UCLA

CS143
Entity-Relationship Model

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Entity-Relationship (E/R) Model

- Q: How should we design tables in our database?
  - Tables are not “given”
  - “Good” tables may not be easy to come up with
- E/R model: graphical, intuitive and “informal” representation of information on database
  - Used to “capture” what we learn from domain experts/database users
  - Not directly implemented by DBMS
  - Tools exists to automatically convert E/R model into tables
- Two main components
  - Entity sets and relationship sets

Entity Set

- Entity: “thing” or “object” in real world
  - E.g., I, this book, UCLA
- Entity set: a set of entities (objects). Like a class in OOP
  - Rectangle in ER
  - Consists of “name” and “attributes”

Students
sid
name
addr
age
GPA

Classes
dept
cnum
sec
title
unit

Faculty
name
title
office
email

Entity Set

- Entities with attributes can be thought as “tuples” (or records)
  - (301, John, 13 Hilgard, 18, 3.3), (303, James, 12 De Neve, 19, 2.5), …
- Key: a set of attributes that uniquely identifies an entity in an entity set
  - Underline in E/R
  - ***All entity sets*** in E/R need a key

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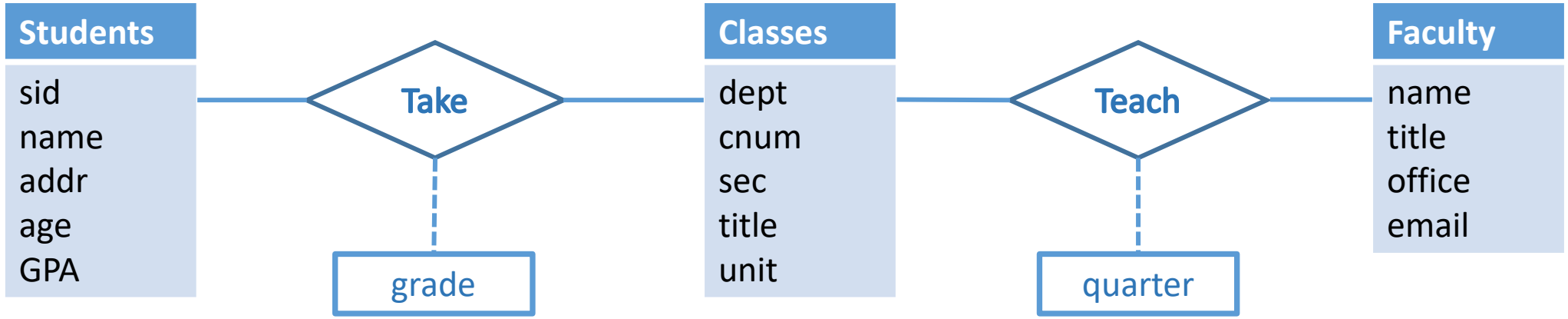
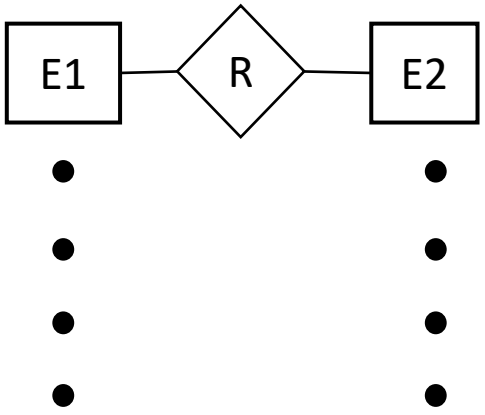
Relationship Set

- Relationship: “connection” between entities
- Relationship set: a set of relations of the same kind
  - Diamond in ER
  - Relationships can be thought as “edges” between entities
- Relationships can have attributes
- Not all entities have to participate in a relationship

