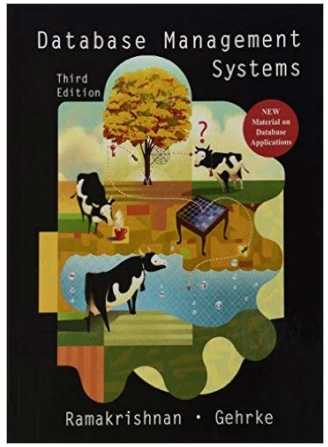
The Entity-Relationship Model (Part III)

R &G - Chapter 2

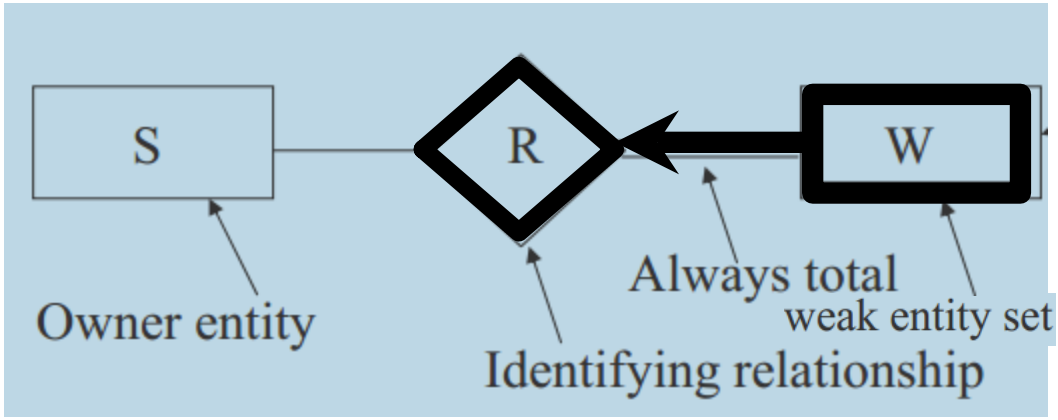
Review: the ER Model

- **Basic issues in ER design**
  - Entities and entity set
  - Relationships and relationship sets
  - Key constraints
  - Cardinality constraints (1:1, 1:M, M:N)
  - Participation constraints (total, partial)
  - Weak entities

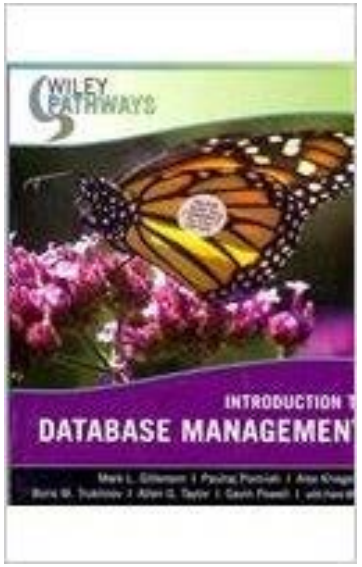
Clarification: How To Draw Weak Entity Sets?



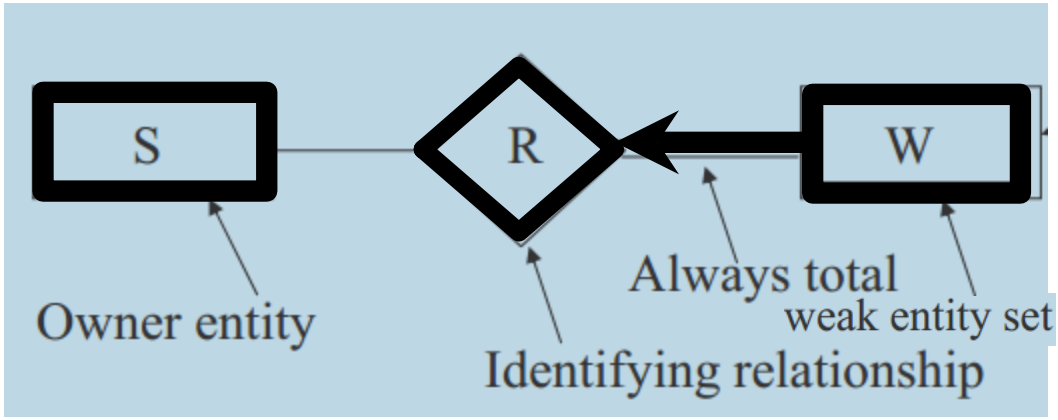
- **Most textbooks (including CS442 required textbook)**



Clarification: How To Draw Weak Entity Sets?

