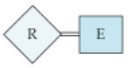
# E-R Model

- **Entity-relationship model**
  - A data model for representing *entities* and *relationships* between them
- **Entities** represent objects in the enterprise
  - Each entity has **attributes** that describe it
  - An **entity set** is a set of entities with the same set of attributes


- **Relationships** represent associations between two or more entities
  - Relationships can also have attributes
  - A **relationship set** is a set of pairs of entities with the same association


- **Mapping cardinalities** tell us how many of one entity can be associated with how many of another entity
  - Many-to-many vs many-to-one vs one-to-many vs one-to-one


- **Participation constraints** tell us how many of the entities in an entity set *must* be involved in a relationship
  - All vs some (total participation vs partial participation)

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# Important Notes About E-R Models

- Entity sets are not relations! (Even though they look like relations in our diagrams.)
- Entity sets do not directly relate to other entity sets
  - Always go through relationship sets
  - (Except for inheritance relationships)
- NO foreign keys
  - Which means no referential integrity
  - Relationship sets tell us everything about how entities sets are related
- NO attribute redundancy
  - An attribute should only appear on one entity set
    - Since there are no foreign keys, there should be no need for an attribute to appear on two entity sets
    - (Attributes like "ID" that appear on both student and instructor are different attributes with the same name—kind of bad design)



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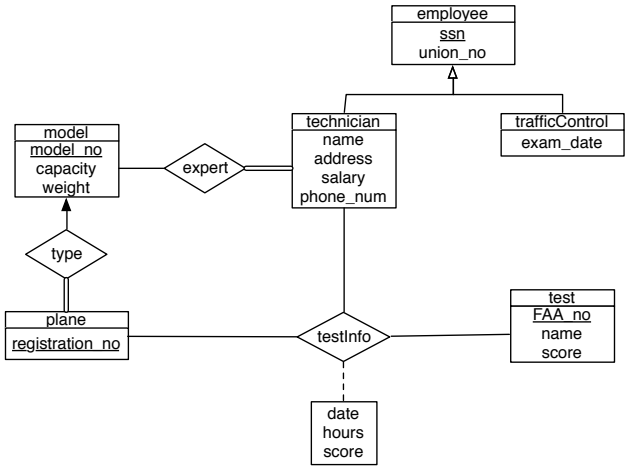
# Airport Requirements

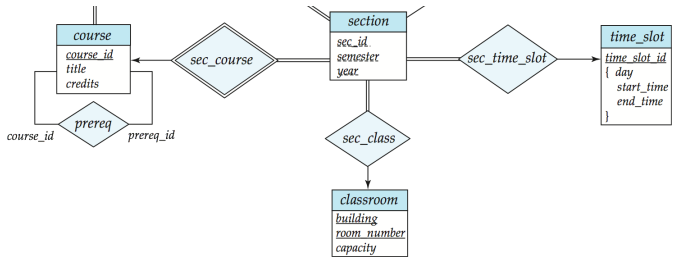
1. Every airplane has a registration number, and each airplane is of a specific model.
2. The airport accommodates a number of airplane models, and each model is identified by a model number (e.g., DC-10) and has a capacity and weight.
3. A number of technicians work at the airport. You need to store the name, SSN, address, phone number, and salary of each technician.
4. Each technician is an expert on one or more plane models, and his or her expertise may overlap with that of other technicians. This information about technicians must also be recorded.
5. Traffic controllers must have an annual medical exam. For each traffic controller, you must store the date of the most recent exam.
6. All airport employees (including technicians) belong to one union. You must store the union membership number of each employee. You can assume that each employee is uniquely identified by a social security number.
7. The airport has a number of tests that are used periodically to ensure that airplanes are still airworthy. Each test has a Federal Aviation Administration (FAA) test number, a name, and a maximum possible score.
8. The FAA requires the airport to keep track of each time a given airplane is tested by a given technician using a given test. For each testing event, the information needed is the date, the number of hours the technician spent doing the test, and the score the airplane received on the test.

