Database Management

COMP3010E FALL 2025

LECTURE 3 ENHANCED ER MODEL

Enhanced E-R Model

- **EER**
  - Cope with more complex data and relationships
  - An extension of the original E-R model with new modeling constructs
  - Most important modeling construct – supertype/subtype relationships
- **Subtype**
  - A subgrouping of the entities in an entity type
  - Meaningful in the business/user environment
  - Share common attributes or relationships distinct from other subgroupings

Undergraduate Student

Graduate Student

- **Supertype**
  - A generic entity type
  - Has a relationship with one or more subtypes

Student

Supertype/Subtype Example (1)

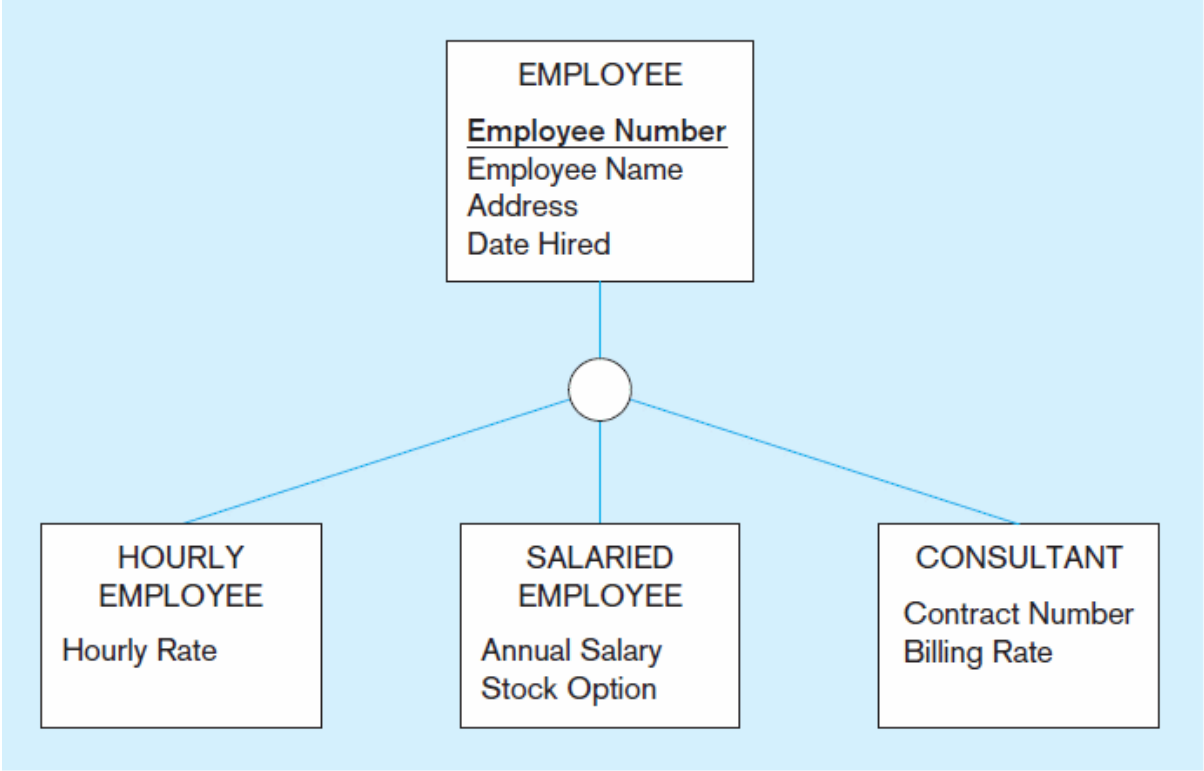
- An organization has three types of **employees** – salaried, hourly, and consultant.
- For **all** of the employees, the organization wants to track the *employee_id*, *name*, *address*, and the *date* on which they were hired.
- For the **hourly employee**, the organization also wants to record the *hourly rate*.
- For the **salaried employee**, the organization needs to record the *annual salary* and *stock option*.
- Also, the *contract number* and the *billing rate* of **consultants** must be stored.

Supertype/Subtype Example (2)

- **Supertype**: EMPLOYEE
- **Subtypes**
  - HOURLY EMPLOYEE
  - SALARIED EMPLOYEE
  - CONSULTANT

