ER Modeling Part 2

Lecture 4

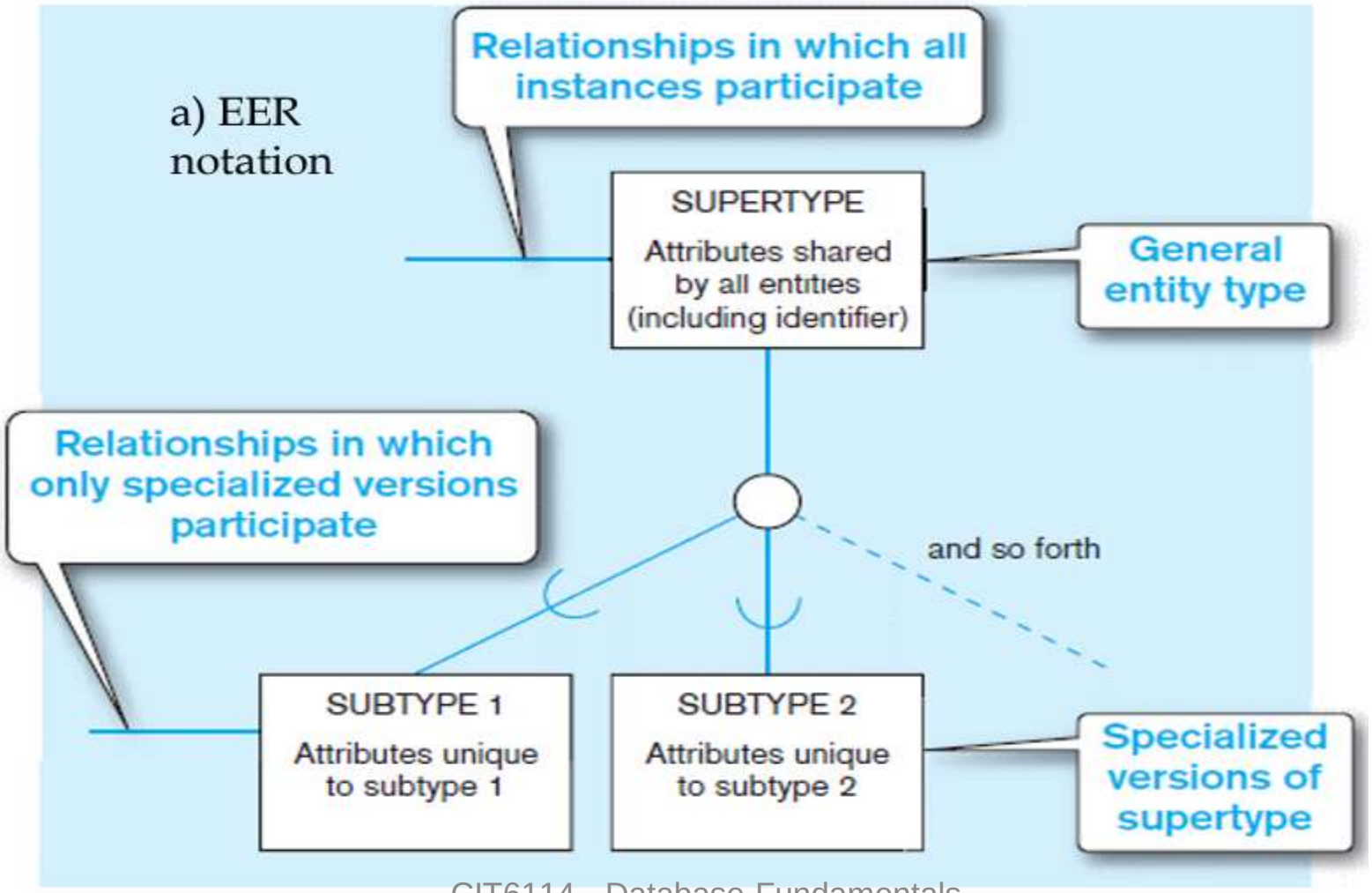
Learning Outcomes

- In this chapter, students will learn:
  - The characteristics of supertype-subtype relationship
  - Constructing an ERD

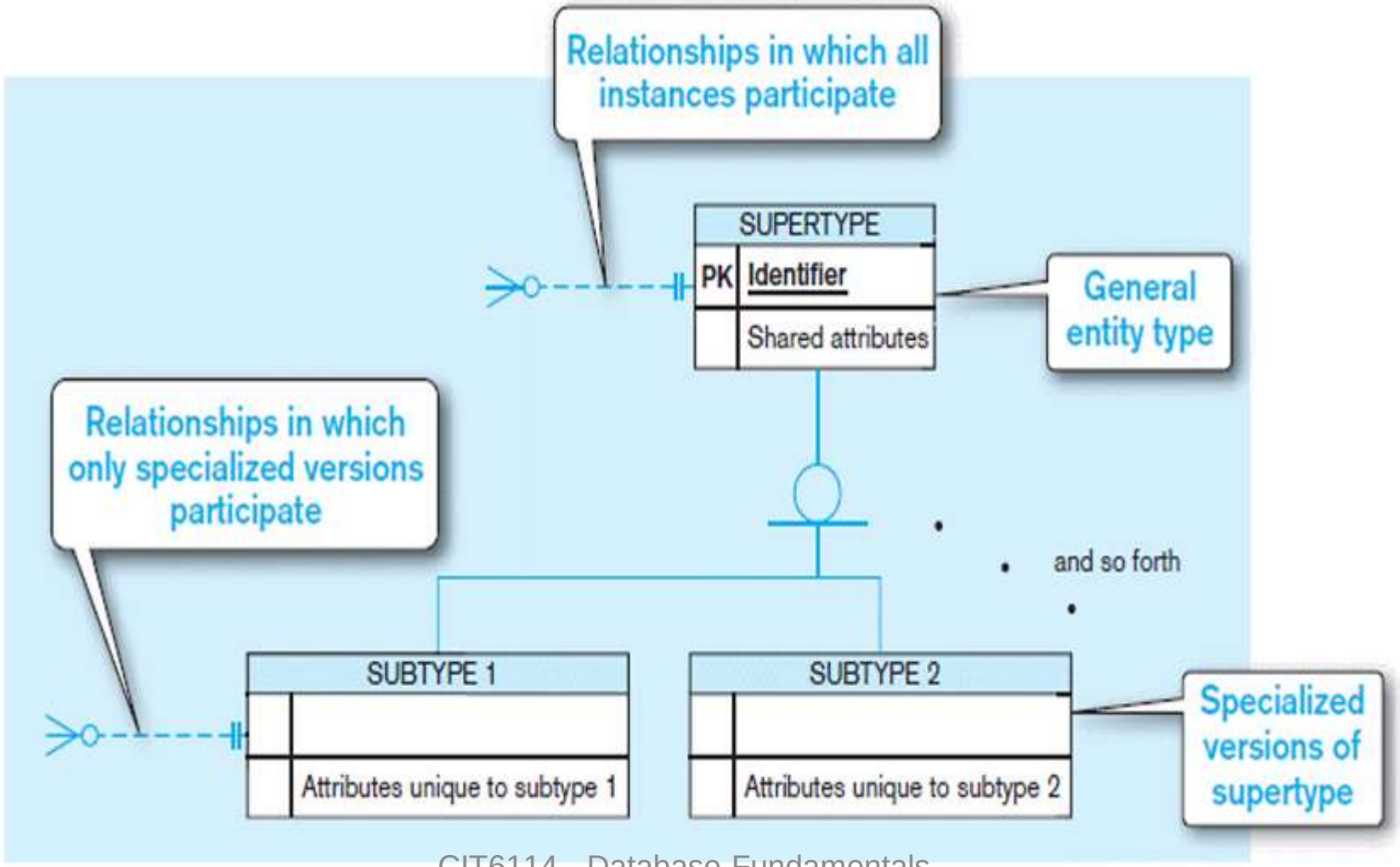
Entity Supertypes and Subtypes

- **Entity supertype**
  - Generic entity type related to one or more entity subtypes
  - Contains common characteristics
- **Entity subtype**
  - Contains unique characteristics of each entity subtype

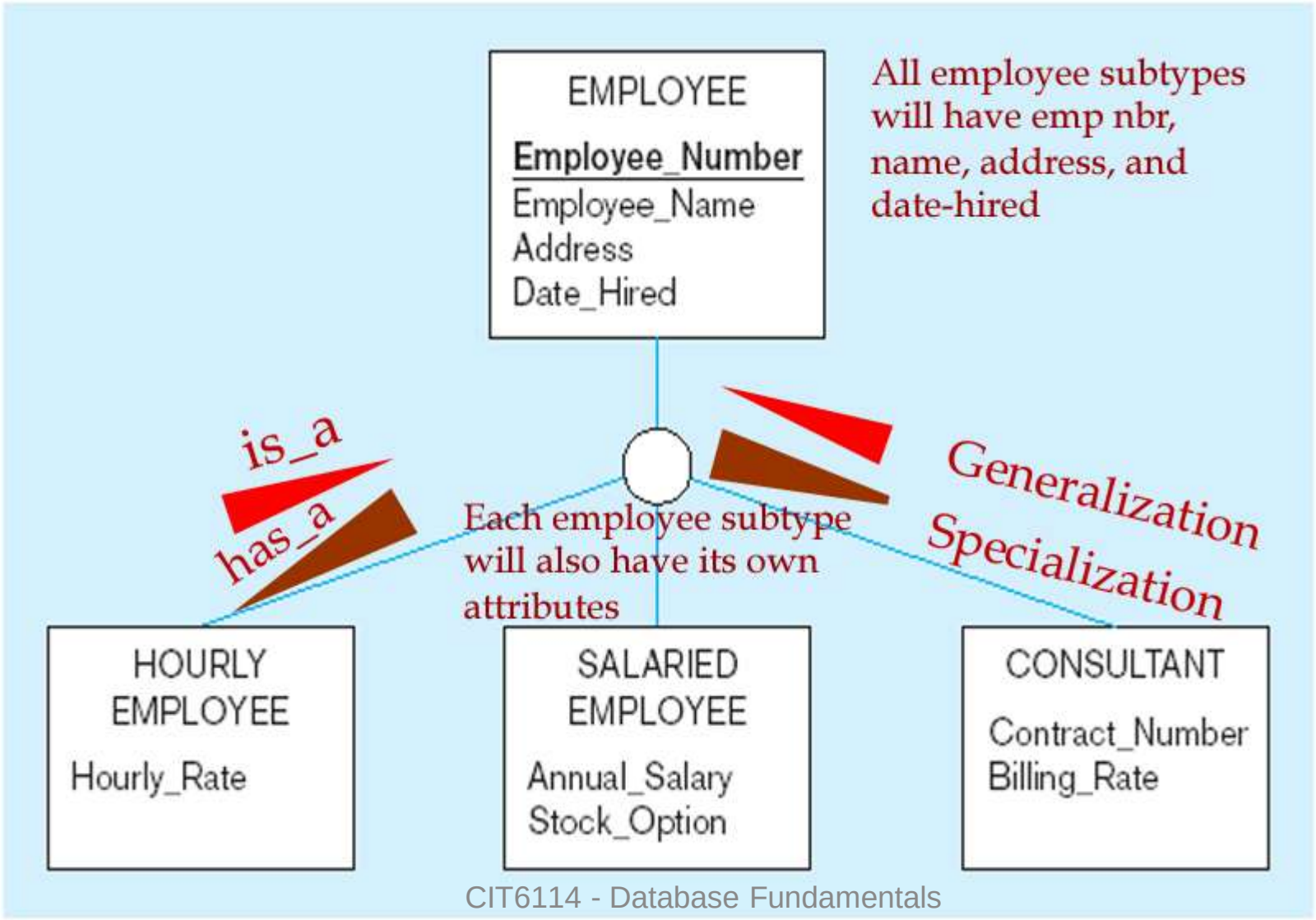
Basic notation for supertype/subtype notation



