Chapter 4: The Enhanced ER Model and Business Rules

Modern Database Management

8th Edition

Jeffrey A. Hoffer, Mary B. Prescott, Fred R. McFadden

alternate Key
For example, in an employee table, empno is a primary key, empname is a alternate key that may not be unique but still helps in identifying a row of the table.

Objectives

- Definition of terms
- Use of supertype/subtype relationships
- Use of generalization and specialization techniques
- Specification of completeness and disjointness constraints
- Develop supertype/subtype hierarchies for realistic business situations
- Develop entity clusters
- Explain universal data model
- Name categories of business rules
- Define operational constraints graphically and in English

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

Figure 4-1 Basic notation for supertype/subtype

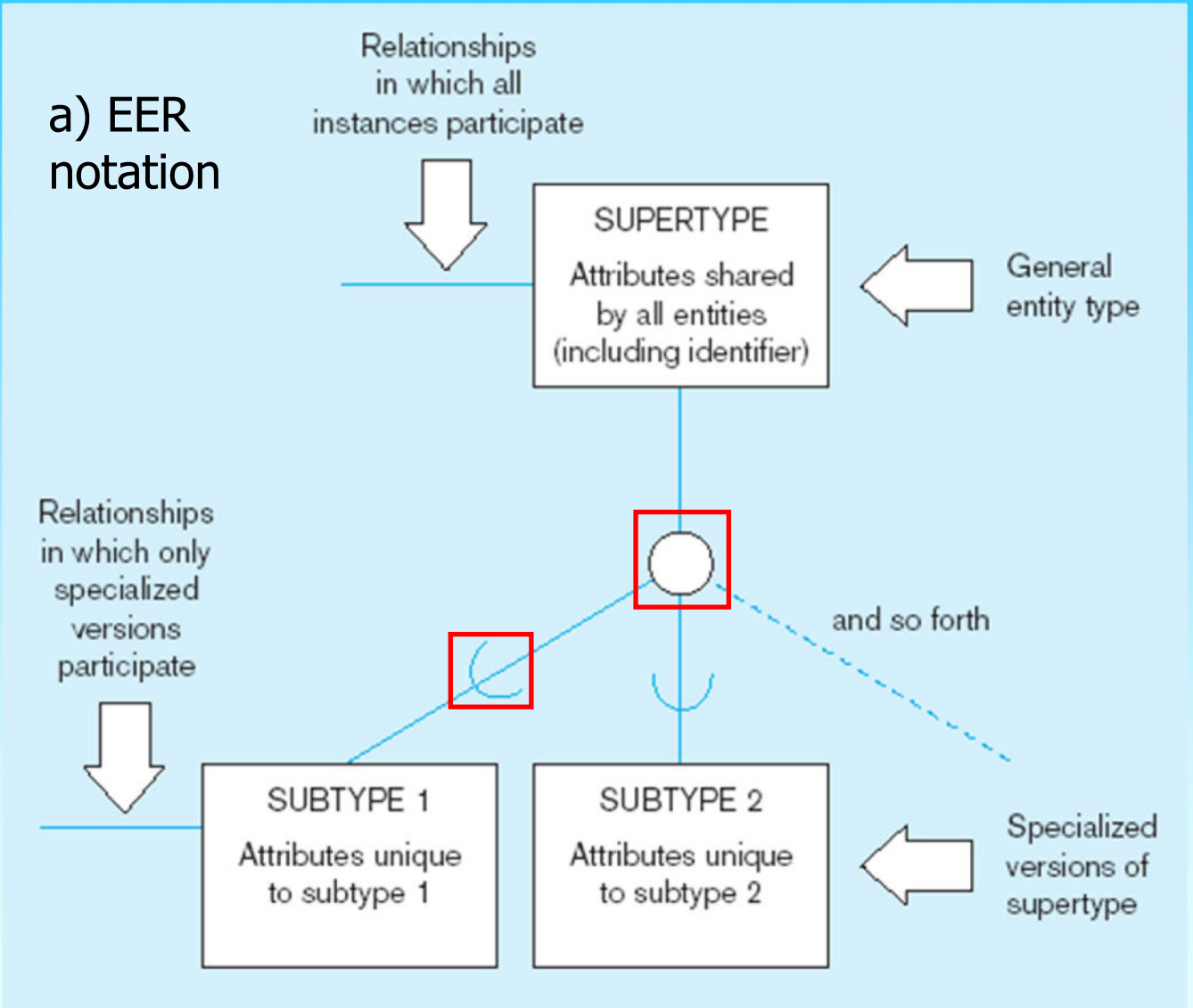
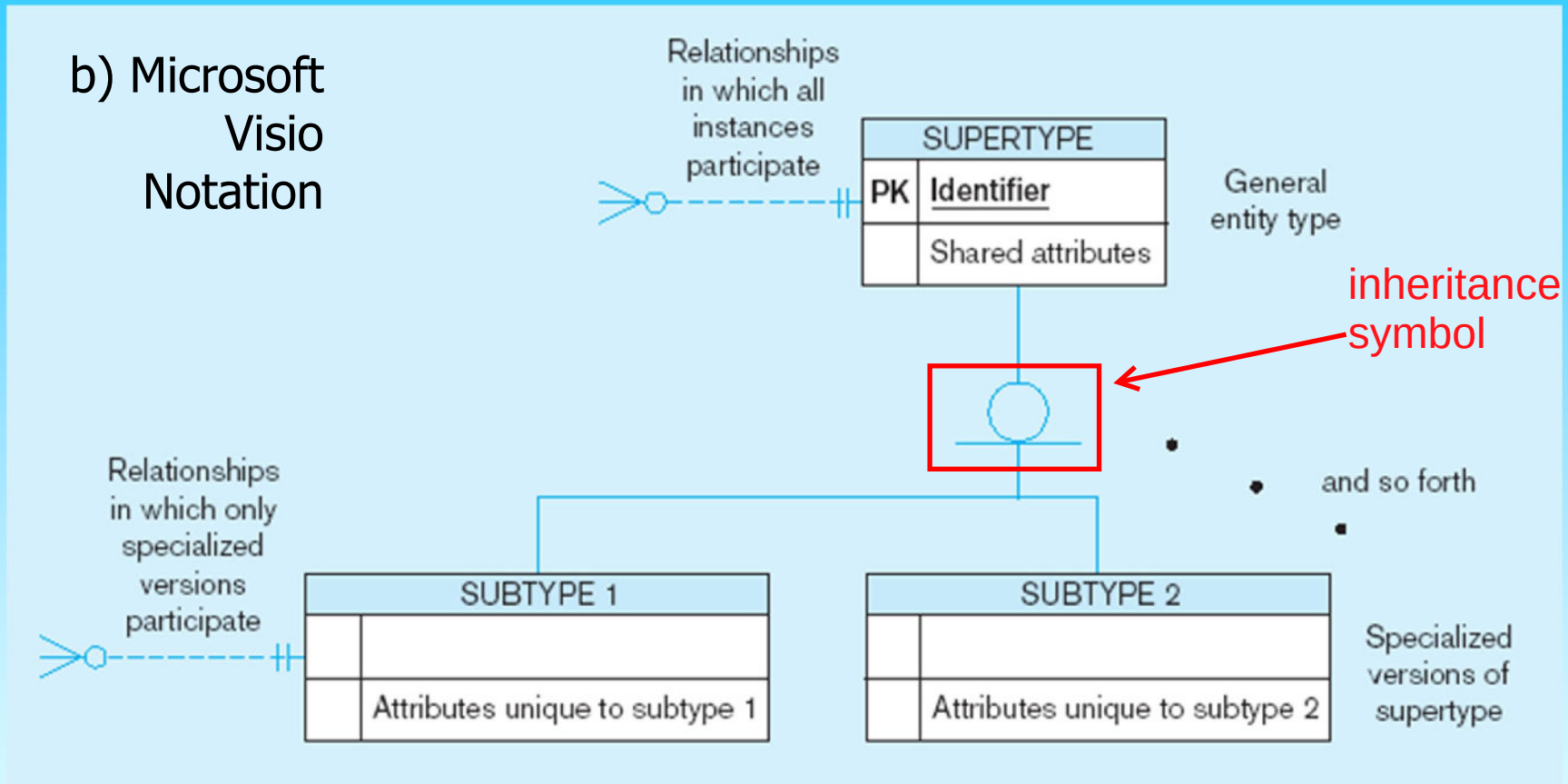
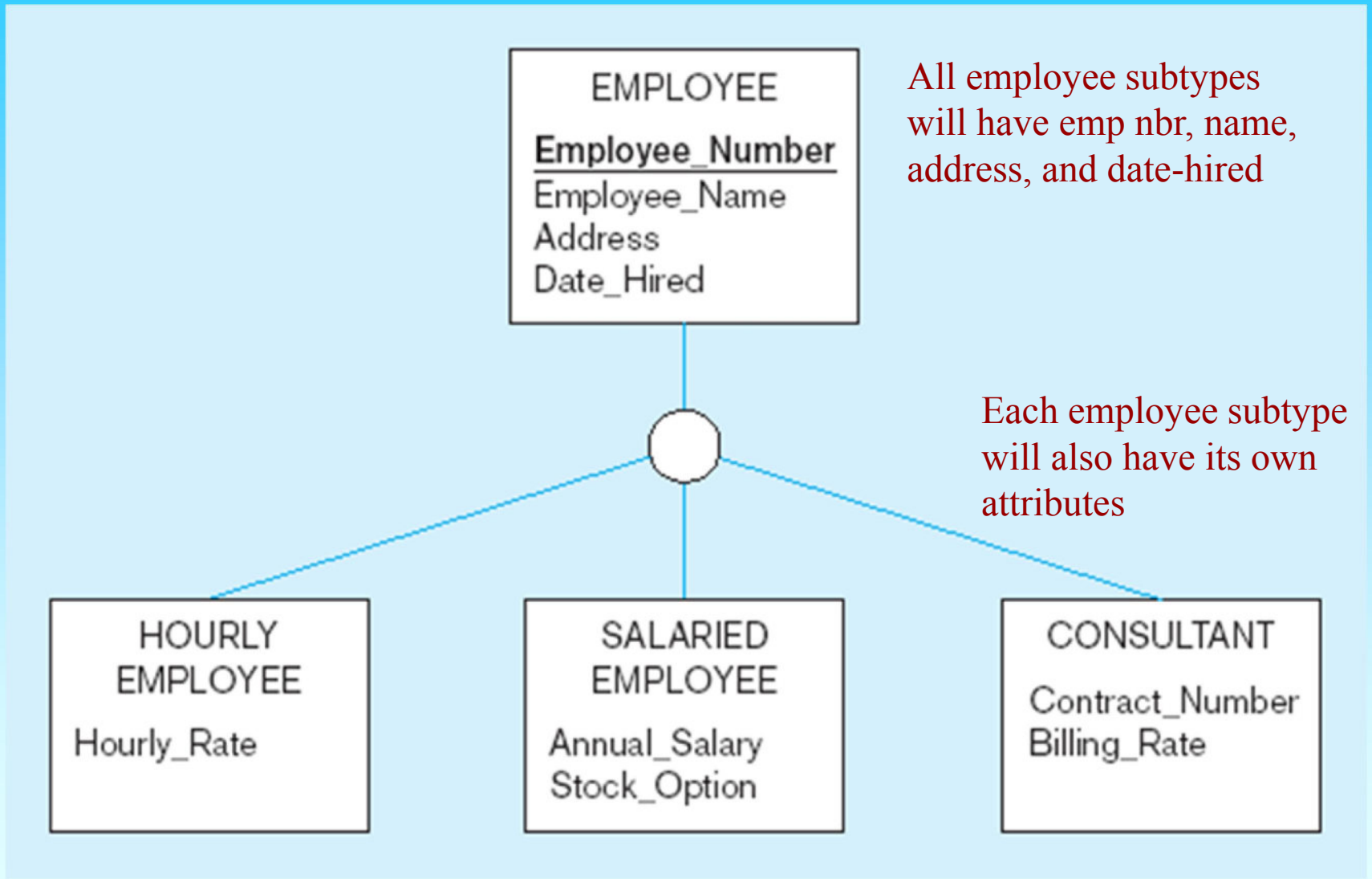


Figure 4-1 Basic notation for supertype/subtype (cont.)



