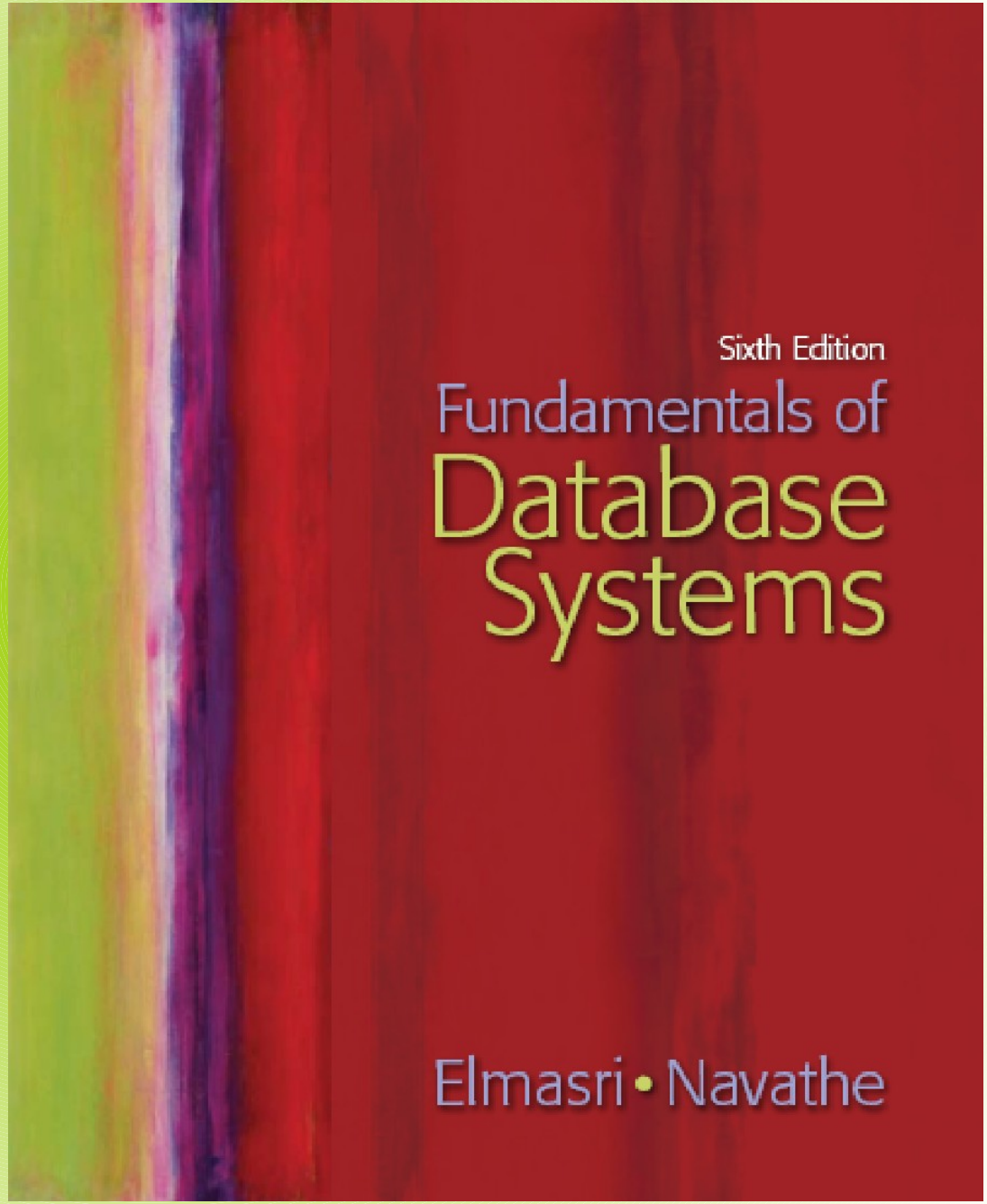
Chapter 8

The Enhanced Entity-Relationship (EER) Model



Addison-Wesley
is an imprint of
PEARSON

Chapter 8 Outline

Subclasses, Superclasses, and Inheritance

Specialization and Generalizationz

Constraints and Characteristics of Specialization and Generalization Hierarchies

Modeling of UNION Types Using Categories

A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions

The Enhanced Entity-Relationship (EER) Model

Enhanced ER (EER) model

Created to design more accurate database schemas

- Reflect the data properties and constraints more precisely

More complex requirements than traditional applications

Subclasses, Superclasses, and Inheritance

EER model includes all modeling concepts of the ER model

In addition, EER includes:

- **Subclasses** and **superclasses**
- **Specialization** and **generalization**
- **Category** or **union type**
- **Attribute** and **relationship inheritance**

Subclasses, Superclasses, and Inheritance (cont'd.)

