

# **THE ENHANCED ER (EER) MODEL**

**CHAPTER 8 (6/E)**

**CHAPTER 4 (5/E)**

# CHAPTER 8 OUTLINE

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- Extending the ER model
  - Created to design more accurate database schemas
    - Reflect the data properties and constraints more precisely
    - Address more complex requirements
  - Subclasses, Superclasses, and Inheritance
  - Specialization and Generalization
  - Modeling of UNION Types Using Categories

# SPECIALIZATION AND INHERITANCE

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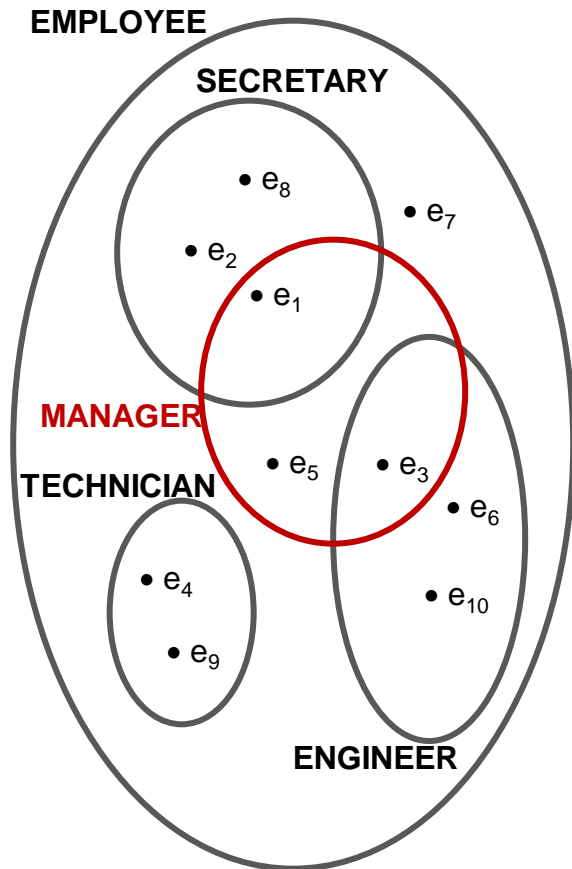
- **Specialization**
  - Process of defining a set of subclasses of an entity type
  - Defined on the basis of some distinguishing characteristic of the entities in the superclass
- Describing the relationship
  - **Superclass/subclass** or **Class/subclass**
  - **Supertype/subtype** or **Type/subtype**
- Subclass can define:
  - Specific attributes
  - Specific relationship types
- Subclass can be a subclass wrt more than one superclass
- **Type inheritance**
  - Subclass entity has all attributes and participates in all relationships of superclass
  - **Multiple inheritance** if more than one superclass

# GENERALIZATION

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- **Generalization**
  - Process of defining a more general entity type from given entity types
- Reverse process of specialization
- Generalize into a single superclass
  - Original entity types are specialized subclasses
  - Entities in generalization must *all* come from subclasses