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

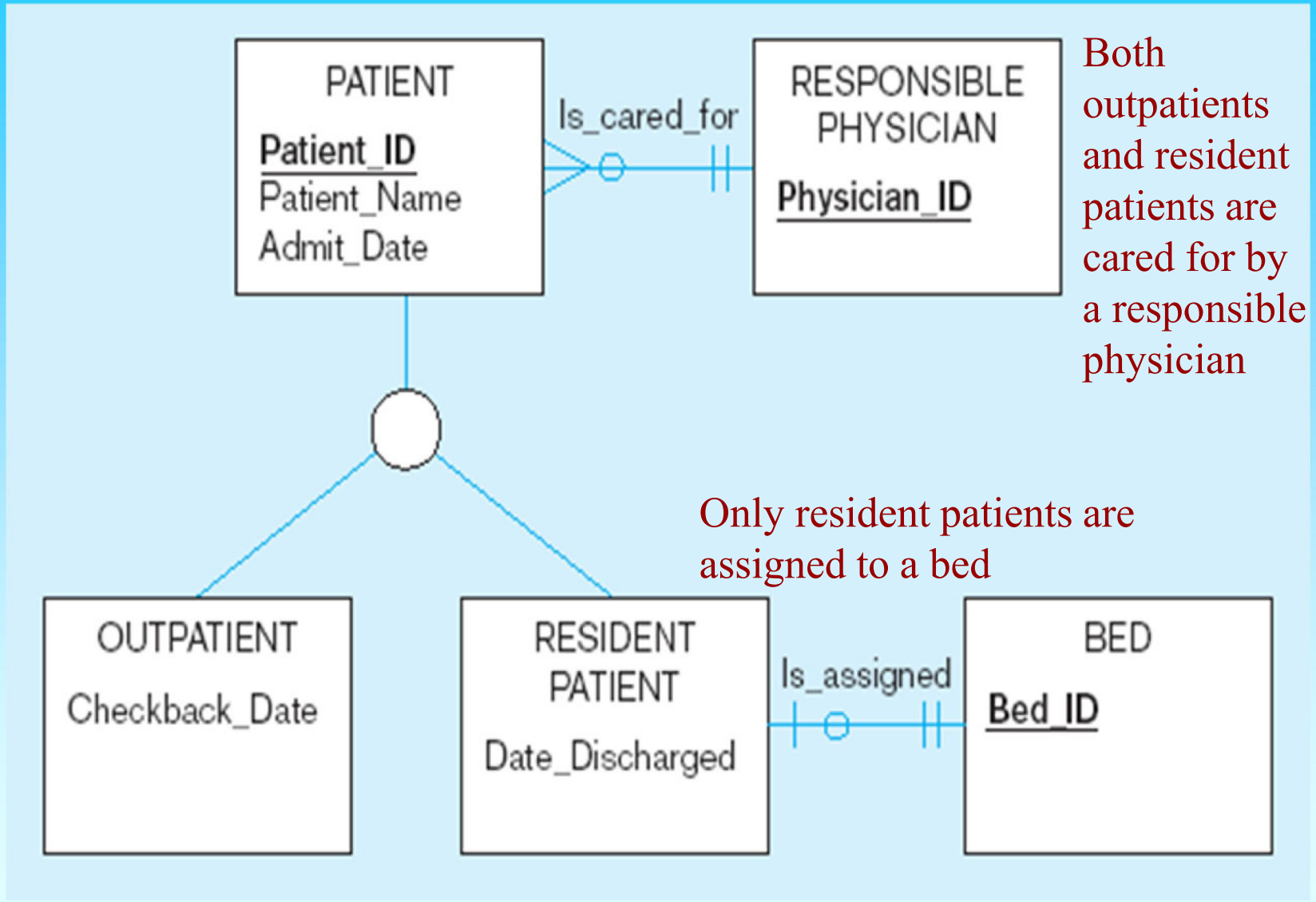
Figure 4-2 Employee supertype with three subtypes



