The Enhanced ER Model

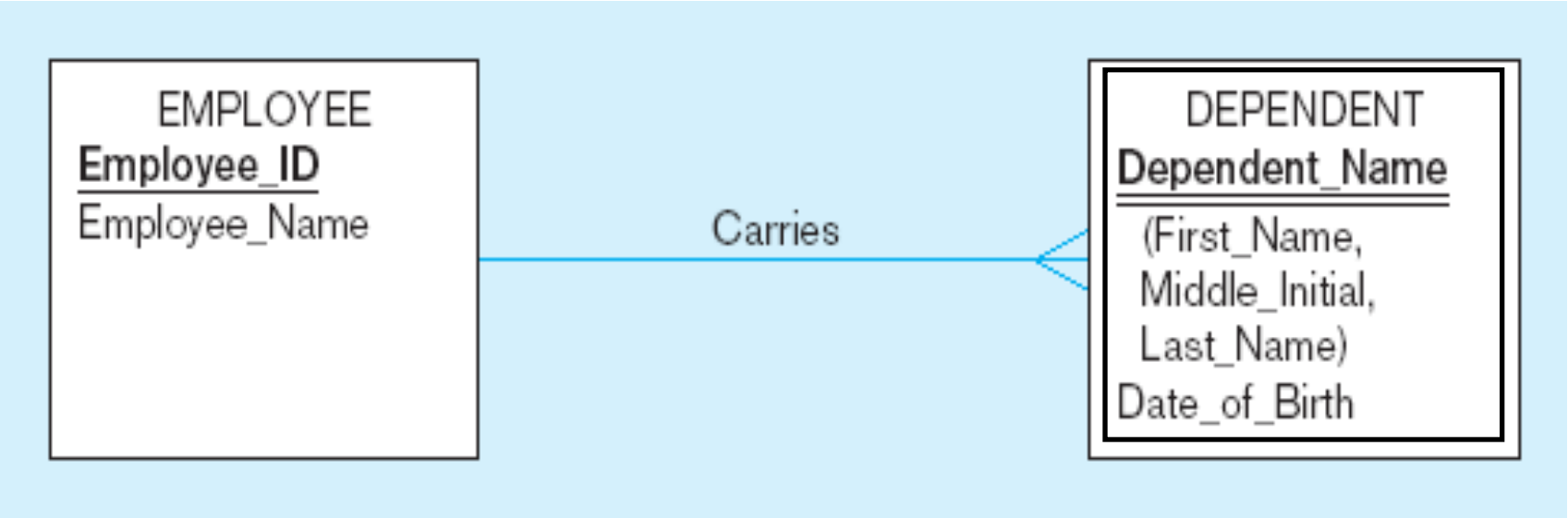
Agenda

- Strong vs Weak entity
- Associative entity
- Enhanced ER (EER)
- Cluster

Strong vs. Weak Entities, and Identifying Relationships

- **Strong entities**
  - exist independently of other types of entities
  - **has its own unique identifier**
  - *identifier underlined with single-line*
- **Weak entity**
  - dependent on a strong entity (identifying owner)…cannot exist on its own
  - **does not have a unique identifier** (only a partial identifier)
  - *Partial identifier underlined with double-line*
  - *Entity box has double line*
- **Identifying relationship**
  - links strong entities to weak entities

Identifying relationship



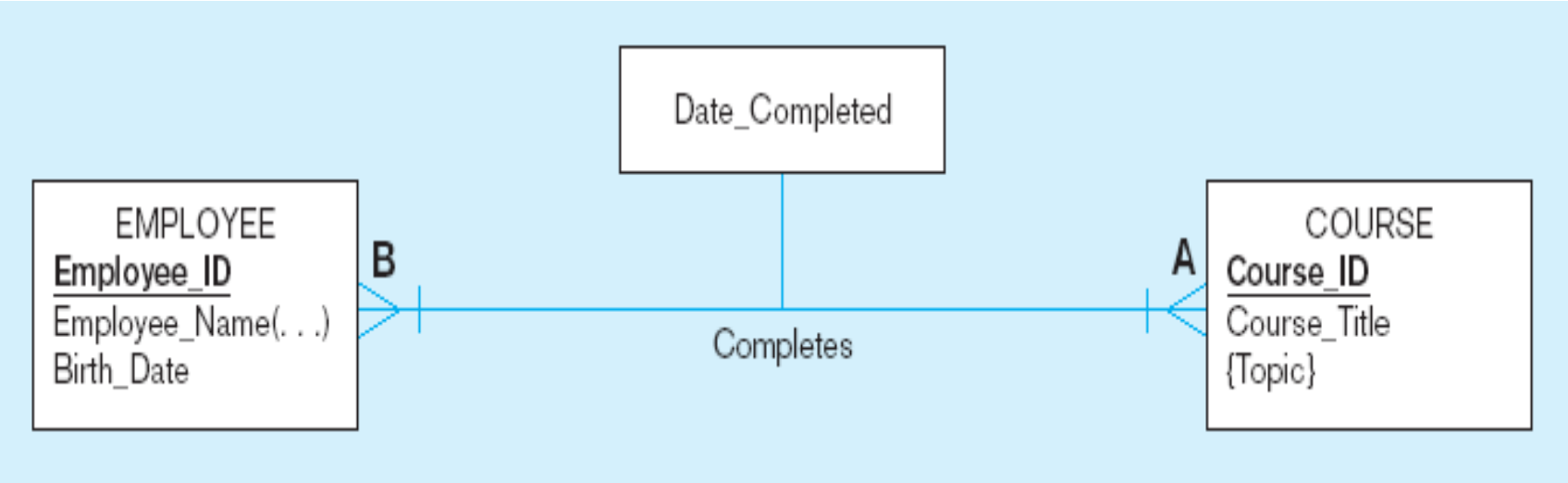
Strong entity

Weak entity

Associative Entities

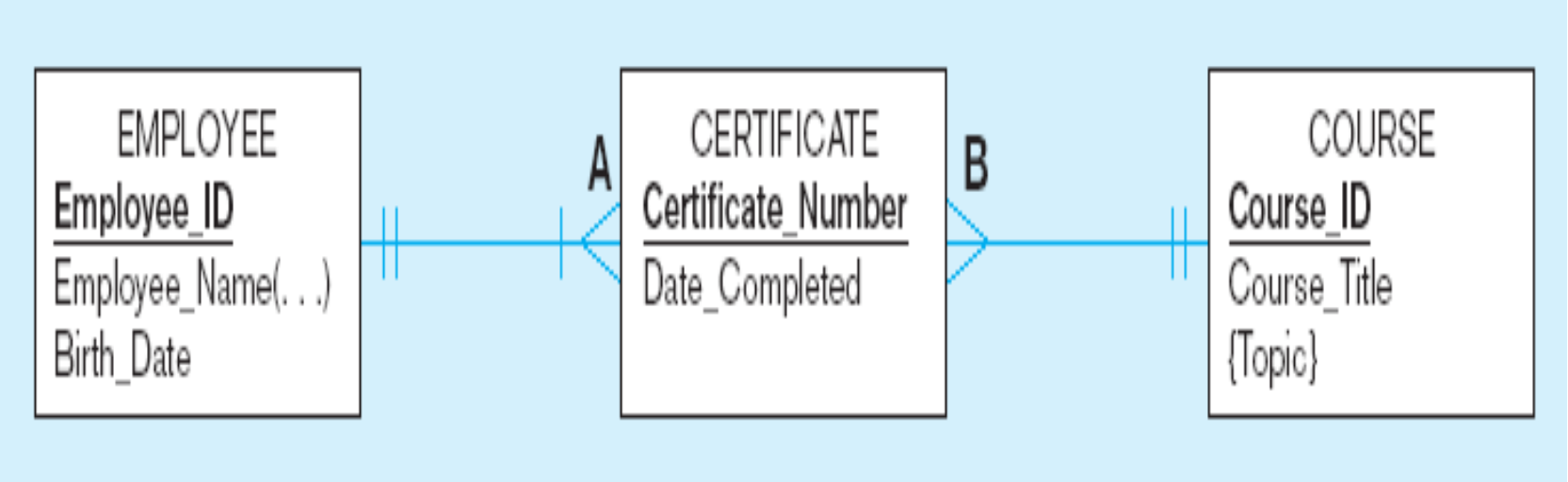
- An entity–has attributes
- A relationship–links entities together
- When should a *relationship with attributes* instead be an *associative entity*?
  - All relationships for the associative entity **should be many**
  - **Ternary relationships** should be converted to associative entities
  - The associative entity preferably has a **unique identifier**, and should also have other attributes
  - The associative entity **may participate** in other relationships other than the entities of the associated relationship

A binary relationship with an attribute



Here, the date completed attribute pertains specifically to the employee's completion of a course…it is an attribute of the *relationship*

An associative entity (CERTIFICATE)

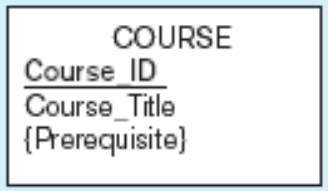


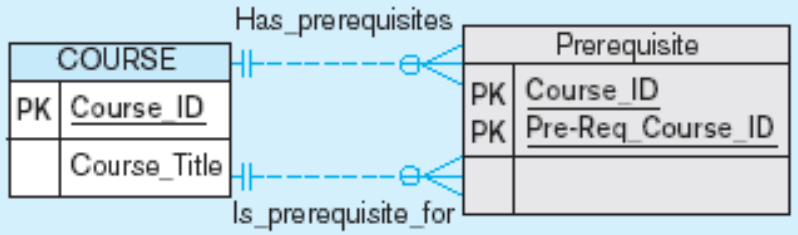
Associative entity is like a relationship with an attribute, but it is also considered to be an entity in its own right.

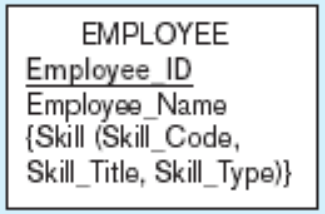
Note that the many-to-many cardinality between entities in Figure 3-11a has been replaced by two one-to-many relationships with the associative entity.