Feature 1: There are **common** attributes shared by all supertype entities

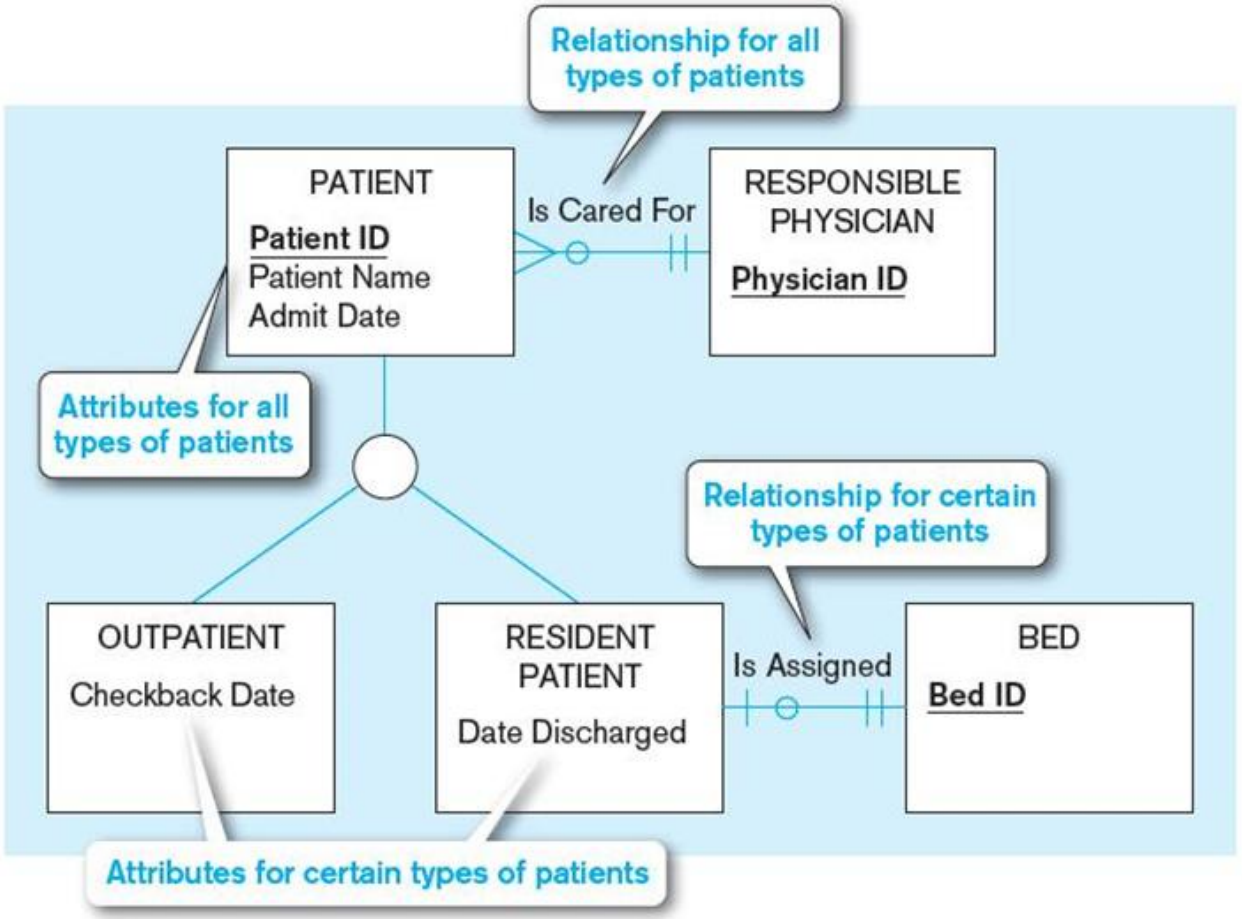
Feature 2: There are attributes that are **unique** to individual subtype entities



Supertype/Subtype Example (3)

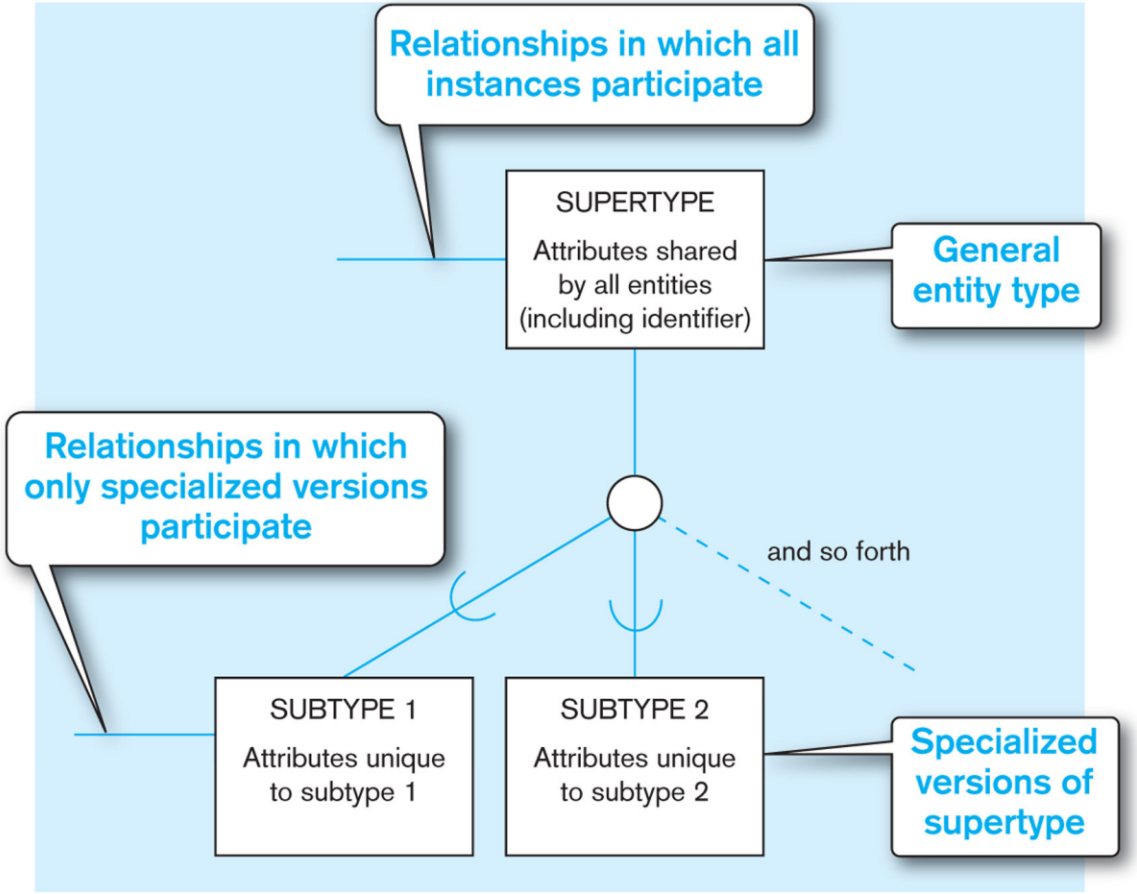
- **Supertype**
  - PATIENT
- **Subtypes**
  - OUTPATIENT
  - RESIDENT PATIENT

