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

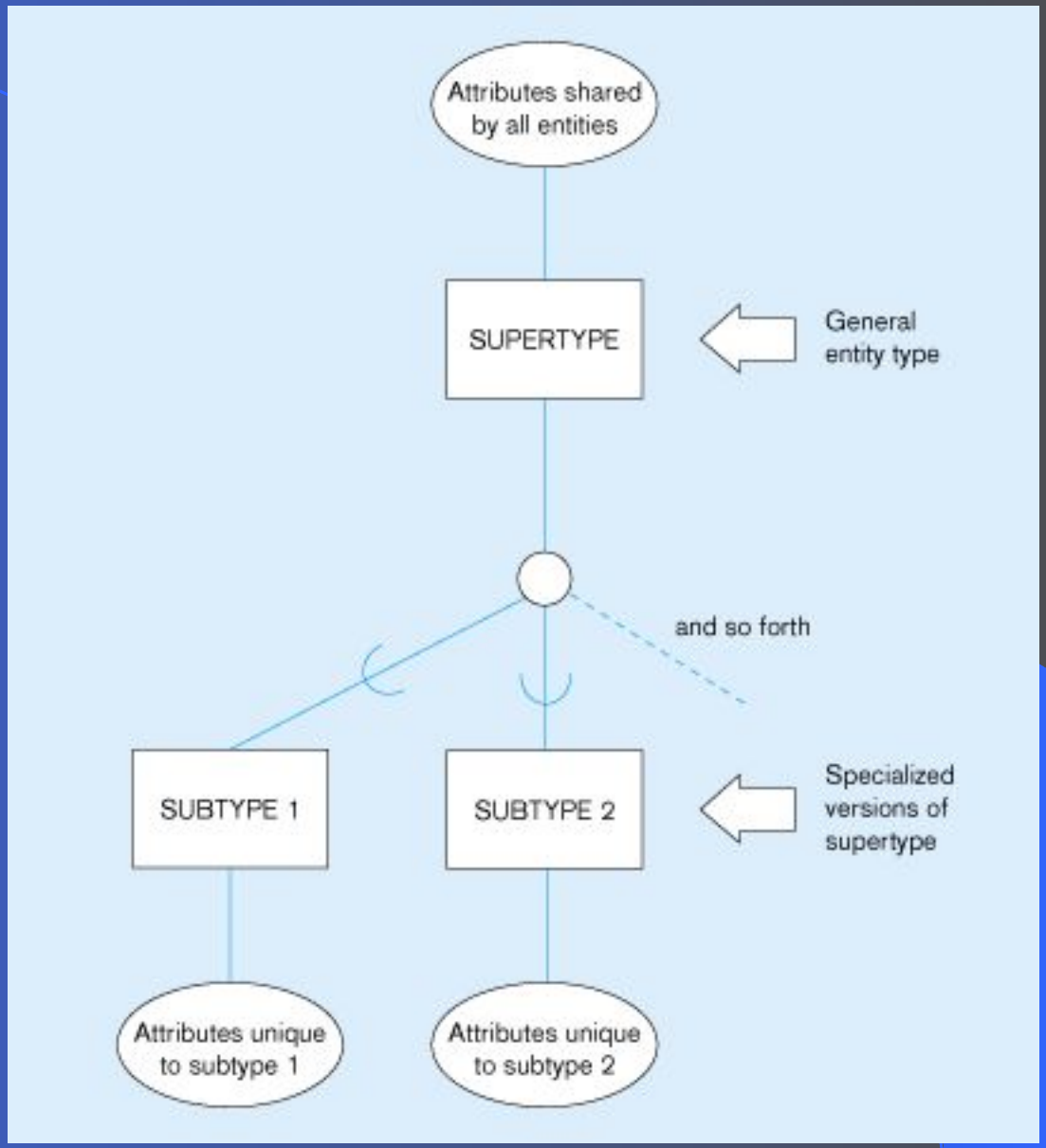
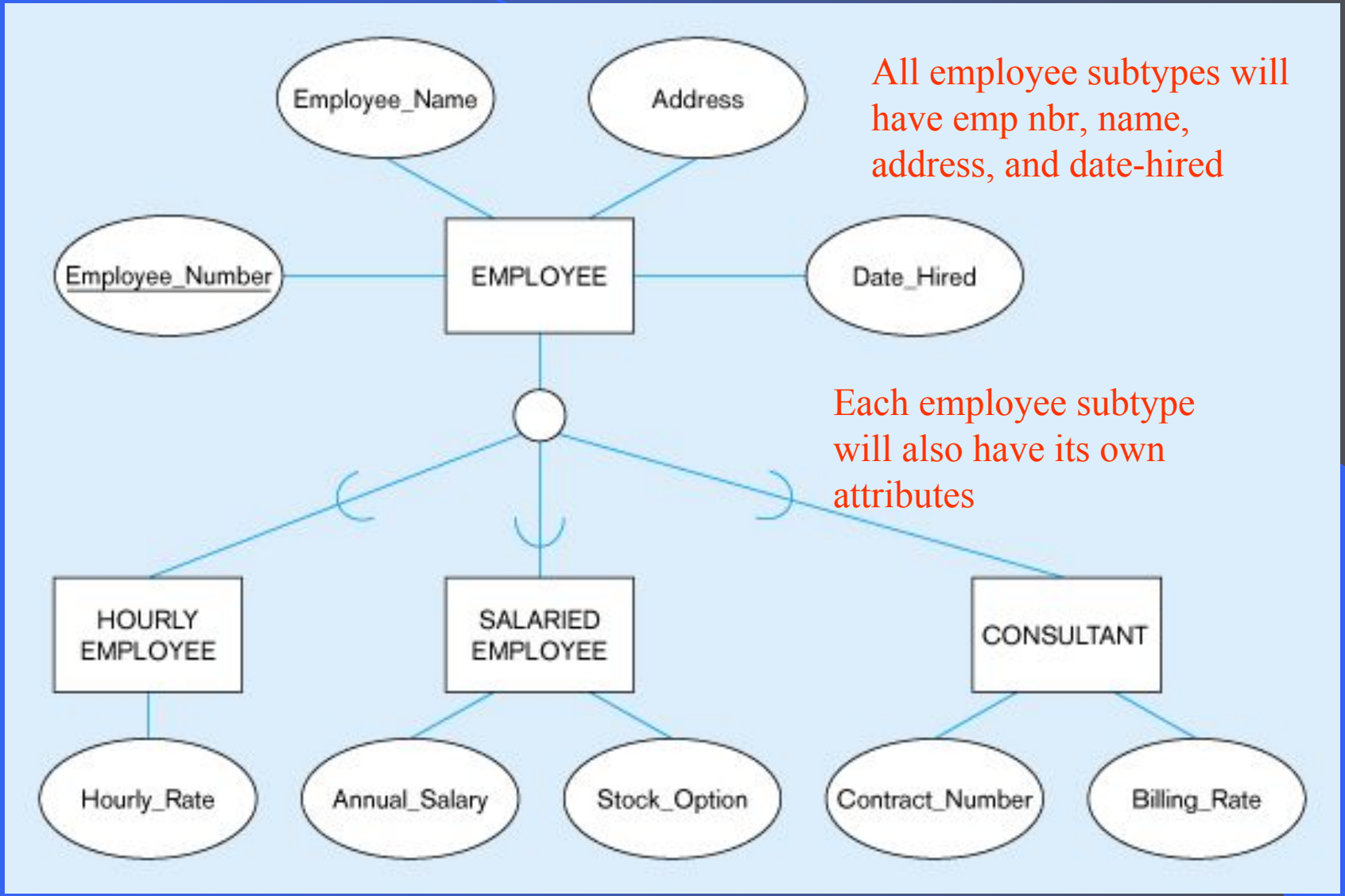


