Chapter 3
The Enhanced E-R Model

Objectives

- Define terms
- Understand use of supertype/subtype relationships
- Understand use of specialization and generalization techniques
- Specify completeness and disjointness constraints
- Develop supertype/subtype hierarchies for realistic business situations

What is the EE-R Model?

- The Enhanced E-R model (EE-R) is an extended E-R model with new modeling constructs.
- Why the EE-R model?
  - The business environment has changed dramatically.
  - Business relationships and data are more complex.

Supertypes and Subtypes

- Supertype: A generic entity type that has a relationship with one or more subtypes (Fig. 3-1, 2)
- Subtype: A subgrouping of the entities in an entity type which has attributes that are distinct from those in other subgroupings
- Inheritance:
  - Subtype entities inherit values of all attributes of the supertype
  - An instance of a subtype is also an instance of the supertype

Figure 3-1 Basic notation for supertype/subtype notation

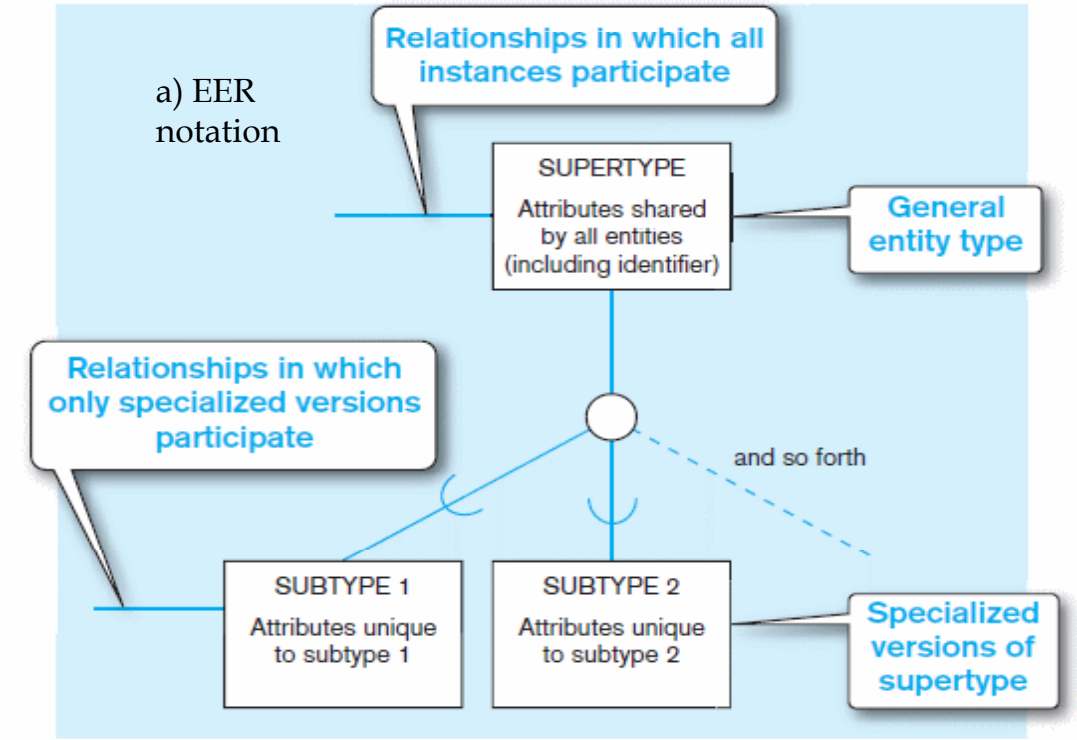
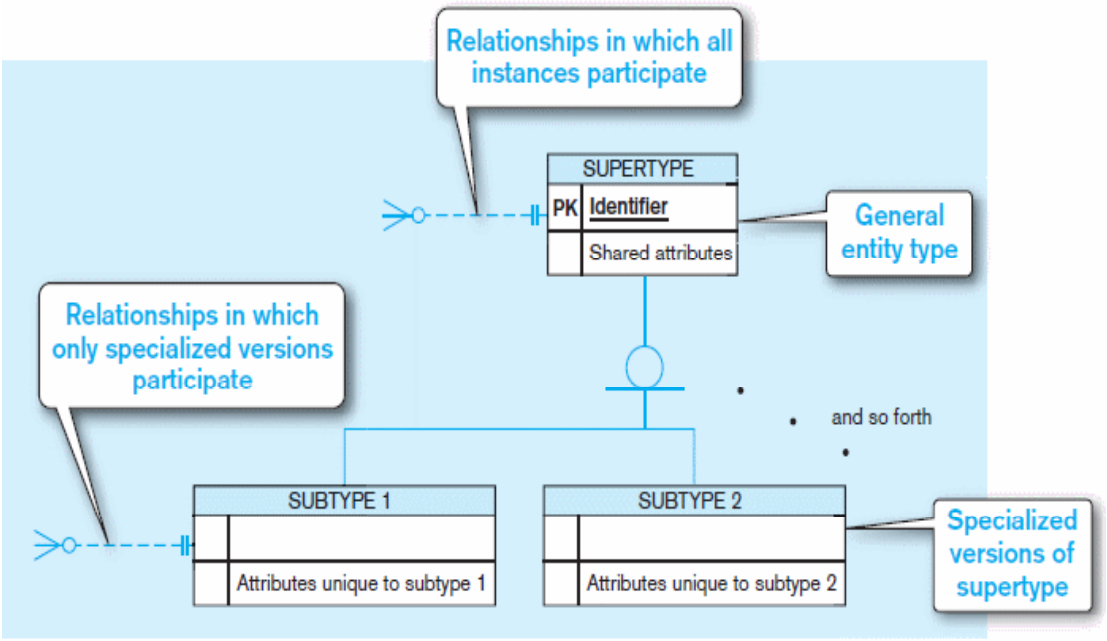
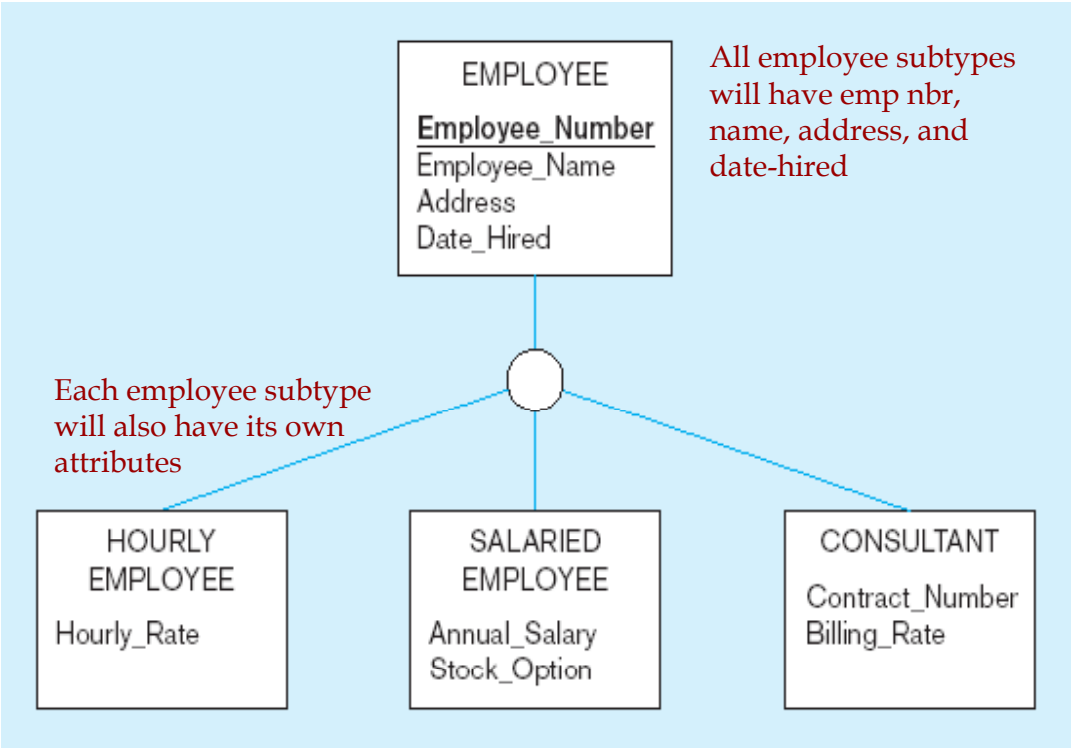