Feature 3: The instances of a subtype may participate in a relationship **unique** to that subtype

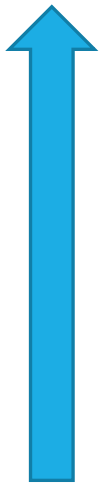


Supertype/Subtype Notation

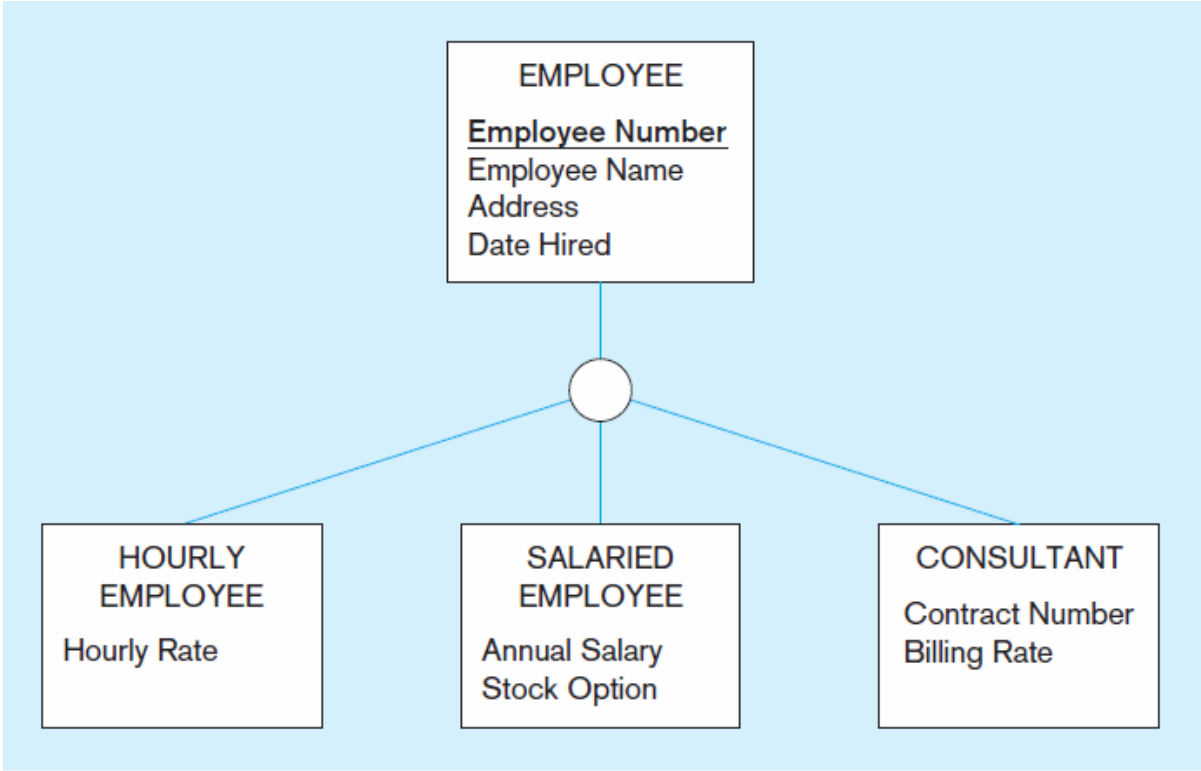
- **Supertype**
  - connected with a line to a circle
  - include the common attributes
  - common relationships
- **Subtypes**
  - connected with a line to the circle
  - (optional) U-shaped symbol on each line
  - include respective unique attributes
  - unique relationships
- **Attribute Inheritance**
  - Subtype entities inherit values of all attributes and instances of all relationships of their supertypes

