Chapter 4: The Enhanced ER Model and Business Rules

Modern Database Management

8th Edition

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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

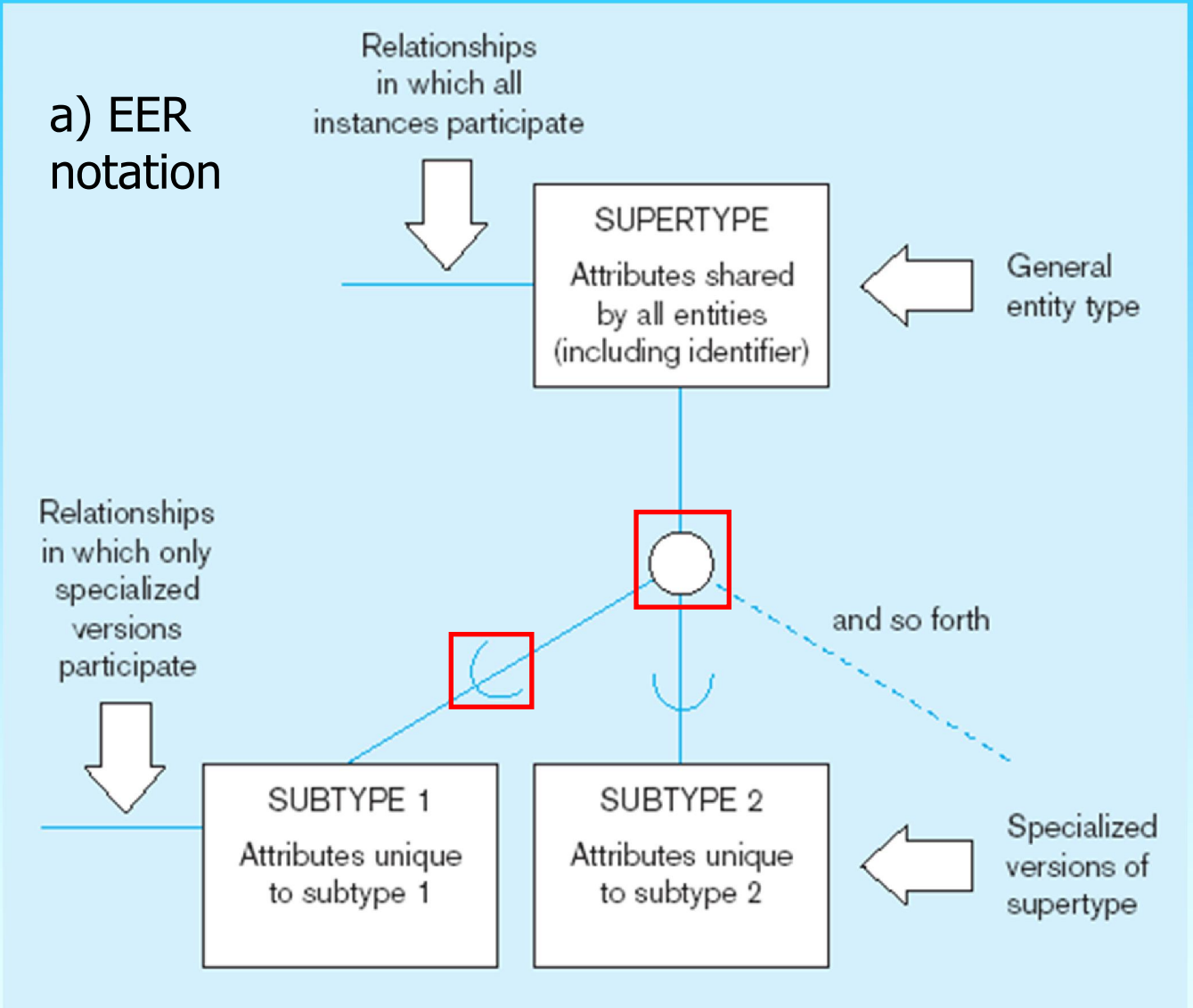
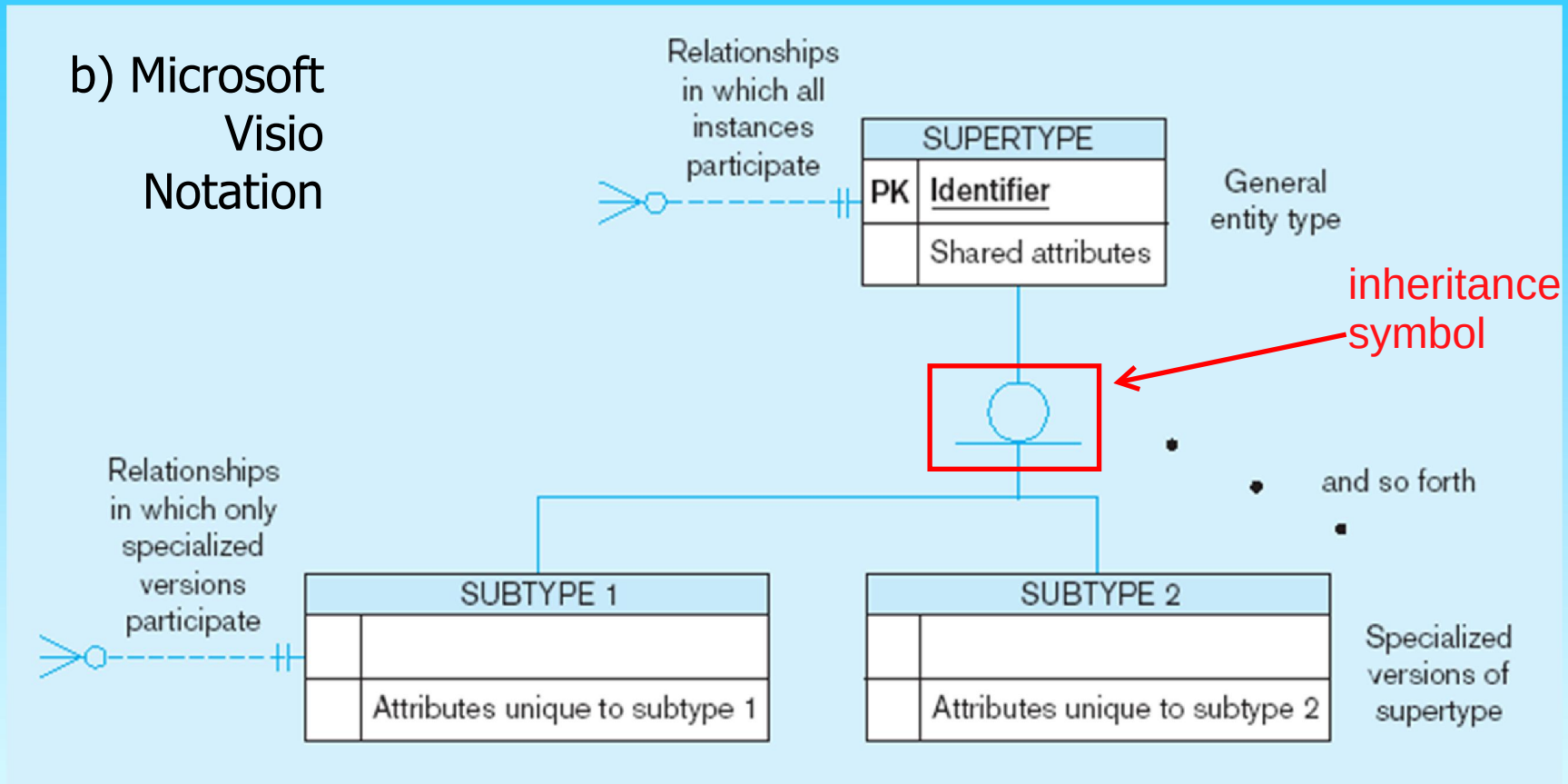
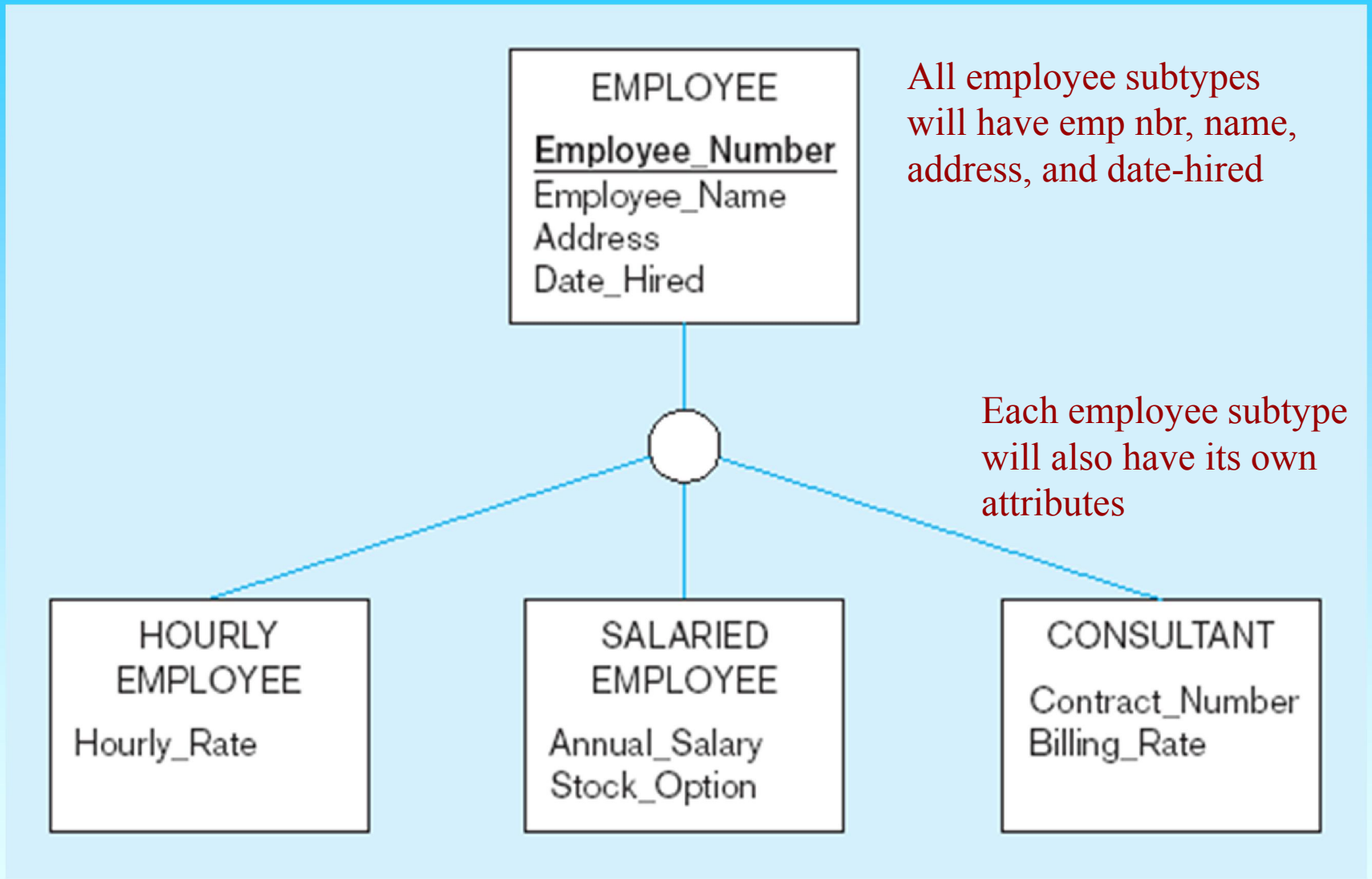


Figure 4-1 Basic notation for supertype/subtype (cont.)



