The Entity-Relationship Model (Part III)

R &G - Chapter 2

Today's Lecture

- Advanced issues for ER diagram design:
  - Hierarchy
  - Aggregation
  - Design Issues of ER diagram

Subclasses

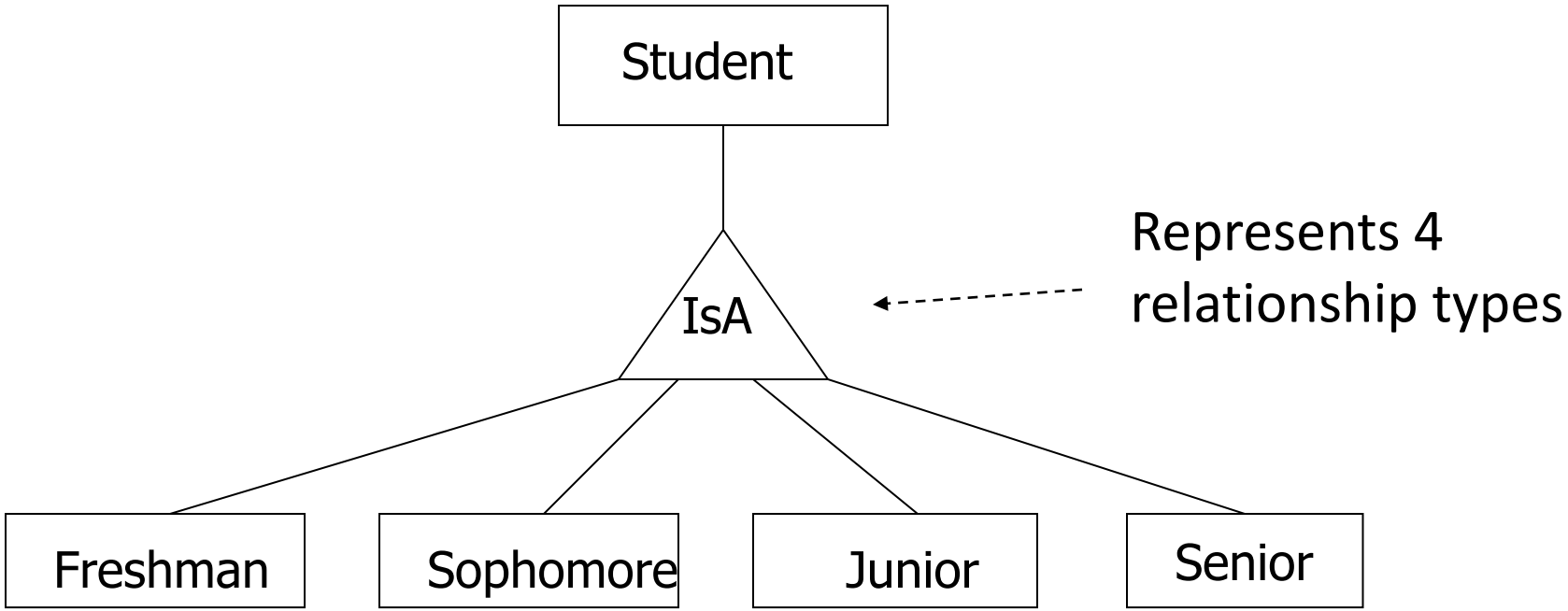
- *Subclass* = special case = fewer entities = more properties.
- Example: Ales are a kind of beer.
  - Not every beer is an ale, but some are.
  - In addition to all the *properties* (e.g., brand, name, manufacture) of beers, ales also have the attribute *color*.
- **Question**: how to define the *Beer* and *Ales* entity sets?

Hierarchy of Entity Set

- One entity type might be subtype of another
  - Ales is a subtype of beer
  - Freshman is a subtype of Student

- The *IsA* ("is a") relationship exists between the superclass entity and its subclass entity
  - Ales IsA beer
  - Freshman IsA Student