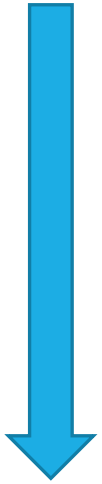


Generalization and Specialization



Generalization



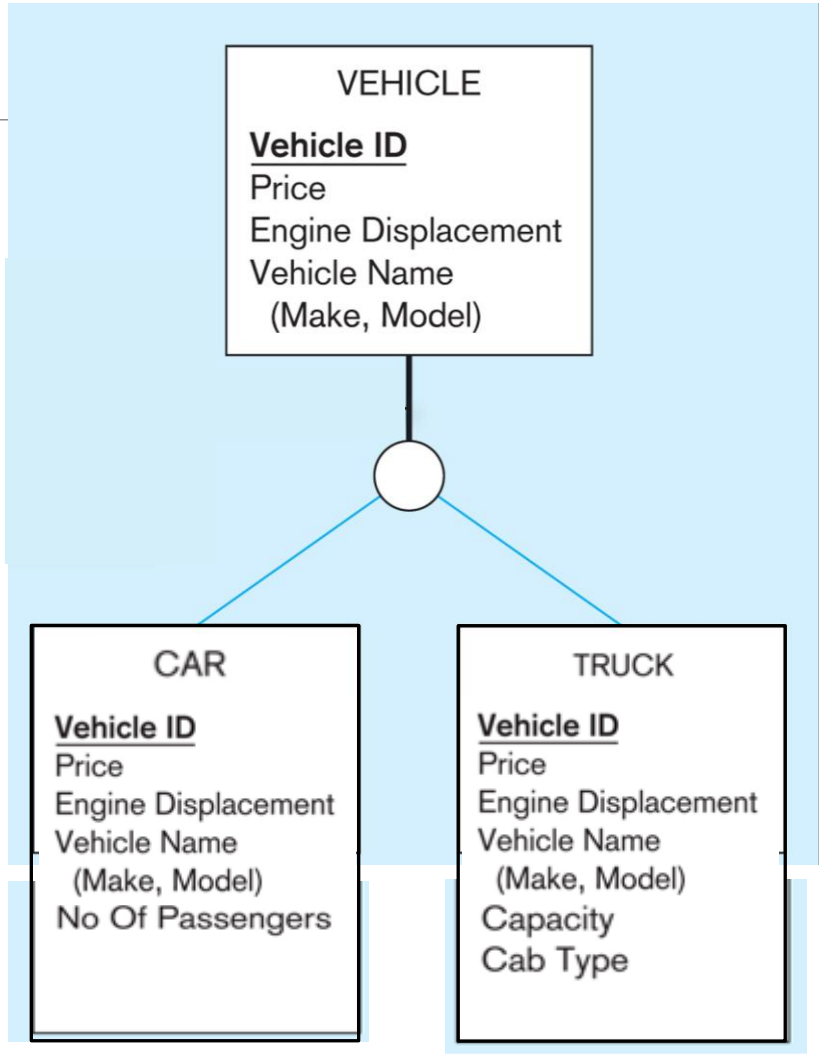


Specialization

Generalization

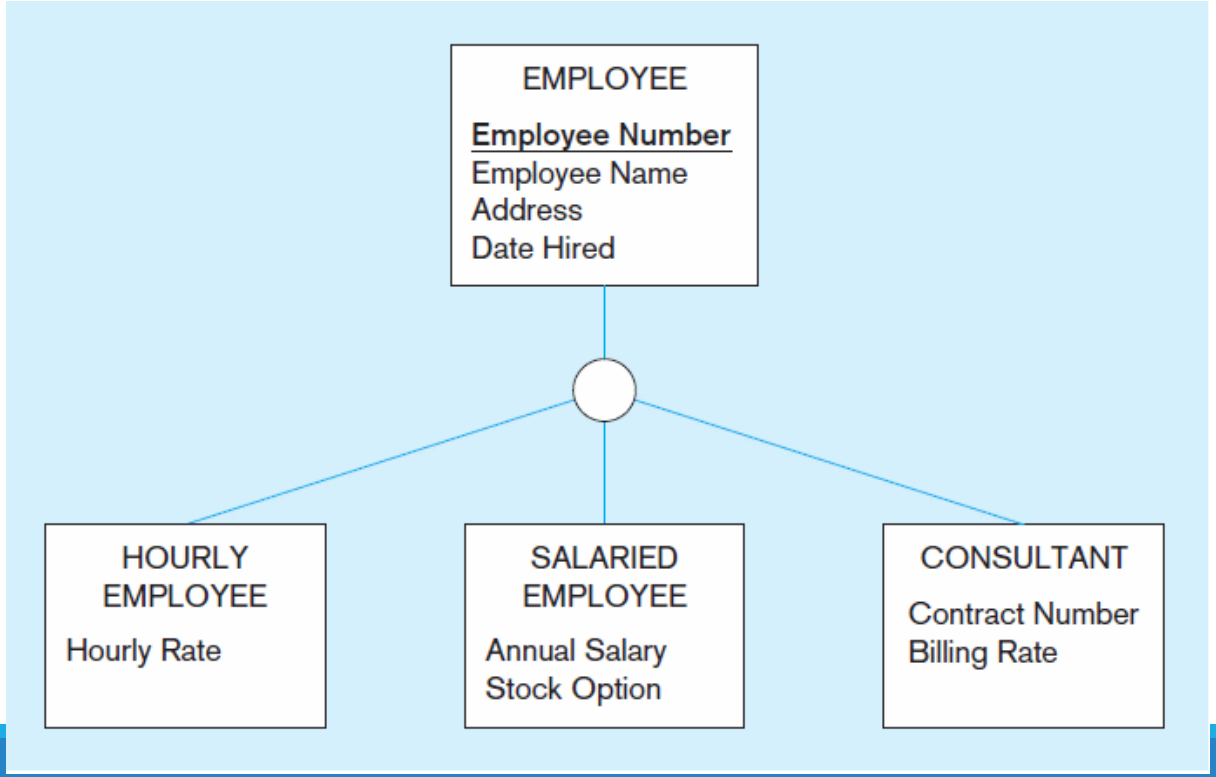
- This process of creating a more general entity from specific types is called ***generalization*** (bottom-up process)