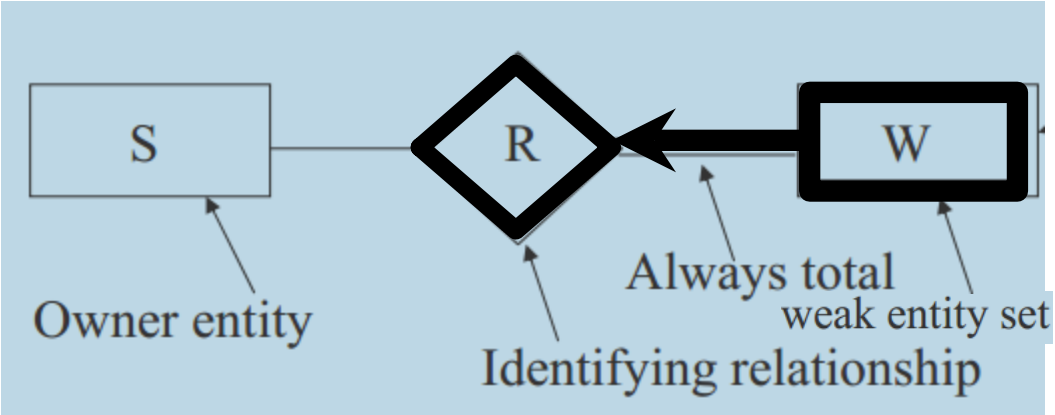


- **Few textbooks**



Final Decision

- **Follow our textbook**



Quiz in Last Class

- **Facts:**
  - The university provides several courses, each course has its name, ID, and number of credits.
  - A popular course may have several sections, each taught by a different professor. Each section has its own ID, classroom and meeting times.
  - It is possible that the sections of different courses may have the same ID.
- **Question**:
  - Design the ER diagram of the *course* and *section* entity sets, and the *has* relationship between them.

Today's Lecture

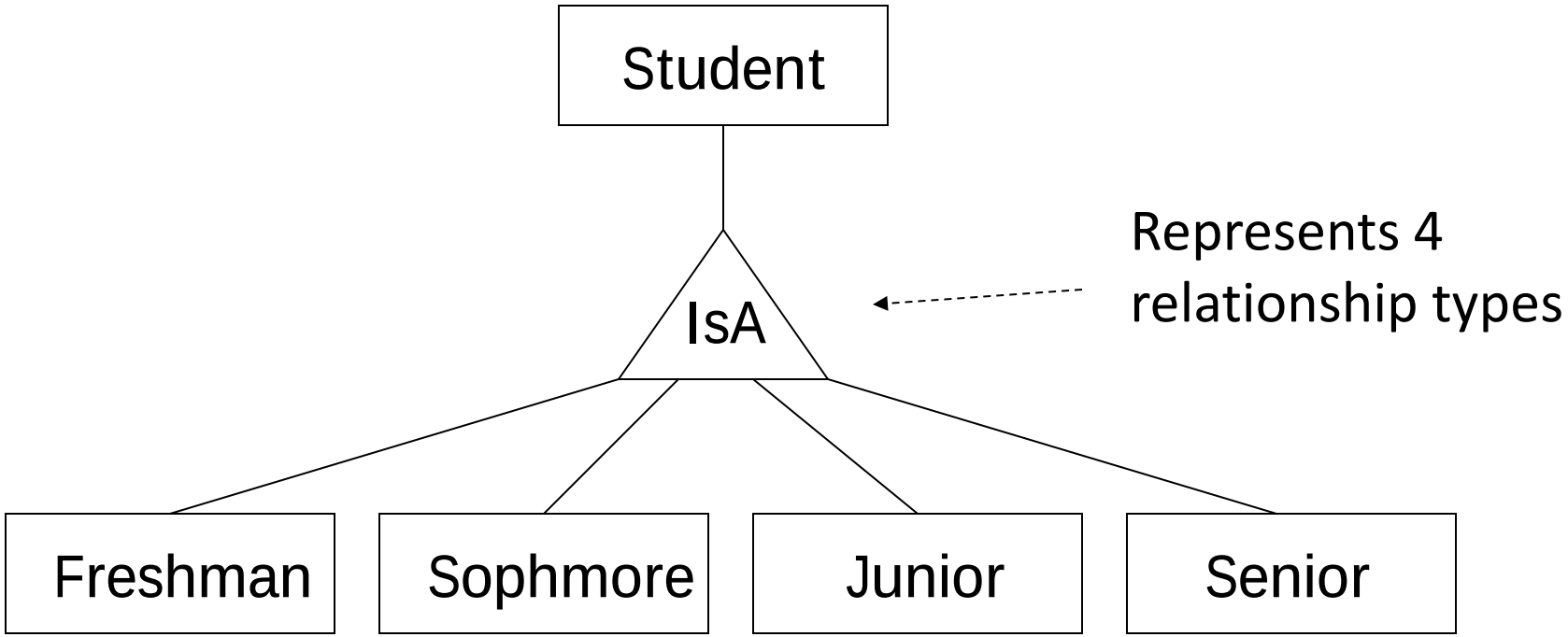
- Advanced ER-diagram:
  - Hierarchy
  - Aggregation
  - Design Issues of ER diagram

Entity Type Hierarchies

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

- The *IsA* (“ is a”) relationship exists between the supertype entity and its subtype entity
  - Freshman IsA Student

