Yellow Stone	2005
Michael	Acadia	1999
Ana	Acadia	2009

A Special Case

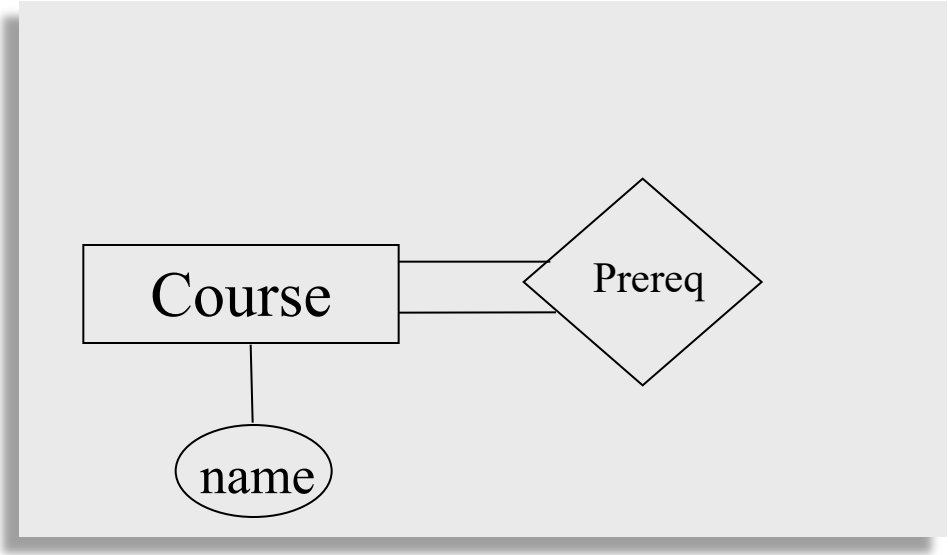
Prereqs for CSCI 4333 are CSCI 3333 and CMPE 3333

How can we describe it in E-R model?



More on Relations

- Entities sets can be related to themselves.



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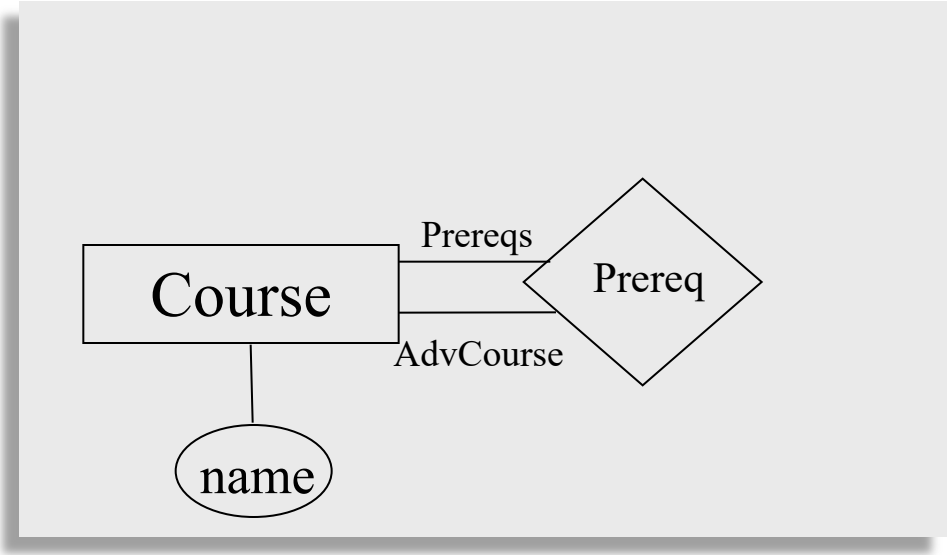