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

Figure 4-3 Supertype/subtype relationships in a hospital

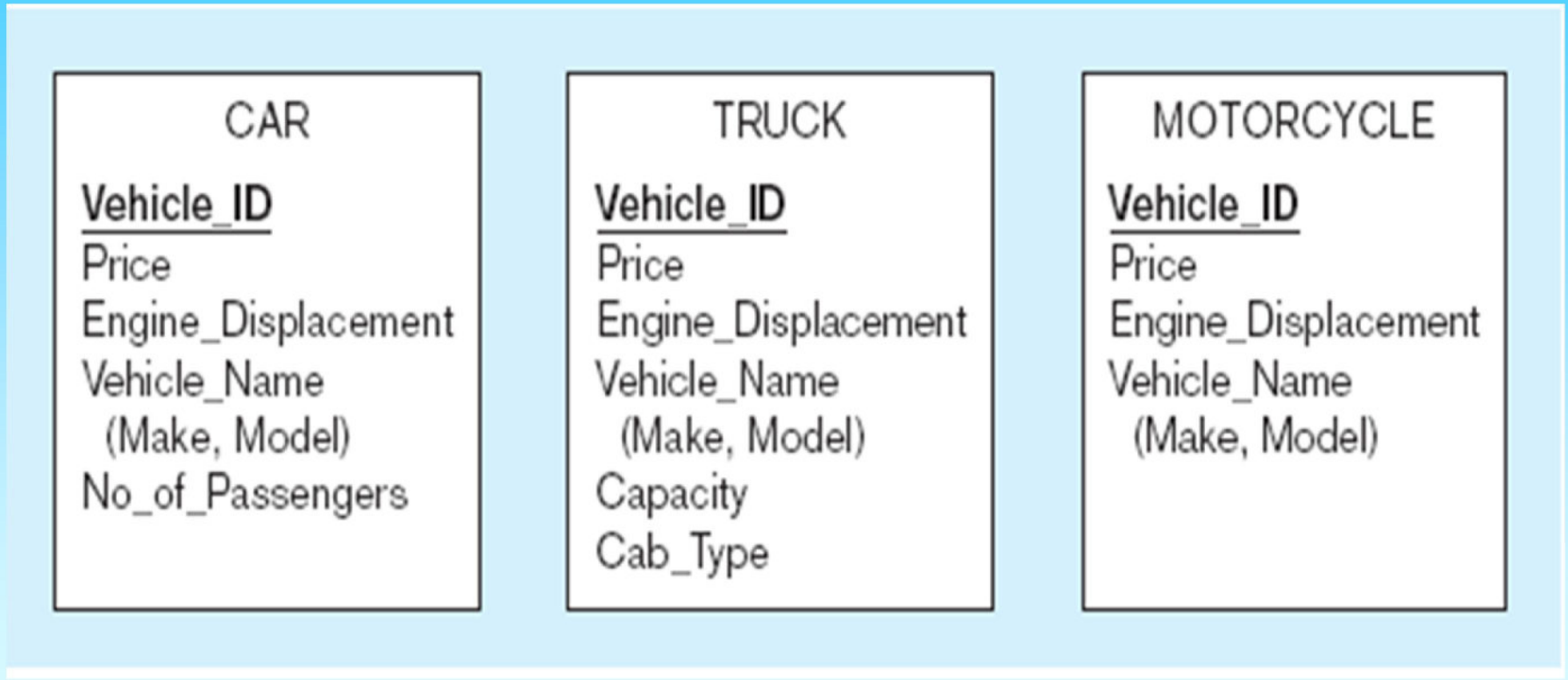


Generalization and Specialization

- ***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

Figure 4-4 Example of generalization

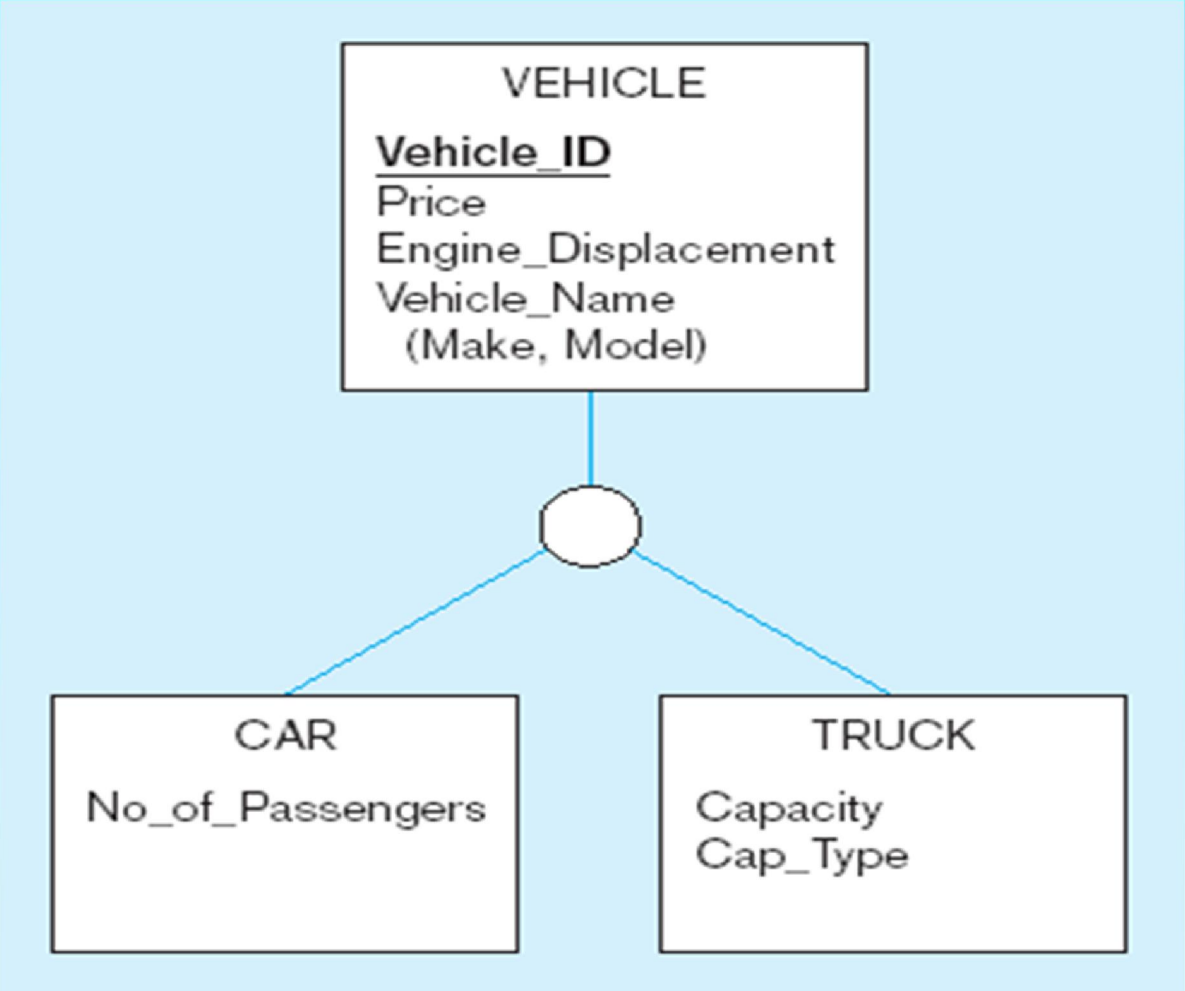
a) Three entity types: CAR, TRUCK, and MOTORCYCLE



All these types of vehicles have common attributes

Figure 4-4 Example of generalization (cont.)

b) Generalization to VEHICLE supertype

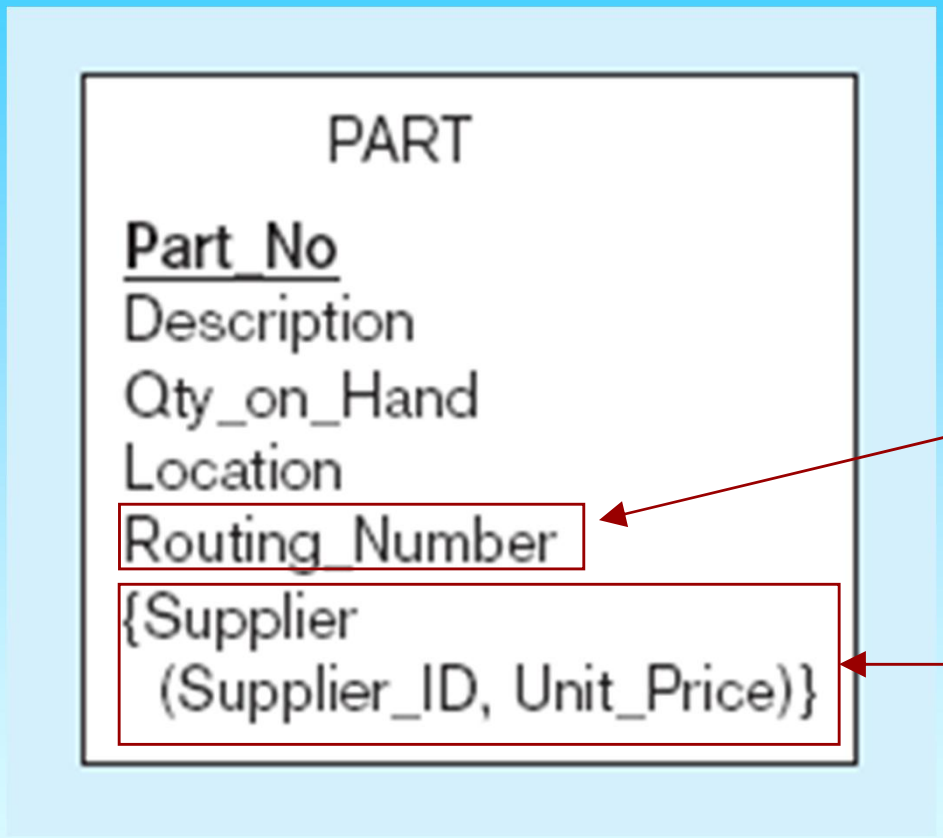


So we put the shared attributes in a supertype

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

Figure 4-5 Example of specialization

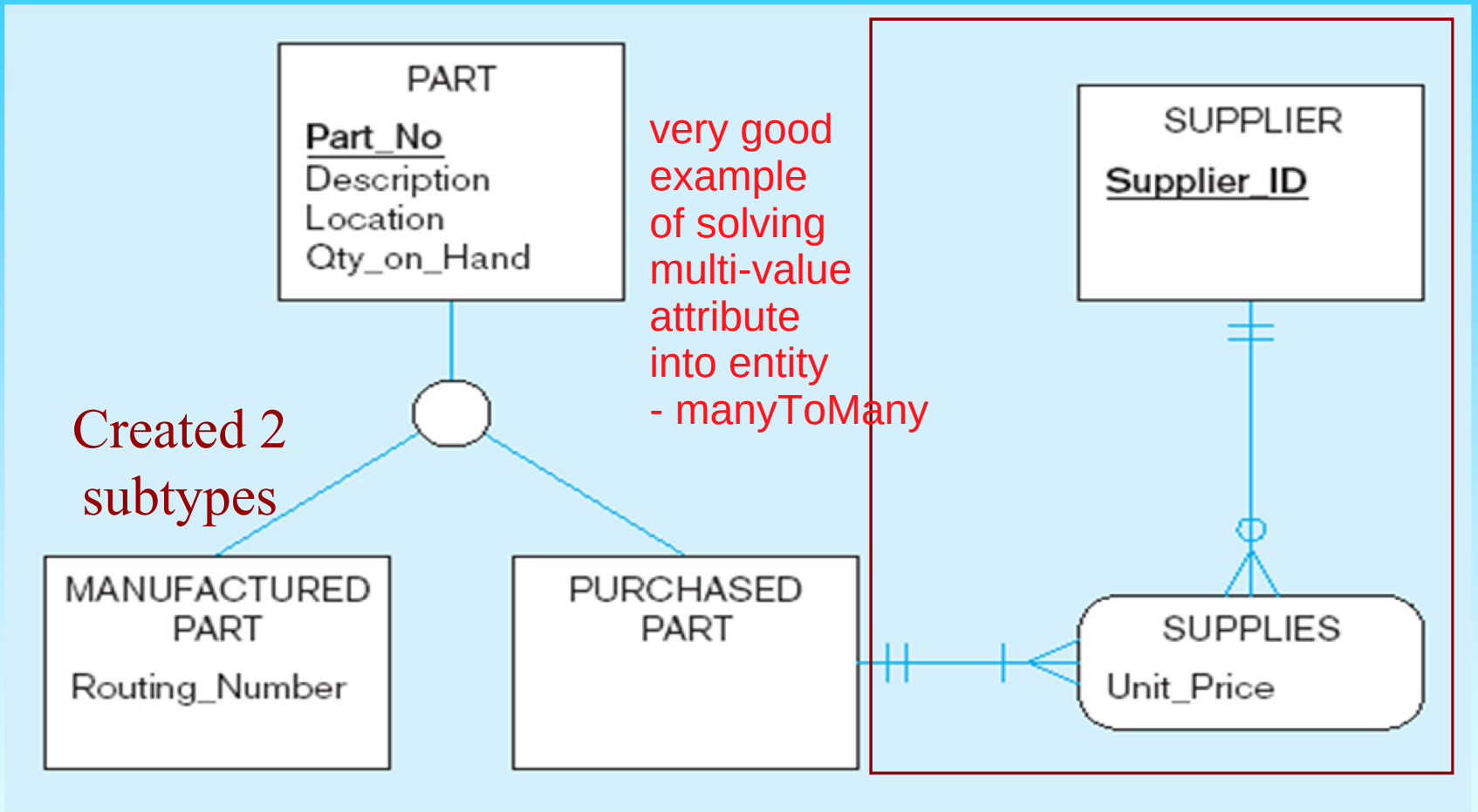
a) Entity type PART



very good example of solving multi-value attribute into entity - manyToMany

Figure 4-5 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)