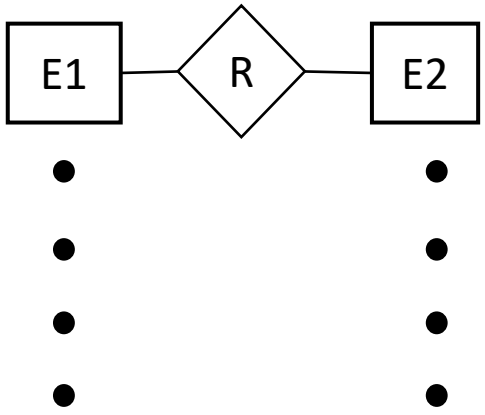


Cardinality of Relationships

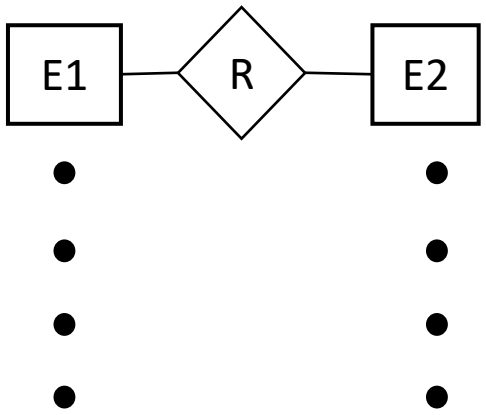
- Cardinality: how many times entities participate in a relationship?
  - One-to-one



  - One-to-many



  - Many-to-many



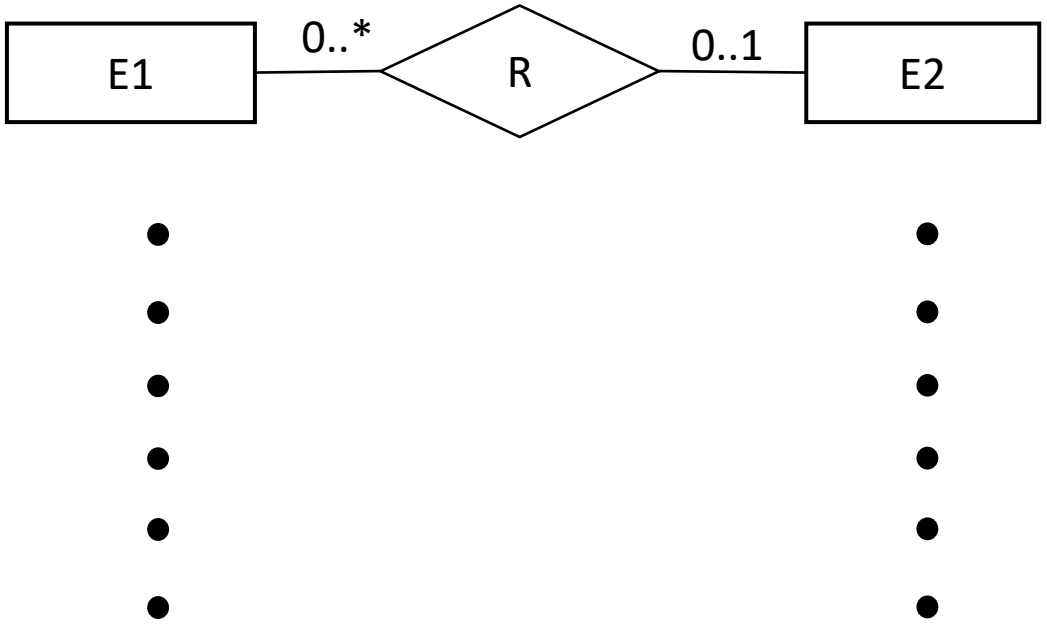
- Cardinality: Add arrow on the “one” side
- Total participation
  - every entity participates in the relationship ***at least once***
  - Double line in E/R model

Meaning of Cardinality

- Q: What does it mean
  - Many-to-one in Teach?
  - One-to-one in Teach?
  - Double-line between Classes and Teach?
  - Double-line and arrow between Teach and Faculty?
  - Double lines at both sides of Teach vs one-to-one of Teach. Are they the same?

