Chapter 4: The Enhanced E-R Model and Business Rules

Modern Database Management

6th Edition

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Supertypes and Subtypes

- **Subtype:** A subgrouping of the entities in an entity type which has attributes that are distinct from those in other subgroupings
- **Supertype:** An generic entity type that has a relationship with one or more subtypes
- **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 relationships

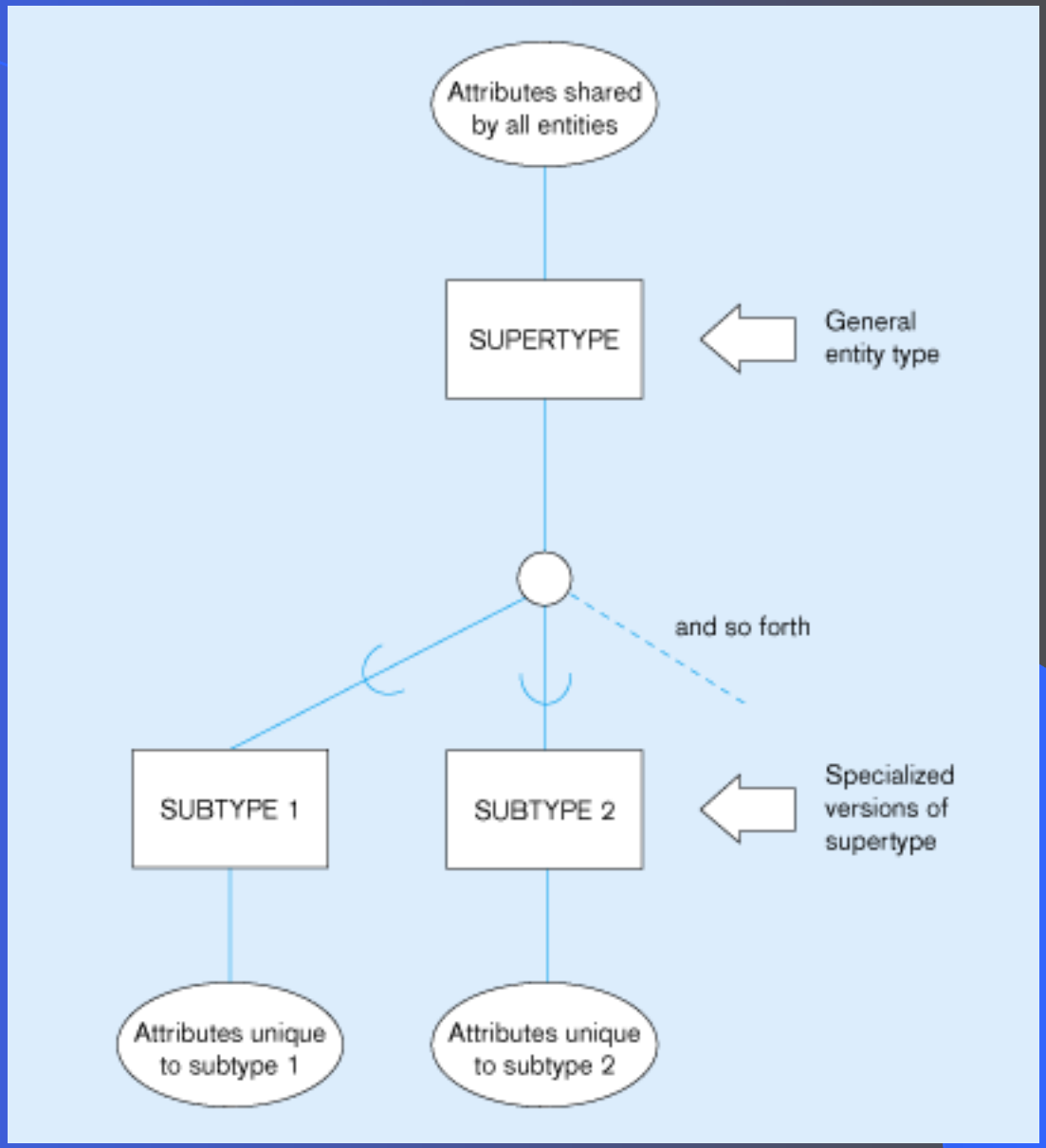
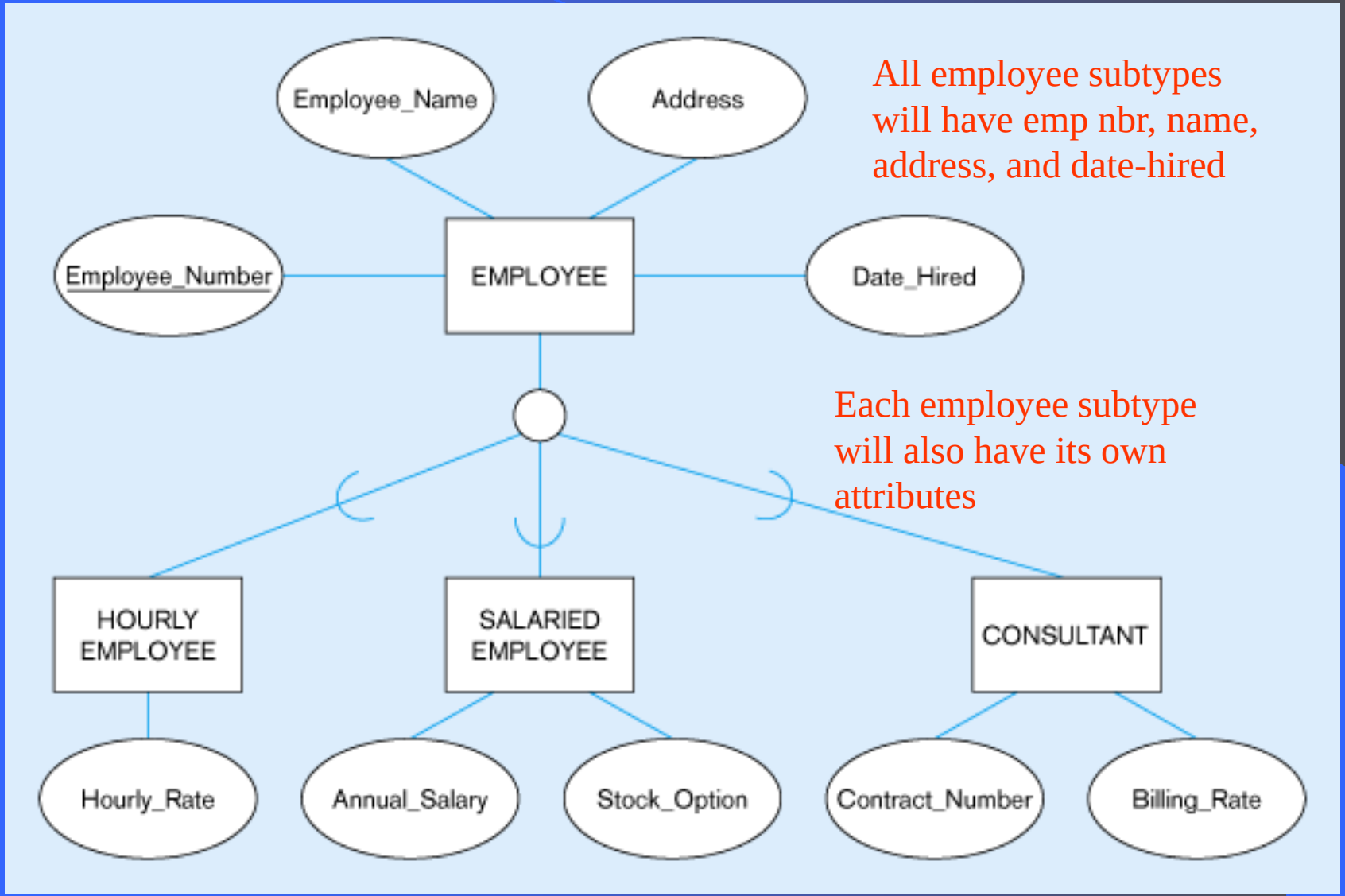