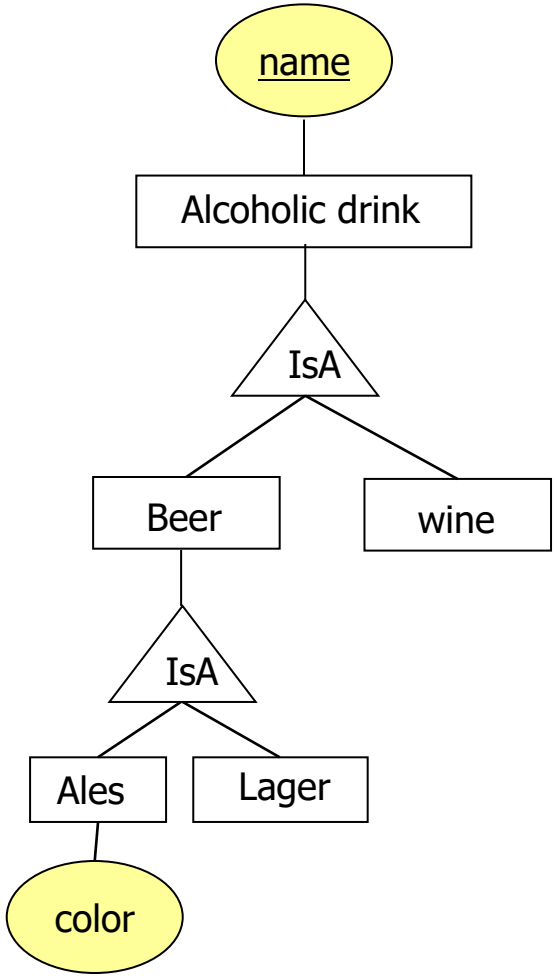
Draw IsA Relationship in ER Diagram



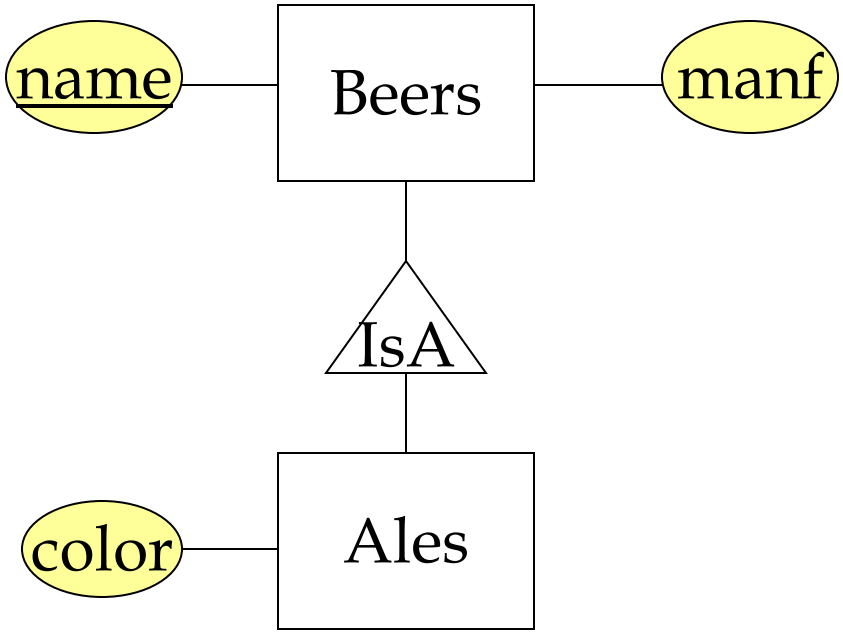
- Always use Triangle for IsA relationship (with the triangle top pointing to the supertype)!
- Do NOT name IsA relationship by yourself! Stick with "IsA"!

Properties of IsA Relationship

- ***Inheritance***
  - Subclass *inherits* all attributes of superclass.
  - The key of the superclass is the key of the subclass
  - Subtypes can have new attributes
    - E.g., *Color* attribute adds to Ales
- ***Transitivity***
  - Ales is a subclass of Beer;
  - Beer is a subclass of Alcoholic drink;
  - So Ales is also a subclass of Alcoholic drink.
  - Question: what is the key of Ales?

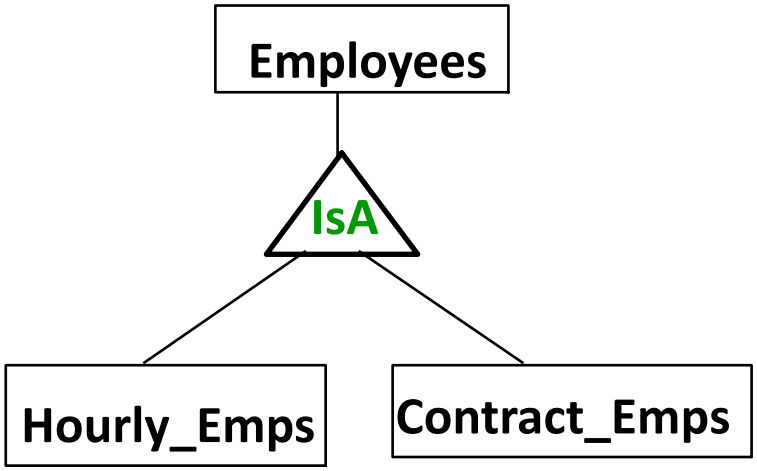


Example: IsA



- What are the attributes of Beers?
- What are the attributes of Ales?
- What is the key of Ales?