General Cardinality Notation

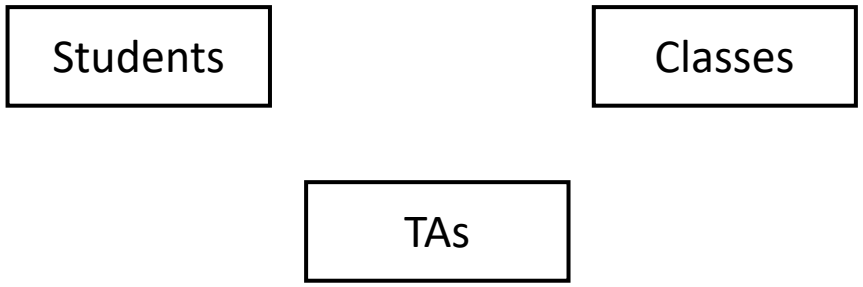
- Label an edge with “a..b”
  - The entity participates in the relationship between a through b times
  - * means unlimited



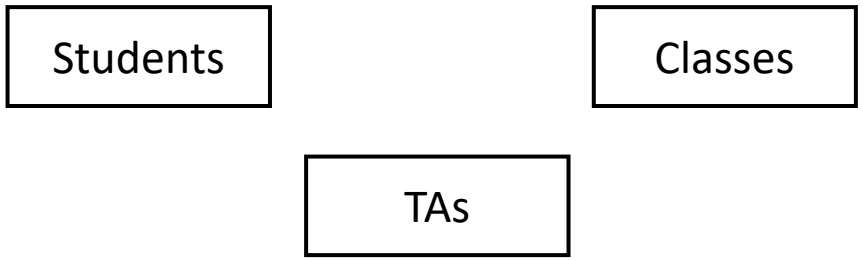
  - Don’t get confused: for one-to-many relationship, “0..*” appears on the “one” side and “0..1” appears on the “many” side

N-ary Relationship

- We may need more than binary relationship sometimes
- Example: Students, TA's, and Classes
  - All TA's help all students