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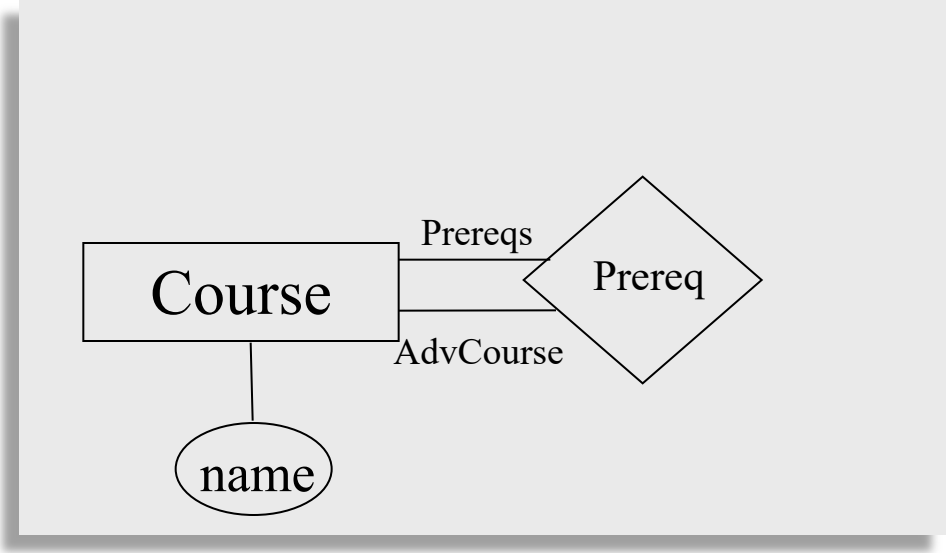
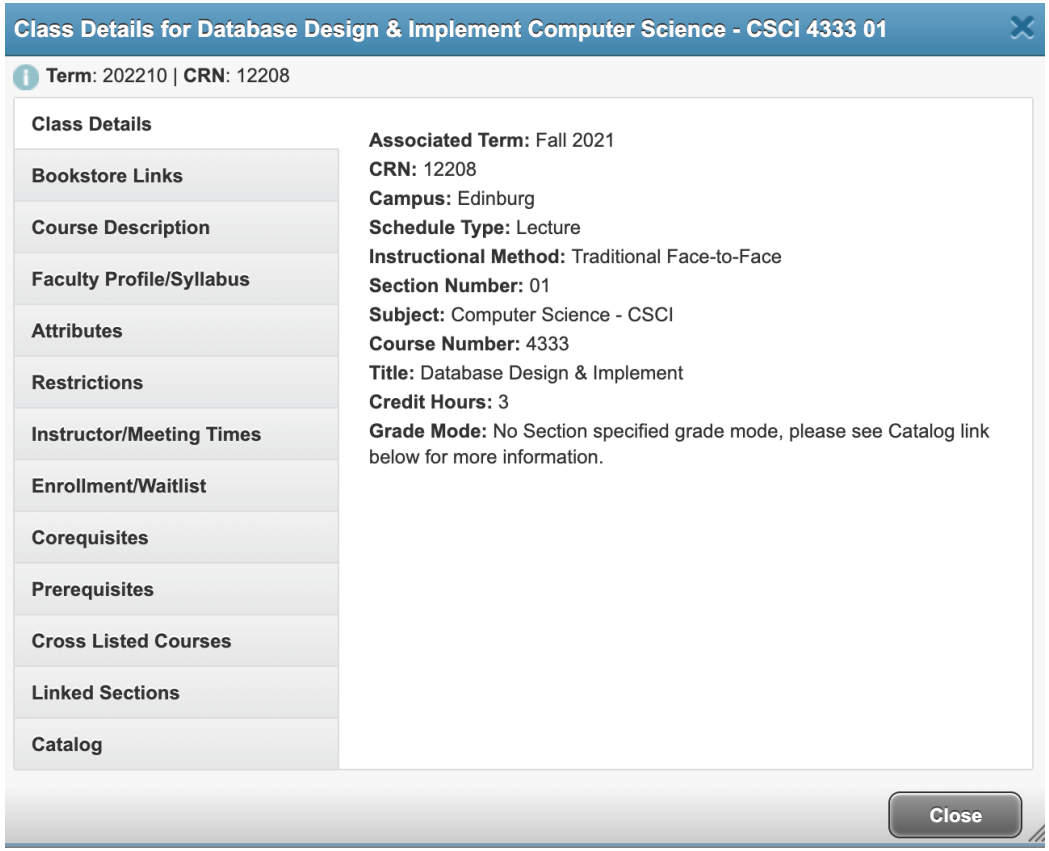


When entities are related to themselves, it is almost always a good idea to indicate their roles.

