

Database Design using ER Model—Part 2

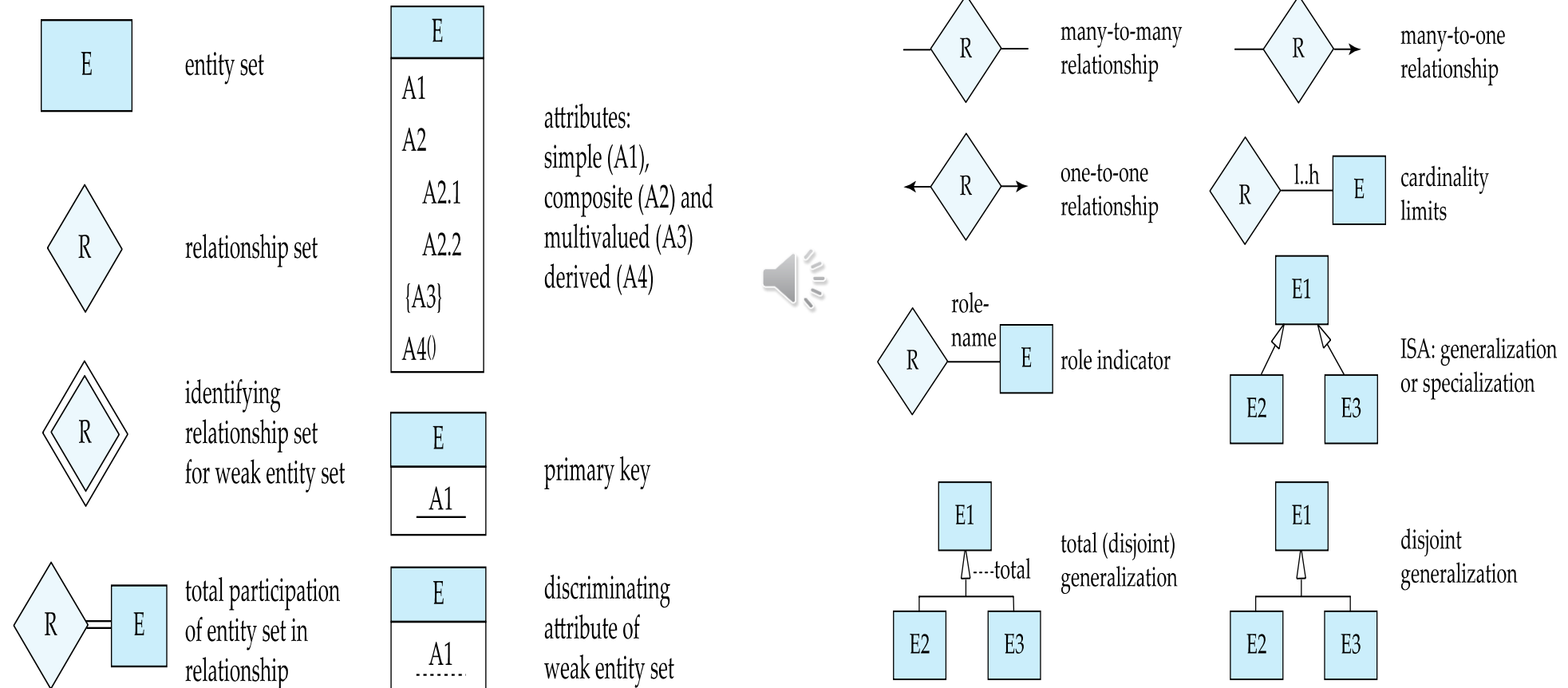


ER Diagrams

- Can express the overall logical structure of a database graphically.