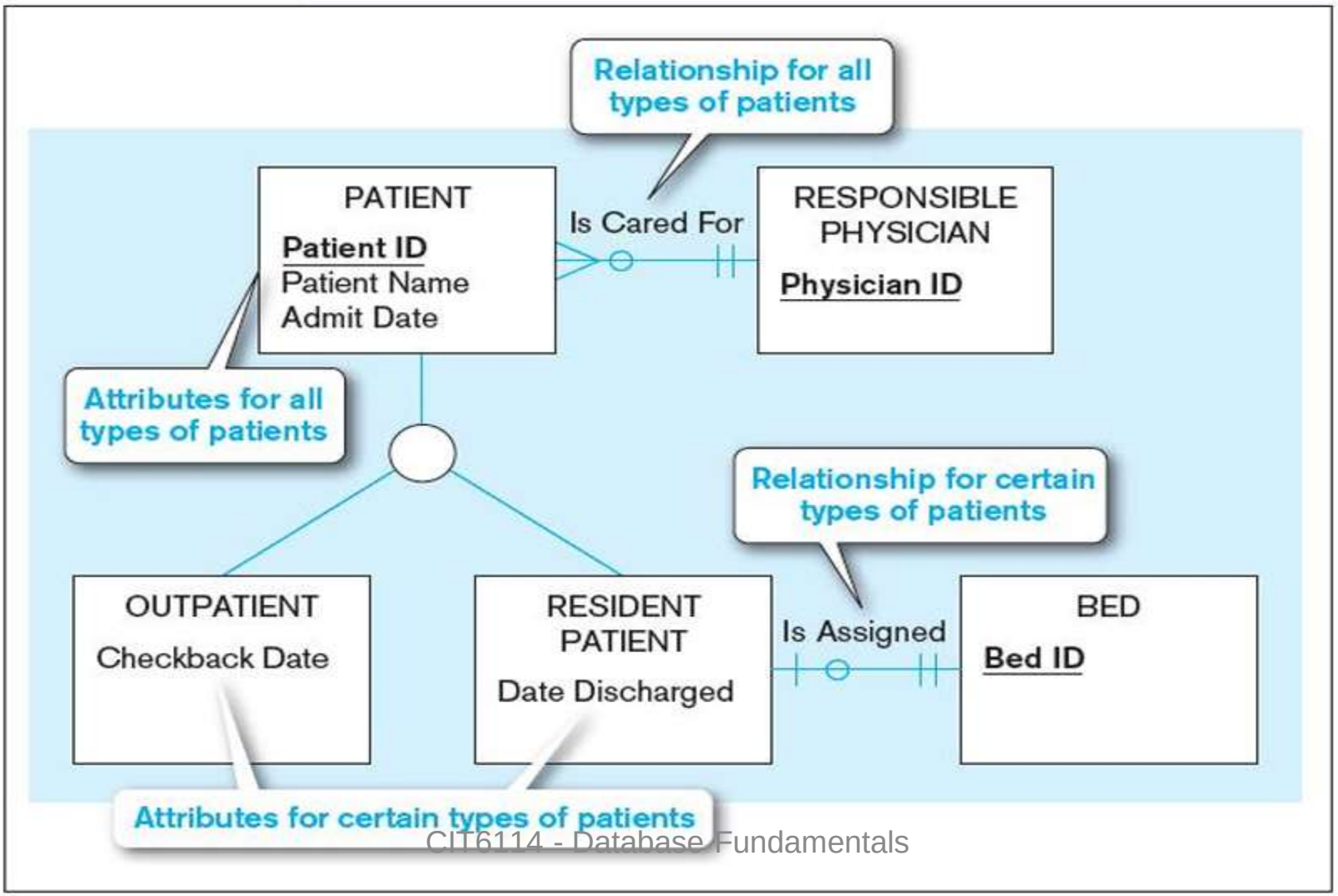
Basic notation for supertype/subtype notation



Employee supertype with three subtypes



Supertype/subtype relationships in a hospital

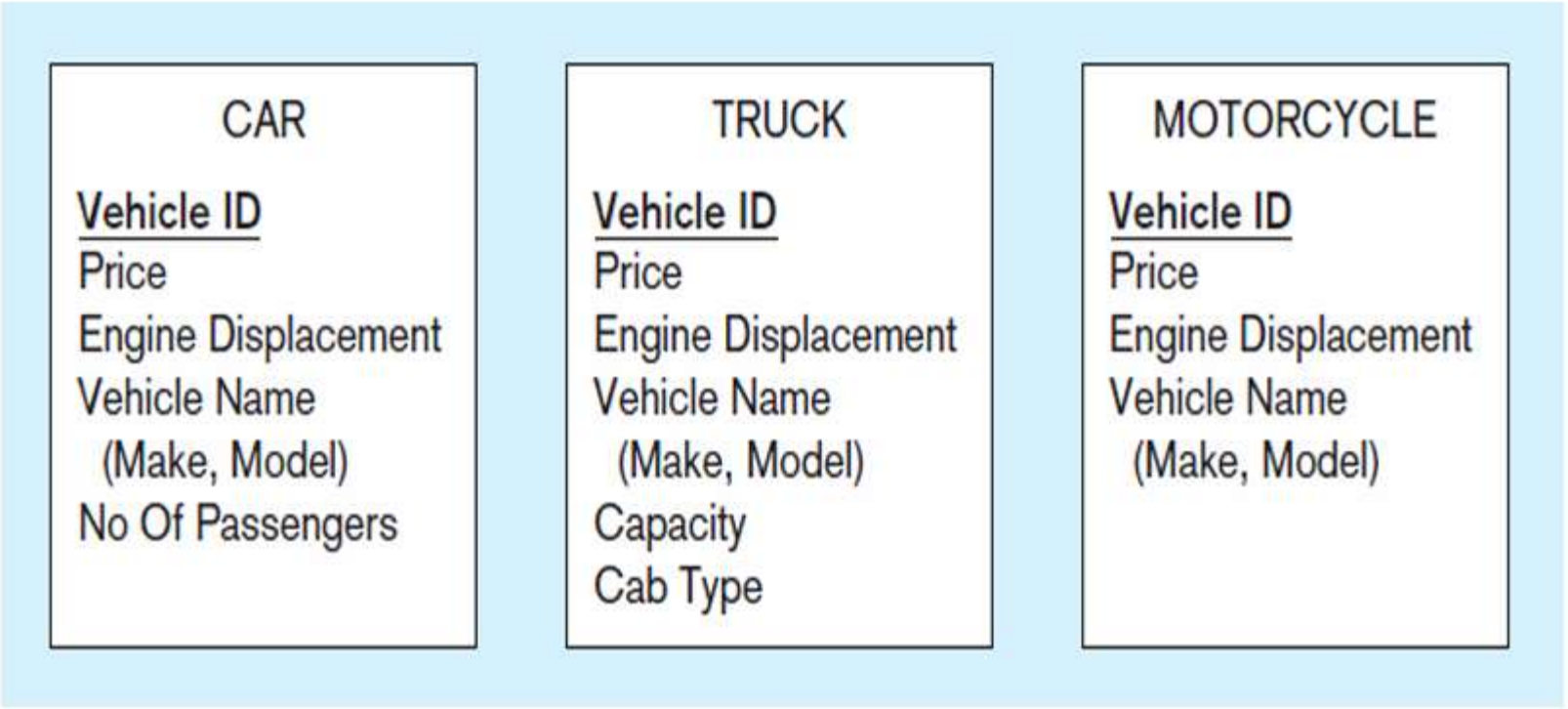


Generalization and Specialization

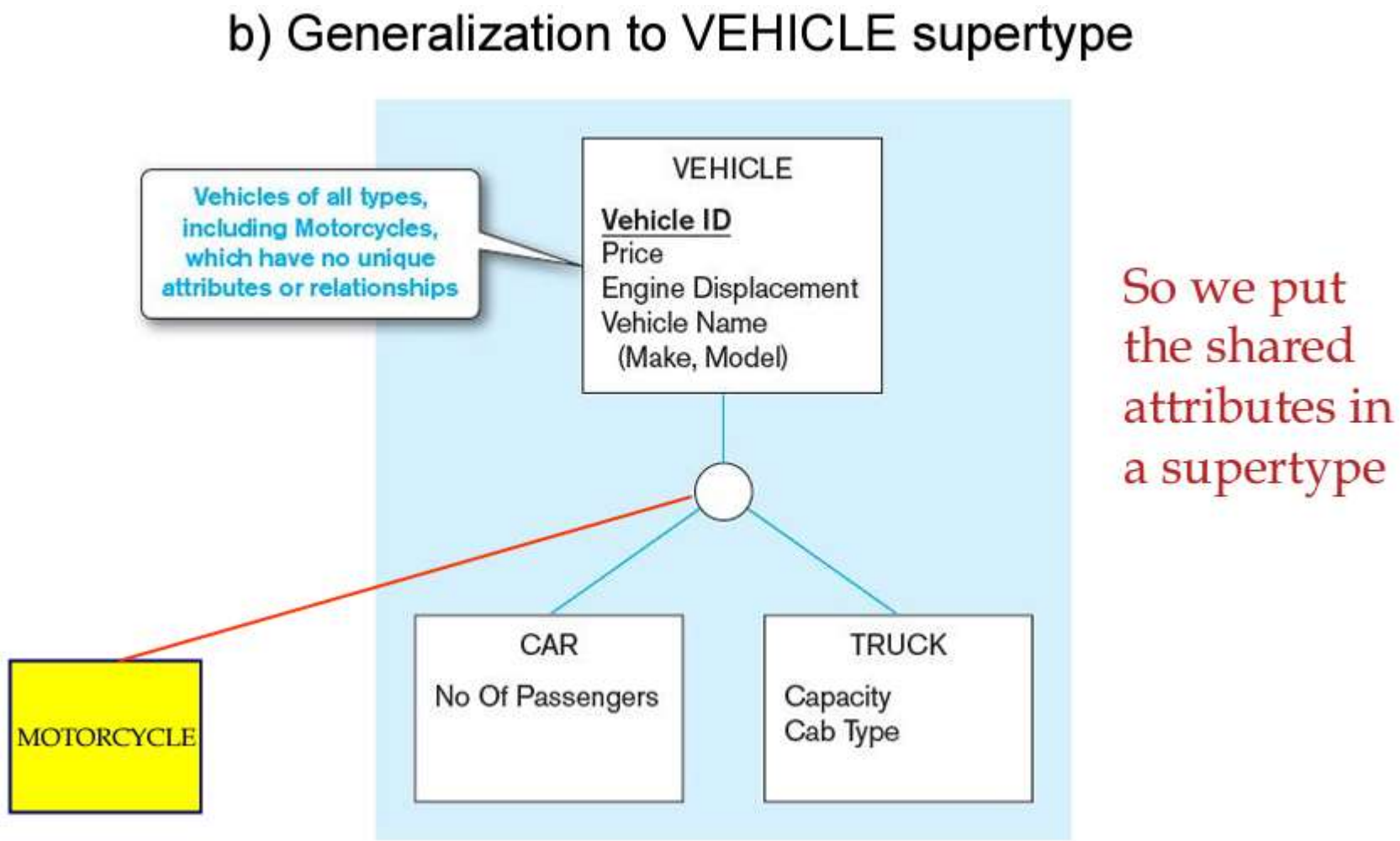
- Generalization: The process of defining a more general entity type from a set of more specialized entity types: BOTTOM-UP
- Specialization: The process of defining one or more subtypes of the supertype, and forming supertype/subtype relationships: TOP-DOWN