Figure 4-6 Examples of completeness constraints

a) Total specialization rule

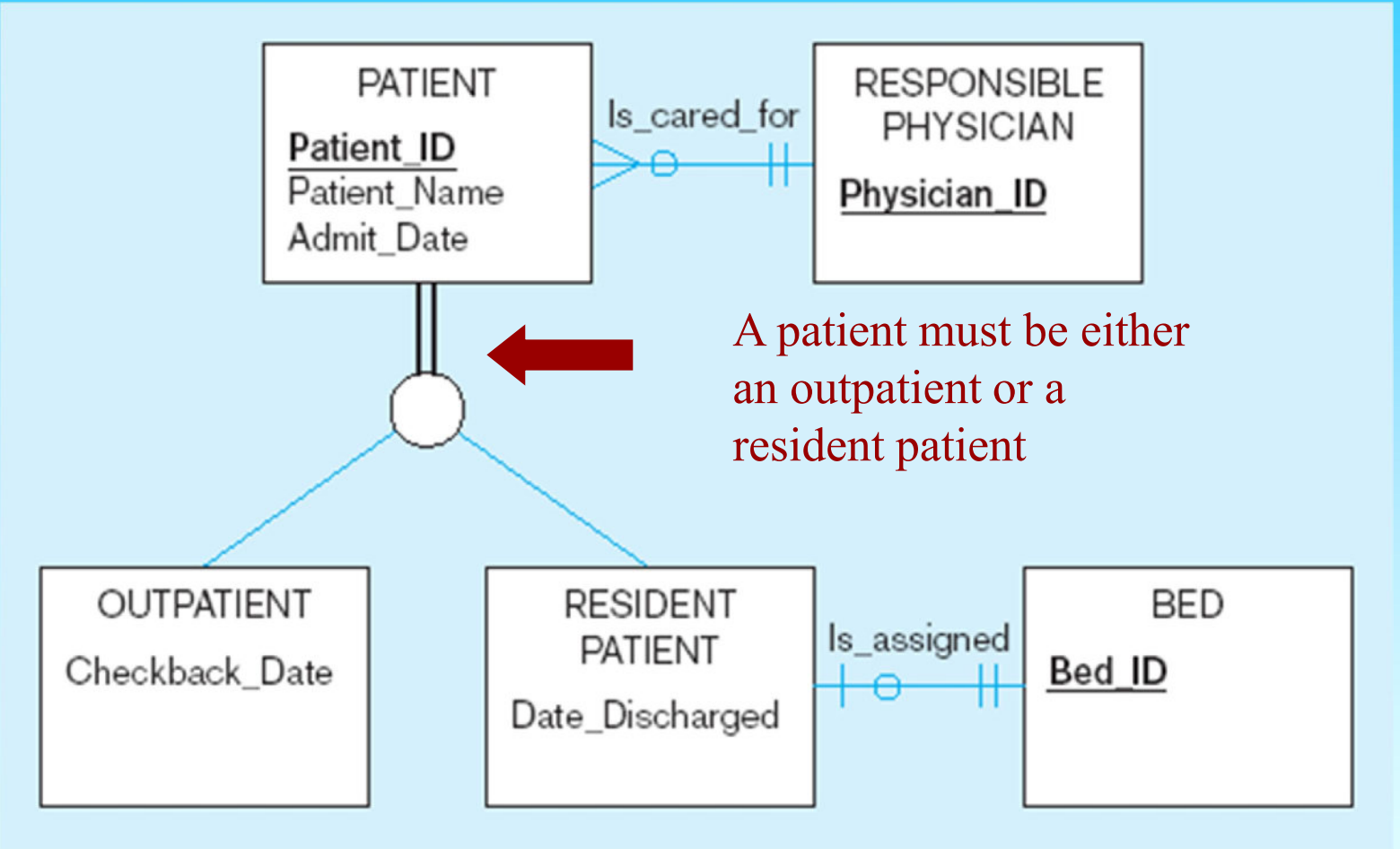
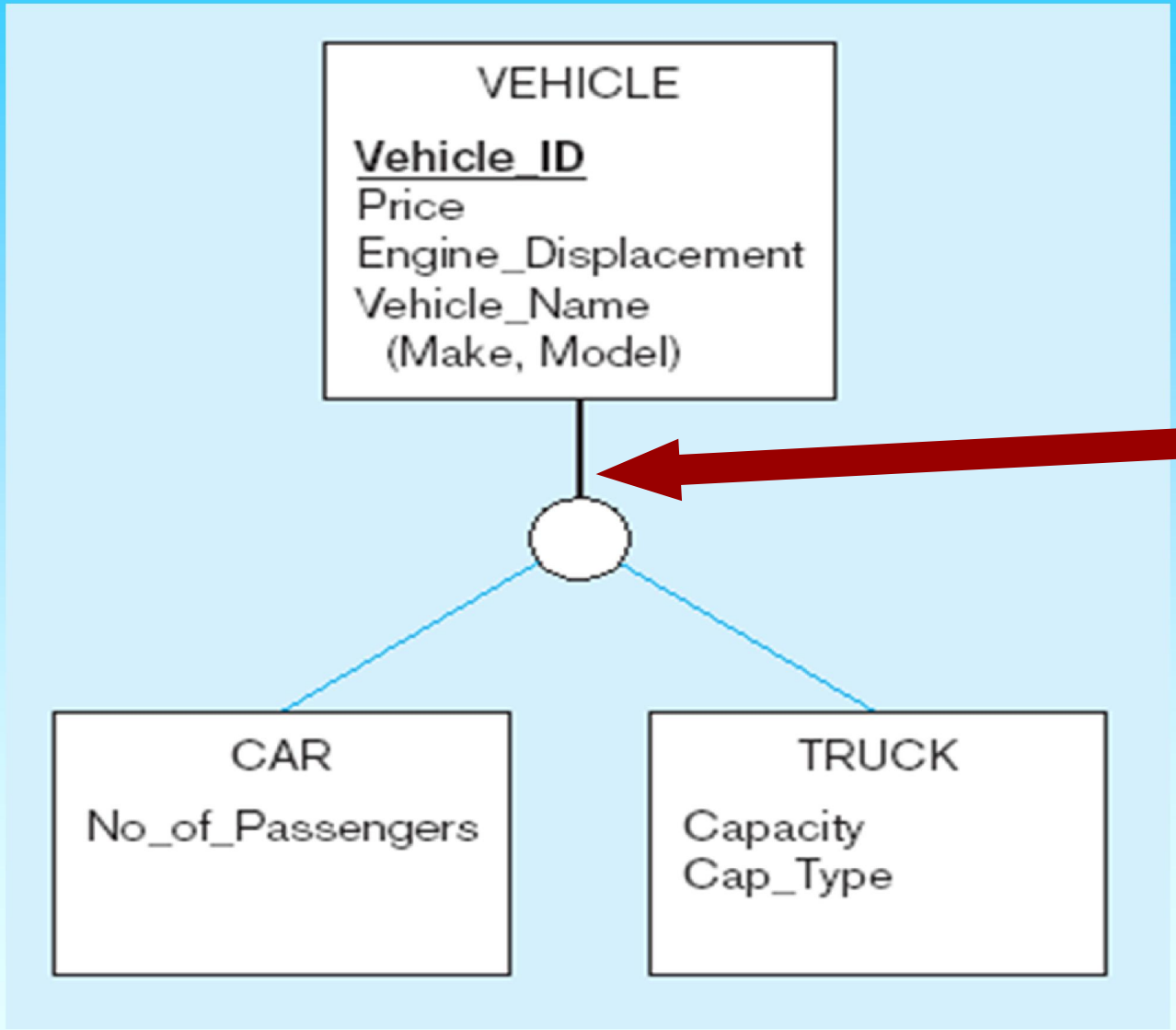


Figure 4-6 Examples of completeness constraints (cont.)

b) Partial specialization rule



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

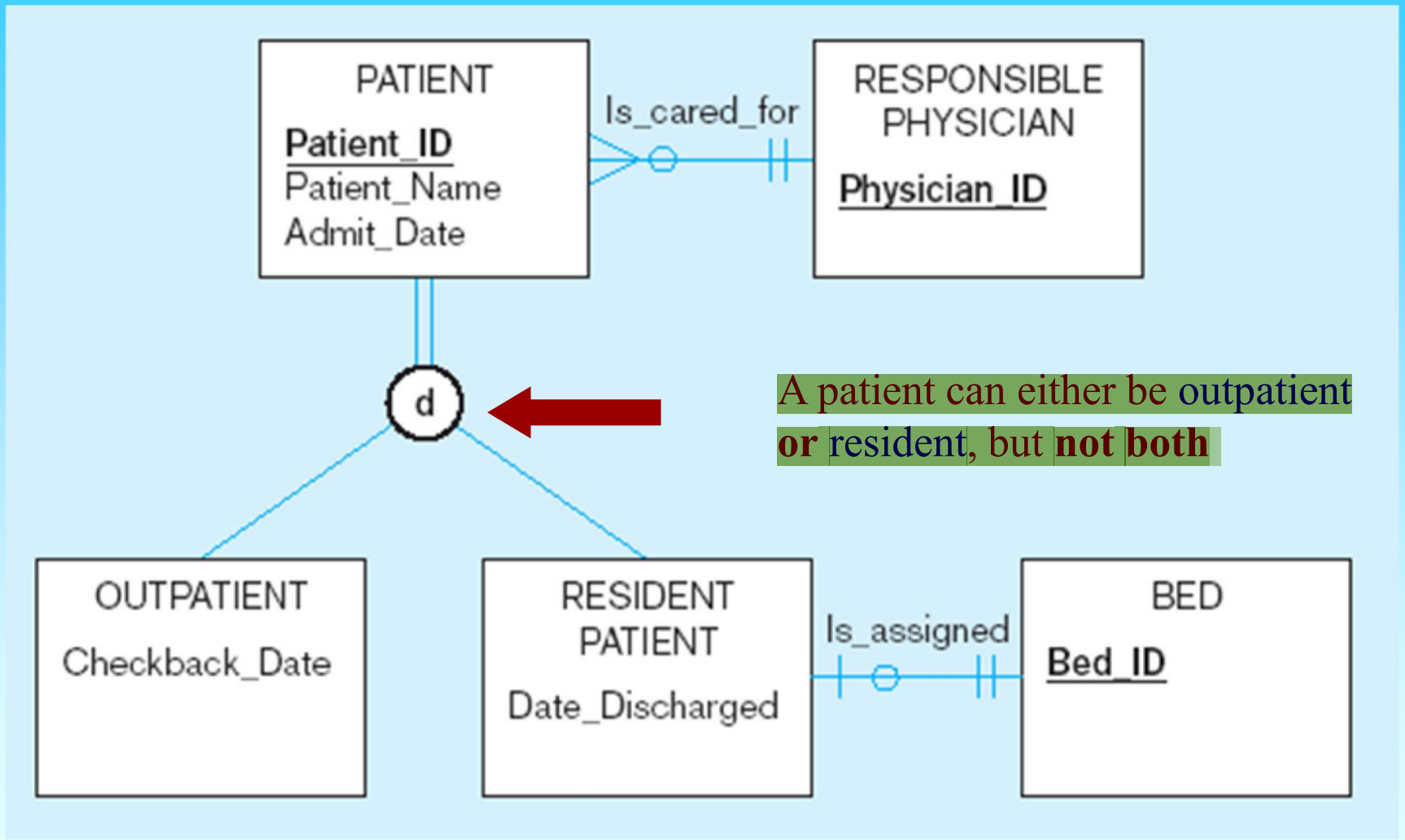
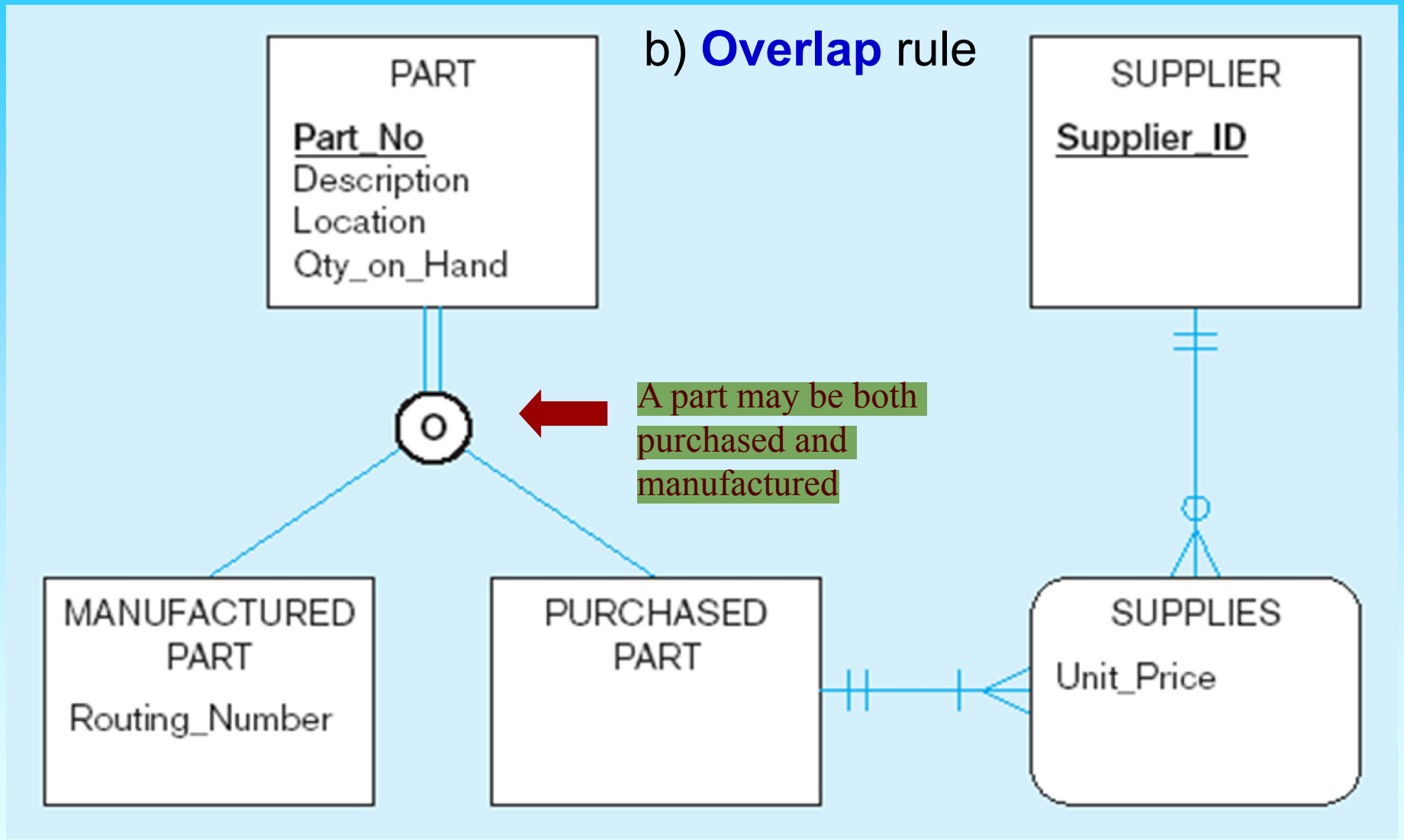


