

MDBM-Chapter 3

The Enhanced E-R Model

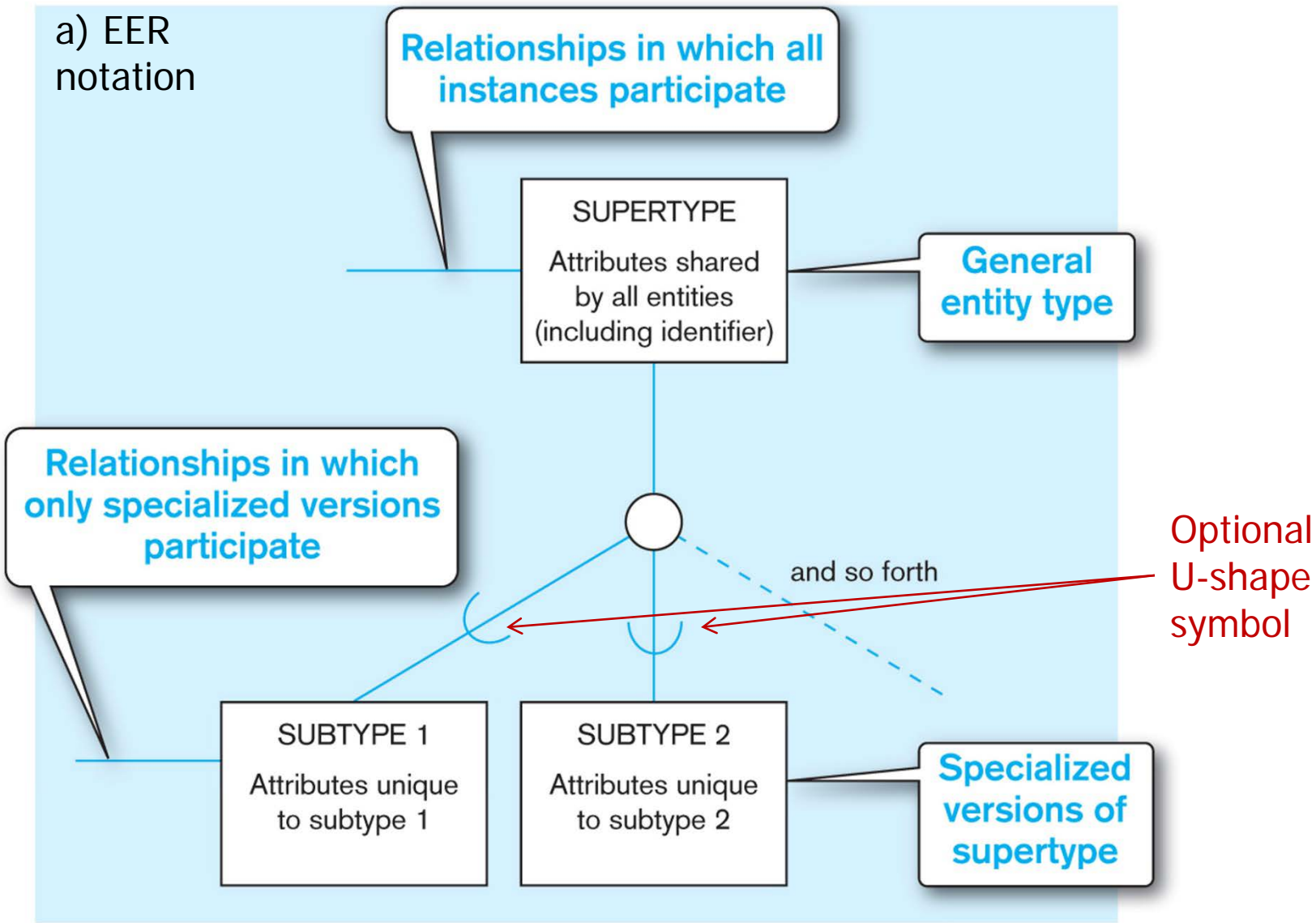
Objectives

- ❑ Understand use of supertype/subtype relationships
- ❑ Understand use of specialization and generalization techniques
- ❑ Specify completeness and disjointness constraints
- ❑ Develop supertype/subtype hierarchies for realistic business situations
- ❑ Develop entity clusters

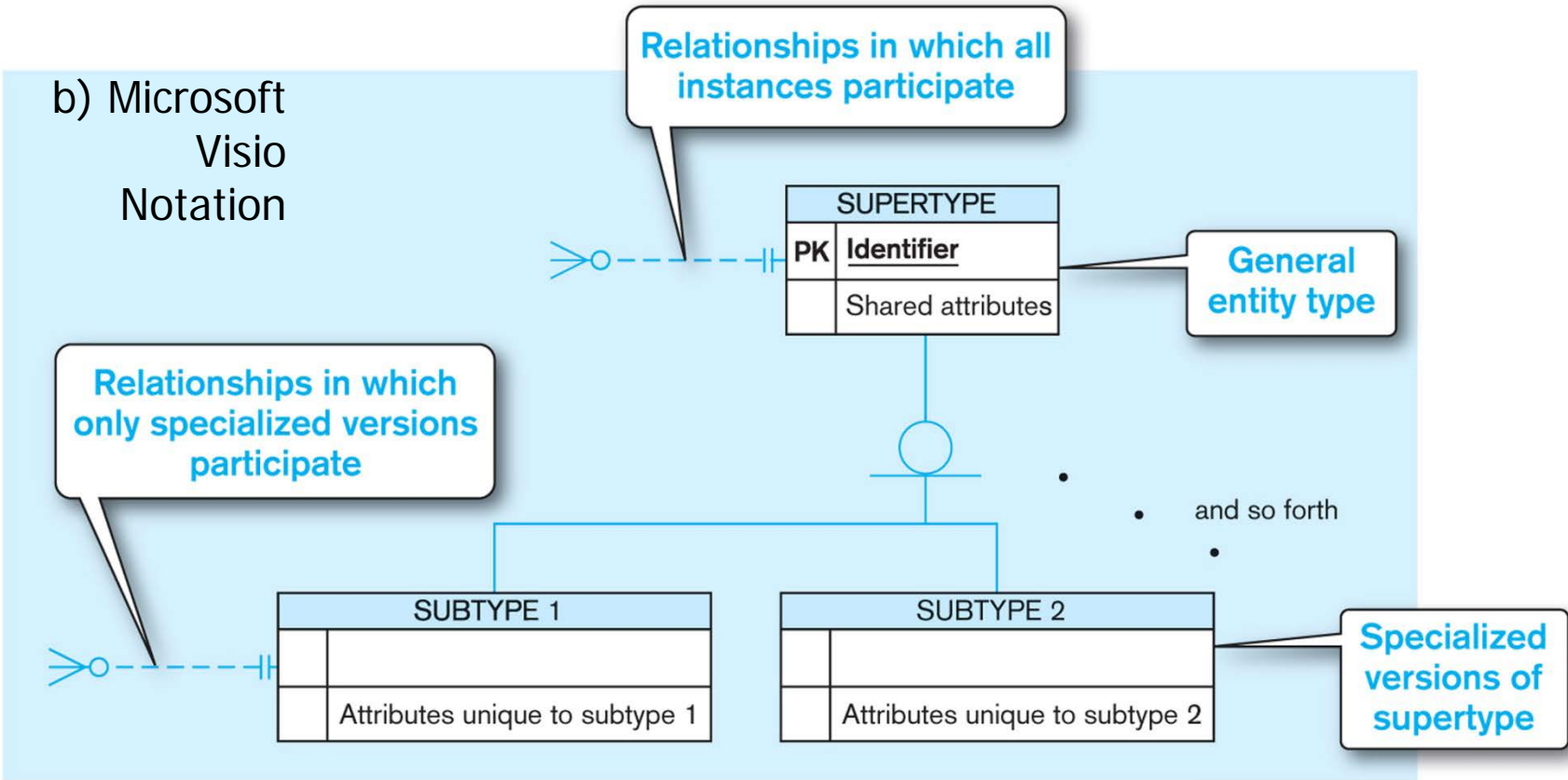
Supertypes and Subtypes

- ❑ Enhanced ER (EER) model: A model extended from the original ER model with new modeling constructs
- ❑ Supertype: A generic entity type that has a relationship with one or more subtypes
- ❑ Subtype: A subgrouping of the entities in an entity type that has attributes distinct from those in other subgroupings
- ❑ Attribute Inheritance:
 - ❖ Subtype entities inherit values of all attributes of the supertype
 - ❖ An instance of a subtype is also an instance of the supertype