- *Car*
- *Truck*
- *Car and Truck → vehicle*



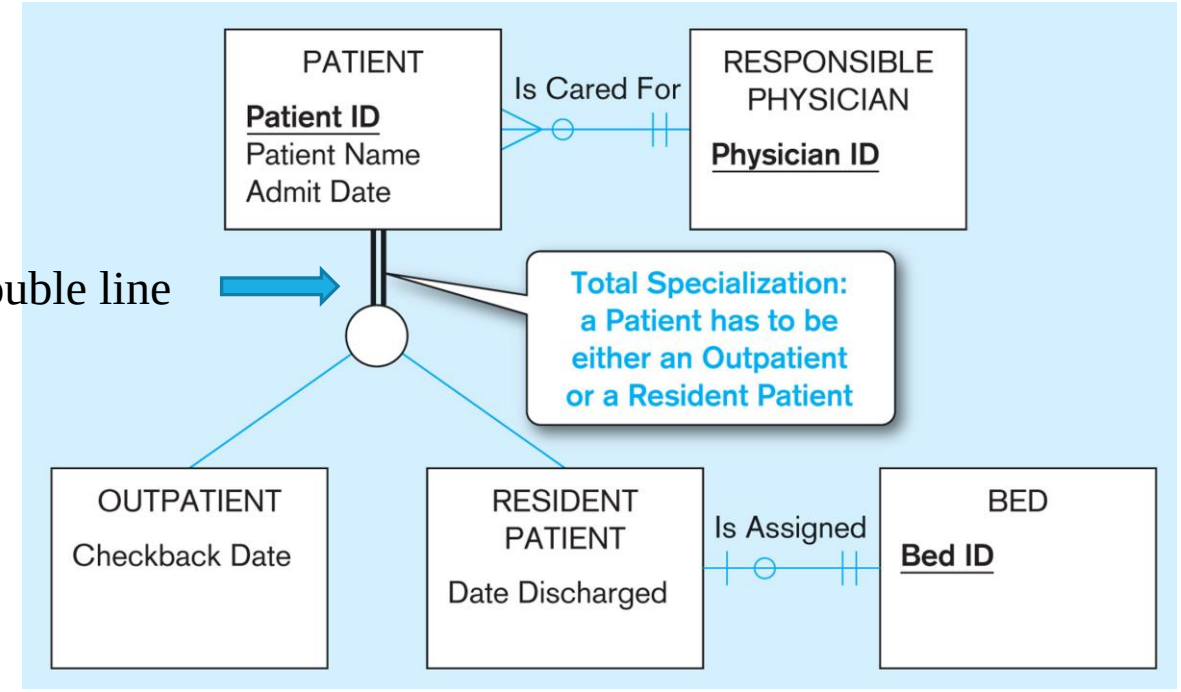
Specialization

- The process of creating more specific entities from a general entity is called ***specialization*** (top-down process).



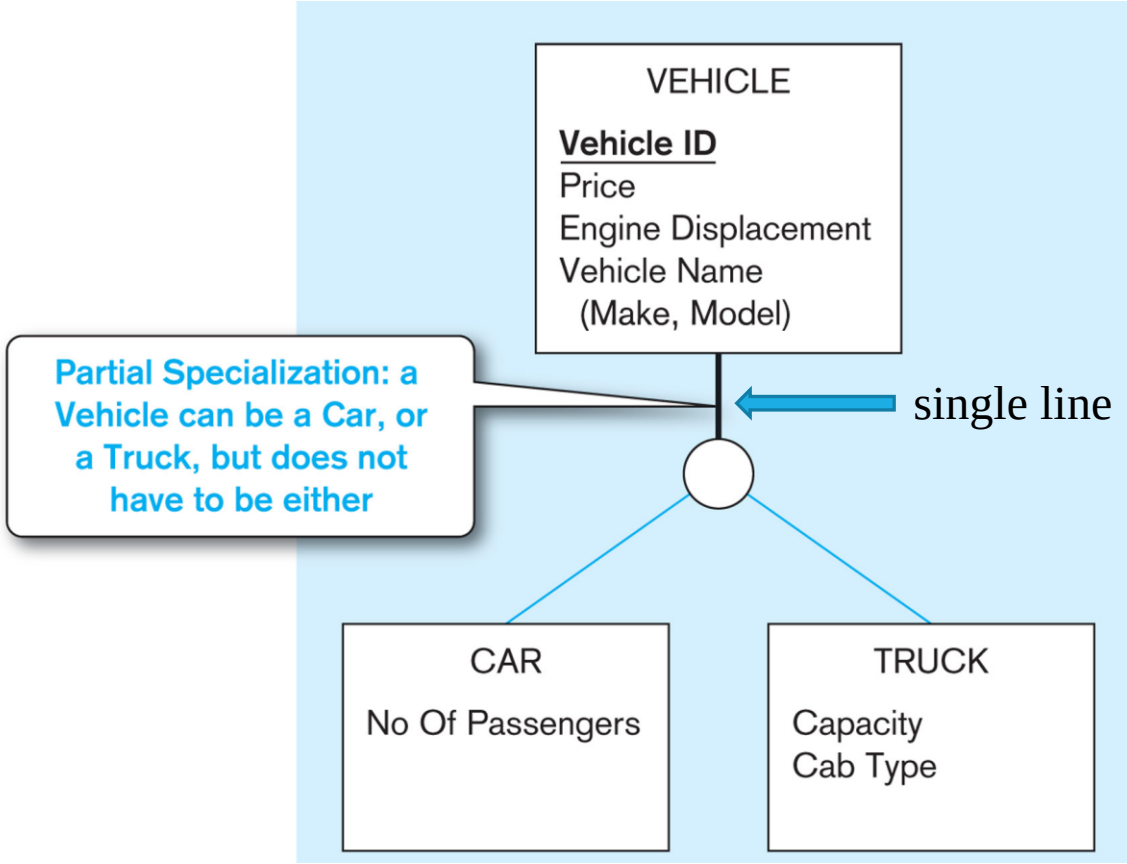
Completeness Constraints (1)

- **Completeness constraint**
  - Address whether an instance of a supertype must also be a member of at least one subtype
  - Two possible rules
- **Total specialization rule**
  - Each instance of the supertype must be a member of at least one subtype
  - Indicated by the double line