Multivalued attributes can be represented as relationships

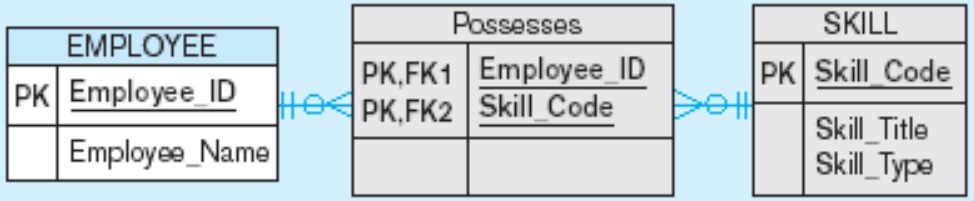
ATTRIBUTE	RELATIONSHIP & ENTITY
simple	



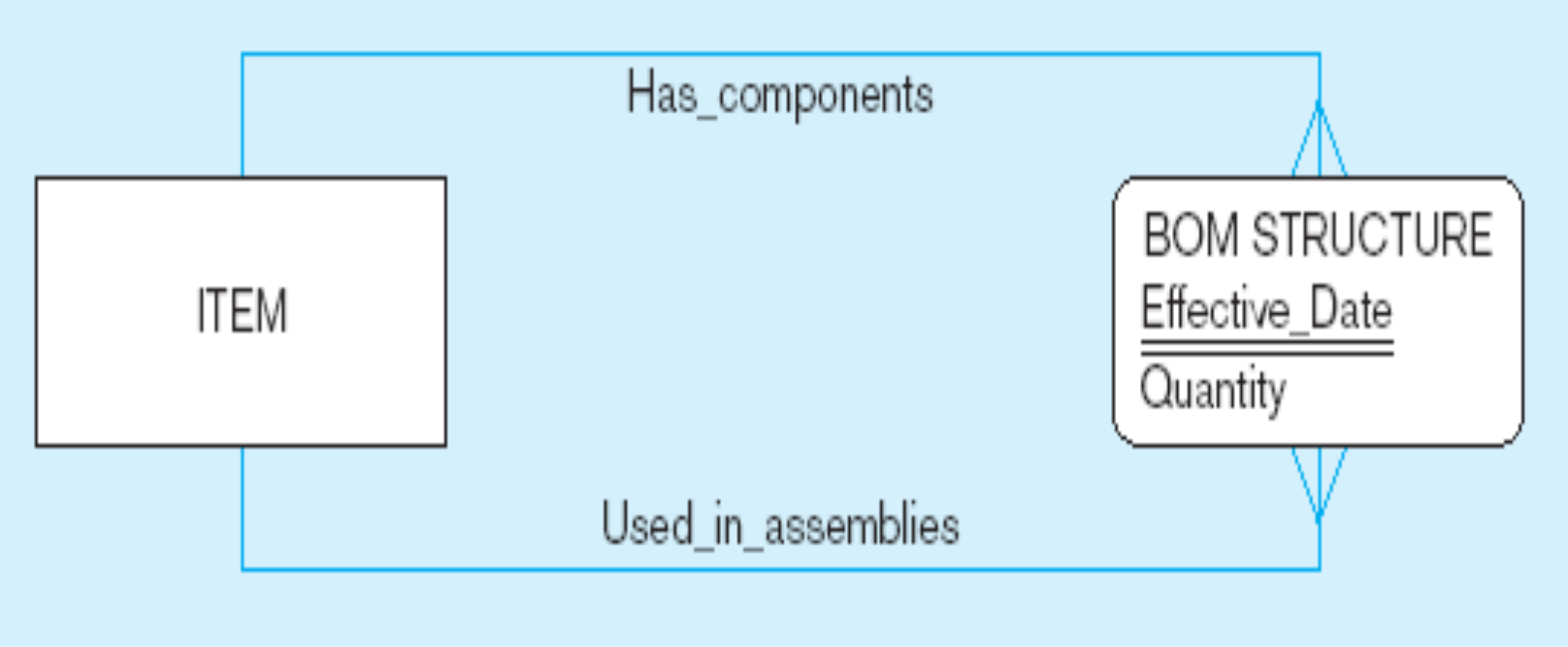




composite

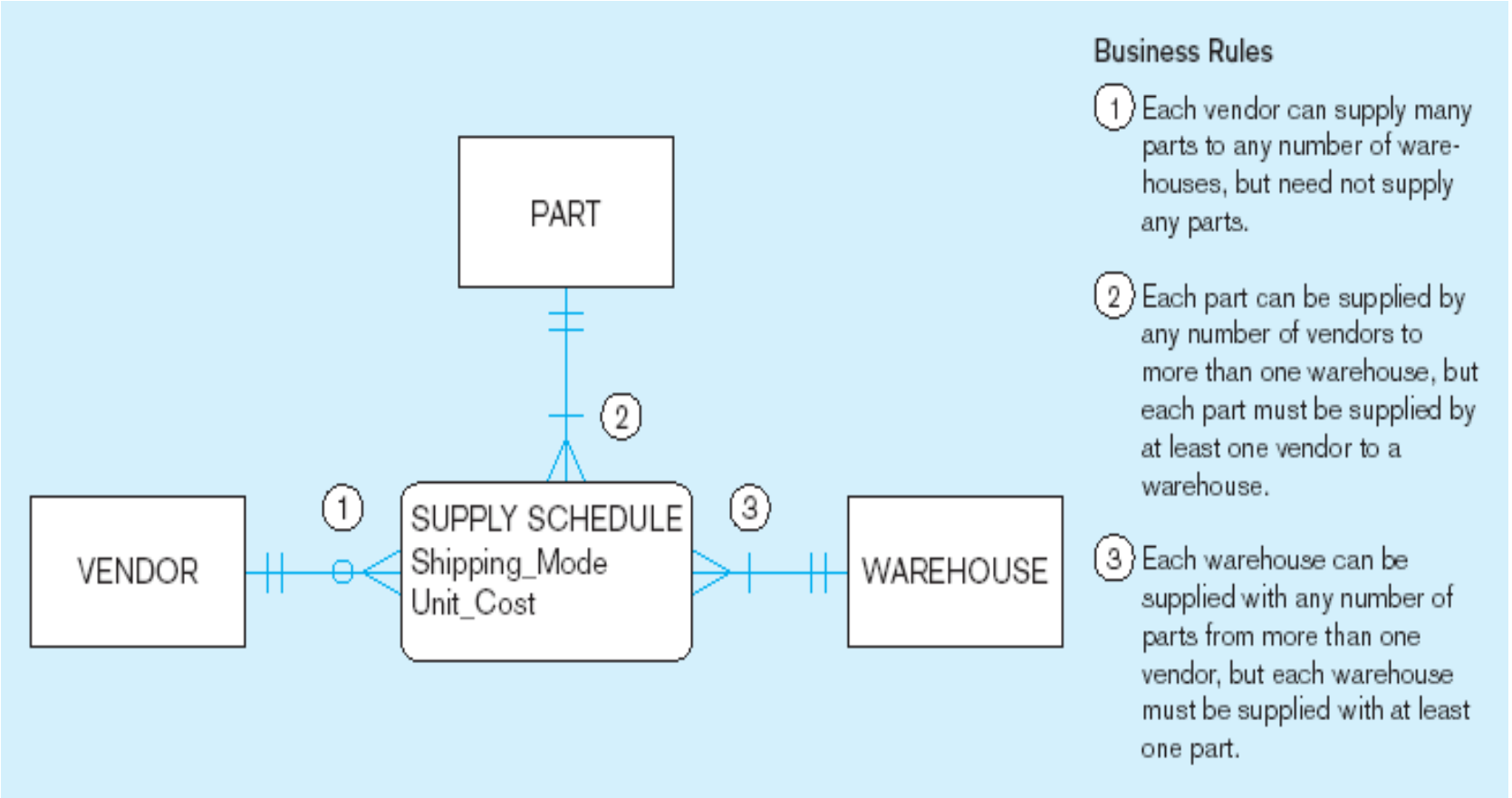


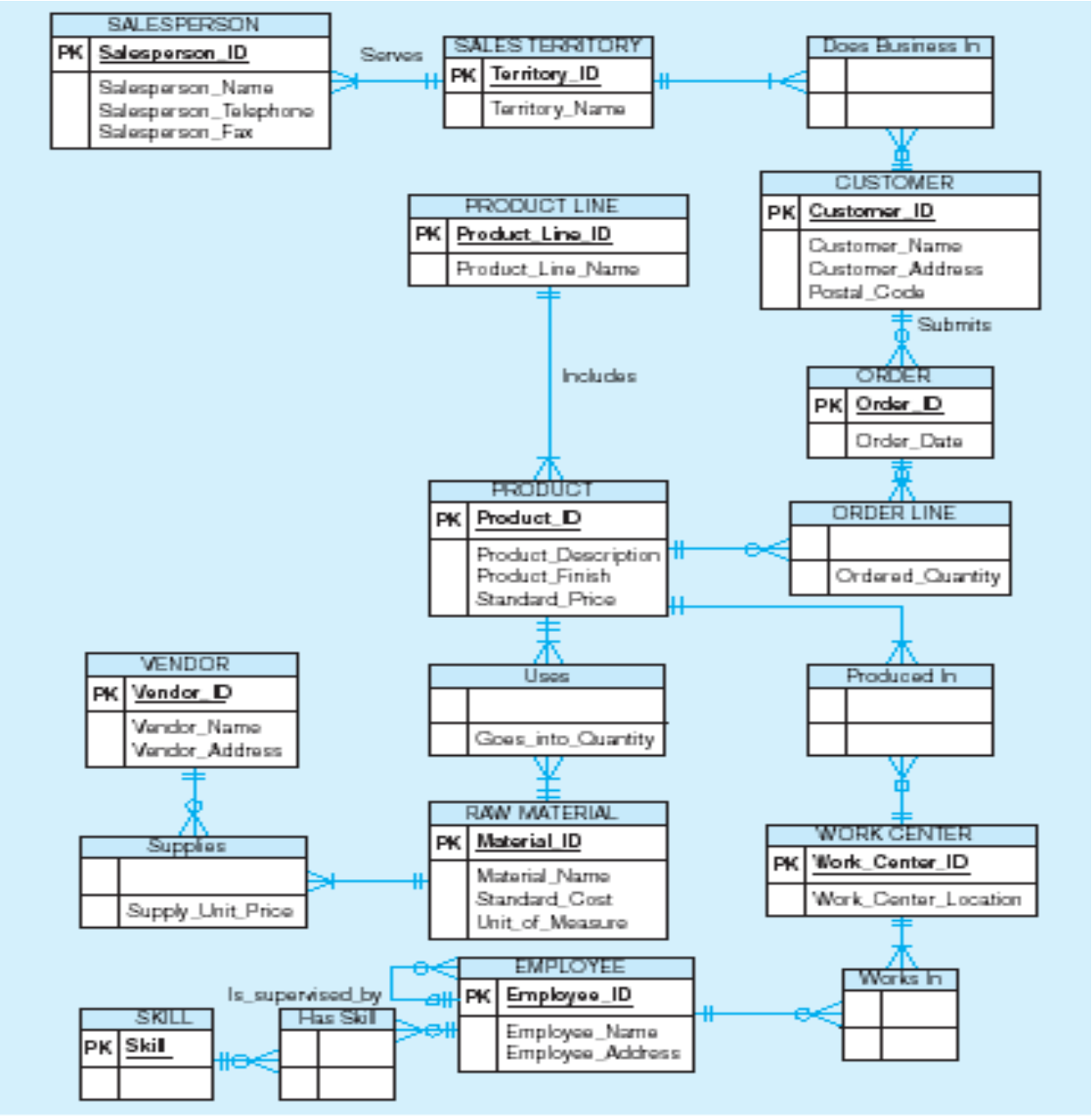
An associative entity – bill of materials structure