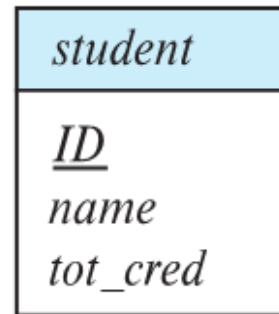
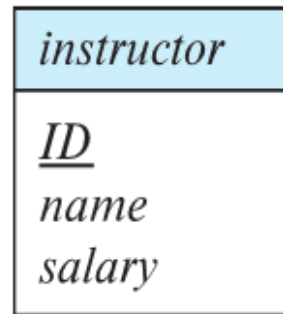


Symbols Used in E-R Notation

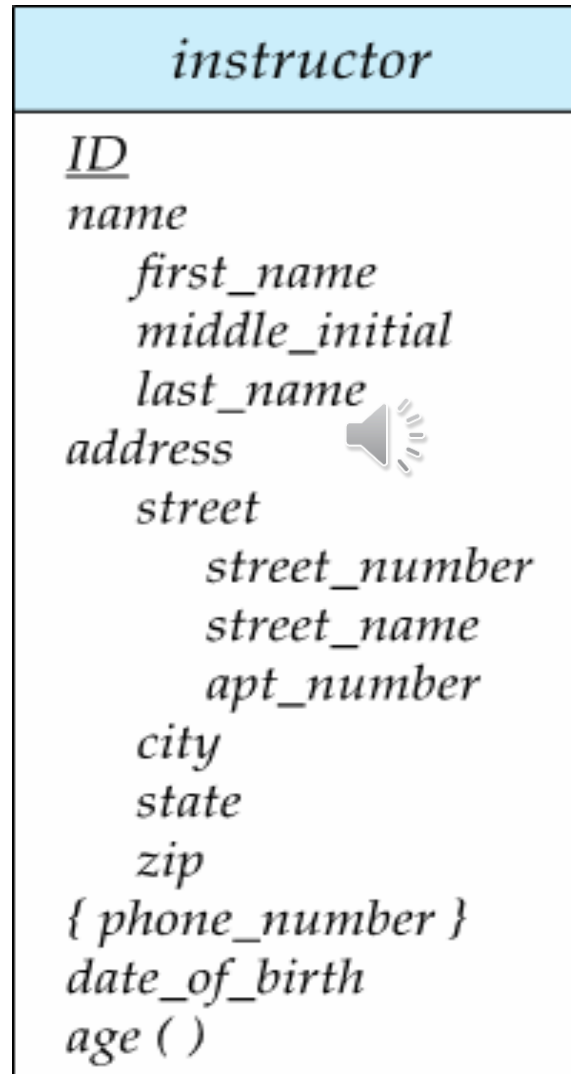


Representing Entity sets in ER Diagram

- Entity sets can be represented graphically as follows:
 - Rectangles represent entity sets.
 - Attributes listed inside entity rectangle
 - Underline indicates primary key attributes