Figure 4-7 Examples of disjointness constraints (cont.)



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

Figure 4-8 Introducing a subtype discriminator (*disjoint* rule)

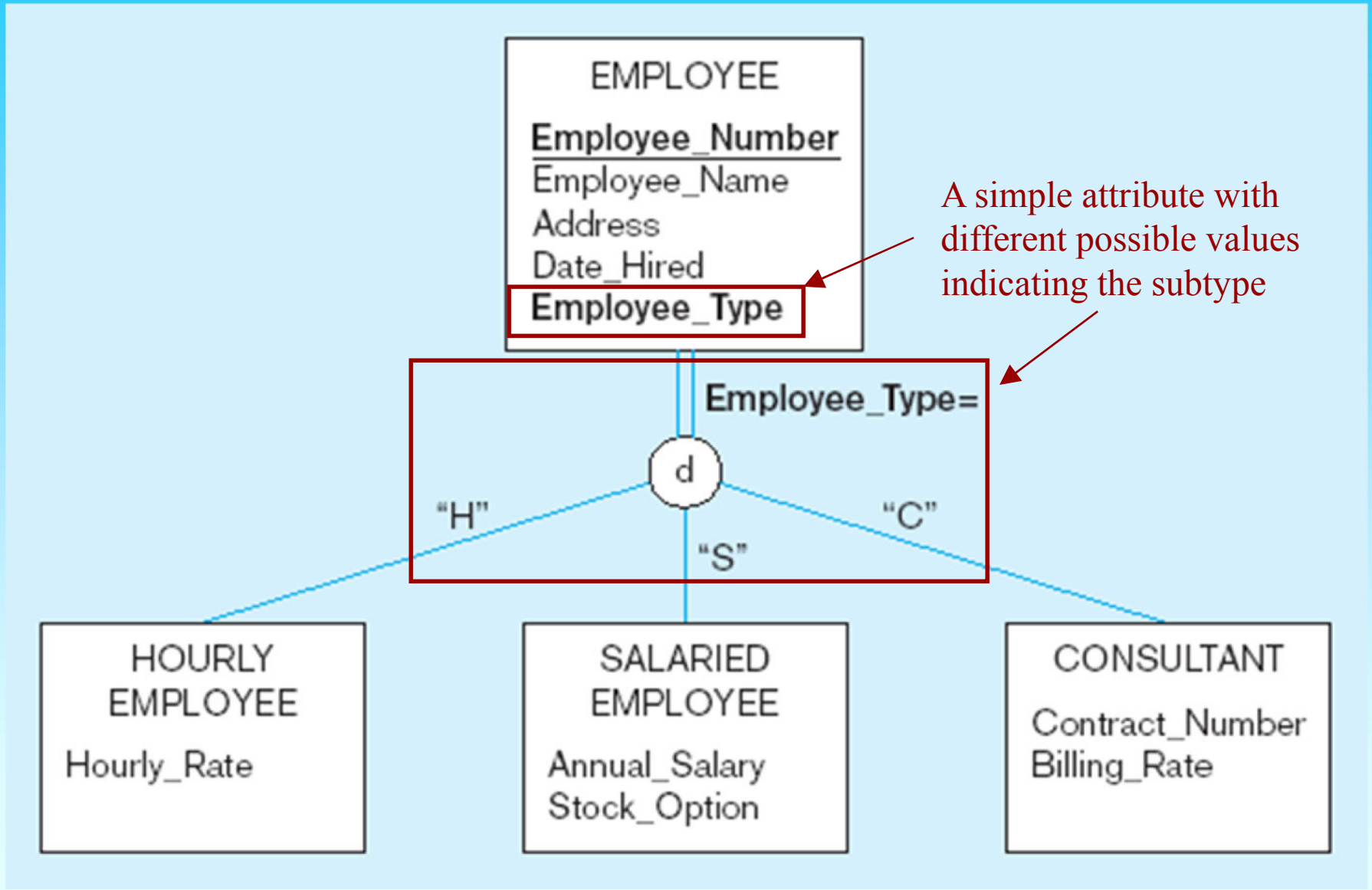


Figure 4-9 Subtype discriminator (*overlap* rule)

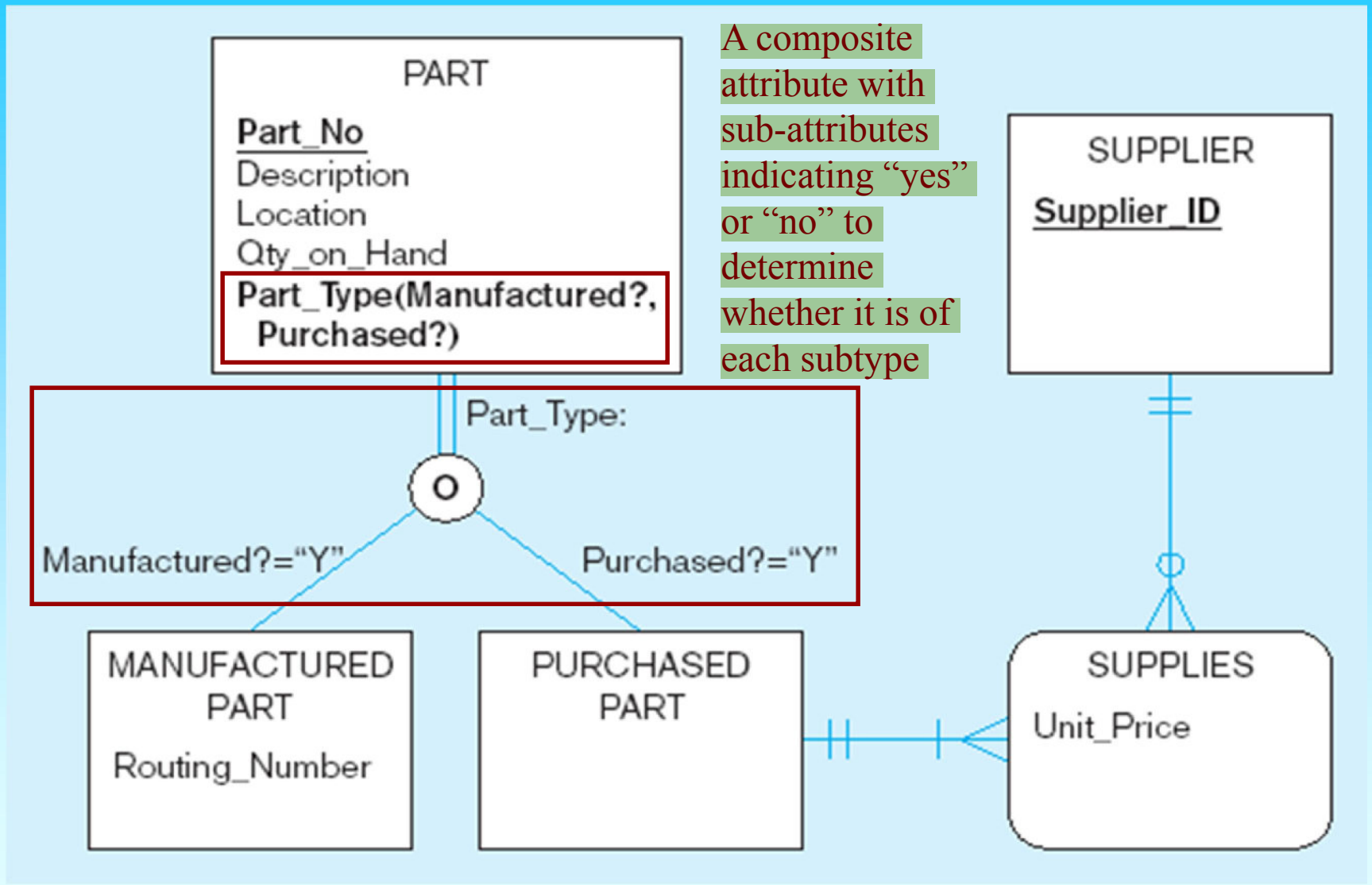
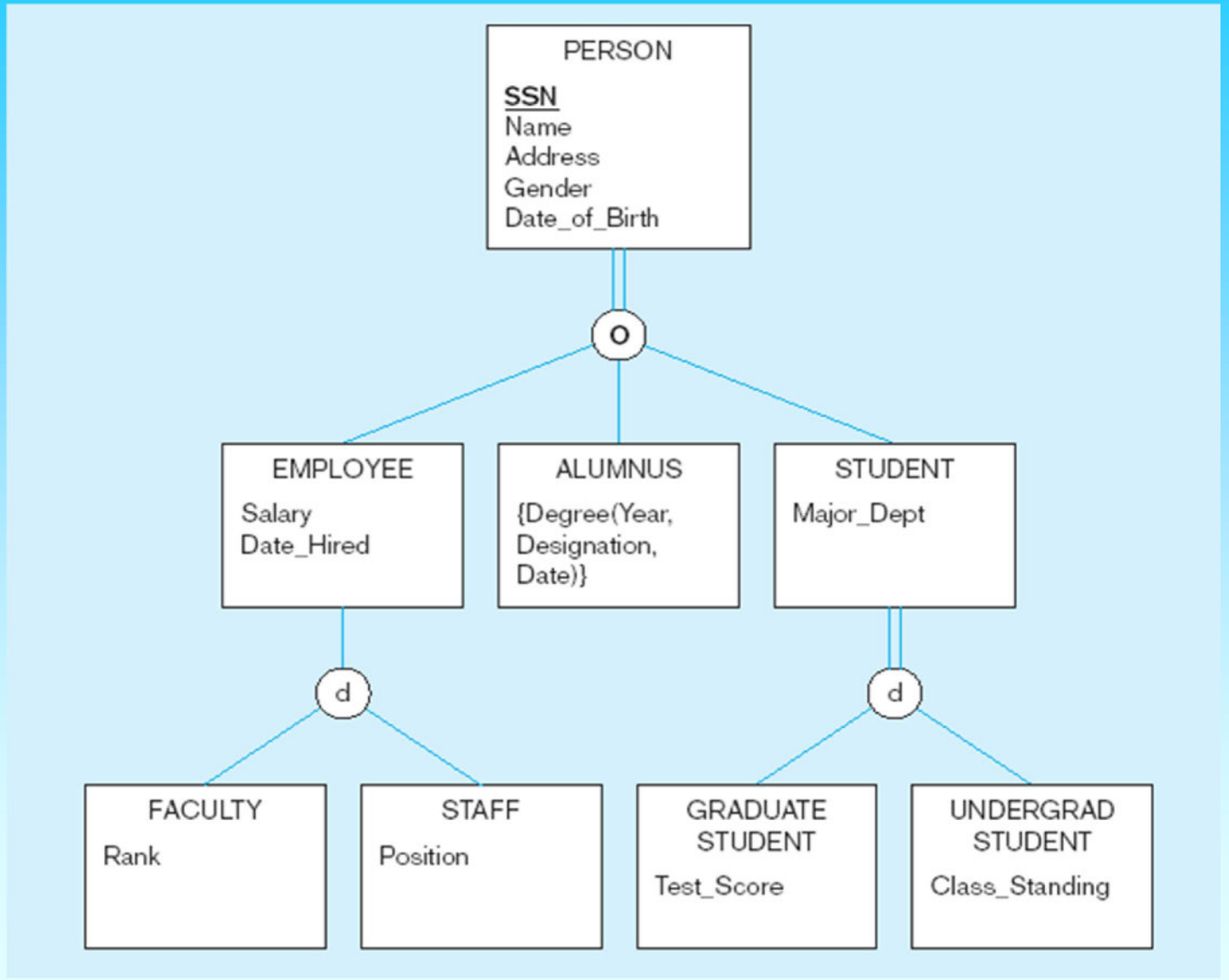