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

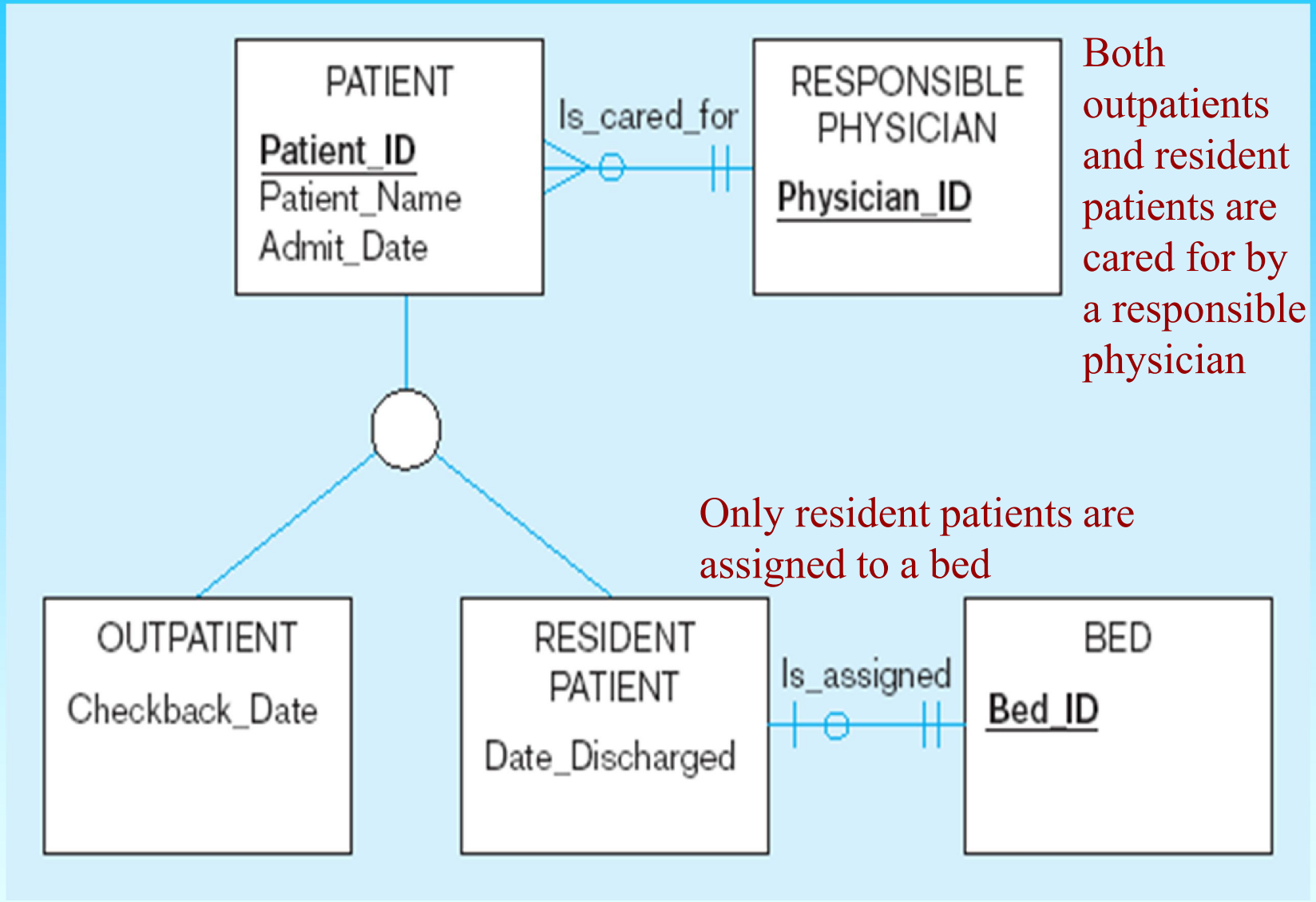
Figure 4-2 Employee supertype with three subtypes