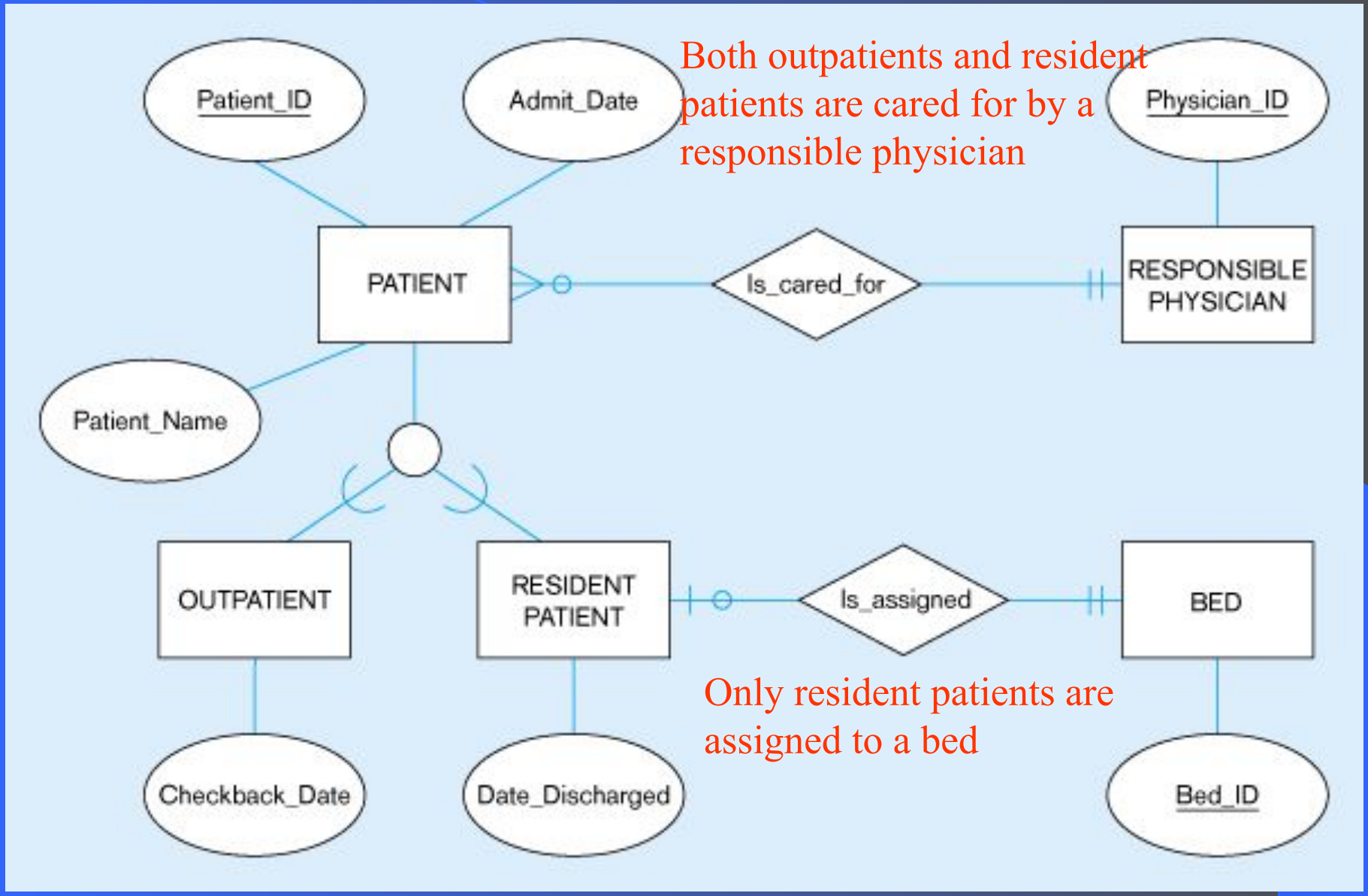
Figure 4-2 -- Employee supertype with three subtypes



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

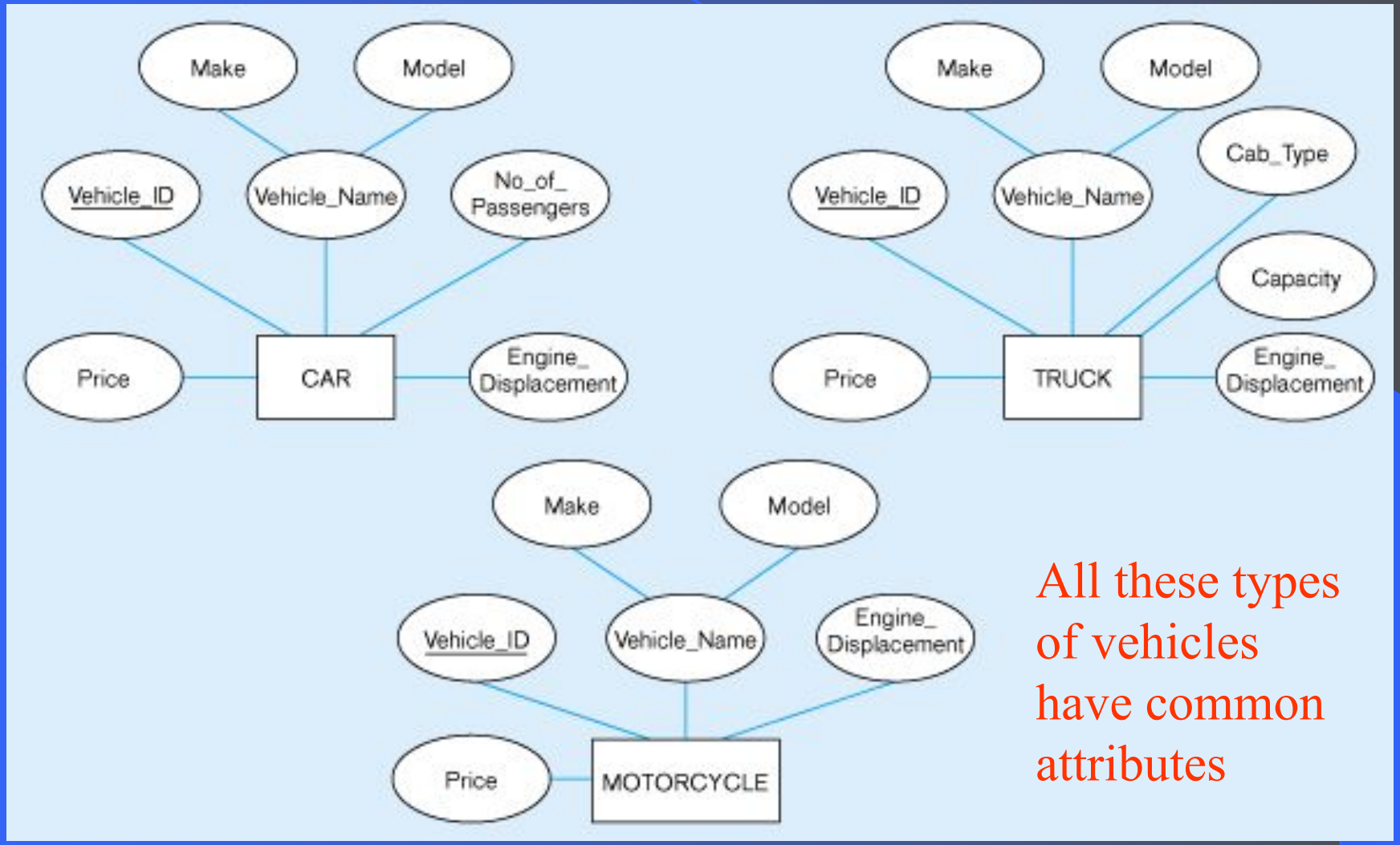
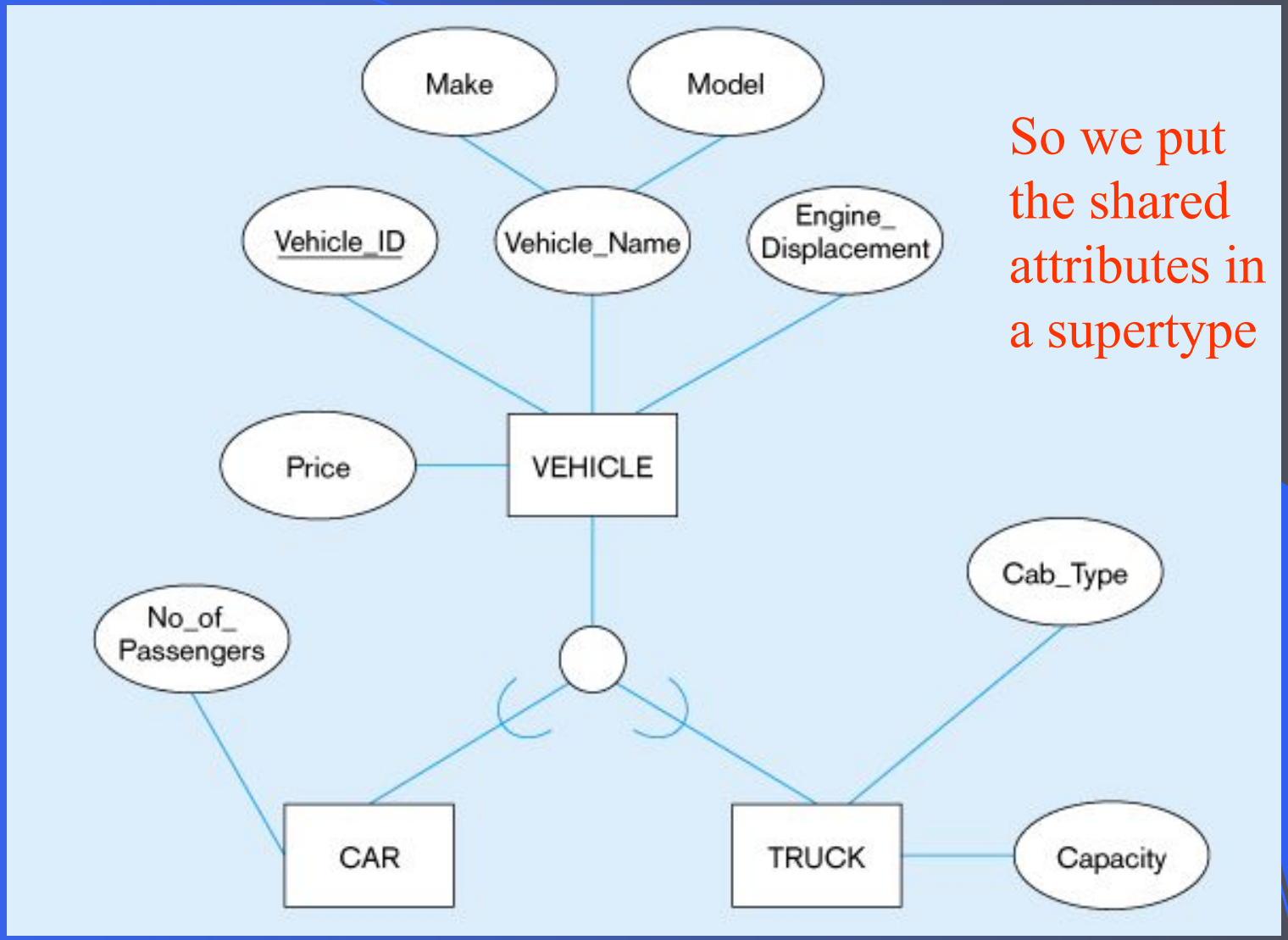