IsA


Student
IsA
Represents 4
relationship types
Freshman
Sophmore
Junior
Senior

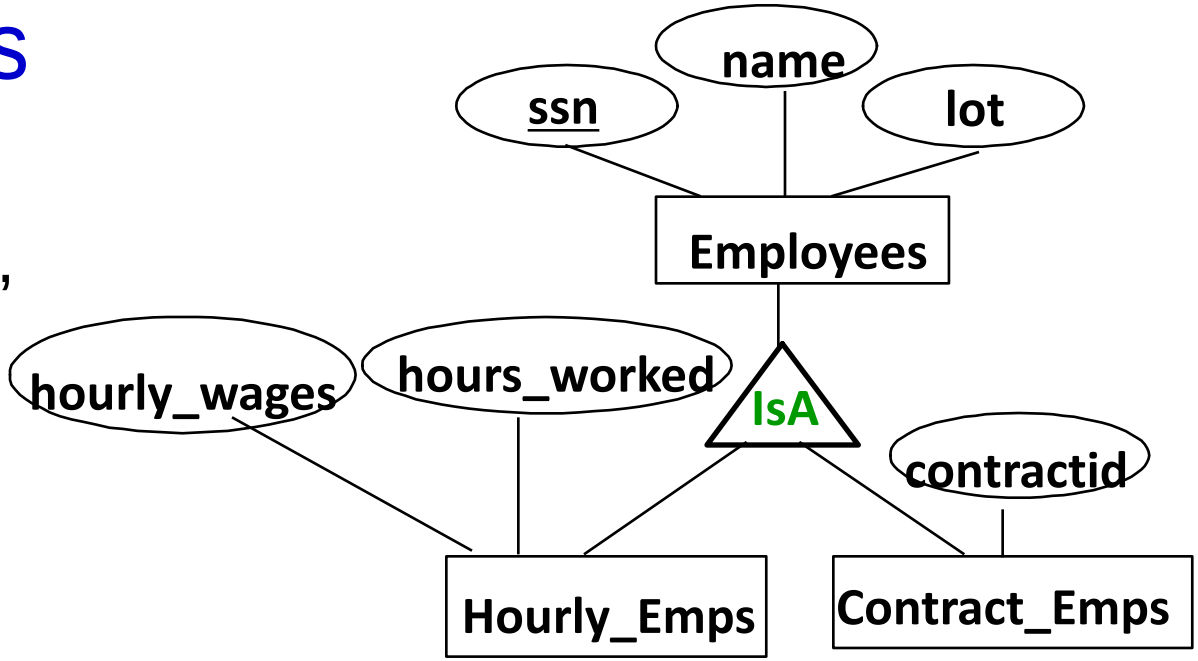
Properties of IsA

- ***Inheritance***
  - Subtype *inherits* all attributes of supertype.
  - The key of the supertype is the key of the subtype
  - Subtypes can have new attributes
    - E.g., *GraduationDate* attribute adds to Senior

- ***Transitivity***
  - Freshman is subtype of Student, Student is subtype of Person, so Freshman is also a subtype of Person
  - Question: what is the key of Freshman?

IsA Constraints

❖If we declare A **IsA** B, every A entity is also considered to be a B entity.



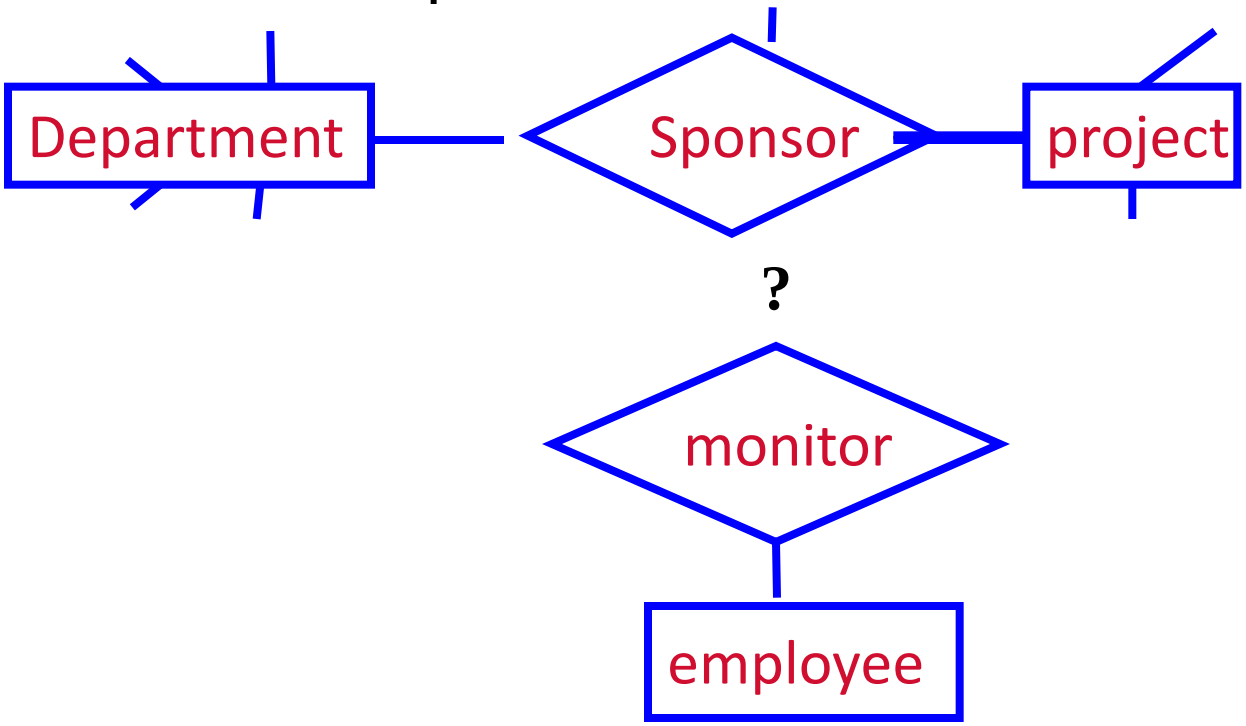
- ***Overlap constraints***: Can Simon be an Hourly_Emps as well as a Contract_Emps entity?
  - *Allowed:* overlap constraint
  - *Disallowed*: no overlap constraint
- ***Covering constraints***: Does every Employees entity have to be either an Hourly_Emps or a Contract_Emps entity?
  - *Yes:* covering constraint
  - *No:* no covering constraint