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

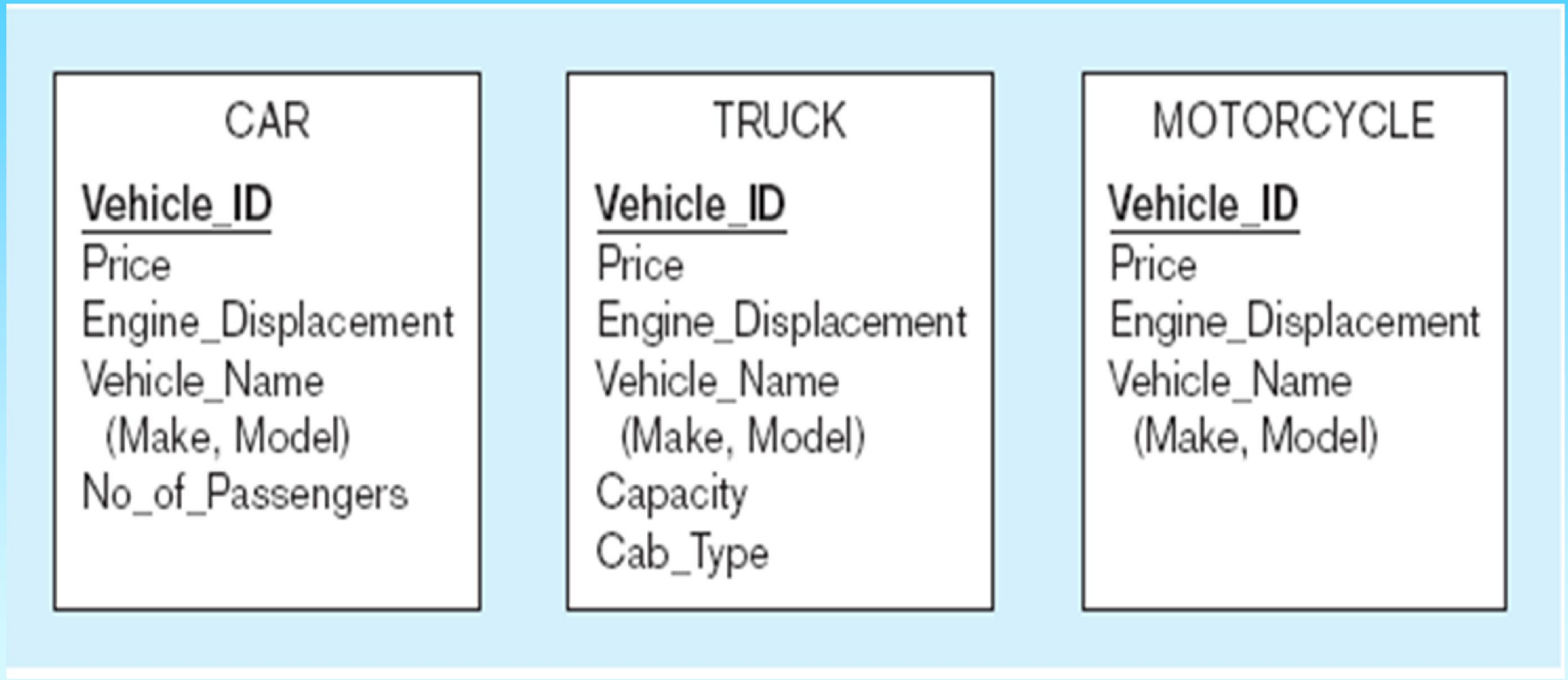


Generalization and Specialization

- ***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

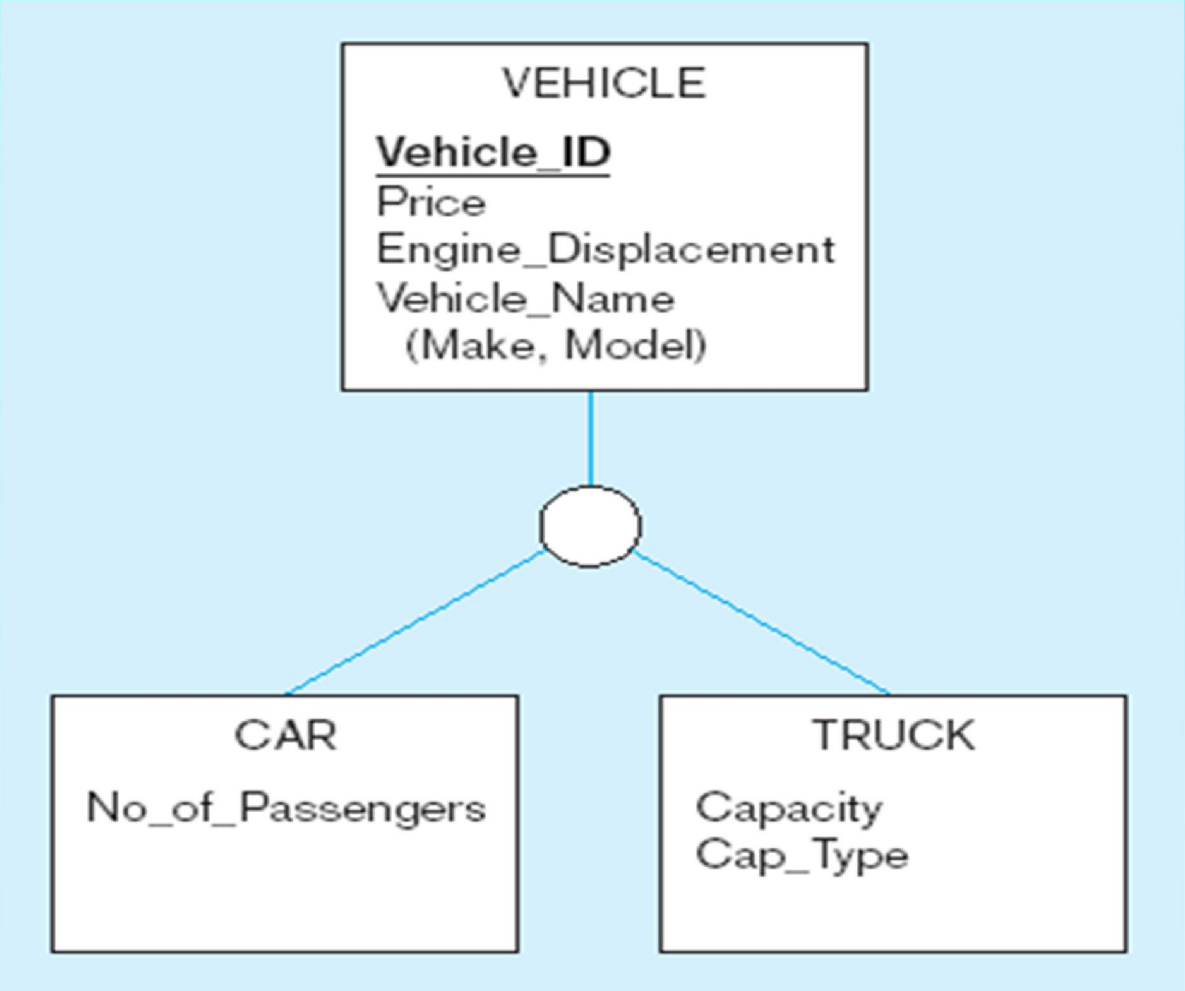
a) Three entity types: CAR, TRUCK, and MOTORCYCLE



All these types of vehicles have common attributes

Figure 4-4 Example of generalization (cont.)