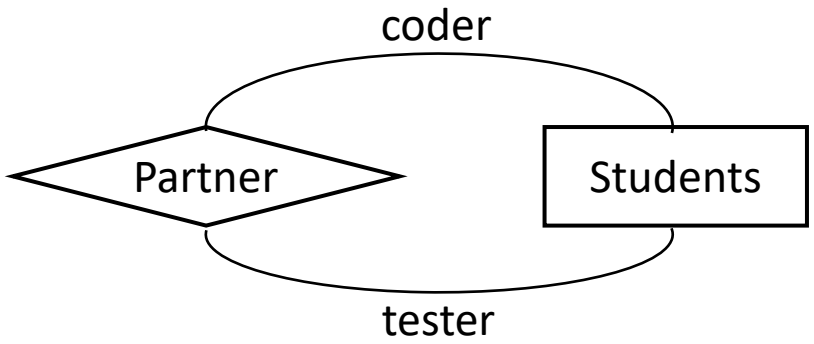


  - Each student is assigned to a particular TA

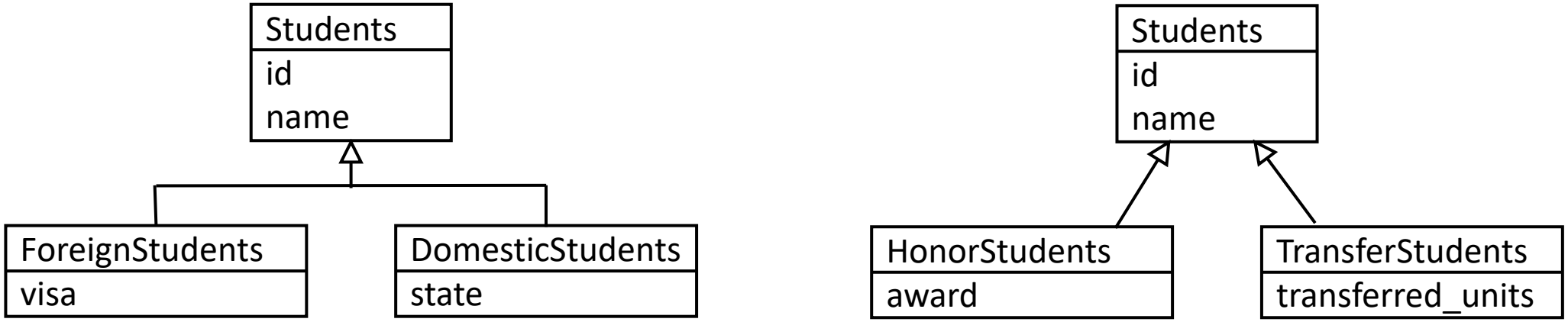


Roles

- We can designate a “role” to each entity set that participate in a relationship set
  - Labels on edges of a relationship in E/R model
  - Useful if an entity set participates more than once in a relationship

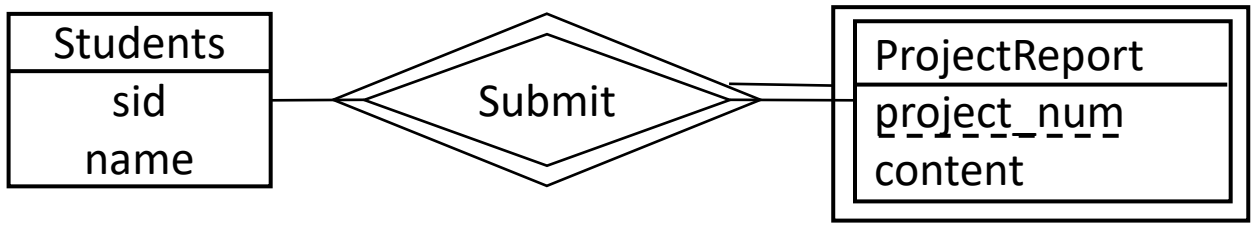


Superclass and Subclass



- ISA relationship in E/R connects superclass and subclass
- Notes
  - Specialization: superclass → subclass, generalization: subclass → superclass
  - Subclass inherits all attributes of its superclass
  - Subclass participates in the relationships of its superclass
  - Subclass may participate in its own relationship
  - Disjoint specialization vs overlapping specialization
    - Either-or vs multiple specialization
    - single hollow arrow vs multiple hallow arrows

Weak Entity Set



- Weak Entity Set: An entity set without a unique key
  - Double rectangle in E/R model
- Part of its key comes from one or more entity sets it is linked to
  - Owner entity set: entity set providing part of the key
  - Identifying relationship: relationship between a weak entity set and owner entity set
    - Double diamond in E/R model
  - Discriminator: attributes in a weak entity set that become part of the key
    - Dashed underline

E/R for Stores and Products

- All products are either “private-label products” (like Kirkland shoes at Costco) or “national-brand products” (like Kleenex Tissue)
- Every product is manufactured by exactly one manufacturer (like 7up by Coke company, etc.)
- Every private-label product is carried by exactly one chain store (eg, Kirkland shoes by Costco)
- Some national-brand products may not be carried by any chain store