Quick Question



Key Constraints

Suppose the university has the following rule: A student is allowed to be advised by at most one professor. However, a professor is allowed to advise more than one student.

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This is an example of a **many-to-one constraint**

- many students can be advised by one professor
- but each student can only have (at most) one advisor.

Key Constraints Continued

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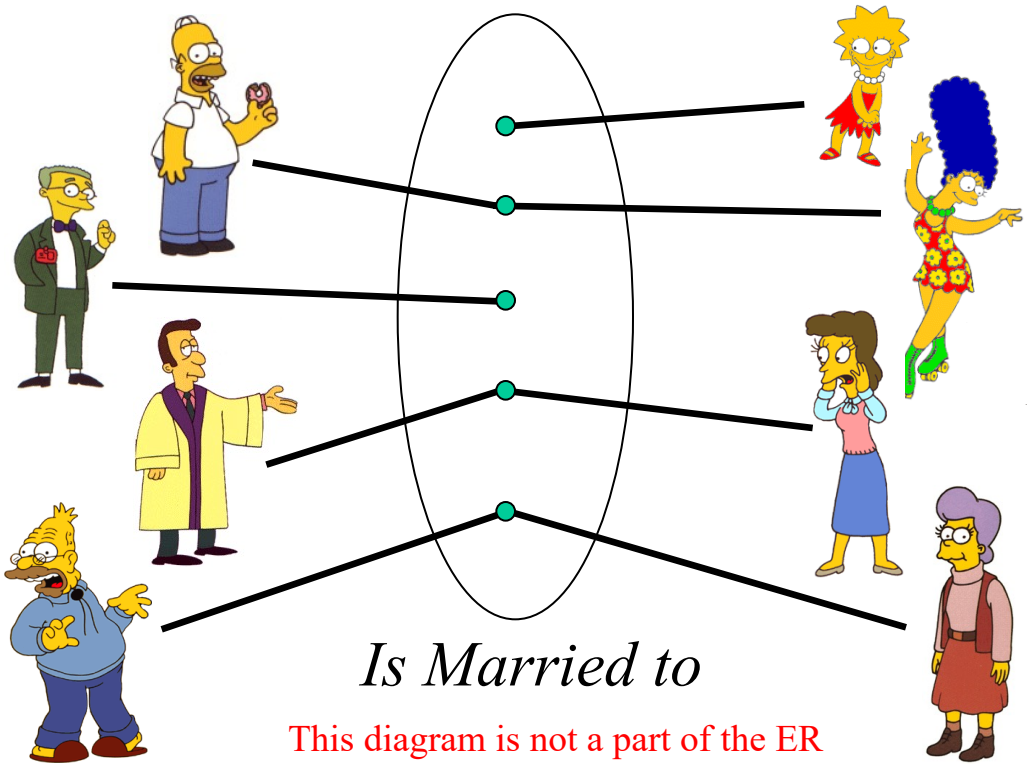
- For binary relationship sets between entity sets A and B, the mapping cardinality must be one of:
  - **One-to-one**:
    - An entity in A is associated with at most one entity in B
    - An entity in B is associated with at most one entity in A.

Key Constraints: Examples

- **one-to-one**: An entity in A is associated with at most one entity in B, and An entity in B is associated with at most one entity in A.