Basics for supertype/subtype notation

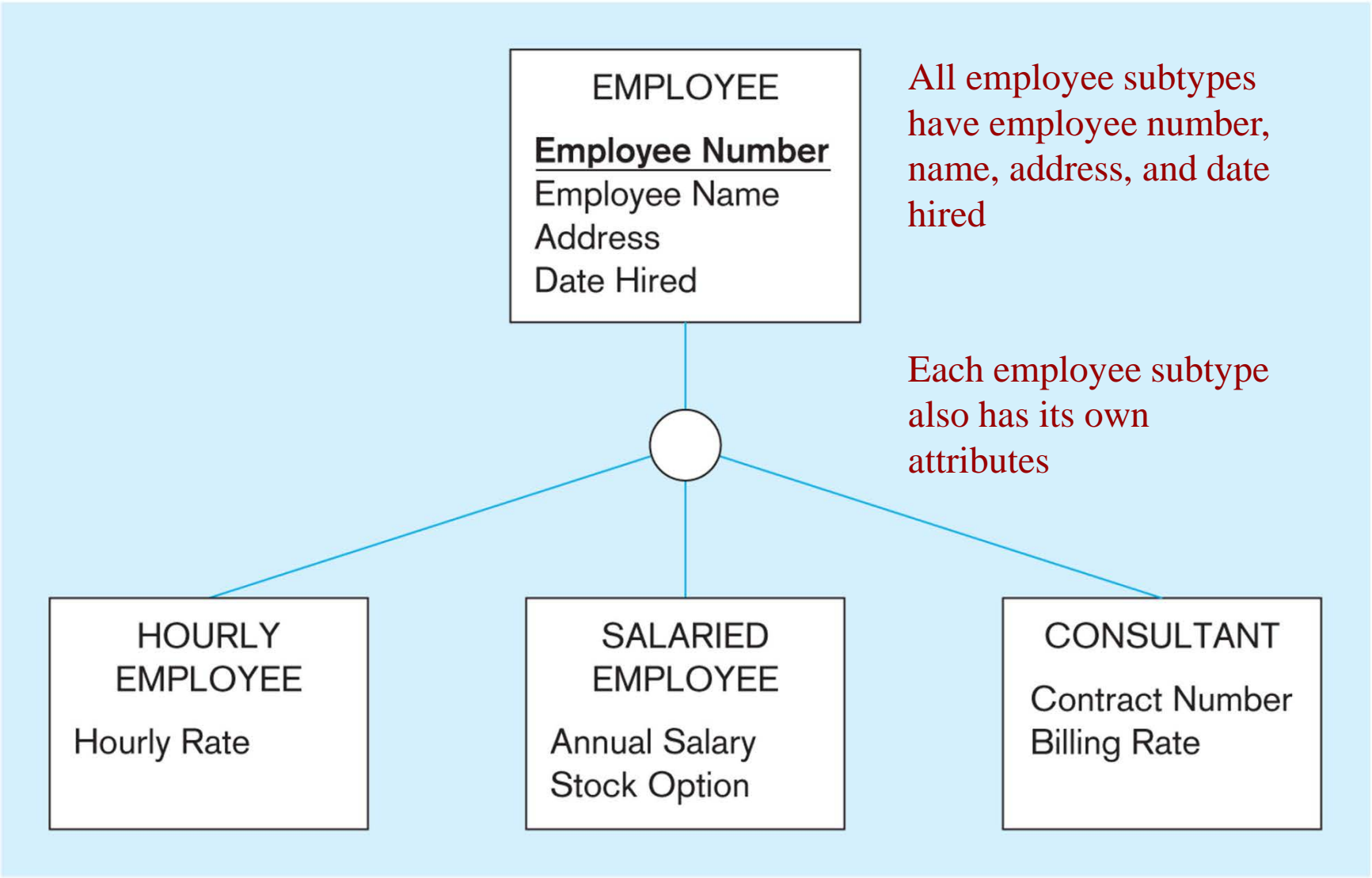


Basics for supertype/subtype notation (cont.)



Different modeling tools may have different notations for the same modeling constructs

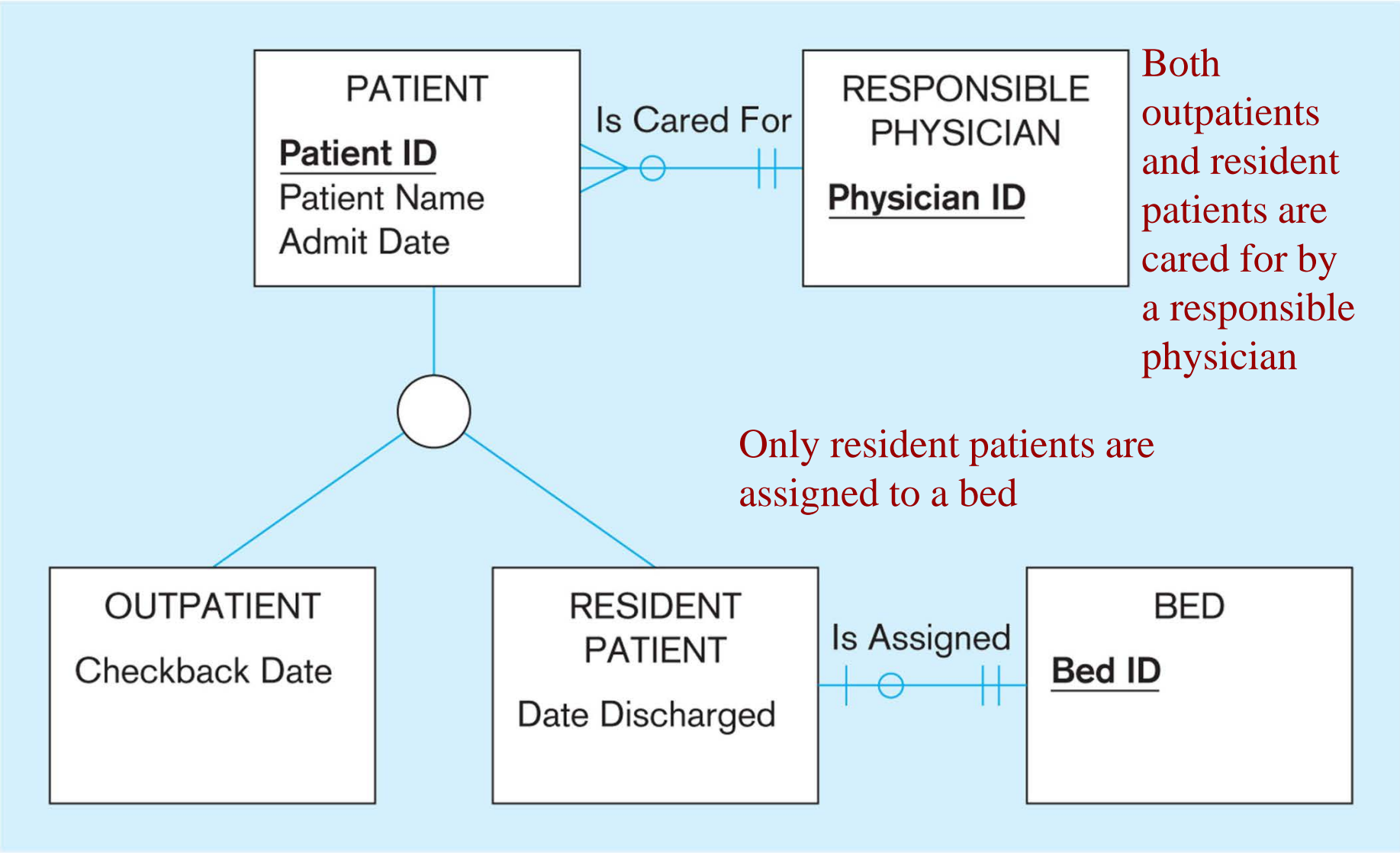
Employee supertype with three subtypes



Relationships and Subtypes

- ❑ Relationships at the *supertype* level indicate that all subtypes will participate in the relationship
- ❑ The instances of a *subtype* may participate in a relationship unique to that subtype. In this situation, the relationship is shown at the subtype level