Figure 4-10 Example of supertype/subtype hierarchy

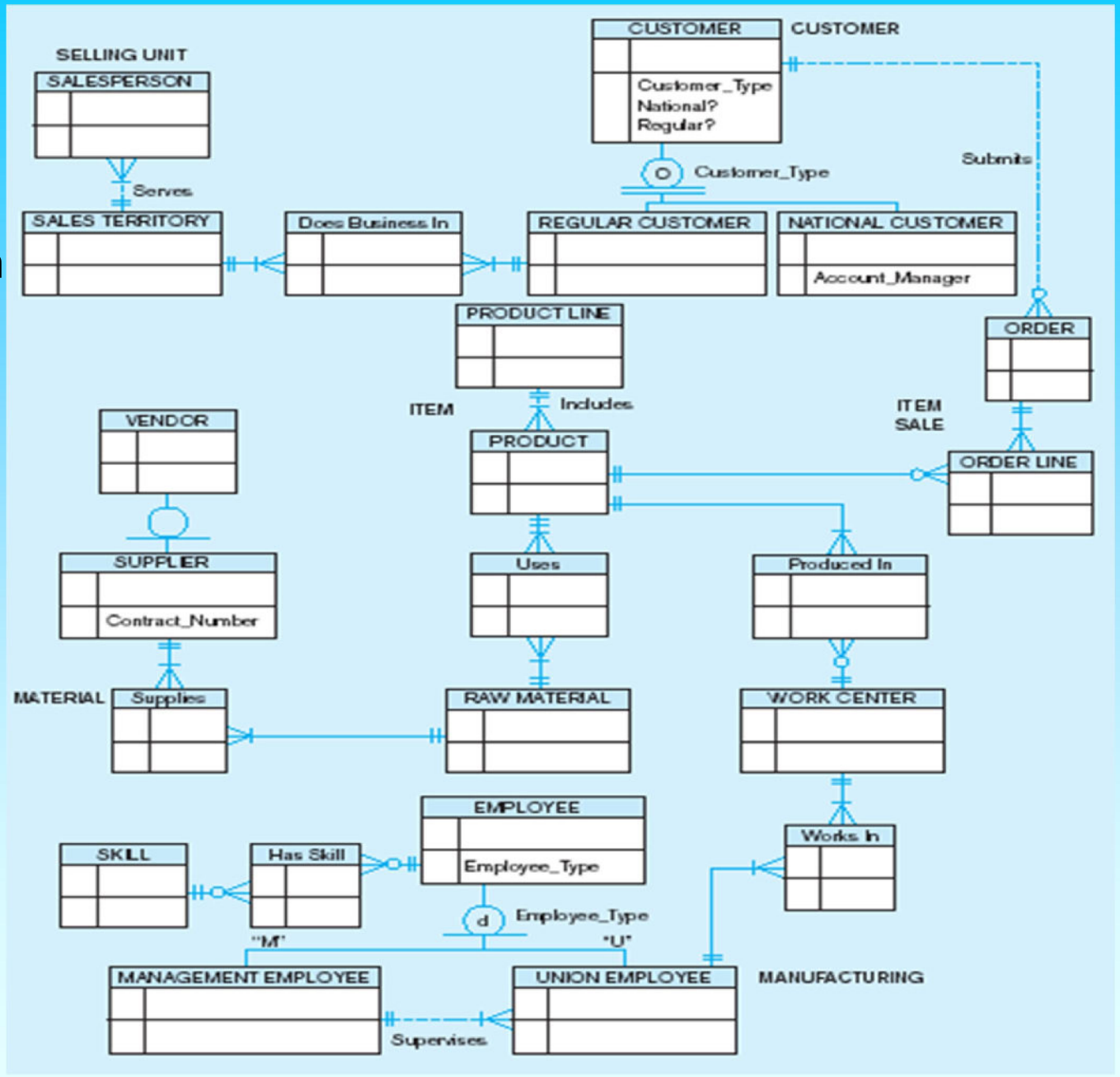


Entity Clusters

- 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

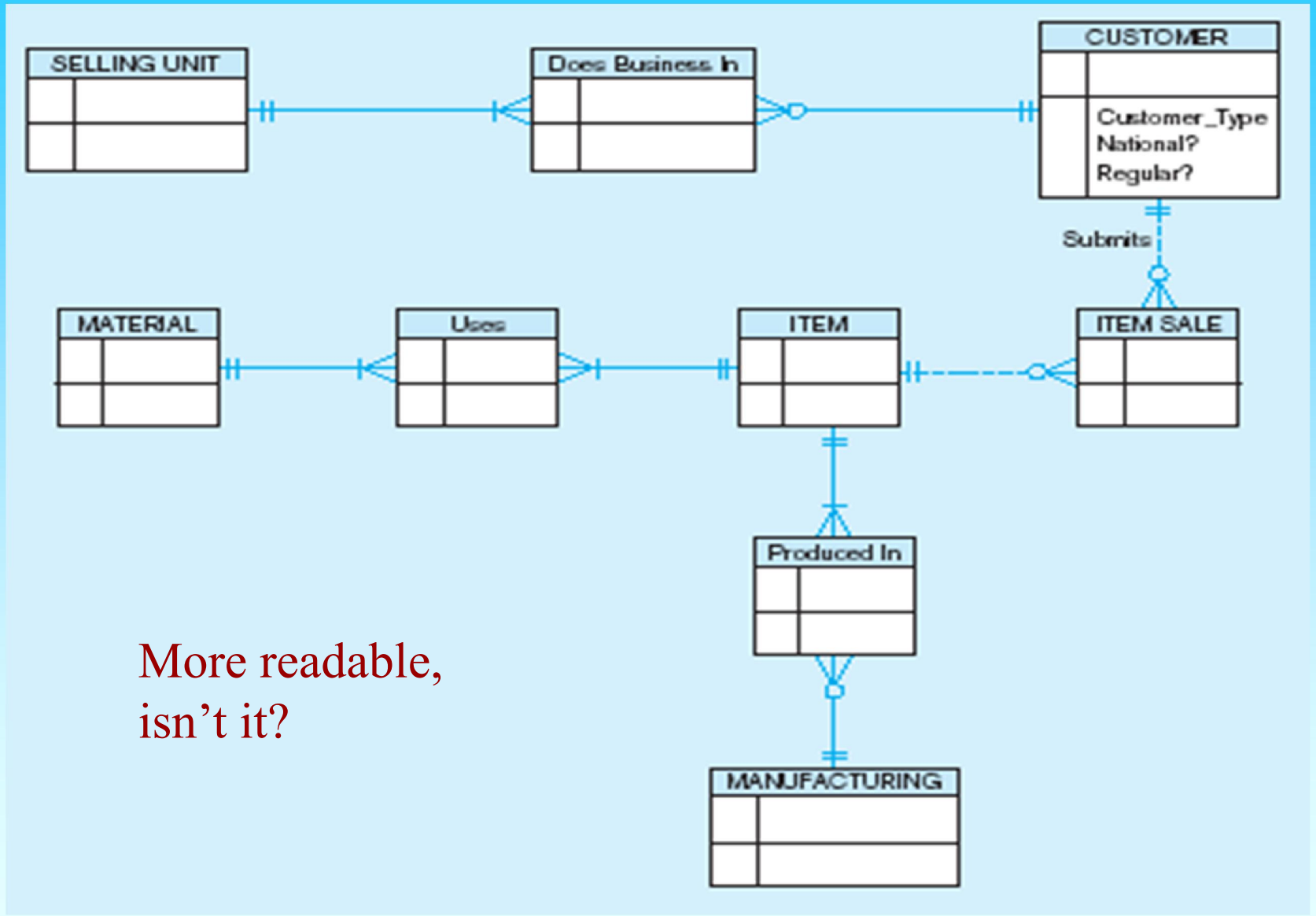
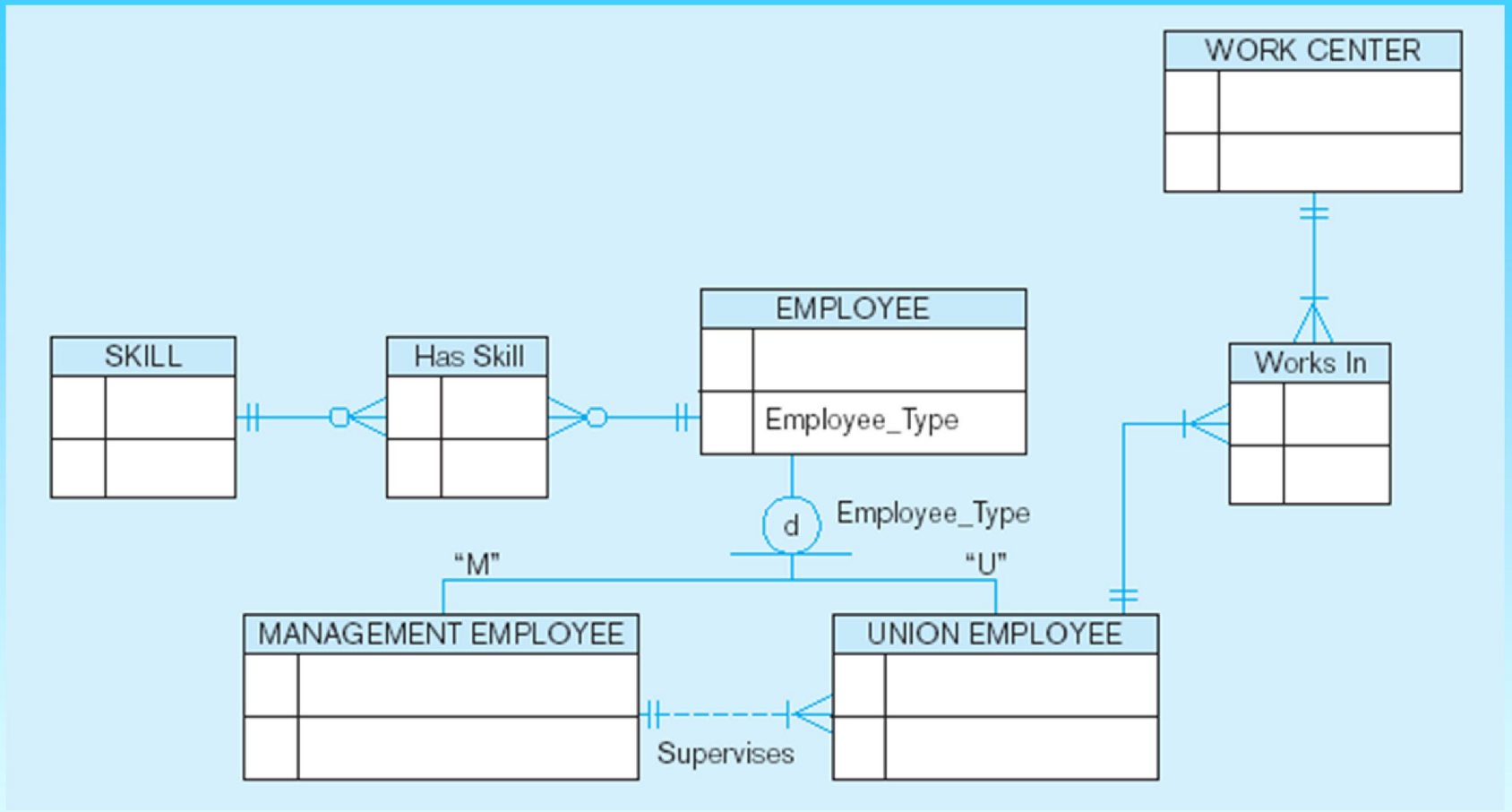