b) Generalization to VEHICLE supertype

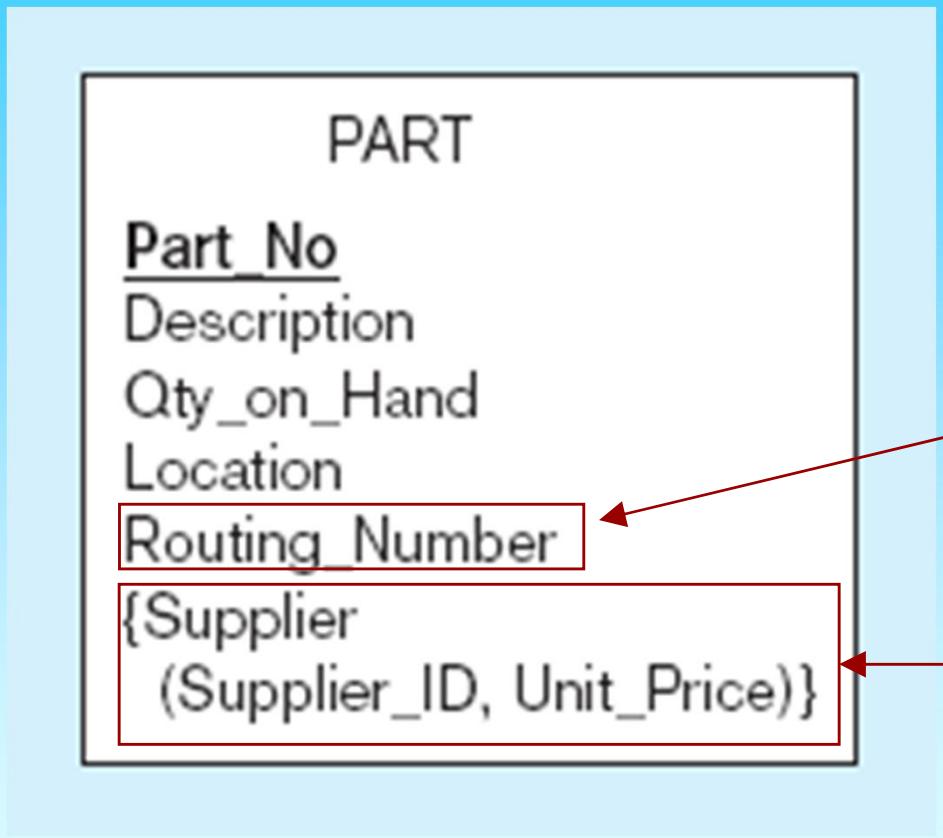


So we put the shared attributes in a supertype

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

Figure 4-5 Example of specialization

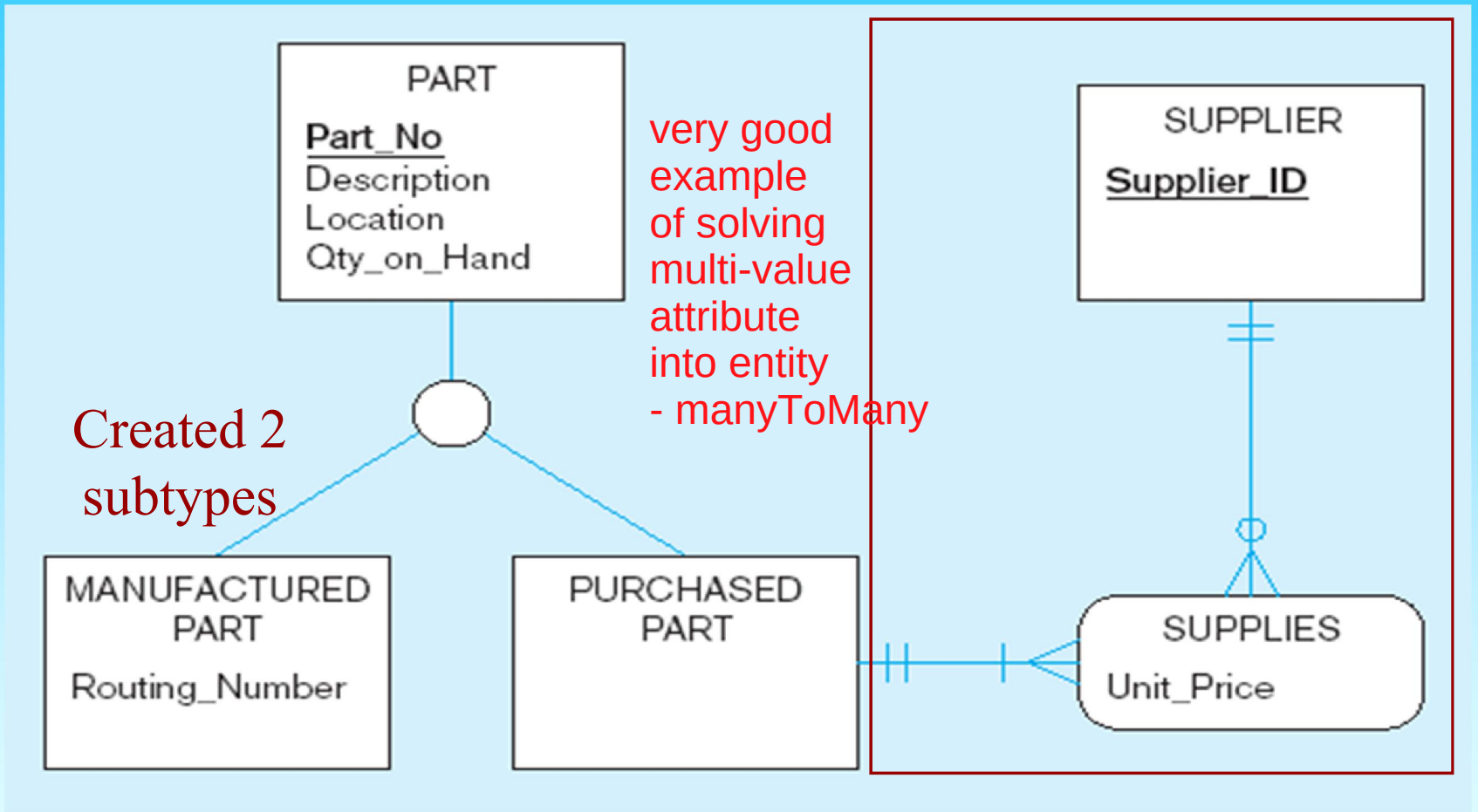
a) Entity type PART



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

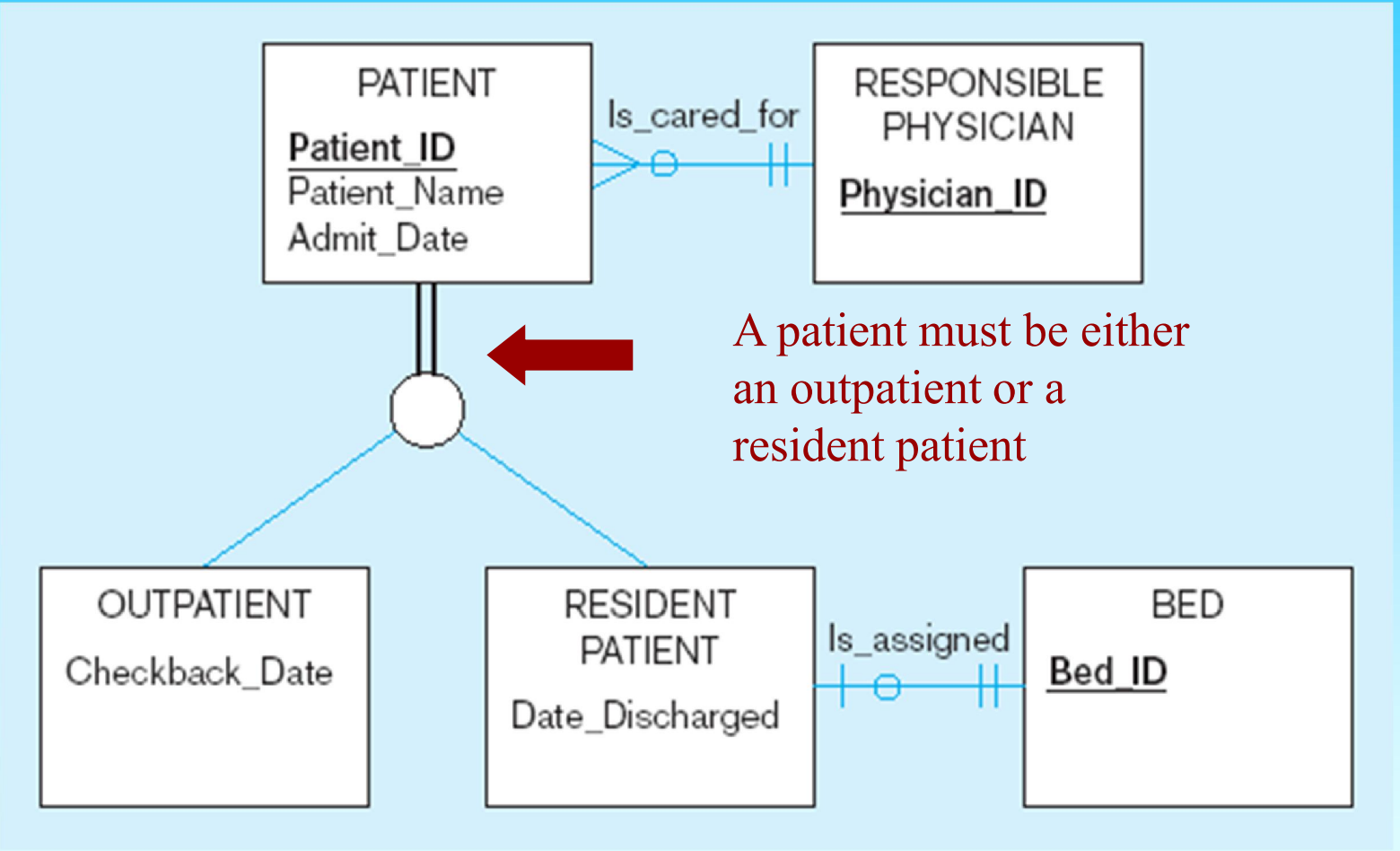
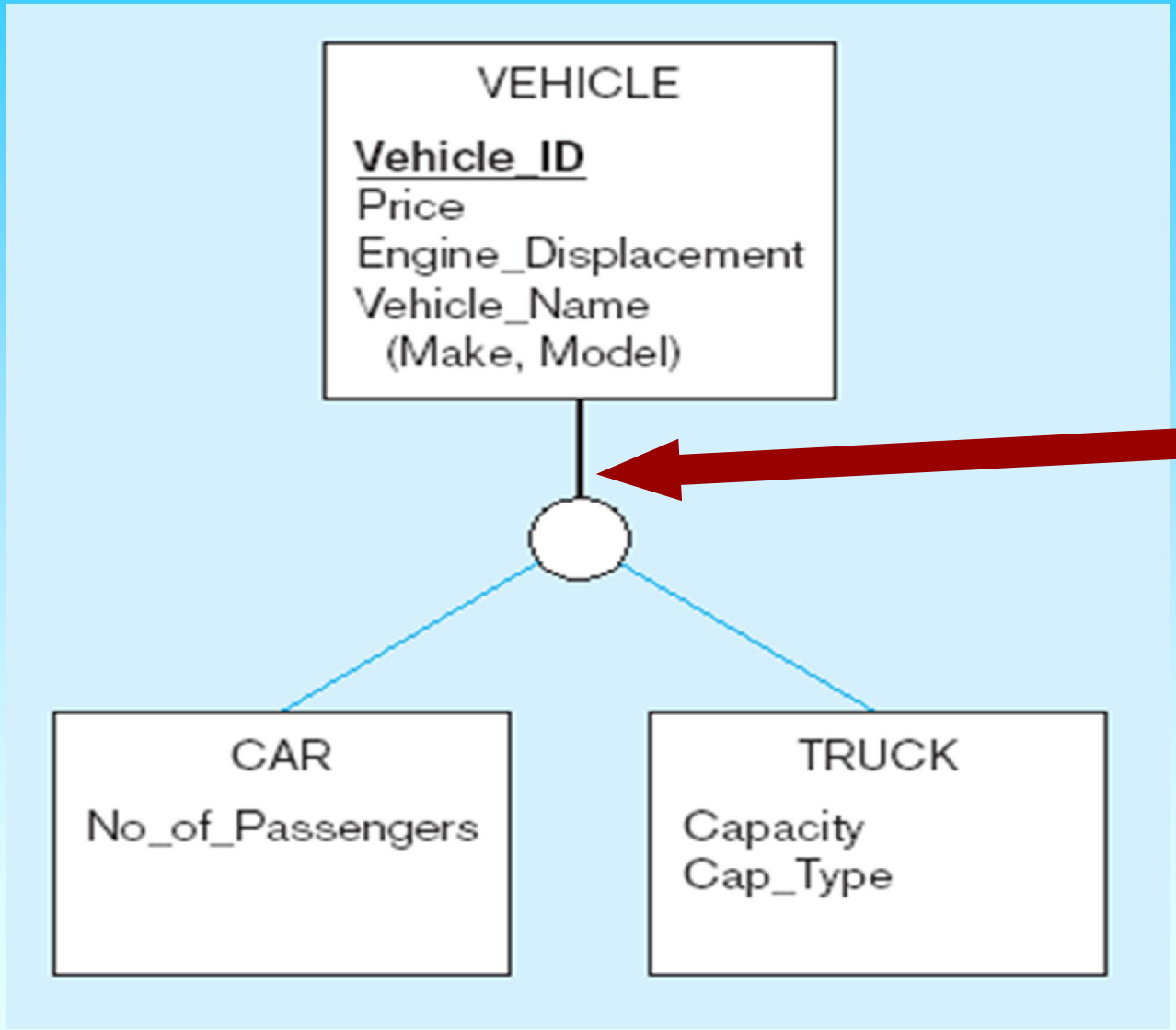


Figure 4-6 Examples of completeness constraints (cont.)

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

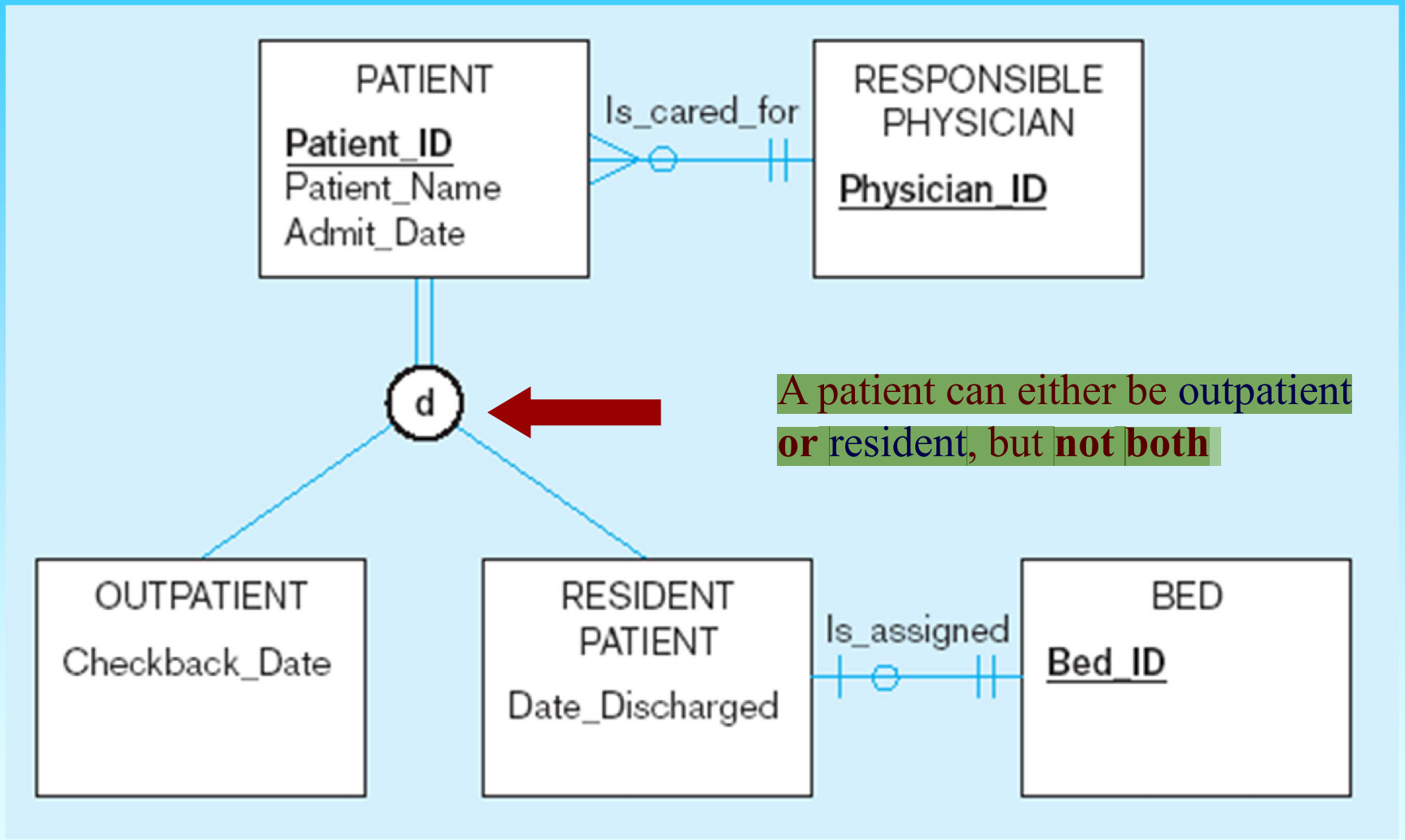
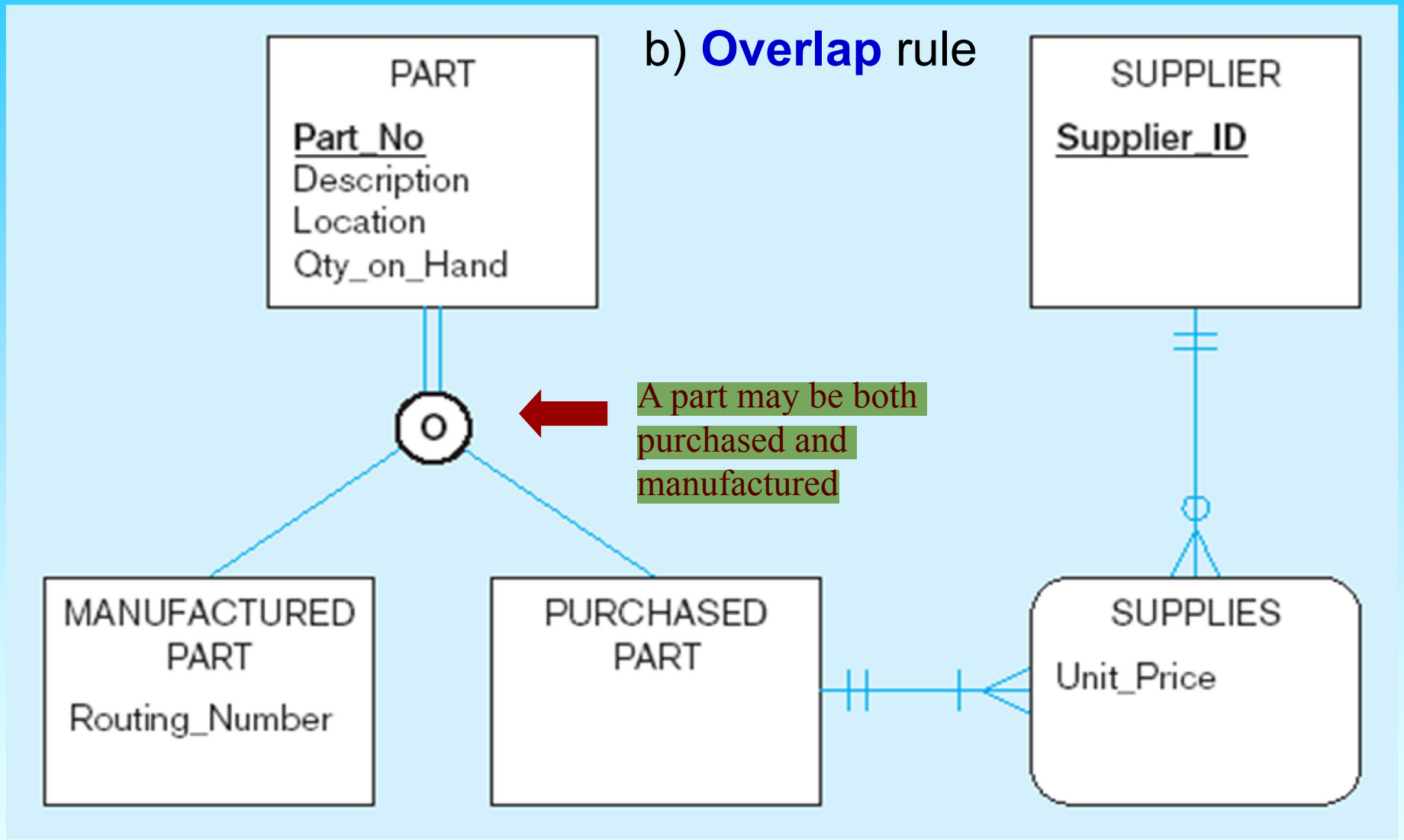