Today's Lecture

- Advanced ER diagram:
  - Hierarchy
  - Aggregation
  - Design Issues of ER diagram

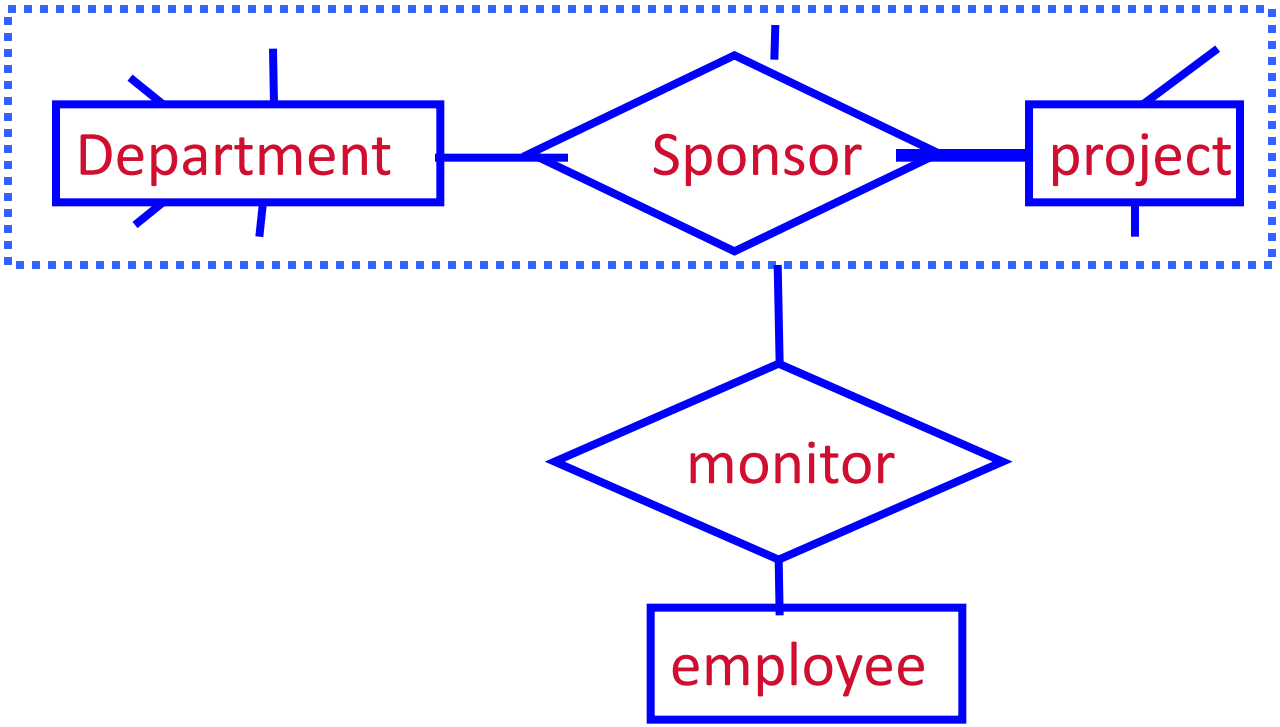
Aggregation: Motivation Example

- **How to model relationships between relationships?**
  - E.g.: Associate project monitor officers with *sponsor* relationship set