  A man may be married to at most one woman, and a woman may be married to at most one man (both men and women can be unmarried)



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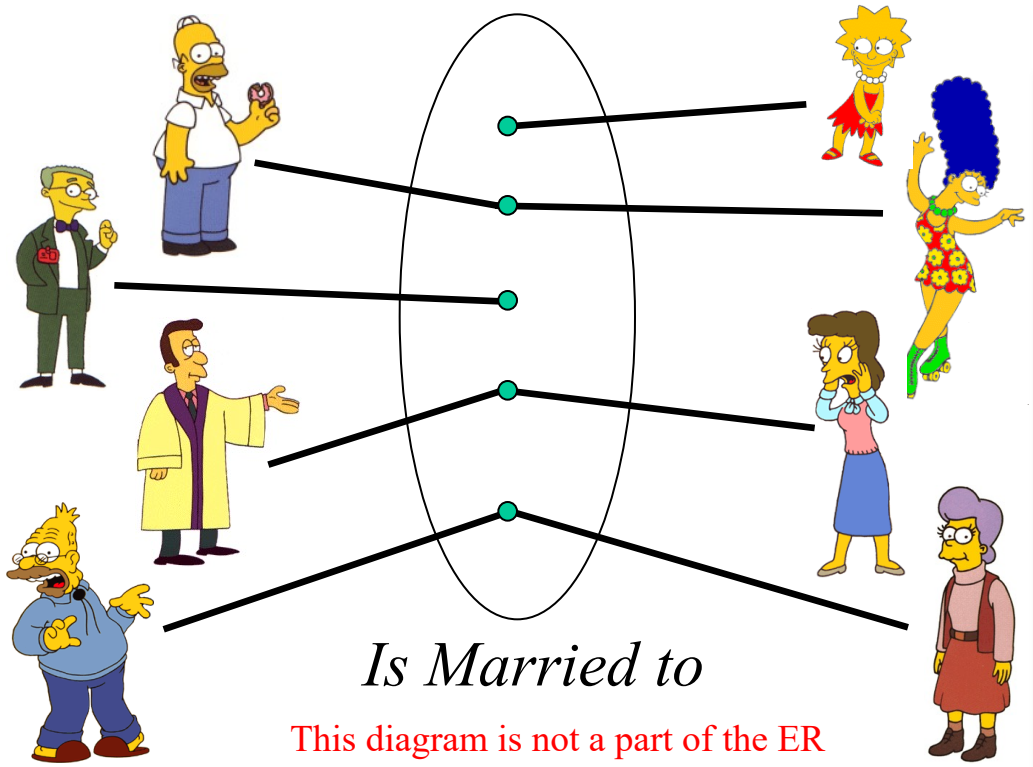