- **Enhanced ER** or **EER diagrams**
  - Diagrammatic technique for displaying these concepts in an EER schema
- **Subtype** or **subclass** of an entity type
  - Subgroupings of entities that are meaningful
  - Represented explicitly because of their significance to the database application

Subclasses, Superclasses, and Inheritance (cont'd.)

Terms for relationship between a superclass and any one of its subclasses

- **Superclass/subclass**
- **Supertype/subtype**
- **Class/subclass** relationship

Type inheritance

Subclass entity inherits all attributes and relationships of superclass

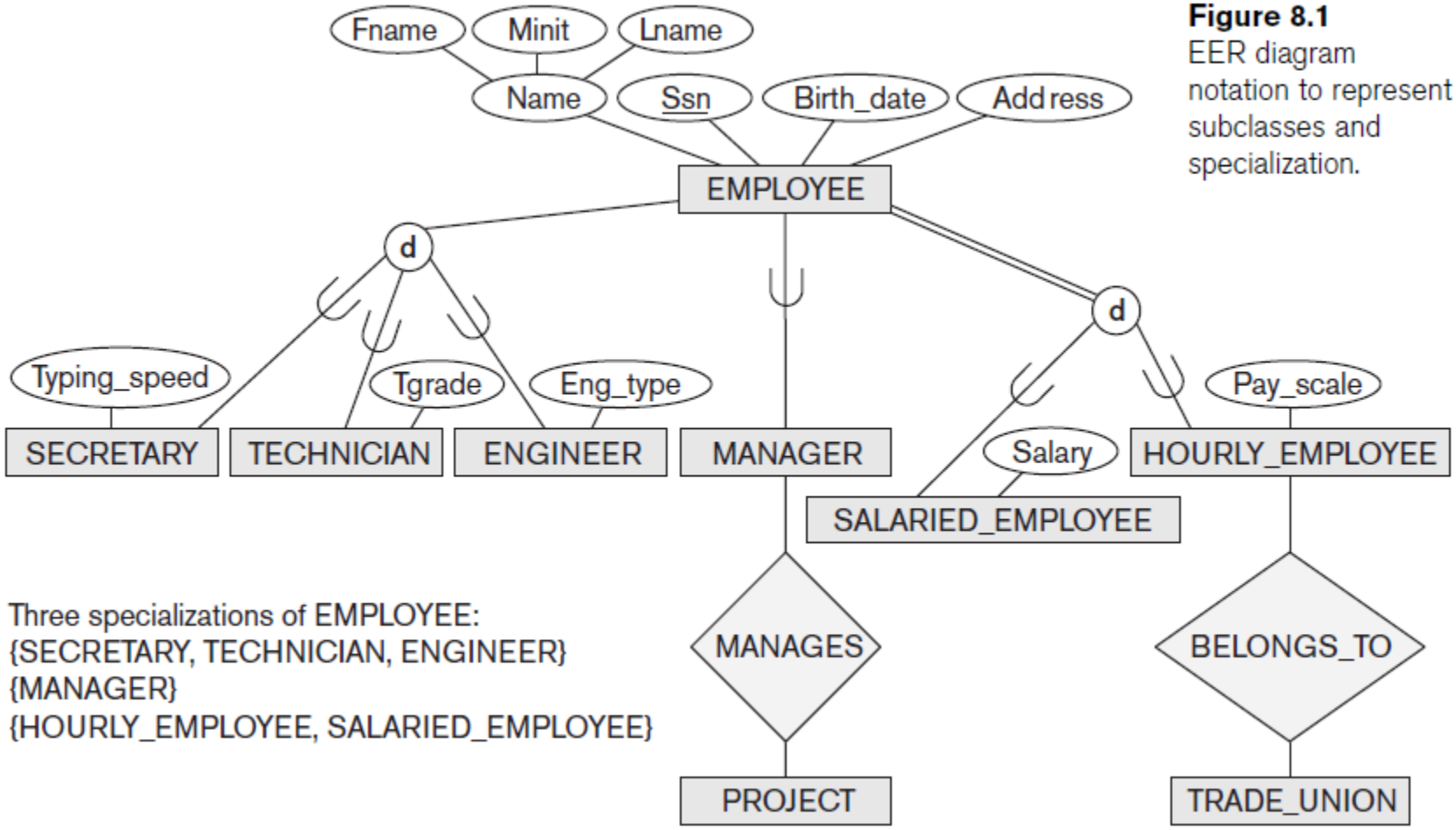


Figure 8.1
EER diagram notation to represent subclasses and specialization.