Figure 4-2 -- Employee supertype with three subtypes

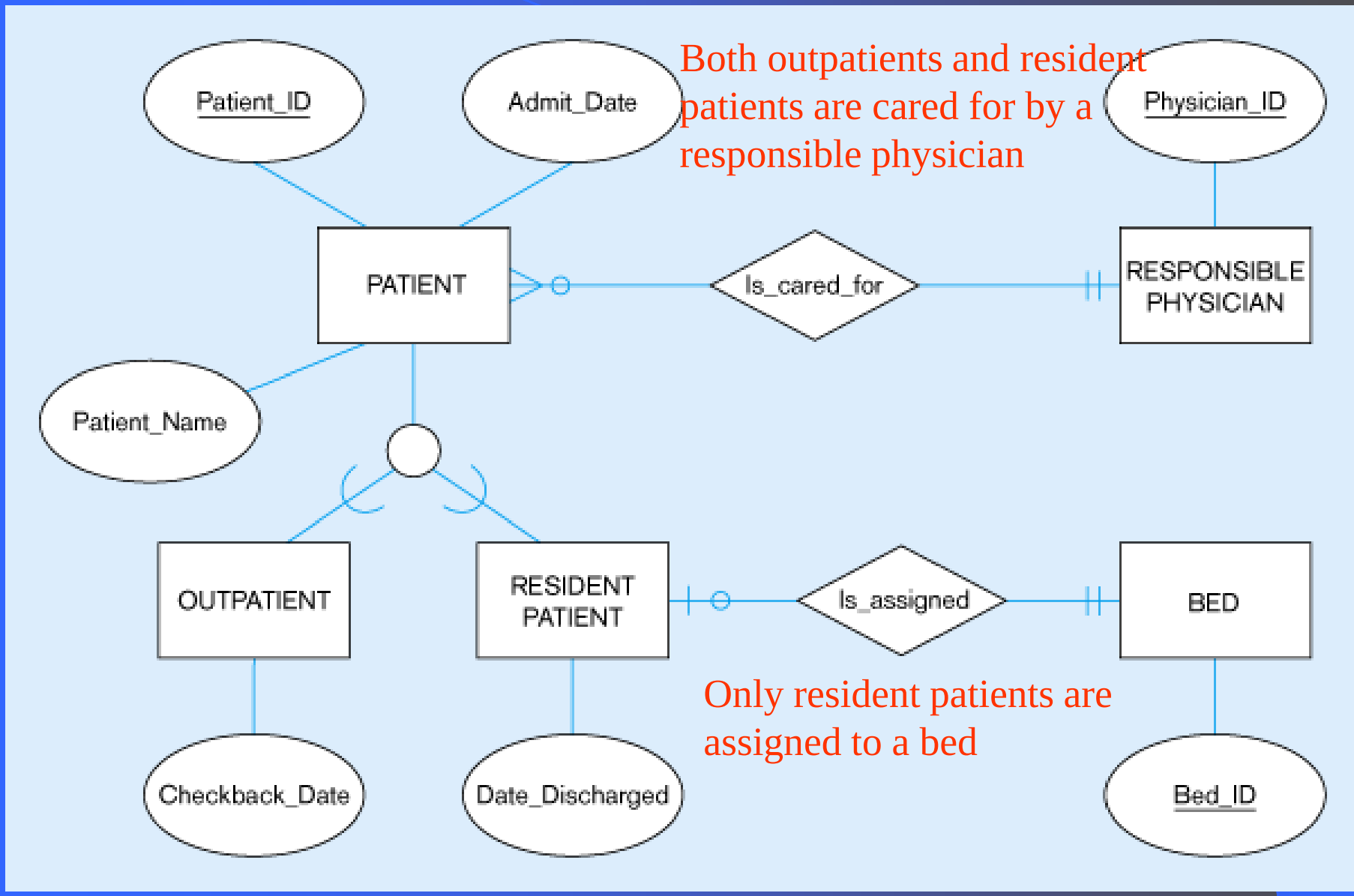


Relationships and Subtypes

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

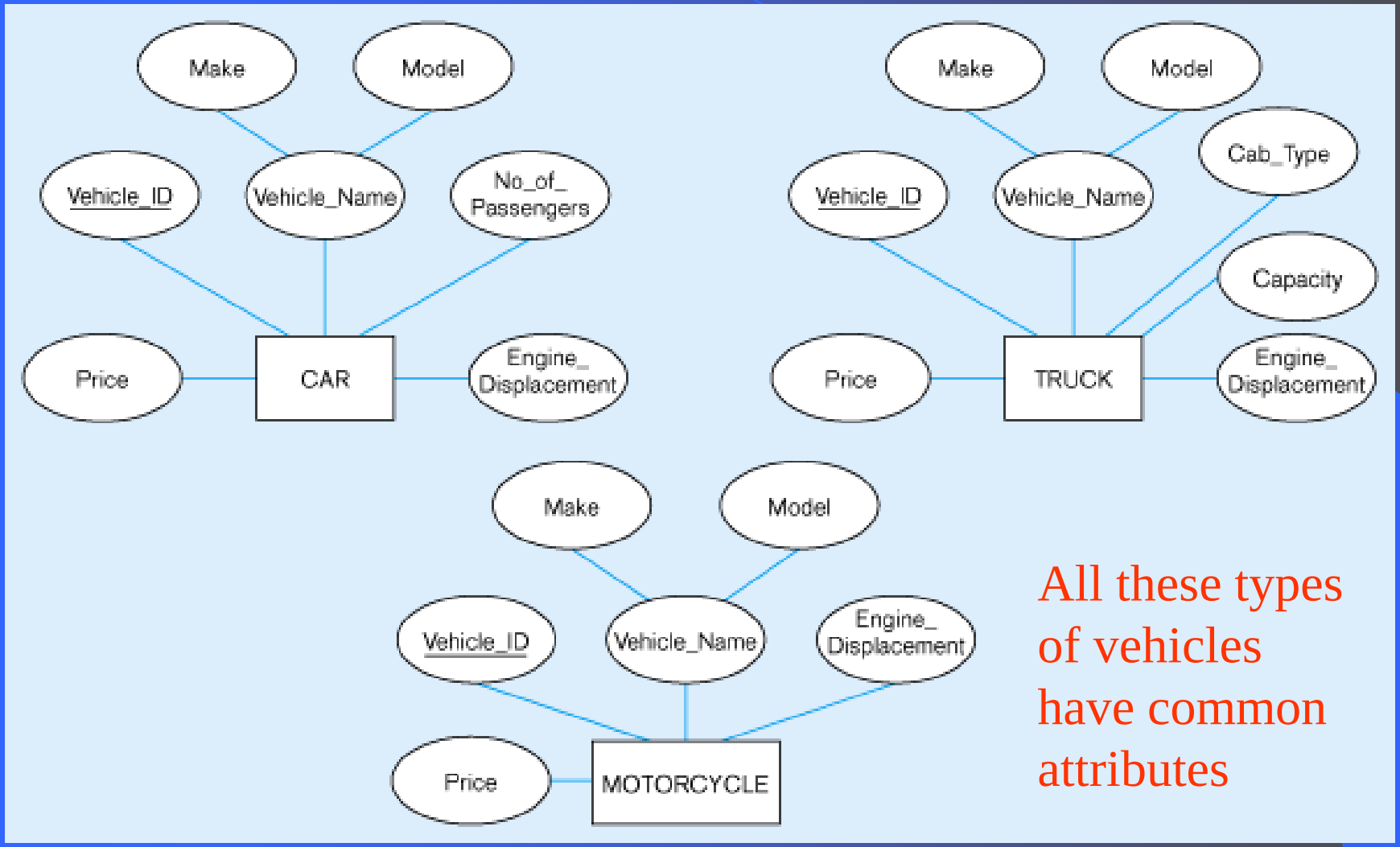
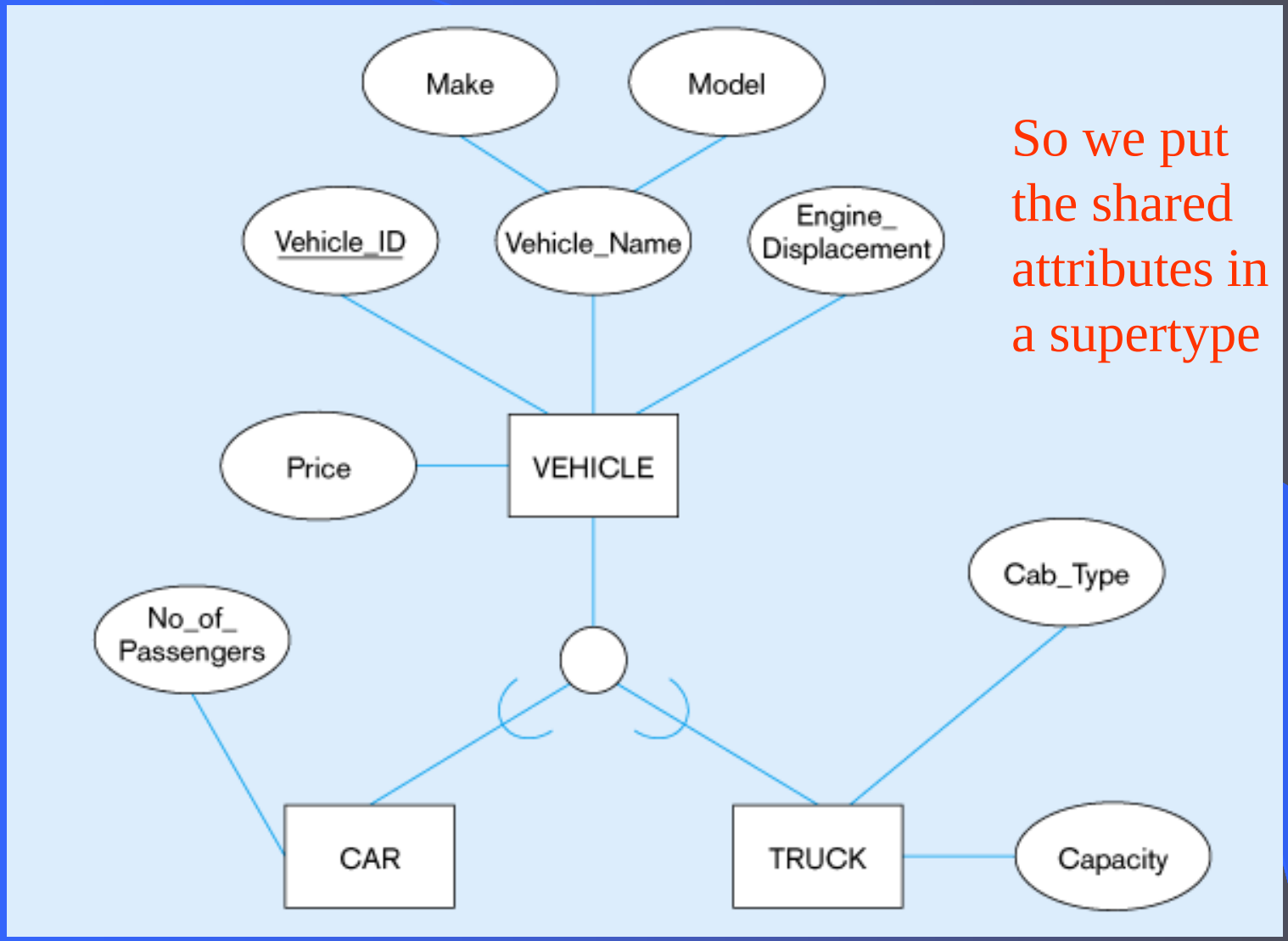