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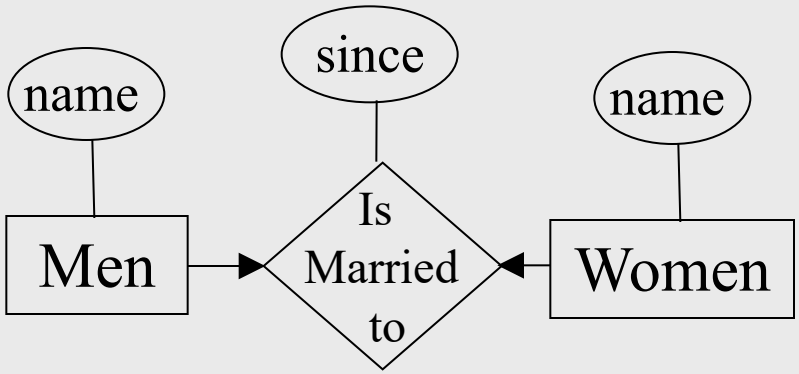
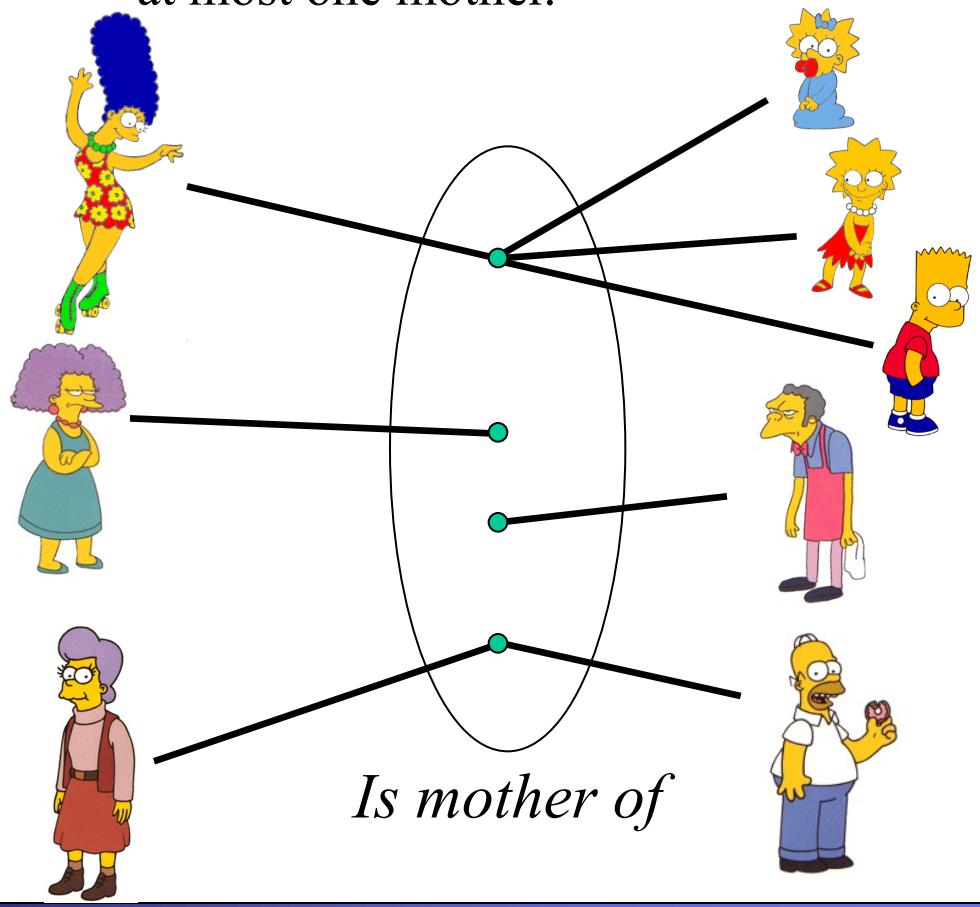
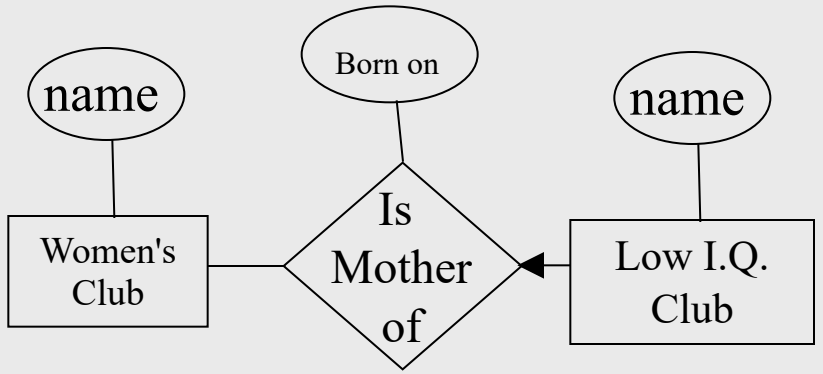


Key Constraints: Examples

• **one-to-many**: An entity in A is associated with any number in B. An entity in B is associated with at most one entity in A.

A woman may be the mother of many (or no) children. A person may have at most one mother.