Figure 4-7 Examples of disjointness constraints (cont.)



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)

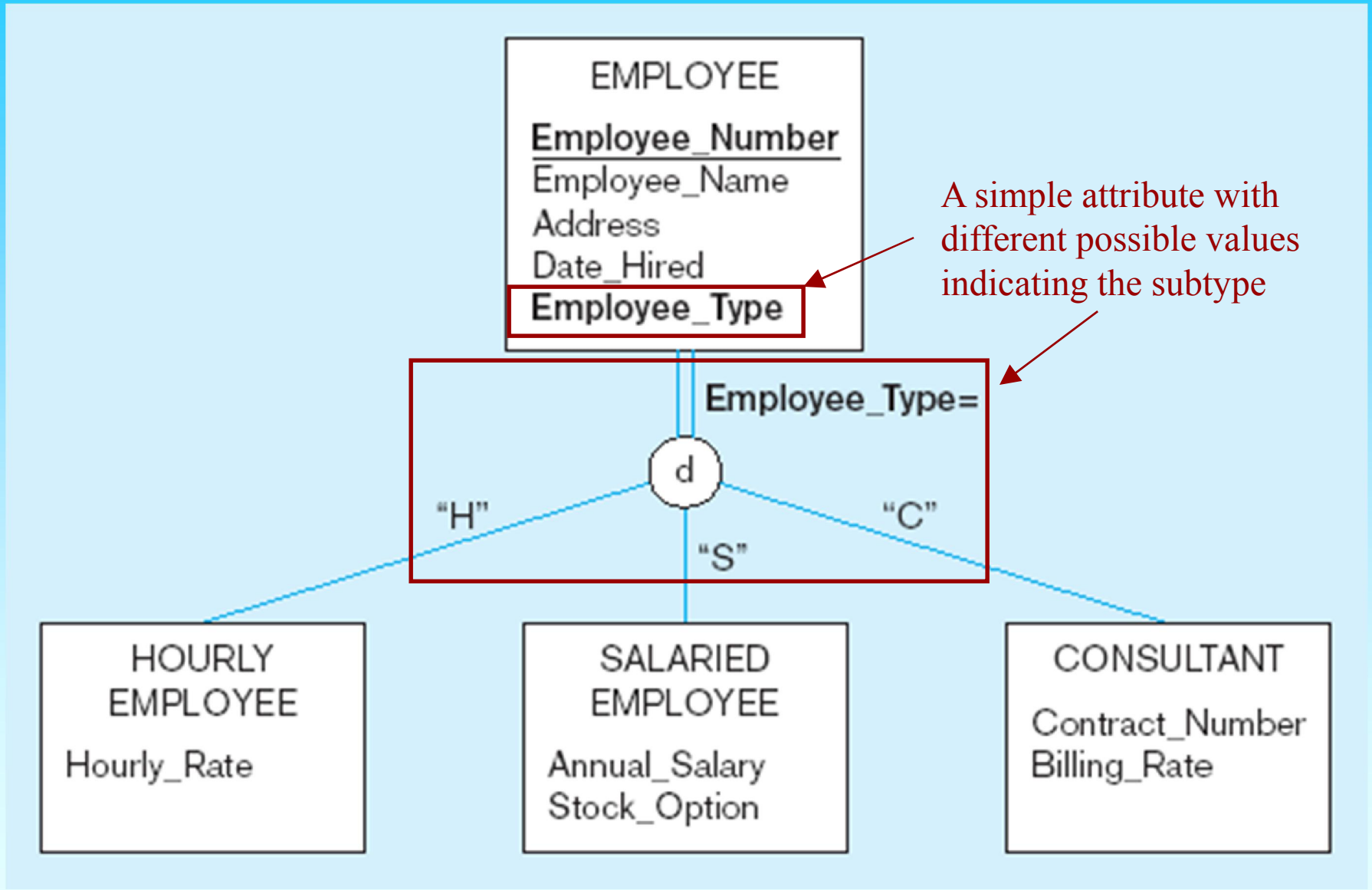


Figure 4-9 Subtype discriminator (*overlap* rule)