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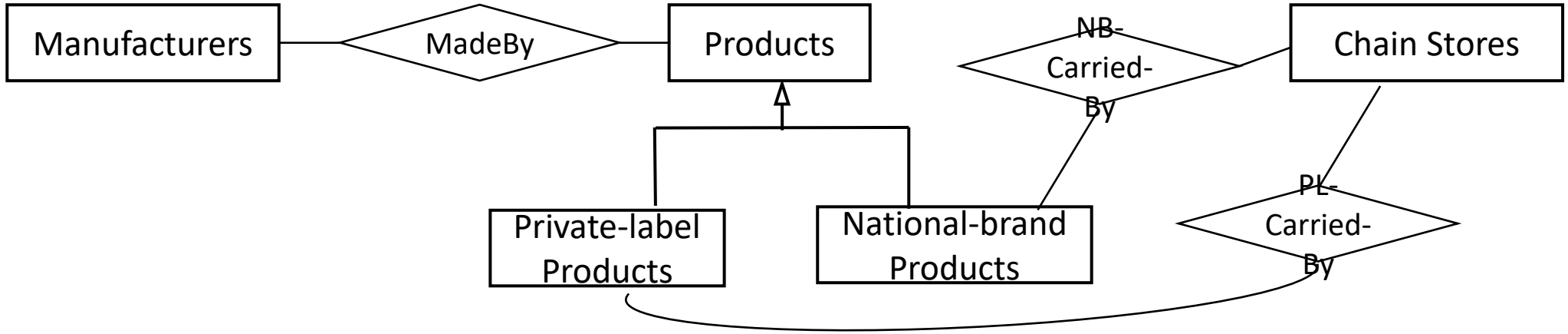
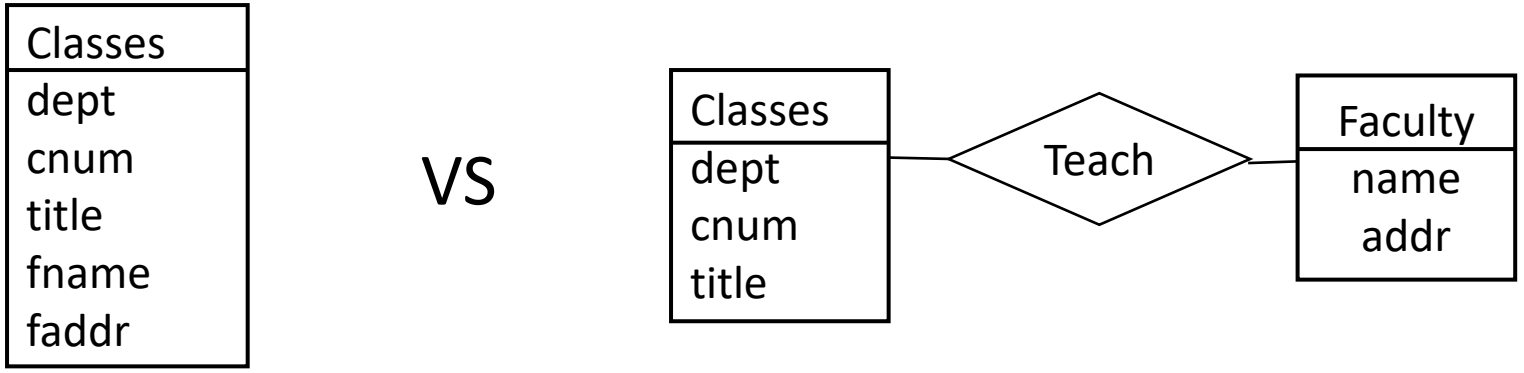


E/R Design Principles

- Often it is not clear what choices to make
  - One gigantic entity set with many attributes vs many smaller entity sets?
  - Attribute vs Entity set?
- General rule of thumb for good design: avoid redundancy
  - Saying the same thing more than once
  - Space waste and potential inconsistency

E/R Design Example

- Faculty(name, addr) are instructors of Class(dept, cnum, title)