Example of Generalization

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

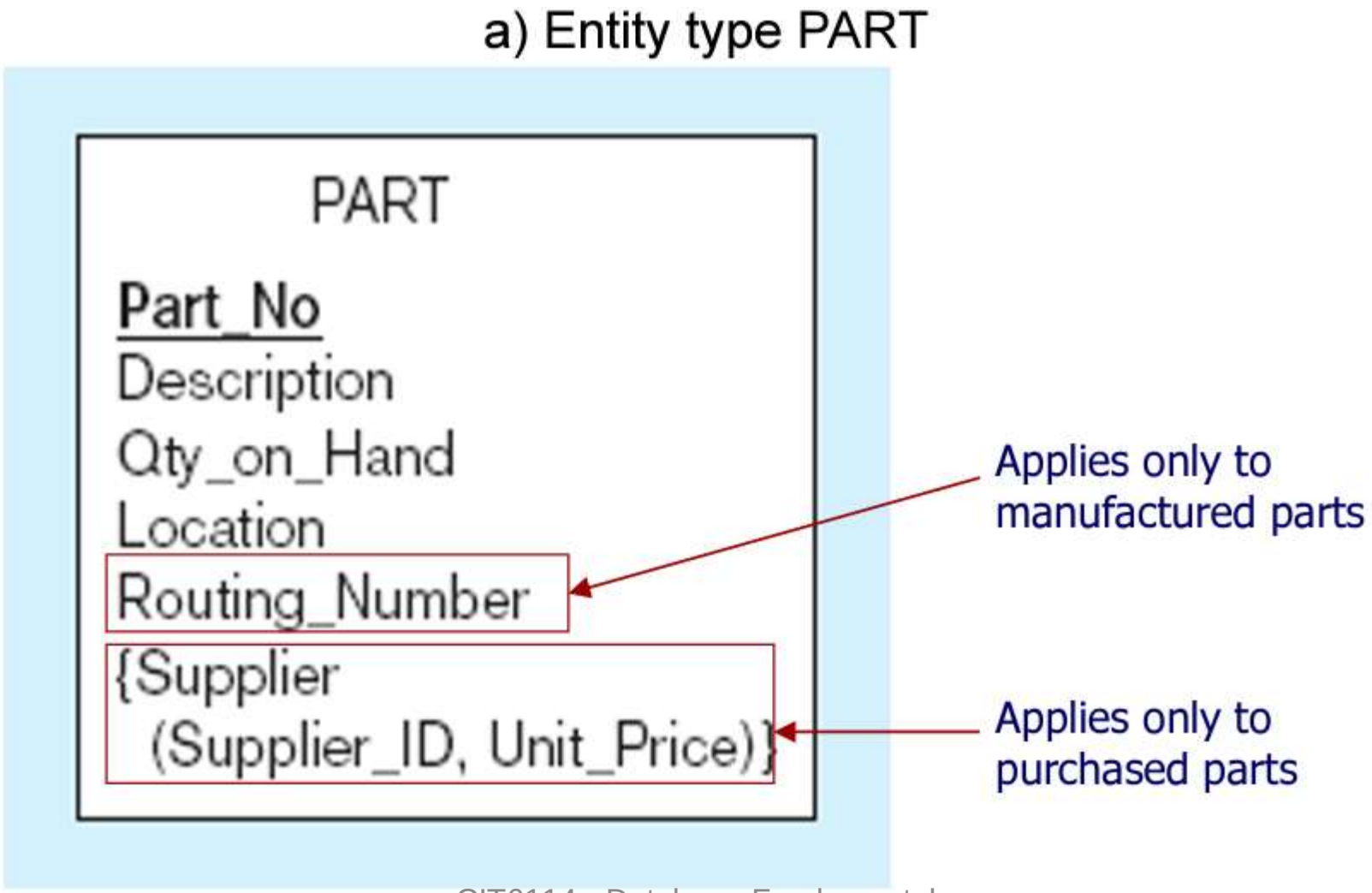


Example of Generalization



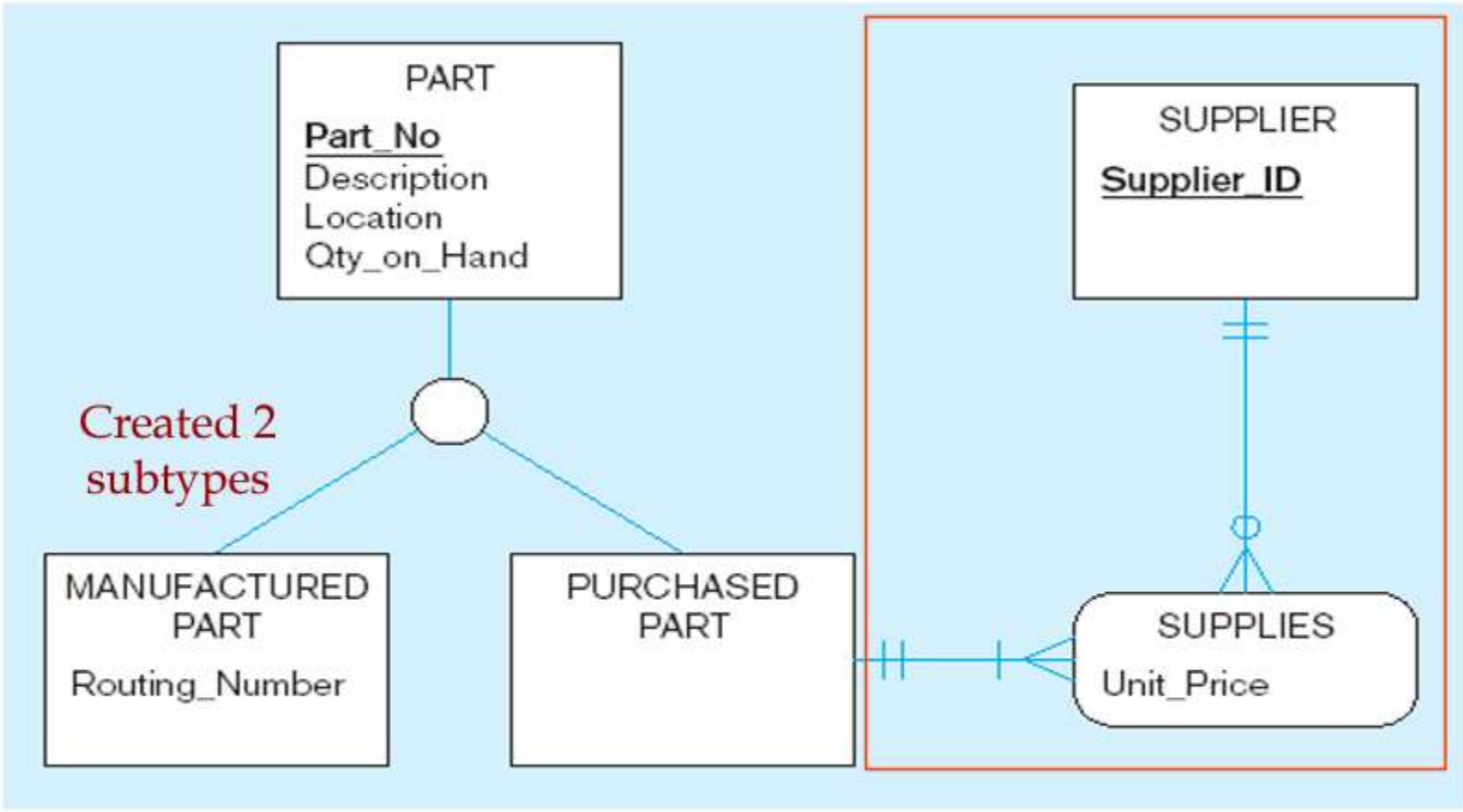
So we put the shared attributes in a supertype

Example of Specialization



Example of Specialization

b) Specialization to MANUFACTURED PART and PURCHASED PART



Inheritance

- Enables entity subtype to ***inherit*** attributes and relationships of supertype
- All entity subtypes inherit their primary key attribute from their supertype
- At implementation level, supertype and its subtype(s) maintain a 1:1 relationship