Specialization and Generalization

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

Subclass can define:

Specific attributes

Specific relationship types

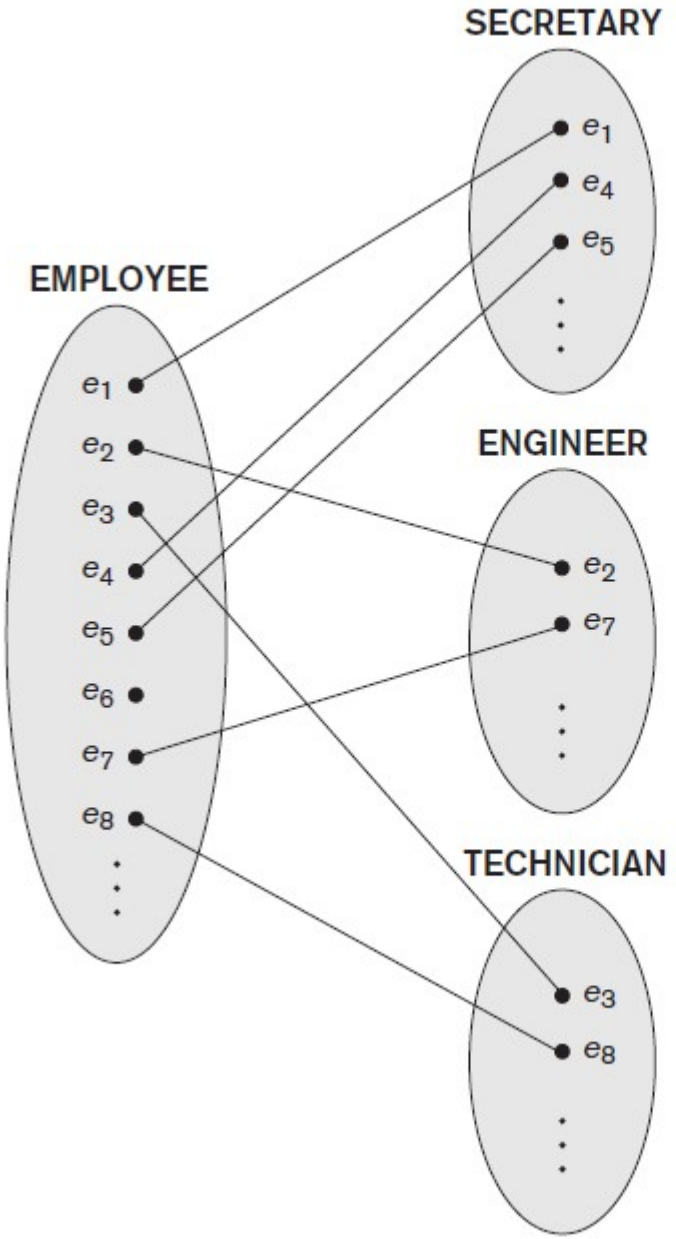


Figure 8.2
Instances of a specialization.

Specialization and Generalization (cont'd.)

- Certain attributes may apply to some but not all entities of the superclass
- Some relationship types may be participated in only by members of the subclass