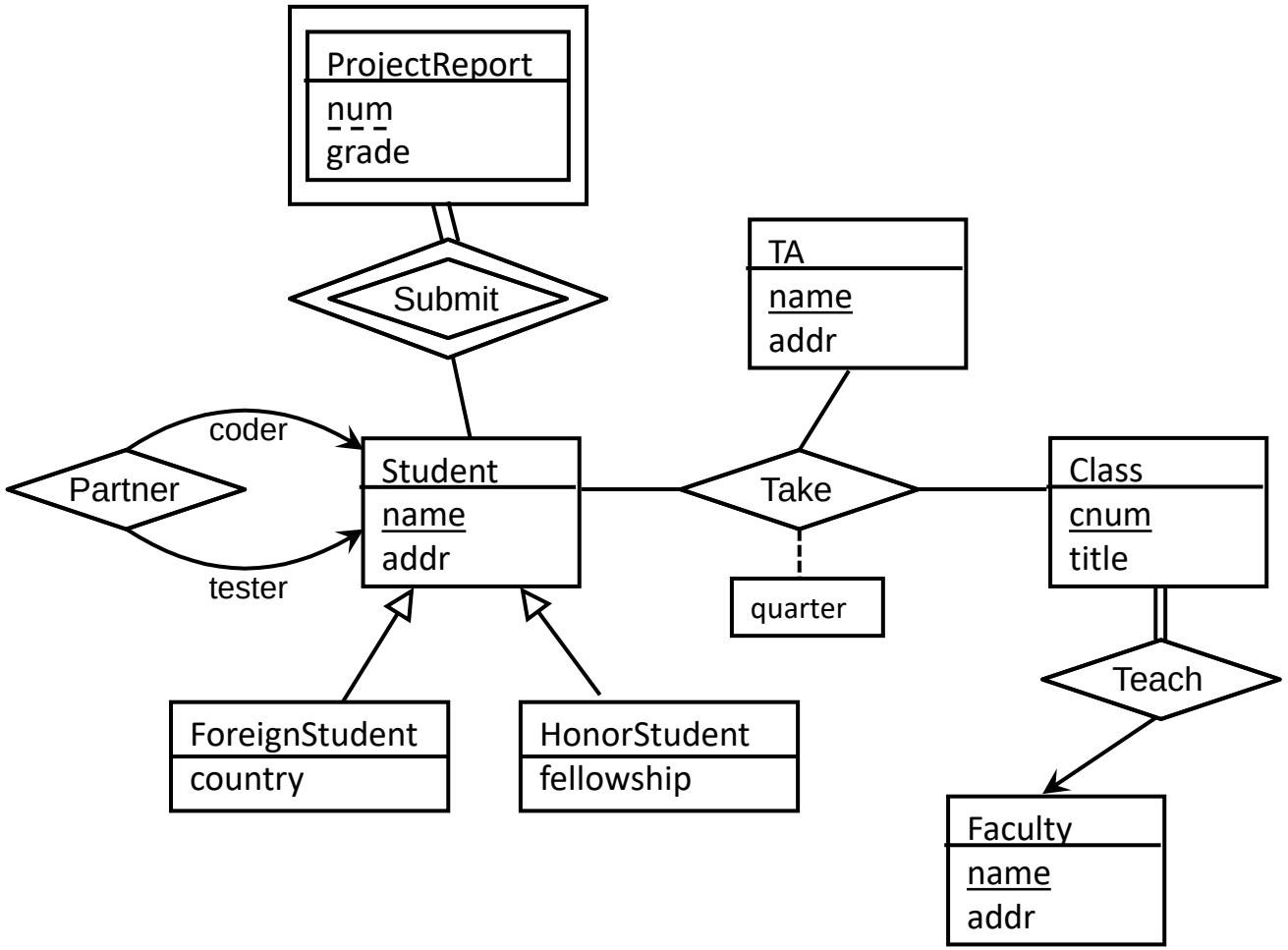


- Things to consider for entity set vs attribute
  - Do we need more attributes than keys?
  - Is it one-to-one relationship?
    - Create multiple entity sets for many-to-many or many-to-one relationships

E/R to Relation

- Converting E/R diagram to tables is mostly straightforward
  - Automatic conversion tools exists
- (Strong) entity set: one table with all attributes

Example Conversion from E/R to Relation



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  - If attribute names conflict, prefix them with entity set name