FIGURE 5.3 The EMPLOYEE-PILOT supertype-subtype relationship

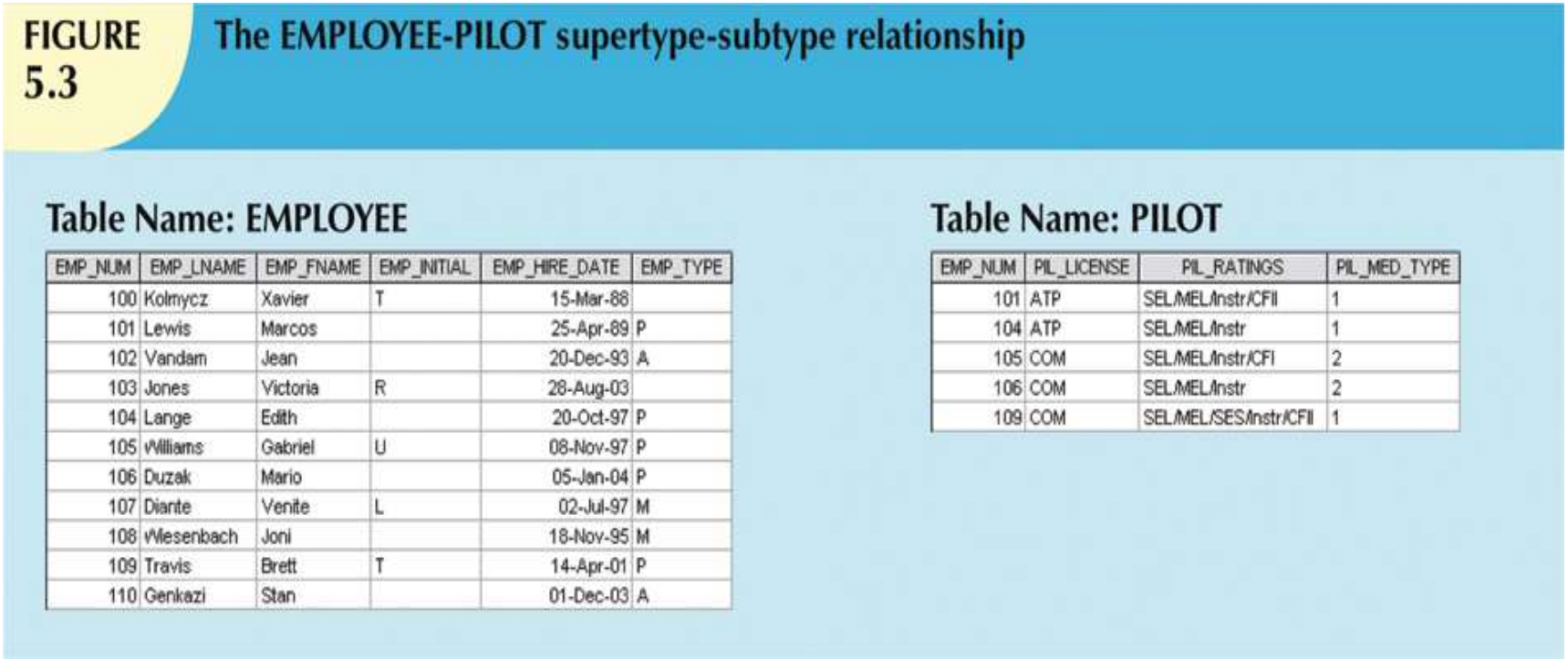


Table Name: EMPLOYEE

EMP_NUM	EMP_LNAME	EMP_FNAME	EMP_INITIAL	EMP_HIRE_DATE	EMP_TYPE
100	Kolmycz	Xavier	T	15-Mar-88	
101	Lewis	Marcos		25-Apr-89	P
102	Vandam	Jean		20-Dec-93	A
103	Jones	Victoria	R	28-Aug-03	
104	Lange	Edith		20-Oct-97	P
105	Williams	Gabriel	U	08-Nov-97	P
106	Duzak	Mario		05-Jan-04	P
107	Diante	Venite	L	02-Jul-97	M
108	Wiesenbach	Joni		18-Nov-95	M
109	Travis	Brett	T	14-Apr-01	P
110	Genkazi	Stan		01-Dec-03	A

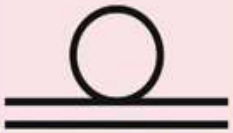
Table Name: PILOT

EMP_NUM	PIL_LICENSE	PIL_RATINGS	PIL_MED_TYPE
101	ATP	SEL/MEL/Instr/CFII	1
104	ATP	SEL/MEL/Instr	1
105	COM	SEL/MEL/Instr/CFI	2
106	COM	SEL/MEL/Instr	2
109	COM	SEL/MEL/SES/Instr/CFII	1

Constraints in Supertype/ Subtype Relationships

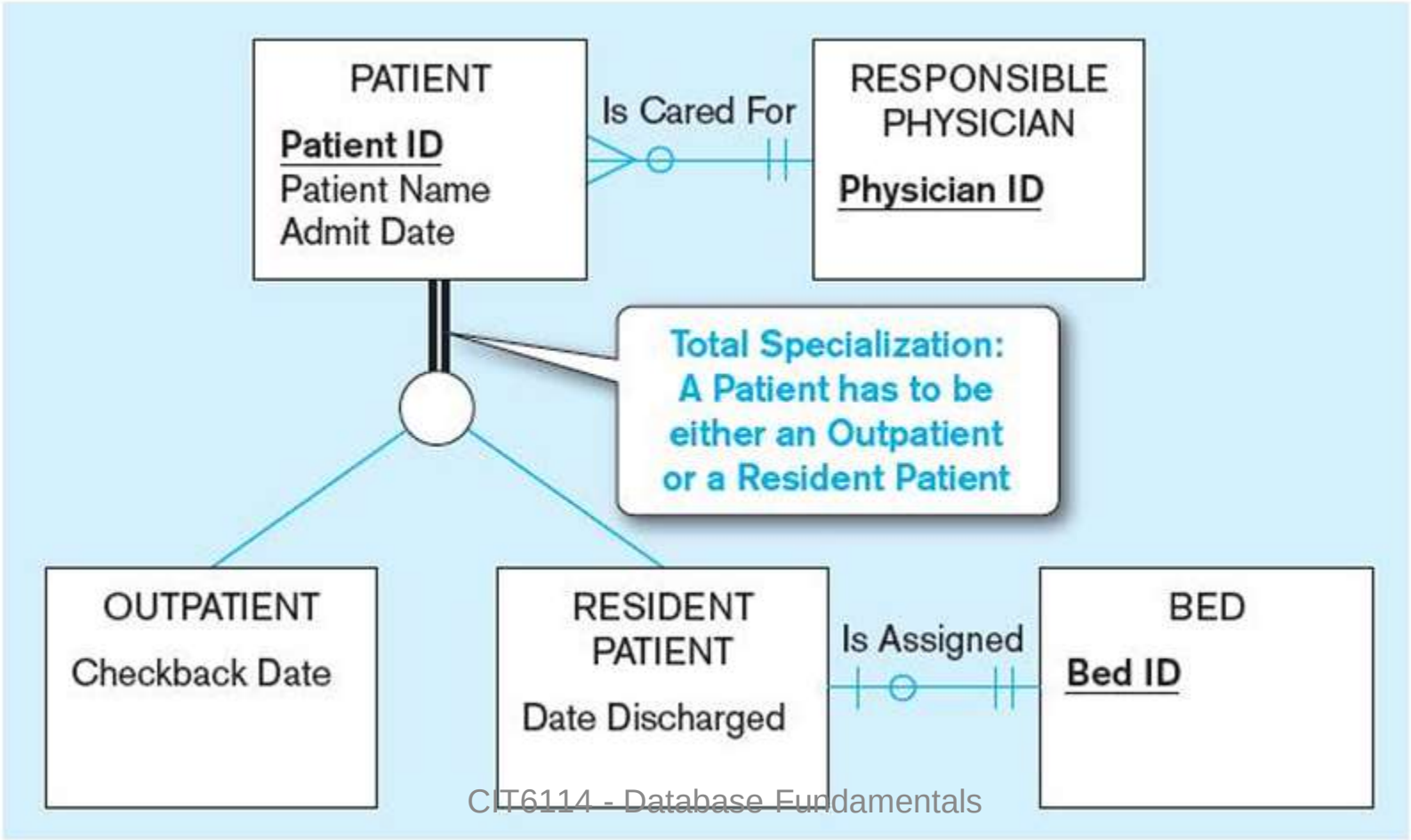
- Completeness Constraints: Whether an instance of a supertype must also be a member of at least one subtype.
  - Total Specialization Rule: Yes (double line)
  - Partial Specialization Rule: No (single line)

TABLE 5.2 Specialization Hierarchy Constraint Scenarios

TYPE	DISJOINT CONSTRAINT	OVERLAPPING CONSTRAINT
Partial 	Supertype has optional subtypes. Subtype discriminator can be null. Subtype sets are unique.	Supertype has optional subtypes. Subtype discriminators can be null. Subtype sets are not unique.
Total 	Every supertype occurrence is a member of a (at least one) subtype. Subtype discriminator cannot be null. Subtype sets are unique.	Every supertype occurrence is a member of a (at least one) subtype. Subtype discriminators cannot be null. Subtype sets are not unique.