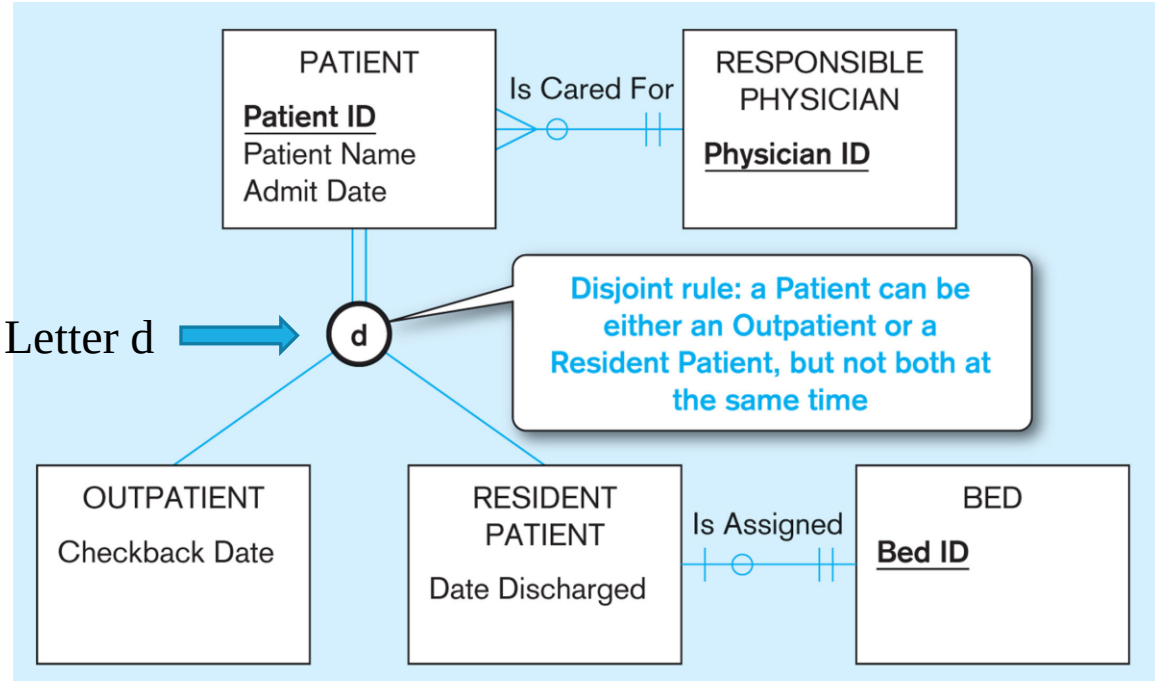
Completeness Constraints (2)

- **Partial specialization rule**
  - An instance of the supertype may (or may not) belong to any subtype (e.g. a motorcycle)
  - Indicated by the single line



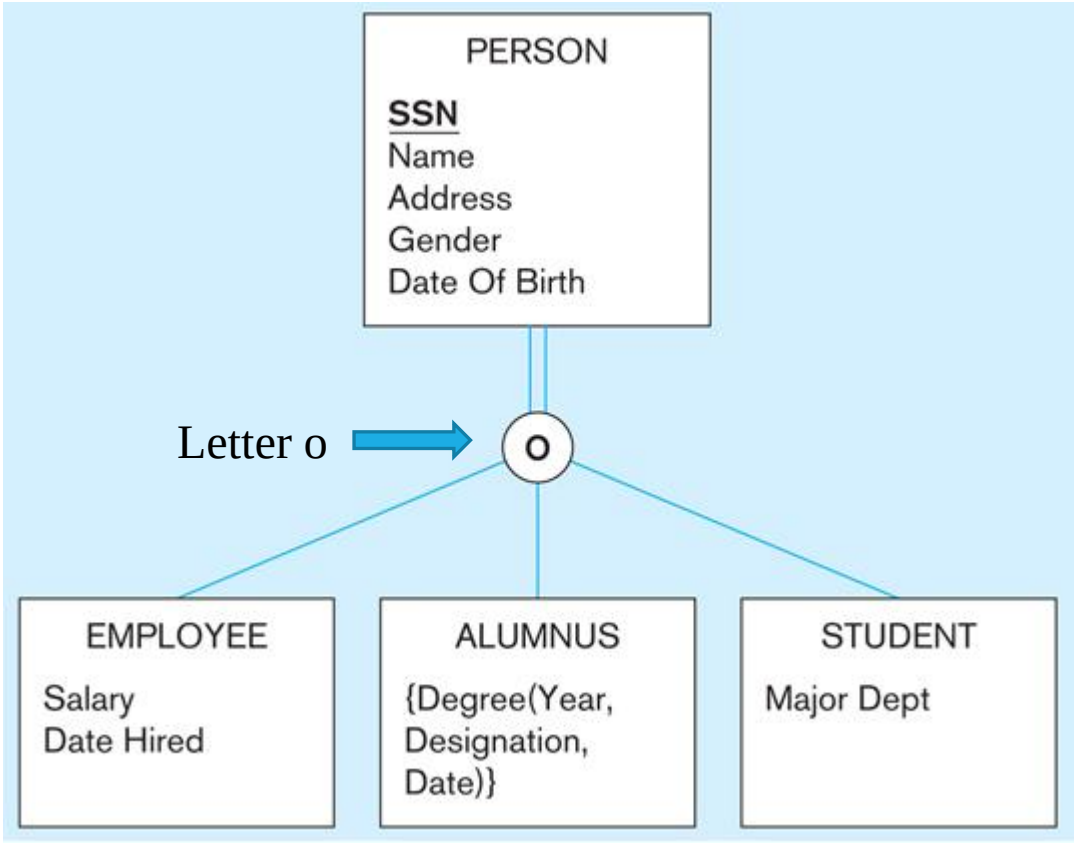
Disjointness Constraints (1)

- **Disjointness constraint**
  - Address whether an instance of a supertype may simultaneously be a member of two or more subtypes
  - Two possible rules
- **Disjoint rule**
  - An instance of the supertype may not simultaneously be a member of two or more subtypes
  - Indicated by the letter d



Disjointness Constraints (2)

- **Overlap rule**
  - An instance of the supertype may simultaneously be a member of two or more subtypes
  - Indicated by the letter o