Figure 3-1 Basic notation for supertype/subtype notation (cont.)



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

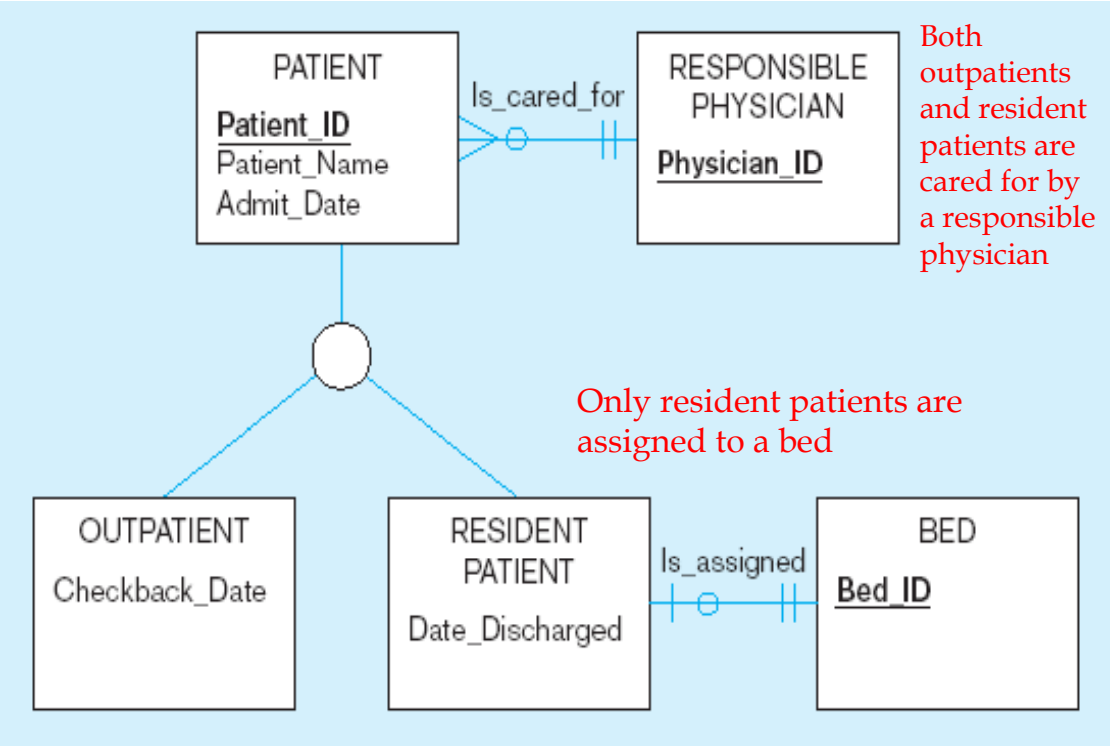
Fig. 3-2: Employee supertype with three subtypes