IsA Constraints



- ***Overlap constraints***: Some instances can appear in two or more subclass entity sets
  - Example: can some employee be an Hourly_Emps and a Contract_Emps at the same time?
    - *Allowed:* overlap constraint
    - *Disallowed*: no overlap constraint
- ***Covering constraints***: all instances in the superclass entity set are covered by at least one subclass entity set.
  - Example: does every employee have to be either an Hourly_Emps or a Contract_Emps entity?
    - *Yes:* covering constraint
    - *No:* no covering constraint (e.g., there are full-time employees too)

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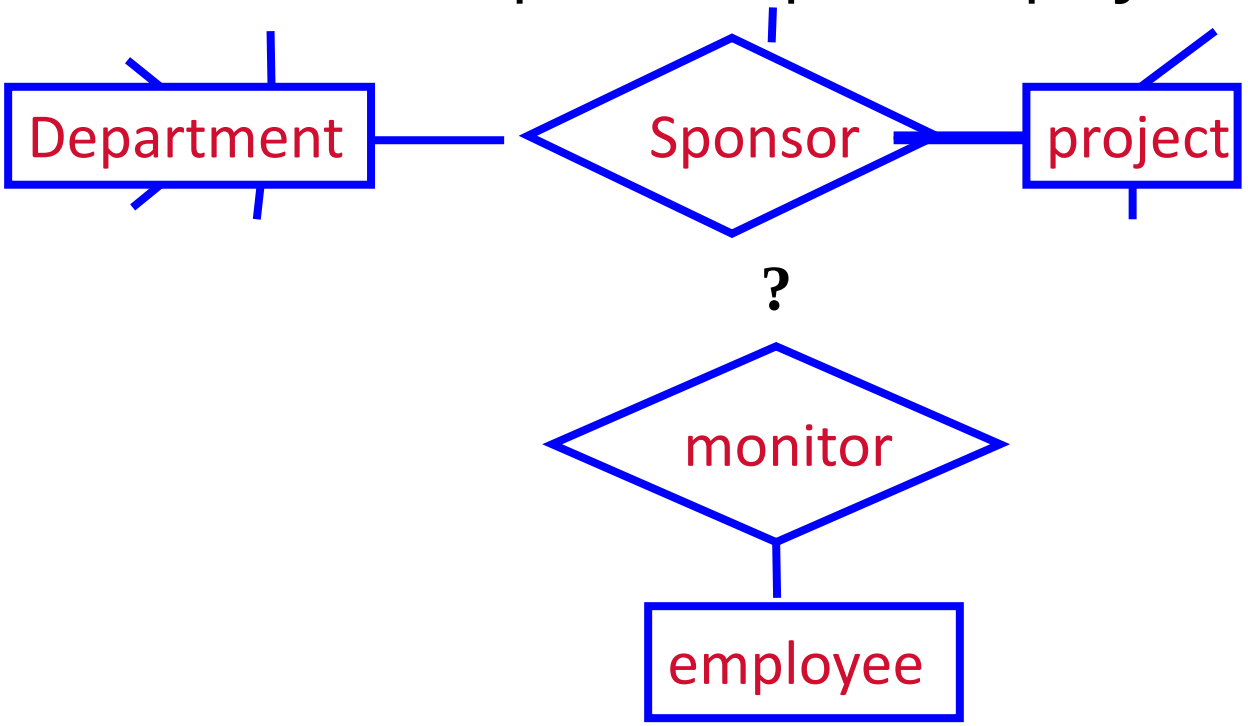
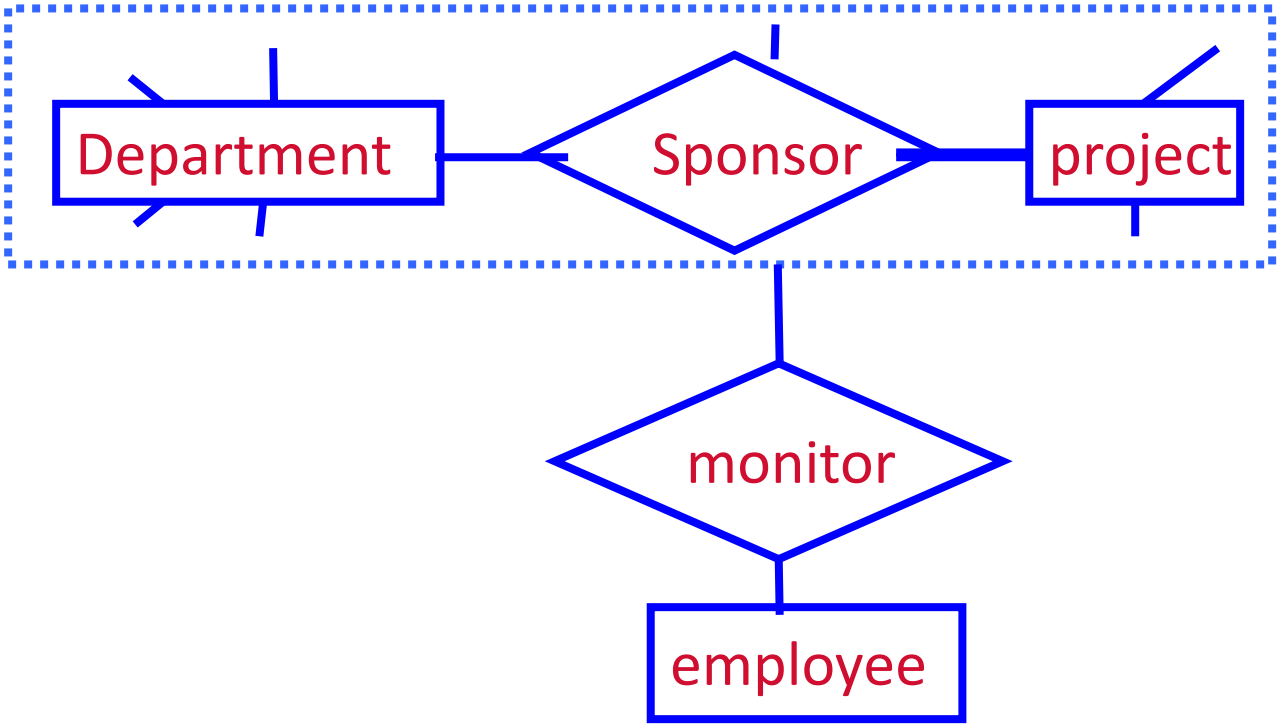
Aggregation: Motivation Example