Figure 4-4(b) – Generalization to VEHICLE supertype



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

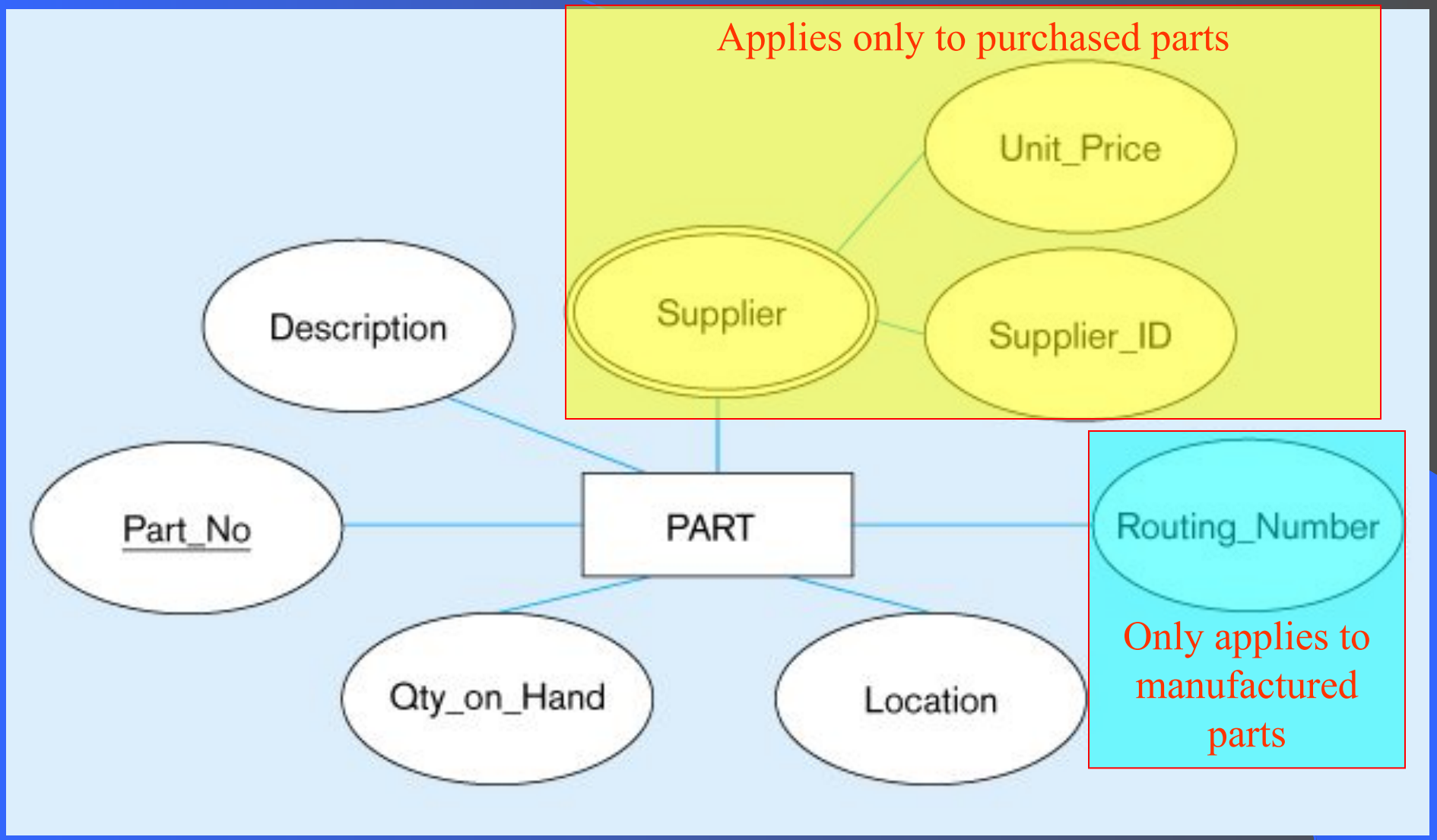
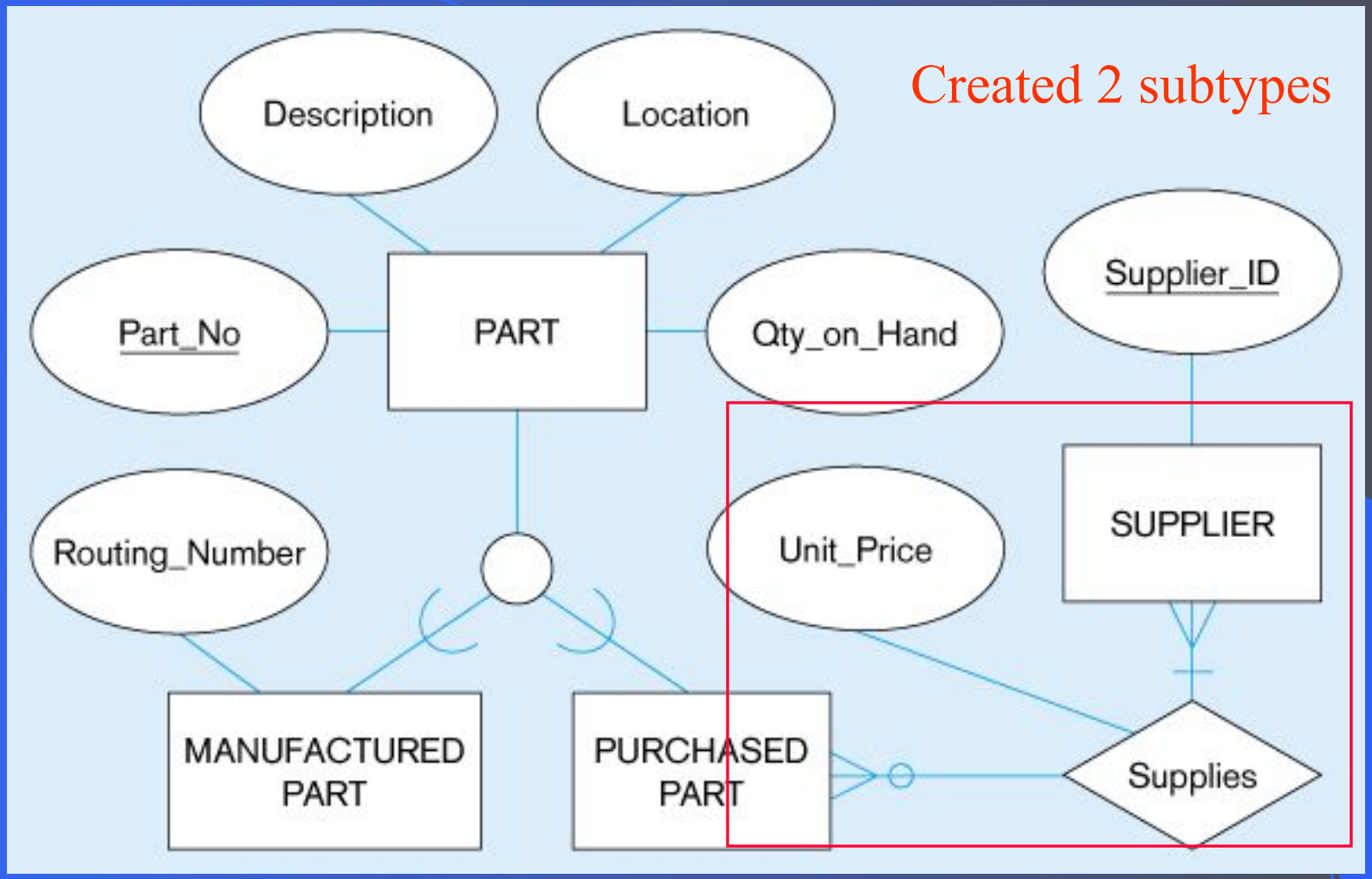