Generalization

Reverse process of abstraction

Generalize into a single **superclass**

Original entity types are special subclasses

Generalization

Process of defining a generalized entity type from the given entity types

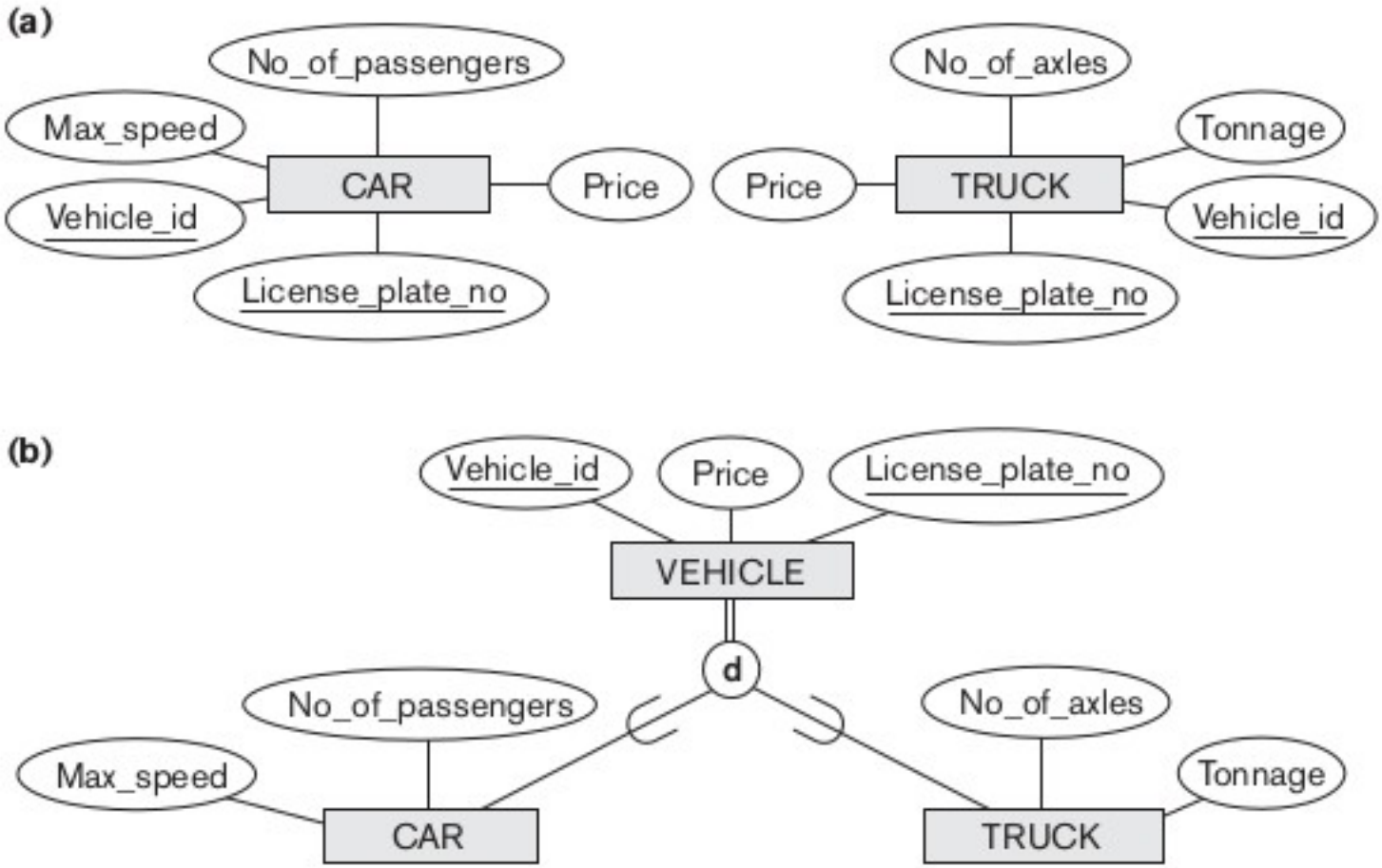


Figure 8.3
Generalization. (a) Two entity types, CAR and TRUCK. (b) Generalizing CAR and TRUCK into the superclass VEHICLE.

Constraints and Characteristics of Specialization and Generalization Hierarchies

- Constraints that apply to a single specialization or a single generalization
- Differences between specialization/ generalization lattices and hierarchies