- **How to model relationships between relationships?**
  - E.g.: For each project, it is assigned an officer to monitor the sponsorship of the project.



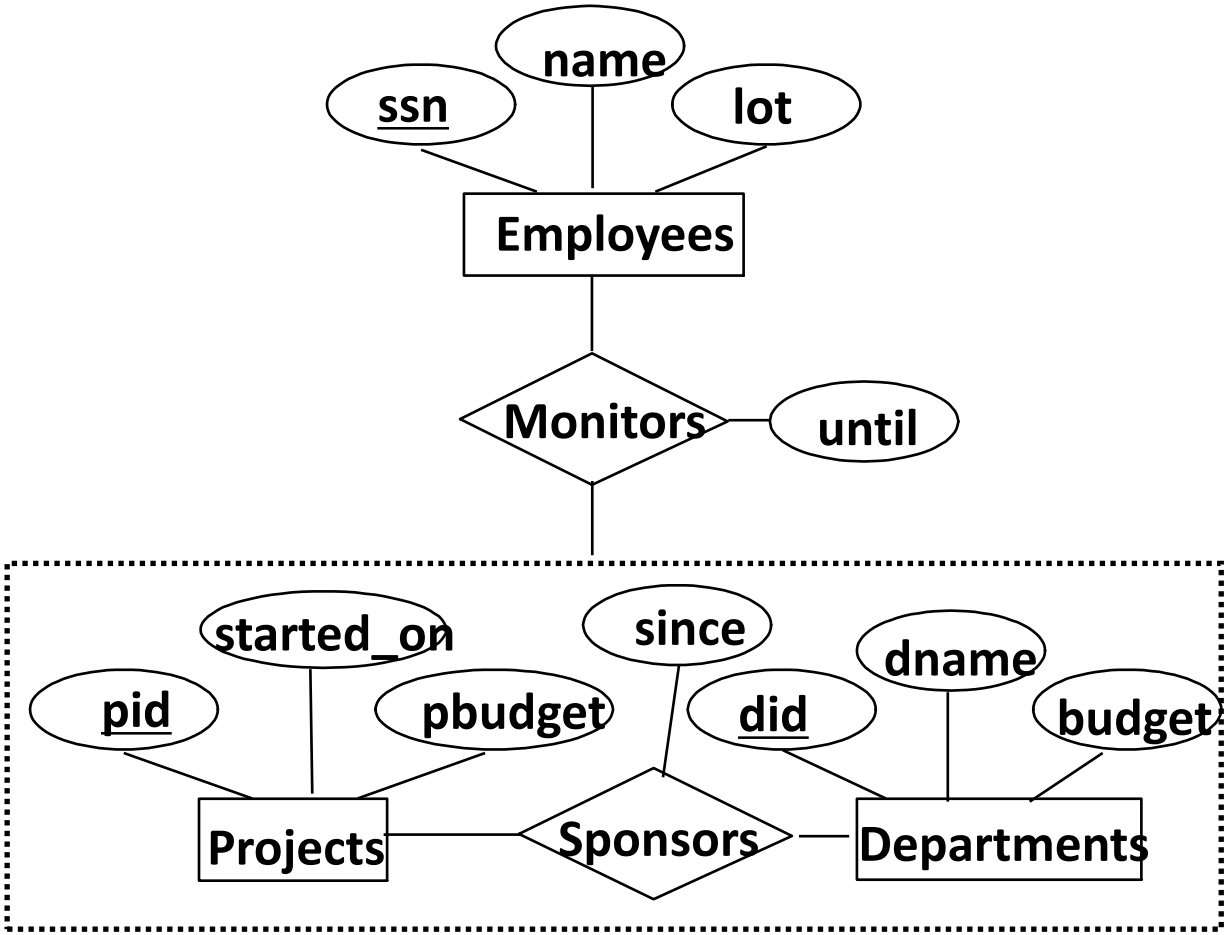
Aggregation

- **Solution: Aggregation**
  - Used to model a relationship involving a relationship set.
  - How to draw aggregation in ER diagram: a rectangle in dotted line.