Figure 4-5(b) –
Specialization to MANUFACTURED PART and PURCHASED PART



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

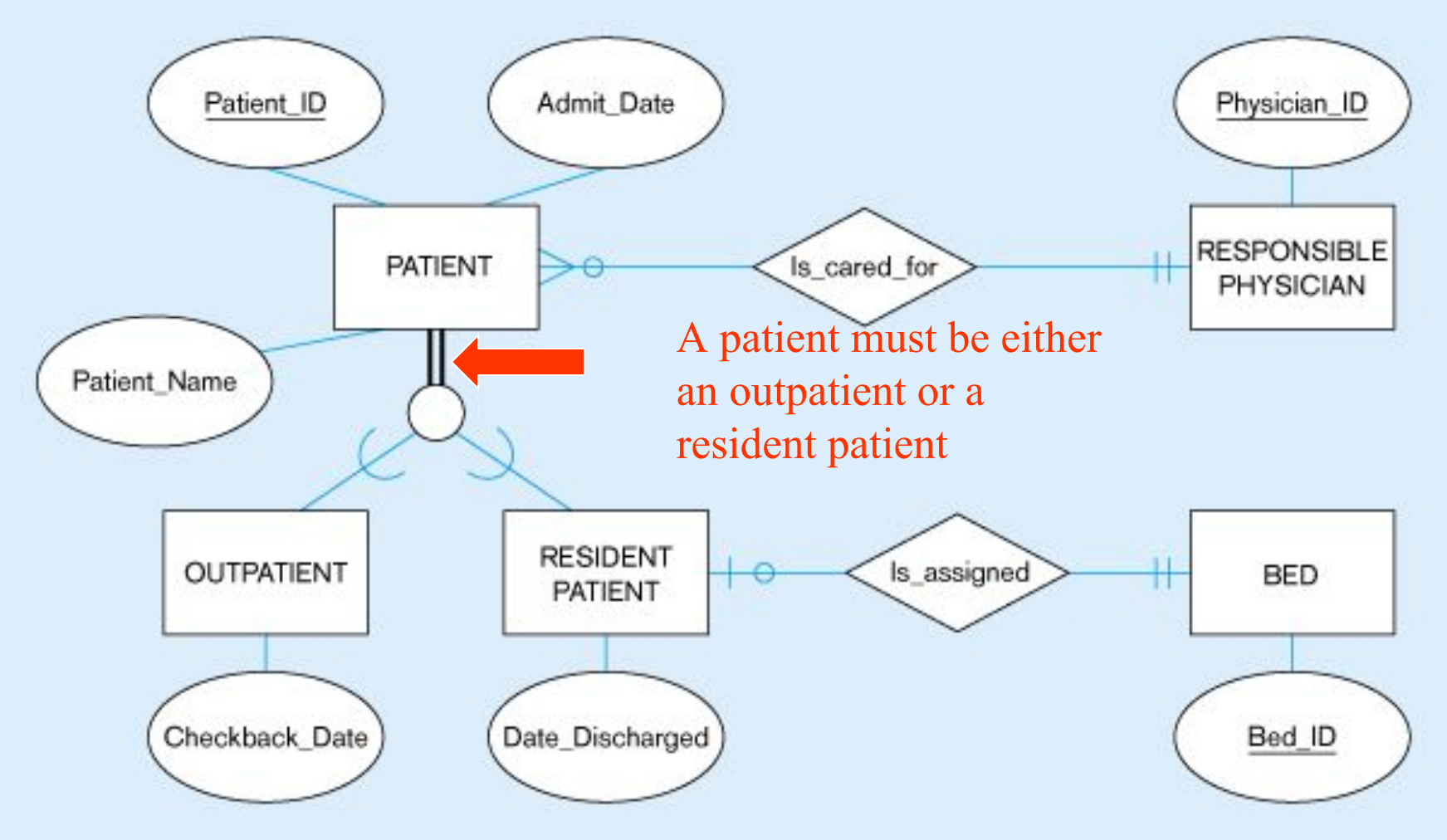
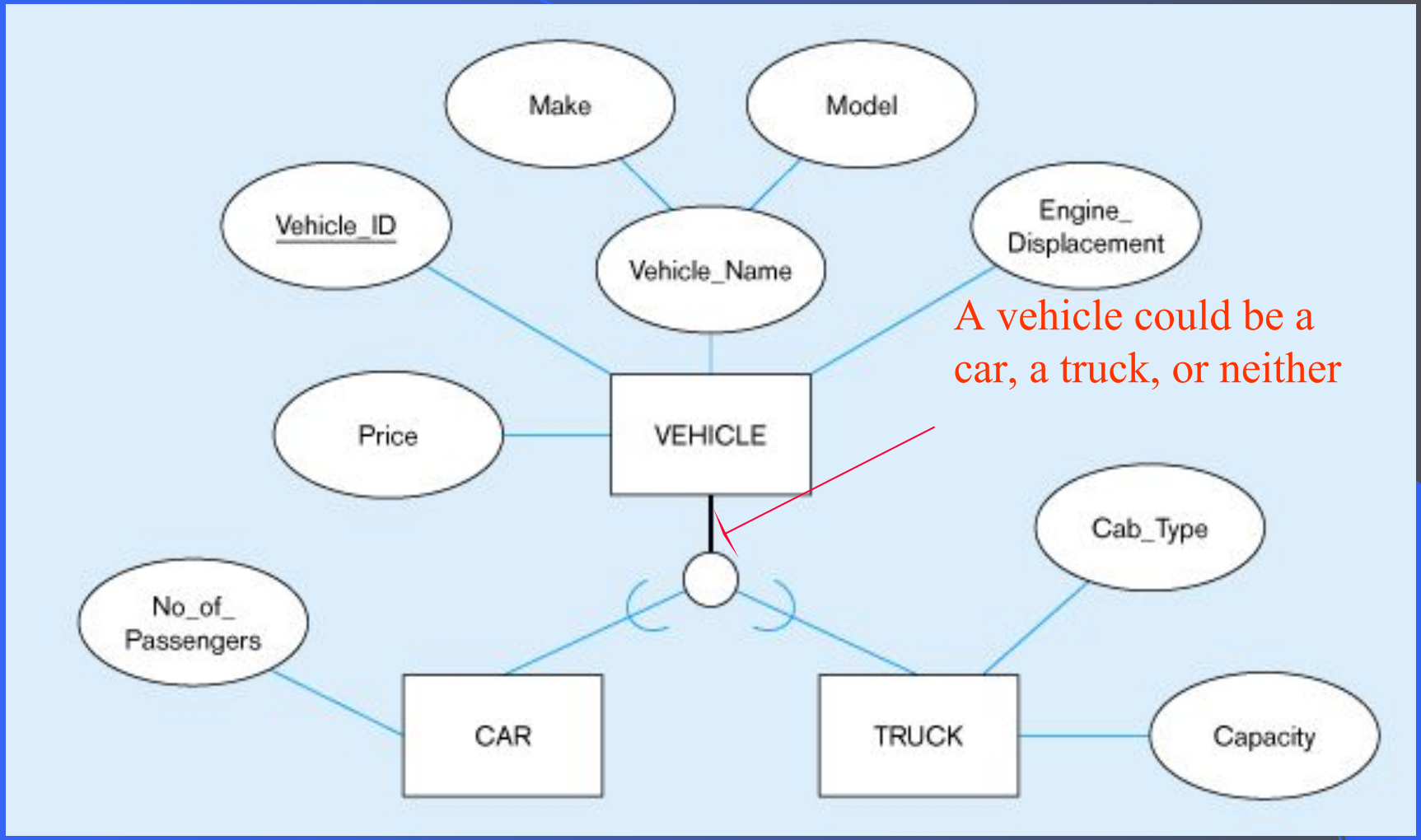