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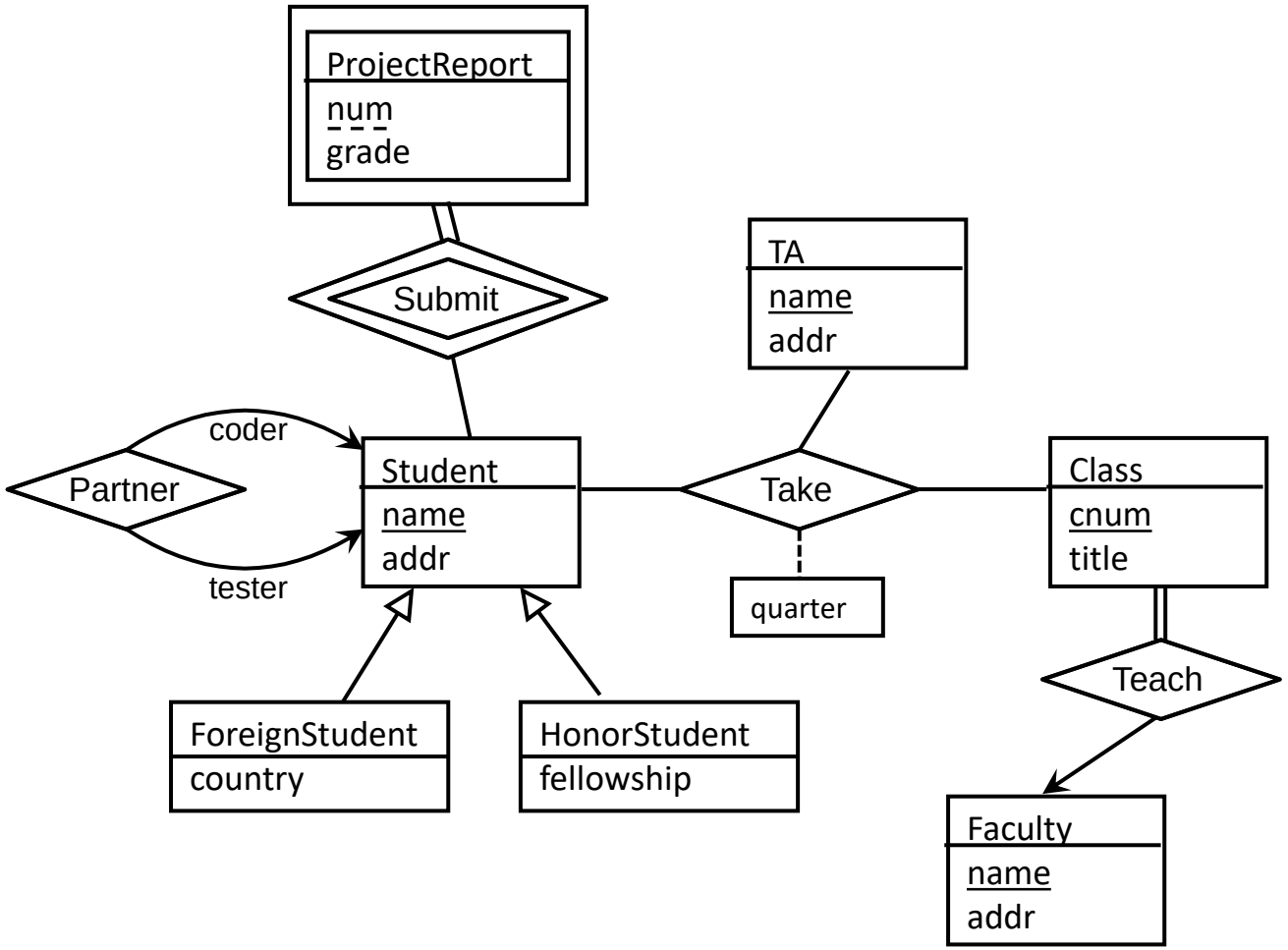

- Student(name, addr)
  Class(cnum, title)
  TA(name, addr)
  Faculty(name, addr)

E/R to Relation

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- (Strong) entity set: one table with all attributes
- Relationship set: one table with keys from the linked entity sets and its own attributes
  - If attribute names conflict, prefix them with entity set name
- Weak entity set: one table with its own attributes and keys from owner entity set
  - No table for identifying relationship set