Constraints on Specialization and Generalization

May be several or one subclass

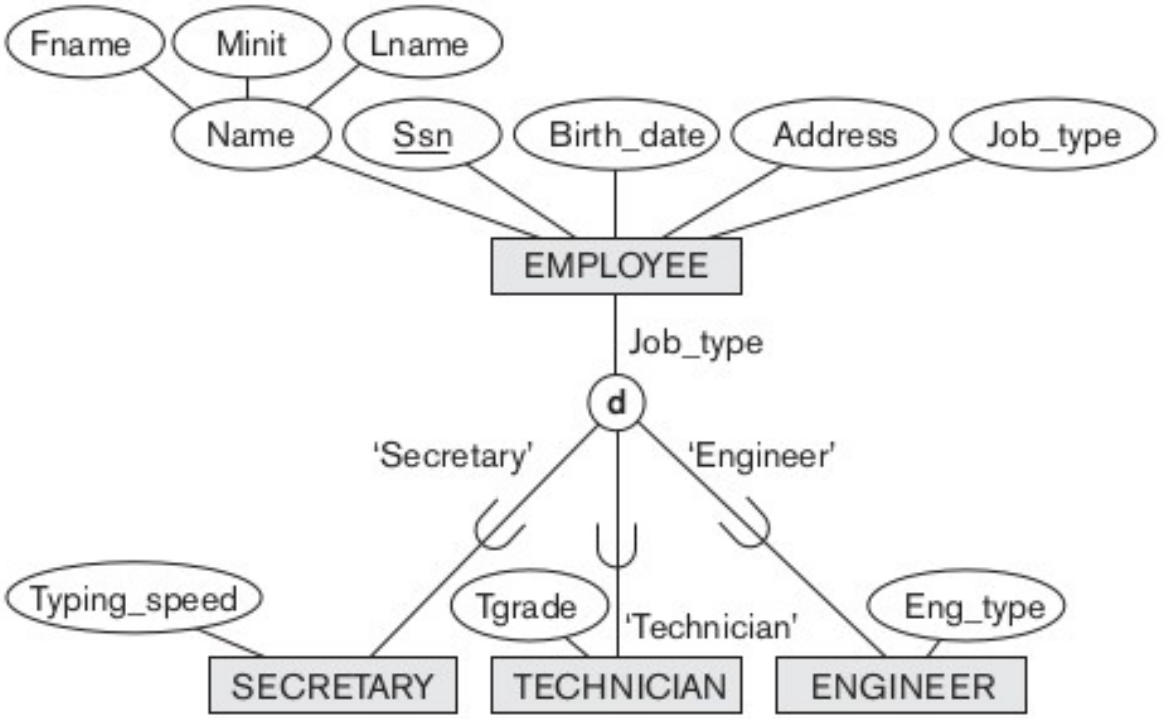
Determine entity subtype:

Predicate-defined (or c**ondition-defined**) **subclasses**

Attribute-defined specialization

User-defined

Figure 8.4
EER diagram notation for an attribute-defined specialization on Job_type.



[6]Such an attribute is called a *discriminator* in UML terminology.

Constraints on Specialization and Generalization (cont'd.)

Disjointness constraint

Specifies that the subclasses of the specialization must be disjoint

Completeness (or **totalness**) **constraint**

May be **total** or **partial**

Disjointness and completeness constraints are independent

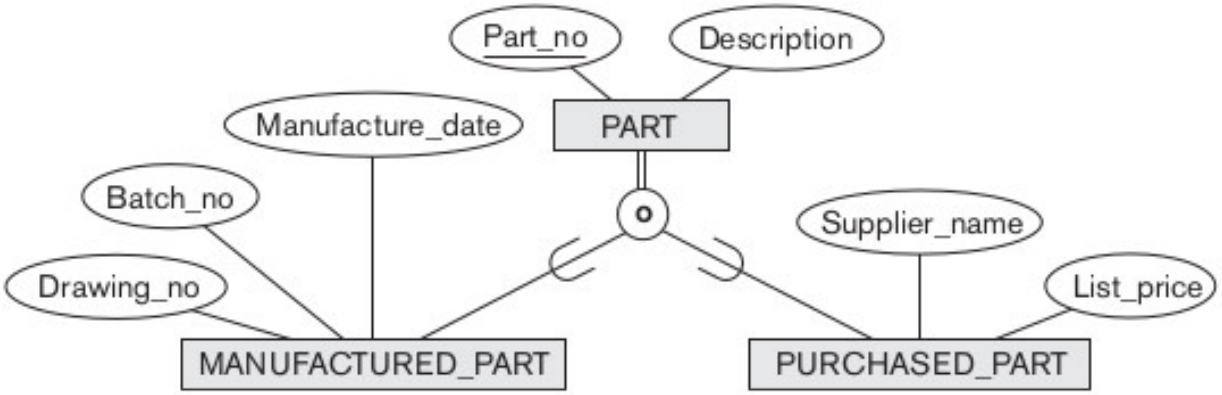


Figure 8.5
EER diagram notation for an overlapping (nondisjoint) specialization.