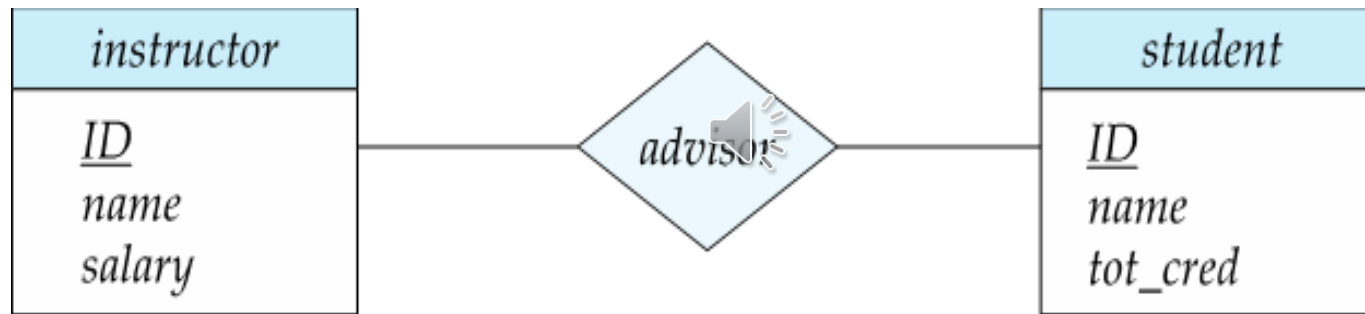


Representing Complex Attributes in ER Diagram

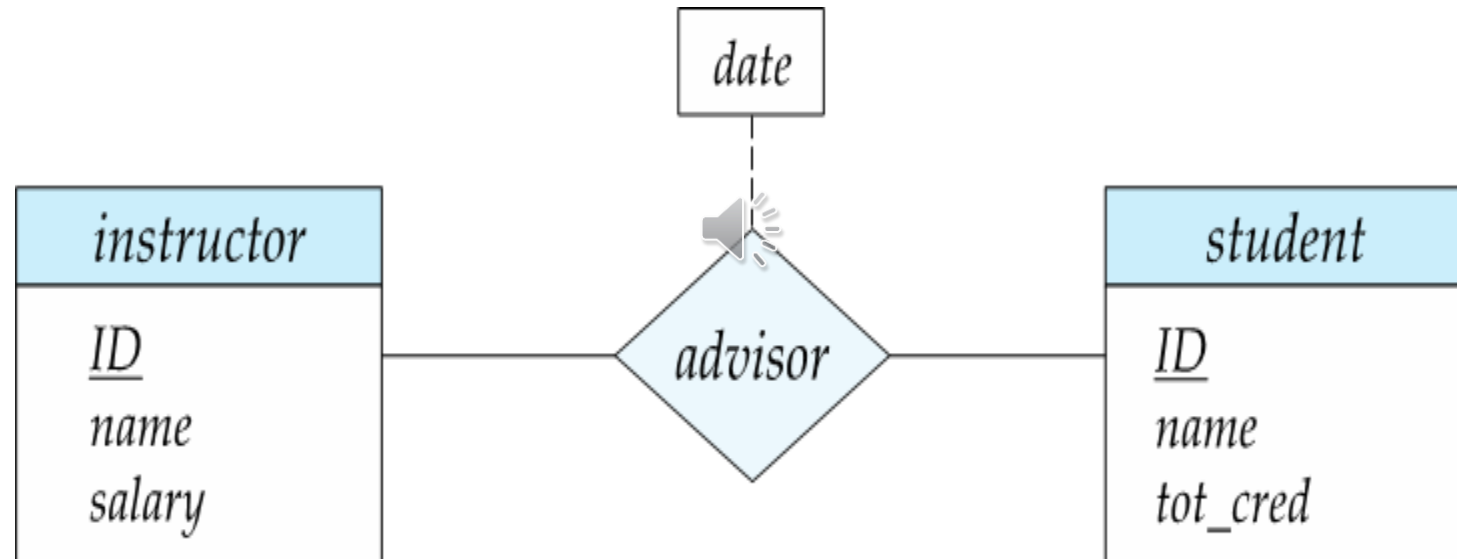


Representing Relationship Sets via ER Diagrams

- Diamonds represent relationship sets.