Supertype/subtype relationships in a hospital

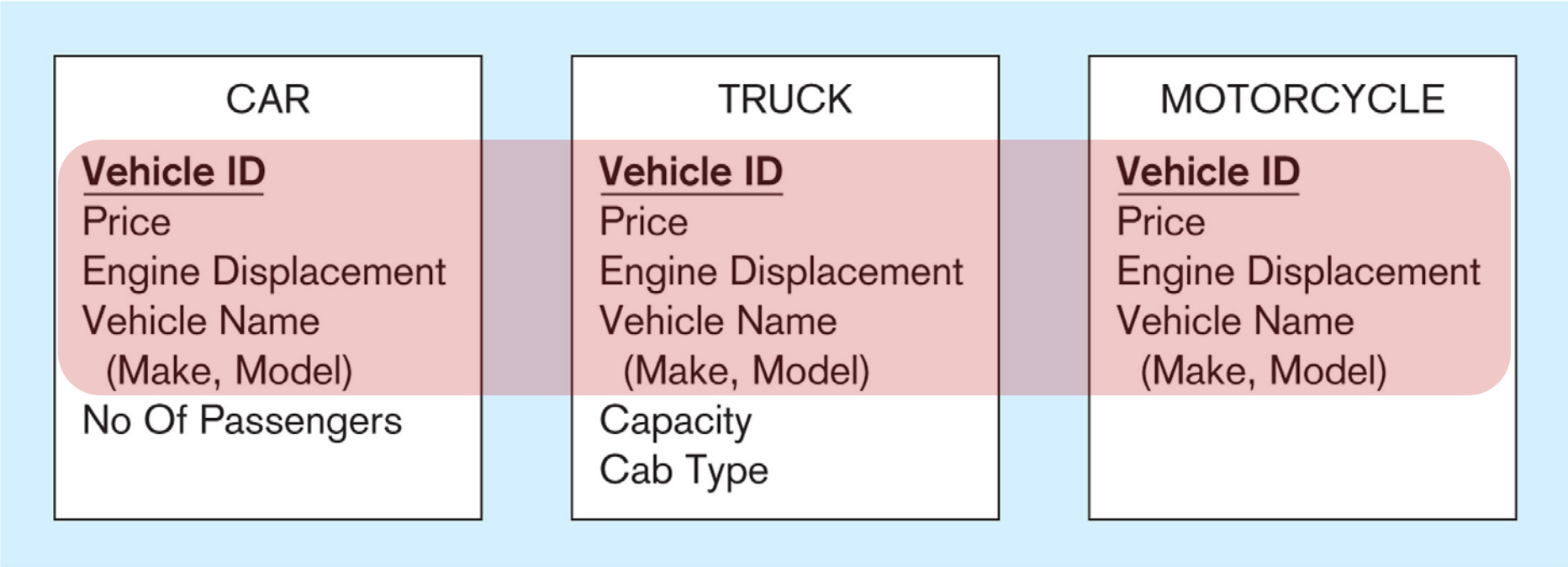


Generalization and Specialization

- ❑ ***Generalization***: The process of defining a more general entity type (supertype) from a set of more specialized entity types, a BOTTOM-UP approach
- ❑ ***Specialization***: The process of defining one or more subtypes of the supertype and forming supertype/subtype relationships, a TOP-DOWN approach

Example of generalization

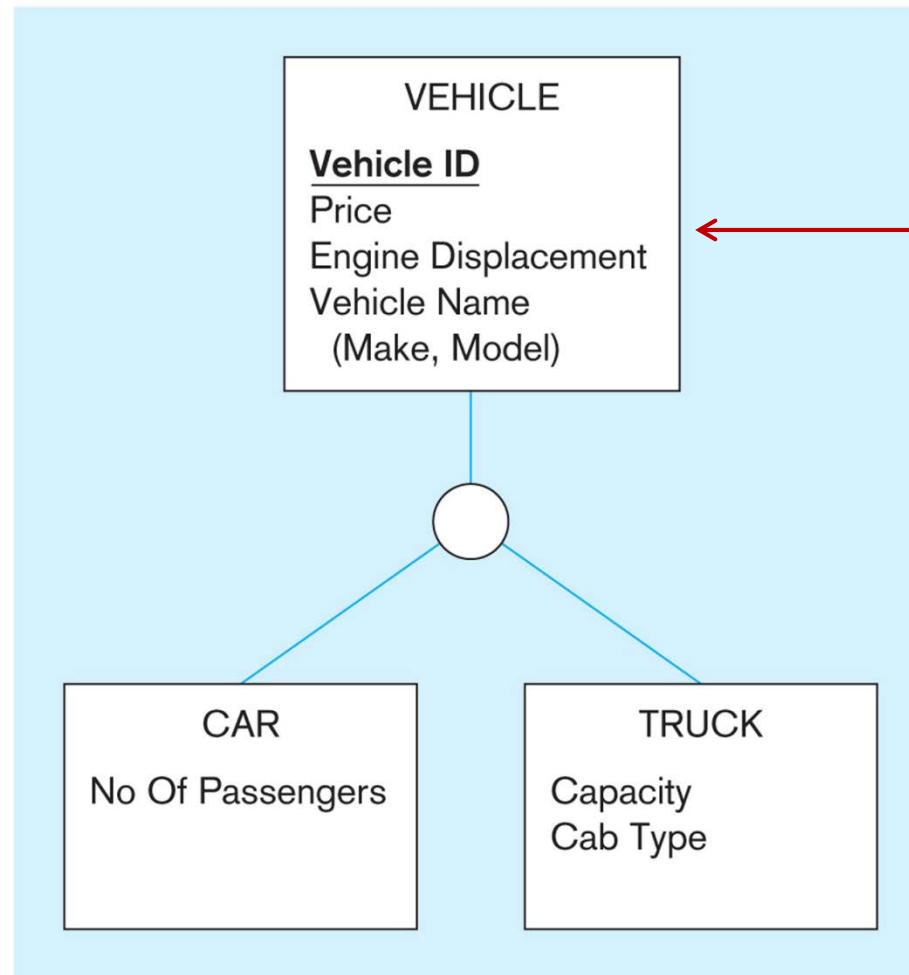
a) Three entity types: CAR, TRUCK, and MOTORCYCLE



All these types of vehicles have some common attributes

Example of generalization (cont.)