Figure 4-6(b) – Partial specialization rule



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

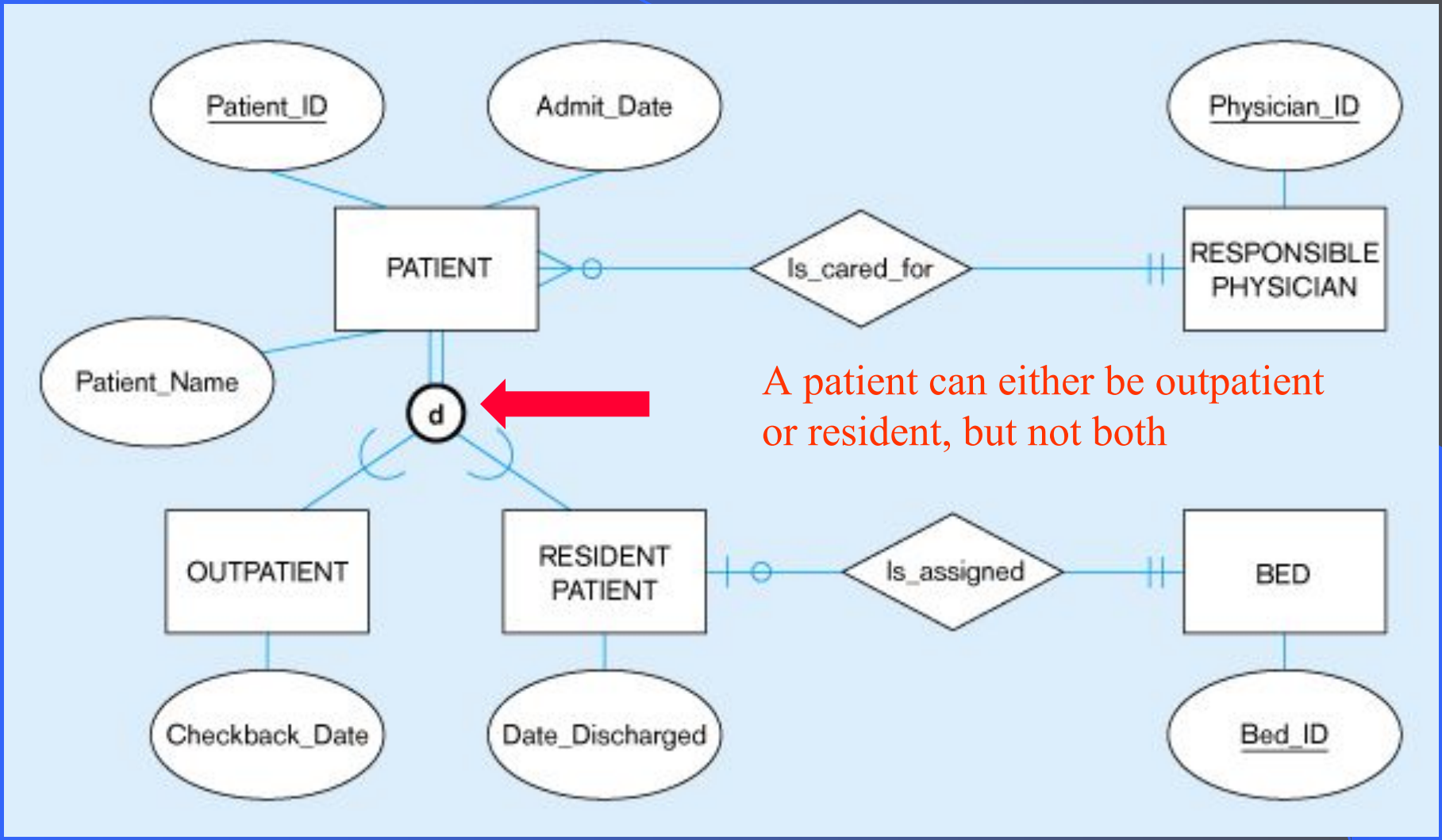
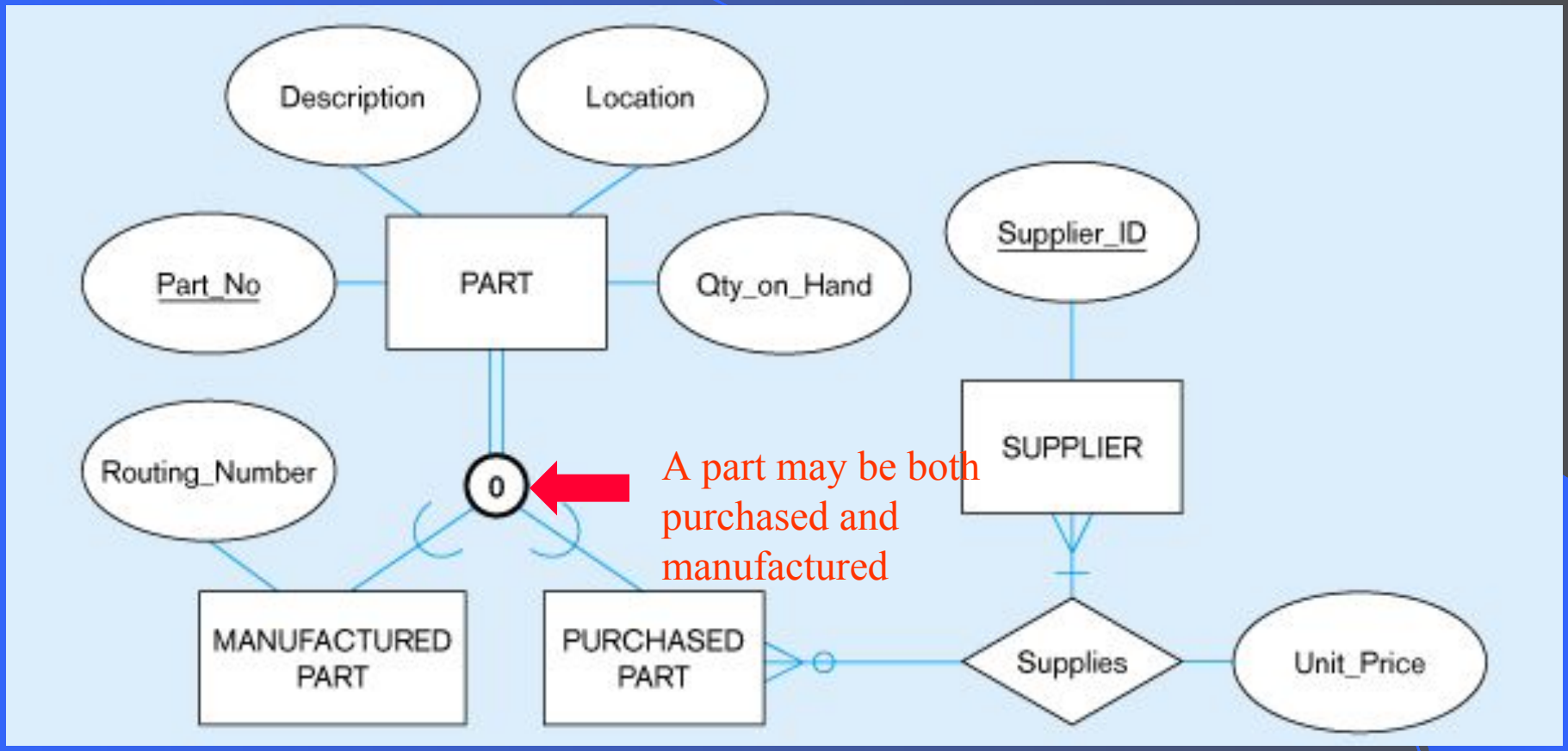


Figure 4-7(b) Overlap rule



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)

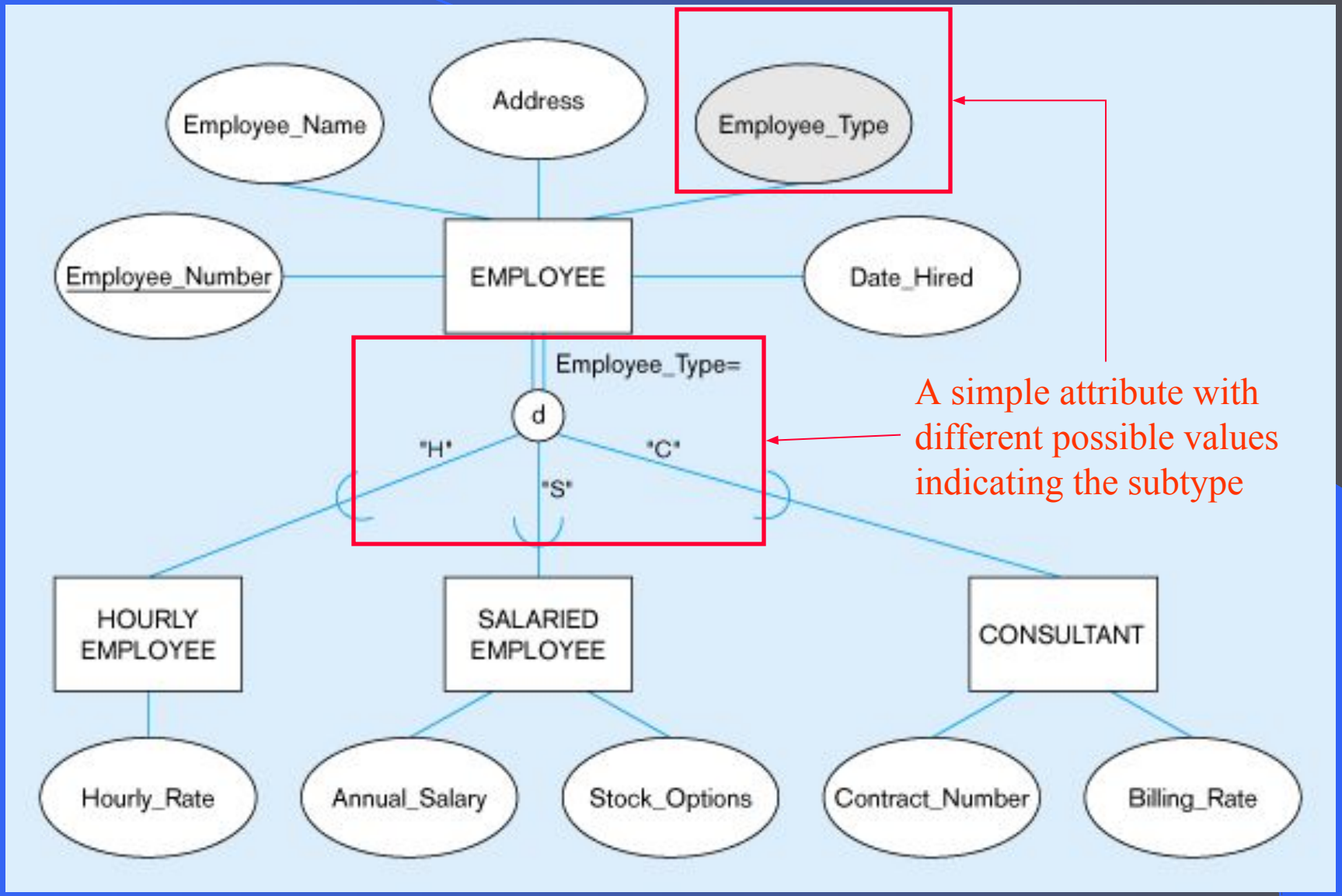


Figure 4-9 – Subtype discriminator (***overlap*** rule)