# SPECIALIZED ENTITIES



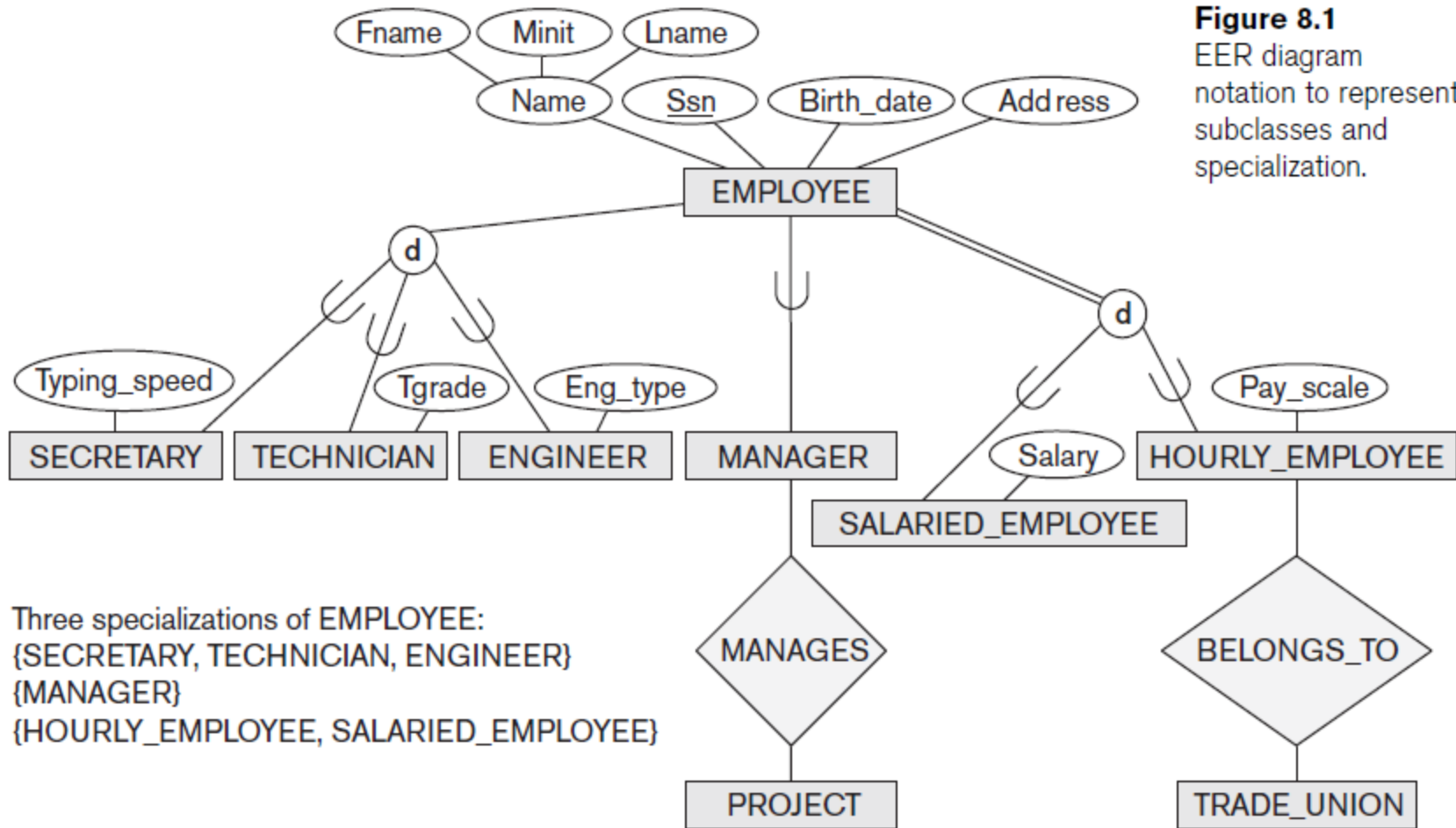
- Every technician/secretary/engineer is an employee.
- Not every employee of superclass must be in a subclass (unless specified as **generalization**).
- All properties of employee (attributes *and* relationships) are inherited by specialized subclasses.
- Specialized entities might have additional attributes and be involved in additional relationships.
- Subclasses may be **disjoint** or **overlapping**.

# CONSTRAINTS ON SUBCLASSES

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- **Disjointness constraint**
  - Specifies that the subclasses of the specialization must be disjoint
- **Completeness constraint**
  - Specifies that every superclass entity must be in a subclass
  - Required of generalization
- Disjointness and completeness constraints are *independent* constraints

# EER DIAGRAM WITH SUBCLASSES



**Figure 8.1**  
EER diagram notation to represent subclasses and specialization.

# REFINING CONCEPTUAL SCHEMAS

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- Using specialization
  - Starting with entity type, define subclasses by successive specialization
  - **Top-down conceptual refinement**
- Using generalization
  - Starting with entity type, define superclasses by successive generalization
  - **Bottom-up conceptual synthesis**