    - The rectangle includes the relationship and all of its connected entity sets



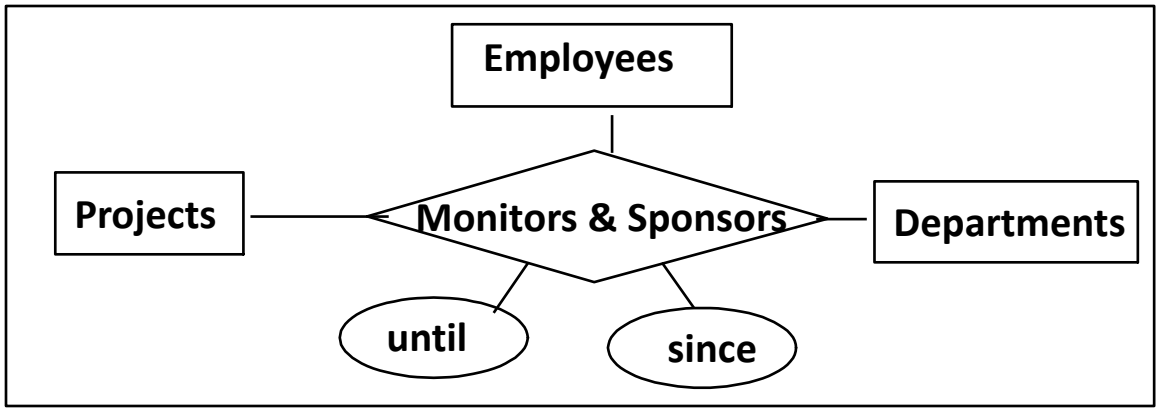
Aggregation

- Describes relationship among relationships
- Treat a relationship set as an entity set

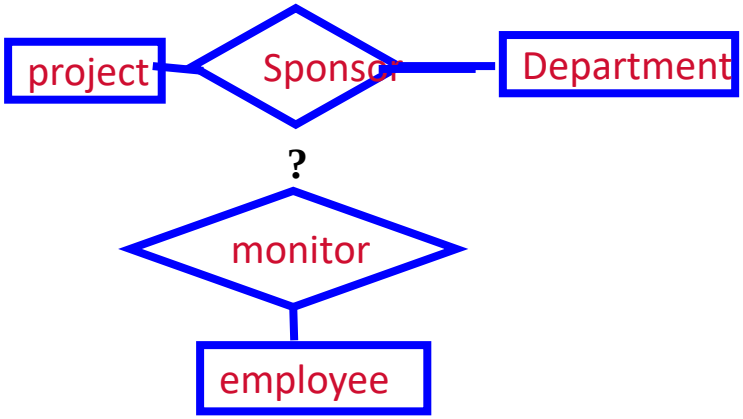


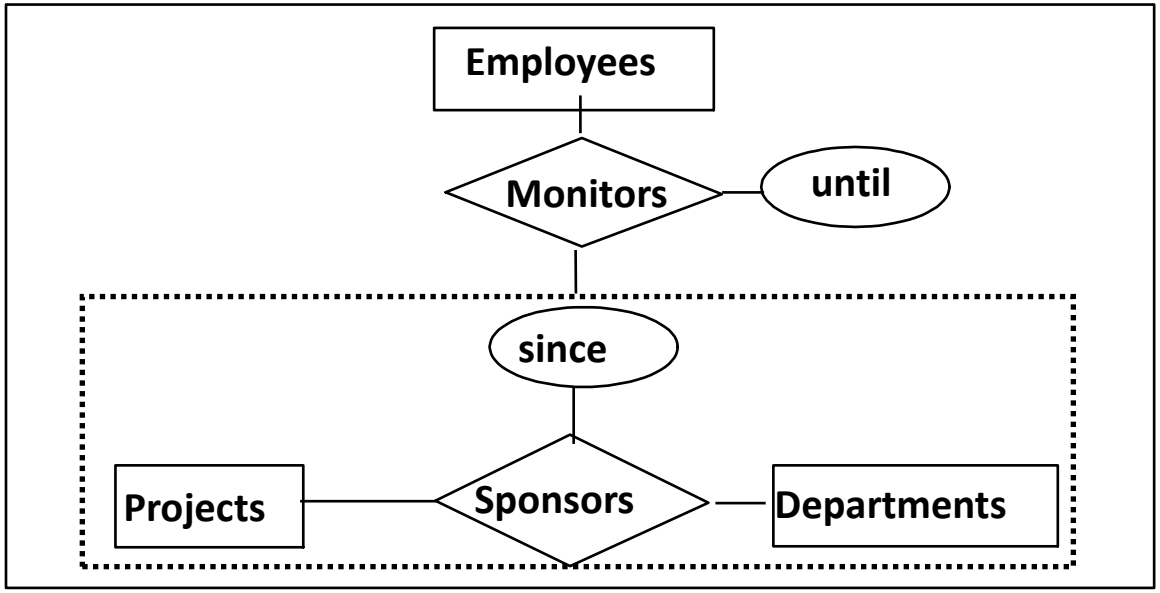
Aggregation vs. Ternary Relationship?