Figure 4-4(b) – Generalization to VEHICLE supertype



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

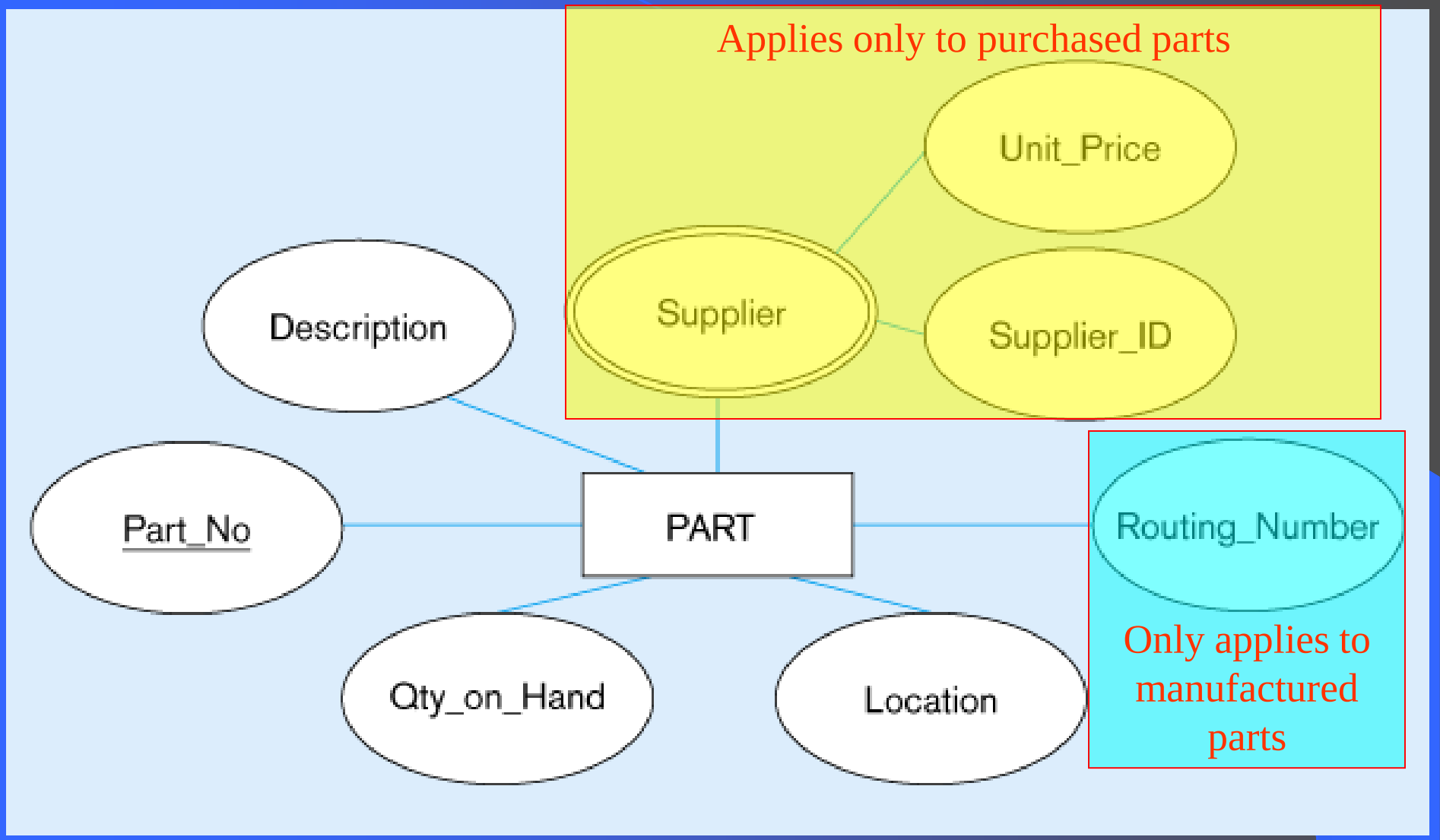
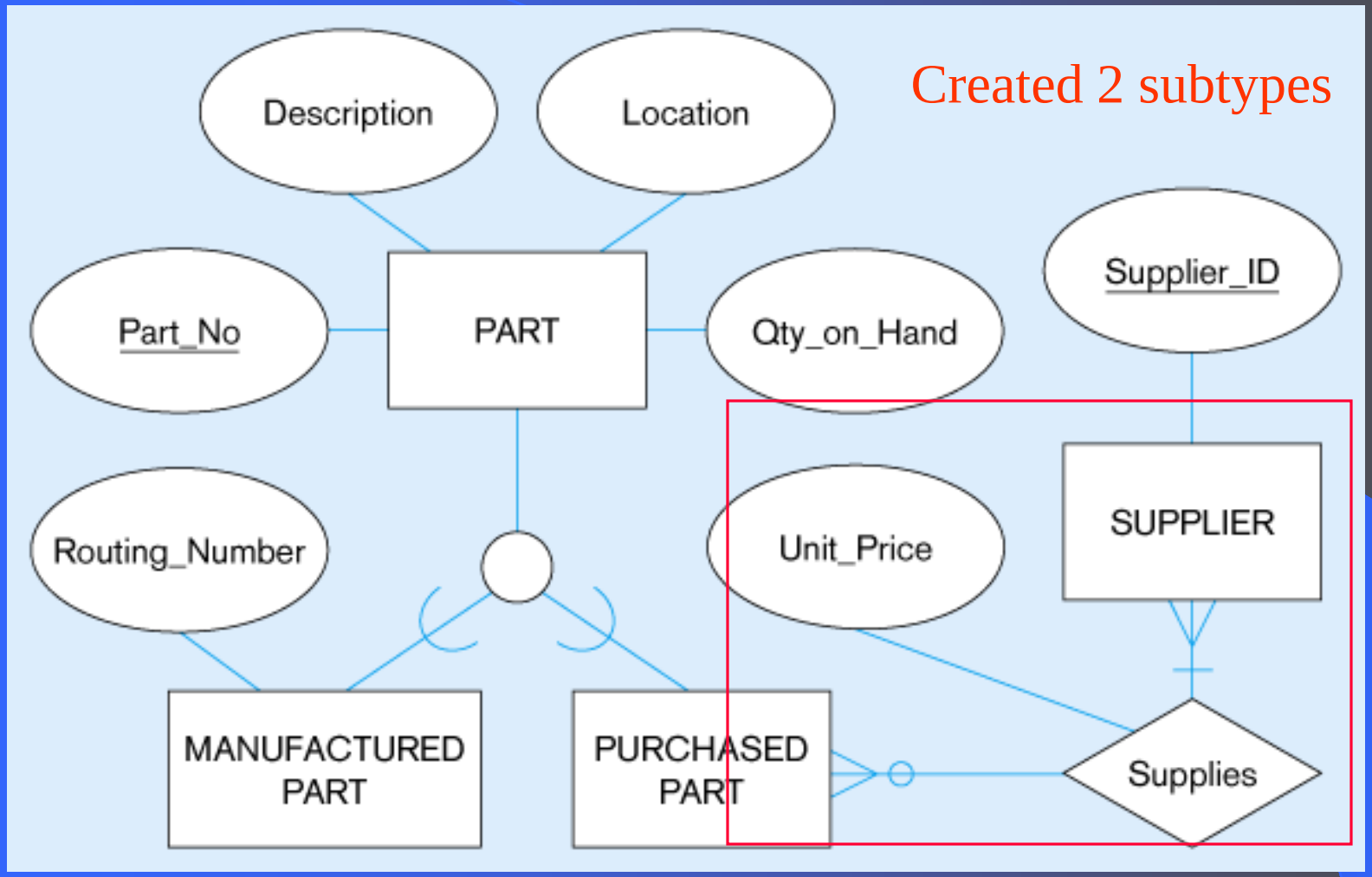


Figure 4-5(b) – Specialization to MANUFACTURED PART and PURCHASED PART



Note: multivalued attribute was replaced by a 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