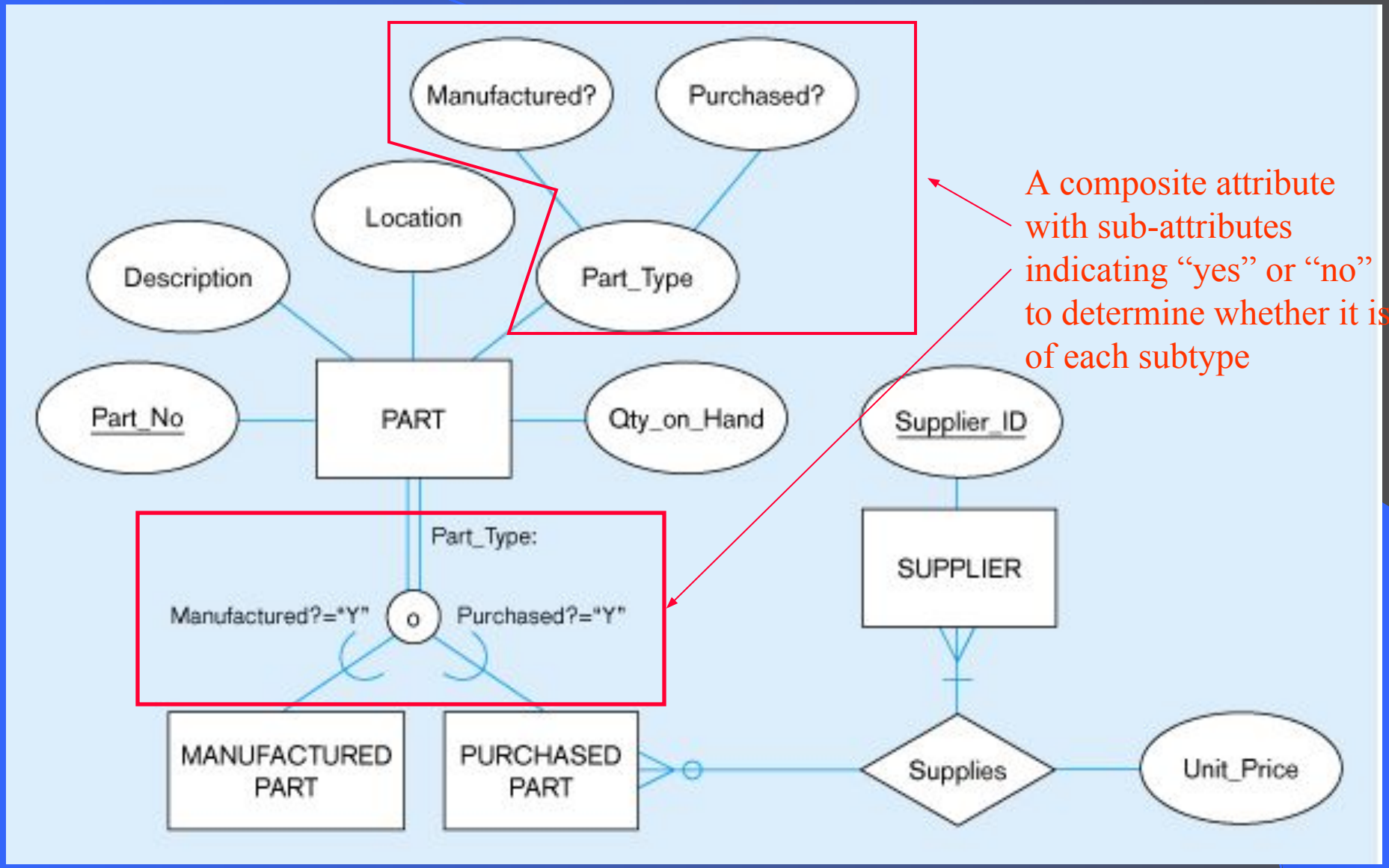
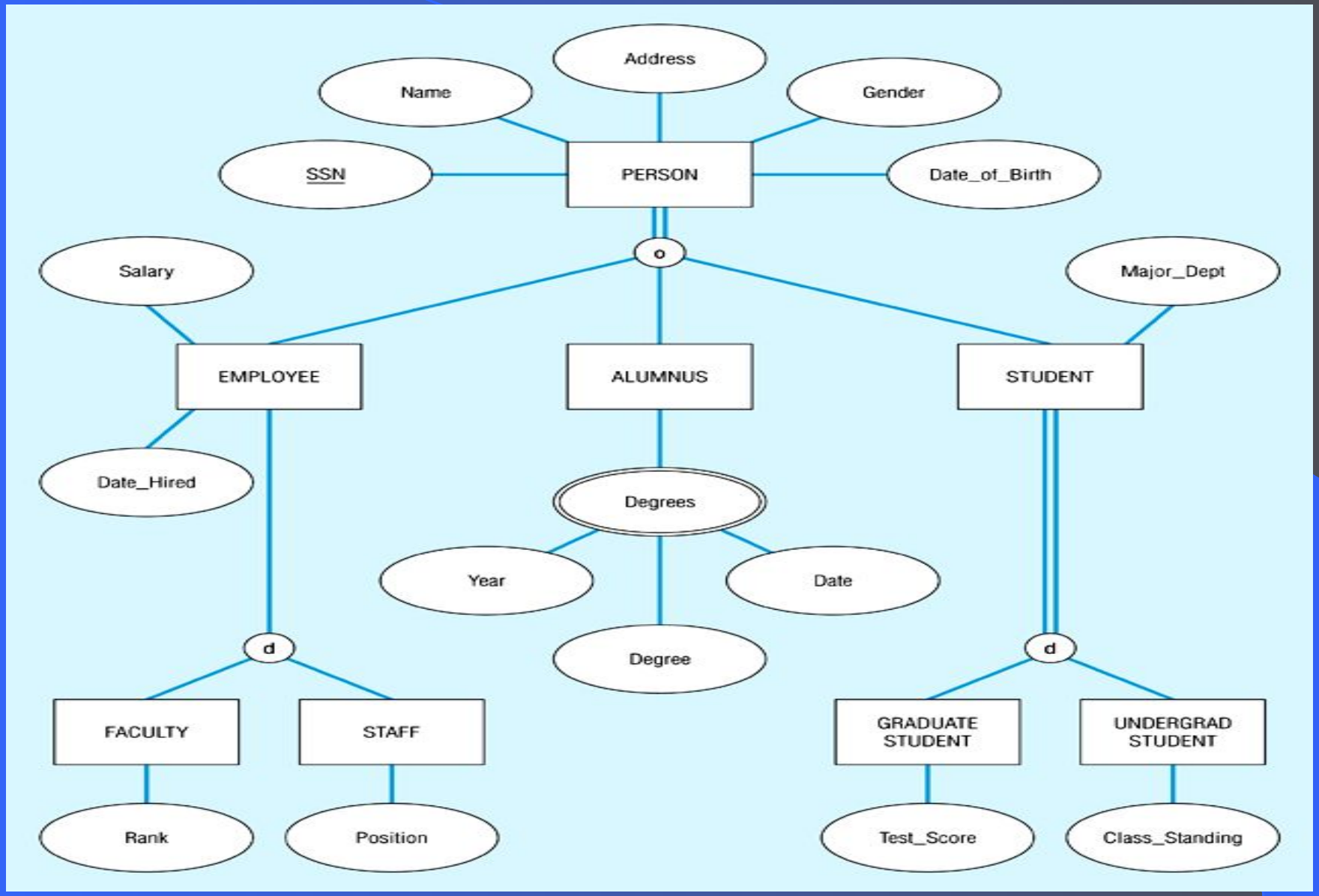