- ***Can we merge Monitors and Sponsors relationships?***



Schema 1: Ternary relationship (after merge)

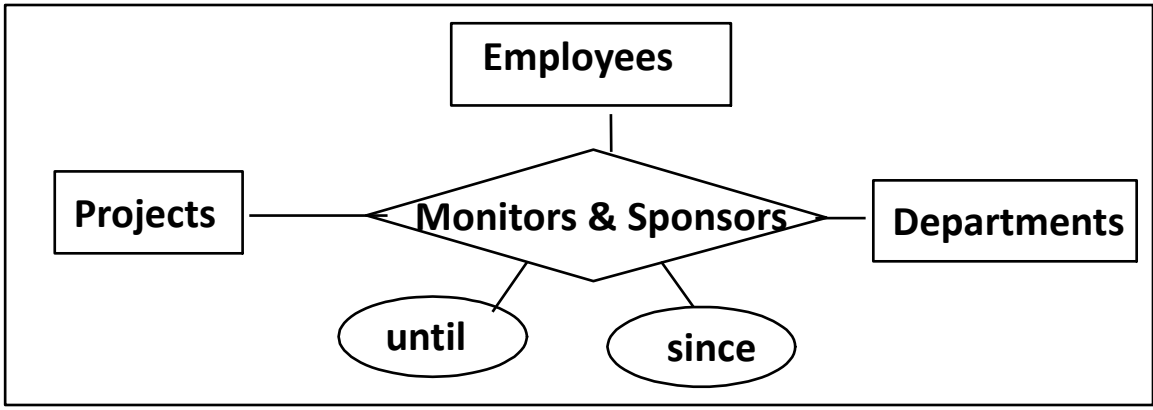




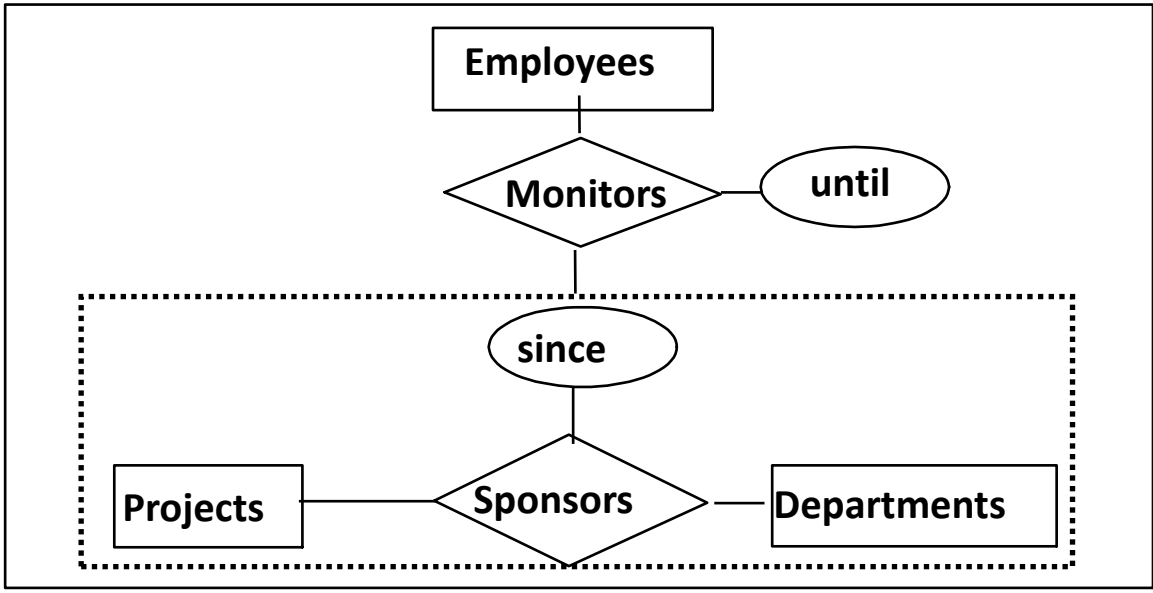
Schema 2: Aggregation

Aggregation vs. Ternary Relationship?