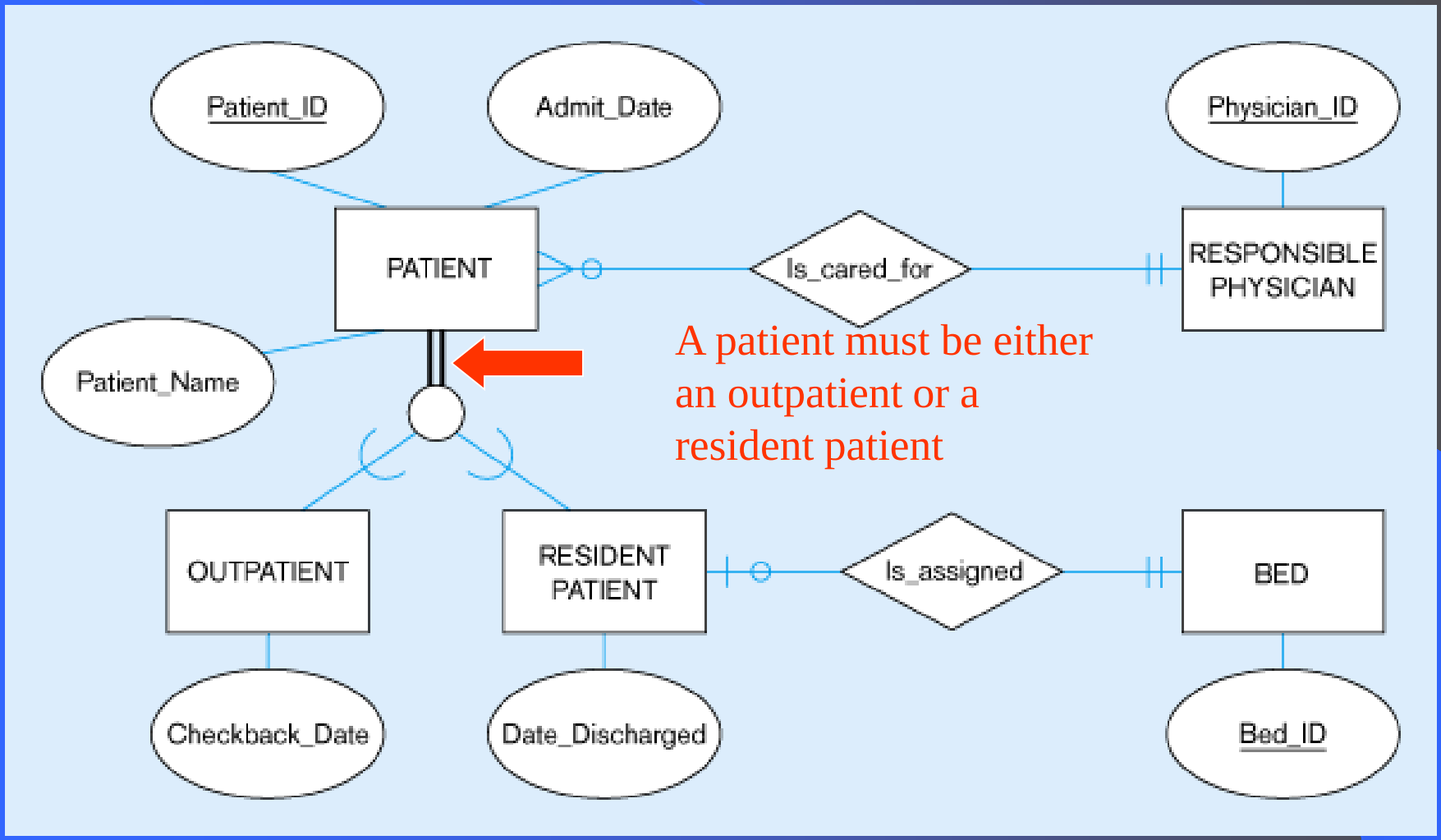
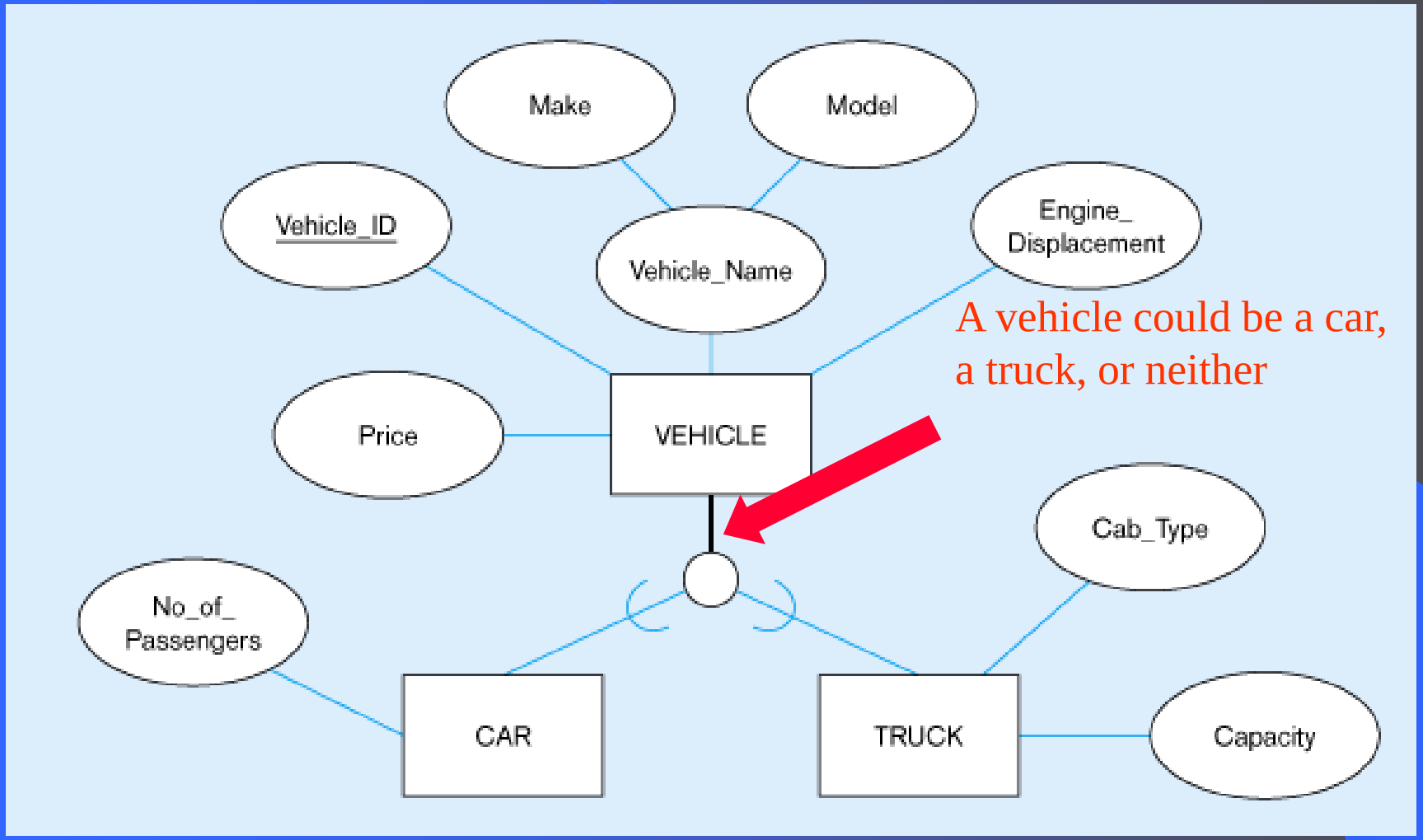