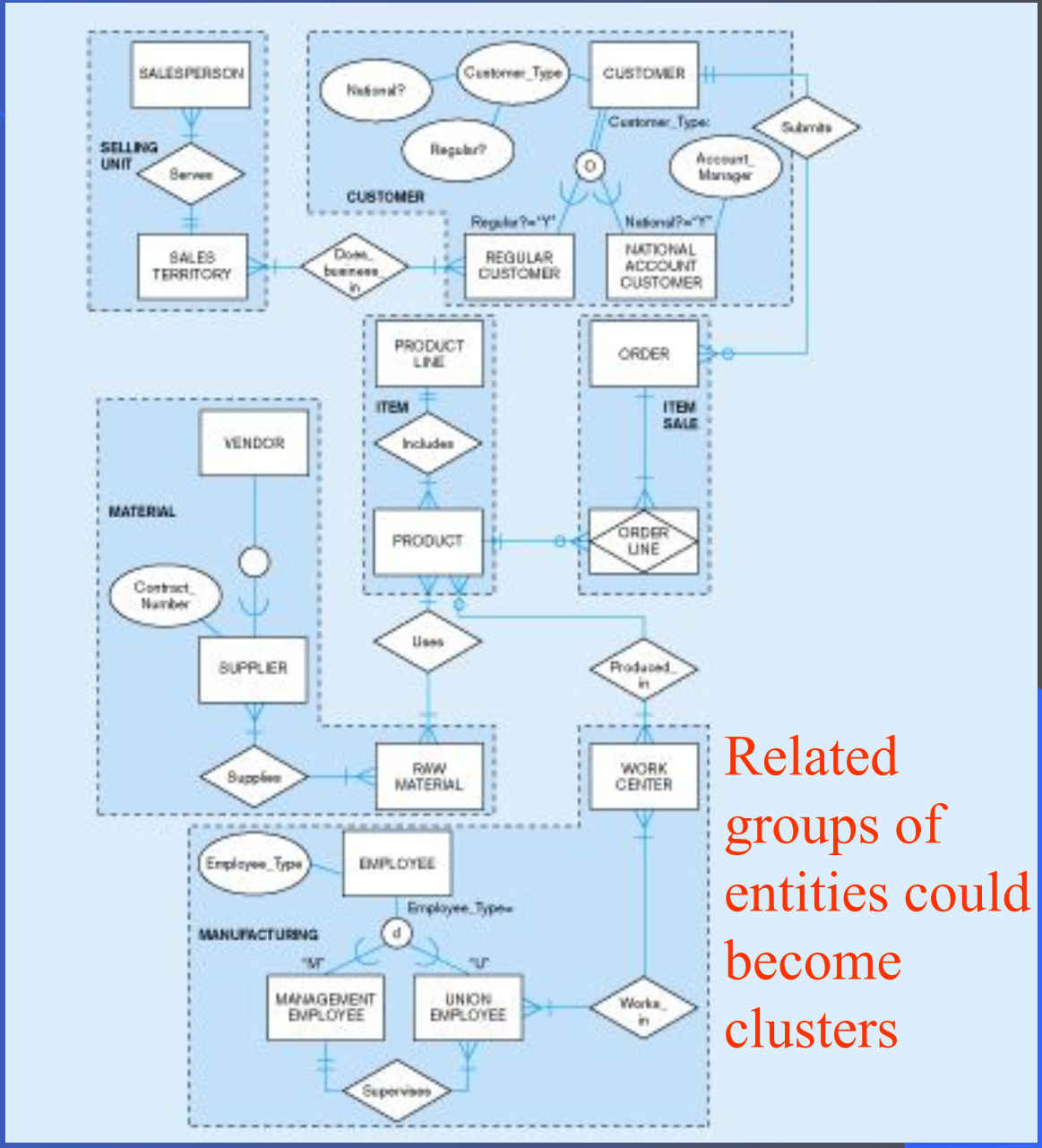
Figure 4-10 – Example of supertype/subtype hierarchy



Entity Clusters

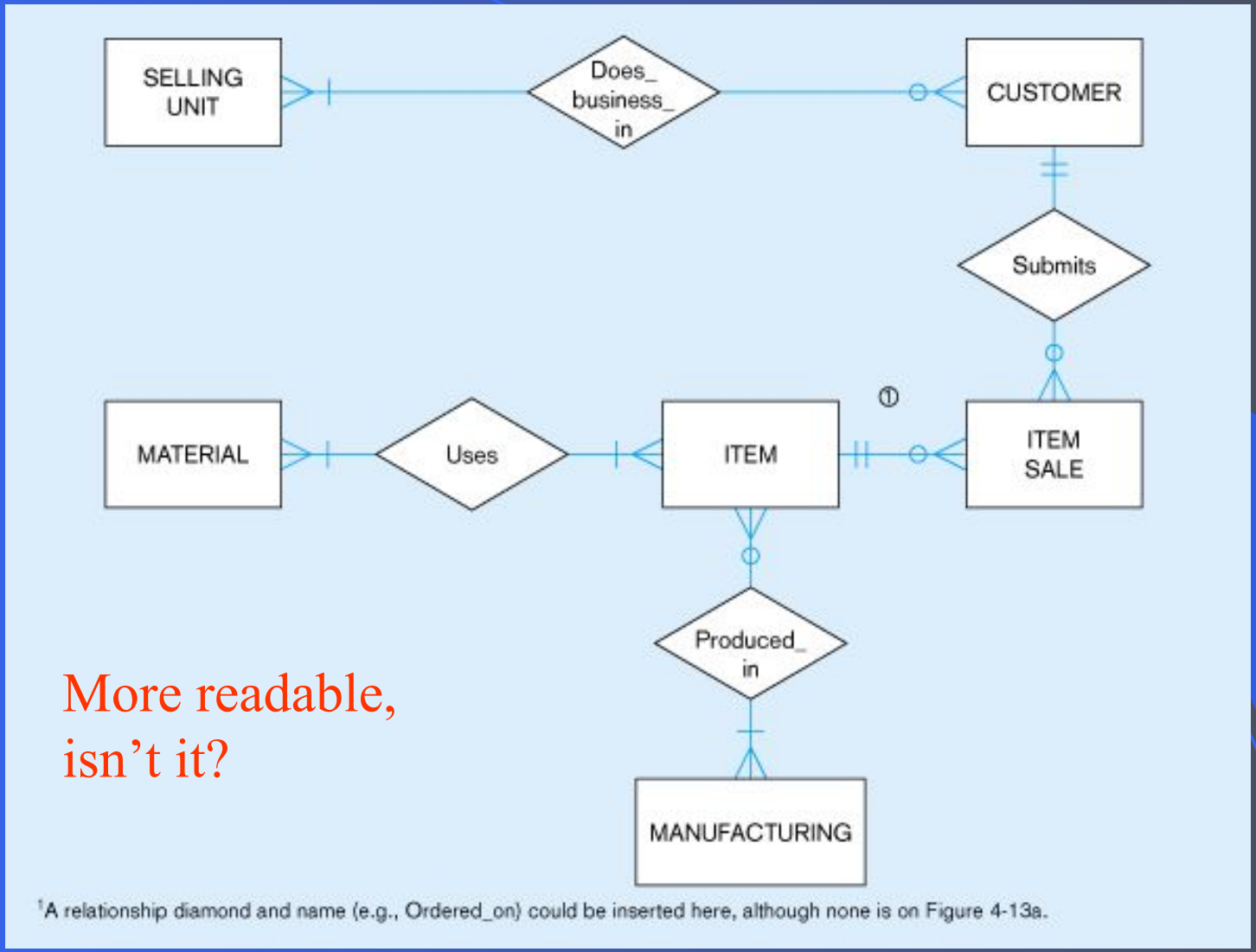
- EER diagrams are difficult to read when there are too many entities and relationships
- Solution: group entities and relationships into ***entity clusters***
- **Entity cluster**: set of one or more entity types and associated relationships grouped into a single abstract entity type

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



Related groups of entities could become clusters

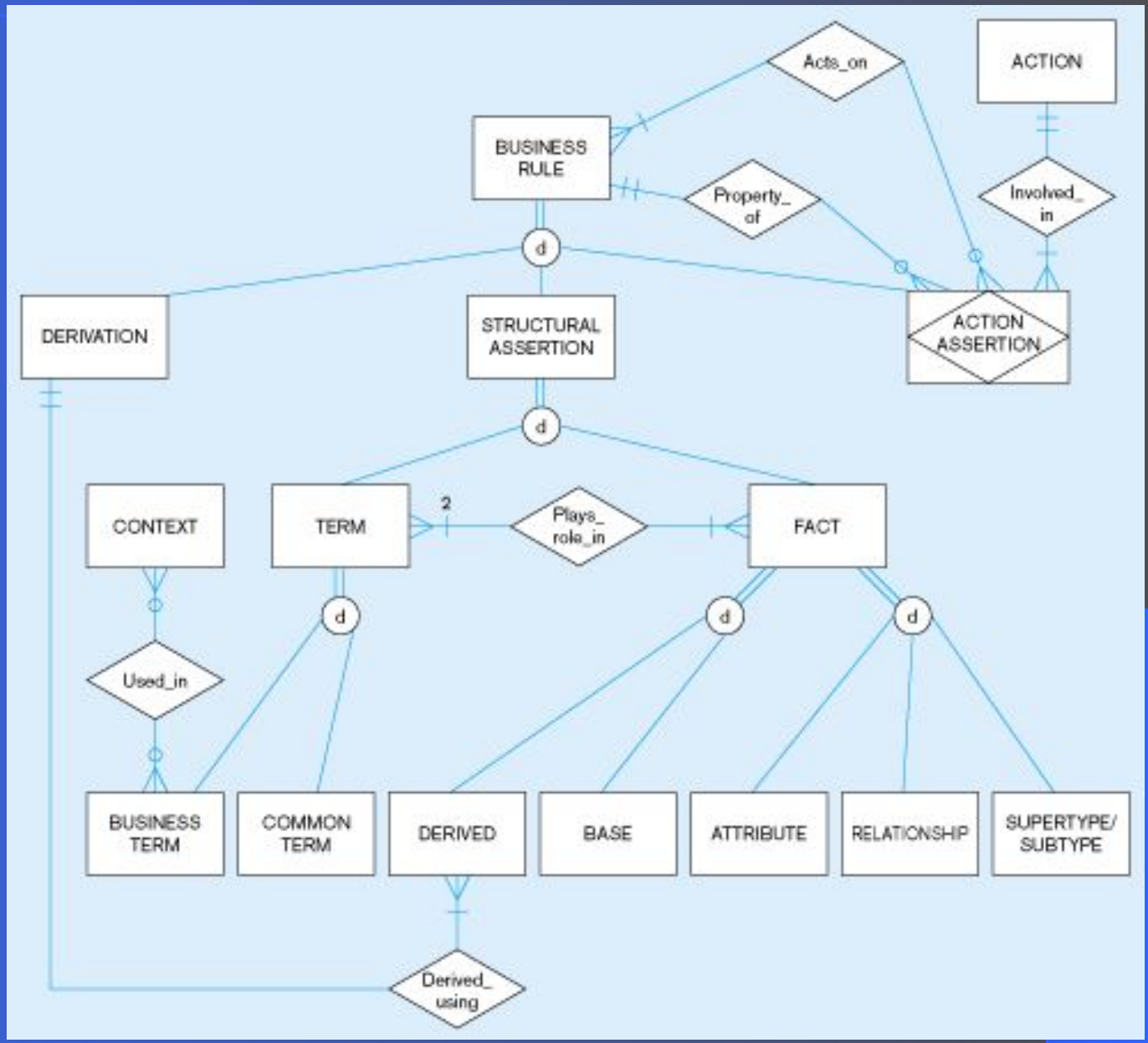
Figure 4-13(b) – EER diagram of PVF entity clusters