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 (Fig. 3-3)
- Subtype entities **inherit** values of all attributes of the supertype.
- An occurrence of a subtype is also an occurrence of the supertype

Figure 3-3 -- Supertype/subtype relationships in a hospital

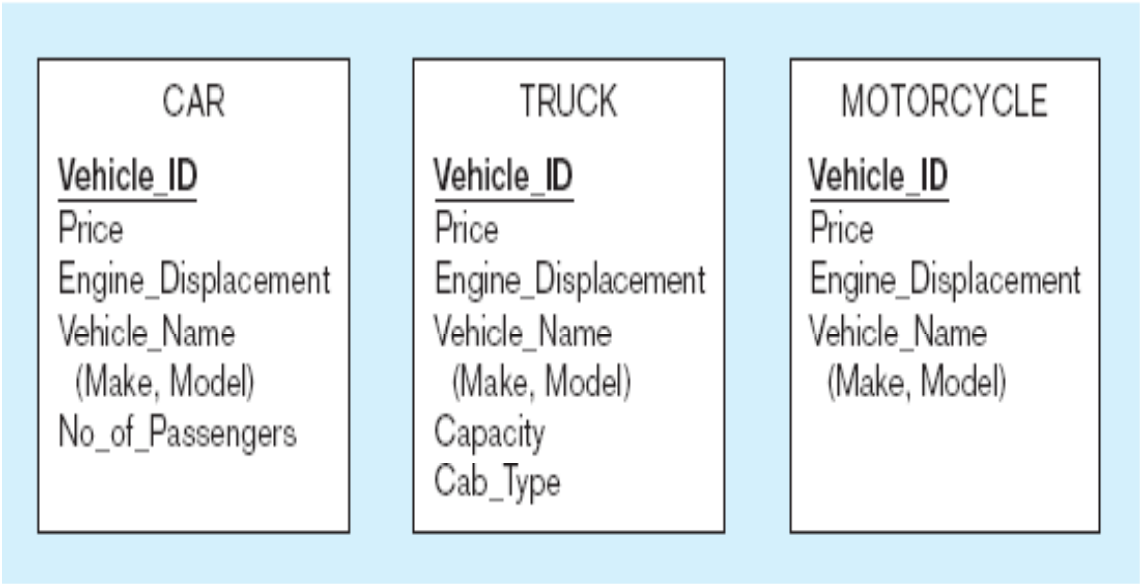


Generalization and Specialization

- **Generalization**: The process of defining a more general entity type from a set of more specialized entity types. BOTTOM-UP (Fig. 3-4)
- **Specialization**: The process of defining one or more subtypes of the supertype, and forming supertype/subtype relationships. TOP-DOWN (Fig. 3-5)

Figure 3-4 Example of Generalization

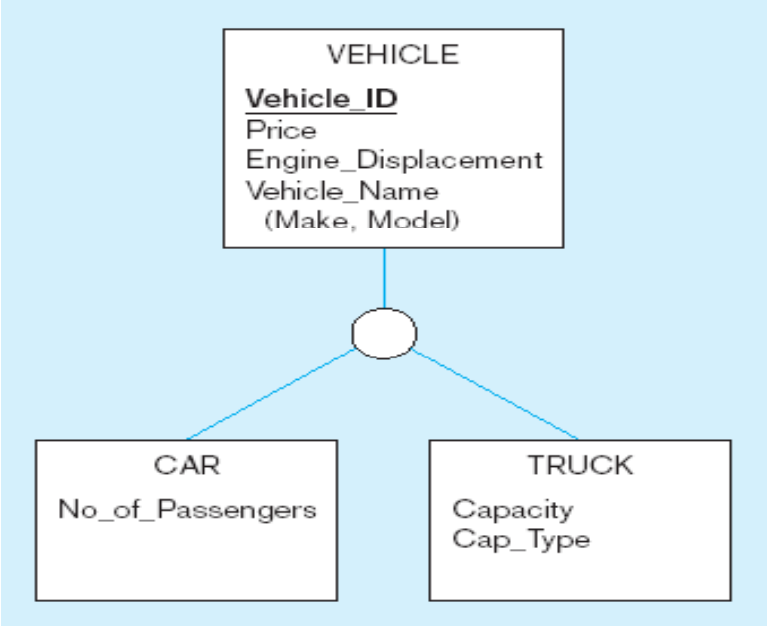
a) Three entity types: CAR, TRUCK, and MOTORCYCLE



All these types of vehicles have common attributes

Figure 3-4 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, and it has no unique relationships.