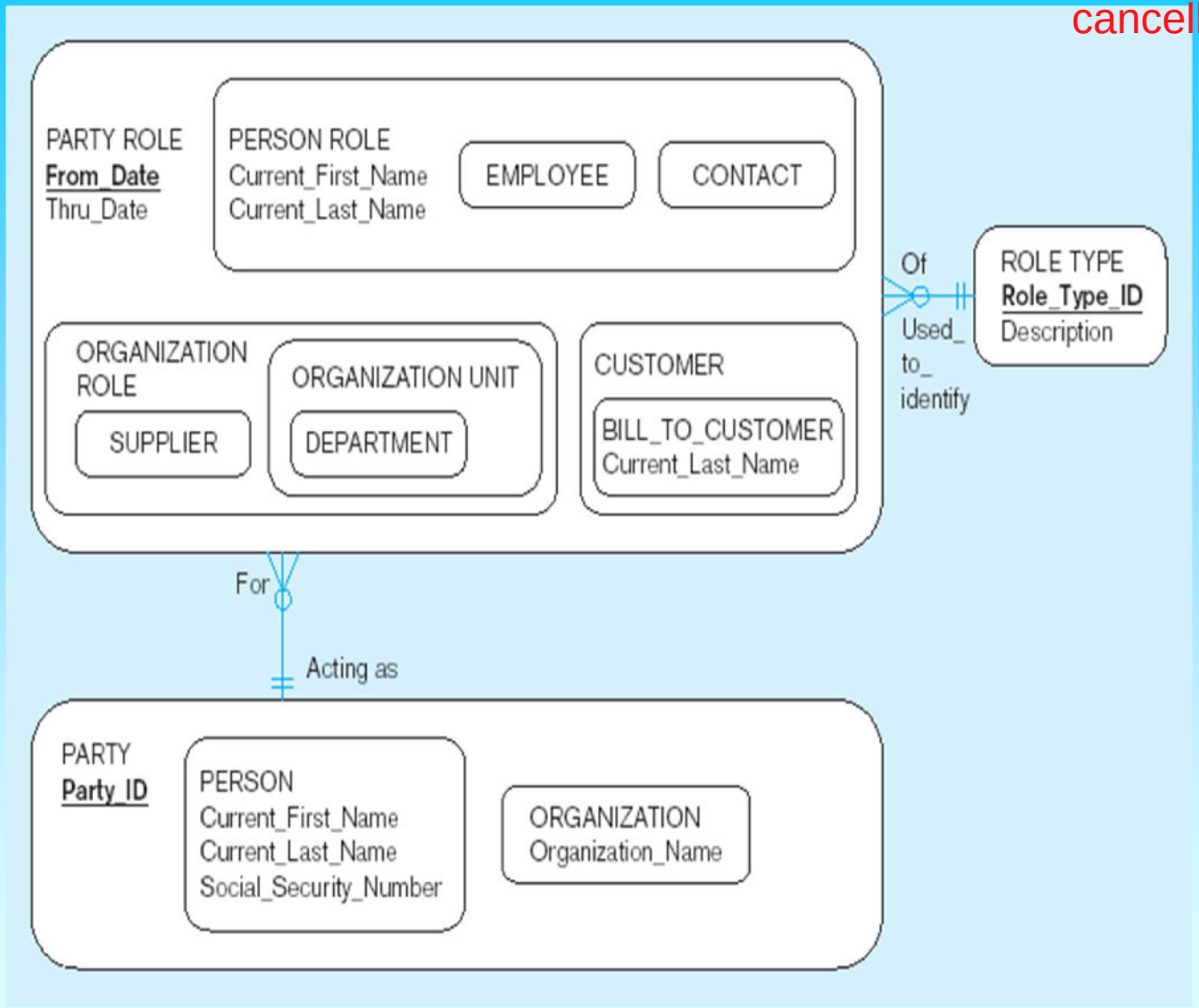


Figure 4-14 Manufacturing entity cluster



Detail for a single cluster

cancelled

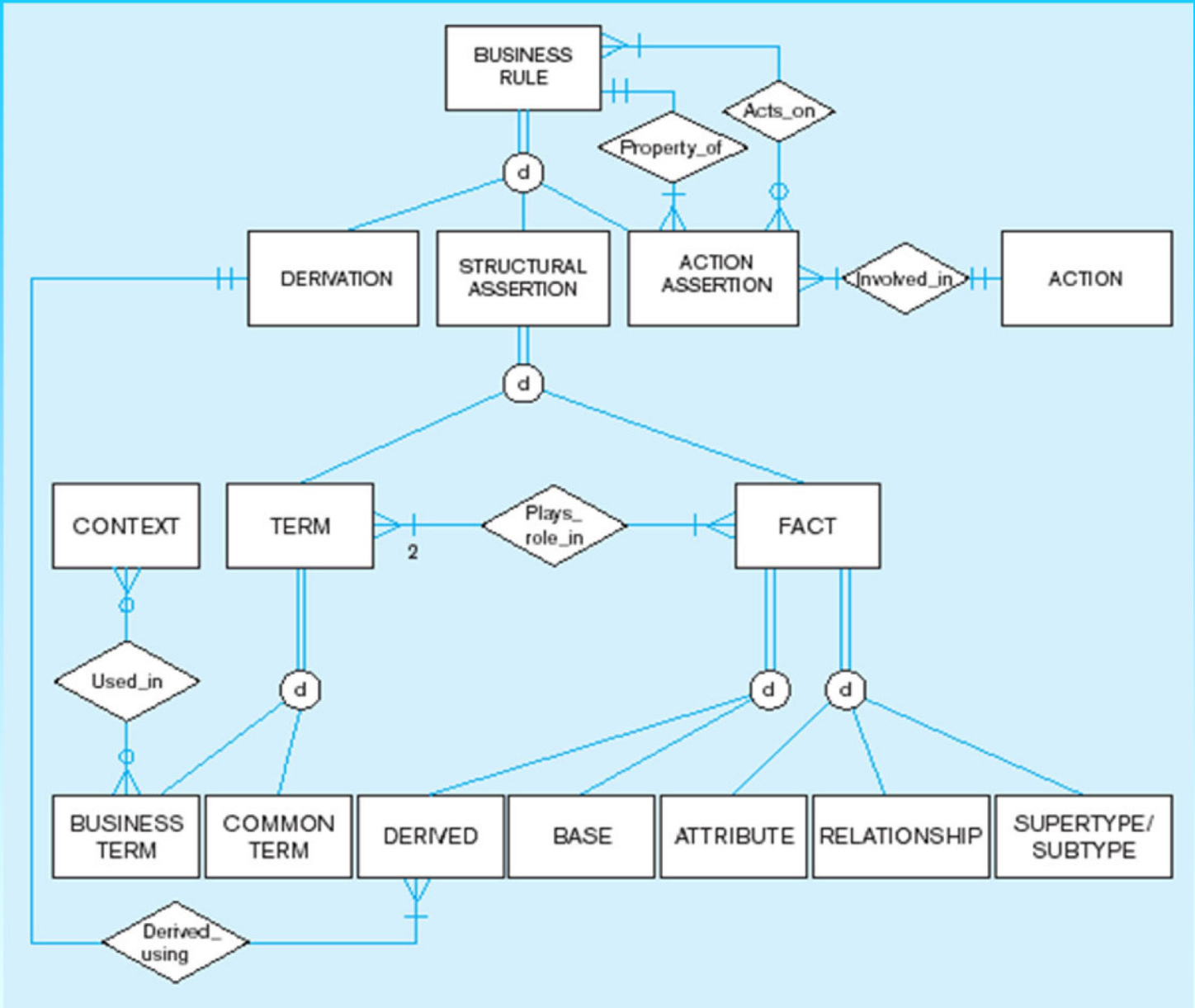


Packaged data models provide generic models that can be customized for a particular organization's business rules