Figure 4-6(b) – Partial specialization rule



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

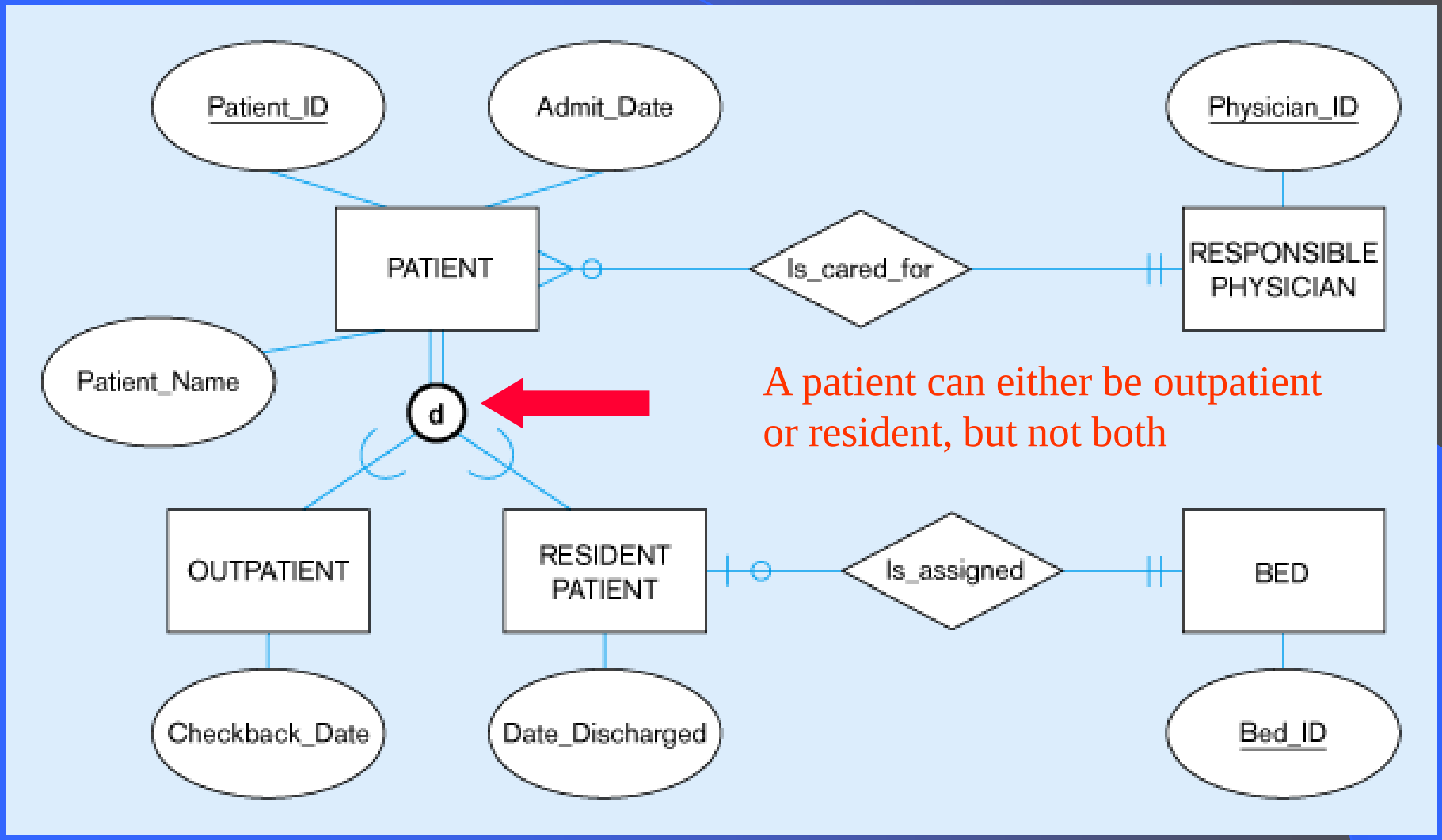
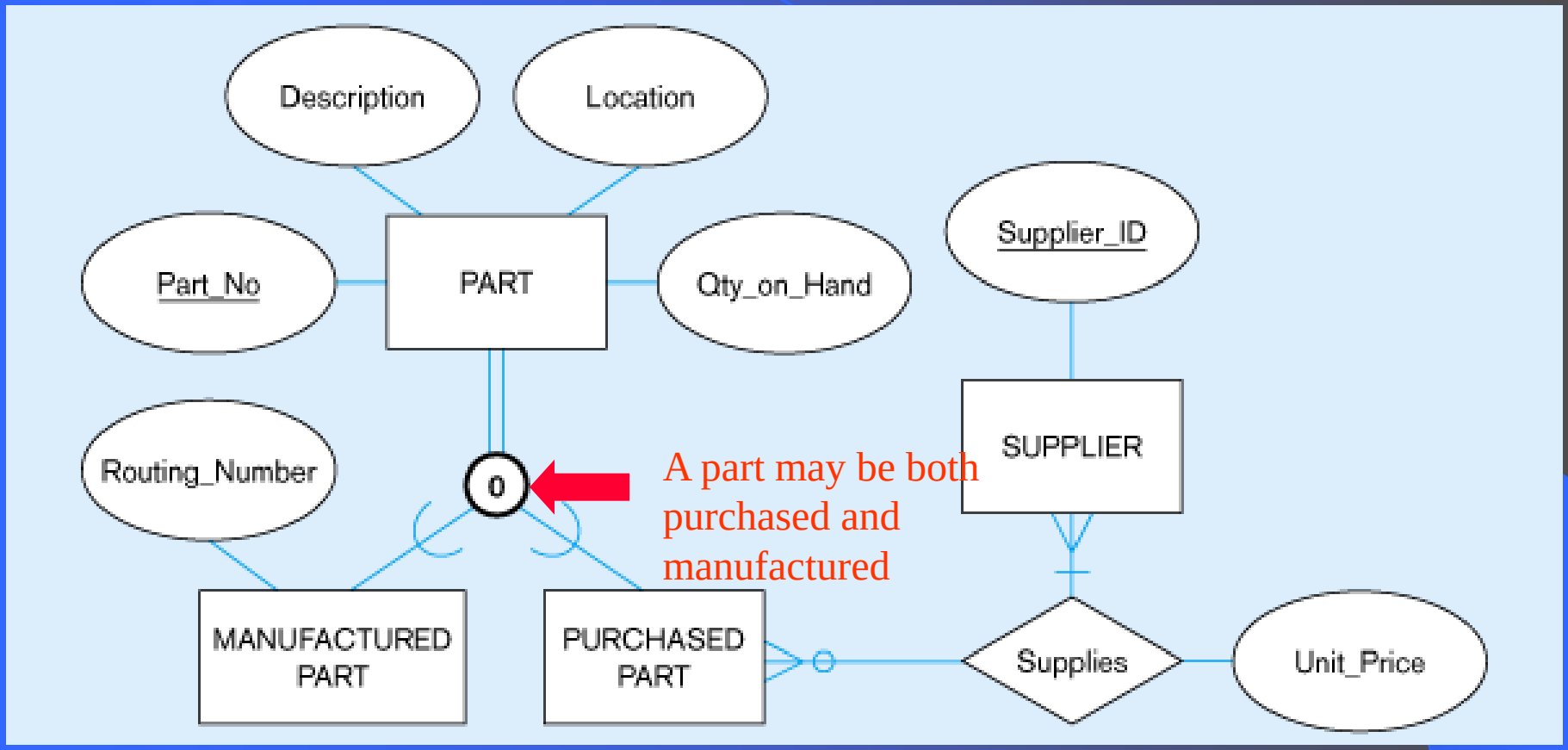


Figure 4-7(b) Overlap rule



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)

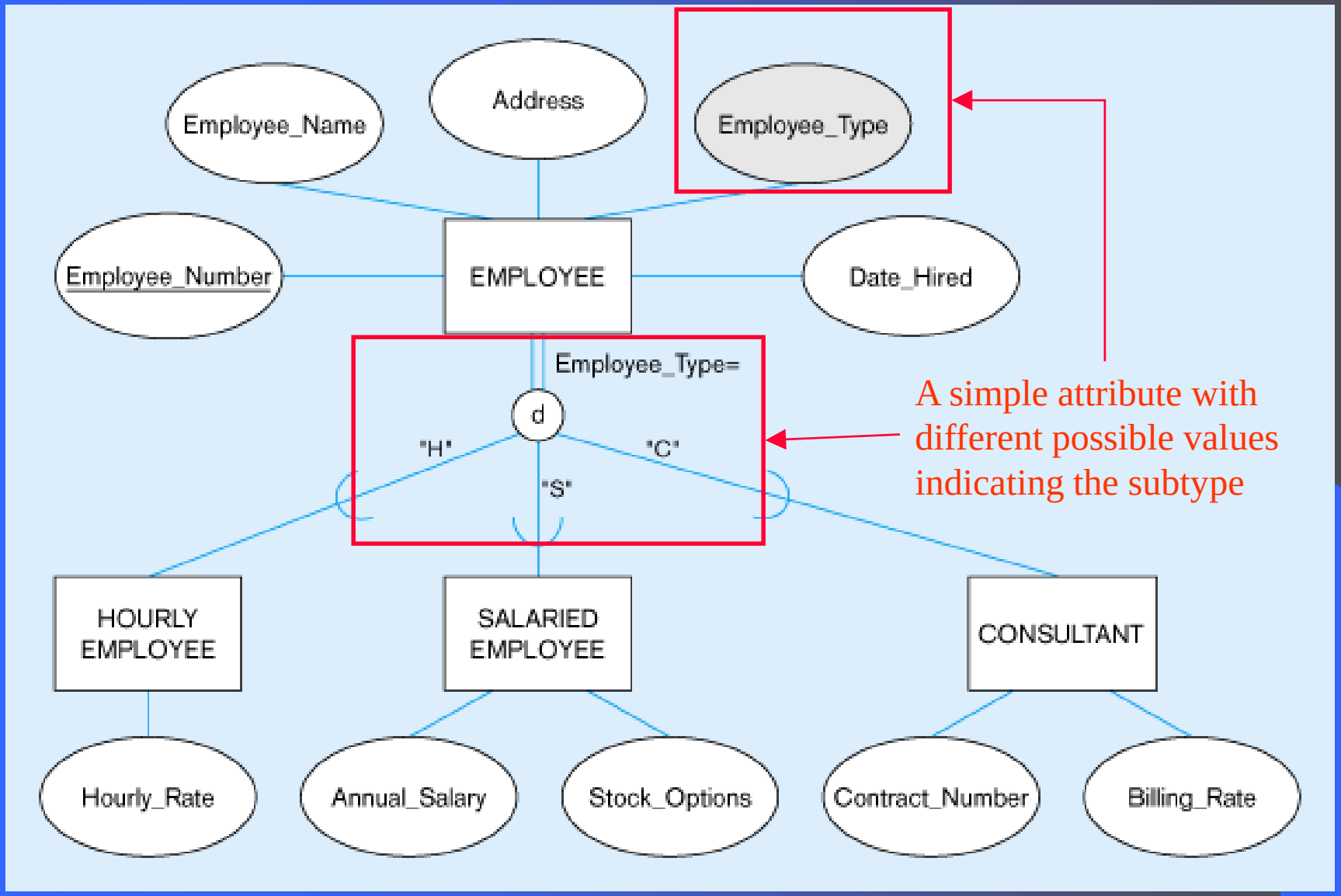


Figure 4-9 – Subtype discriminator (***overlap*** rule)