Figure 3-5 Example of Specialization

a) Entity type PART

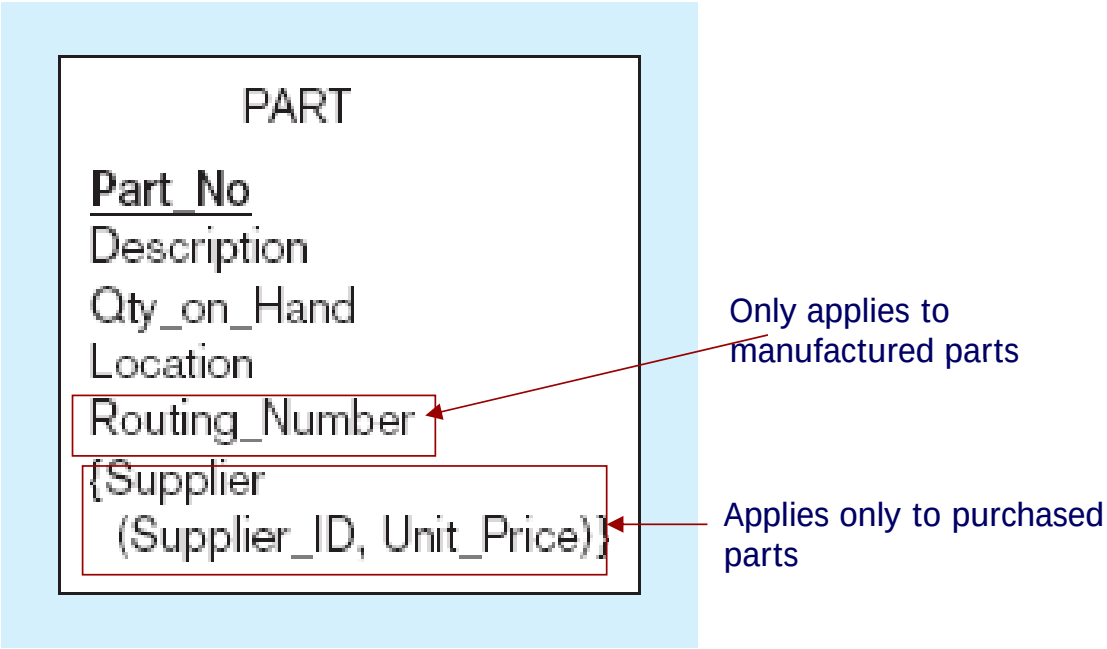
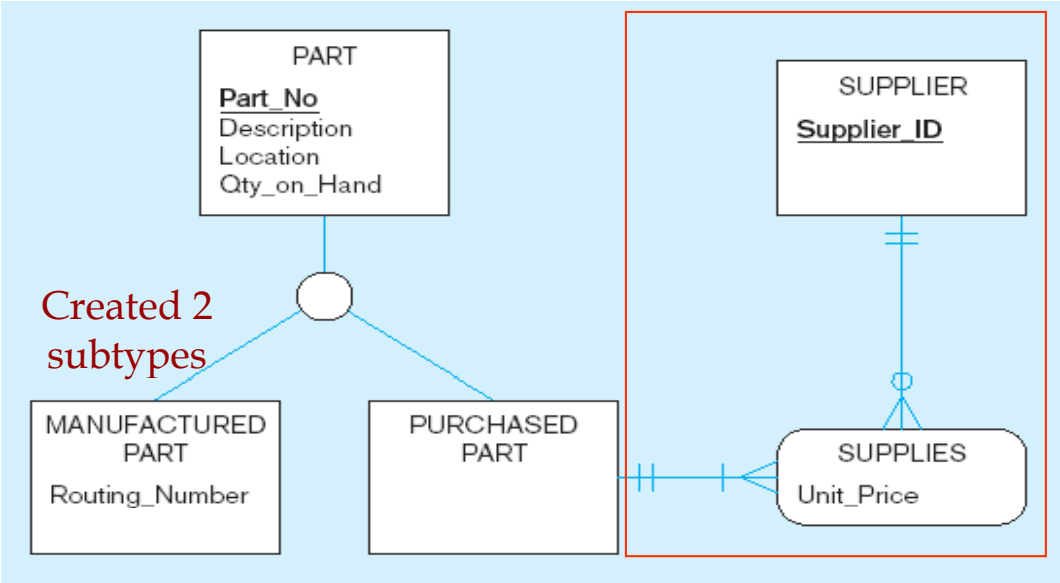


Figure 3-5 Example of Specialization (cont.)

b) Specialization to MANUFACTURED PART and PURCHASED PART



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

Constraints in Supertype/ Subtype Relationships

- **Completeness Constraints**: Whether an instance of a supertype must also be a member of at least one subtype.
  - Total Specialization Rule: Yes (Fig. 3-6a - double line convention)
  - Partial Specialization Rule: No (Fig. 3-6b - single line convention)