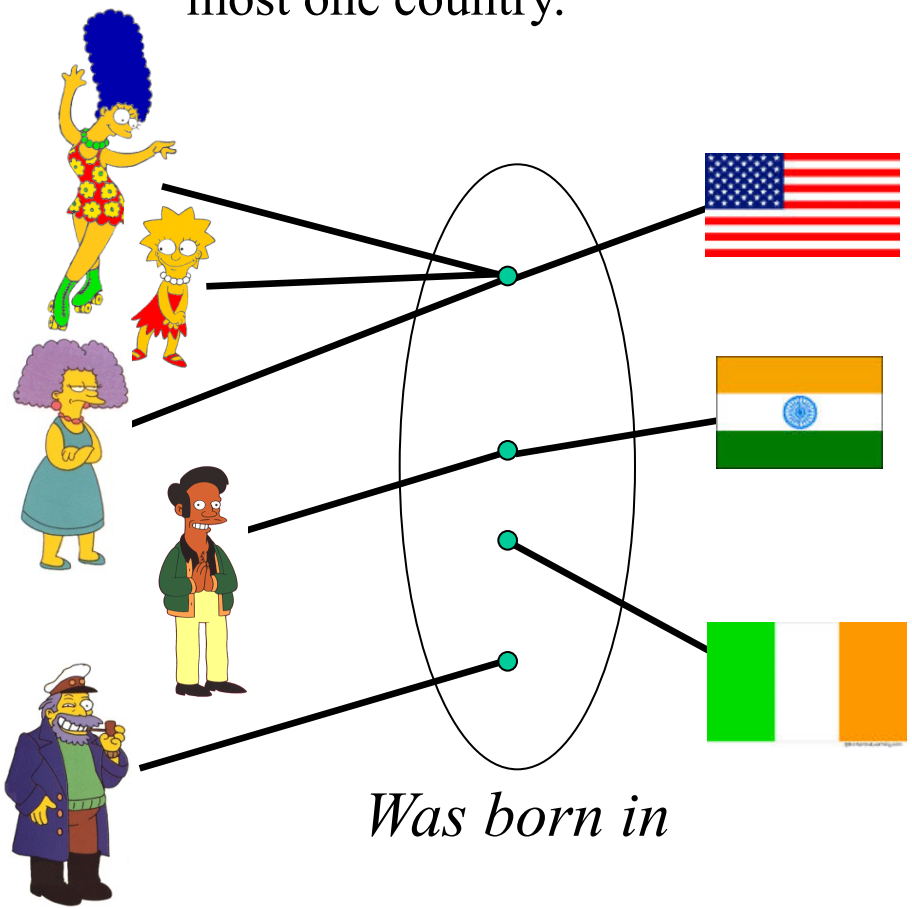


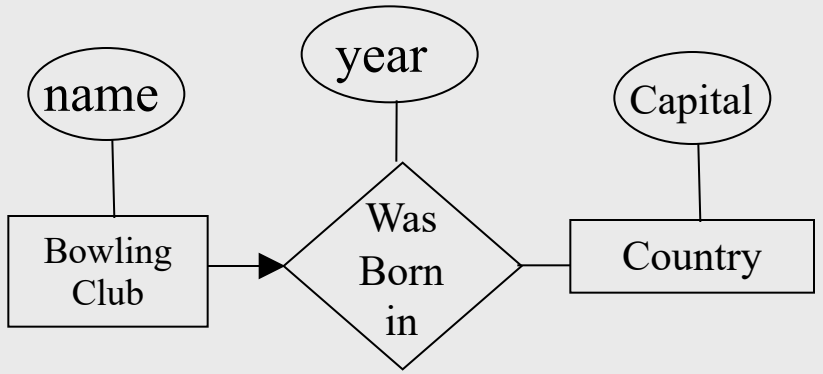
Note that this example is not saying that Moe does not have a mother, since we know as a biological fact that everyone has a mother. It is simply the case that Moe's mom is not a member of the Women's club.

Key Constraints: Examples

•**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 in A.

Many people can be born in any county, but any individual is born in at most one country.