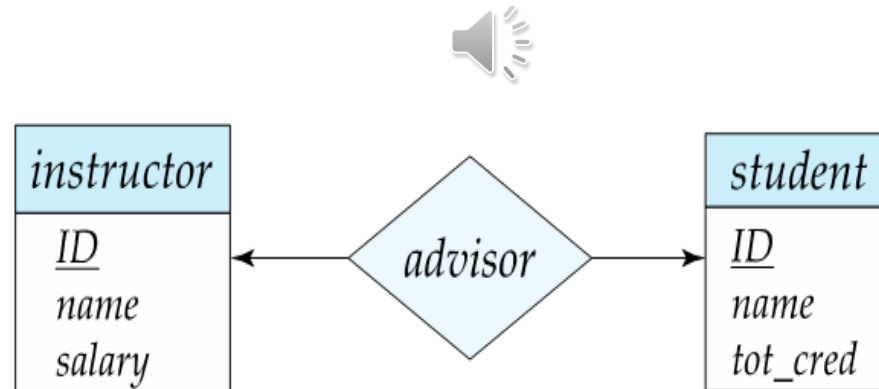


Relationship Sets with Attributes



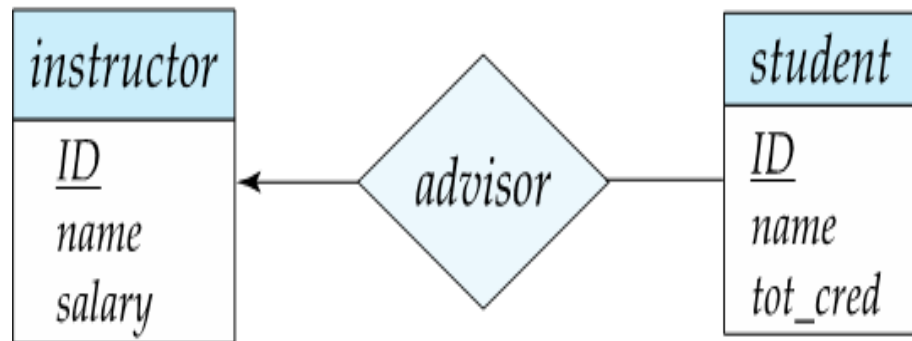
Representing Cardinality Constraints in ER Diagram

- We express cardinality constraints by drawing either a directed line (\rightarrow), signifying “one,” or an undirected line (—), signifying “many,” between the relationship set and the entity set.
- One-to-one relationship between an *instructor* and a *student* :
 - A student is associated with at most one *instructor* via the relationship *advisor*



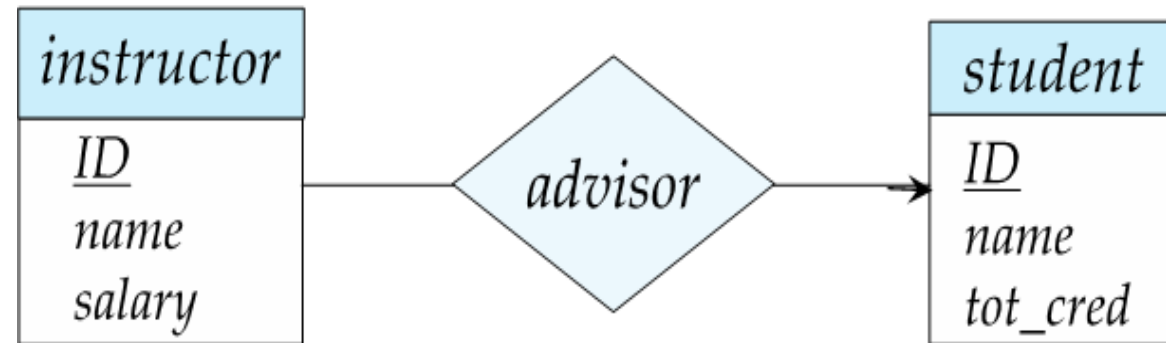
One-to-Many Relationship

- one-to-many relationship between an *instructor* and a *student*
 - an instructor is associated with several (including 0) students via *advisor*
 - a student is associated with at most one instructor via *advisor*,



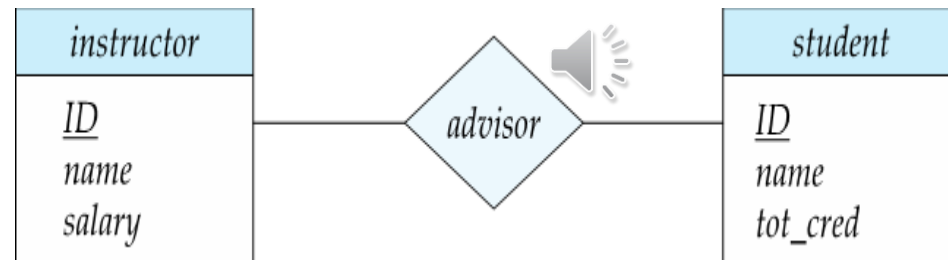
Many-to-One Relationships

- In a many-to-one relationship between an *instructor* and a *student*,
 - an instructor is associated with at most one student via *advisor*,
 - and a student is associated with several (including 0) instructors via *advisor*