Figure 3-6 Examples of Completeness constraints

a) Total Specialization rule

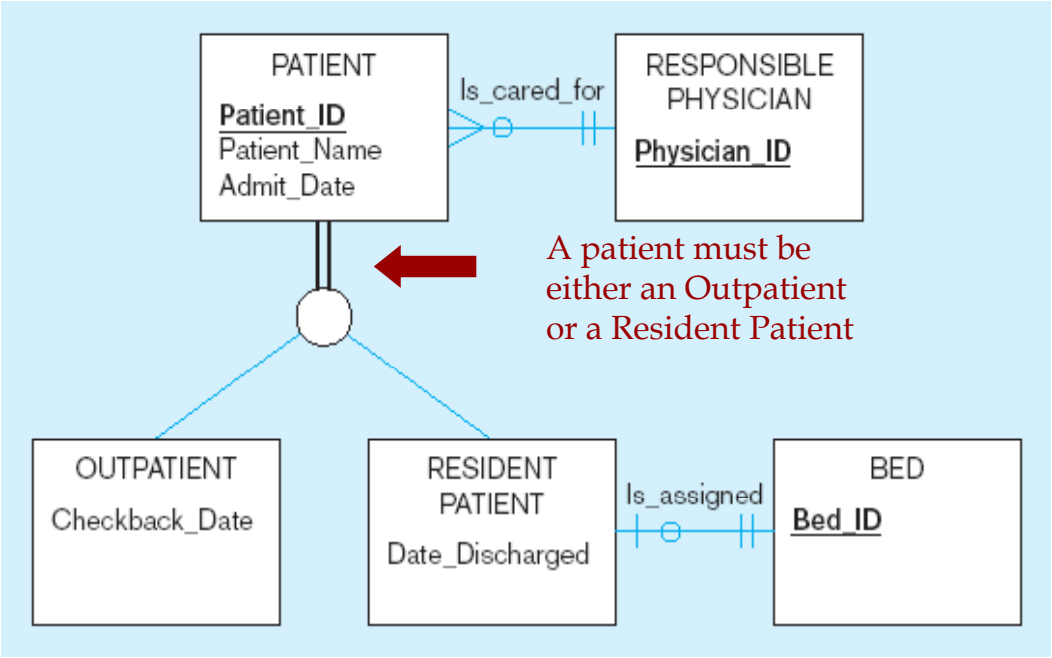
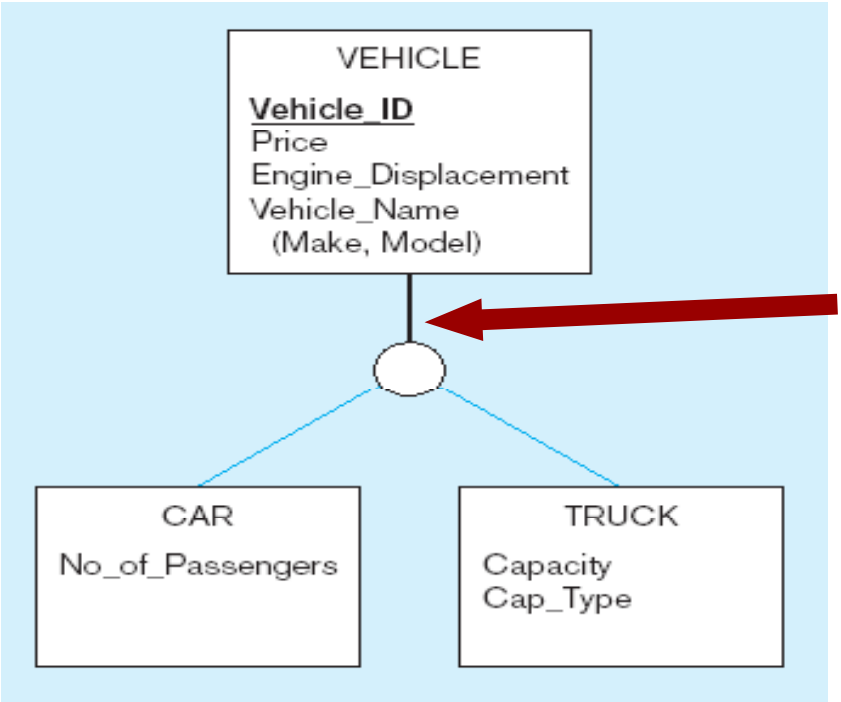


Figure 3-6 Examples of completeness constraints (cont.)

b) Partial Specialization rule



A vehicle can be a Car, a Truck, but does not have to be either

Practice Exercise #8, page #144

At a weekend retreat, the entity type PERSON has three subtypes: CAMPER, BIKER, and RUNNER. Draw a separate EER diagram segment for each of the following situations:

a) At a given time, a person must be exactly one of these subtypes.

b) A person may or may not be one of these subtypes. However, a person who is one of these subtypes cannot at the same time be one of the other subtypes.

c) A person may or may not be one of these subtypes. On the other hand, a person may be any two (or even three) of these subtypes at the same time.

d) At a given time, a person must be at least one of these subtypes.

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 3-7 Examples of disjointness constraints