- *Can we merge Monitors and Sponsors relationships?*
- *Answer: NO*
  - *Monitors* is a distinct relationship, with a descriptive attribute *until*.
  - Similar to *Sponsors* relationship.
- So use aggregation!



Schema 1: Ternary relationship (after merge)



Schema 2: Aggregation

Today's lecture

- Advanced issues for ER diagram design:
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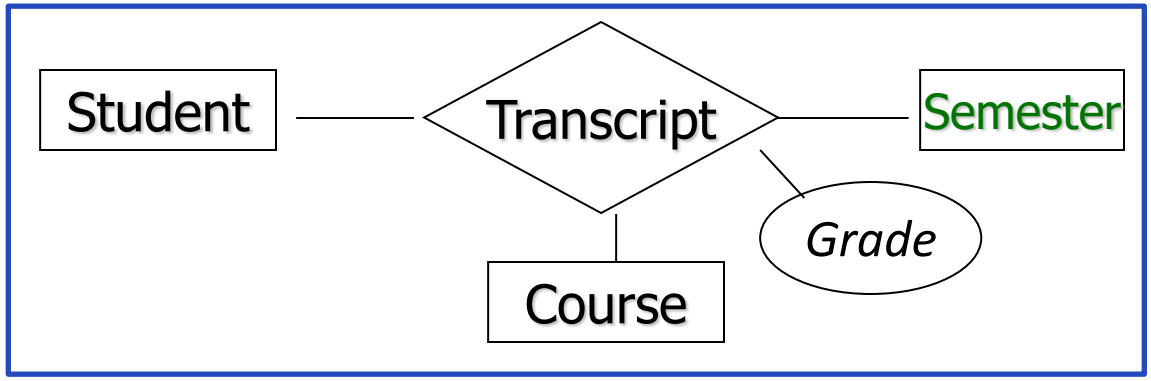
Conceptual Design Using the ER Model

- **ER modeling can get tricky!**
- **Design choices:**
  1. Should a concept be modeled as an entity set or an attribute?
  2. Should a concept be modeled as an entity set or a relationship?
  3. Identifying relationships: Binary or ternary?

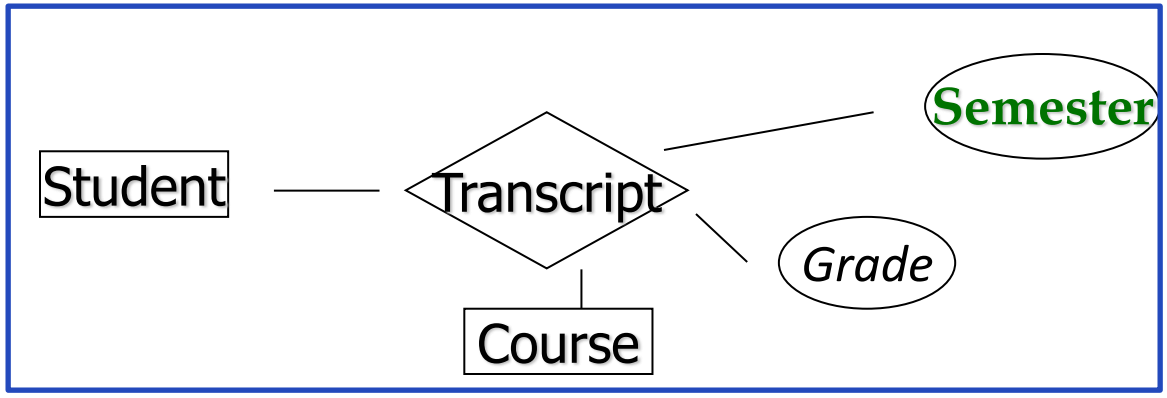
Design Issue #1: Entity Set vs. Attributes

- Sometimes a concept can be represented as either an entity set or an attribute.



Schema 1

Question: should *Semester* be defined as an attribute, or an entity set?