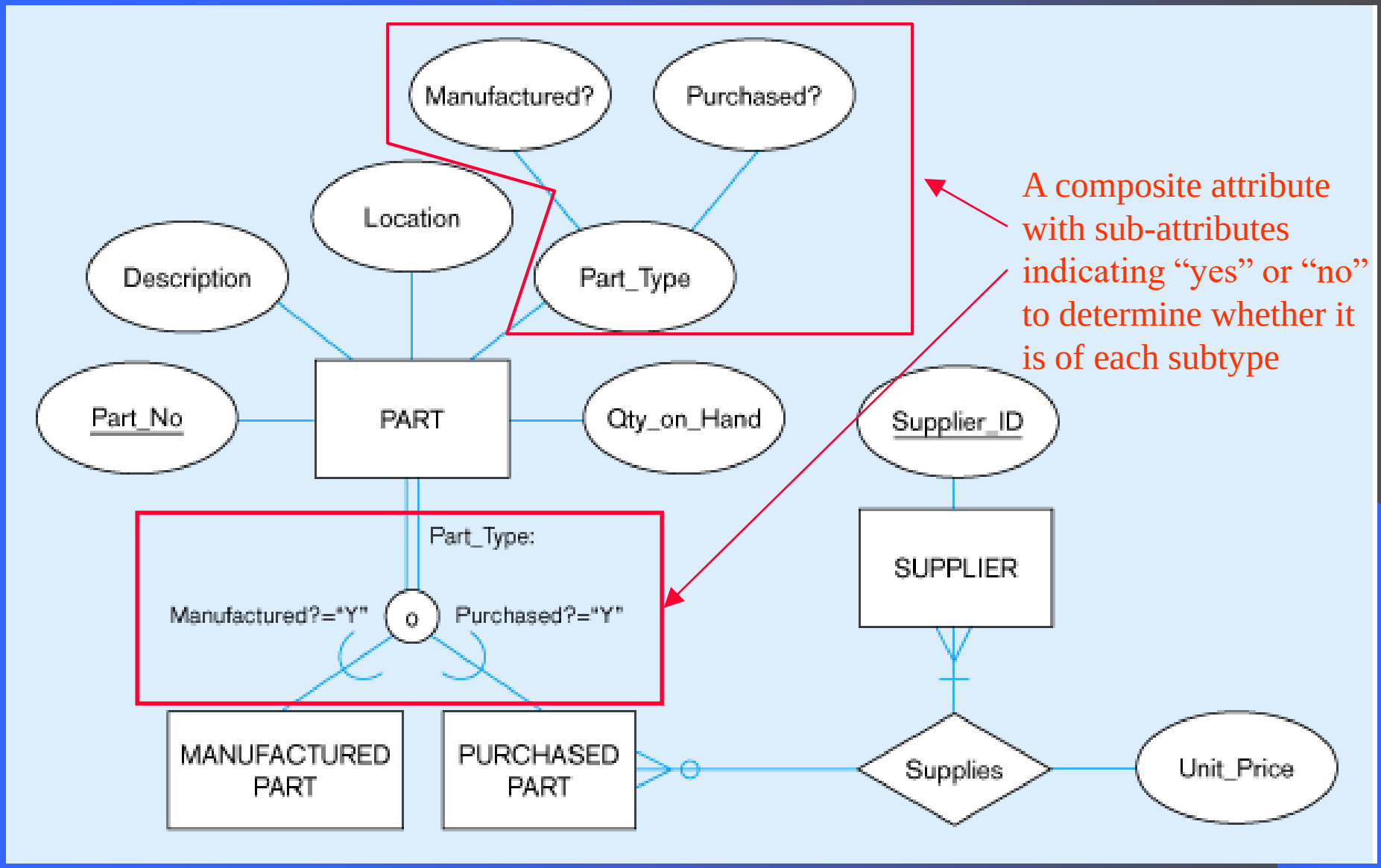
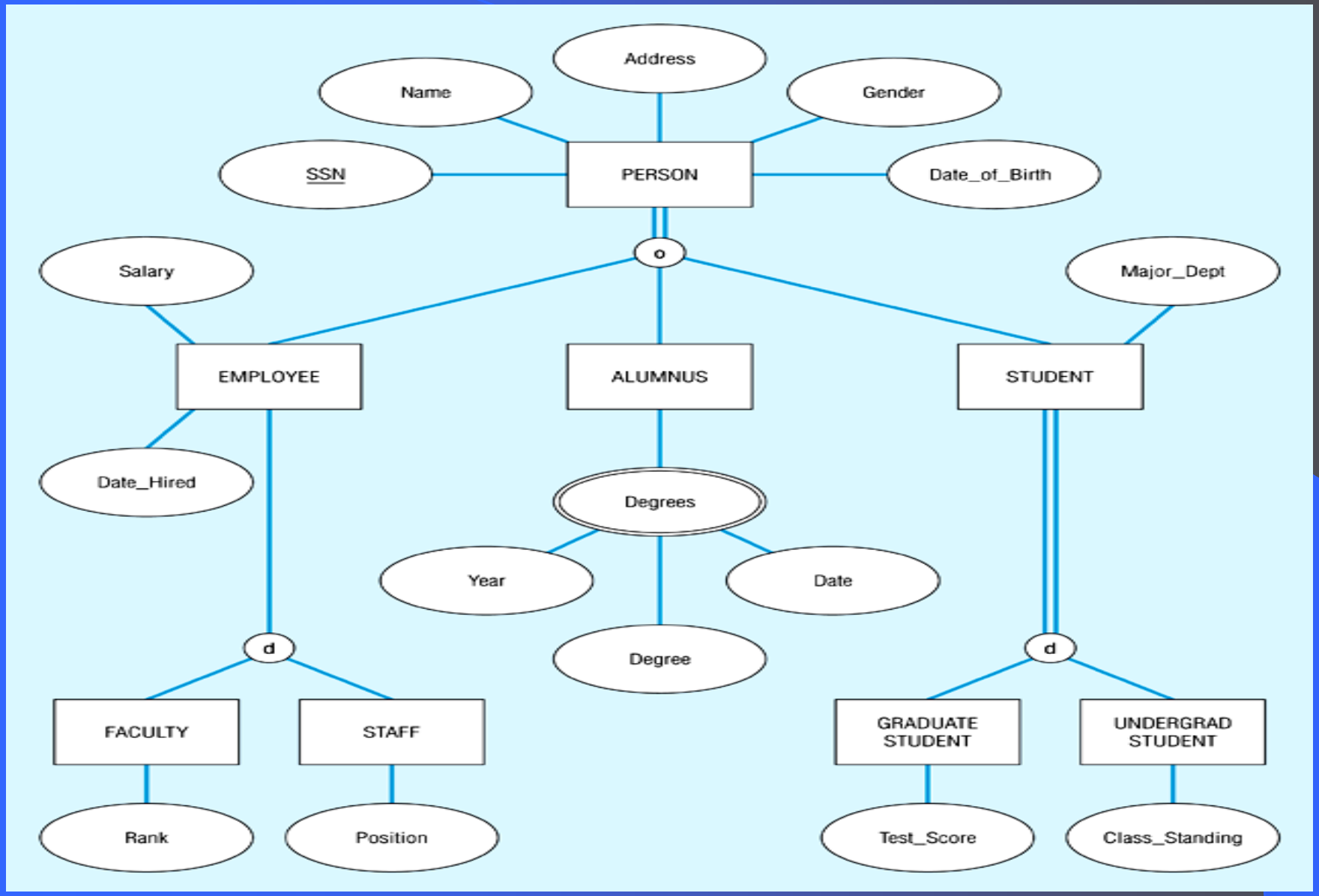