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

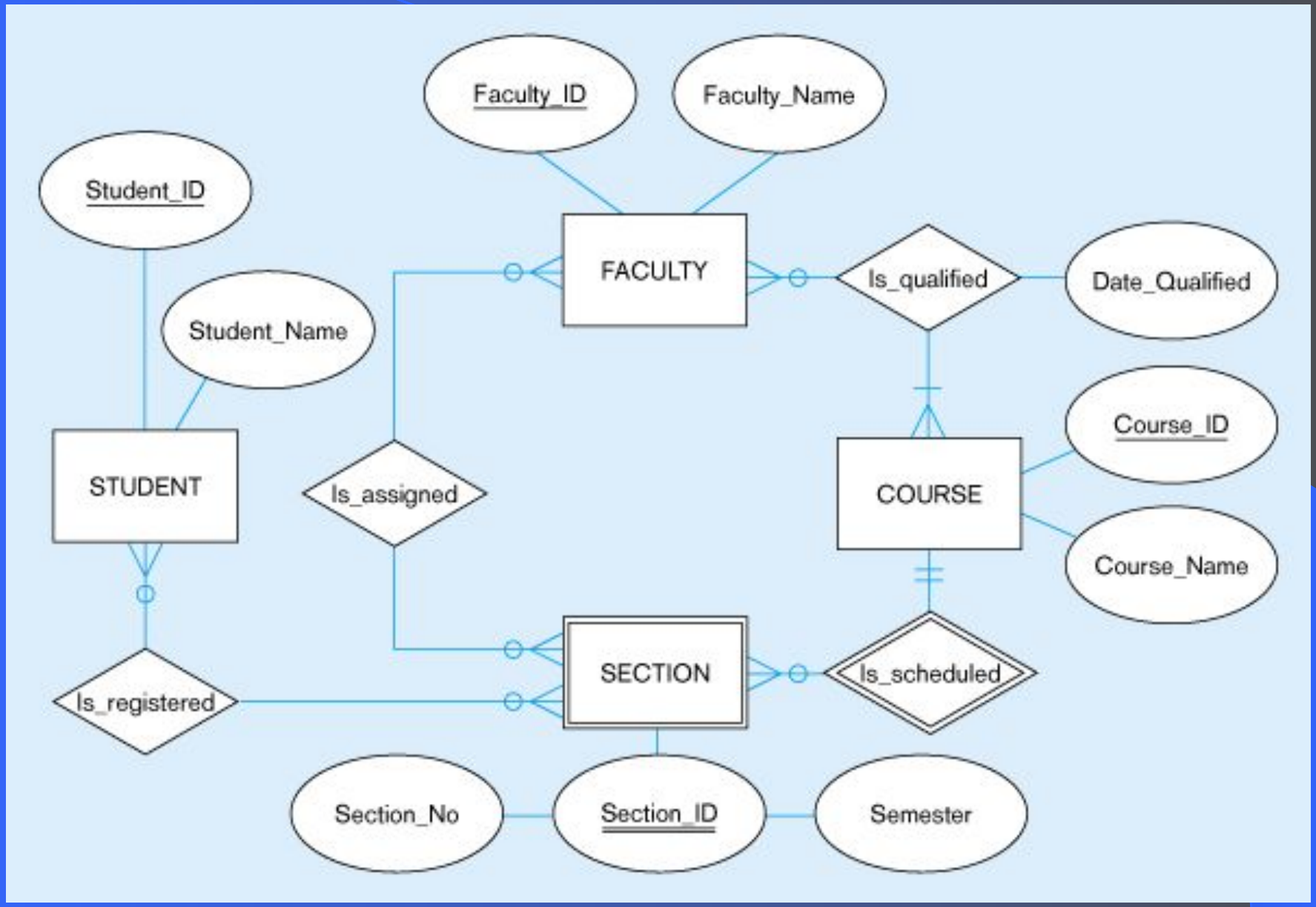


Figure 4-17 – Business Rule 1: For a faculty member to be assigned to teach a section of a course, the faculty member must be qualified to teach the course for which that section is scheduled

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

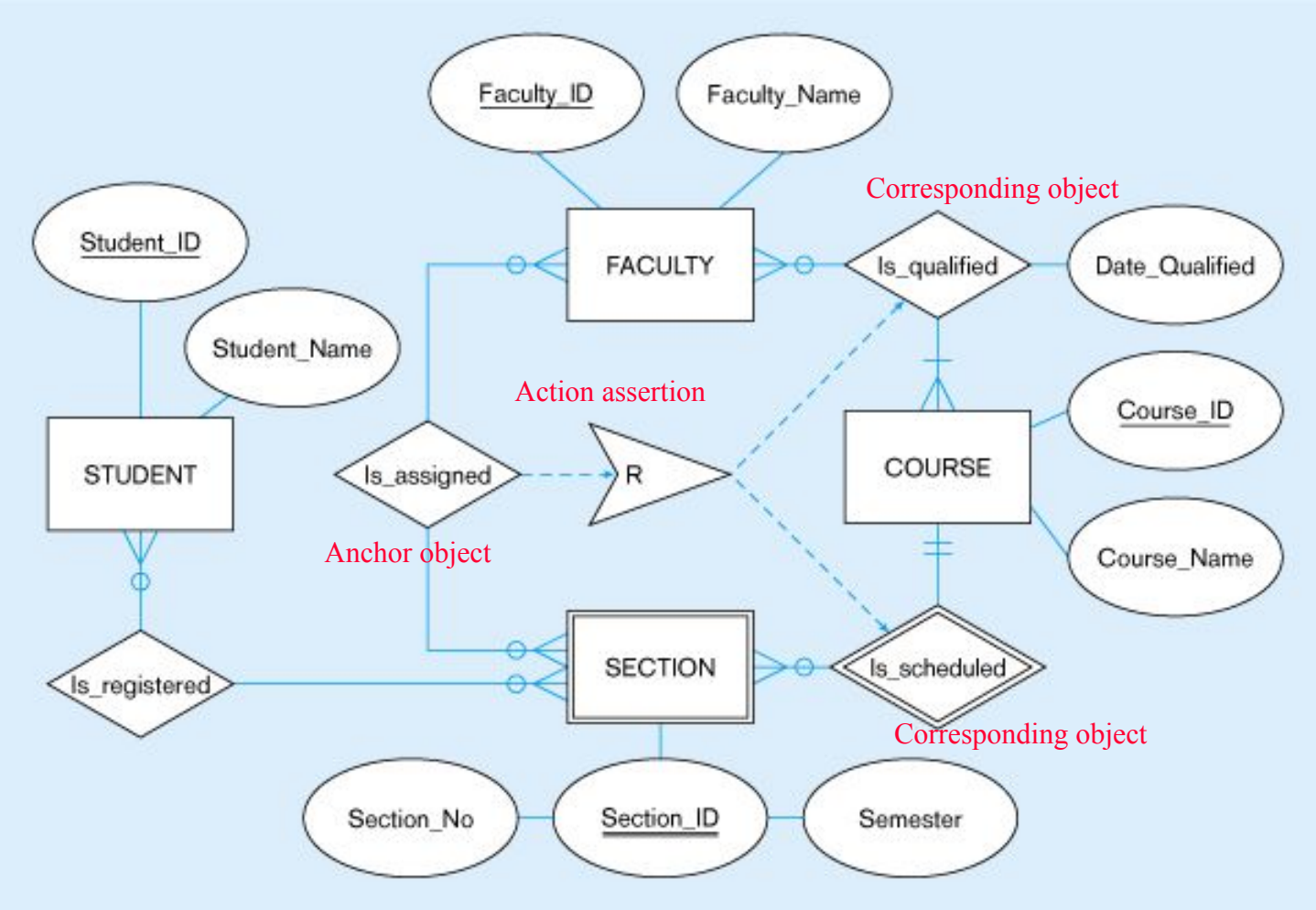


Figure 4-18 –Business Rule 2: For a faculty member to be assigned to teach a section of a course, the faculty member must not be assigned to teach a total of more than three course sections

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