This could just be a relationship with attributes…it's a judgment call

Ternary relationship as an associative entity

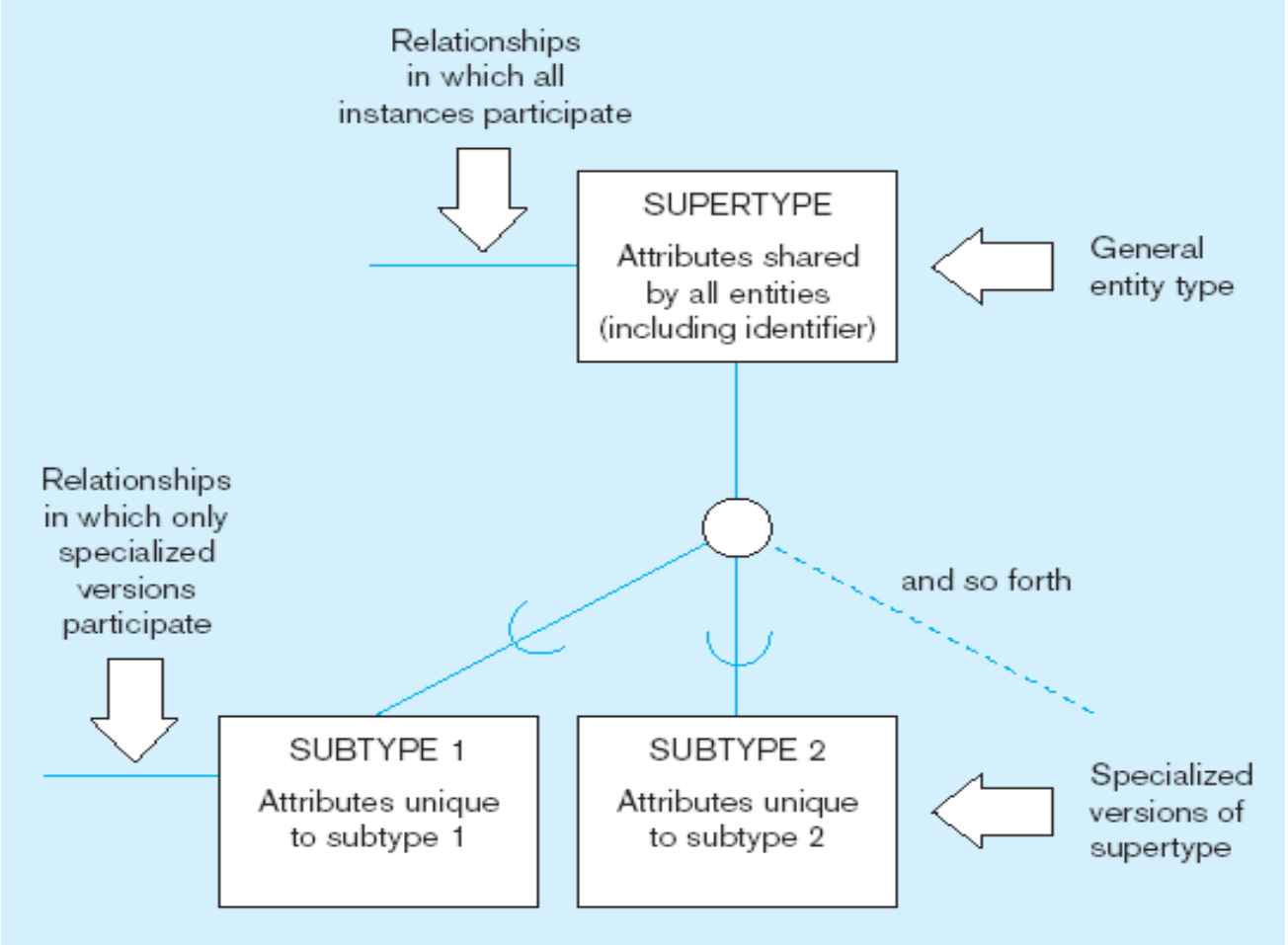




Microsoft Visio Notation for Pine Valley Furniture E-R diagram

Different modeling software tools may have different notation for the same constructs

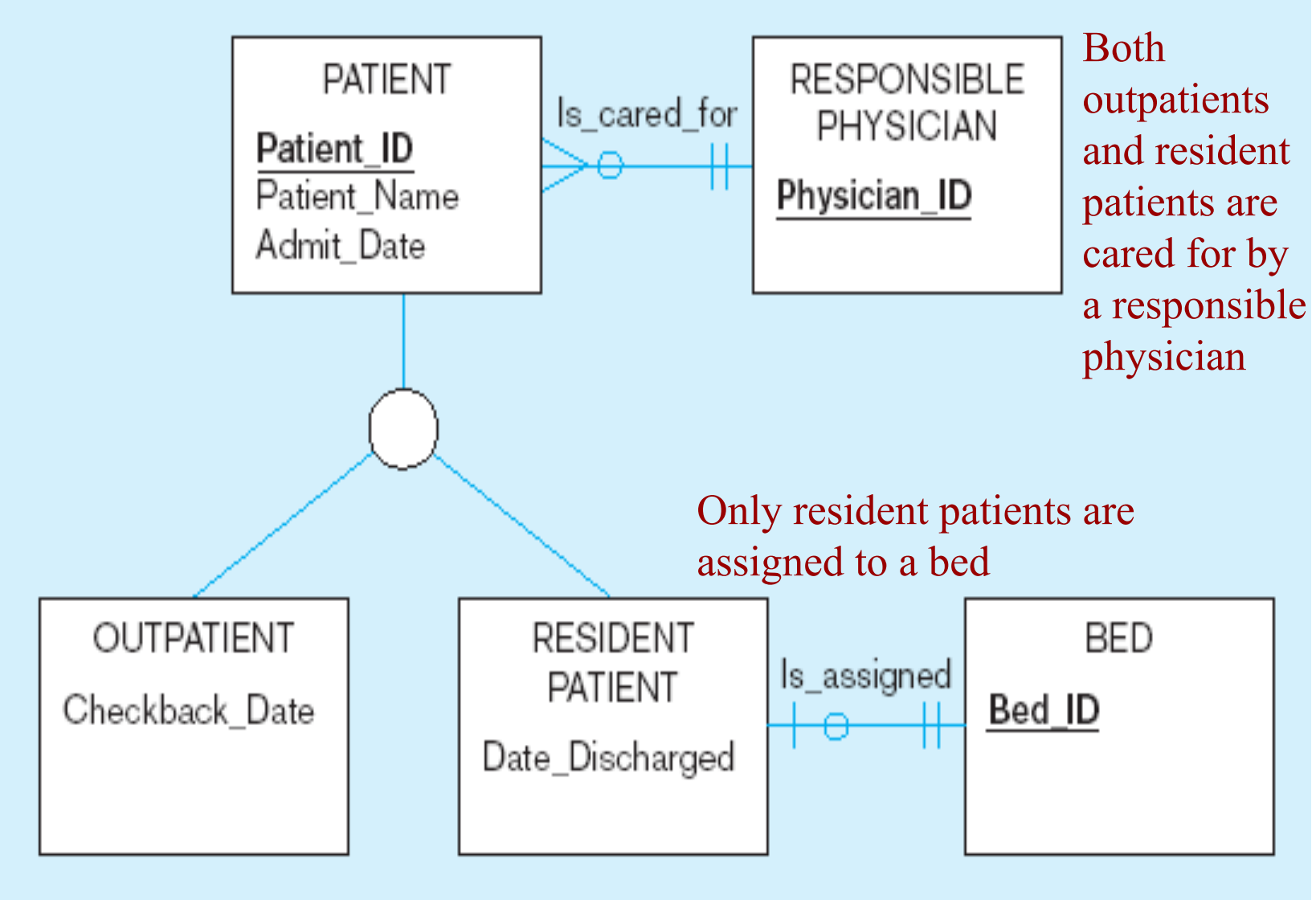
Basic notation for supertype/subtype notation



Supertypes and Subtypes

- ***Subtype***: A subgrouping of the entities in an entity type that has attributes distinct from those in other subgroupings
- ***Supertype***: A generic entity type that has a relationship with one or more subtypes
- ***Attribute Inheritance***:
  - Subtype entities inherit values of all attributes of the supertype
  - An instance of a subtype is also an instance of the supertype