Specialization and Generalization Hierarchies and Lattices

Specialization hierarchy

Every subclass participates as a subclass in only one class/subclass relationship

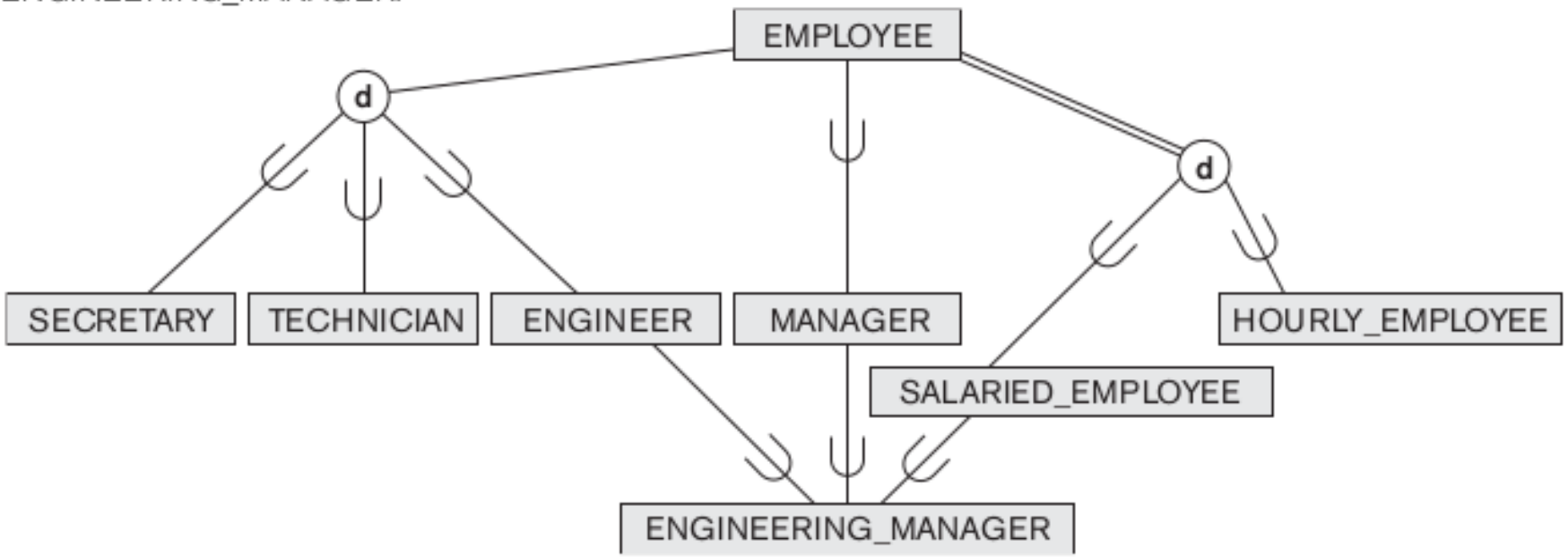
Results in a **tree structure** or **strict hierarchy**

Specialization lattice

Subclass can be a subclass in more than one class/subclass relationship

Figure 8.6

A specialization lattice with shared subclass ENGINEERING_MANAGER.



Specialization and Generalization Hierarchies and Lattices (cont'd.)

Multiple inheritance

Subclass with more than one superclass

If attribute (or relationship) originating in the same superclass inherited more than once via different paths in lattice

- Included only once in shared subclass

Single inheritance

Some models and languages limited to single inheritance

Utilizing Specialization and Generalization in Refining Conceptual Schemas

- Specialization process
  - Start with entity type then define subclasses by successive specialization
  - **Top-down conceptual refinement process**
- **Bottom-up conceptual synthesis**
  - Involves generalization rather than specialization