Figure 4-10 – Example of supertype/subtype hierarchy



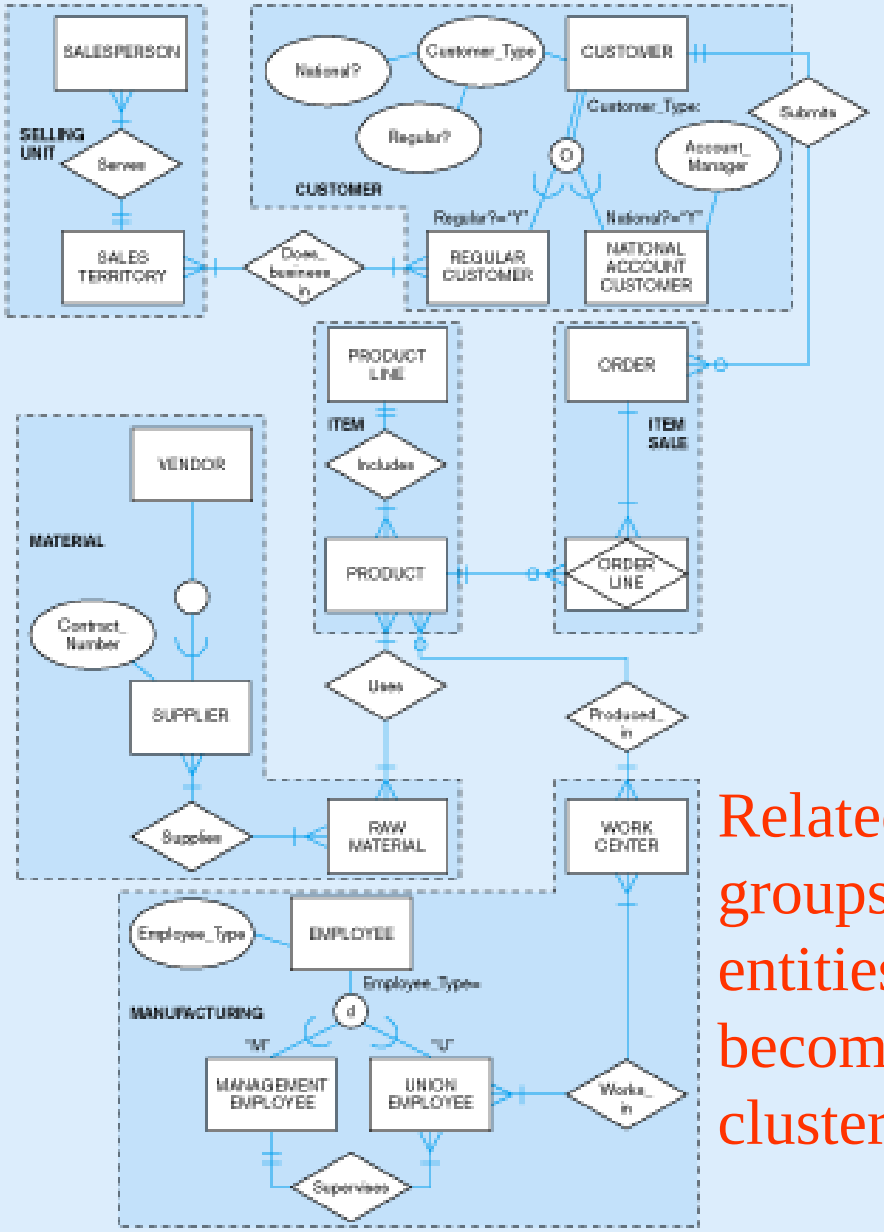
Entity Clusters

EER diagrams are difficult to read when there are too many entities and relationships

Solution: group entities and relationships into ***entity clusters***

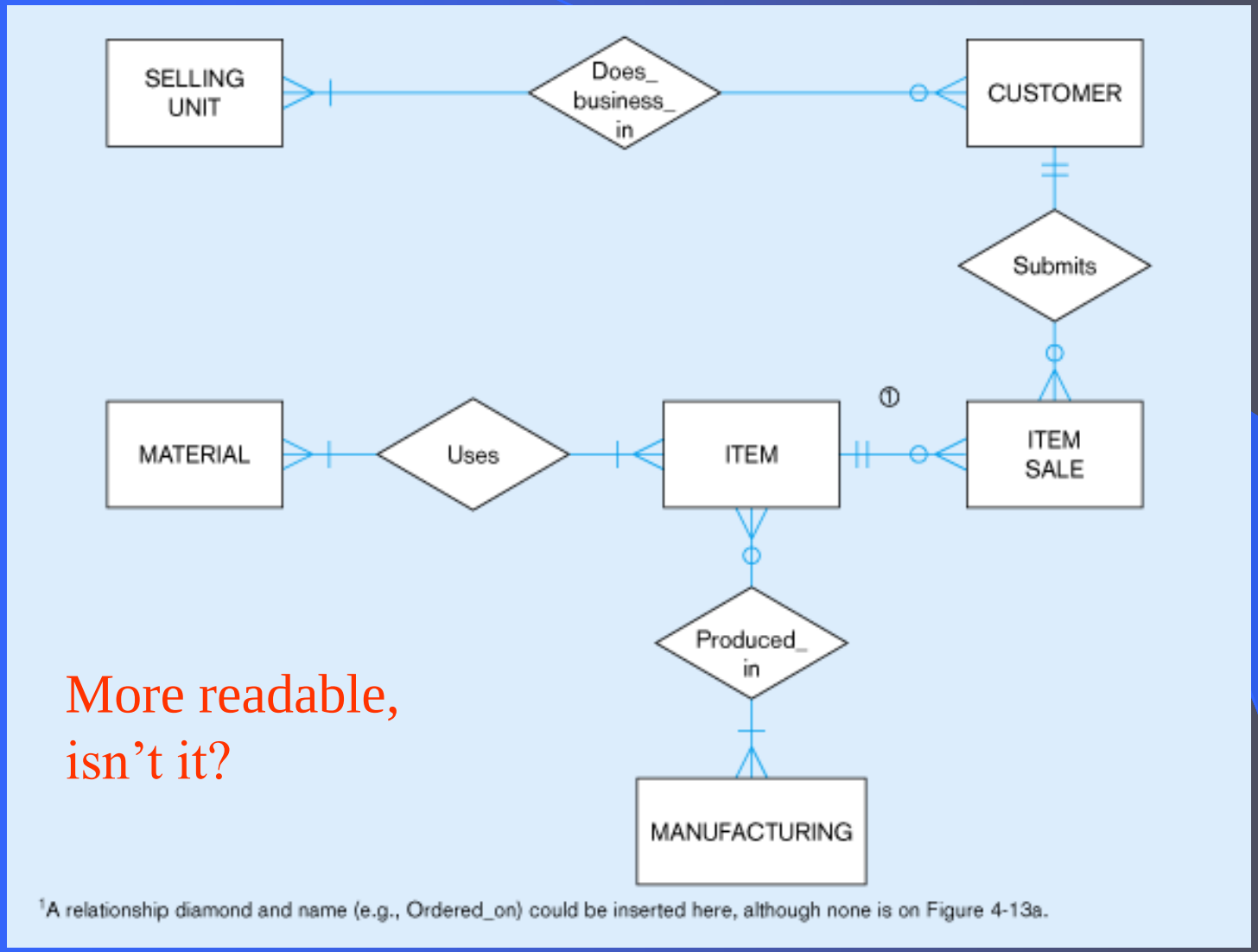
Entity cluster: set of one or more entity types and associated relationships grouped into a single abstract entity type

Figure 4-13(a) – Possible entity clusters for Pine Valley Furniture



Related groups of entities could become clusters

Figure 4-13(b) – EER diagram of PVF entity clusters



Business rules

Statements that *define* or *constrain* some aspect of the business.

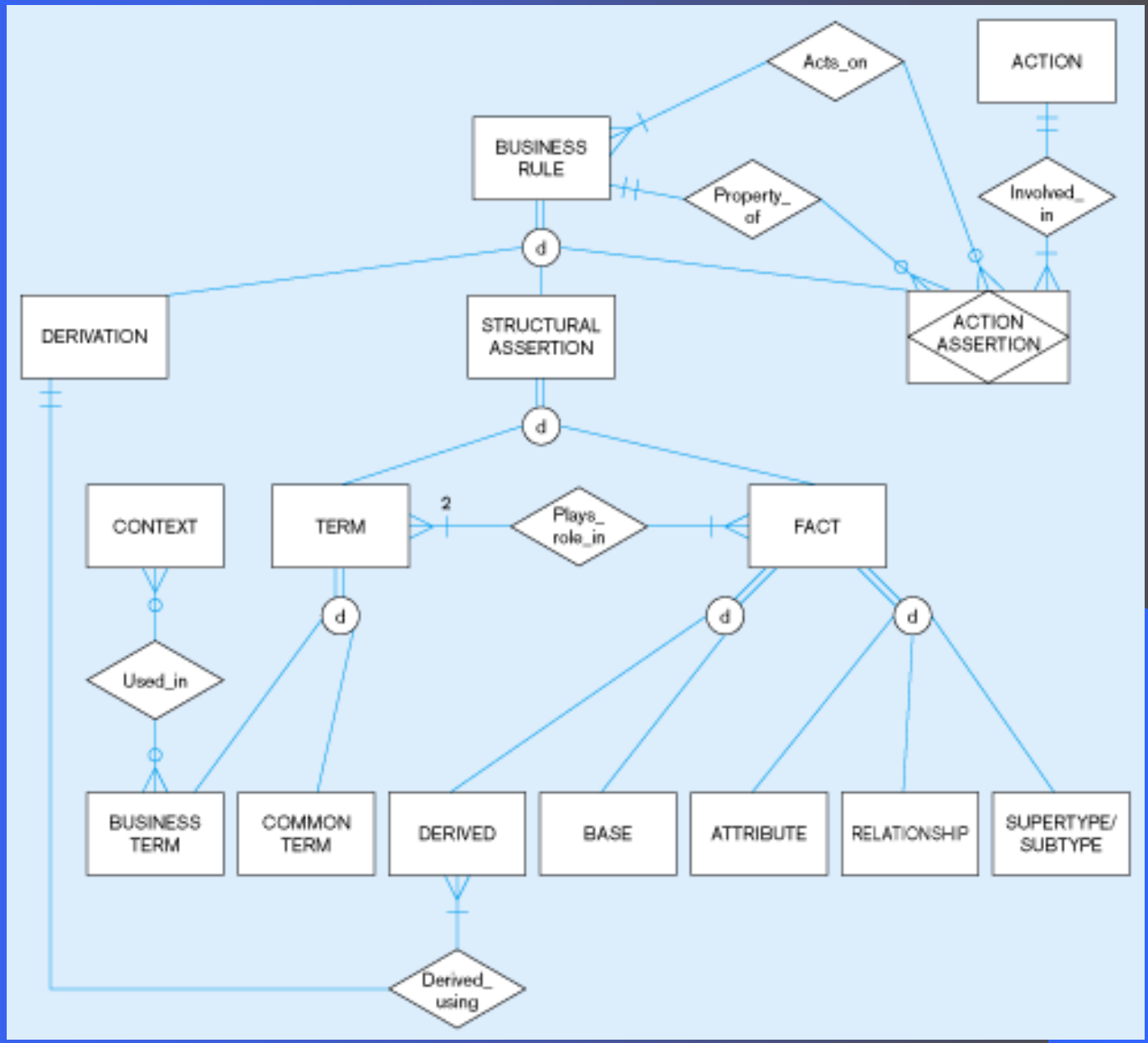
Constraints can impact:

- Structure (definition, domain, relationship)
- Behavior (operational constraints)

Classification of business rules:

- Derivation – rule derived from other knowledge
- Structural assertion – rule expressing static structure
- Action assertion – rule expressing constraints/control of organizational actions

Figure 4-15 – EER depiction of business rules classification



Source: adapted from GUIDE Business Rules Project, 1997.