a) Disjoint rule

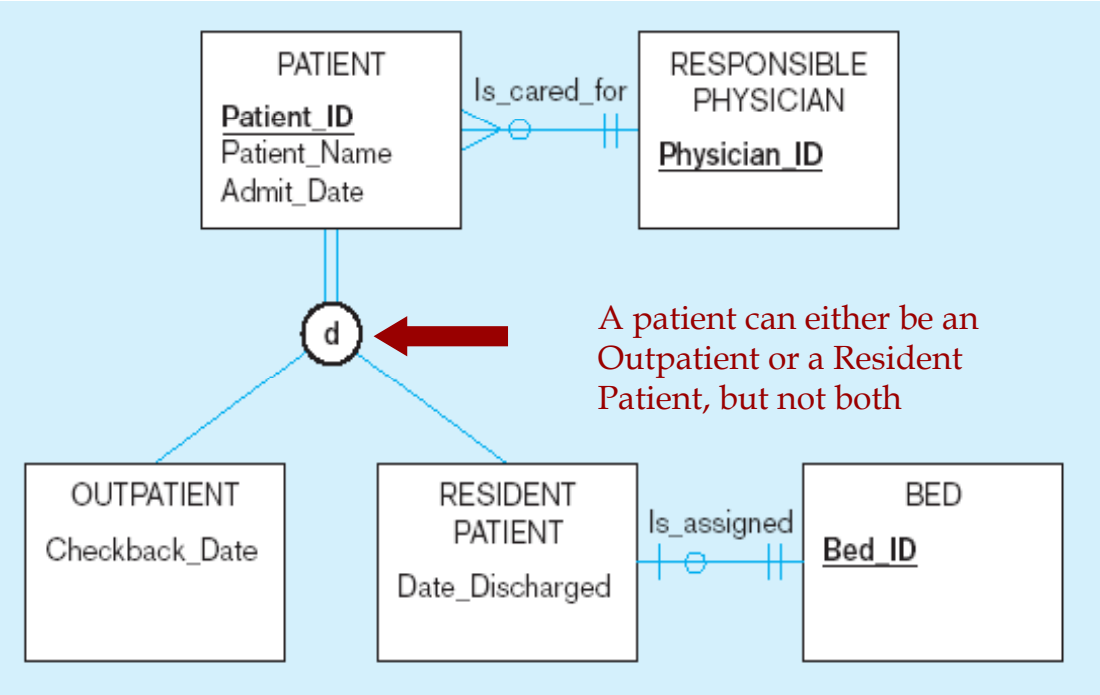
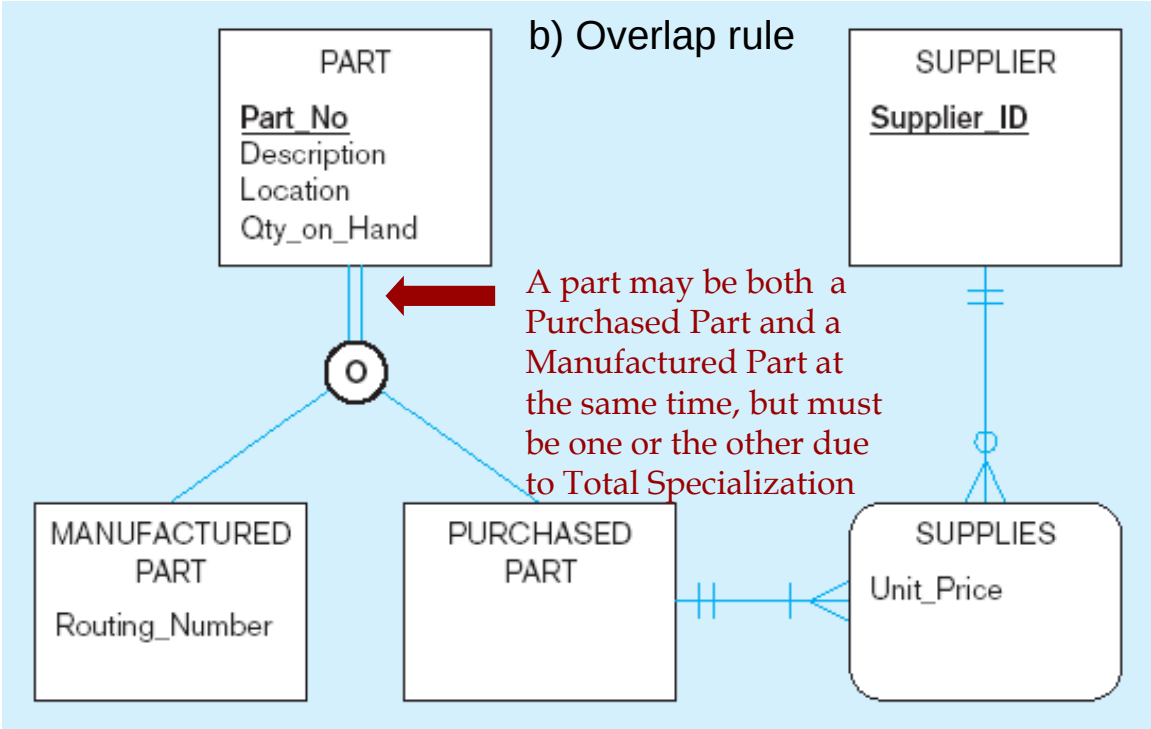


Figure 3-7 Examples of disjointness constraints (cont.)

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 (Fig. 3-8)
  - **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 (Fig. 3-9)
  - Summary Example (Fig. 3-10)

Figure 3-8 Introducing a subtype discriminator (*disjoint* rule)