Modeling of UNION Types Using Categories

Union type or a **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

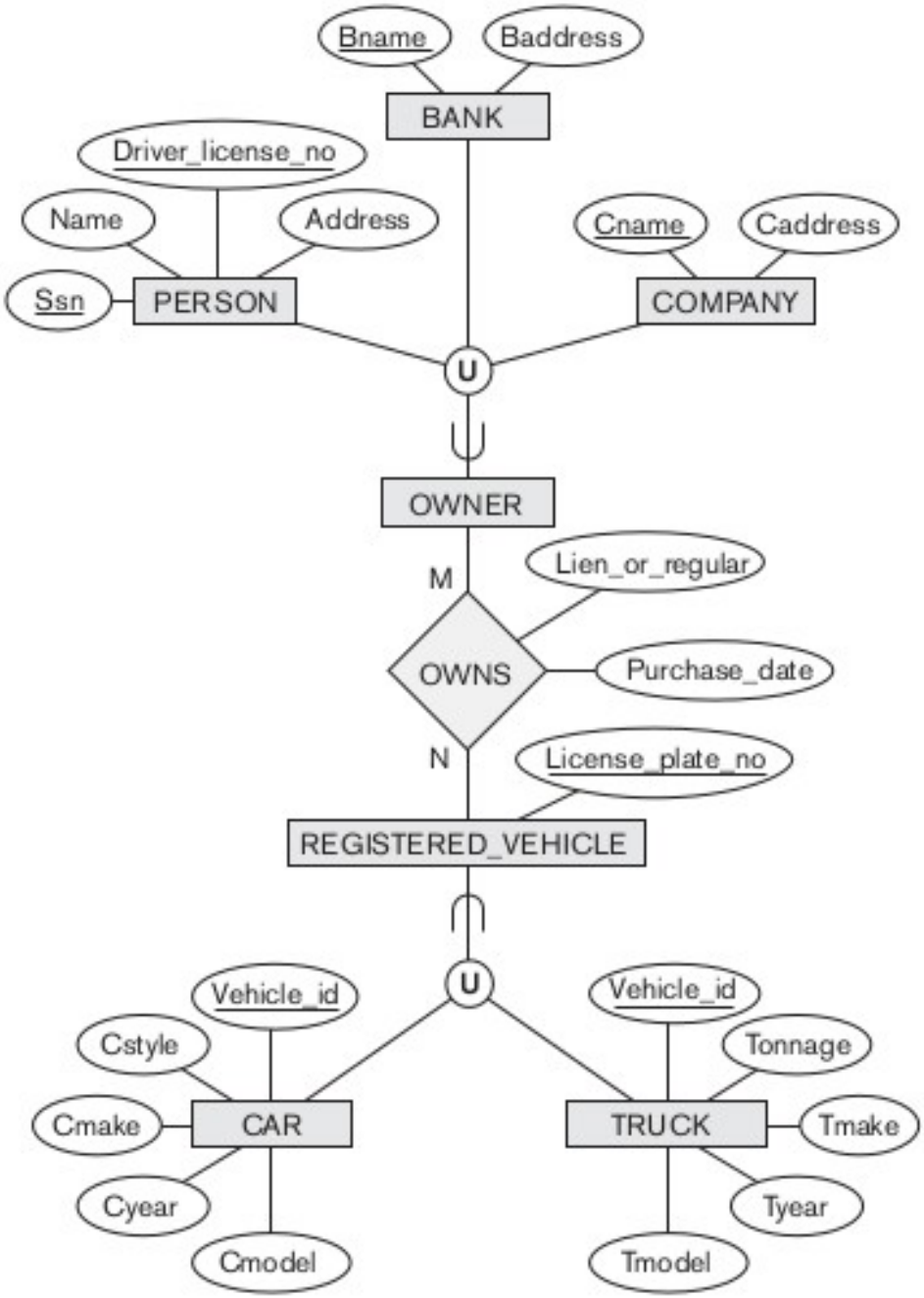


Figure 8.8
Two categories (union types): OWNER and REGISTERED_VEHICLE.

A Sample UNIVERSITY EER Schema, Design Choices, and Formal Definitions

The UNIVERSITY Database Example

UNIVERSITY database

- Students and their majors
- Transcripts, and registration
- University's course offerings