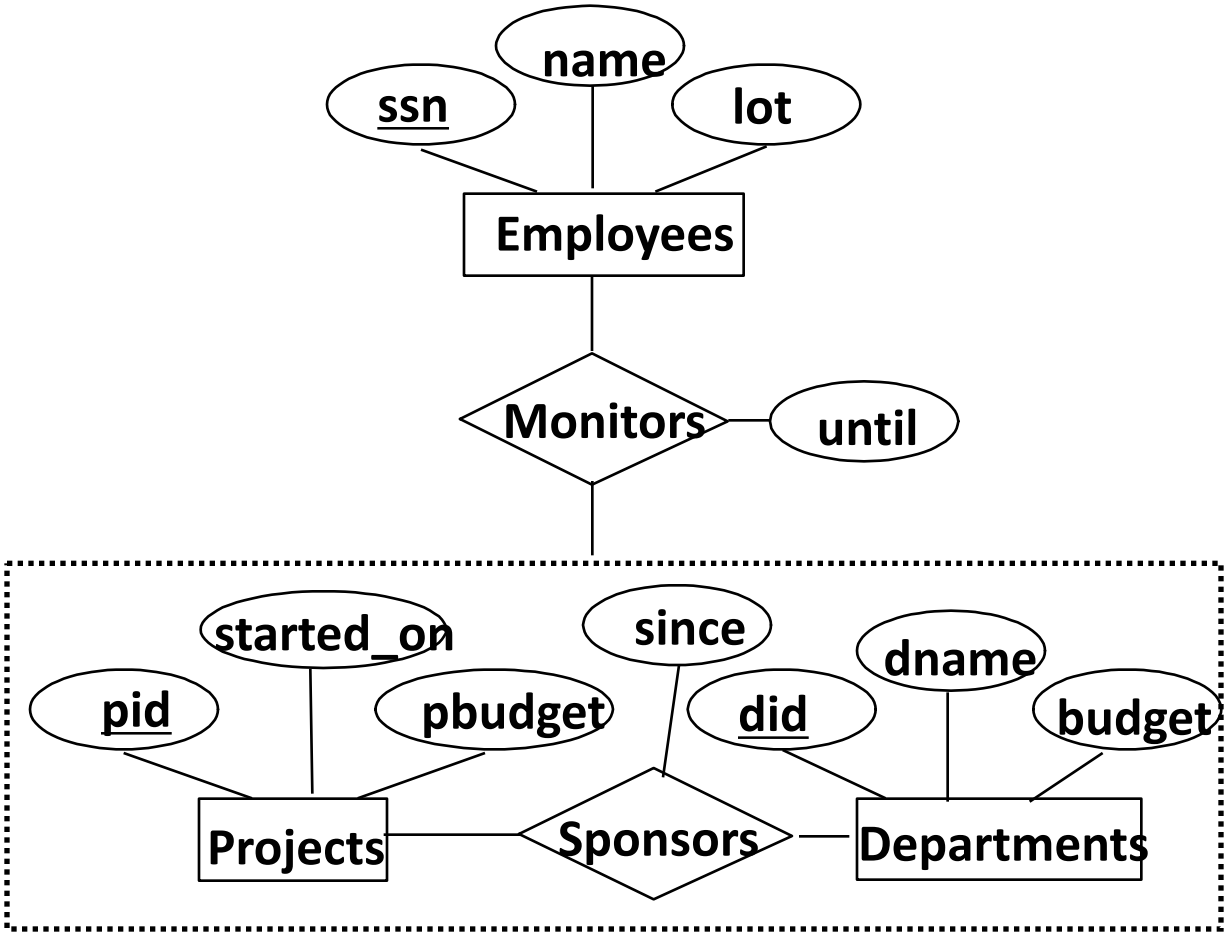
Aggregation

- **Solution: Aggregation**
  - Used to model a relationship involving a relationship set.