b) Generalization to the VEHICLE supertype

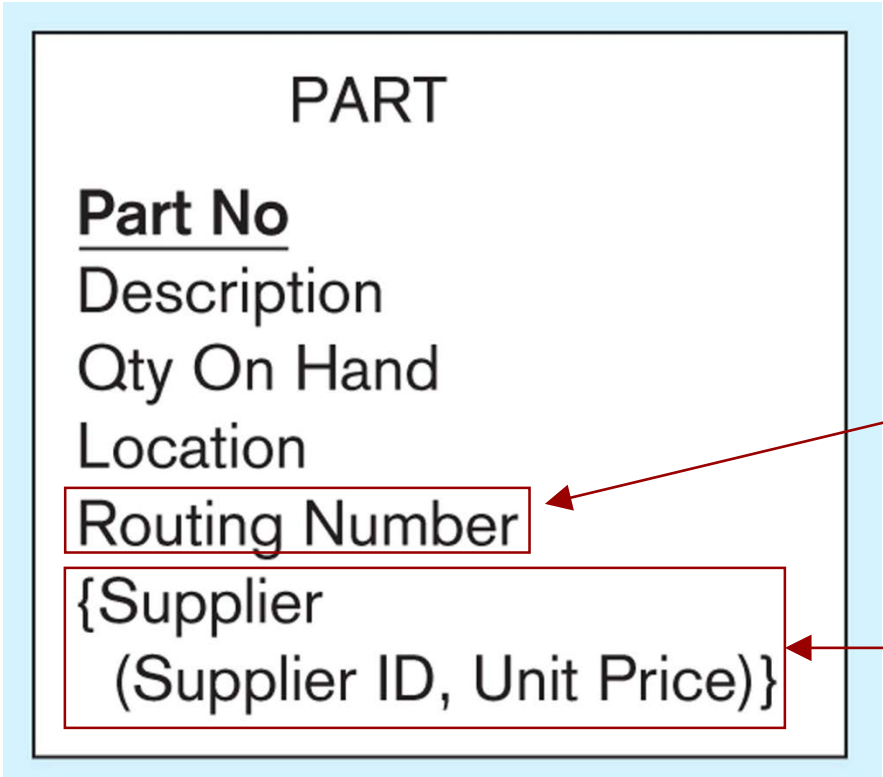


The shared attributes are put in the supertype

Note: there is no subtype for motorcycle in this case

Example of specialization

a) Entity type PART

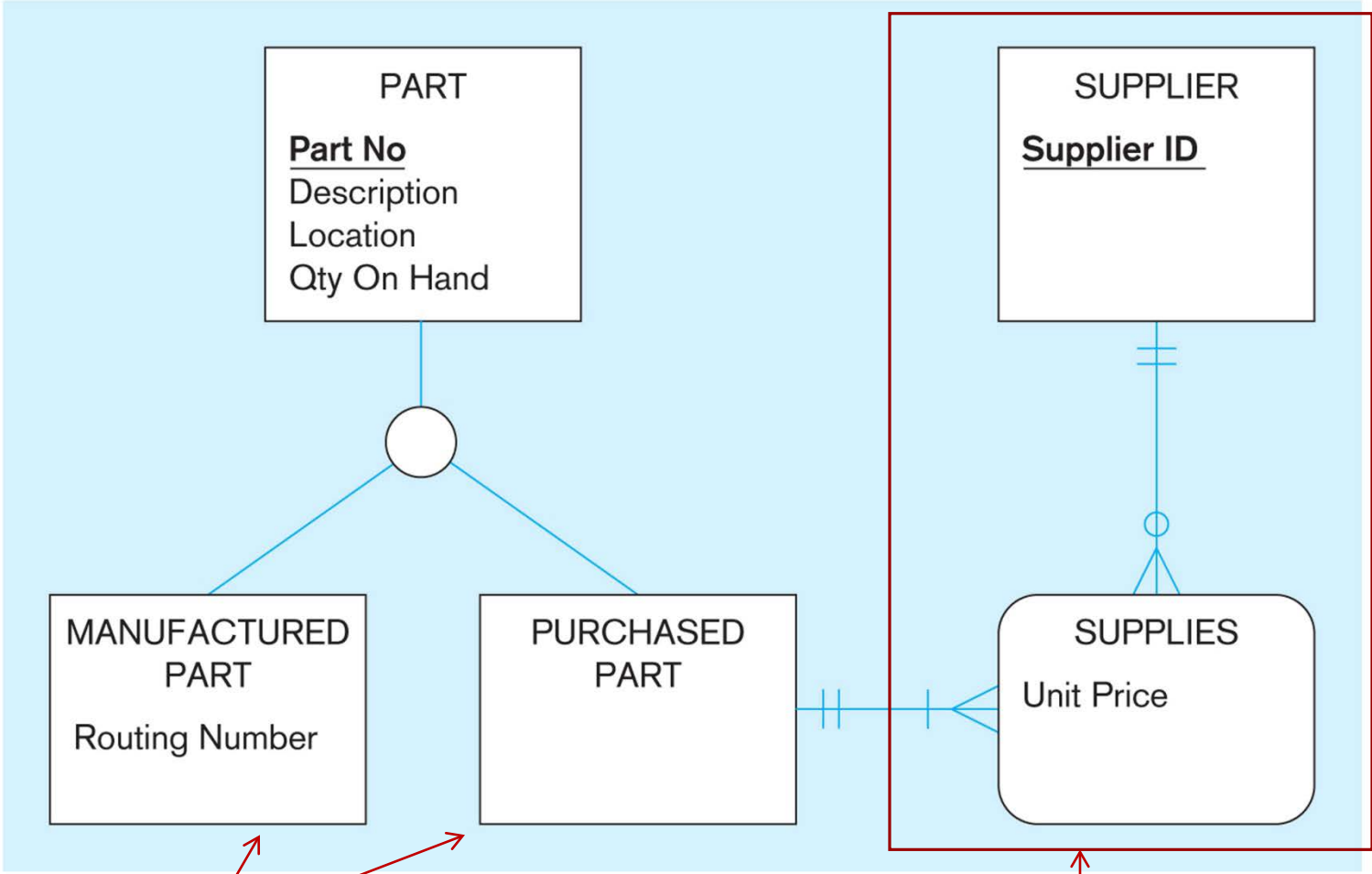


Only applies to
manufactured parts

Applies only to purchased parts

Example of specialization (cont.)

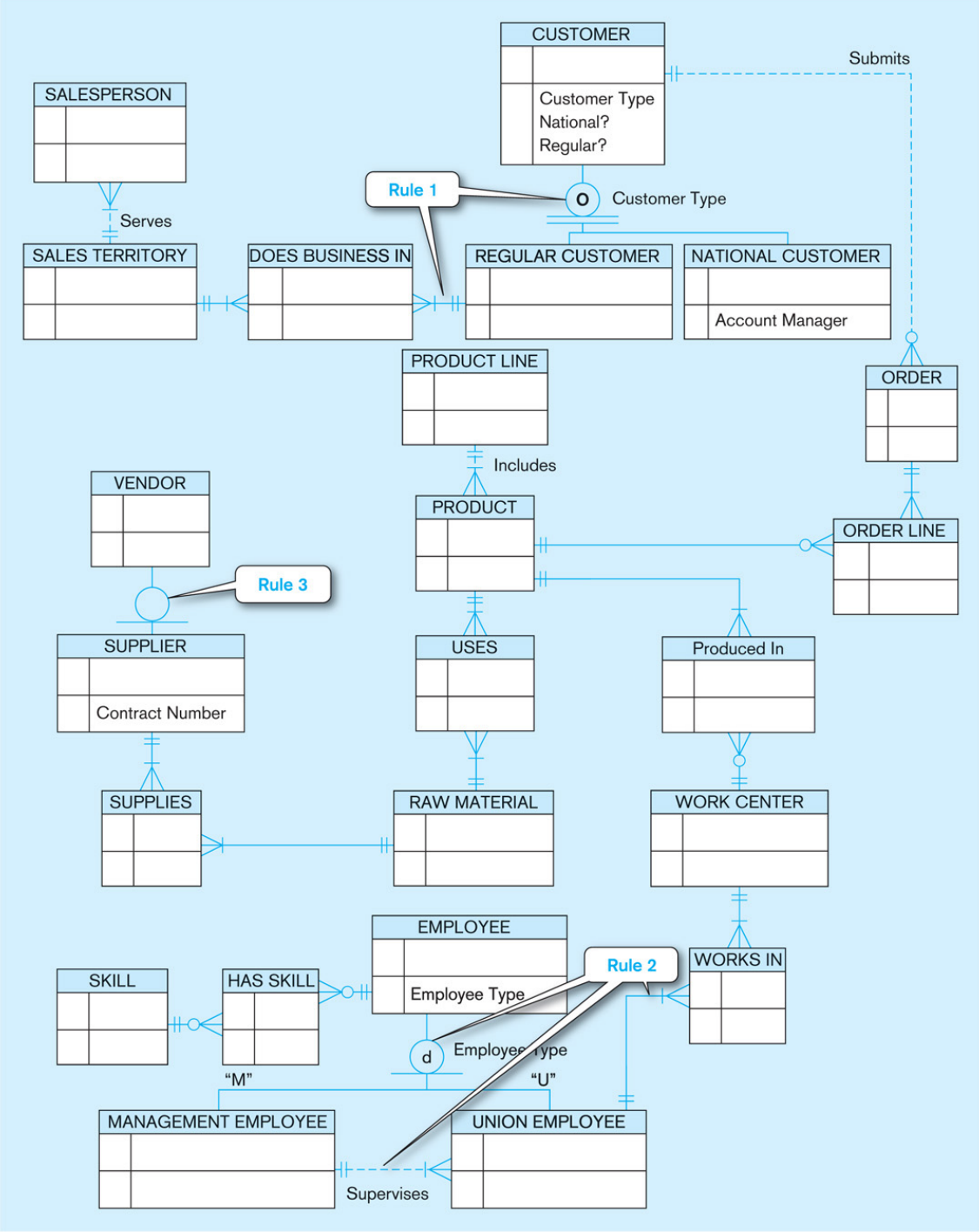
b) Specialization to MANUFACTURED PART and PURCHASED PART



Two new subtypes

Note: multivalued attribute was replaced by an associative entity ...

EER Diagram of PVFC



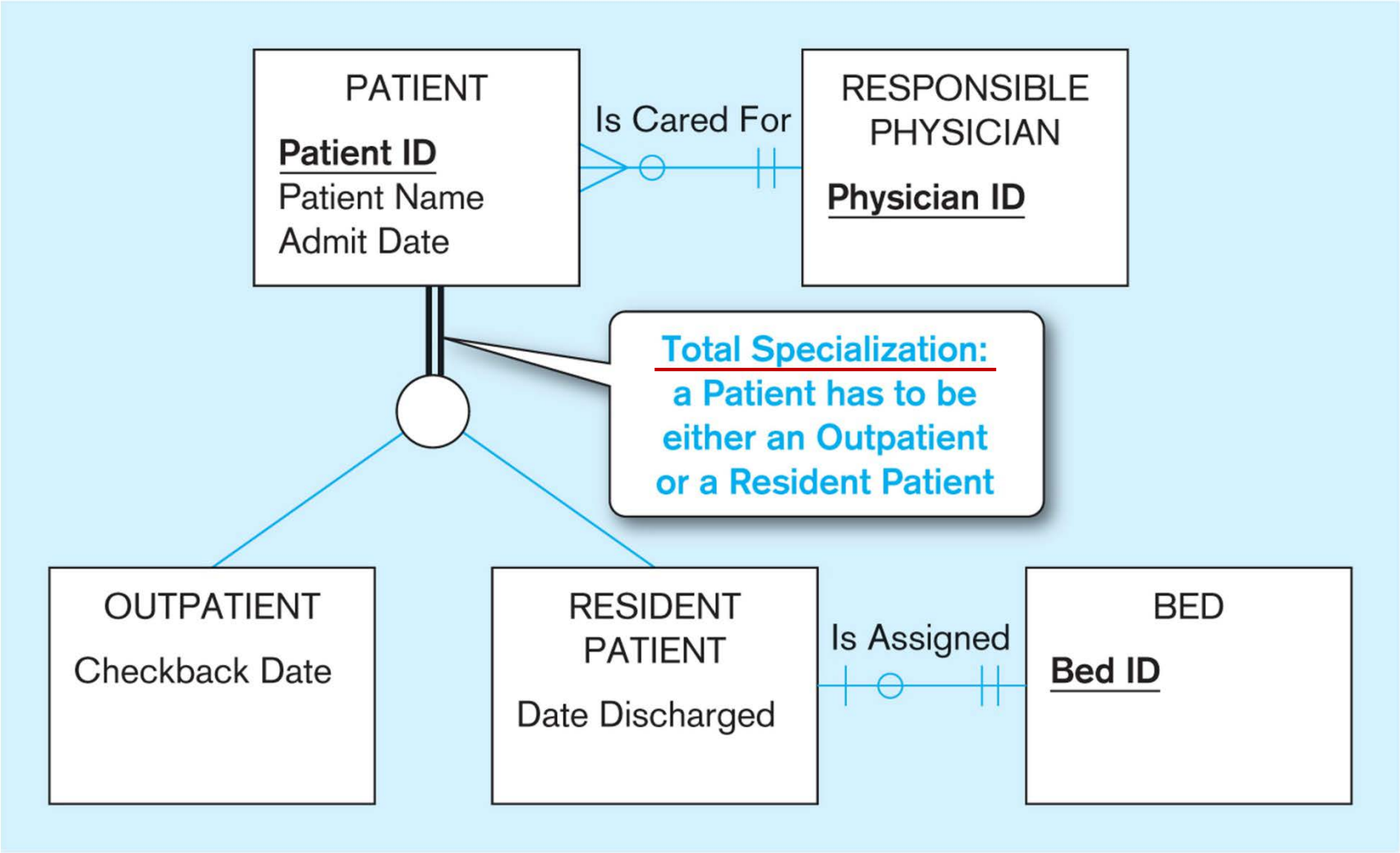
Constraints in Supertype/Subtype Relationship: Completeness Constraint