Action Assertion Classifications

Result

- Condition – IF/THEN rule
- Integrity constraint – must always be true
- Authorization – privilege statement

Form

- Enabler – leads to creation of new object
- Timer – allows or disallows an action
- Executive – executes one or more actions

Rigor

- 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 assertion will identify corresponding objects that constrain the ability to perform actions on anchor objects

Figure 4-16 – Data model segment for class scheduling

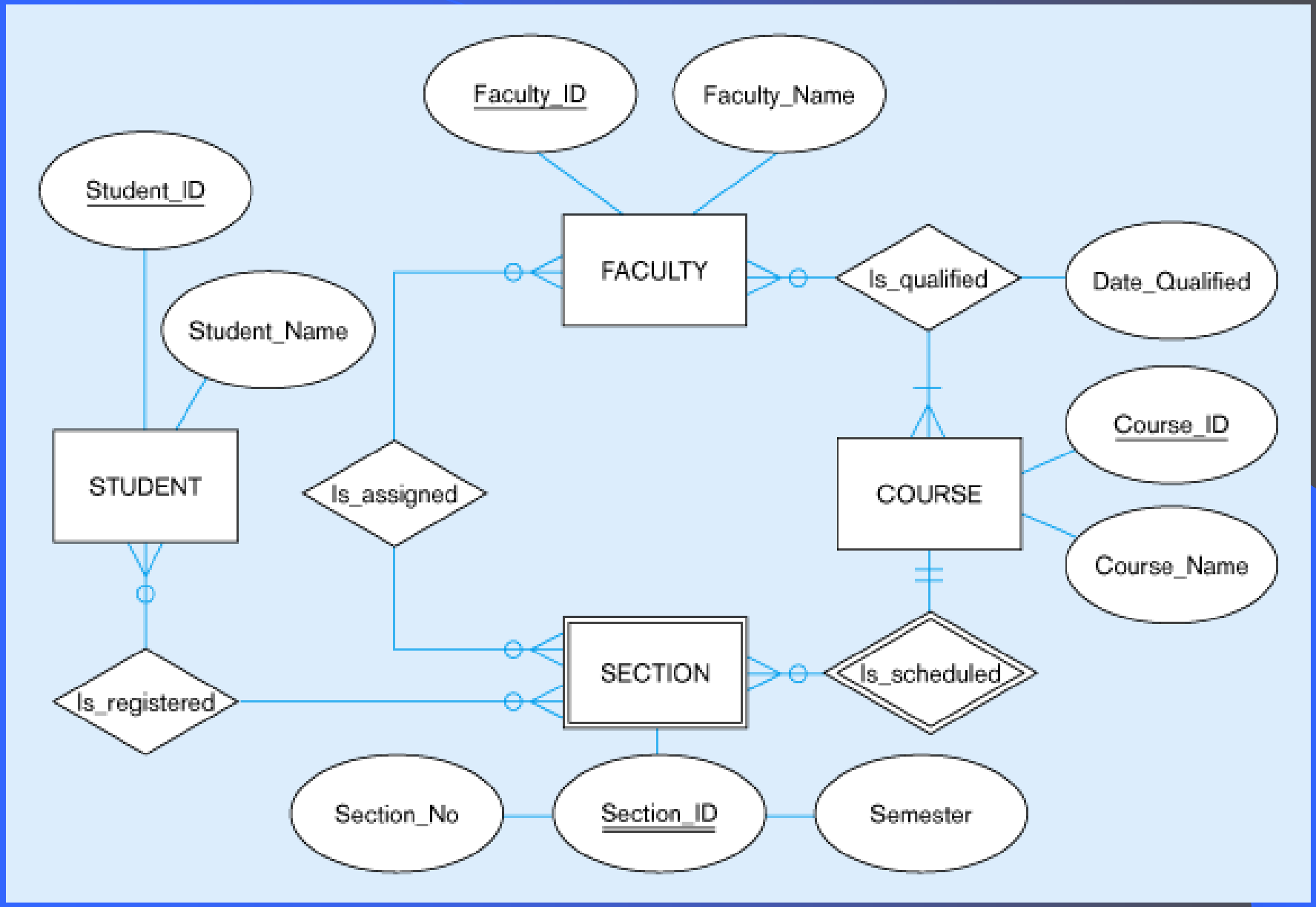


Figure 4-17 – Business Rule 1: For a faculty member to be assigned to teach a section of a course, the faculty member must be qualified to teach the course for which that section is scheduled

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

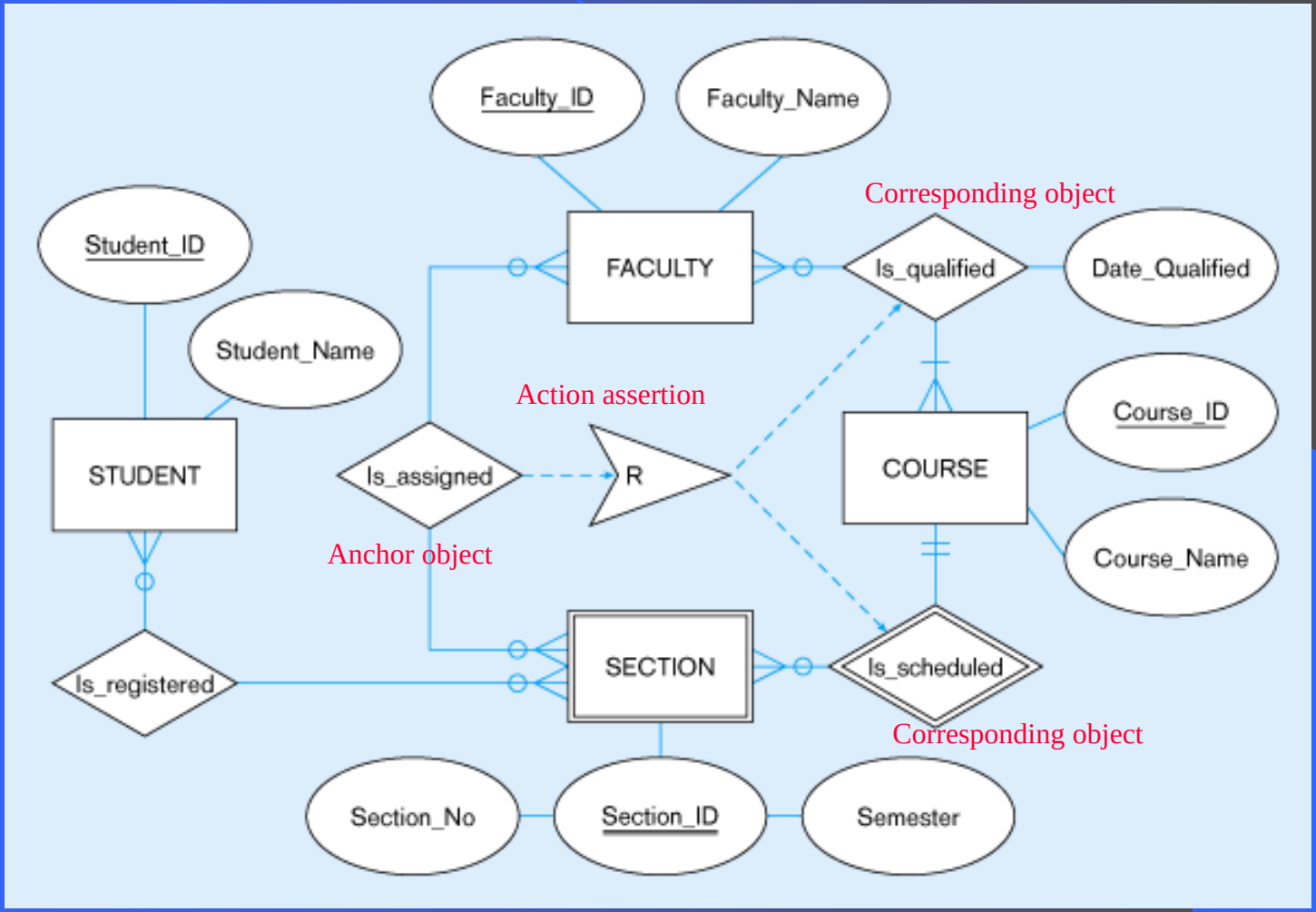


Figure 4-18 –Business Rule 2: For a faculty member to be assigned to teach a section of a course, the faculty member must not be assigned to teach a total of more than three course sections

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