Supertype/subtype relationships in a hospital

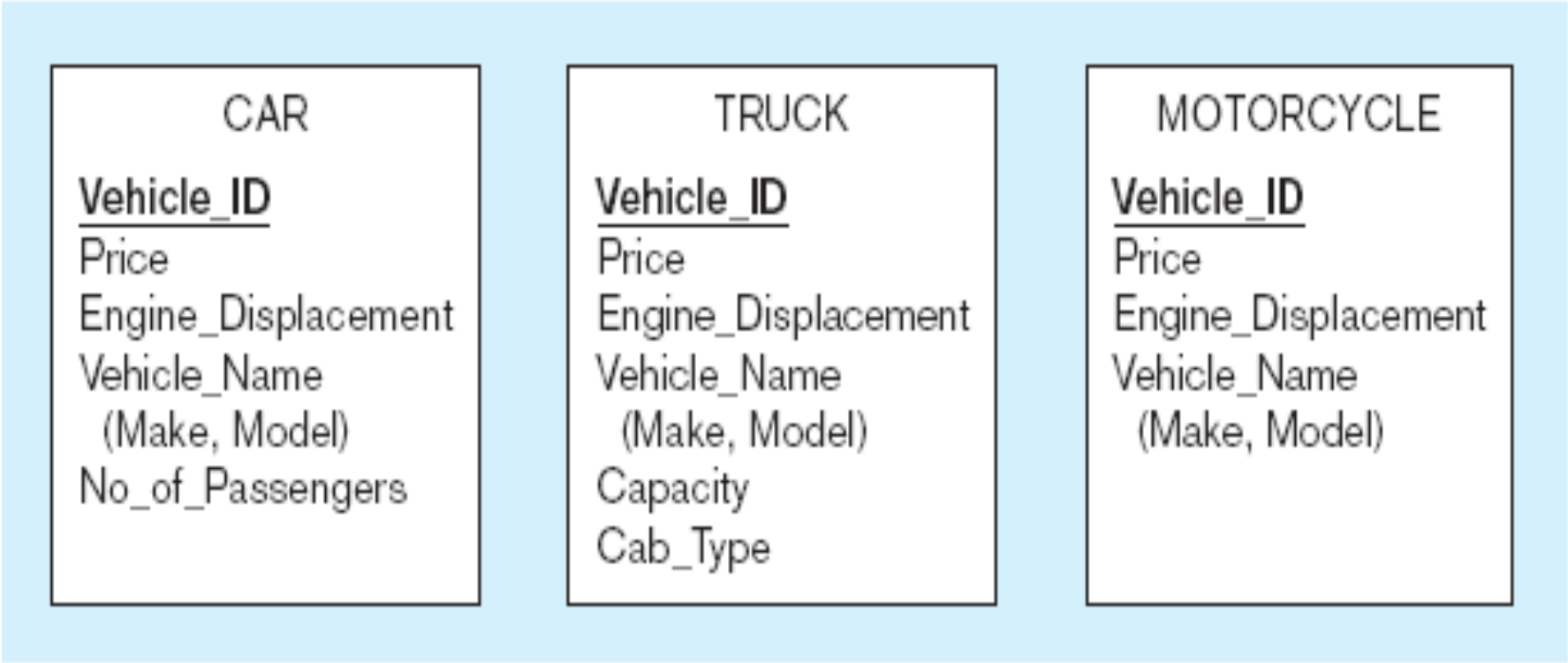


Generalization and Specialization

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

Example of generalization

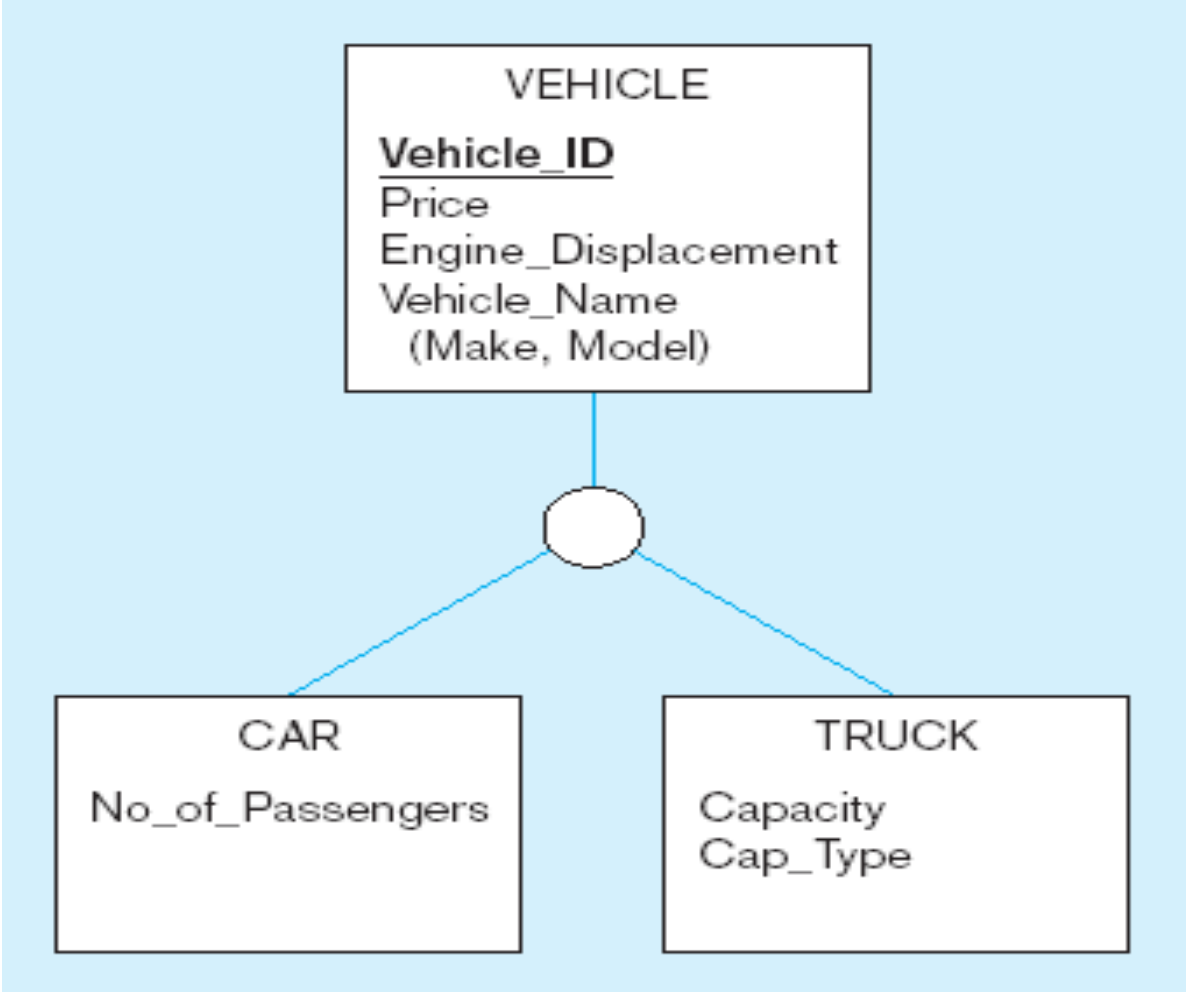
a) Three entity types: CAR, TRUCK, and MOTORCYCLE



All these types of vehicles have common attributes

Example of generalization (cont.)

b) Generalization to VEHICLE supertype

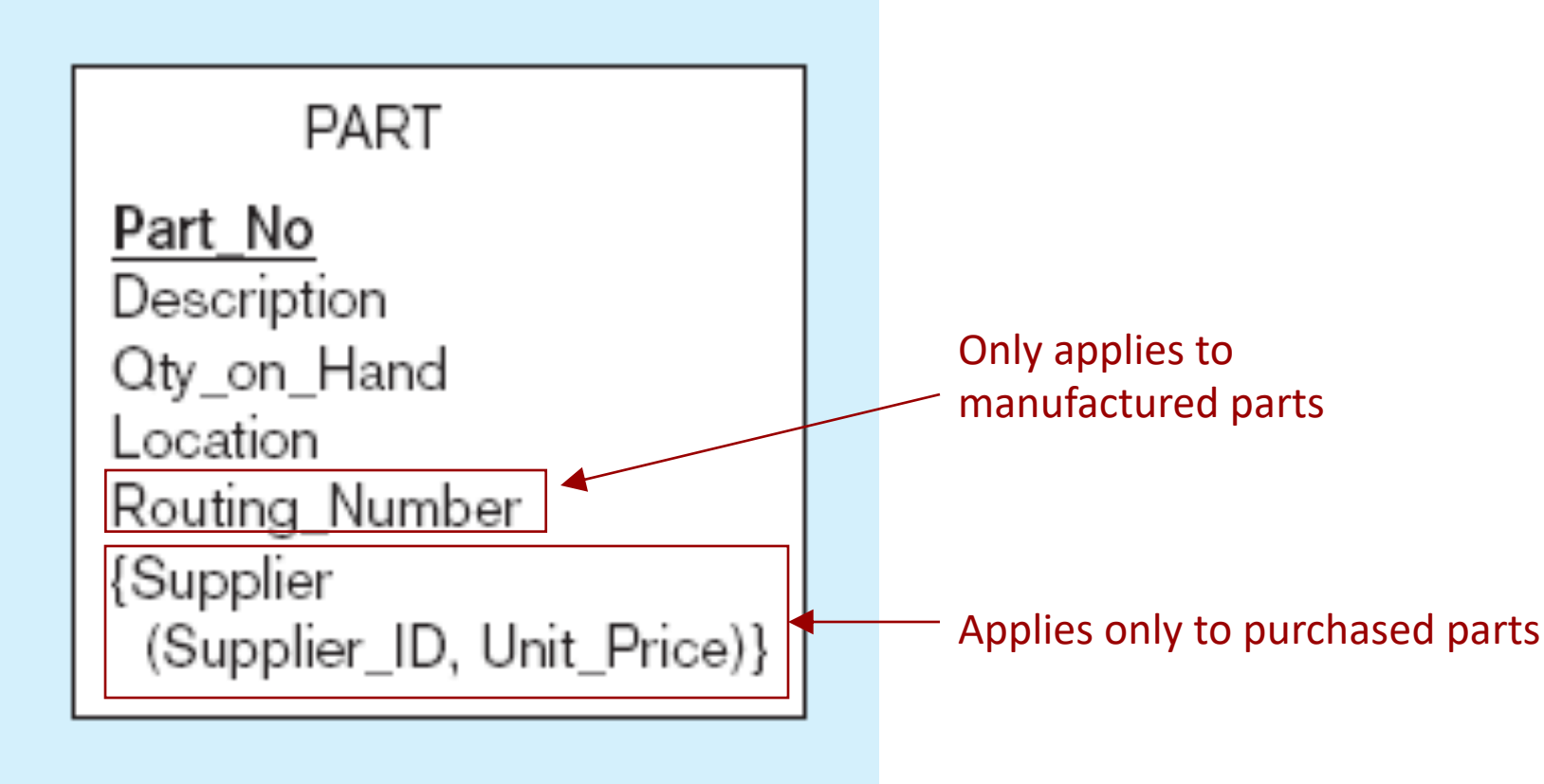


So we put the shared attributes in a supertype

Note: no subtype for motorcycle, since it has no unique attributes

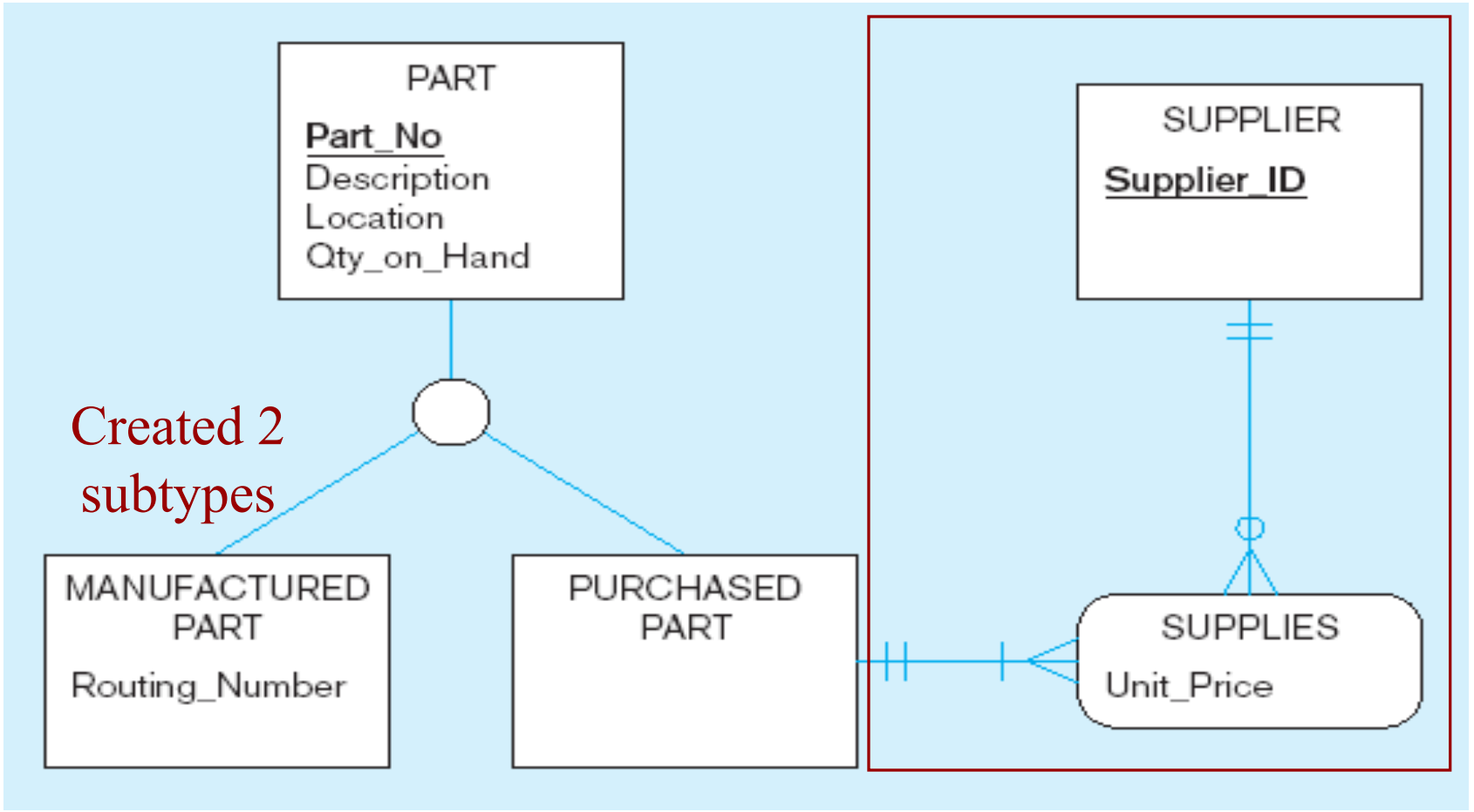
Example of specialization

a) Entity type PART



Example of specialization (cont.)