Completeness Constraints: Whether an instance of a supertype *must* also be a member of at least one subtype

- ❑ Yes: **total specialization rule** (double line)
- ❑ No: **partial specialization rule** (single line)

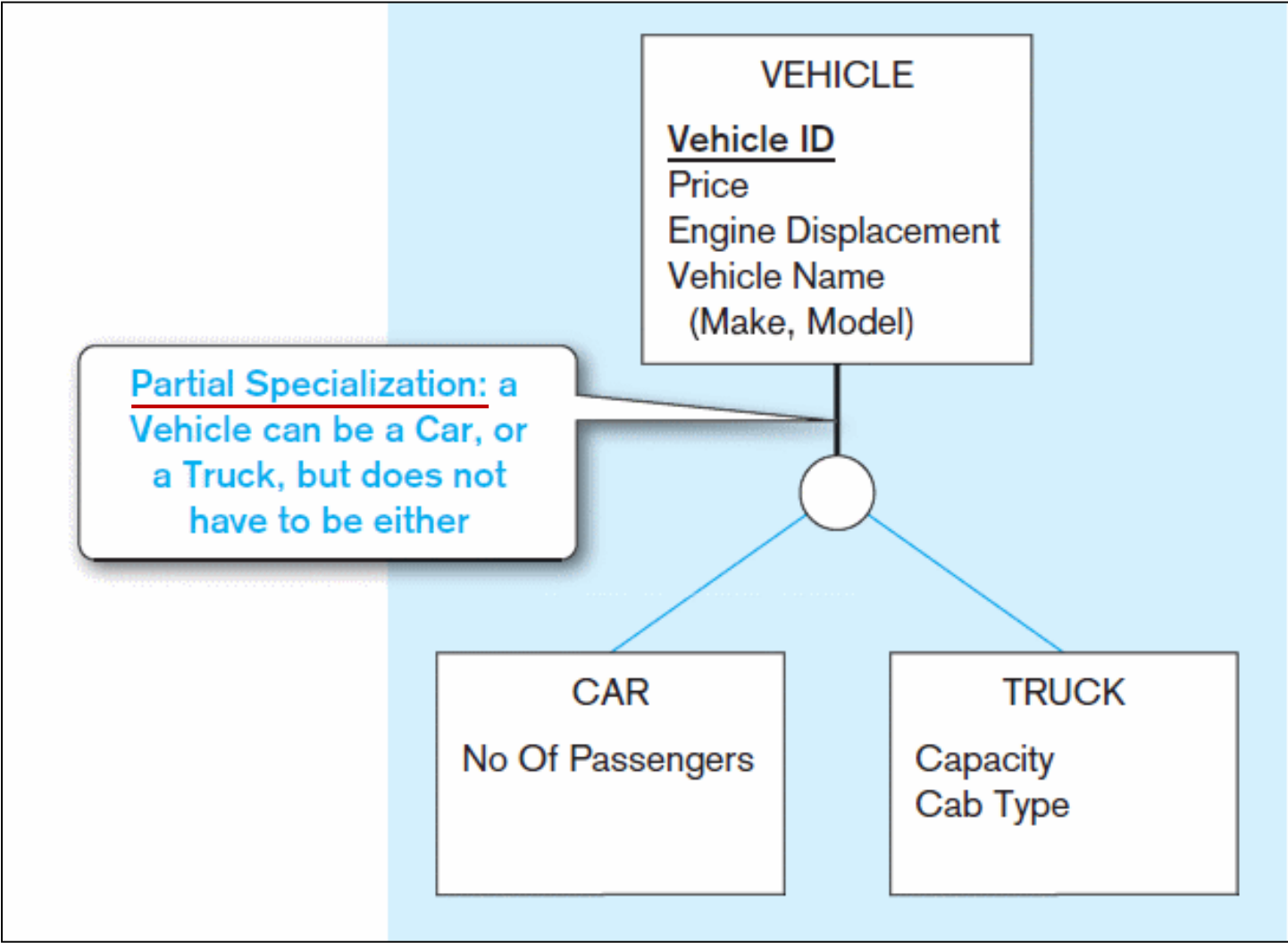
Examples of completeness constraints

a) Total specialization rule



Examples of completeness constraints (cont.)

b) Partial specialization rule



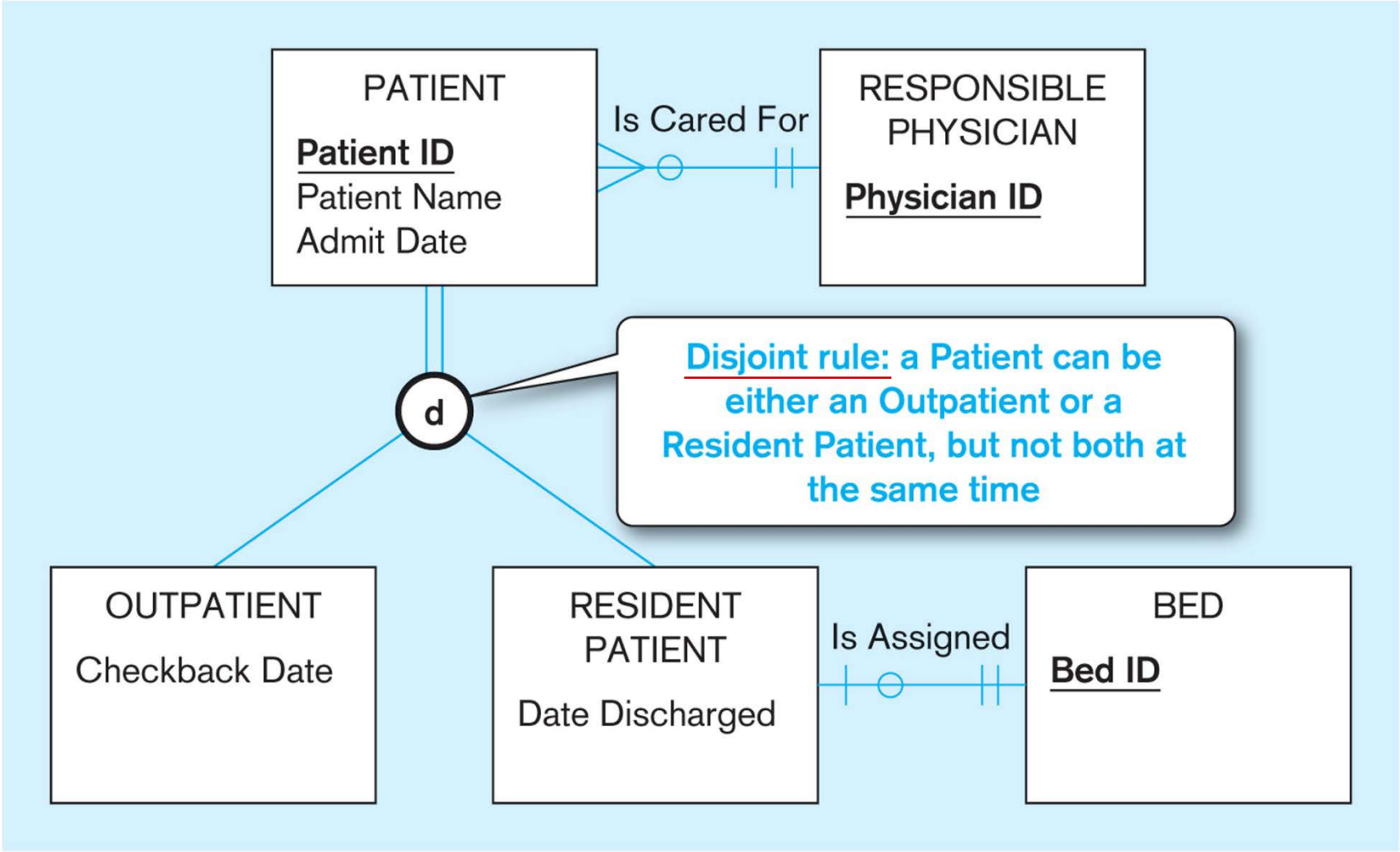
Constraints in Supertype/Subtype Relationship: Disjointness Constraint