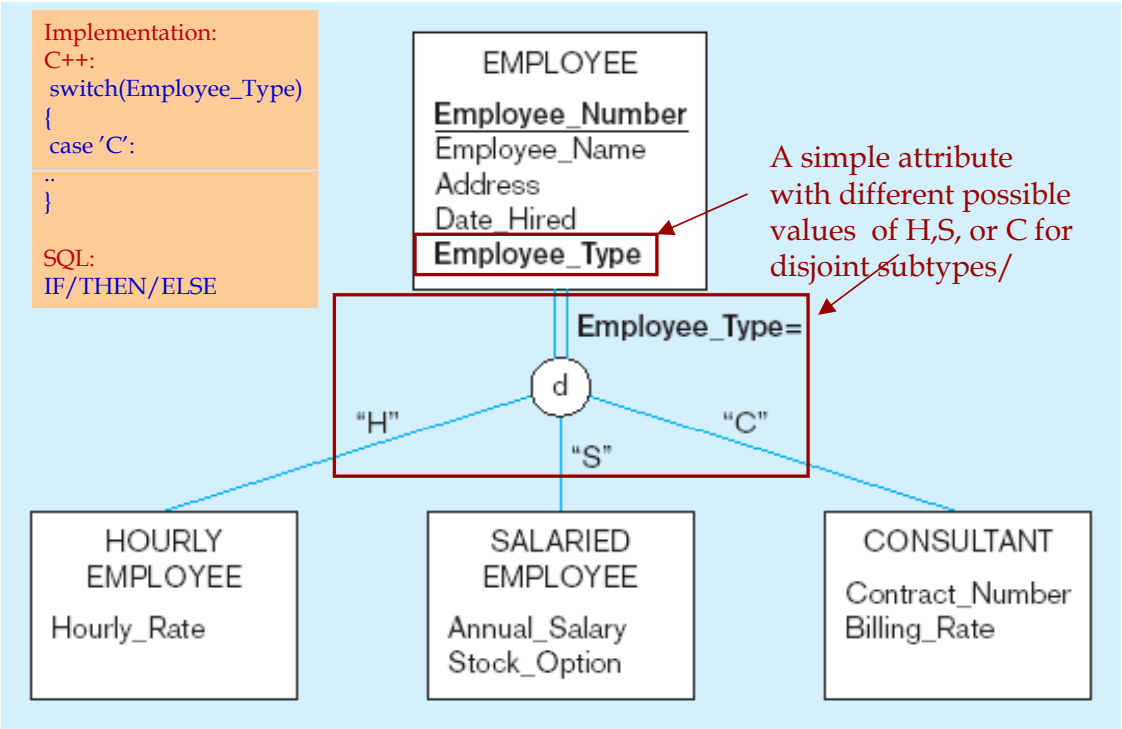


Figure 3-9 Subtype discriminator (*overlap* rule)