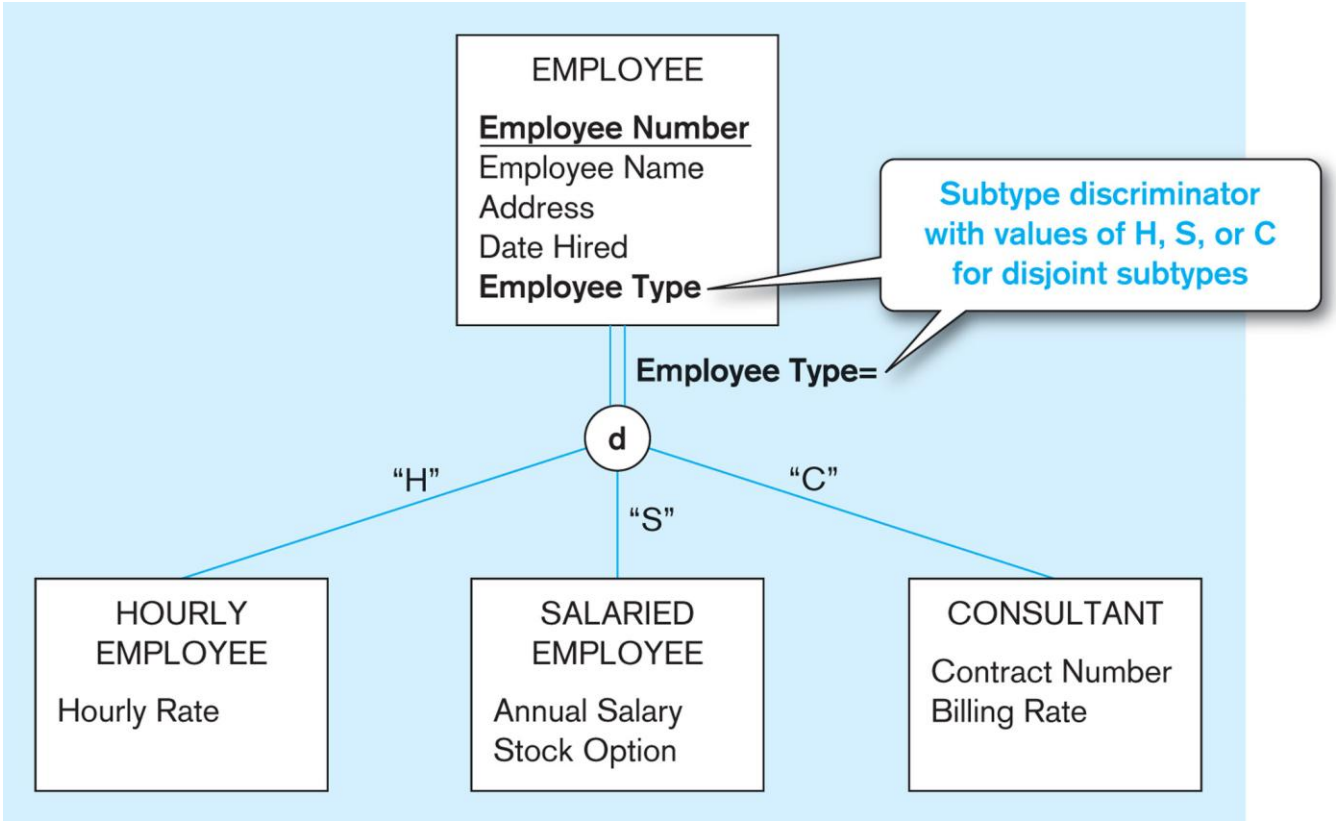


Subtype Discriminator (1)

- **Subtype discriminator**
  - An attribute of a supertype whose value determines the target subtype or subtypes

- **Disjoint subtype**
  - A simple attribute to define the subtype

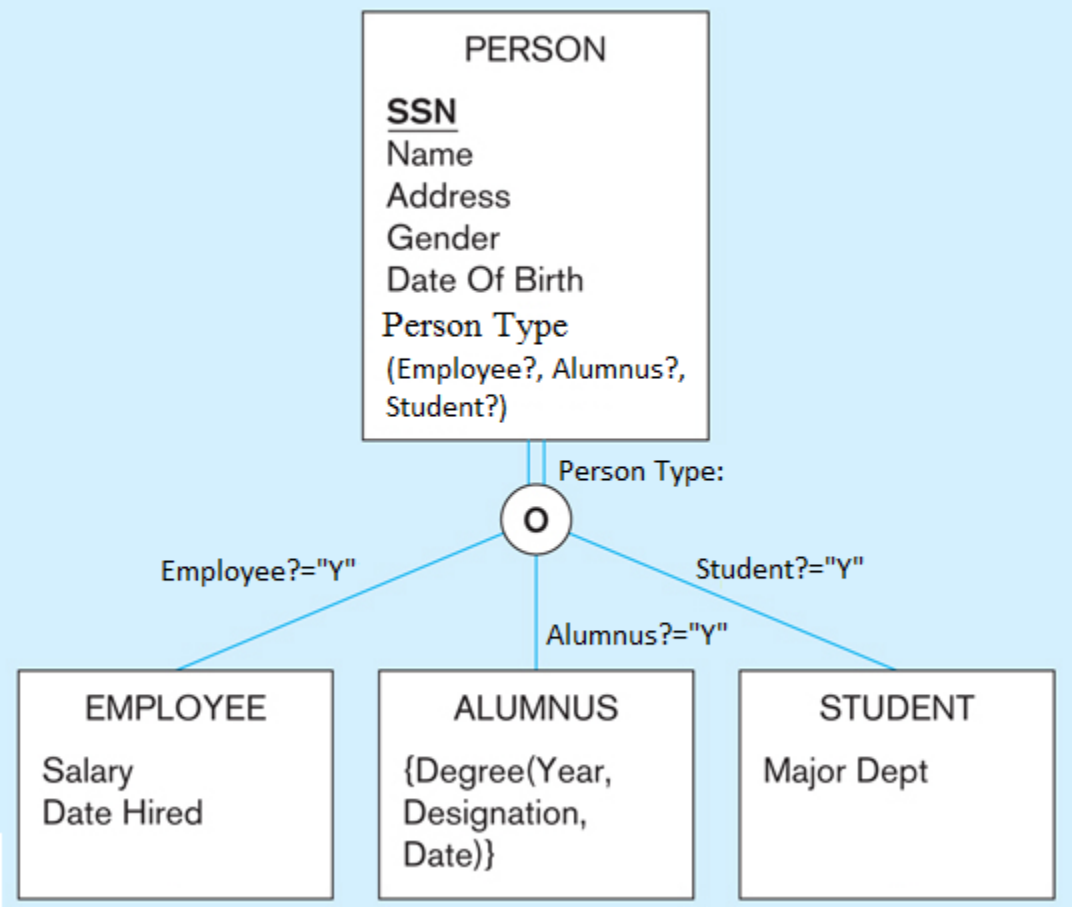
How to implement the completeness constraint with disjoint subtypes?