# Airport Diagram



# Scheduling Sections

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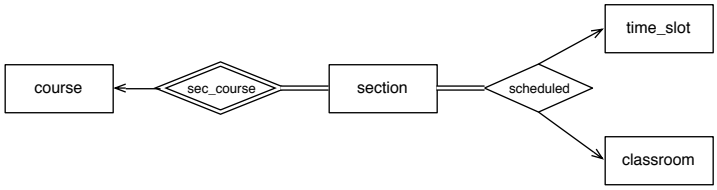
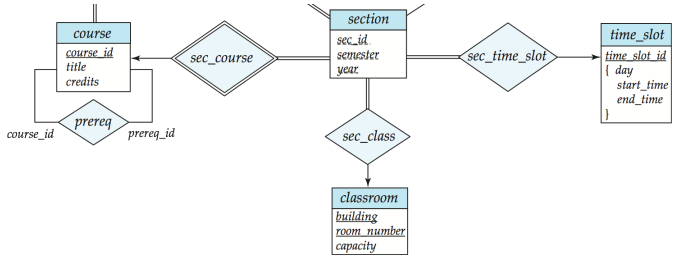


# Scheduling Sections

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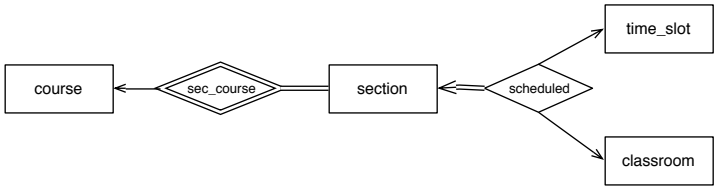


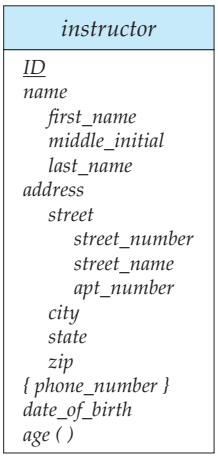
# Students and Advisors

- Let's say we want to be able to accommodate students with multiple majors
- Change to university requirements:
  - Students can have majors in one or more departments
  - Each instructor is an advisor in at most one department
  - Students can have multiple advisors, but no more than one advisor per department
- How would we change our E-R diagram?

# More E-R Model Features

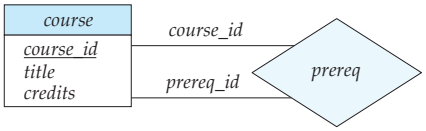
- Complex attributes
- Multivalued attributes
- Derived attributes



# More E-R Model Features

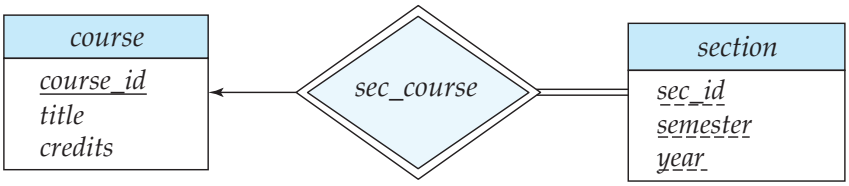
- Roles
  - For when a table has a relationship with itself
  - Used to identify the role the entity plays in each side of the relationship



# More E-R Model Features

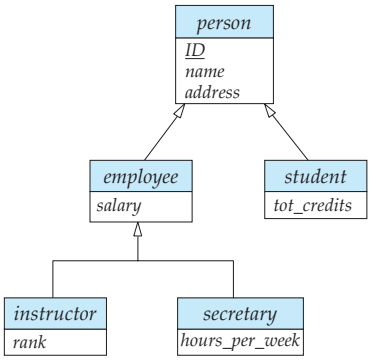
- Weak entity sets
  - An entity set that cannot exist without another entity set
  - Example: sections only make sense when associated with a specific course_id
    - `section` is a weak entity set
    - `course` is its *identifying owner*
      - `section` is *existence dependent* on `course`



# More E-R Model Features

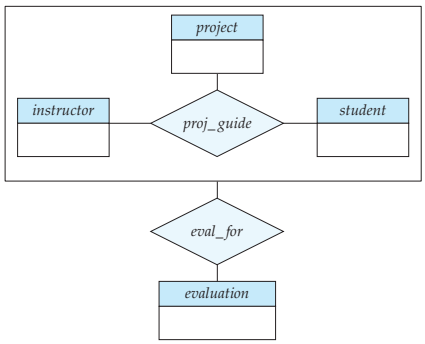
- Specialization/generalization hierarchies & inheritance
  - Employees and students have IDs, names, and addresses
  - Instructor and secretary are *disjoint*—an employee cannot be both
  - Student and employee are *overlapping*—a student can also be an employee



# More E-R Model Features

- Aggregation
  - For relationships between relationship sets
  - Aggregate a relationship set and its entity sets into a *virtual entity set*
  - That virtual entity set can be involved in other relationships



# Summary

- The E-R model is a conceptual model for showing relationships between entities in an enterprise
  - It is meant to help solidify requirements and aid creation of full relational model
  - Also meant to help you think about the data in a different way
- Similar to UML
- Many different notations exist
  - I have shown the book's notation, but other books use different notations