b) Specialization to MANUFACTURED PART and PURCHASED PART



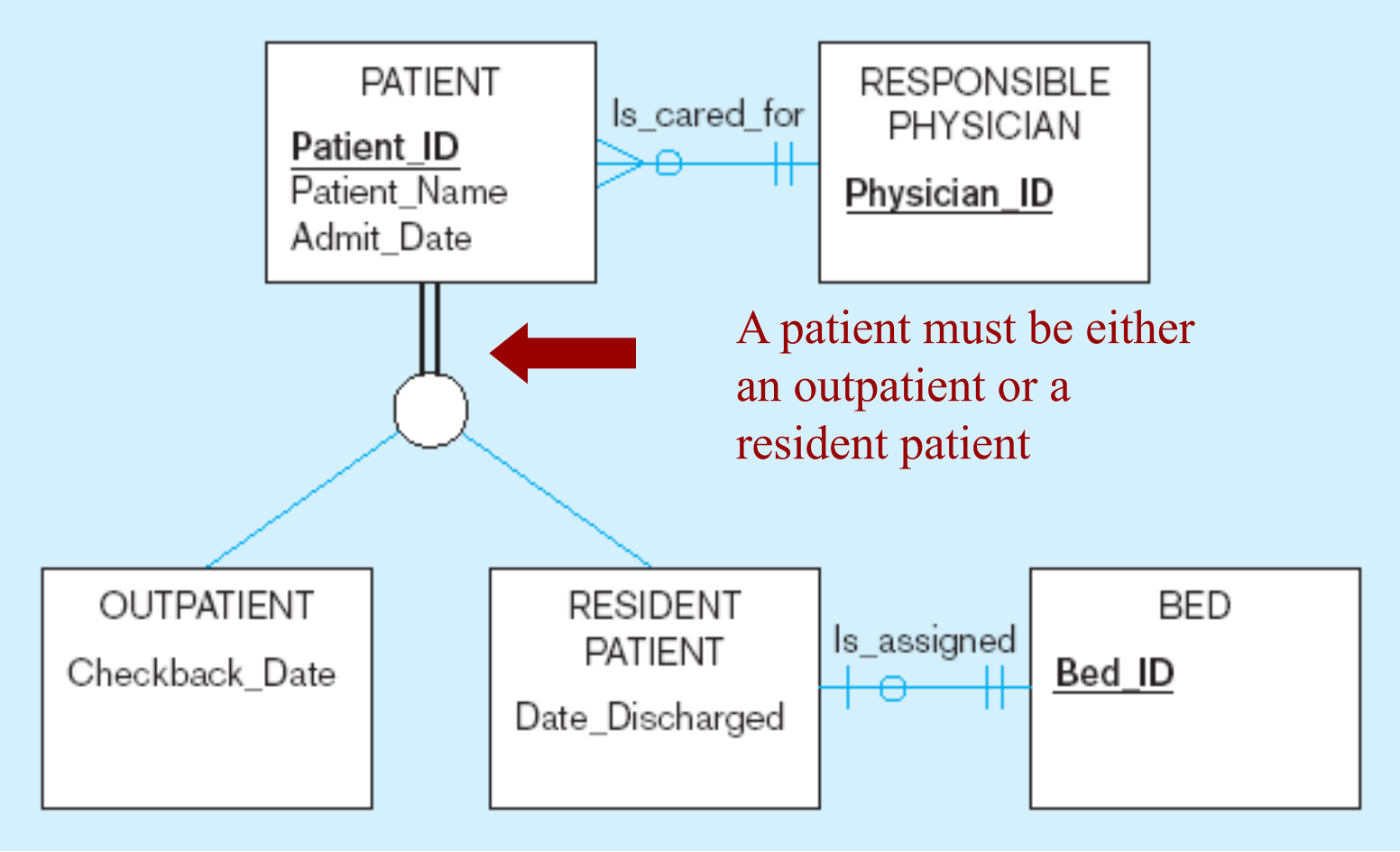
Note: multivalued attribute was replaced by an associative entity relationship to another entity

Constraints in Supertype/ Completeness Constraint

- ***Completeness Constraints***: Whether an instance of a supertype ***must*** also be a member of at least one subtype
  - Total Specialization Rule: Yes (double line)
  - Partial Specialization Rule: No (single line)

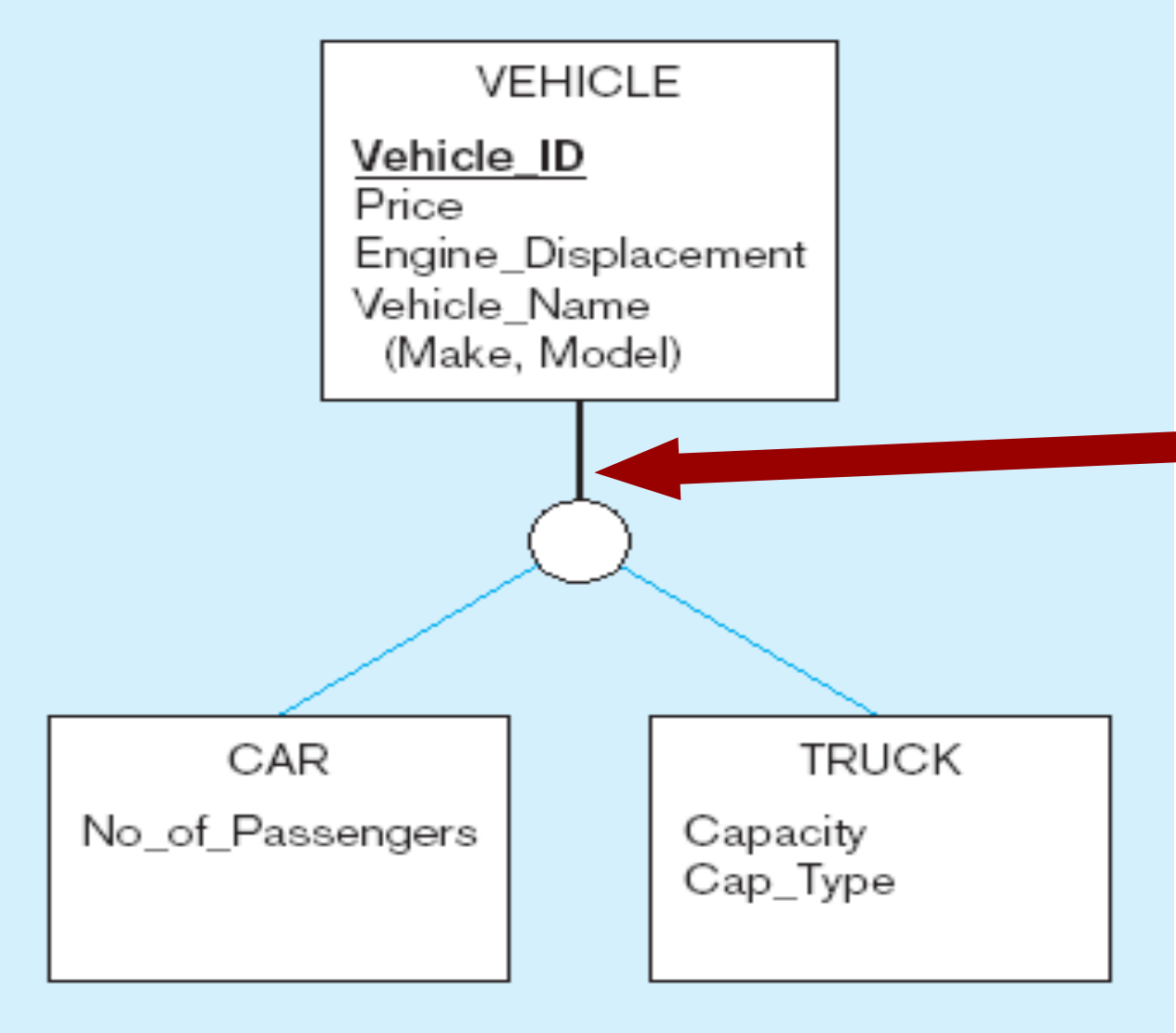
Examples of completeness constraints

a) Total specialization rule



Examples of completeness constraints (cont.)

b) Partial specialization rule



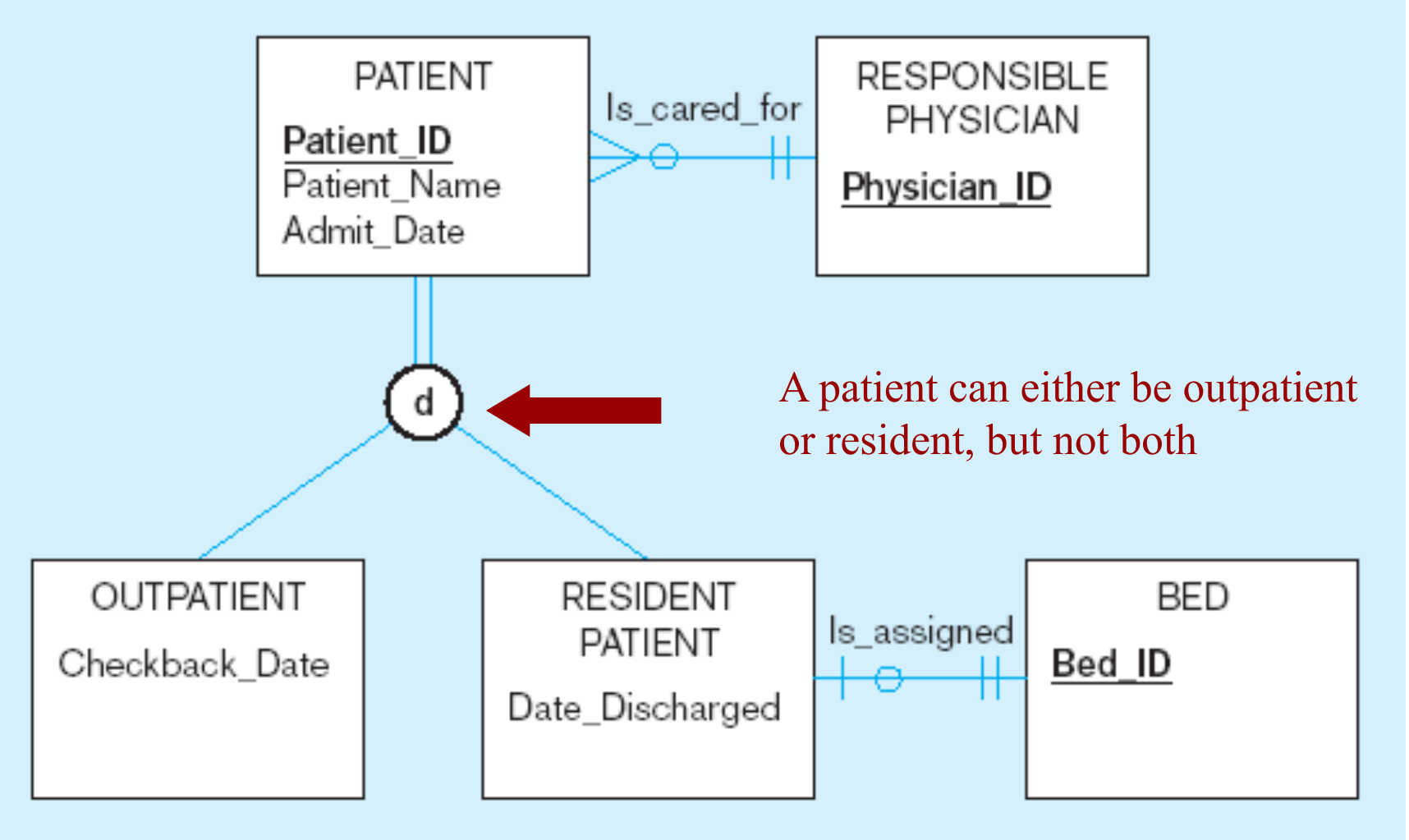
A vehicle could be a car, a truck, or neither