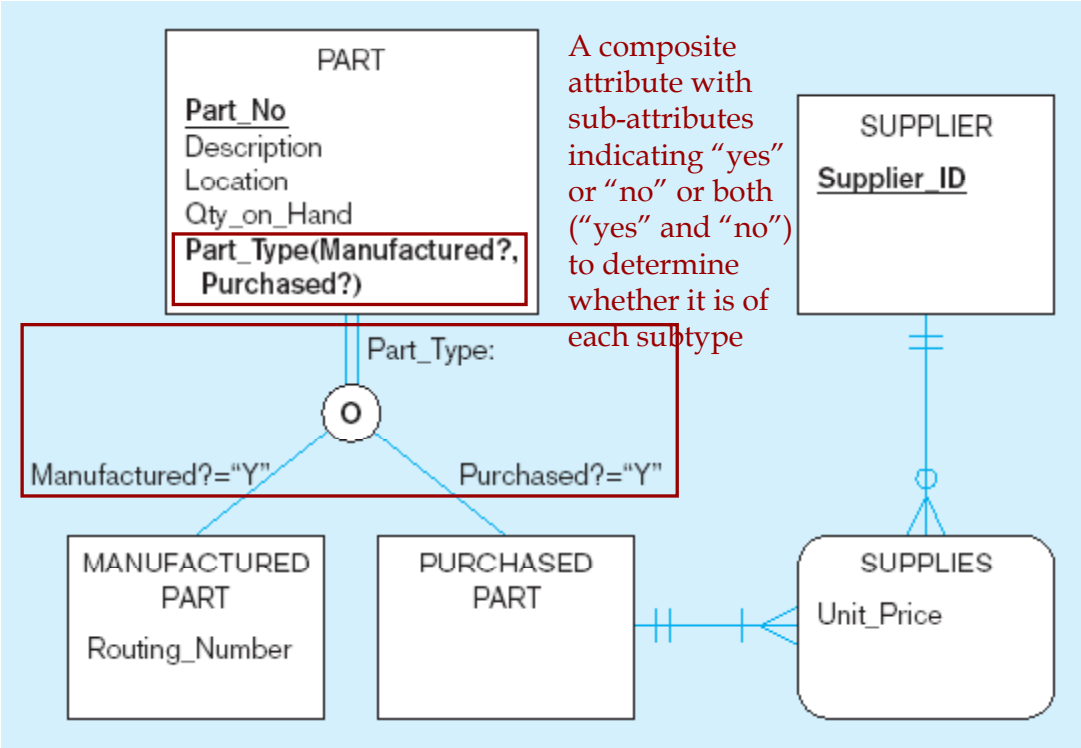
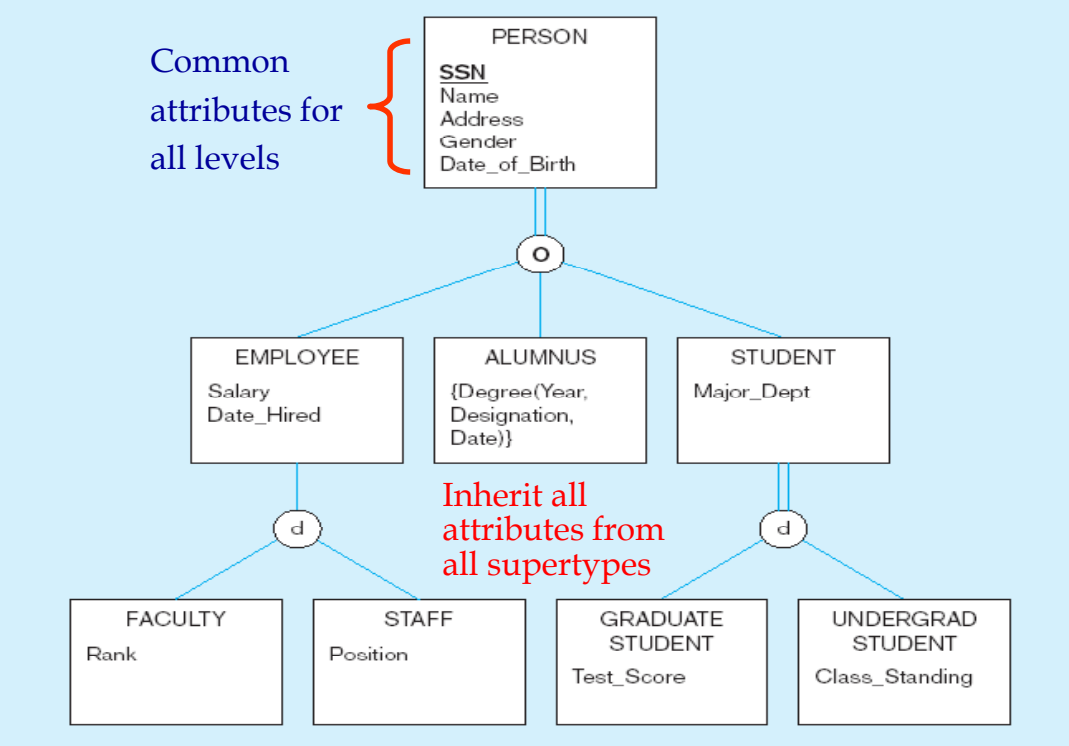
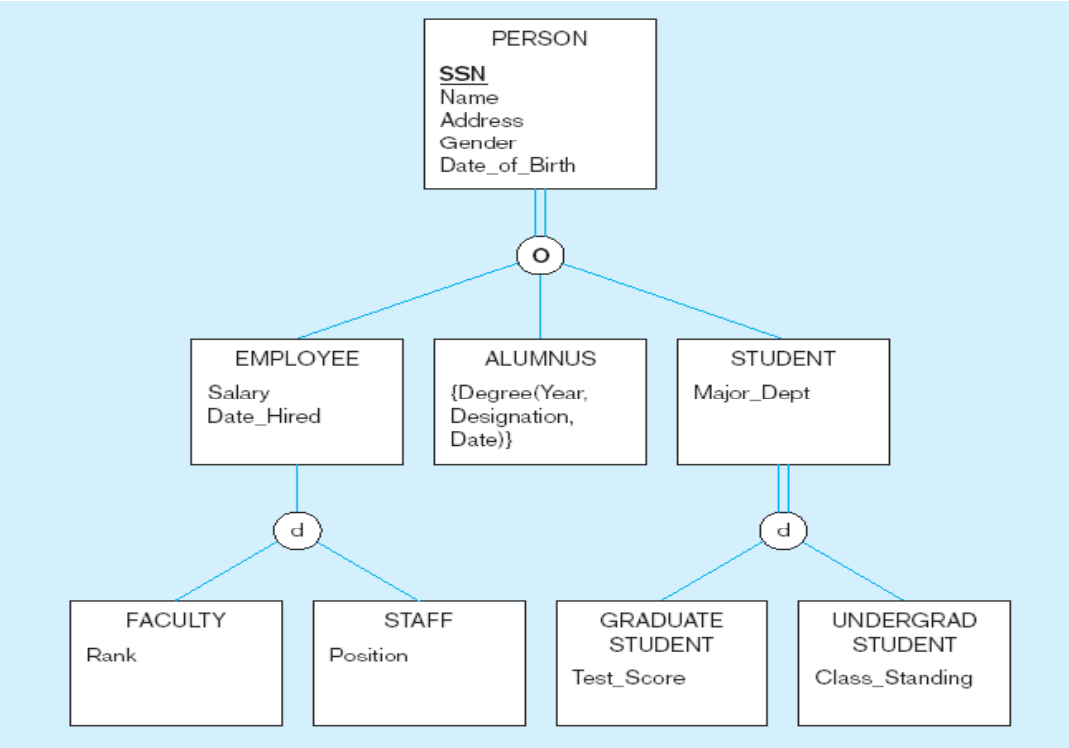


Figure 3-10 Example of supertype/subtype hierarchy



Add a subtype discriminator for each supertype:



Practice Exercise #9, page #144

A bank has three types of accounts: checking, savings, and loan.

Following are the attributes for each type of account:
- CHECKING: Acct No, Date Opened, Balance, Service Charge
- SAVINGS: Acct No, Date Opened, Balance, Interest Rate
- LOAN: Acct No, Date Opened, Balance, Interest Rate, Payment

Assume that each bank account must be a member of exactly one of these subtypes. Using generalization, develop an EER model segment to represent this situation using the traditional EER notation.