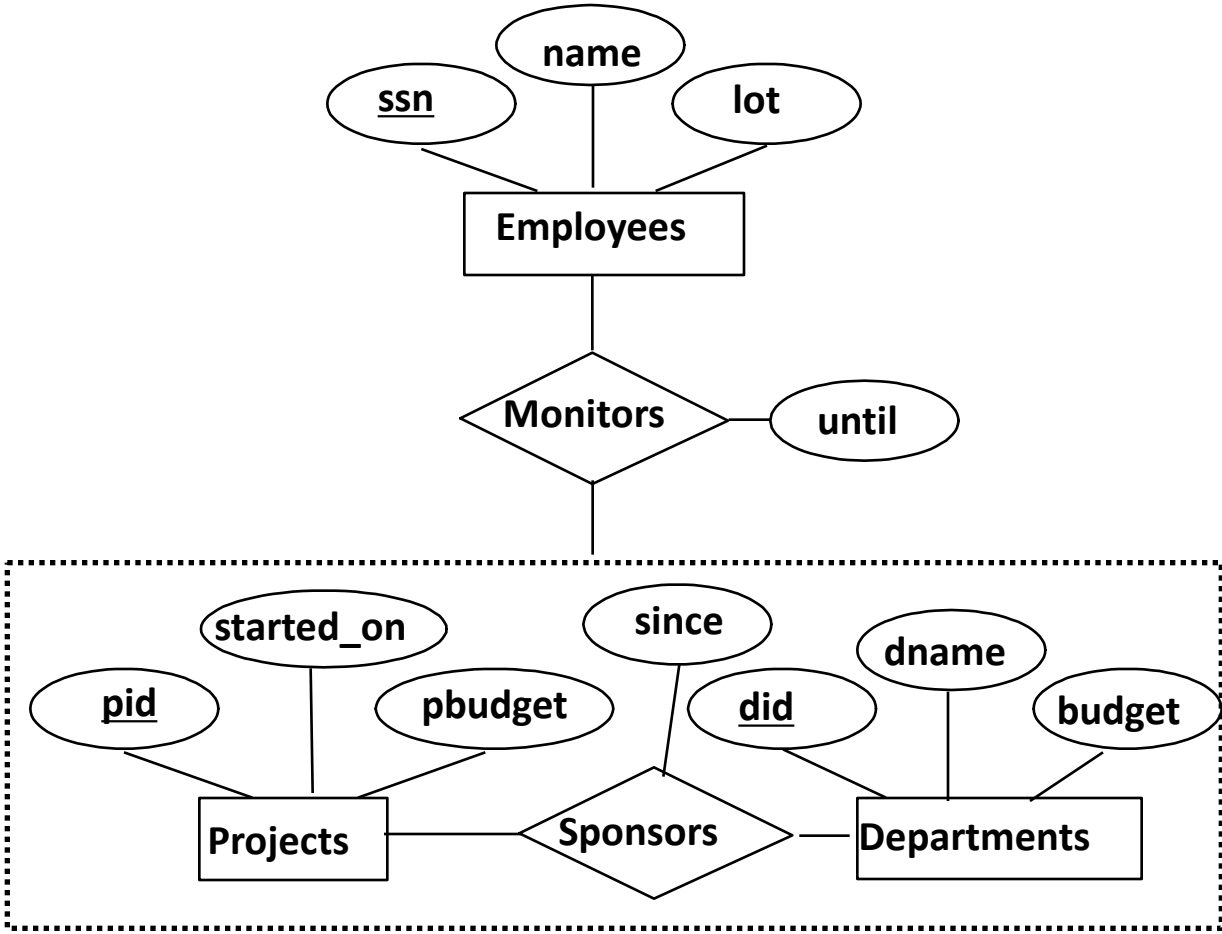
Aggregation

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



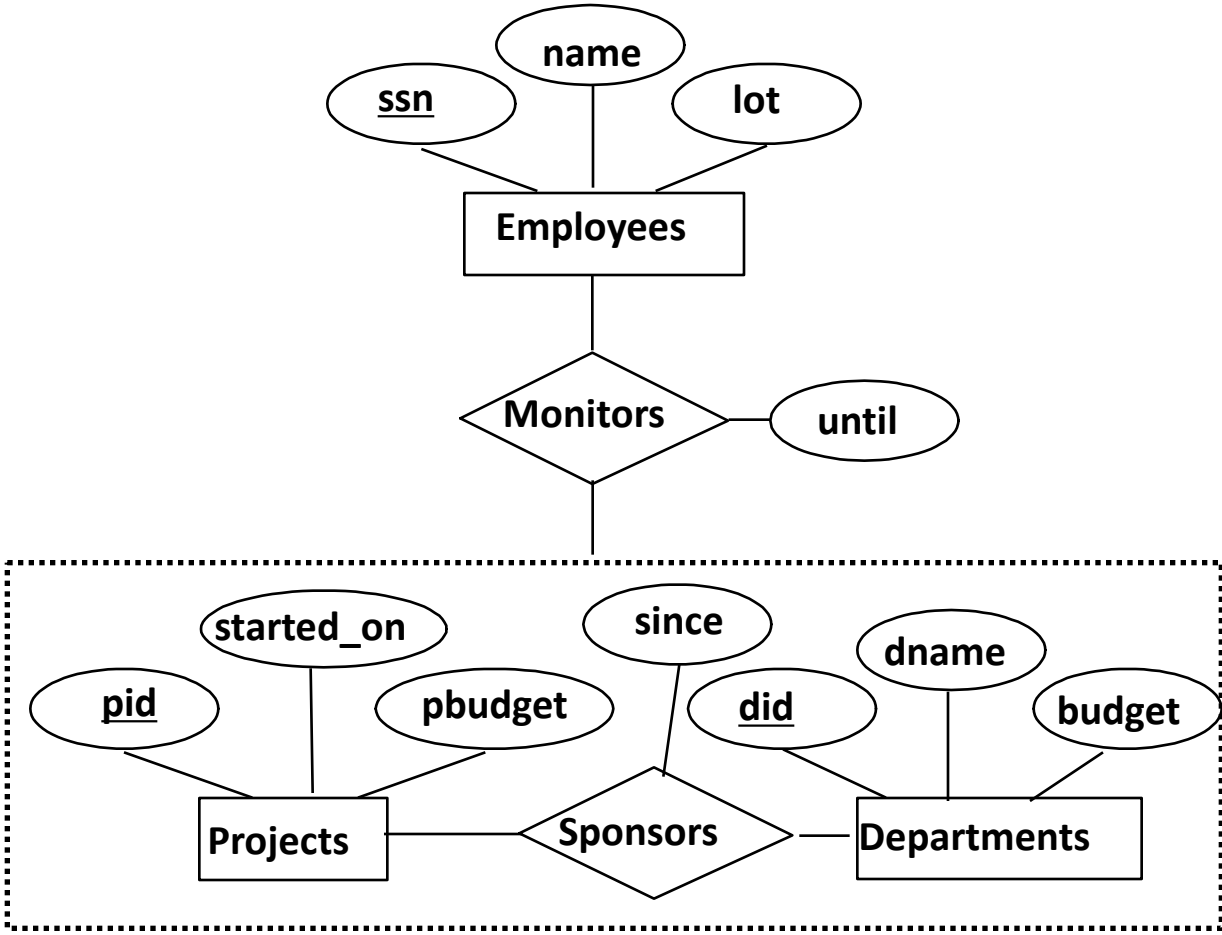
Aggregation vs. Ternary Relationship?