Business rules

- Statements that *define* or *constrain* some aspect of the business
- Classification of business rules:
  - Derivation–rule derived from other knowledge, often in the form of a formula using attribute values
  - Structural assertion–rule expressing static structure. Includes attributes, relationships, and definitions
  - Action assertion–rule expressing constraints/control of organizational actions

Figure 4-18
EER diagram
to describe
business
rules



Types of Action Assertions

- Result from assertion
  - Condition – IF/THEN rule
  - Integrity constraint – must always be true
  - Authorization – privilege statement
- Form of the assertion
  - Enabler – leads to creation of new object
  - Timer – allows or disallows an action
  - Executive – executes one or more actions (trigger)
- Rigor of the assertion
  - Controlling – something must or must not happen
  - Influencing – guideline for which a notification must occur

Stating an Action Assertion

- Anchor Object – an object on which actions are limited
- Action – creation, deletion, update, or read
- Corresponding Objects – an object influencing the ability to perform an action on another business rule

Action assertions identify corresponding objects that constrain the ability to perform actions on anchor objects

Figure 4-19 Data model segment for class scheduling

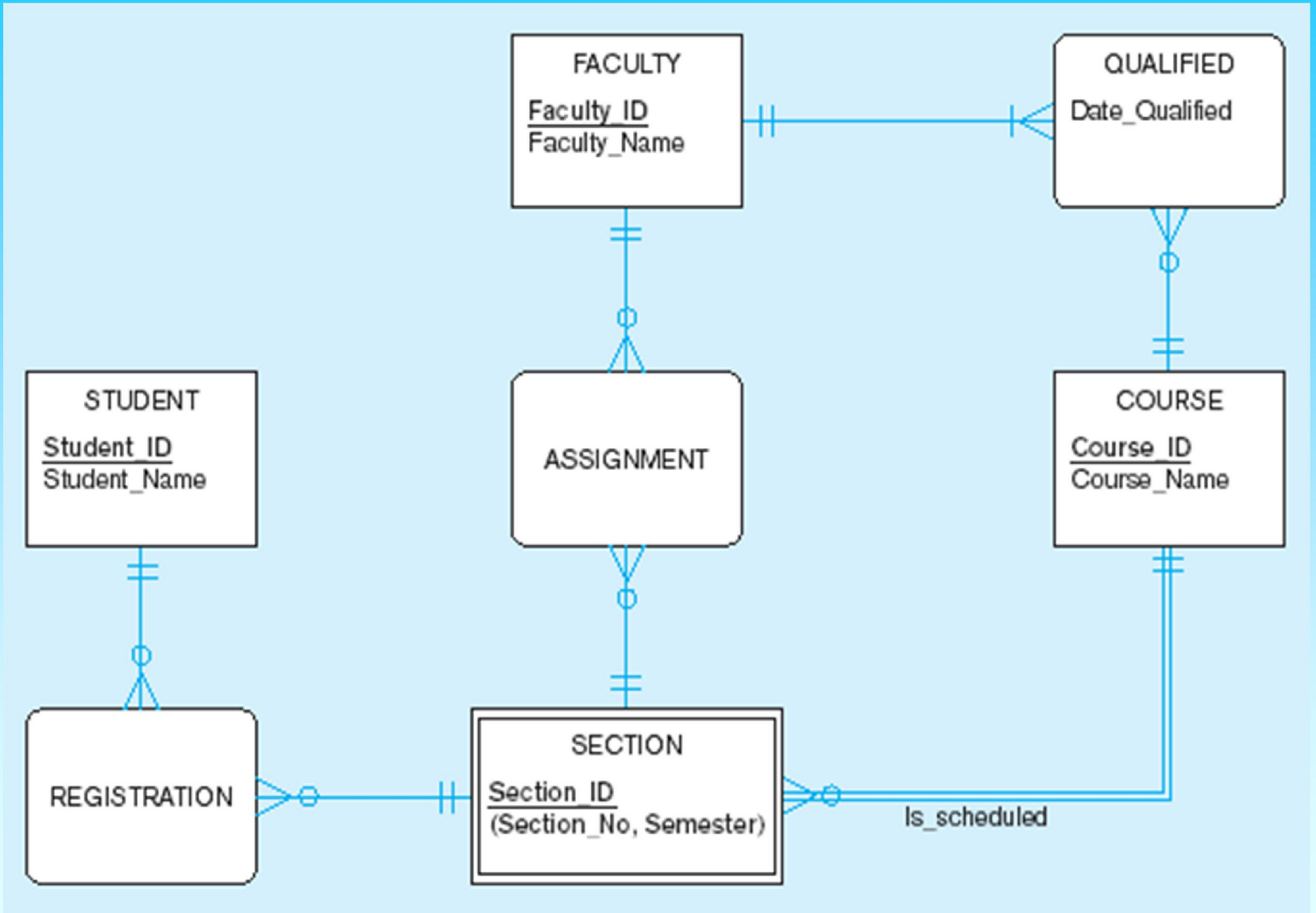


Figure 4-20 Business Rule 1: For a faculty member to be assigned to teach a section of a course, the faculty member must be qualified to teach the course for which that section is scheduled

In this case, the action assertion is a ***R***estriction

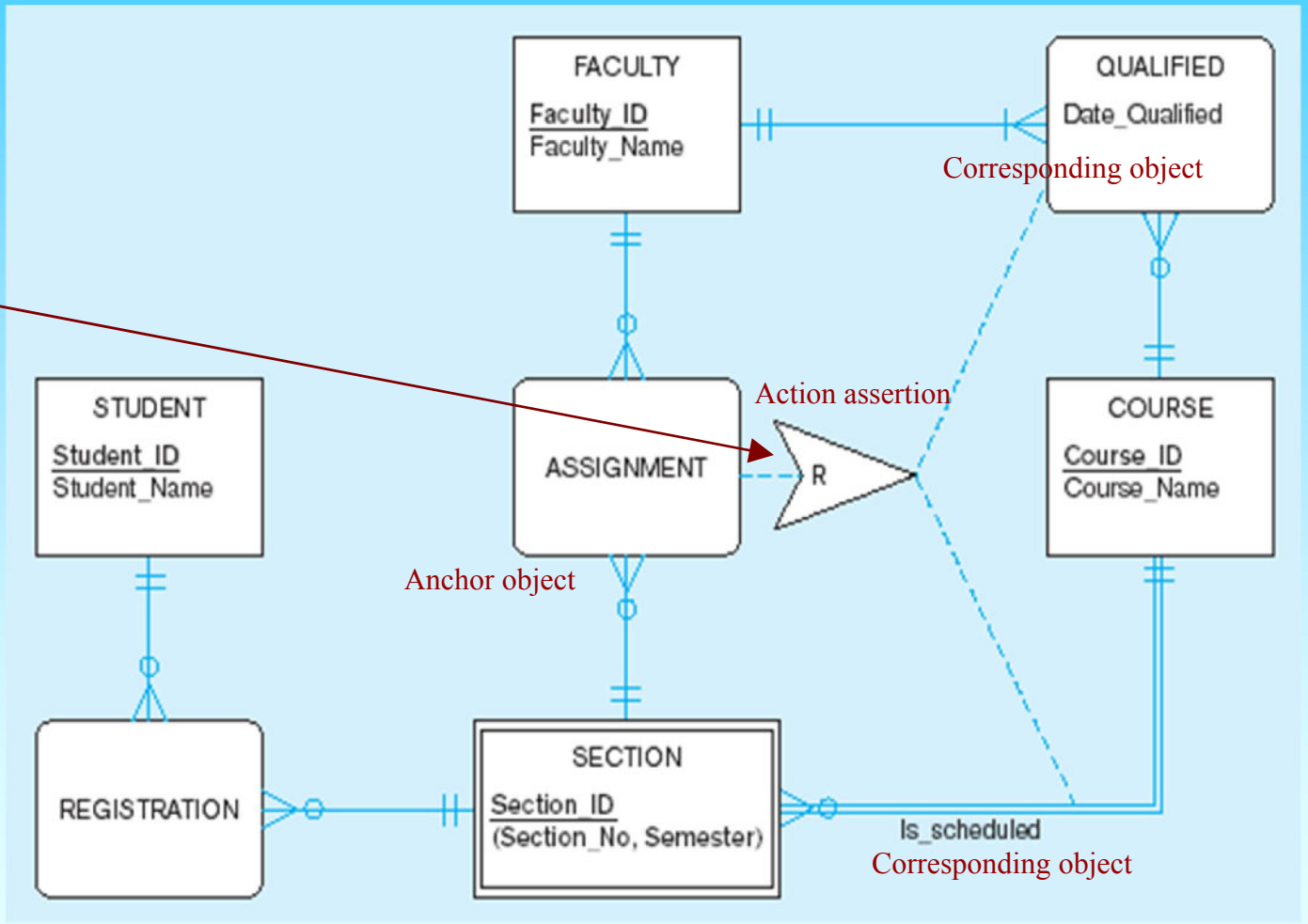


Figure 4-21 Business Rule 2: For a faculty member to be assigned to teach a section of a course, the faculty member must not be assigned to teach a total of more than three course sections

In this case, the action assertion is an ***U**pper **LIM**it*