Disjointness Constraints: Whether an instance of a supertype may simultaneously be a member of two (or more) subtypes

- ❑ **Yes: Overlap Rule** (represented with an “o” in the circle)
- ❑ **No: Disjoint Rule** (represented with a “d” in the circle)

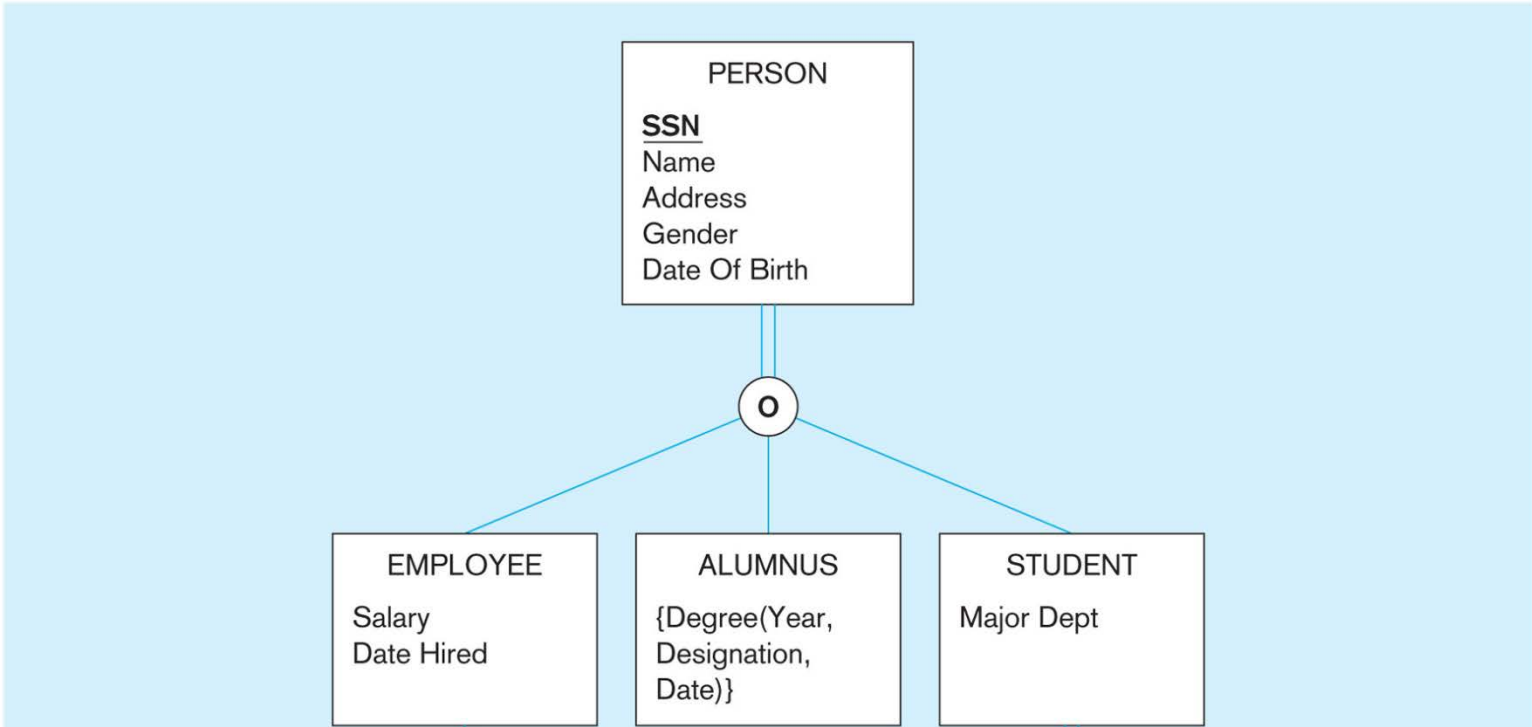
Examples of disjointness constraints

a) Disjoint rule



Examples of disjointness constraints (cont.)