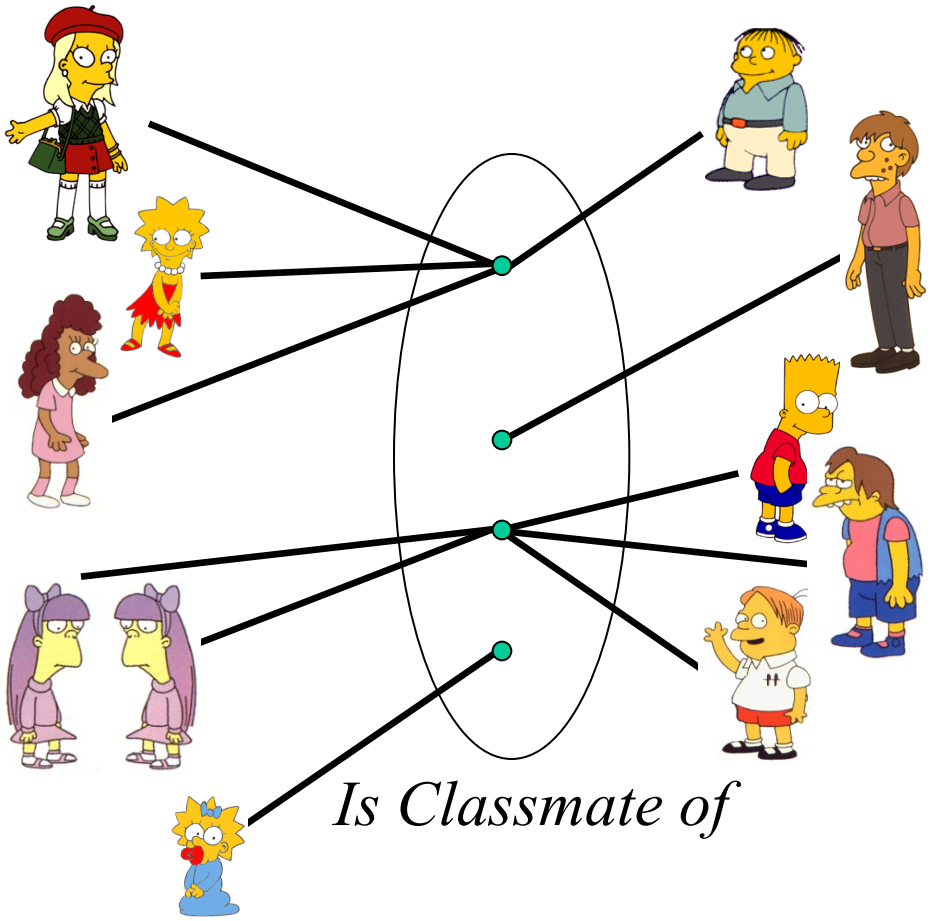


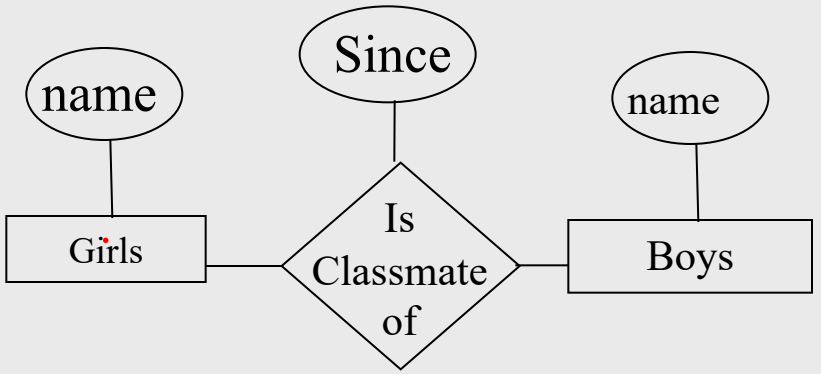


Note that we are not saying that the Sea Captain was not born in any country, he almost certainly was, we just don't know which country, or it is not in our Country entity set.
Also note that we are not saying that no one was born in Ireland, it is just that no one in the Bowling Club was.

Key Constraints: Examples

•**Many-to-many**: Entities in A and B are associated with any number from each other.





Key Constraints Continued

- There are four possible **key constraints,** they express the number of entities to which another entity can be associated via a relationship.

- For binary relationship sets between entity sets A and B, the mapping cardinality must be one of:
  - **One-to-one**
  - **One-to-many**
  - **Many-to-one**
  - **Many-to-many**

- The appropriate **key constraint** for a particular relationship set depends on the real world being modeled.

Key Constraints

• The arrow positioning is simple once you get it straight in your mind, so do some examples.

•Think of the arrow head as pointing to the entity that "one" refers to.

•Some people use the term "**Mapping Cardinalities**" or "**Multiplicity**" to refer to key constraints.

Exercise

- Researcher vs. Project
- People vs. Driver's License
- President vs. Country