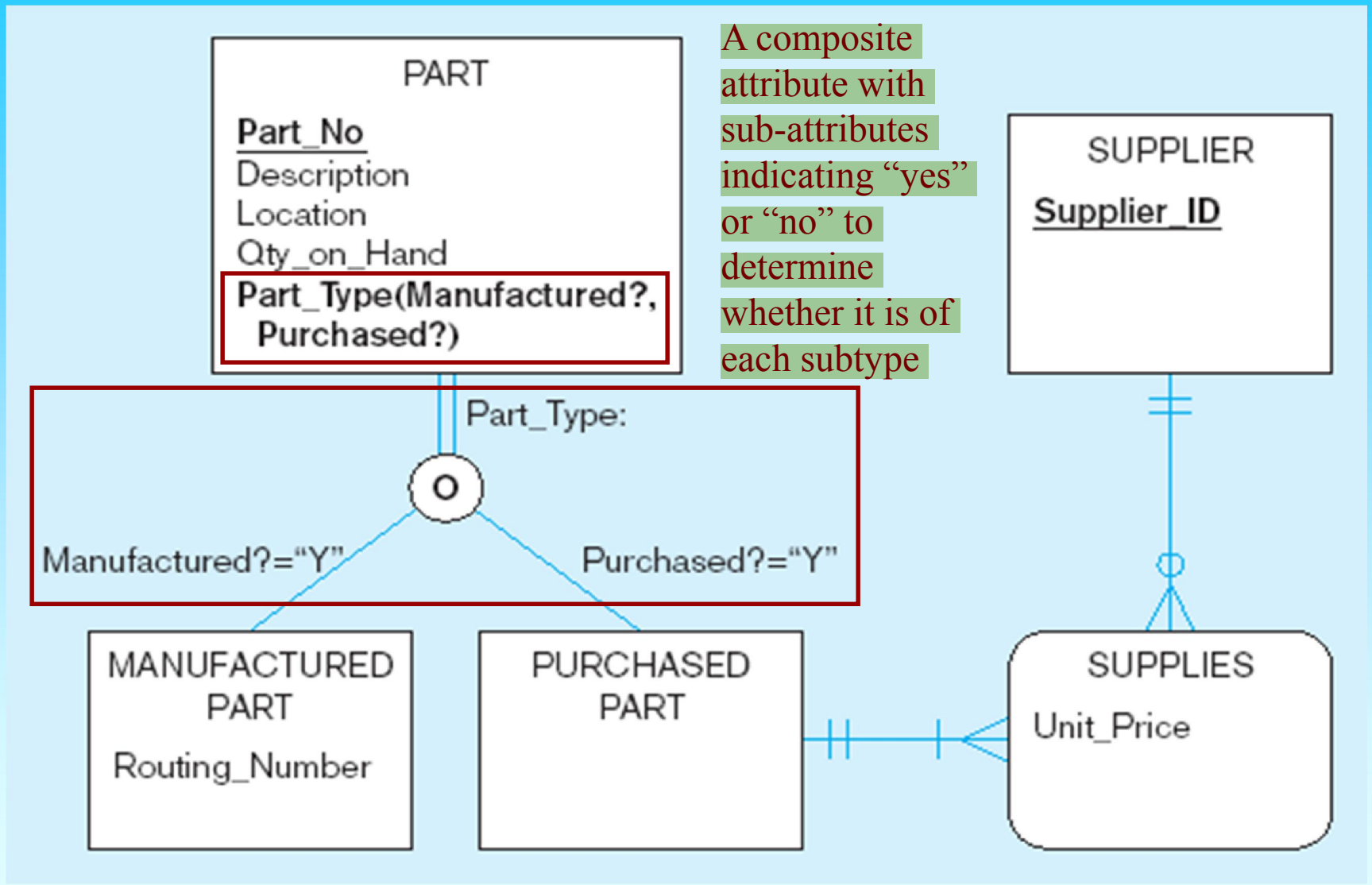
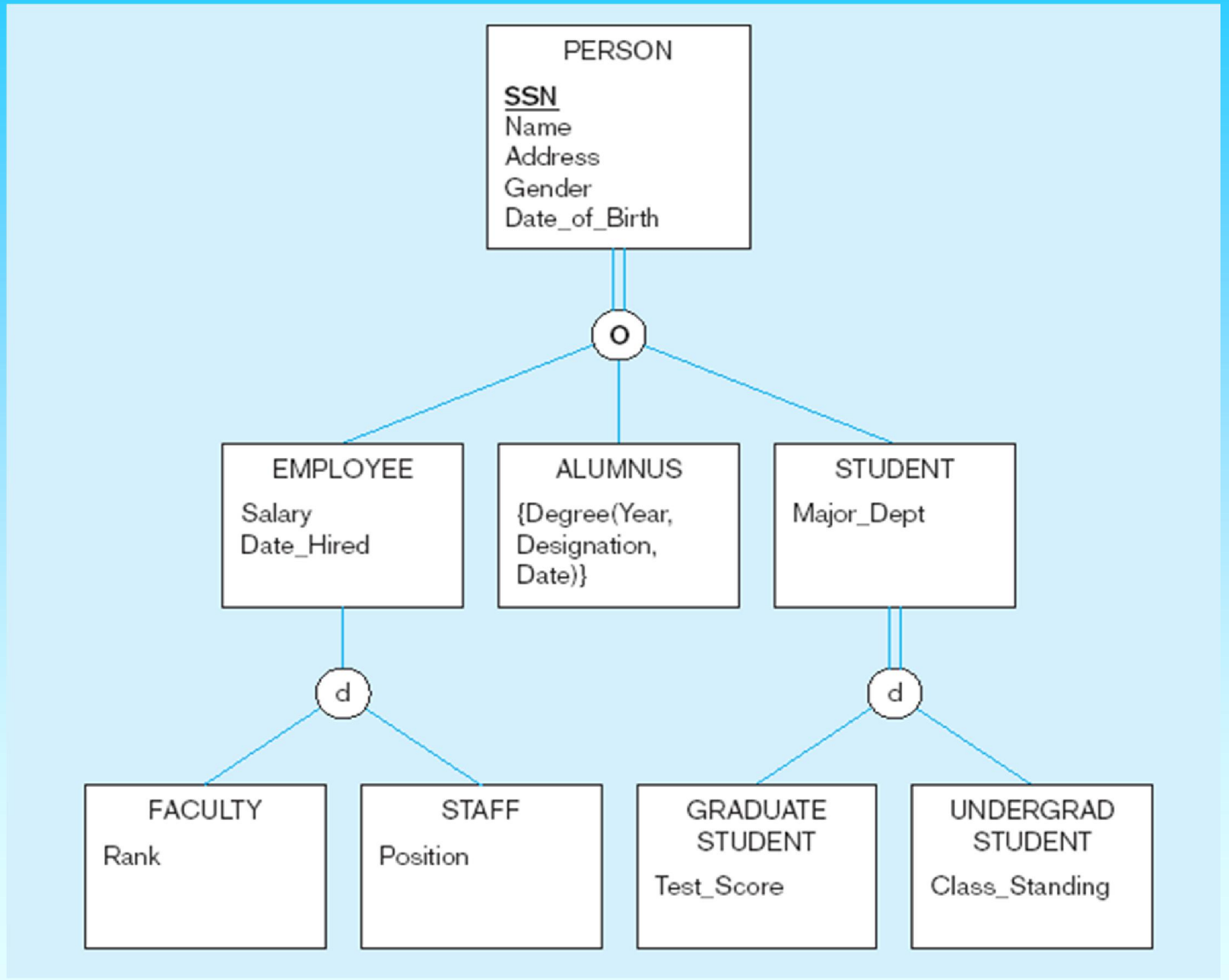