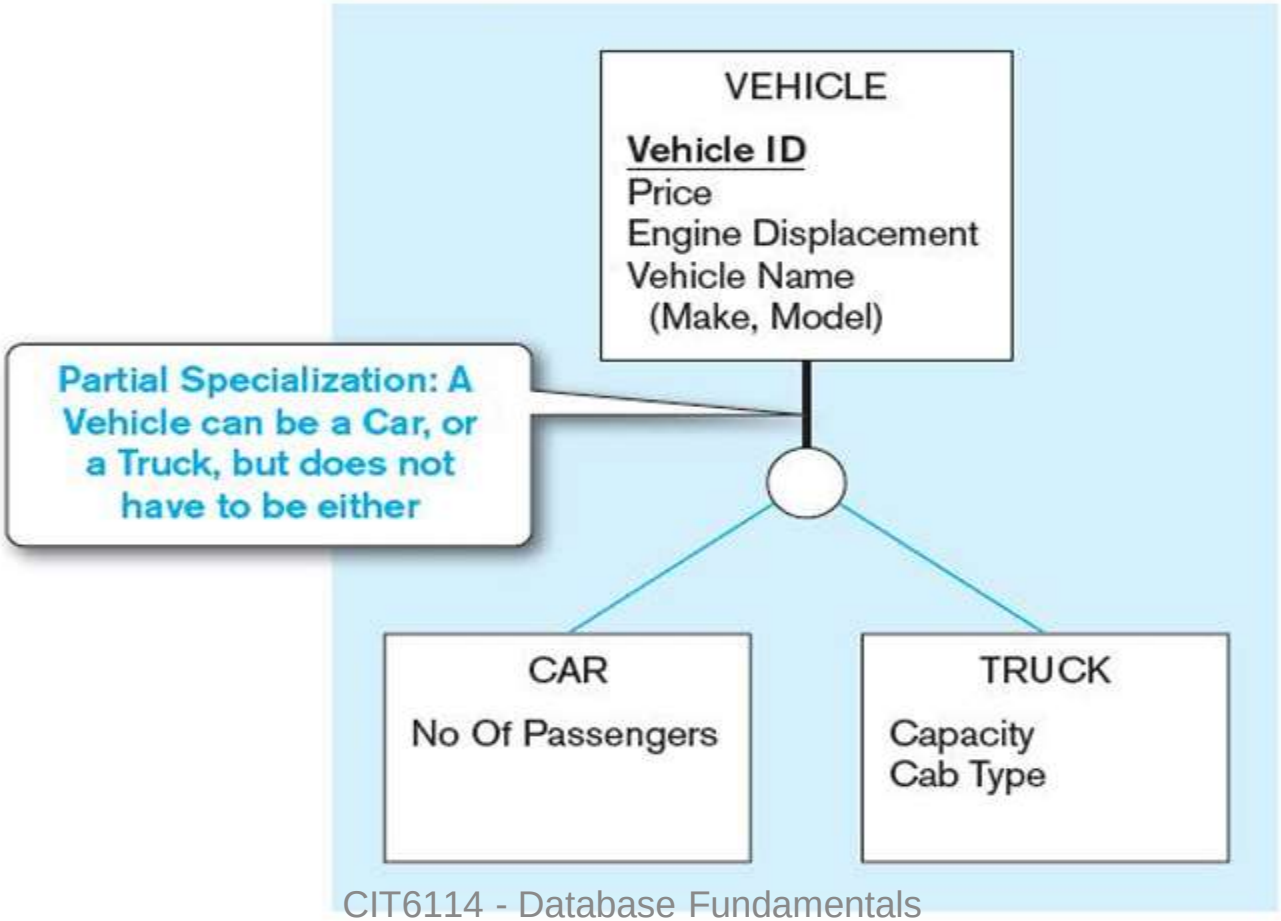
Examples of Completeness constraints

a) Total Specialization rule



Examples of Completeness constraints

a) Partial Specialization rule



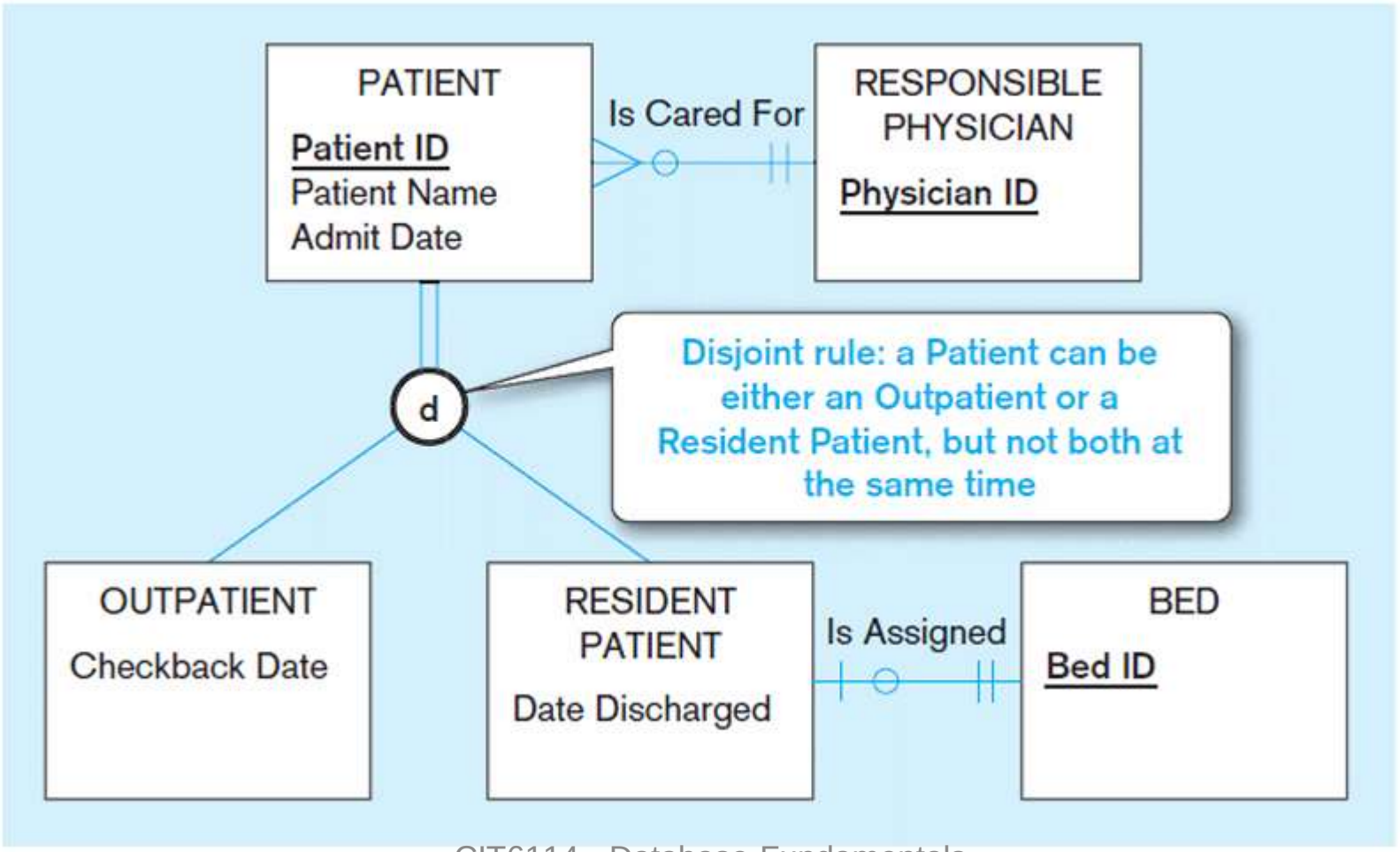
Constraints in Supertype/ Subtype Relationships