Constraints in Supertype/ Disjointness constraint

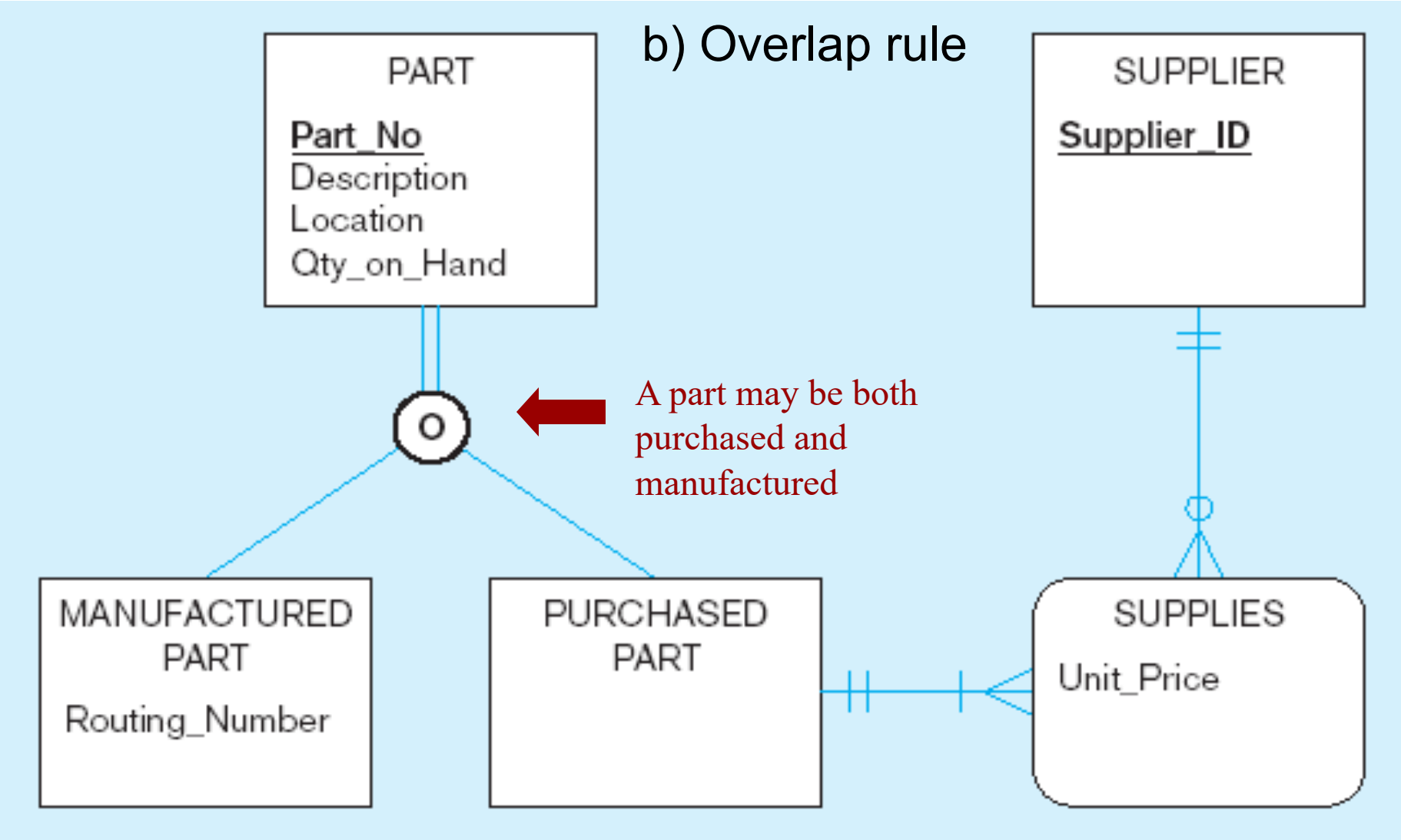
- ***Disjointness Constraints***: Whether an instance of a supertype may *simultaneously* be a member of two (or more) subtypes
  - **Disjoint Rule**: An instance of the supertype can be only ONE of the subtypes
  - **Overlap Rule**: An instance of the supertype could be more than one of the subtypes

Figure 4-7 Examples of disjointness constraints

a) Disjoint rule



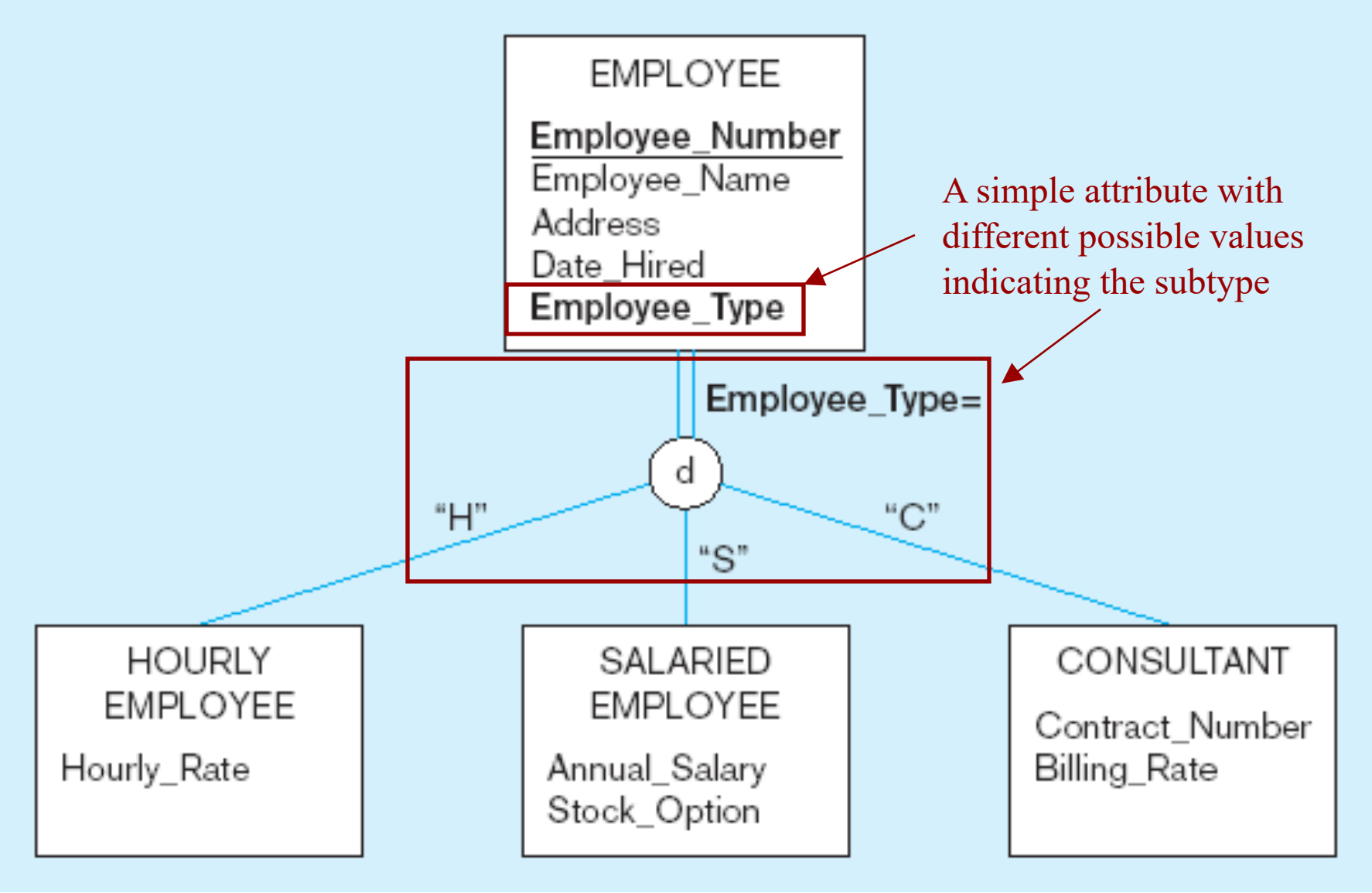
Examples of disjointness constraints (cont.)