Figure 4-10 Example of supertype/subtype hierarchy



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

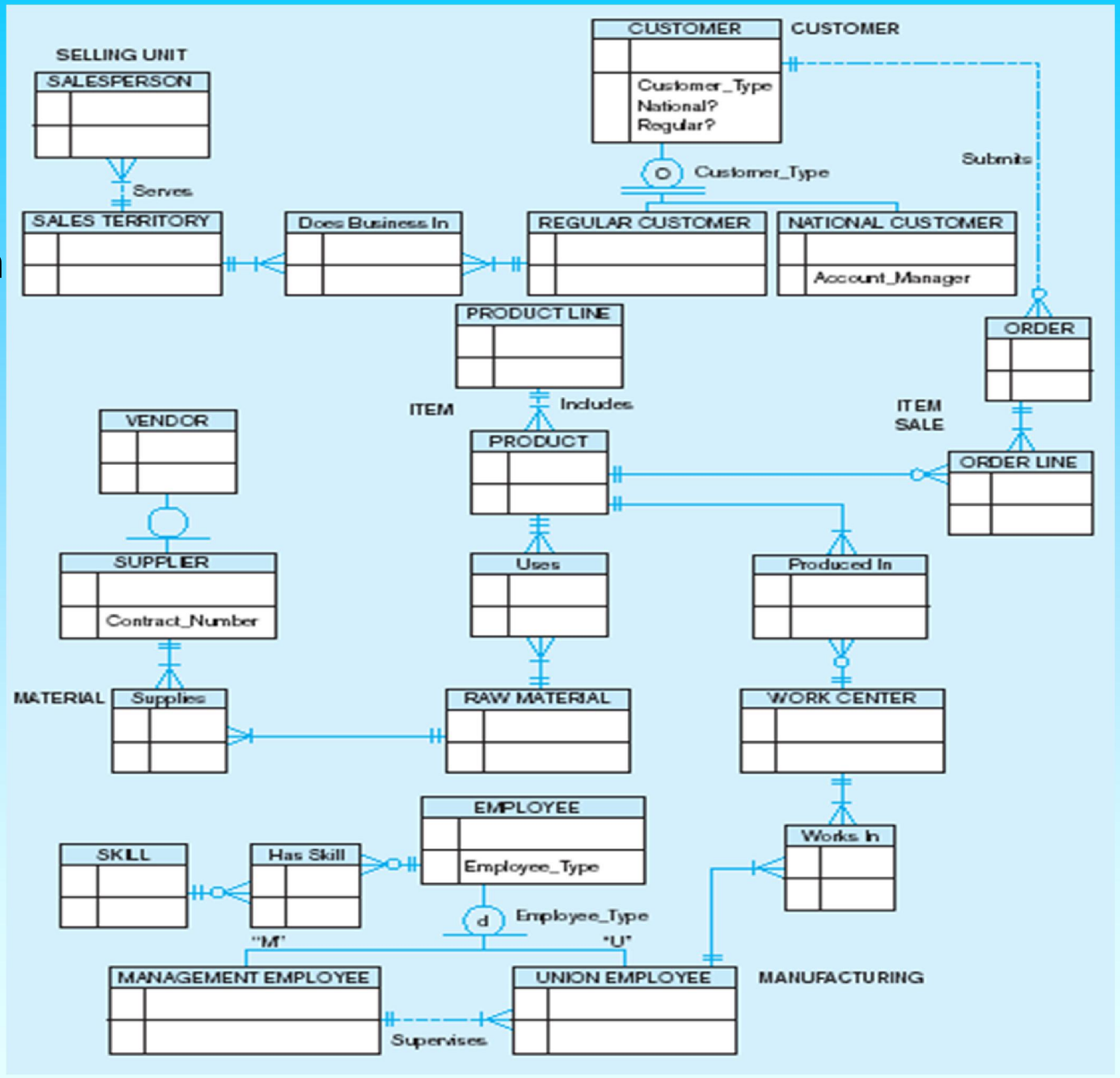


Figure 4-13b EER diagram of PVF entity clusters

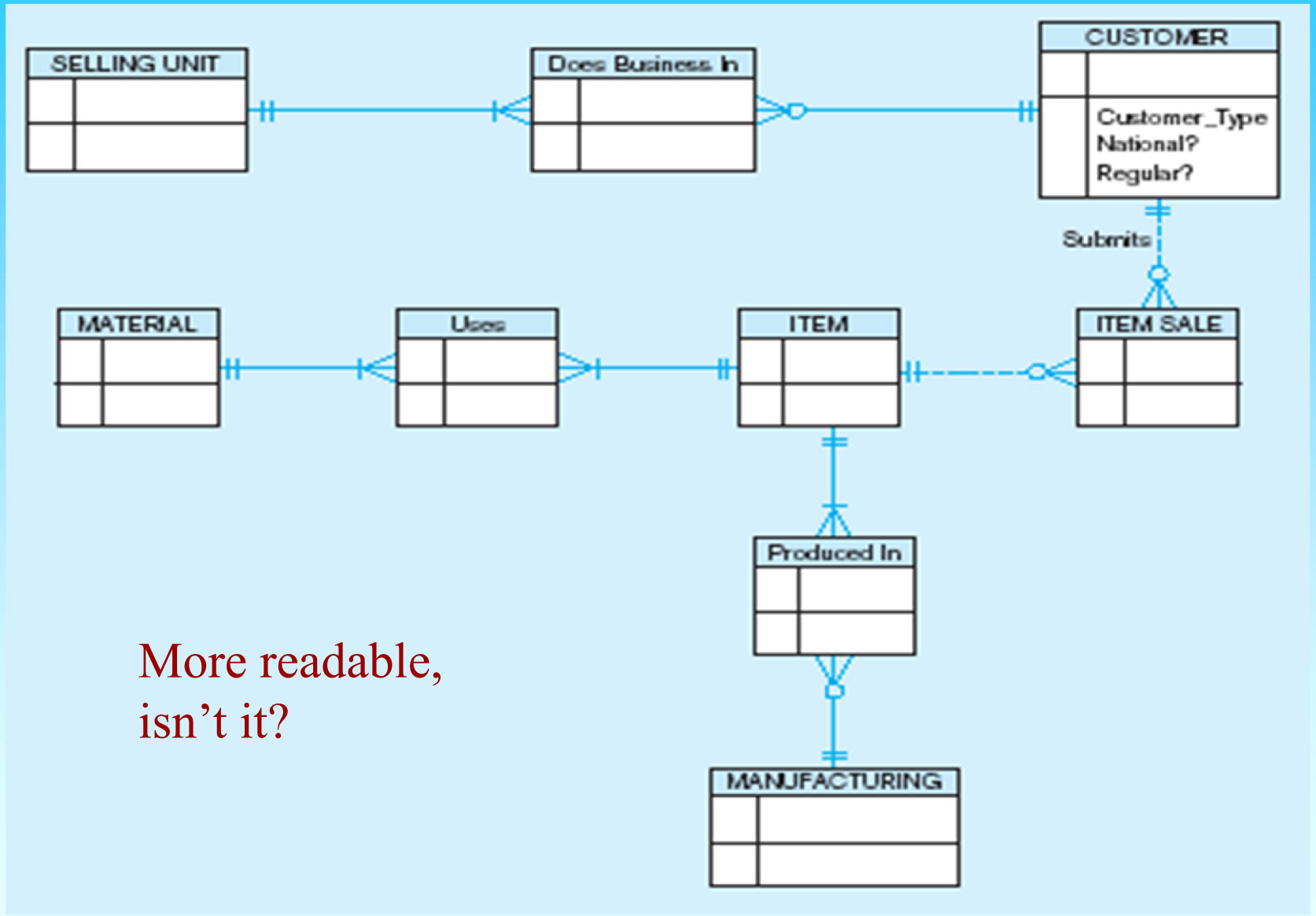
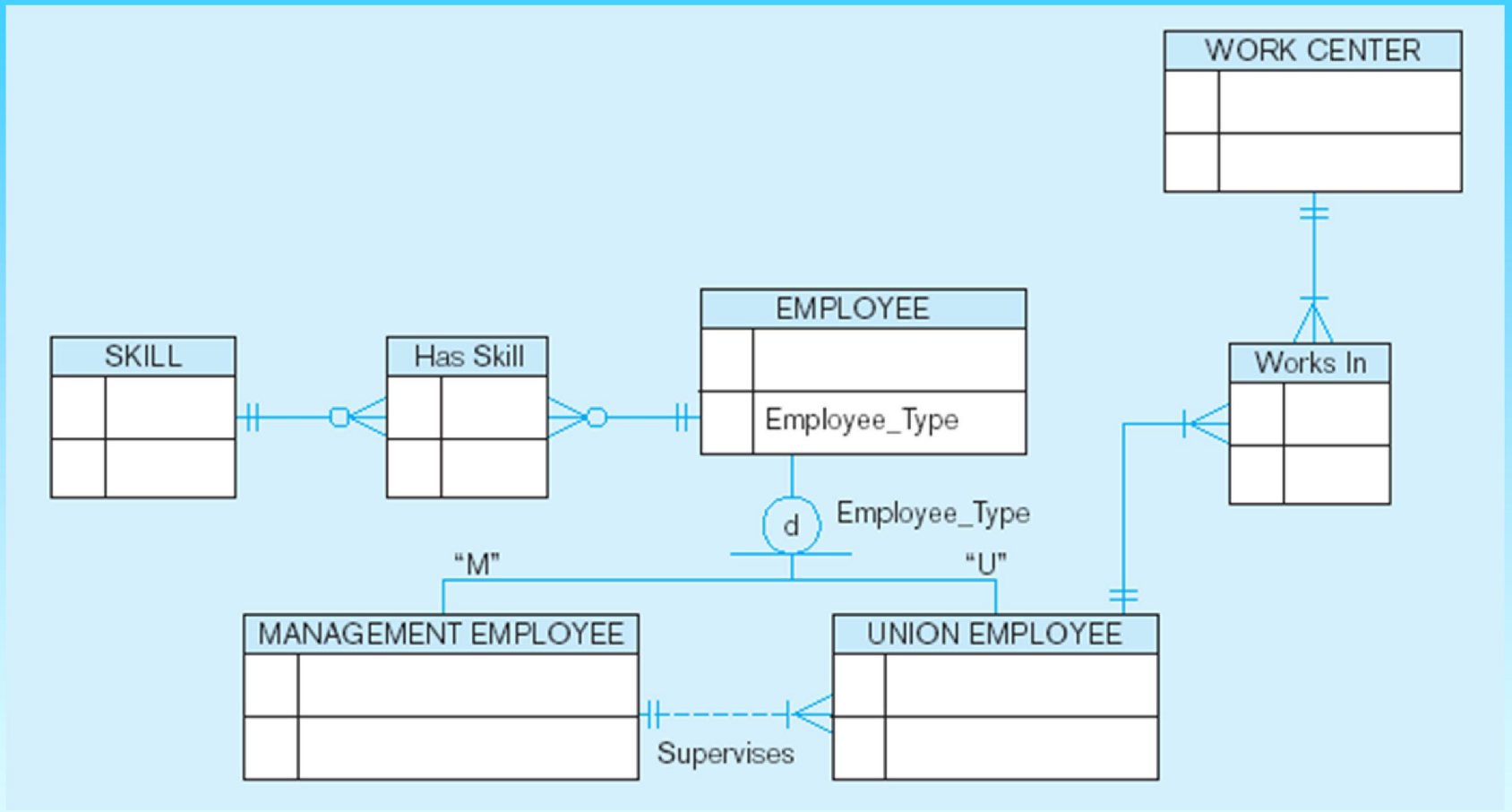
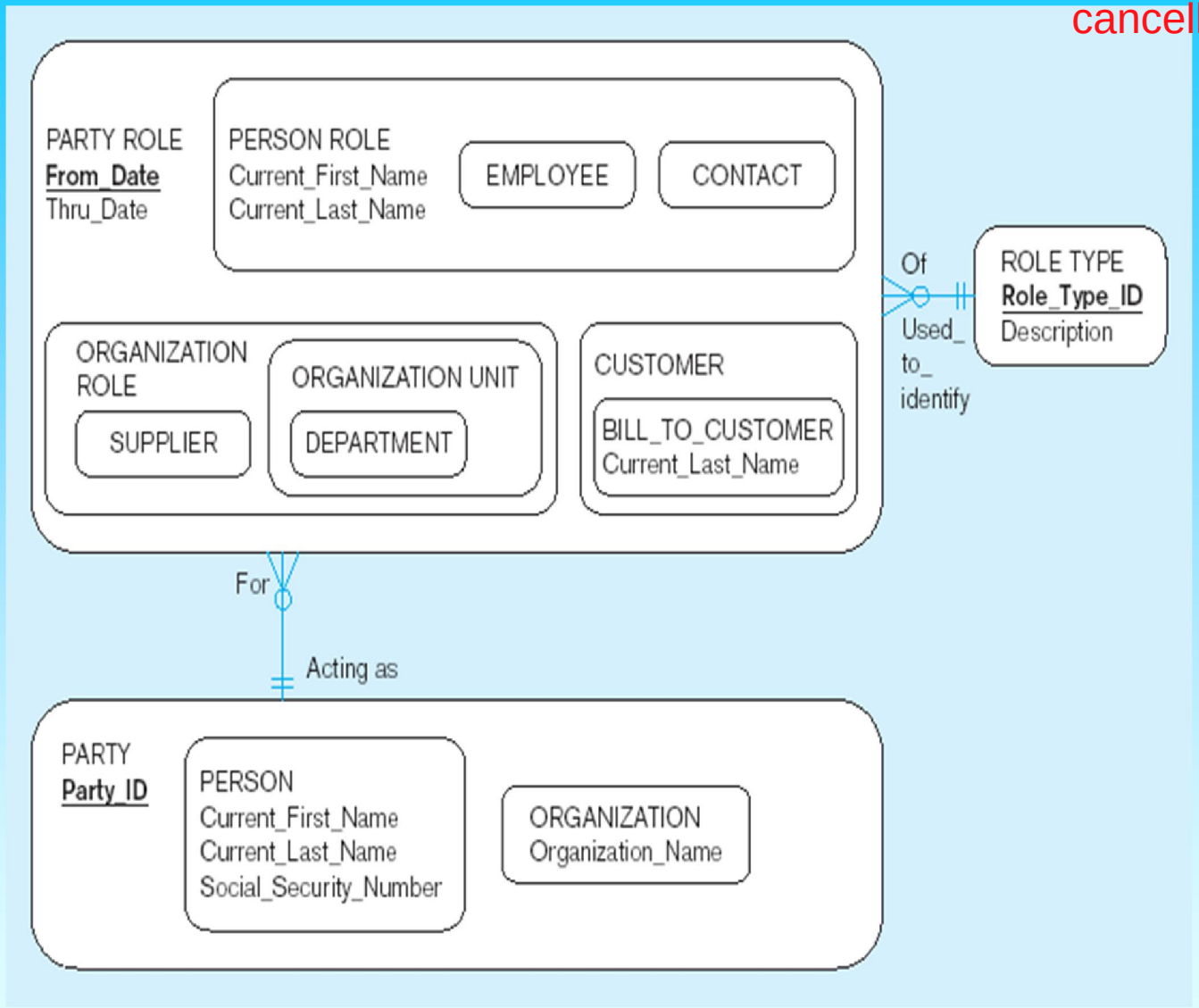