b) Overlap rule

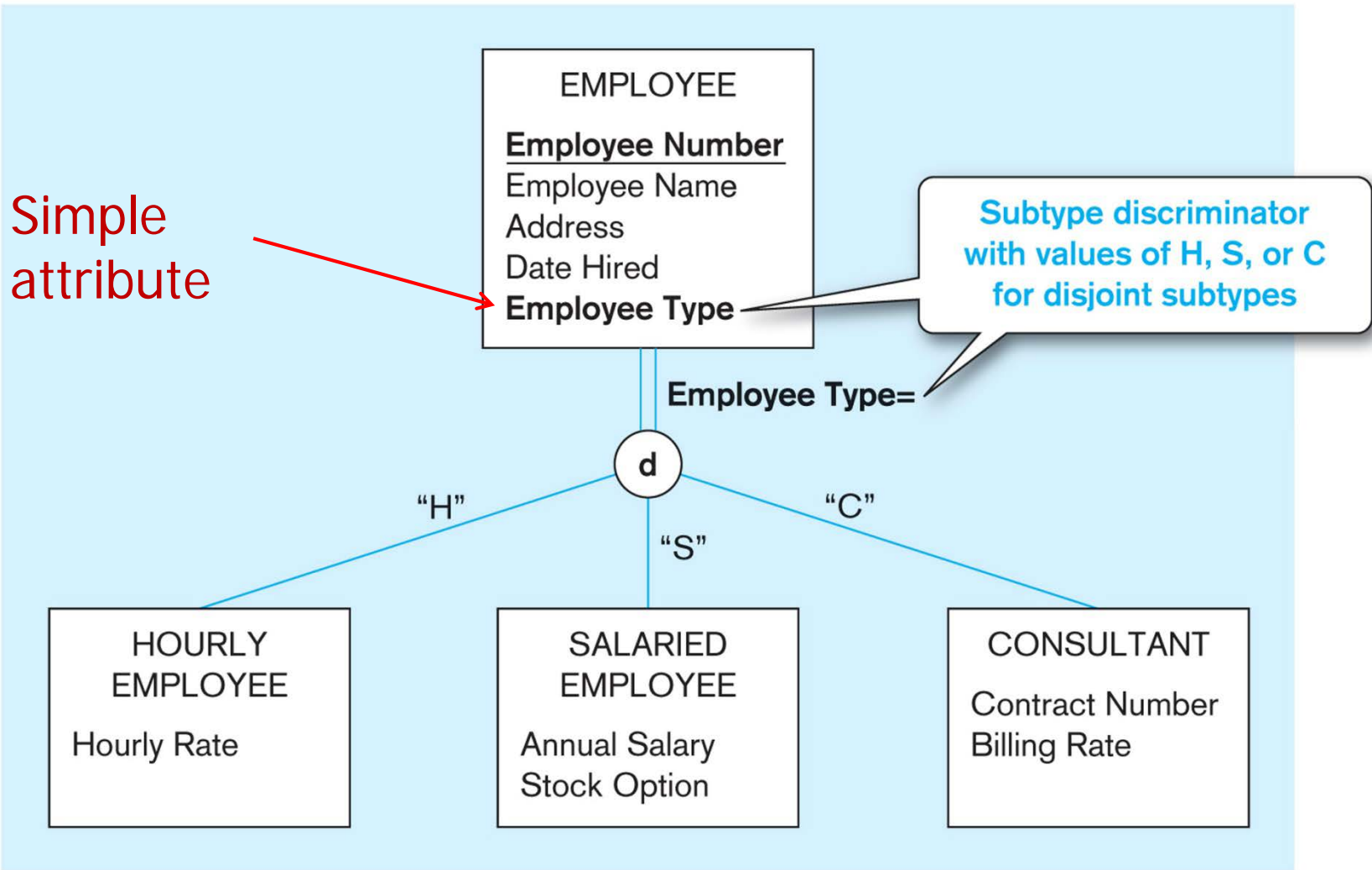


Constraints in Supertype/Subtype Relationship: **Subtype Discriminators**

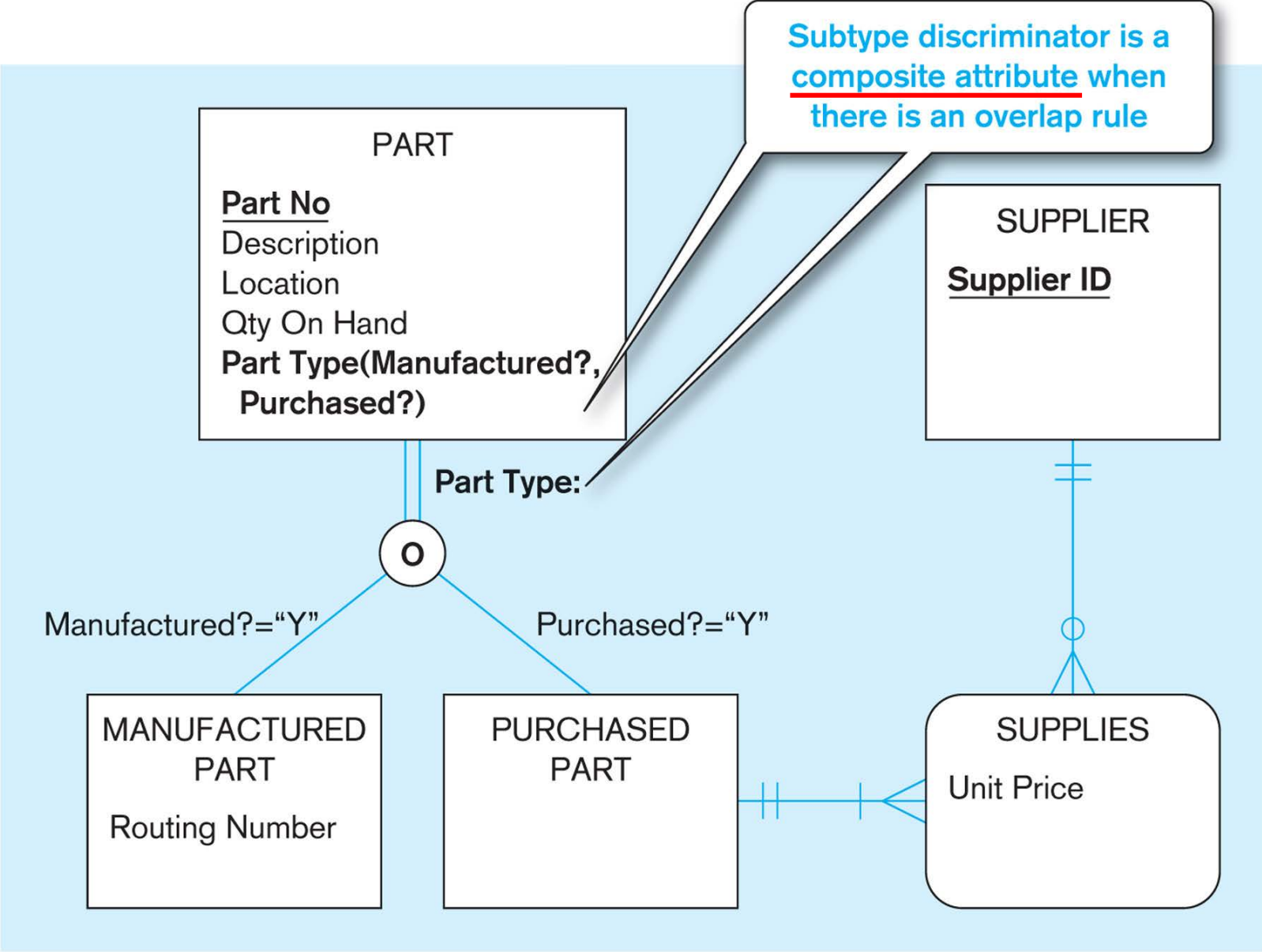
Subtype Discriminator: An attribute of the supertype whose values determine the target subtype(s). It has two situations:

- ❑ **Disjoint** – a *simple* attribute with alternative values to indicate the possible subtypes
- ❑ **Overlapping** – a *composite* attribute whose subparts pertain to different subtypes. Each subpart contains a Boolean value to indicate whether or not the instance belongs to the associated subtype

Subtype discriminator (*disjoint* rule)



Subtype discriminator (overlap rule)

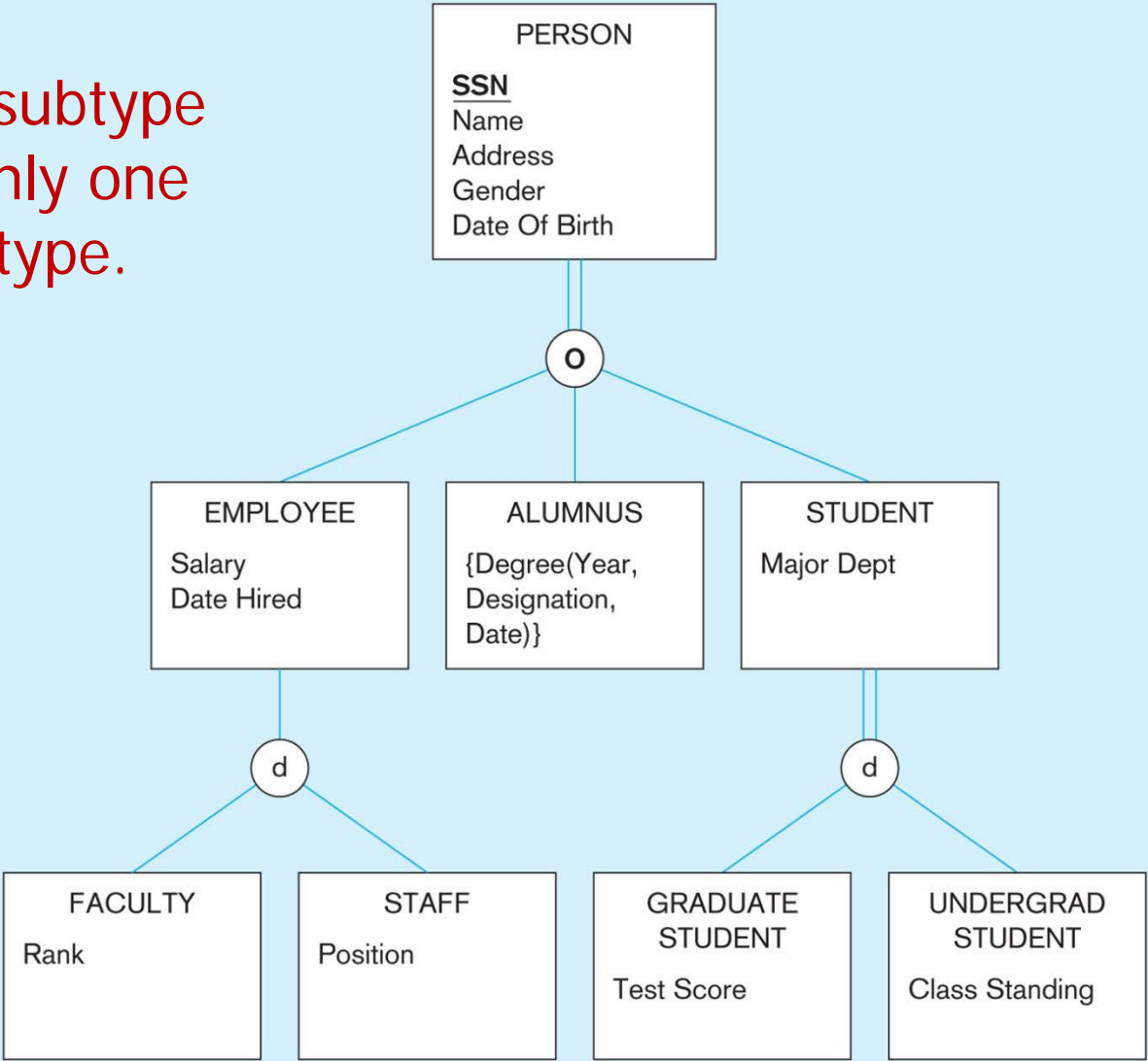


Supertype/Subtype Hierarchy

- ❑ A subtype may have other subtypes defined on it, so that the subtype becomes a supertype of the newly defined subtypes.
- ❑ Supertype/subtype hierarchy is a hierarchal arrangement of supertypes and subtypes in which each subtype has only one supertype.

Example of supertype/subtype hierarchy

Each subtype has only one supertype.