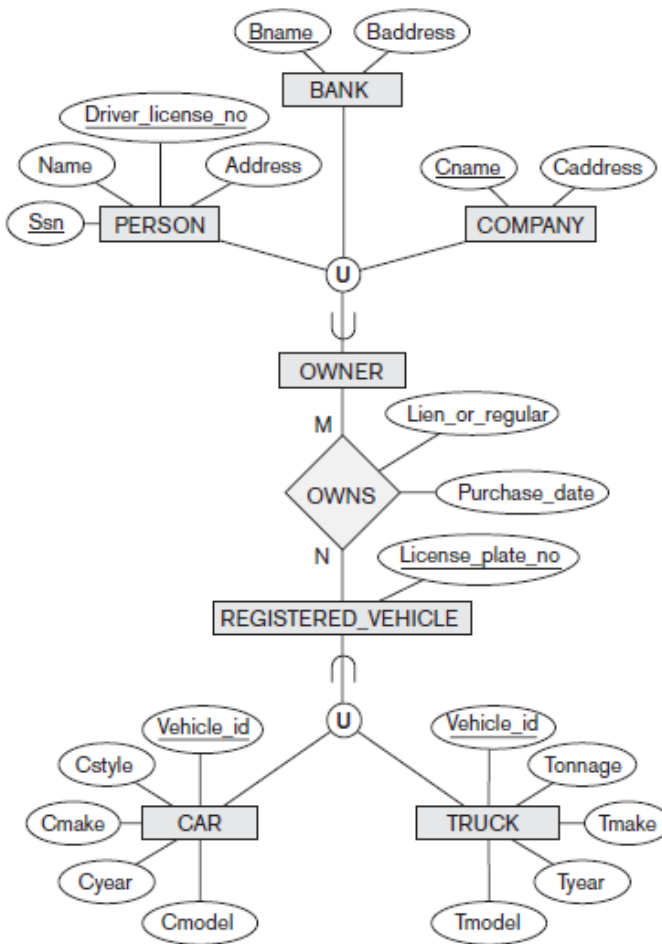


# MODELING WITH UNION TYPES

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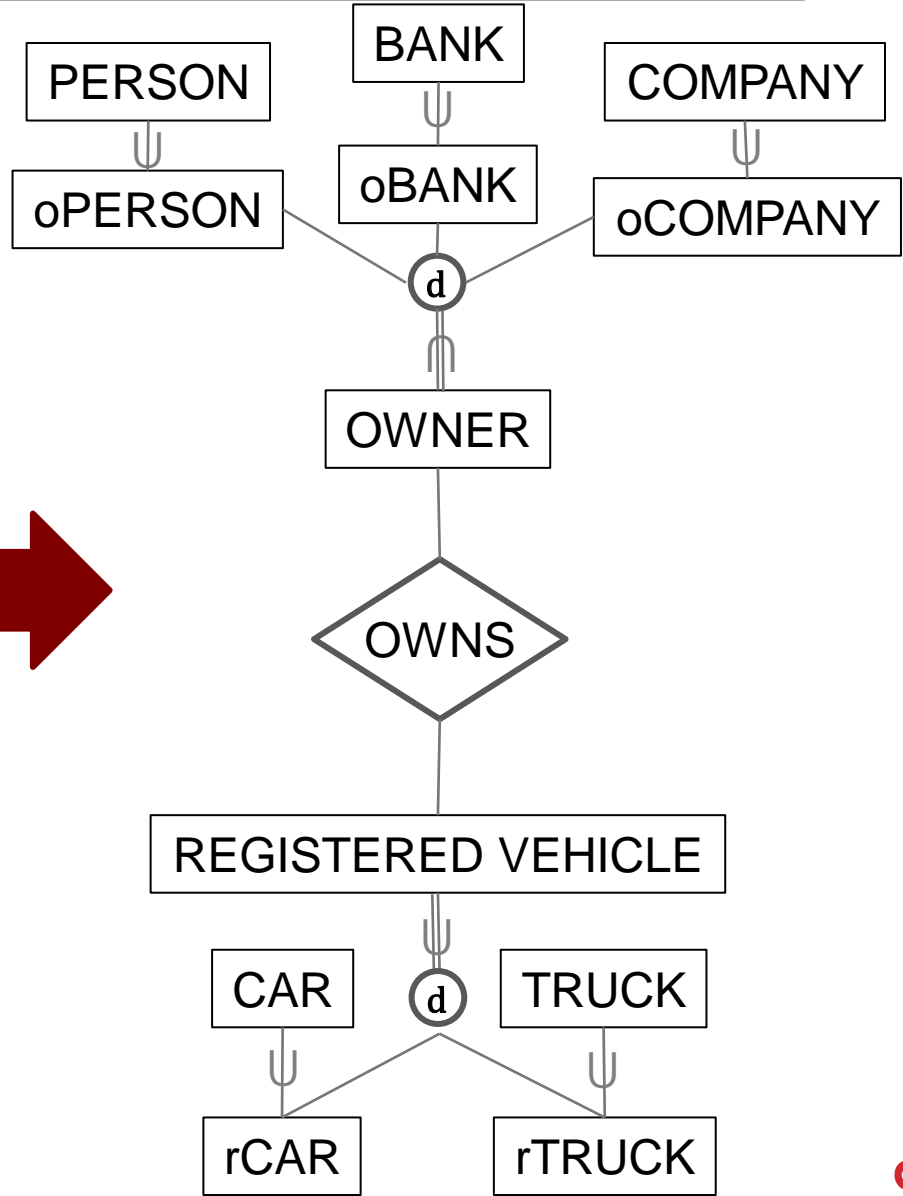
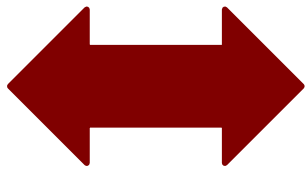
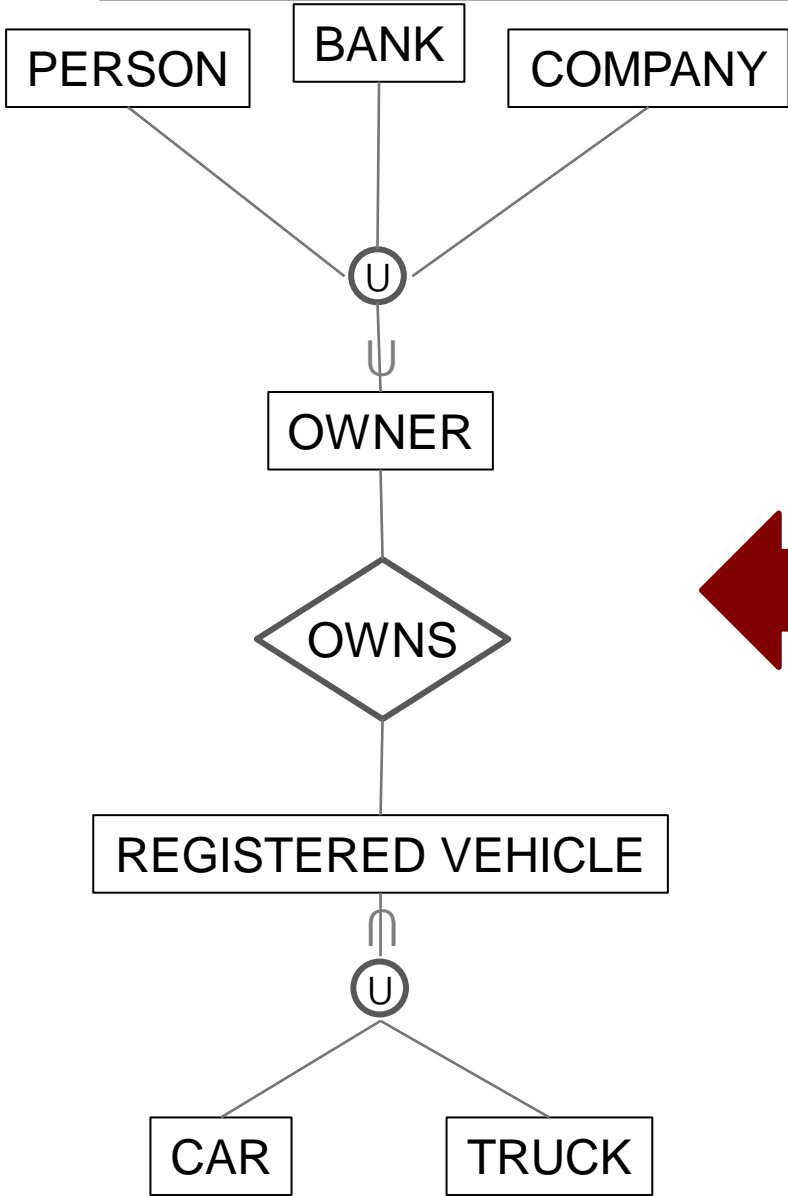
- **Union type** or **category**
  - Represents a single superclass/subclass relationship with more than one superclass
  - Subclass represents a collection of objects that is a subset of the UNION of distinct entity types
  - Attribute inheritance works more selectively
  - Category can be **total** or **partial**
- Some modeling methodologies do not have union types
  - Usually (always?) clearer to use specification/generalization