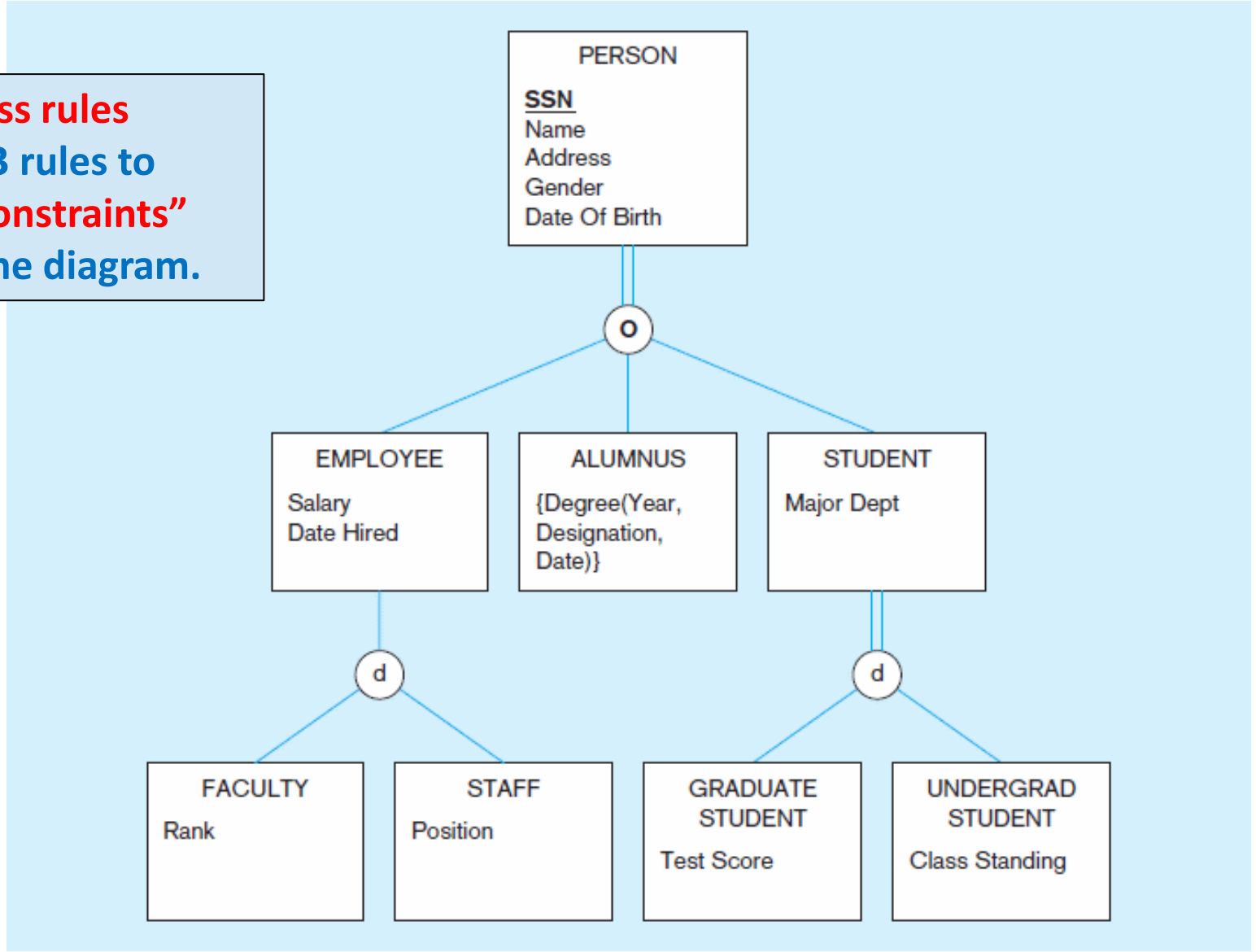
Subtype Discriminator (2)

- **Overlapping subtypes**
  - A composite attribute to define the subtype(s)
  - Each component is a Boolean variable (Y/N)

How to implement the completeness constraint with overlapping subtypes?



Exercise: What are the **business rules** reflected in this EERD? Write 3 rules to describe the **"completeness constraints"** and **"disjoint constraints"** in the diagram.



Common Questions on ERD

- Relationship attributes
  - Allowed for 1:1, M:N and ternary relationships
  - Not for 1:M relationships
- Difference between associative entity and weak entity?
- Associative Entity Type
  - Convert M:N and Ternary relationships to Associative Entity
  - Unary M:N relationship → 1 entity + 1 associative entity