Relational Database Design
Part II

CPS 116
Introduction to Database Systems

Announcements (September 7)
- Homework #1 assigned today
  - Due on September 19
  - Start early!!
  - Help session next week (to be scheduled via email)
- “Notes” vs. “final” versions of lecture slides
- Handout box outside my office
- Details of the course project and a list of suggested ideas will be available next Tuesday

Database design steps: review
- Understand the real-world domain being modeled
- Specify it using a database design model (e.g., E/R)
- Translate specification to the data model of DBMS (e.g., relational)
- Create DBMS schema
  - Next: translating E/R design to relational schema

E/R model: review
- Entity sets
  - Keys
  - Weak entity sets
- Relationship sets
  - Attributes on relationships
  - Multiplicity
  - Roles
  - Binary versus N-ary relationships
    - Modeling N-ary relationships with weak entity sets and binary relationships
  - ISA relationships

Translating entity sets
- An entity set translates directly to a table
  - Attributes → columns
  - Key attributes → key columns

Translating weak entity sets
- Remember the “borrowed” key attributes
- Watch out for attribute name conflicts

Diagram:
- Student (SID, name)
- Course (CID, title)
- Building (building_name, year)
- Room (building_name, room_number, capacity)
- Seat (building_name, room_number, seat_number, left_or_right)
Translating relationship sets

- A relationship set translates to a table
  - Keys of connected entity sets → columns
  - Attributes of the relationship set (if any) → columns
  - Multiplicity of the relationship set determines the key of the table

More examples

- Students
  - Enroll
  - Courses
    - (SID, CID, grade)

Translating double diamonds

- Recall that a double-diamond relationship set connects a weak entity set to another entity set
- No need to translate because the relationship is implicit in the weak entity set's translation

Rooms
- In
  - Buildings
    - (room_building_name, room_number, building_name)

Translating subclasses & ISA (approach 1)

- Entity-in-all-superclasses approach ("E/R style")
  - An entity is represented in the table for each subclass to which it belongs
  - A table includes only the attributes directly attached to the corresponding entity set, plus the inherited key

Students
- Enroll
- Courses
  - (CID, title)

Translating subclasses & ISA (approach 2)

- Entity-in-most-specific-class approach ("OO style")
  - An entity is only represented in one table (corresponding to the most specific entity set to which the entity belongs)
  - A table includes the attributes attached to the corresponding entity set, plus all inherited attributes

Students
- Enroll
- Courses
  - (CID, title)

Translating subclasses & ISA (approach 3)

- All-entities-in-one-table approach ("NULL style")
  - One relation for the root entity set, with all attributes found anywhere in the network of subclasses
  - Use a special NULL value in columns that are not relevant for a particular entity
Comparison of three approaches

- **Entity-in-all-superclasses**
  - Student (SID, name), GradStudent (SID, office)
  - **Pro:** All students are found in one table
  - **Con:** Attributes of grad students are scattered in different tables

- **Entity-in-most-specific-class**
  - Student (SID, name), GradStudent (SID, office, name, office)
  - **Pro:** All attributes of grad students are found in one table
  - **Con:** Students are scattered in different tables

- **All-entities-in-one-table**
  - Student (SID, name), GradStudent (SID, name, office)
  - **Pro:** All students are found in one table
  - **Con:** Too many NULL’s; complicated if class hierarchy is complex

A complete example

![Diagram showing relationships between entities and tables](image)

An alternative design

![Diagram showing simplified design](image)

Design principles

- **KISS**
  - Keep It Simple, Stupid
- **Avoid redundancy**
  - Redundancy wastes space, complicates updates and deletes, promotes inconsistency
- **Capture essential constraints, but don’t introduce unnecessary restrictions**
- **Use your common sense**
  - Warning: Mechanical translation procedures given in this lecture are no substitute for your own judgment