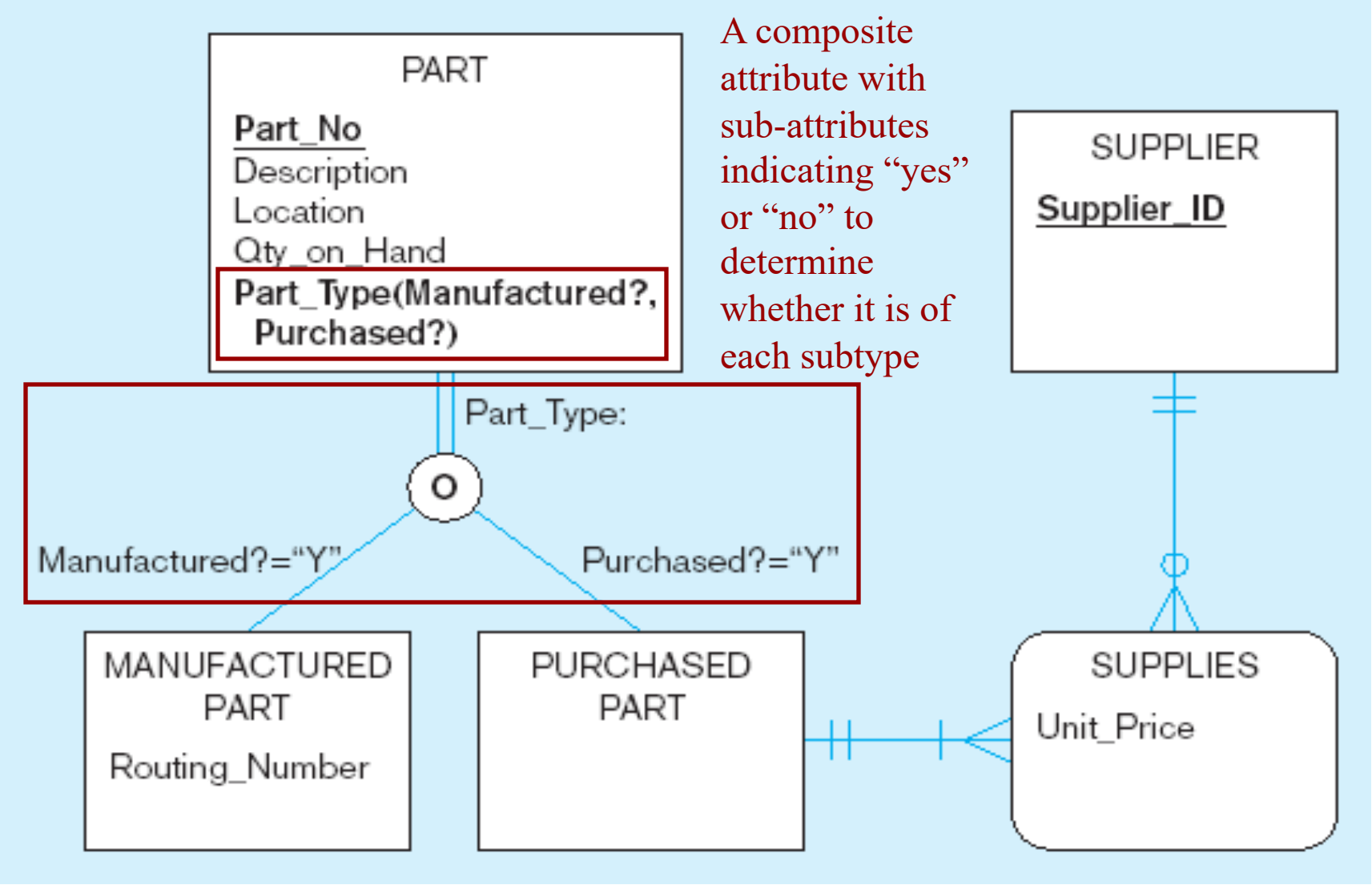
Constraints in Supertype/ Subtype Discriminators

- ***Subtype Discriminator***: An attribute of the supertype whose values determine the target subtype(s)
  - **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

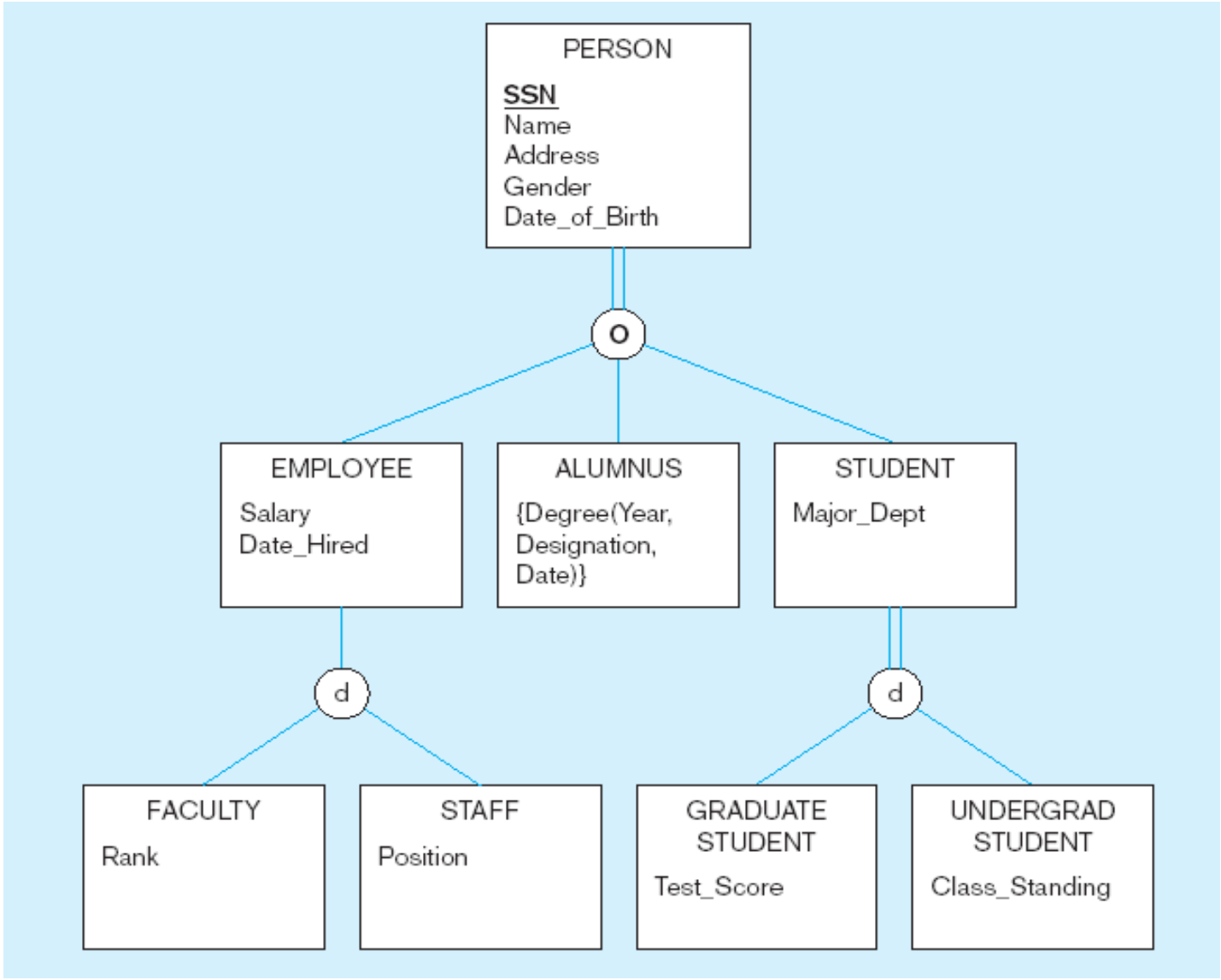
Introducing a subtype discriminator (***disjoint*** rule)



Subtype discriminator (***overlap*** rule)