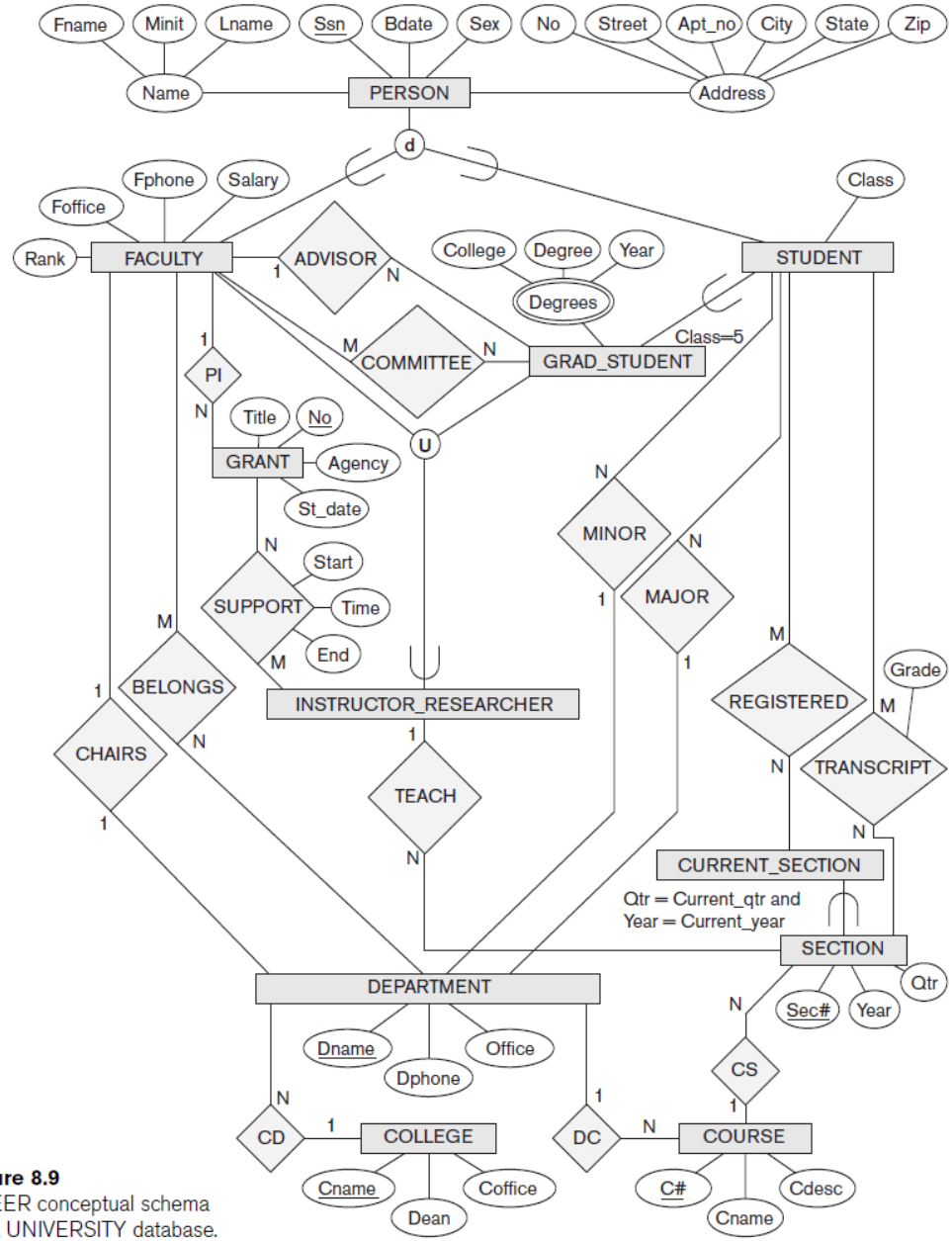


Figure 8.9
An EER conceptual schema for a UNIVERSITY database.

Design Choices for Specialization/Generalization

- Many specializations and subclasses can be defined to make the conceptual model accurate
- If subclass has few specific attributes and no specific relationships
  - Can be merged into the superclass

Design Choices for Specialization/Generalization (cont'd.)

If all the subclasses of a specialization/generalization have few specific attributes and no specific relationships

- Can be merged into the superclass
- Replace with one or more type attributes that specify the subclass or subclasses that each entity belongs to

Design Choices for Specialization/Generalization (cont'd.)

- Union types and categories should generally be avoided
- Choice of disjoint/overlapping and total/partial constraints on specialization/generalization
  - Driven by rules in miniworld being modeled

Formal Definitions for the EER Model Concepts

Class

Set or collection of entities

Includes any of the EER schema constructs of group entities

Subclass

Class whose entities must always be a subset of the entities in another class

Specialization

Set of subclasses that have same superclass

Formal Definitions for the EER Model Concepts (cont'd.)

Generalization

Generalized entity type or superclass

Predicate-defined

Predicate on the attributes of is used to specify which entities in *C* are members of *S*

User-defined

Subclass that is not defined by a predicate

Formal Definitions for the EER Model Concepts (cont'd.)

Category

Class that is a subset of the union of n defining superclasses

Relationship type

Any class can participate in a relationship

Summary

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