- 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

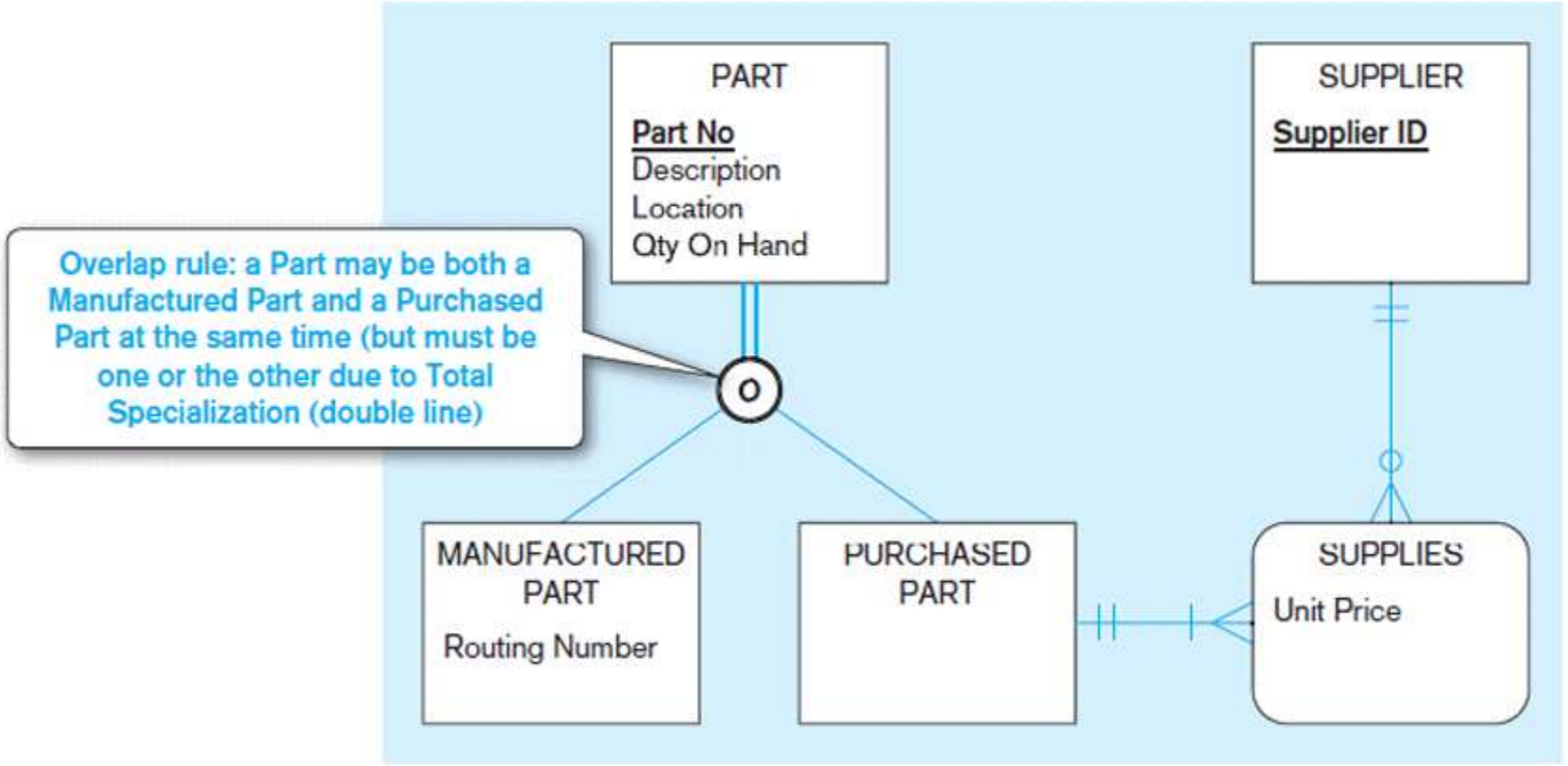
Examples of Disjointness constraints

a) Disjoint rule



Examples of Disjointness constraints

a) Overlap rule

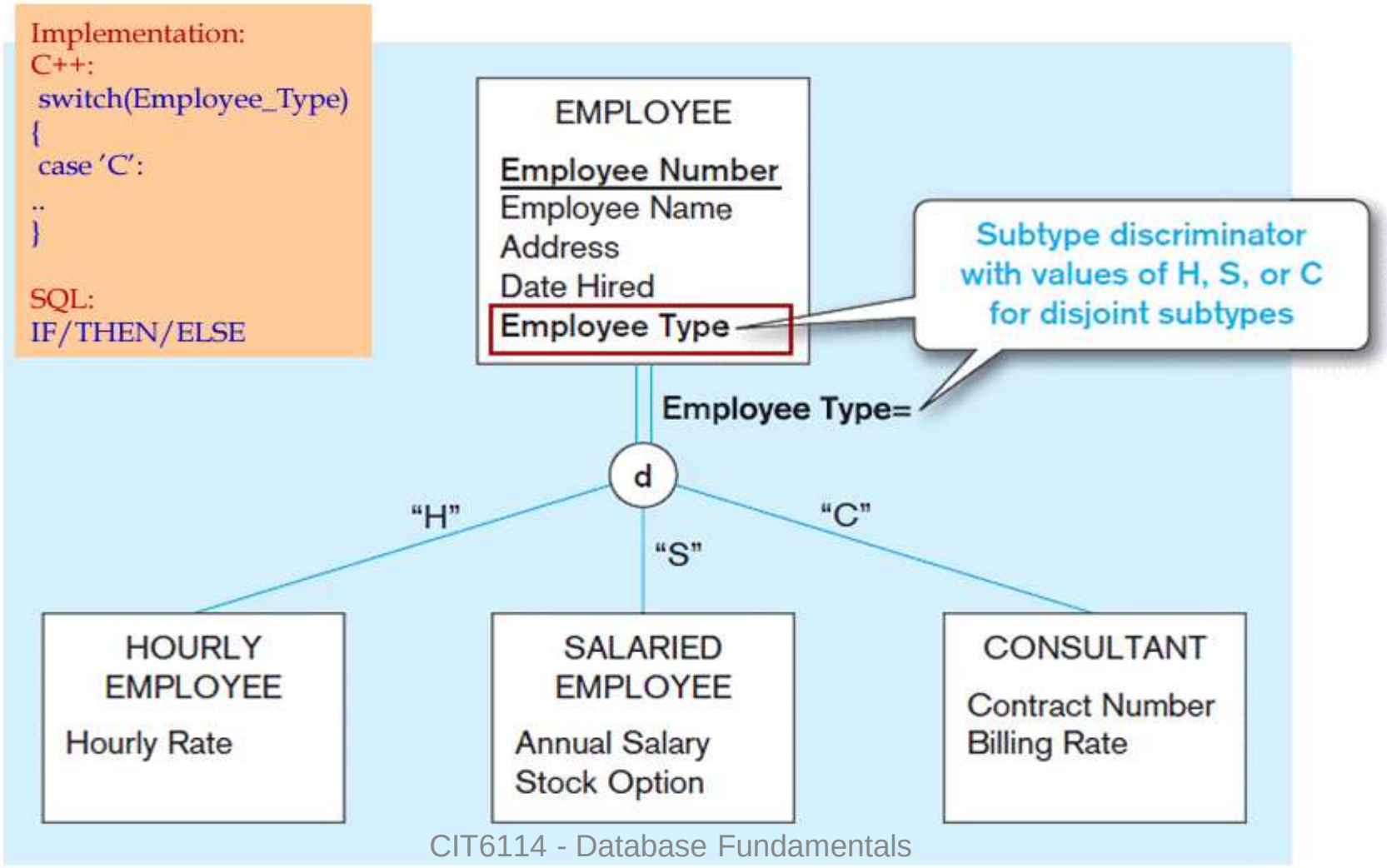


Constraints in Supertype/ Subtype Relationships

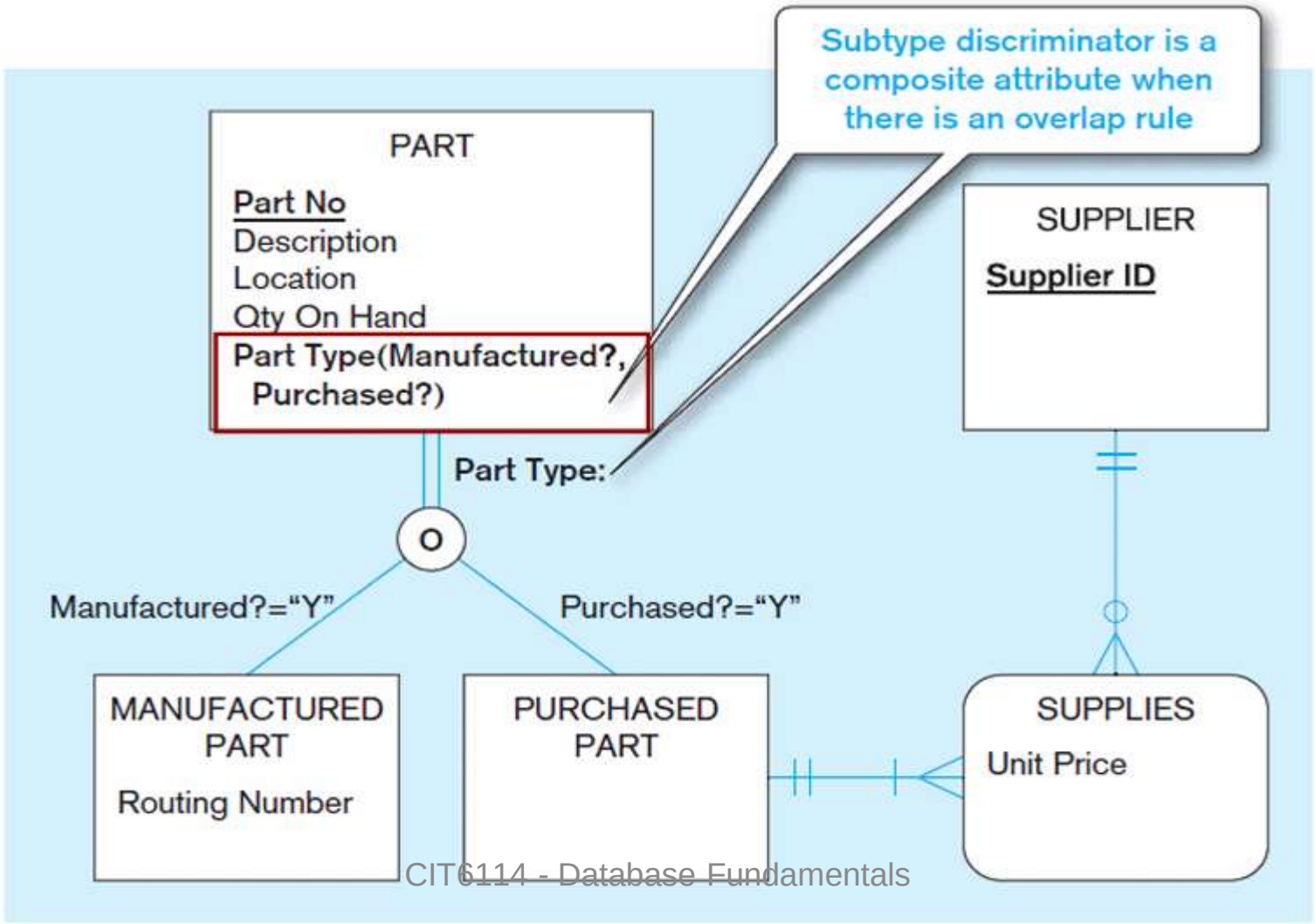
- Subtype Discriminator: An attribute of the supertype whose values determine the target subtype(s)

- 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

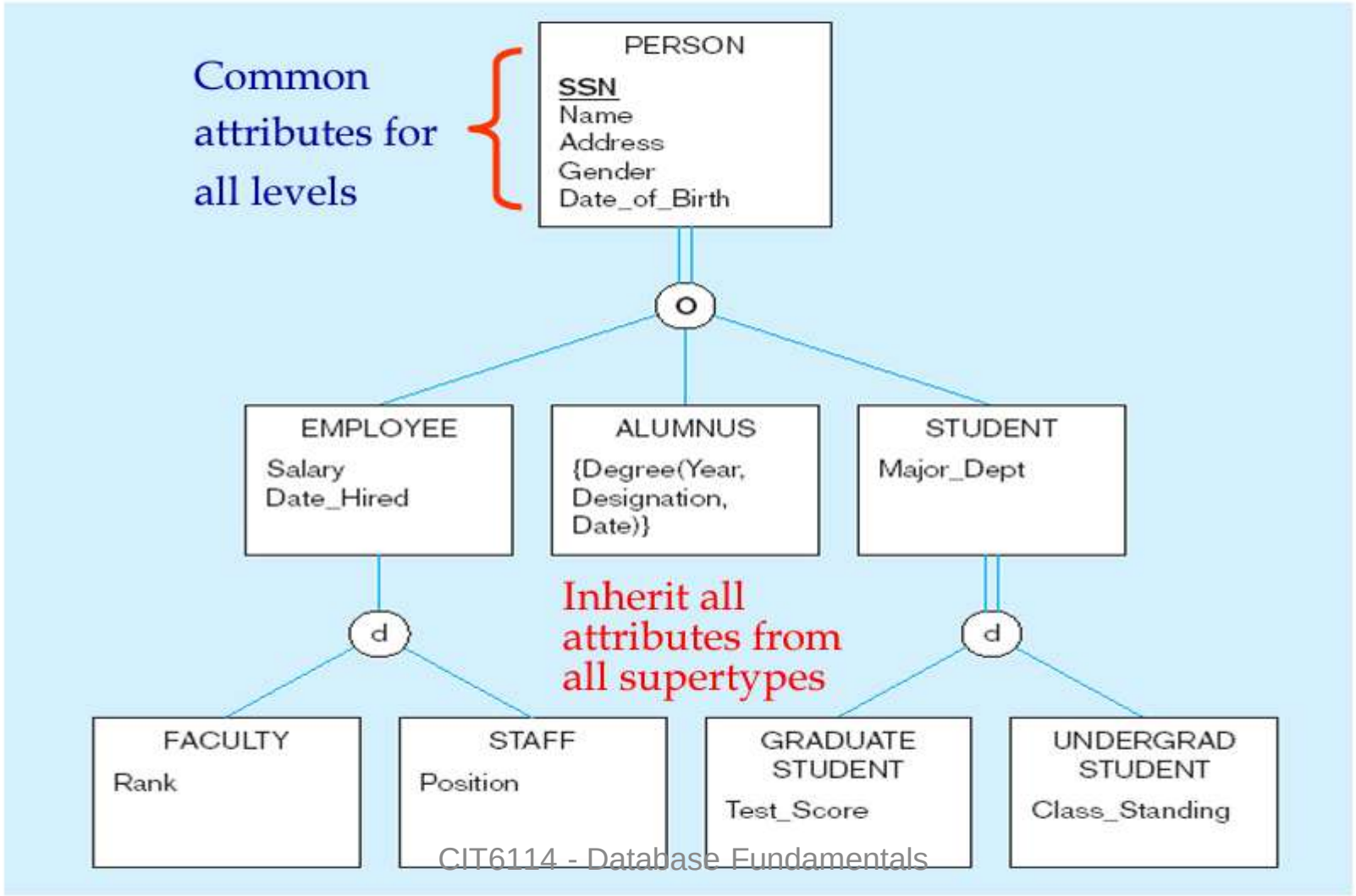
Introducing a subtype discriminator (disjoint rule)



Introducing a subtype discriminator (overlap rule)



Example of supertype/subtype hierarchy



Add a subtype discriminator for each supertype:

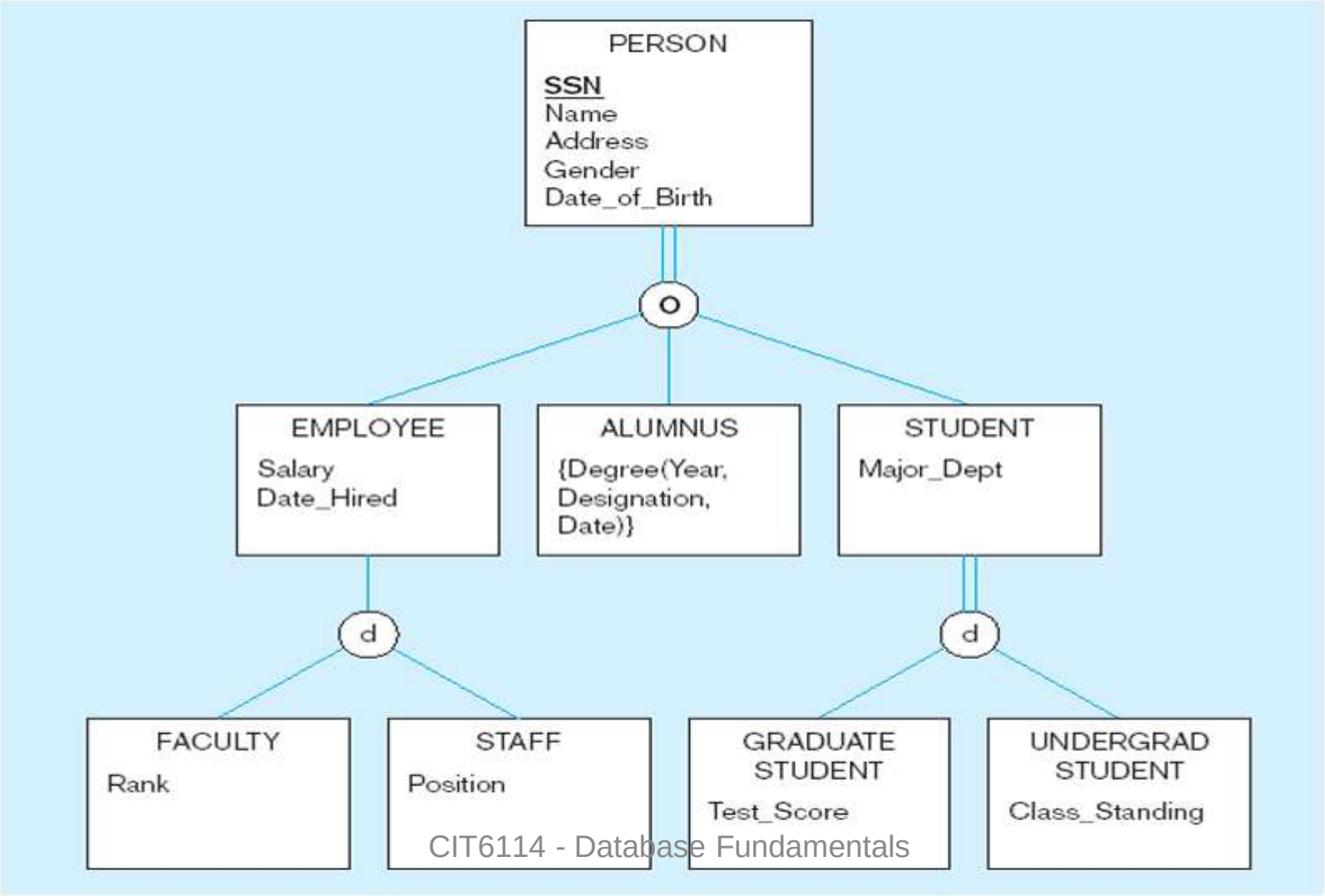
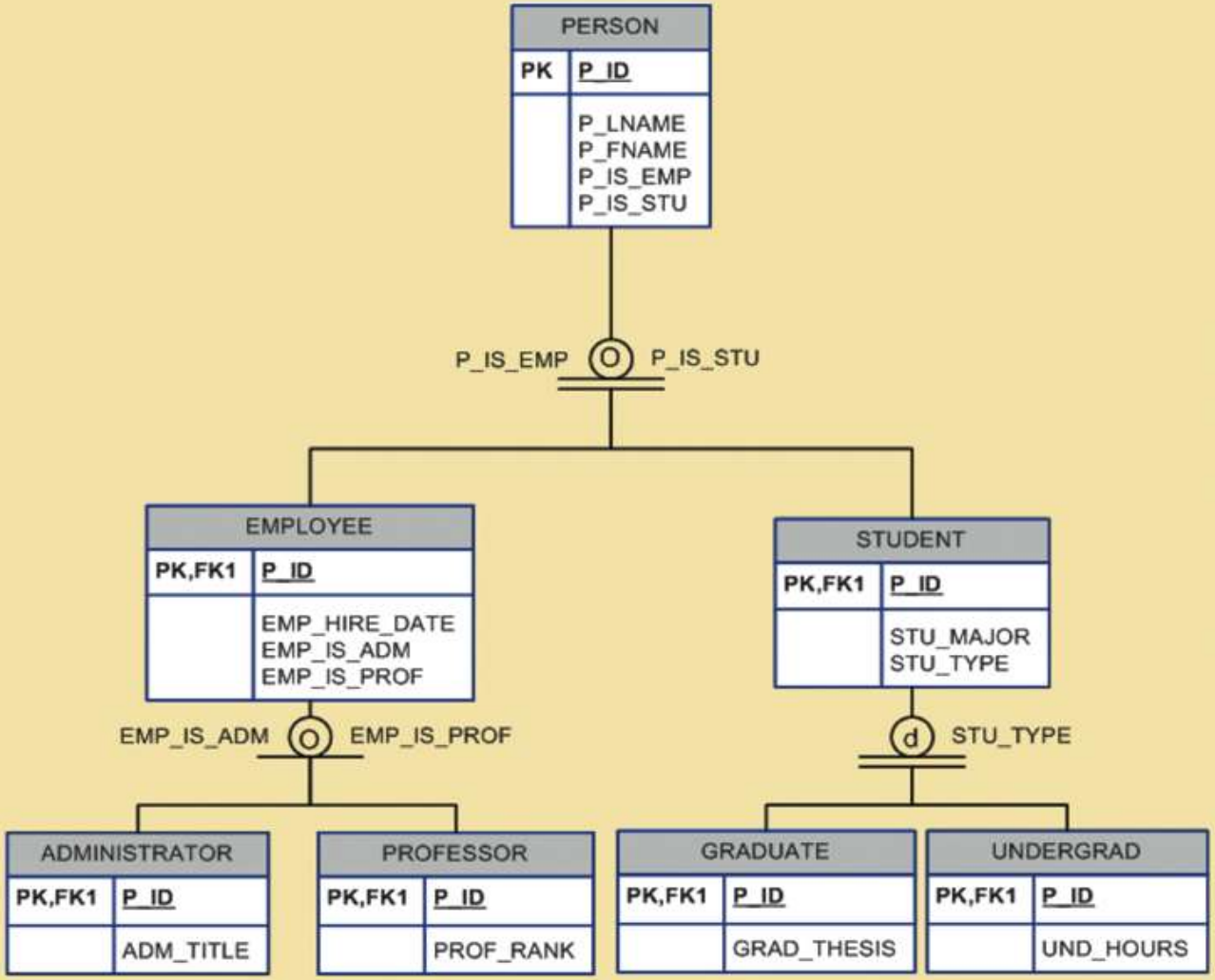


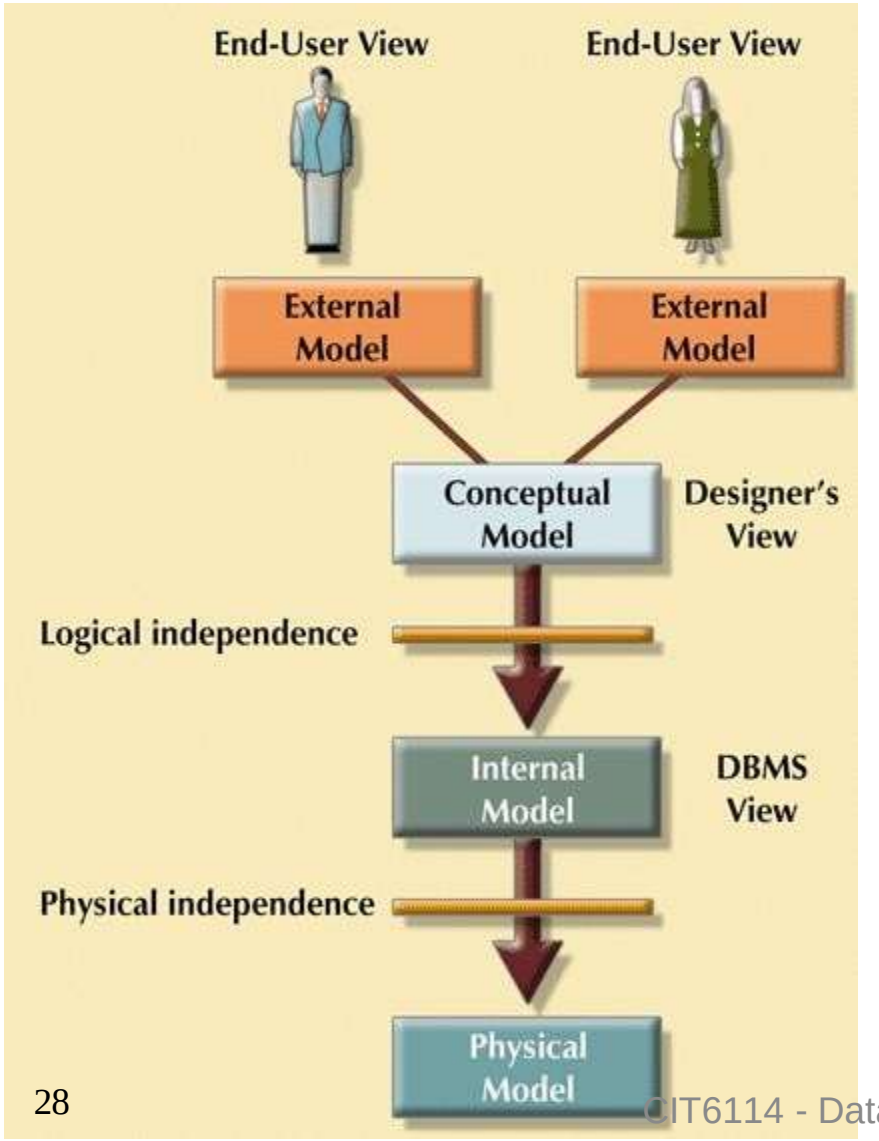
FIGURE 5.4 Specialization hierarchy with overlapping subtypes



Degree of Data Abstraction

- Database designer starts with abstracted view, then adds details
- The data modeling framework have three degrees of data abstraction (1970s):
  - ***External***
  - ***Conceptual***
  - ***Internal***

