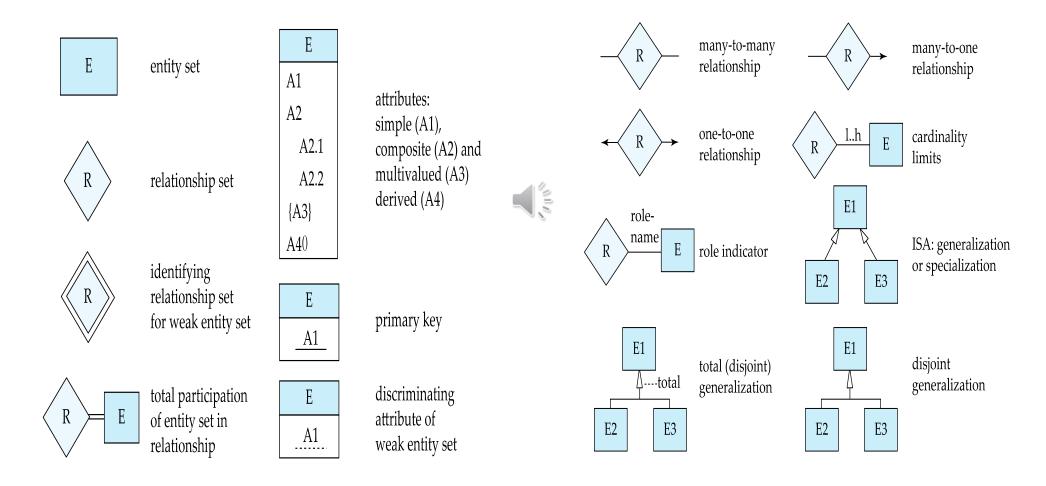
Database Design using ER Model—Part 2

ER Diagrams

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



Symbols Used in E-R Notation

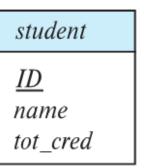


Representing Entity sets in ER Diagram

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

instructor

<u>ID</u>
name
salary



Representing Complex Attributes in ER Diagram

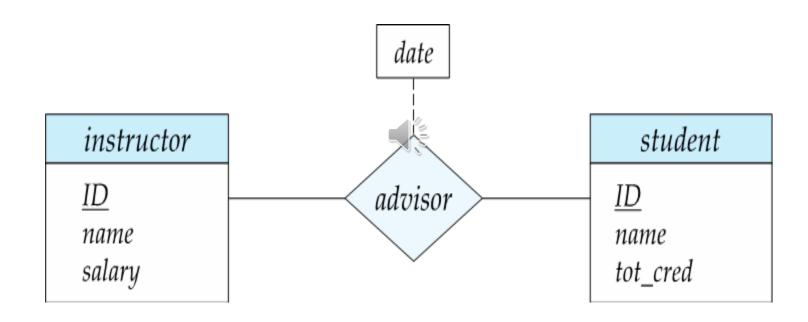
```
instructor
\underline{ID}
name
   first_name
   middle_initial
   last_name
address
   street
      street_number
      street_name
      apt_number
   city
   state
   zip
{ phone_number }
date_of_birth
age()
```

Representing Relationship Sets via ER Diagrams

• Diamonds represent relationship sets.

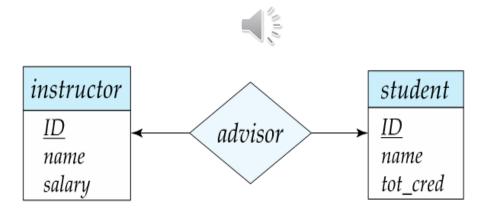


Relationship Sets with Attributes



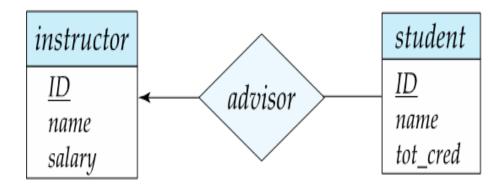
Representing Cardinality Constraints in ER Diagram

- We express cardinality constraints by drawing either a directed line (->), 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*



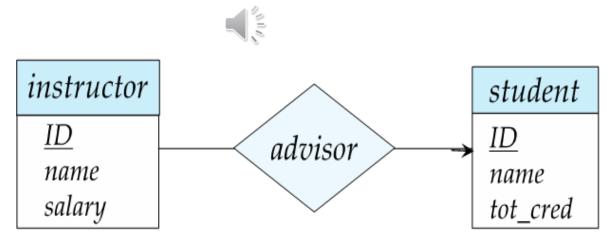
One-to-Many Relationship

- 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 approst 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



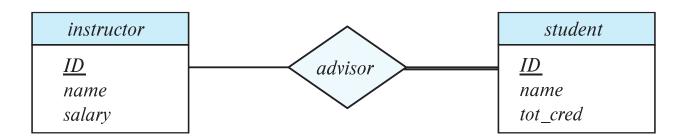
Many-to-Many Relationship

- 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.

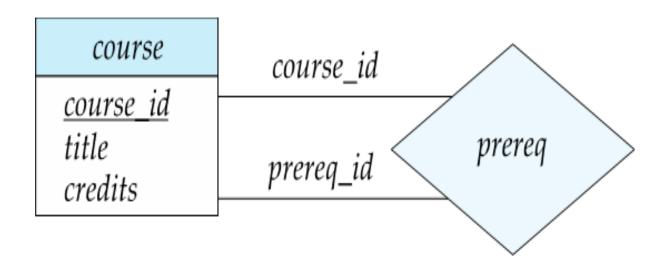
• Example



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

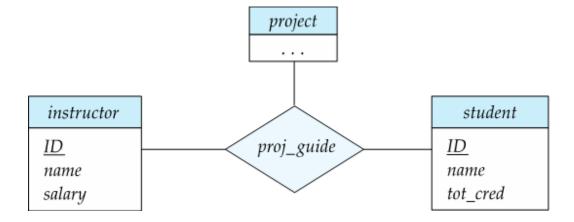
Roles

- 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 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