Figure 4-14 Manufacturing entity cluster



Detail for a single cluster

cancelled

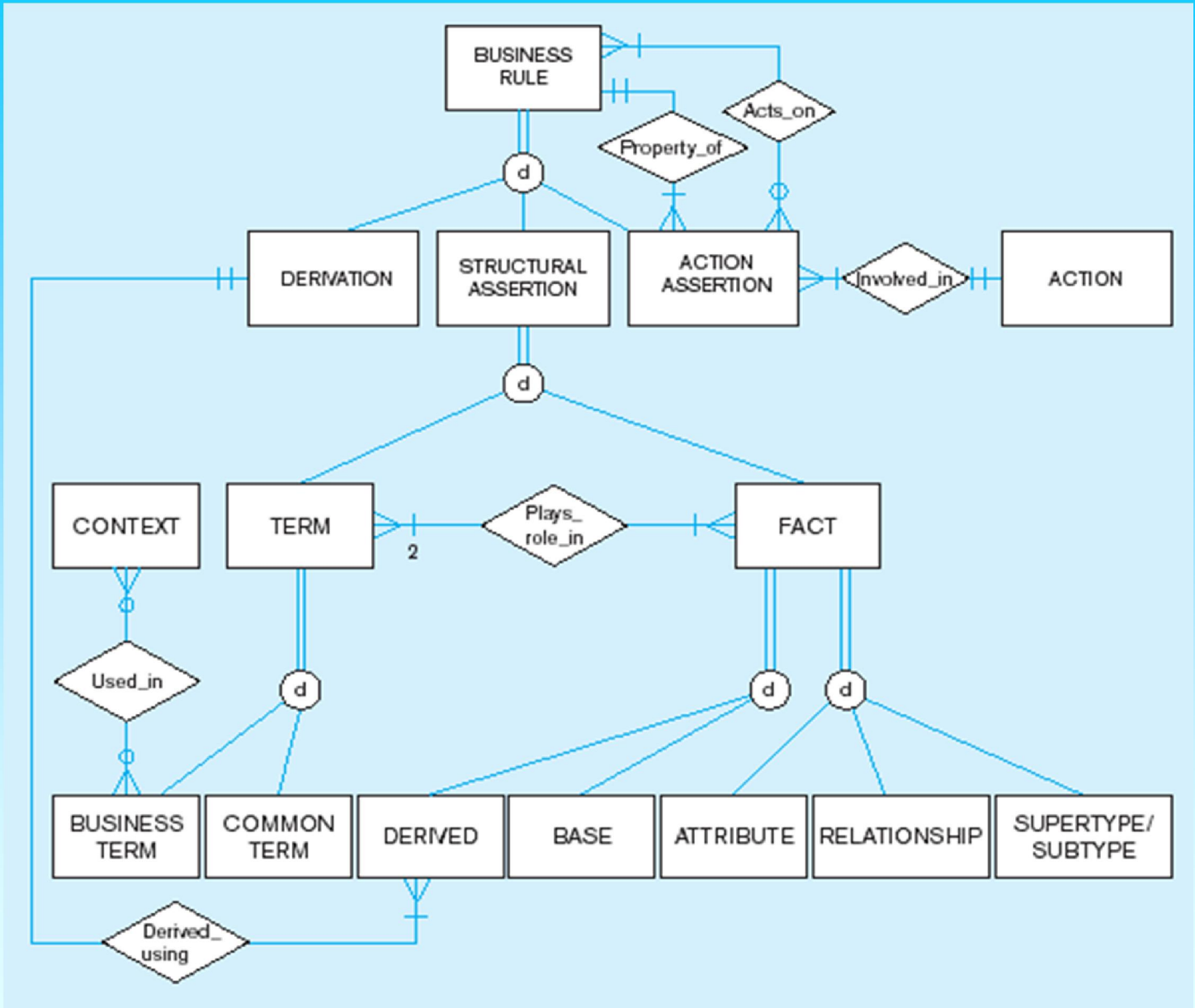


Packaged data models provide generic models that can be customized for a particular organization's business rules

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

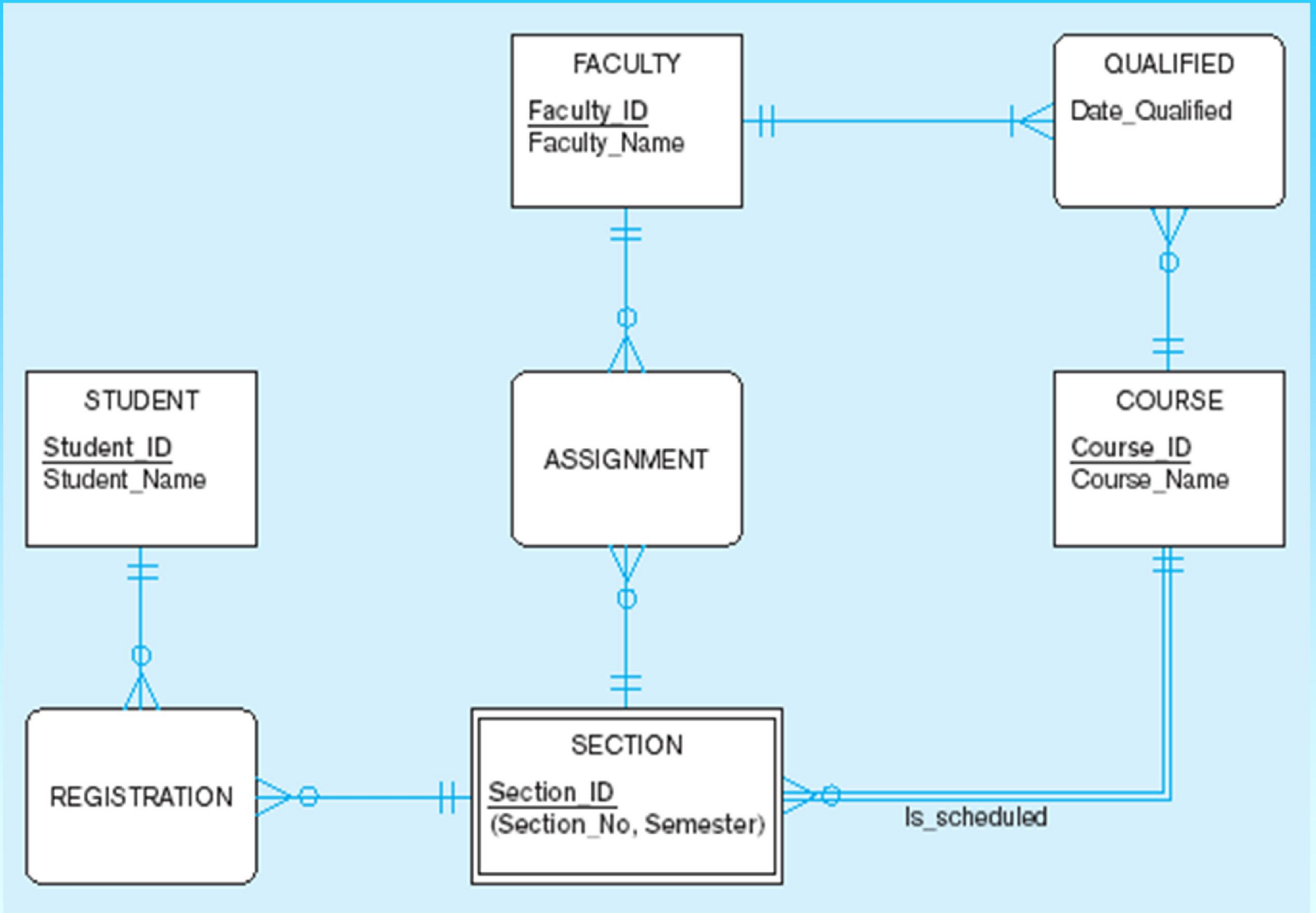


Figure 4-20 Business Rule 1: For a faculty member to be assigned to teach a section of a course, the faculty member must be qualified to teach the course for which that section is scheduled

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

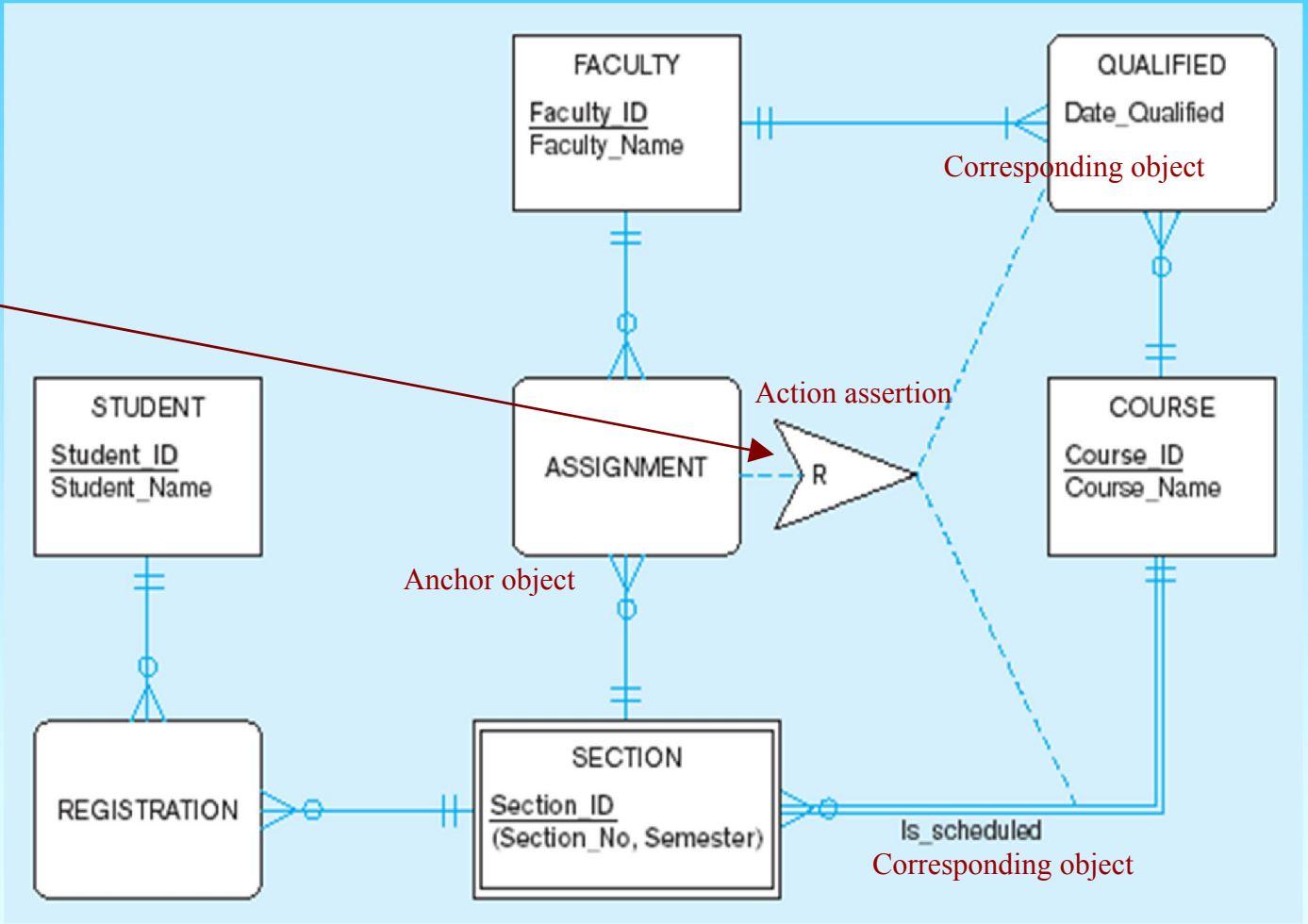


Figure 4-21 Business Rule 2: For a faculty member to be assigned to teach a section of a course, the faculty member must not be assigned to teach a total of more than three course sections

In this case, the action assertion is an *Upper LIMit*