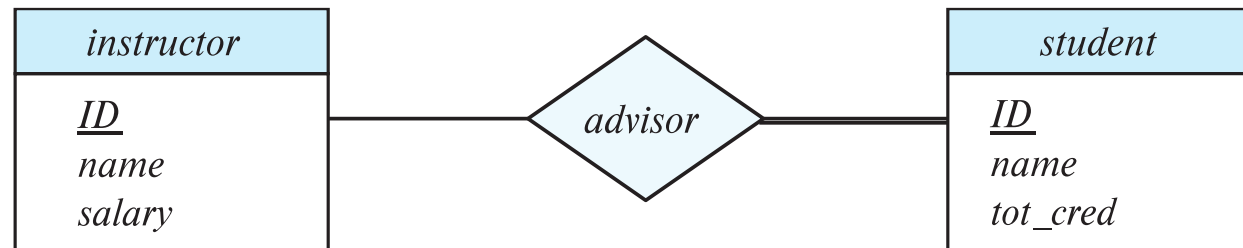
Many-to-Many Relationship

- An instructor is associated with several (possibly 0) students via *advisor*
- A student is associated with several (possibly 0) instructors via *advisor*



Total and Partial Participation

- **Total participation** (indicated by double line): every entity in the entity set participates in at least one relationship in the relationship set
- **Partial participation**: some entities may not participate in any relationship in the relationship set



Notation for Expressing More Complex Constraints

- A line may have an associated minimum and maximum cardinality, shown in the form $l..h$, where l is the minimum and h the maximum cardinality
 - A minimum value of 1 indicates total participation.
 - A maximum value of 1 indicates that the entity participates in at most one relationship
- A maximum value of * indicates no limit.

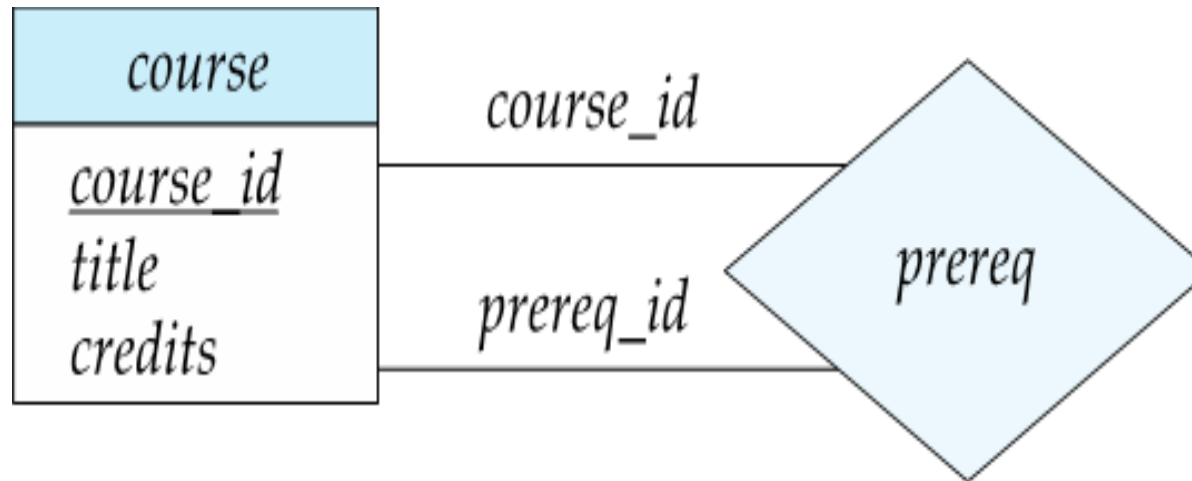
- Example



- Instructor can advise 0 or more students. A student must have 1 advisor; cannot have multiple advisors