Example of supertype/subtype hierarchy



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

Figure 4-13a

Possible entity clusters for Pine Valley Furniture in Microsoft Visio

Related groups of entities could become clusters

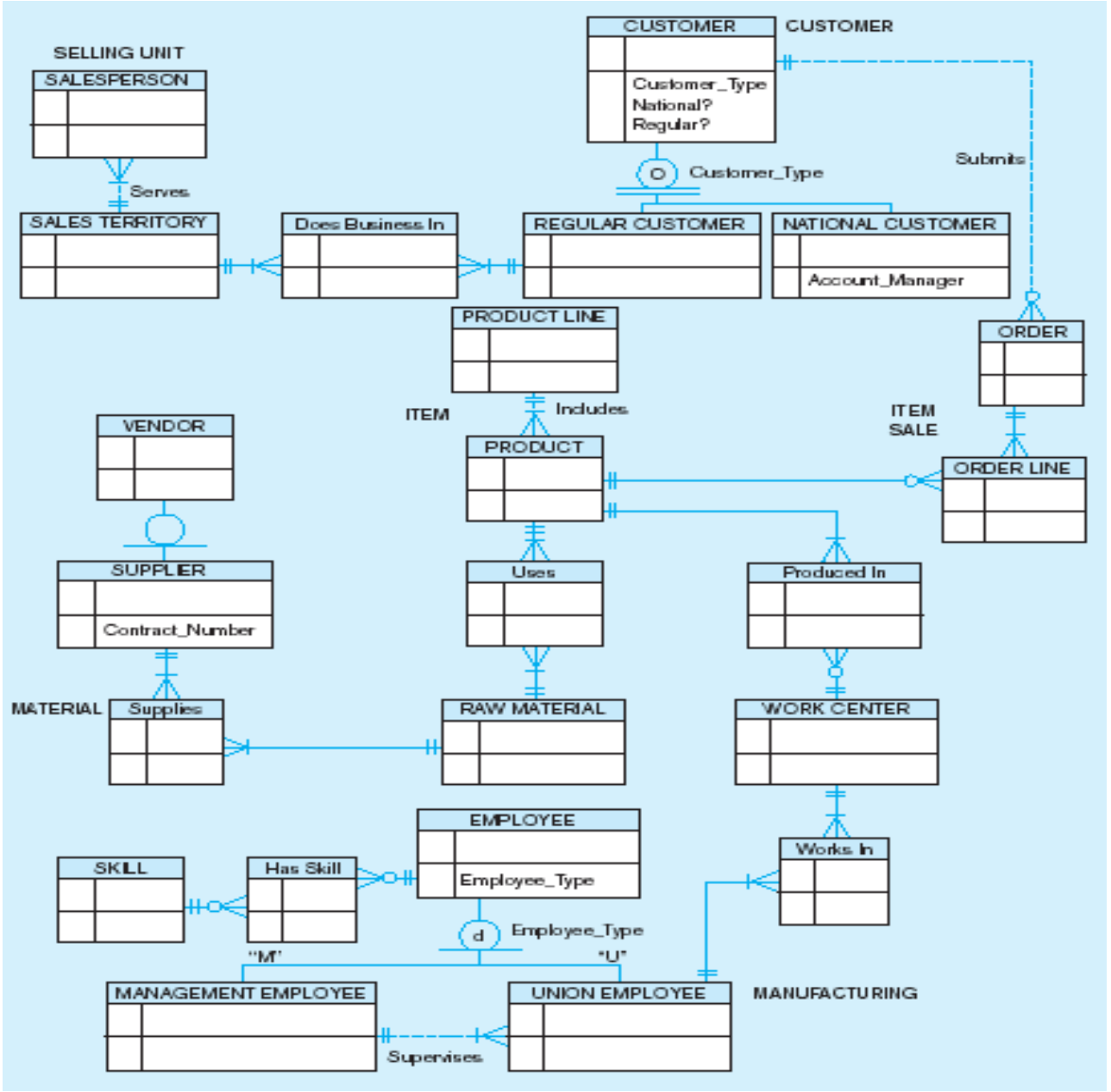


Figure 4-13b EER diagram of PVF entity clusters

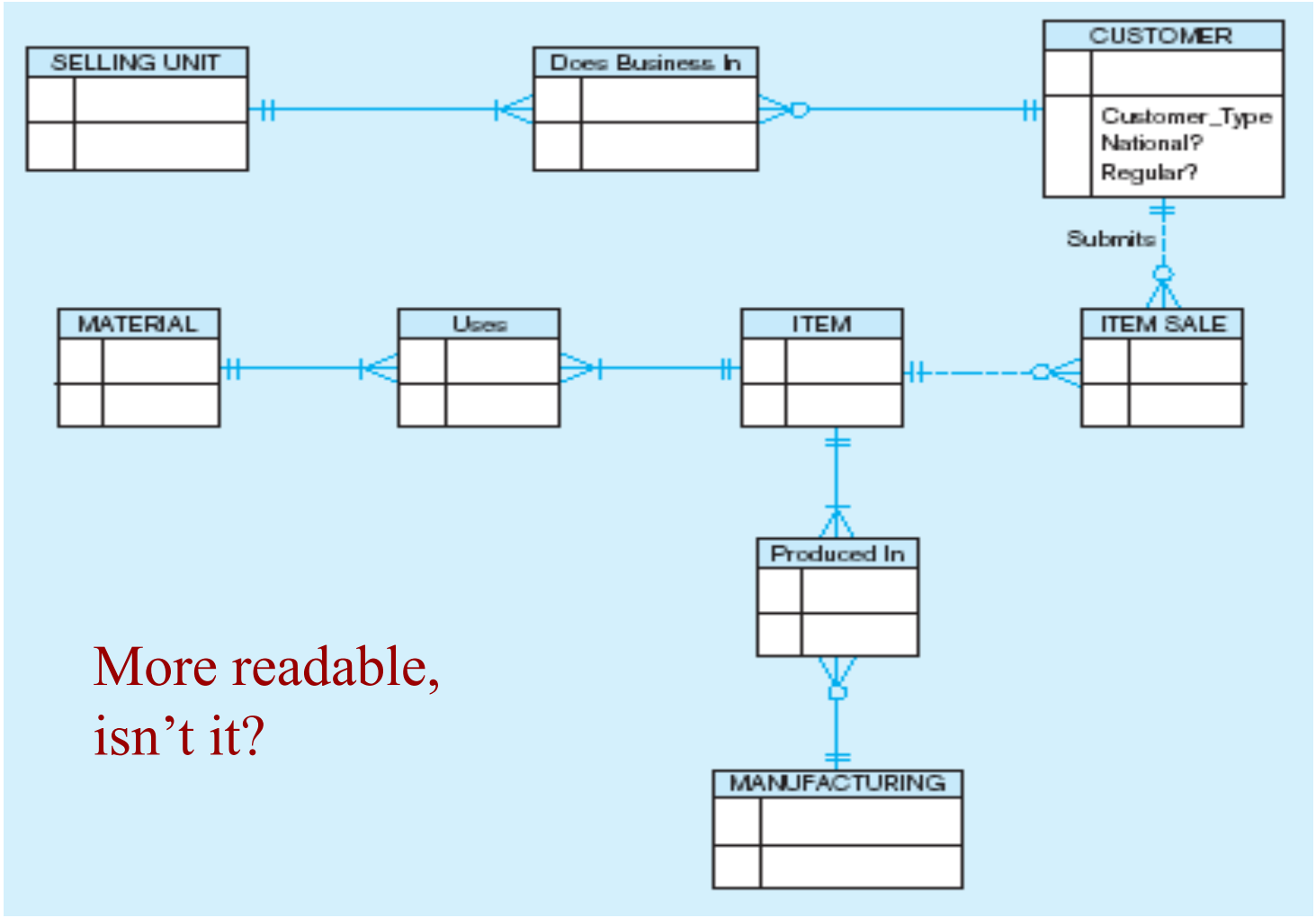
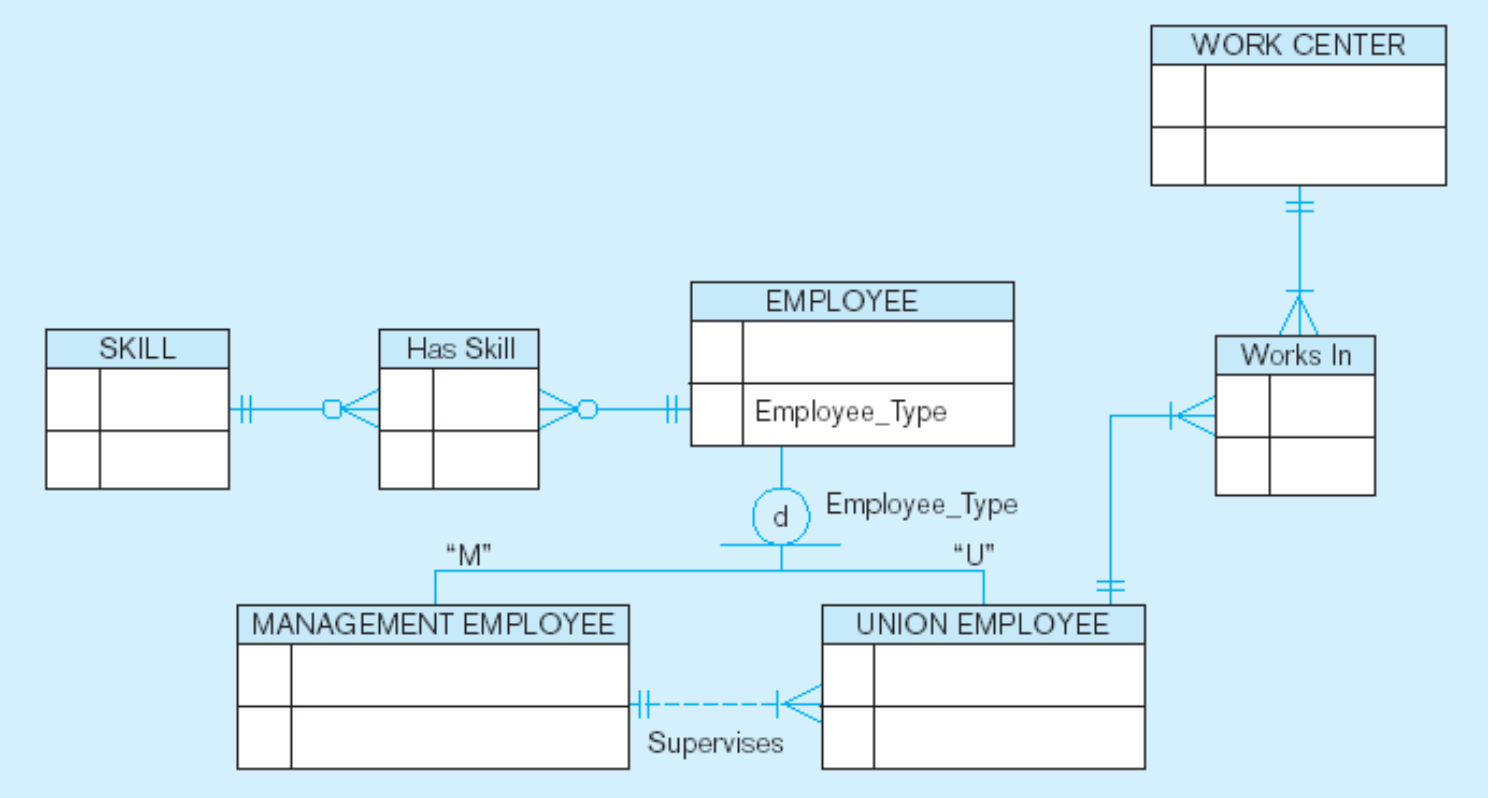
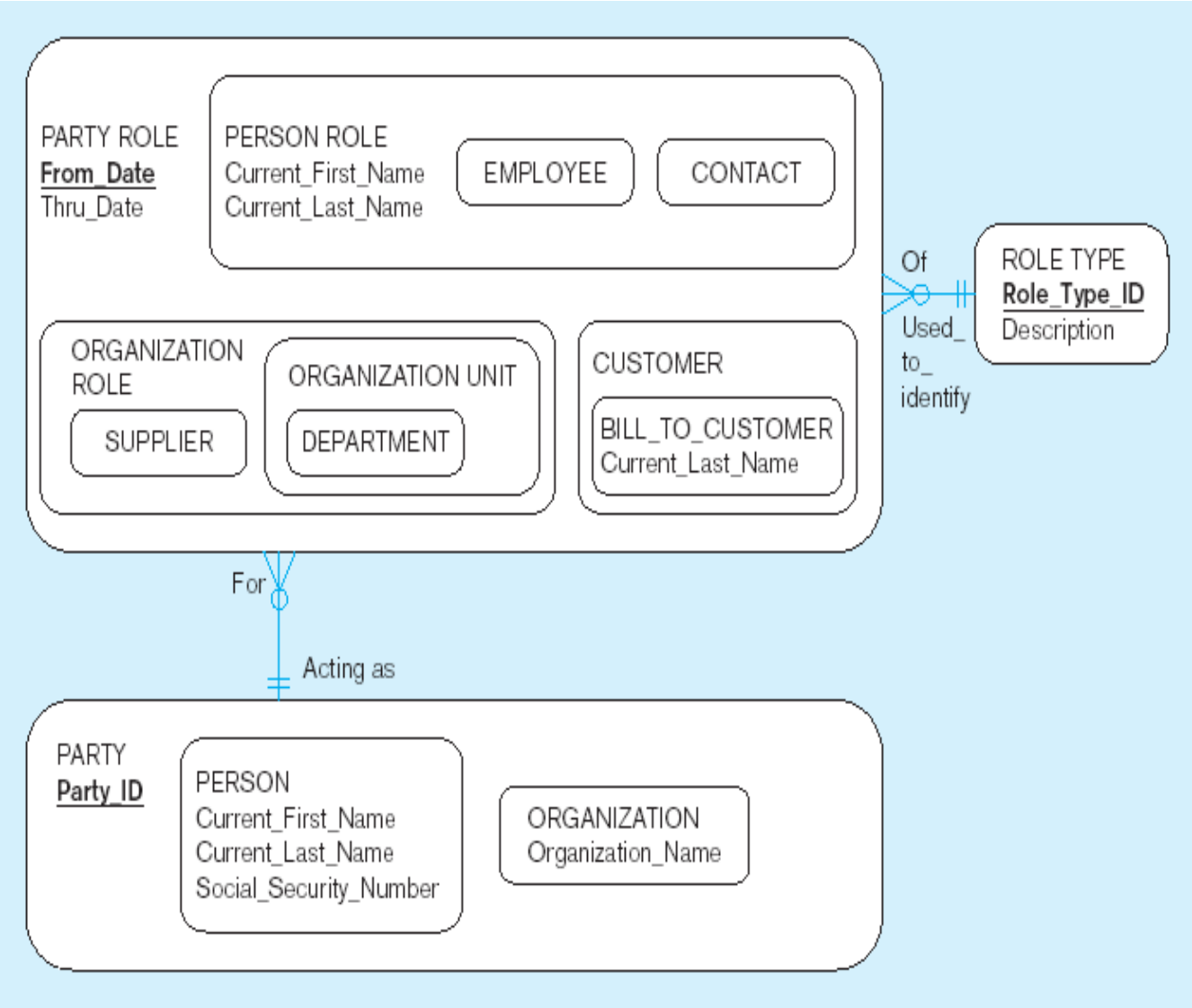


Figure 4-14 Manufacturing entity cluster



Detail for a single cluster



Packaged data models provide generic models that can be customized for a particular organization's business rules

Case study

- A college course may have one or more scheduled sections, or **may not** have a scheduled section.

- Attributes of COURSE include Course ID, Course Name, and Units.
- Attributes of SECTION include Section Number and Semester ID.

- Semester ID is composed of two parts: Semester and Year. Section Number is an integer (such as 1 or 2) that distinguishes one section from another for the same course but does not uniquely identify a section.