Schema 2

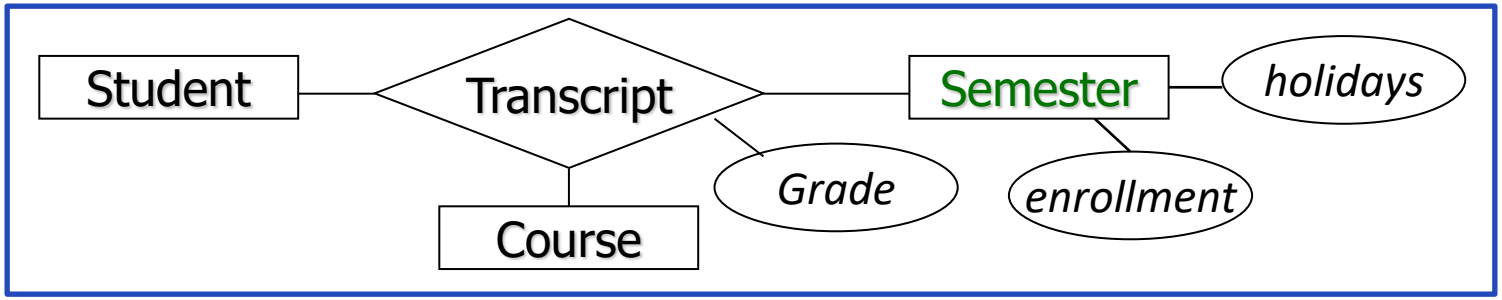
Entity Sets VS Attributes

- A concept C should be defined as an entity set if one of the following conditions happens:
  - 1: It is more than the name of something; it has at least one non-key attribute.
  - 2: More than one instance of C can be associated with one single entity.
  - 3: More than one instance of C can be associated with one single relationship.

Entity Set vs. Attribute (Rule 1)

Rule 1: A concept C should be defined as an entity set if it is more than the name of something; it has at least one non-key attribute.

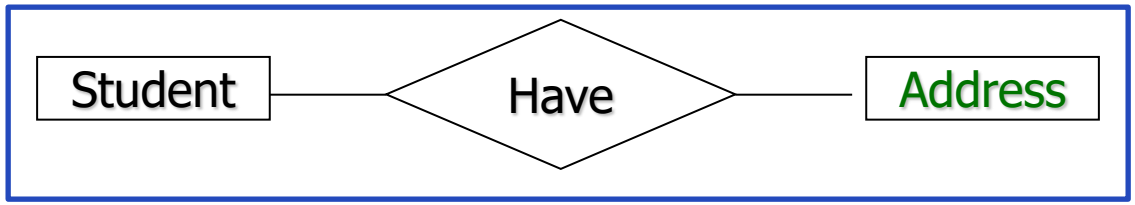
- Example: if each semester is associated with other information (enrollment, holidays, etc.), *semester* must be modeled as an entity set
  - The enrollment, holidays, etc are non-key attributes of semester.



Entity Set vs. Attribute (Rule 2)

Rule 2: A concept C should be defined as an entity set if more than one instance of C can be associated with one single entity.

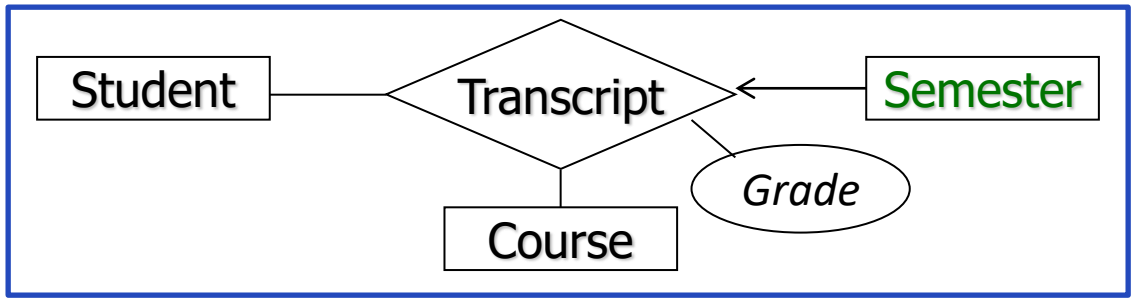
- Example: the students can have both home address and school address
  - i.e., each student can be associated with multiple addresses
  - *Address* should be defined as an entity set.



Entity Set vs. Attribute (Rule 3)

Rule 3: A concept C should be defined as an entity set if more than one instance of C can be associated with one single relationship.

- Example: The students can take the same course in different semesters
  - i.e., A (student, course) pair/relationship can be associated with multiple semesters
  - *Semester* should be defined as an entity set.



Question: if each student can take the same course only once, can *Semester* be defined as an attribute of Transcript?

Exercises

- **Fact 1: each person has his/her contact information as a phone number**
  - Should *contact information* be defined as an entity set or an attribute?
- **Fact 2: each person has his/her contact information including phone numbers for daytime and nigh time.**
  - Should *contact information* be defined as an entity set or an attribute?

Quiz time

- Quiz is available in Canvas
- 5 single-choice questions, 10 minutes.
- Use laptop/cell phone
- Finish the quiz before you leave the classroom.