- *Can we merge Monitors and Sponsors relationships?*



Aggregation vs. Ternary Relationship?

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

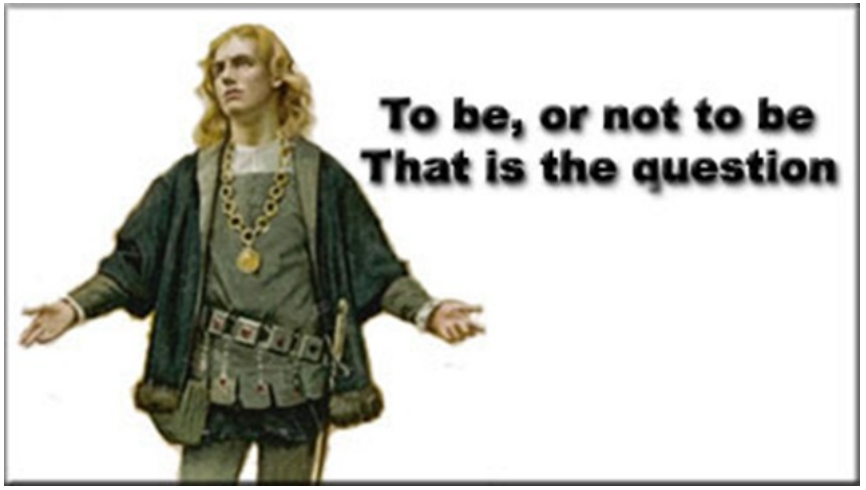


Today's lecture

- **Advanced ER diagram:**
  - Hierarchy
  - Aggregation
  - Design Issues of ER diagram

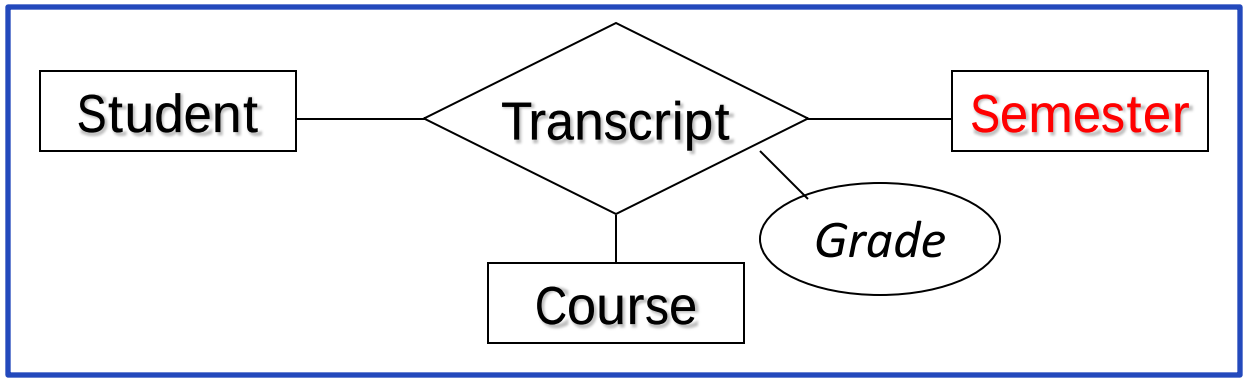
Conceptual Design Using the ER Model

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



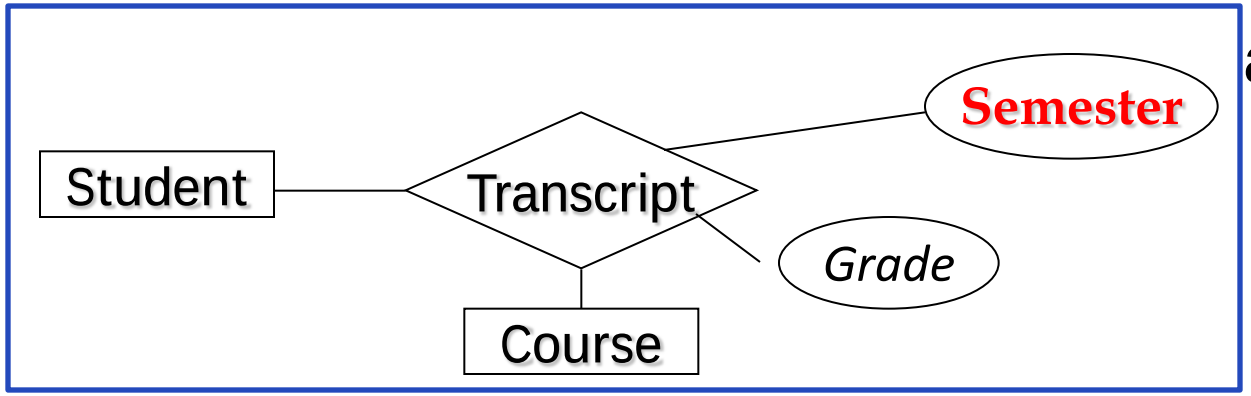
Design Issue #1: Entity vs. Attributes

- **Sometimes information can be represented as either an entity or an attribute.**