Degree of Data Abstraction

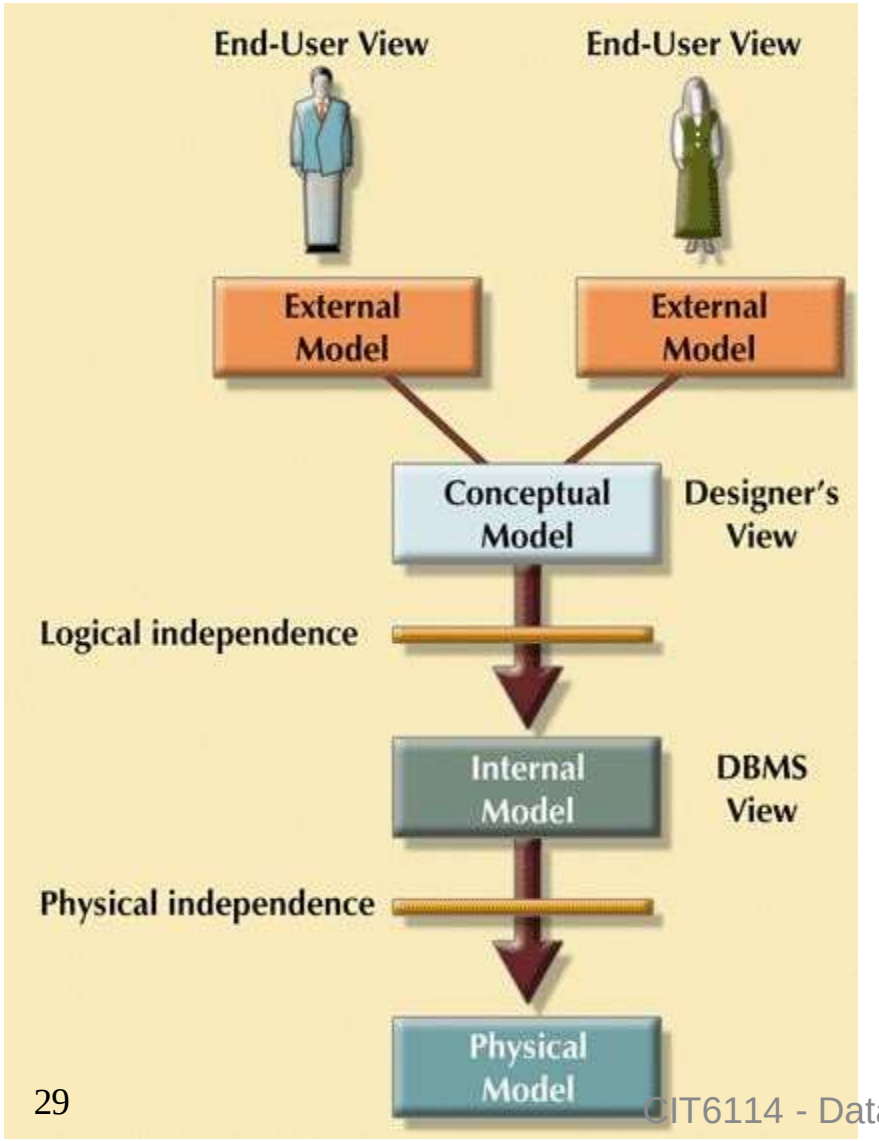


- **External Model**
  - ***End user's view*** of the data environment

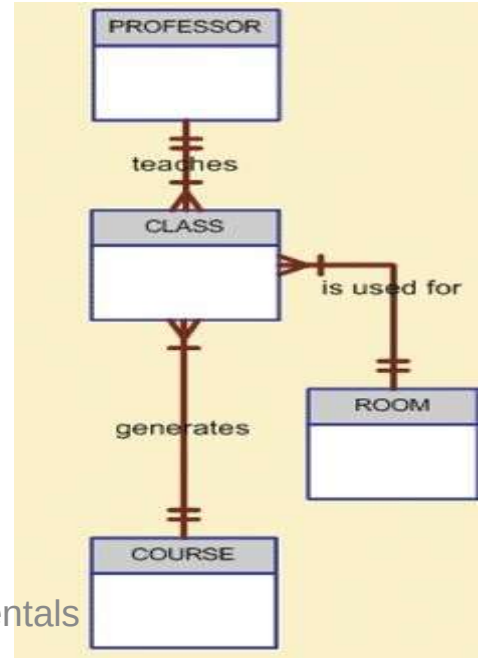
An item may or may not require repair; that is, REPAIR is optional to ITEM.

A repair always references an item. Therefore, ITEM is mandatory to REPAIR.

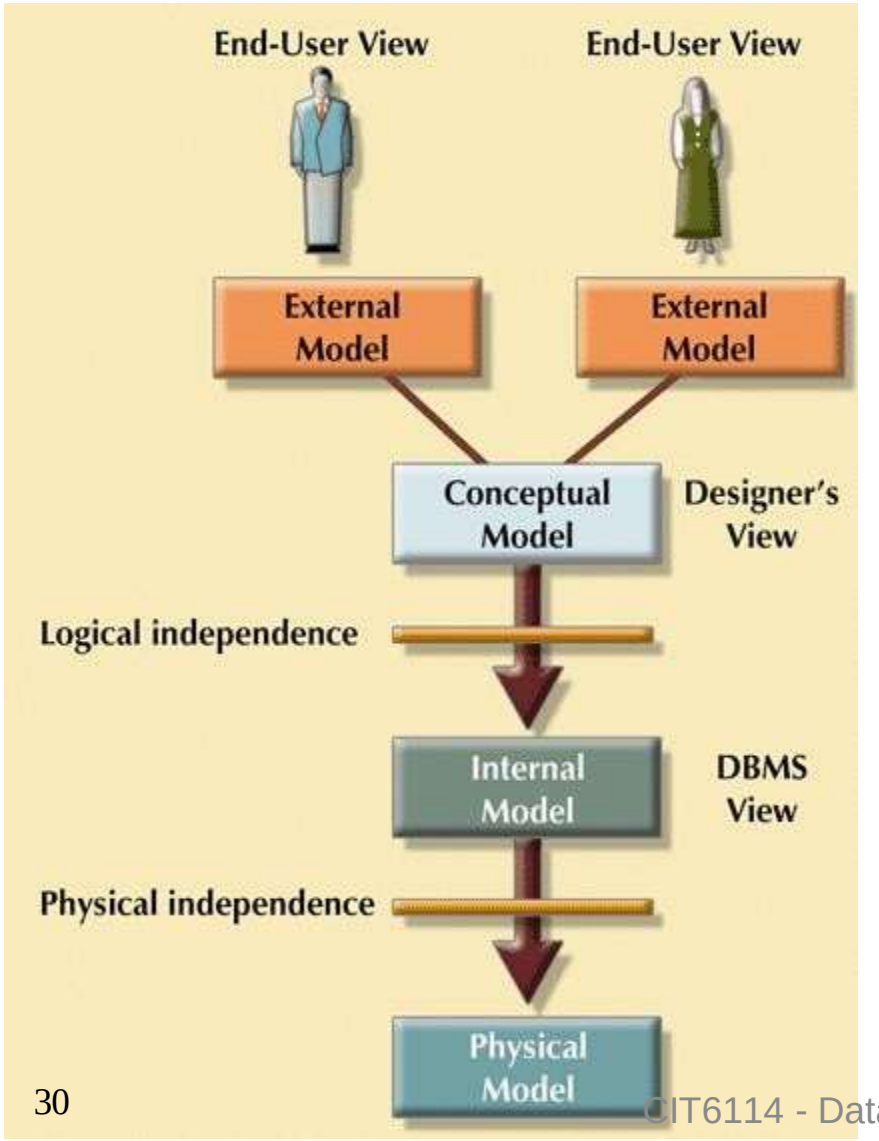
Degree of Data Abstraction



- **Conceptual Model**
  - Represents a global view of the entire database by the entire organization
  - Integrates all external views into a single global view



Degree of Data Abstraction

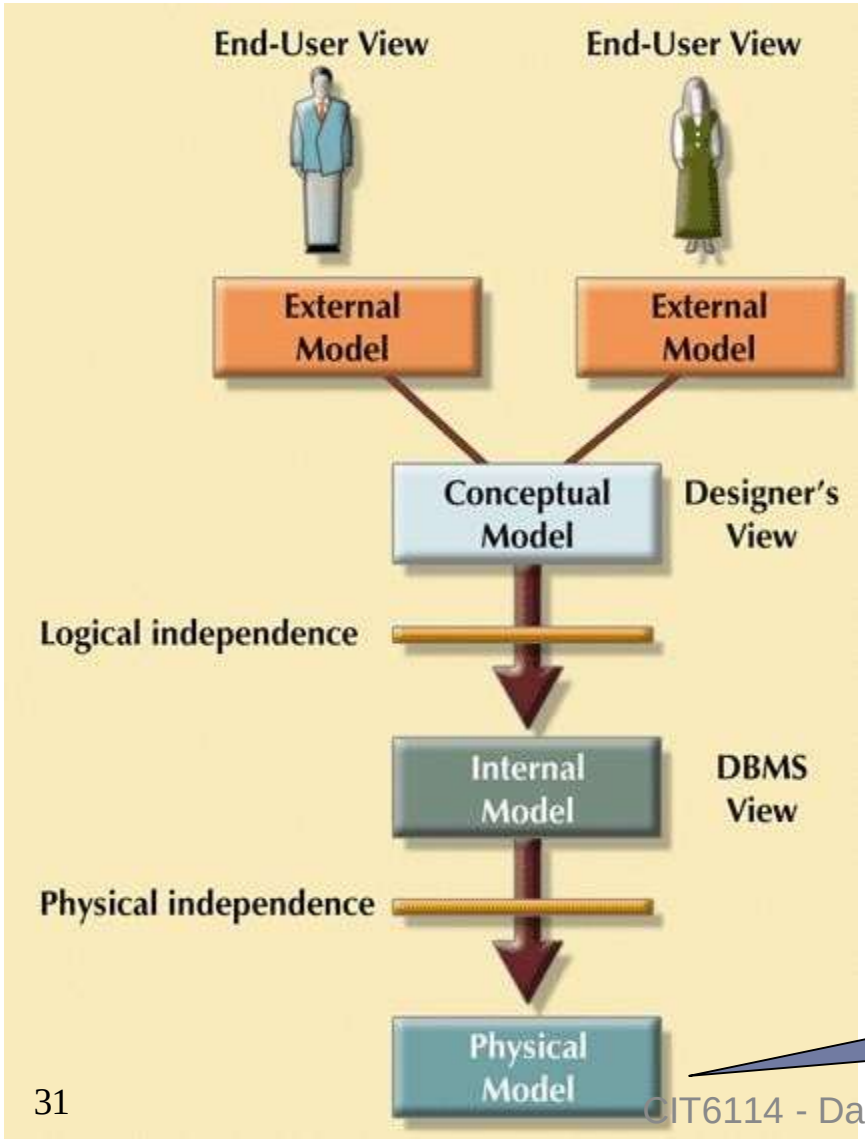


- **Internal Model**
  - Representation of the database as '**seen**' by the DBMS

```
Create Table PROFESSOR(
 PROF_ID          NUMBER PRIMARY KEY,
 PROF_LNAME       CHAR(15),
 PROF_INITIAL     CHAR(1),
 PROF_FNAME       CHAR(15),
  .....);
```

```
Create Table ROOM(
 ROOM_ID          CHAR(8) PRIMARY KEY,
 ROOM_TYPE        CHAR(3),
 .....);
```

Degree of Data Abstraction



Write physically in disk/memory

Degree of Data Abstraction

TABLE 3.4 Levels of Data Abstraction

MODEL	DEGREE OF ABSTRACTION	FOCUS	INDEPENDENT OF
External	High	End-user views	Hardware and software
Conceptual	↕	Global view of data (database model independent)	Hardware and software
Internal	↕	Specific database model	Hardware
Physical	Low	Storage and access methods	Neither hardware nor software