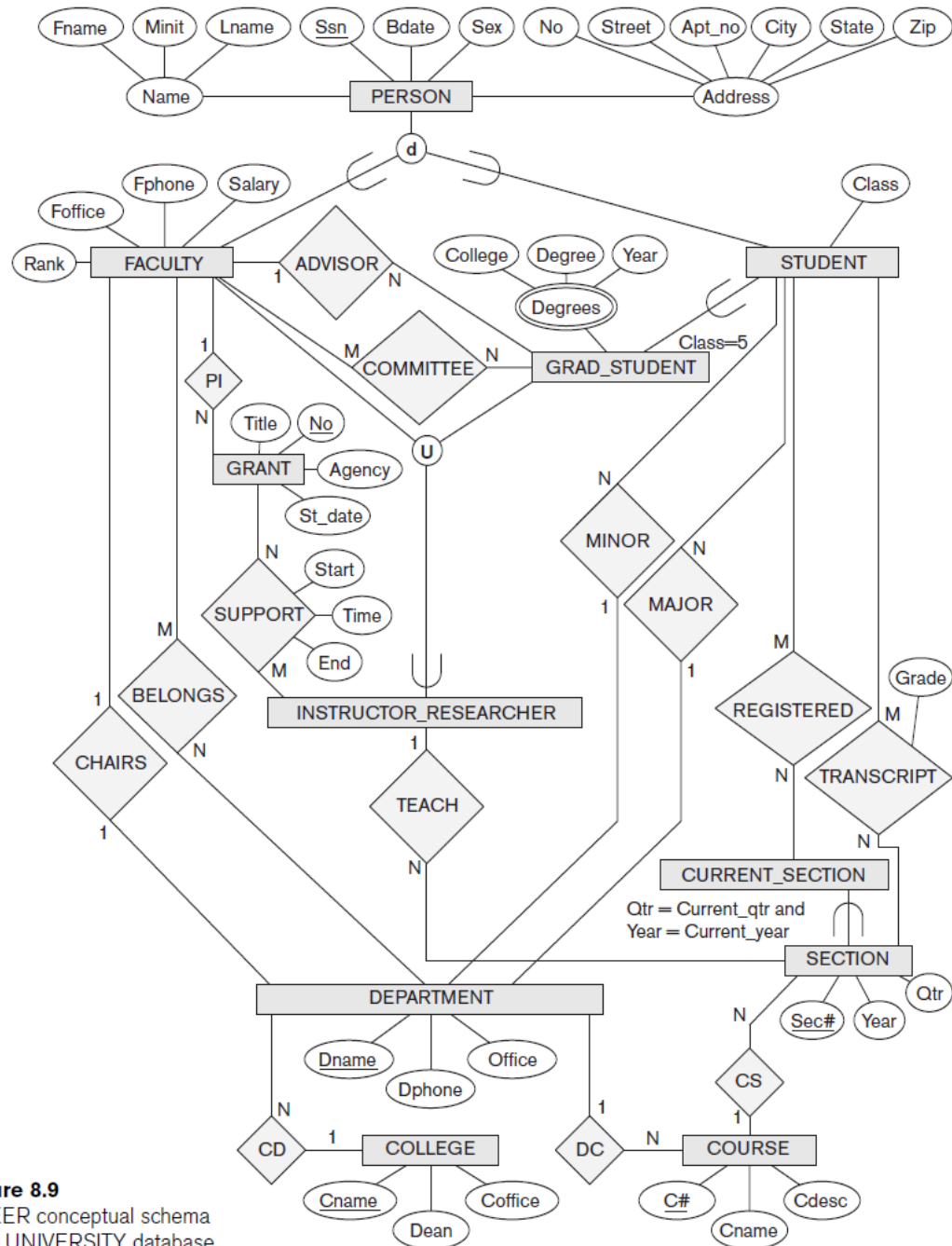
# UNION TYPES



**Figure 8.8**  
Two categories (union types): OWNER and REGISTERED\_VEHICLE.

# REWRITING UNION AS SPECIALIZATION





**Figure 8.9**  
An EER conceptual schema  
for a UNIVERSITY database.

# DESIGN CHOICES

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- Many specializations/generalizations can be defined to make the conceptual model accurate
  - Constrain as disjoint/overlapping or total/partial as needed
  - Driven by rules in miniworld being modeled
- If all the subclasses of a specialization/generalization have few specific attributes and no specific relationships
  - Can be merged into the superclass *C*
  - Include in *C* one or more “type” attributes that specify the (virtual) subclasses to which each entity belongs
- Union types should generally be avoided

# SUMMARY

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- Enhanced ER or EER model
  - Extensions to ER model that improve its representational capabilities
  - Subclass and its superclass
  - Category or union type
  - EER diagrams