Schema 1

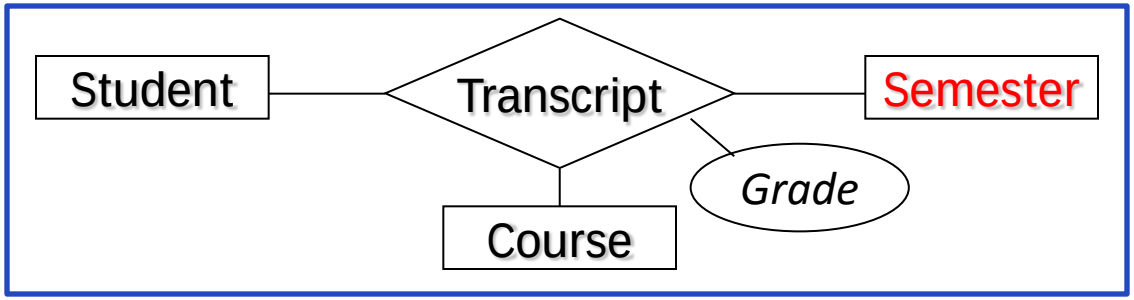
Should *Semester* be: an attribute, or an entity?



Schema 2

Design Issue #1: Entity vs. Attributes

- **Rule 1: If the concept allows multiple values, it must be designed as an entity**
  - Why? Because the attributes cannot be set-valued.
  - E.g., if the students can take the same course in different semesters, *semester* must be an entity



- **E.x.**
  - What about address for the *student* entity?
  - What about name for the *student* entity?

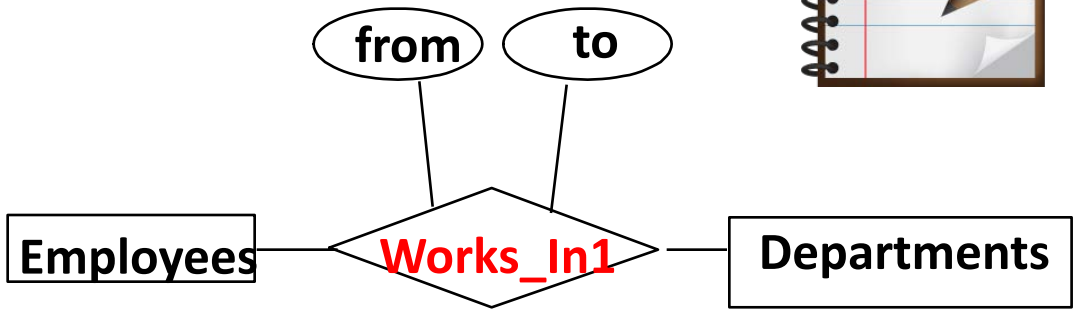
Design Issue #1: Entity vs. Attributes (Cont.)

- **Rule 2: If the concept allows structure (sub-concepts), it must be designed as an entity**
  - Why? Because attribute values are atomic.
  - E.g., if structure (enrollment, holidays, etc.) of *semester* is important, *semester* must be modeled as an entity.

- **E.x.**
  - What about address for the *student* entity?
  - What about name for the *student* entity?

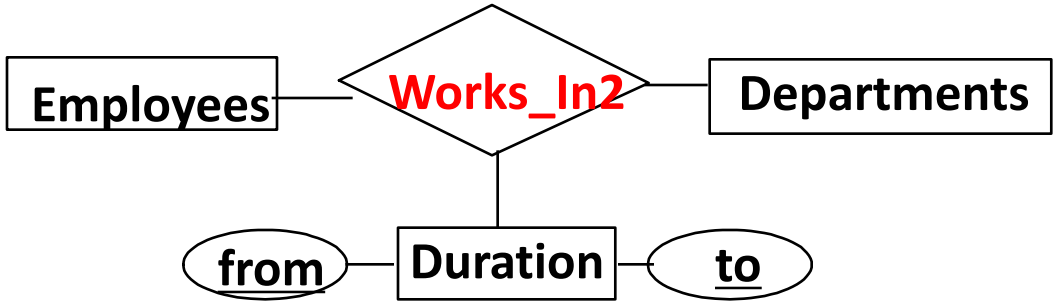
Exercise 1

- **Fact:** an employee can work in the same department for two or more different periods.



Schema 1

- **Question:** Which schema is correct?



Schema 2