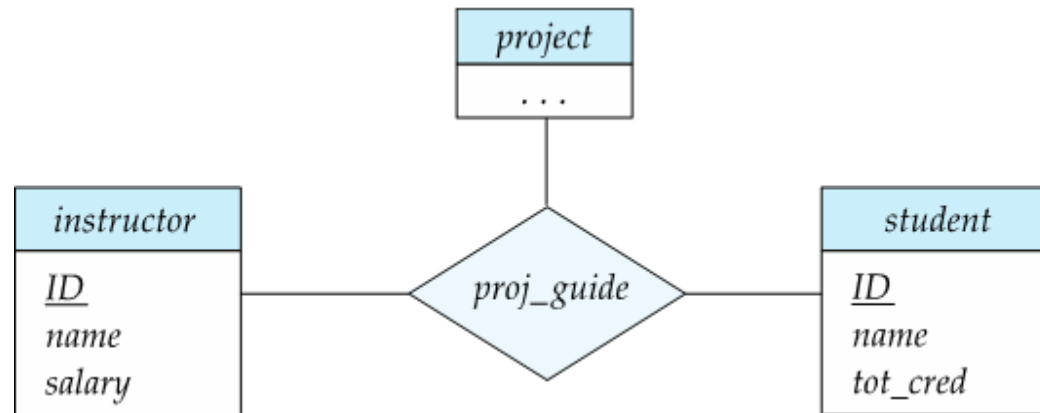
Roles

- Entity sets of a relationship need not be distinct
- Each occurrence of an entity set plays a “role” in the relationship
- The labels “*course_id*” and “*prereq_id*” are called **roles**.



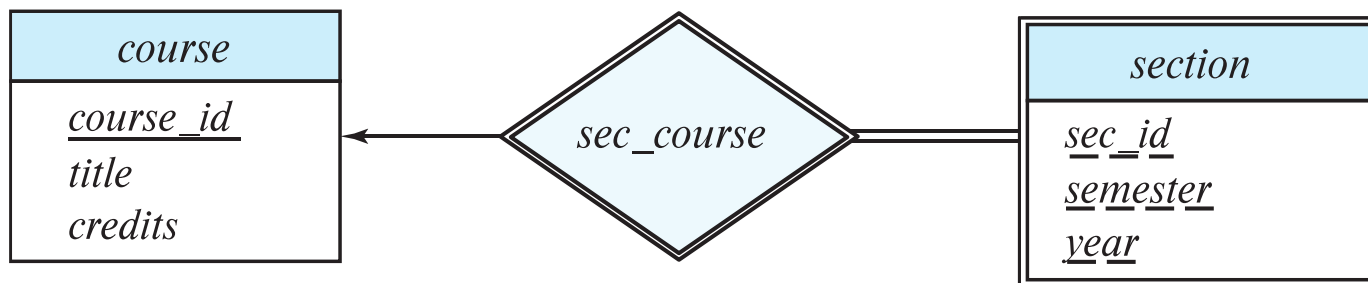
Non-binary Relationship Sets

- Most relationship sets are binary
- There are occasions when it is more convenient to represent relationships as non-binary.
- E-R Diagram with a Ternary Relationship



Expressing Weak Entity Sets

- In E-R diagrams, a weak entity set is depicted via a double rectangle.
- We underline the discriminator of a weak entity set with a dashed line.
- The relationship set connecting the weak entity set to the identifying strong entity set is depicted by a double diamond.
- Primary key for *section* – (*course_id*, *sec_id*, *semester*, *year*)



Database Design for a University Organization

- The university is organized into departments. Each department is identified by a unique name (*dept name*), is located in a particular *building*, and has a *budget*.
- Each department has a list of courses it offers. Each course has associated with it a *course id*, *title*, *dept name*, and *credits*, and may also have associated *prerequisites*.
- Instructors are identified by their unique *ID*. Each instructor has *name*, associated department (*dept name*), and *salary*.
- Students are identified by their unique *ID*. Each student has a *name*, an associated major department (*dept name*), and *tot cred* (total credit hours the student earned thus far).
- The university maintains a list of classrooms, specifying the name of the *building*, *room number*, and room *capacity*.
- The university maintains a list of all classes (sections) taught. Each section is identified by a *course id*, *sec id*, *year*, and *semester*, and has associated with it a *semester*, *year*, *building*, *room number*, and *time slot id* (the time slot when the class meets).
- The department has a list of teaching assignments specifying, for each instructor, the sections the instructor is teaching.
- The university has a list of all student course registrations, specifying, for each student, the courses and the associated sections that the student has taken (registered for).
- In our university database, we have a constraint that each instructor must have exactly one associated department.

E-R Diagram for a University Enterprise