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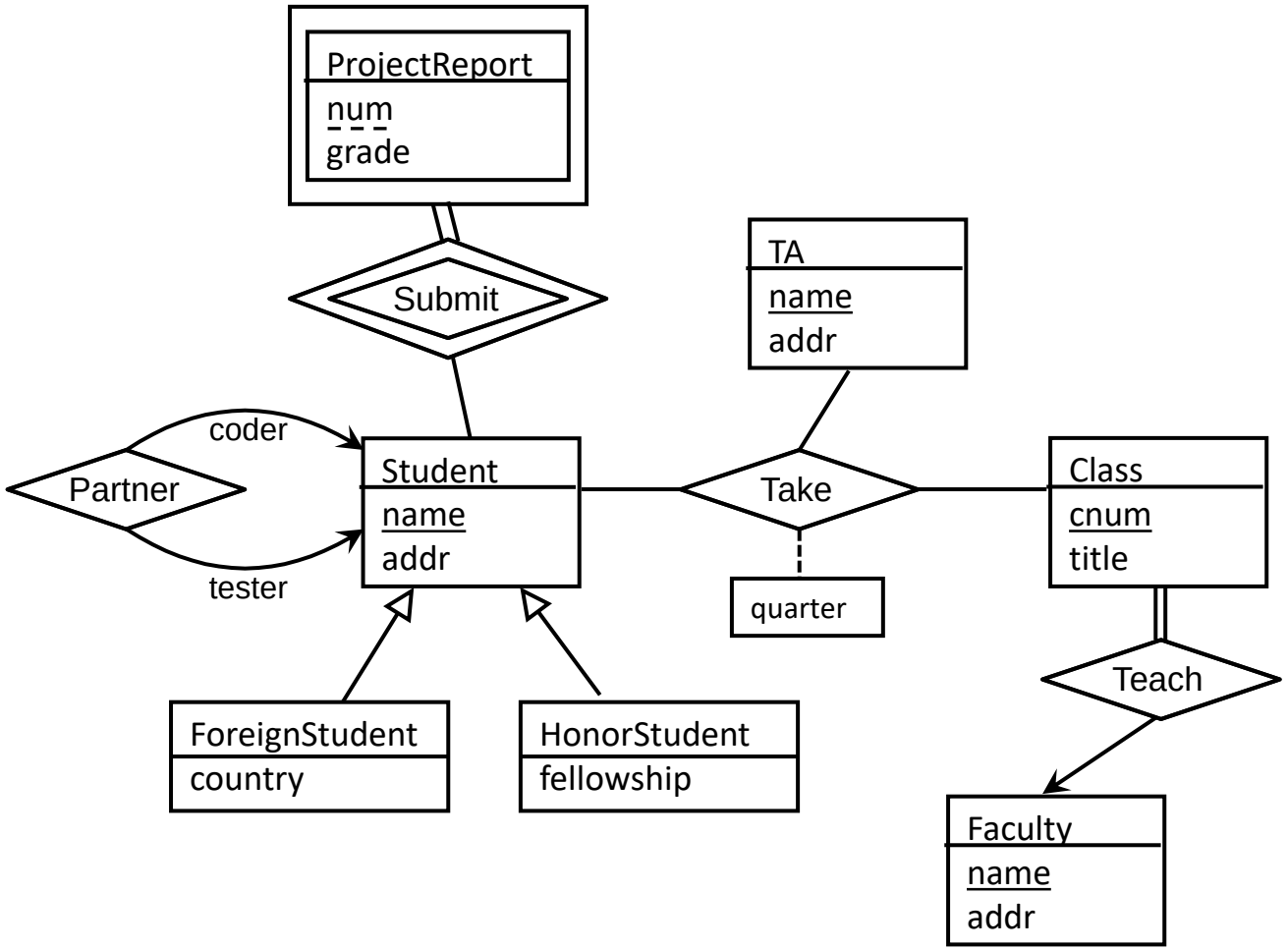

- Student(name, addr)
  Class(cnum, title)
  TA(name, addr)
  Faculty(name, addr)
- Teach(name, cnum)
  Take(Student.name, cnum,
  TA.name, quarter)
  Partner(coder, tester)

Conversion of Subclass(es)

- Two popular approaches
  1. One table for each subclass with its own attributes and the key of its superclass
     - Student(name, addr)
       ForeignStudent(name, country)
       HonorStudent(name, fellowship)
  2. One gigantic table for the super class that includes all attributes
     - Student(name, addr, country, fellowship)
       - NULL values for missing attributes