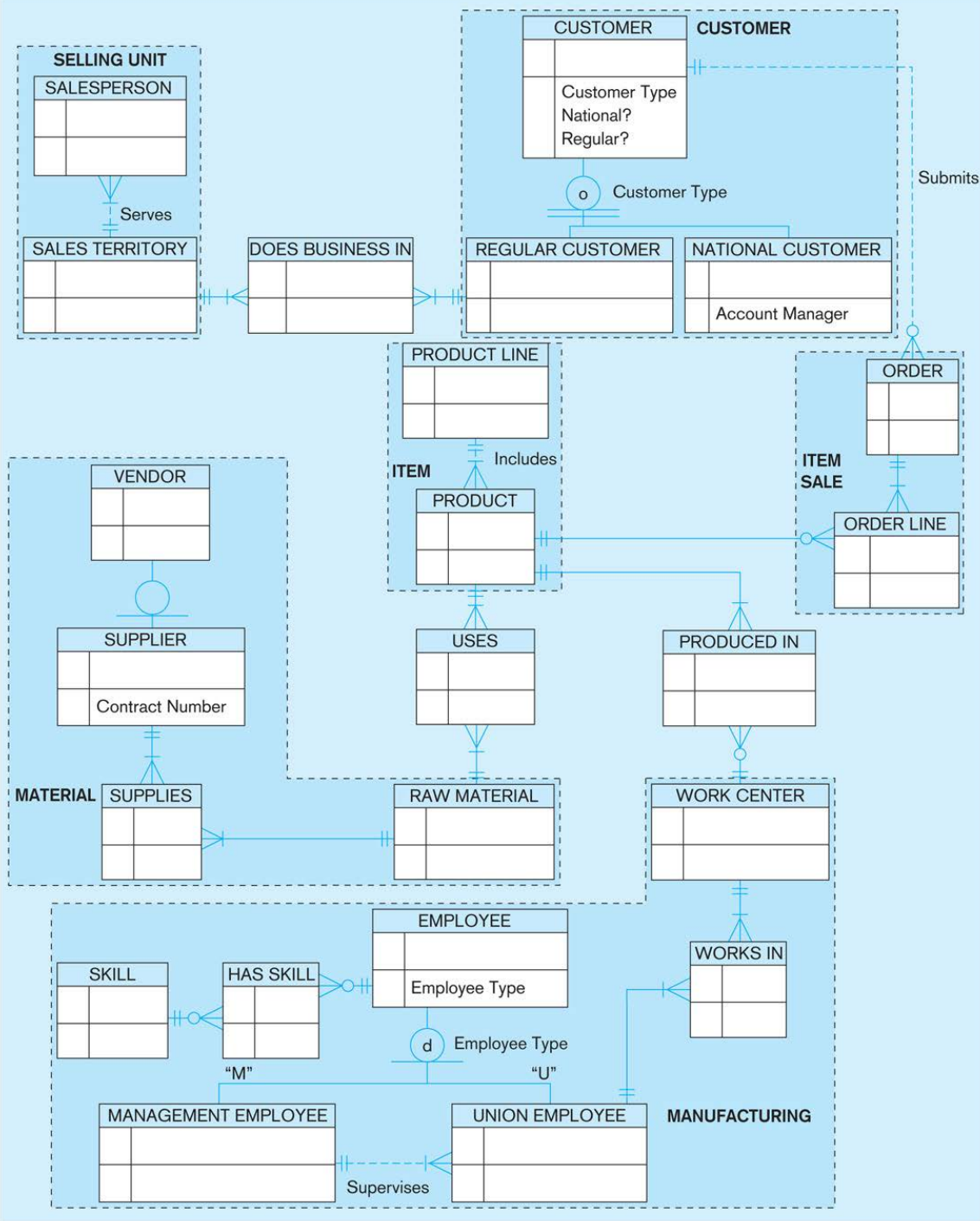


Entity Clusters

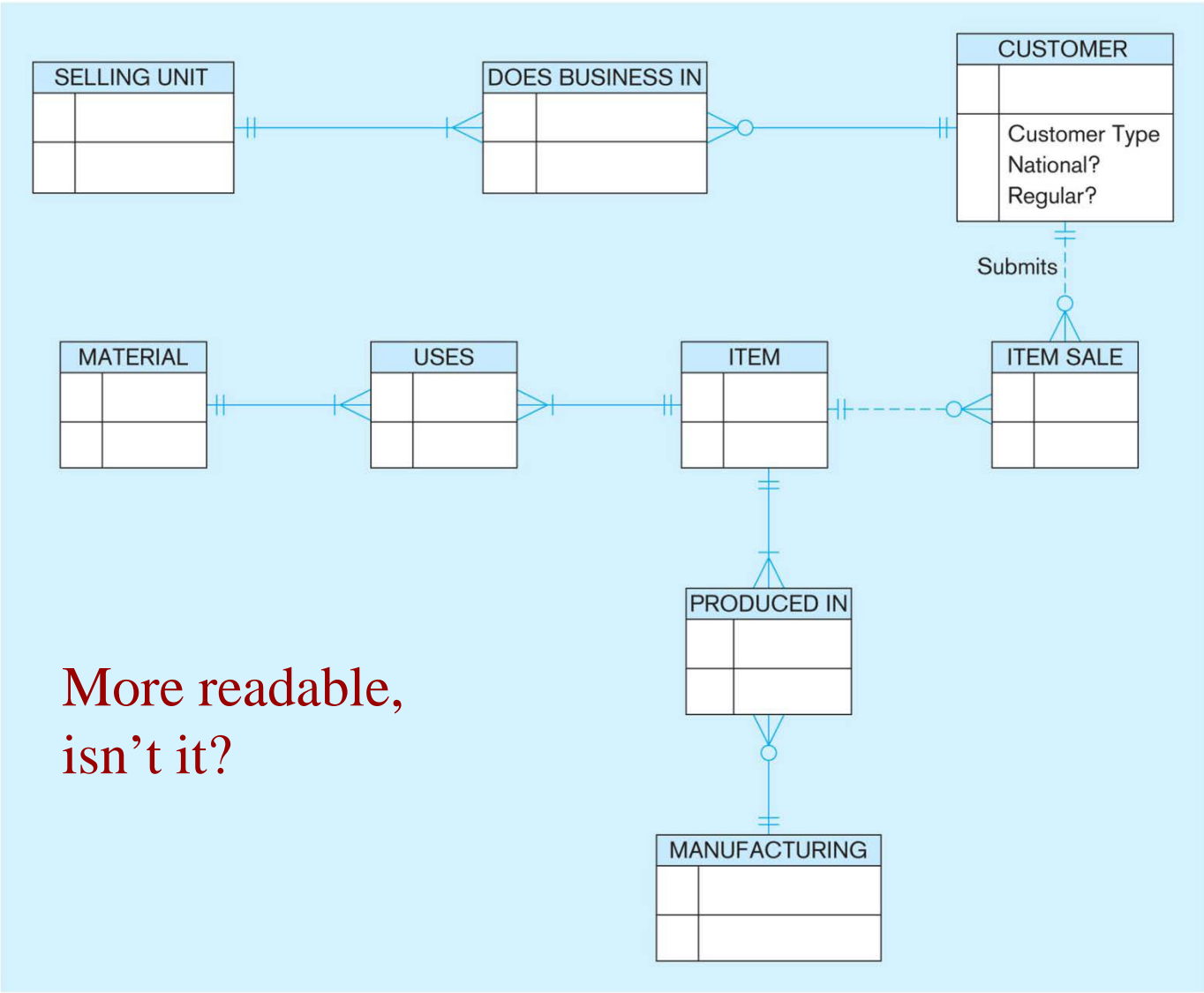
- ❑ EER diagrams are difficult to read when there are too many entities and relationships
- ❑ Solution: Group entities and relationships into *entity clusters*
- ❑ **Entity cluster:** Set of one or more entity types and associated relationships grouped into a single *abstract entity type*

Possible entity clusters for Pine Valley Furniture Company in Microsoft Visio

Related groups of entities could become a cluster.



EER diagram of PVF entity clusters



More readable,
isn't it?

Manufacturing entity cluster

Details for a single cluster

Packaged Data Models

- ❑ Predefined data models
- ❑ Could be universal or industry-specific
- ❑ Universal data model = a generic or template data model that can be reused as a starting point for a data modeling project (also called a “pattern”)

Advantages of Packaged Data Models

- ❑ Use proven model components
- ❑ Save time and cost
- ❑ Less likelihood of data model errors
- ❑ Easier to evolve and modify over time
- ❑ Aid in requirements determination
- ❑ Easier to read
- ❑ Supertype/subtype hierarchies promote reuse
- ❑ Many-to-many relationships enhance model flexibility
- ❑ Vendor-supplied data model fosters integration with vendor's applications
- ❑ Universal models support inter-organizational systems