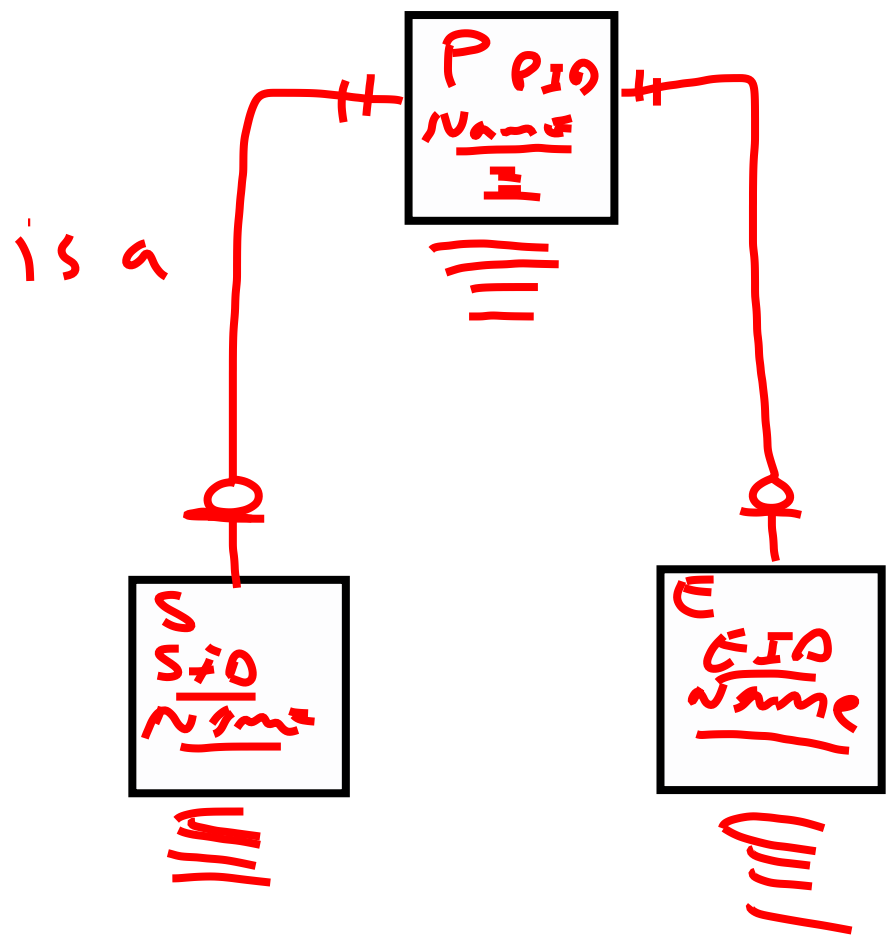
Chapter 5
Advanced Data Modeling

Objectives

Understand extended entity relationship model
Use clusters to represent multiple entities and relationships
Choose good primary keys
Use flexible solutions for special cases

Supertypes and Subtypes

Consider the case of PERSON, STUDENT, EMPLOYEE



Inheritance

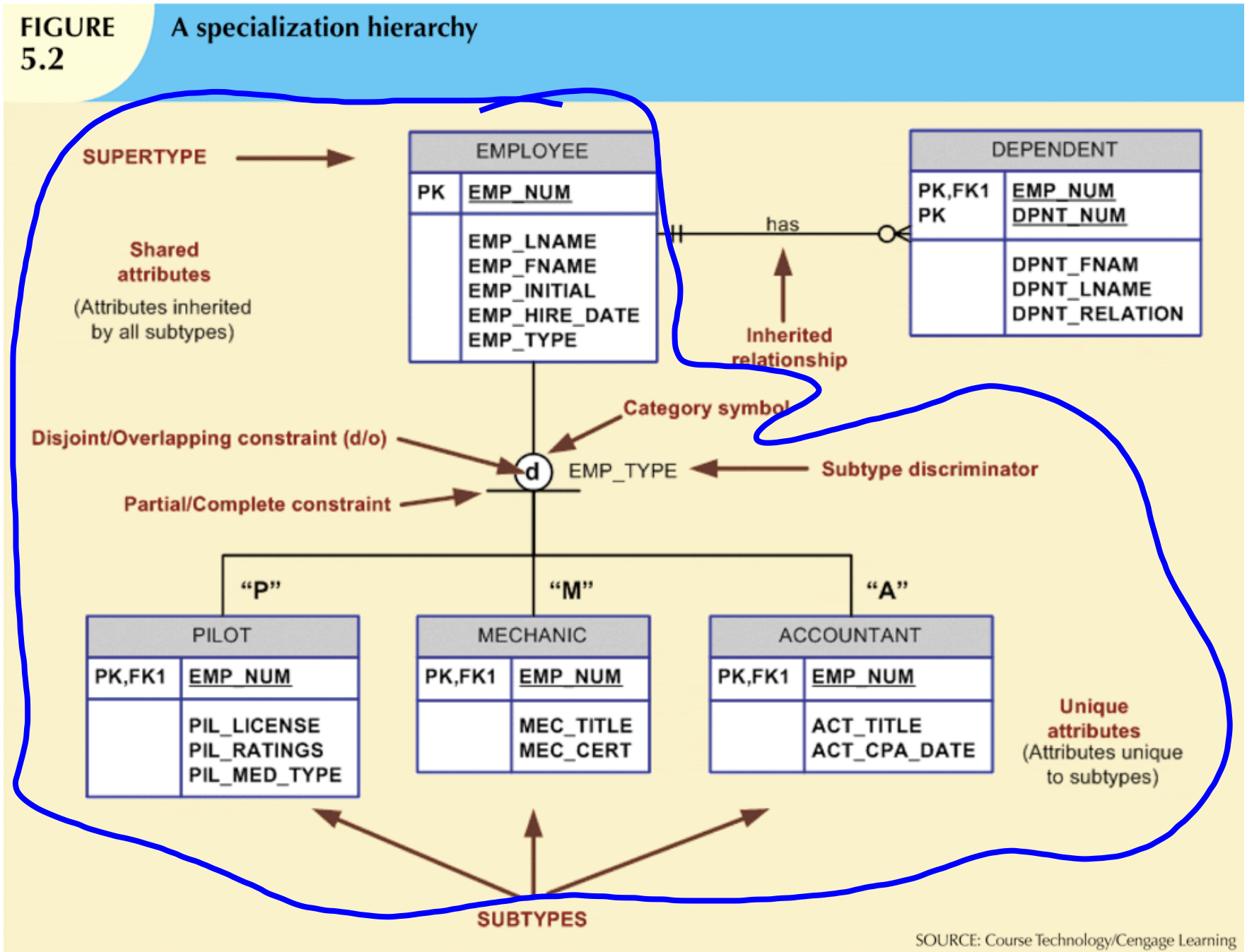
ALL subtypes inherit their primary key from their supertype.

One-to-one relationship between subtype and supertype.

Subtypes participate in the supertype's relationships

All subtypes are weak entities

Specialization (is-a)



Subtype Discriminator

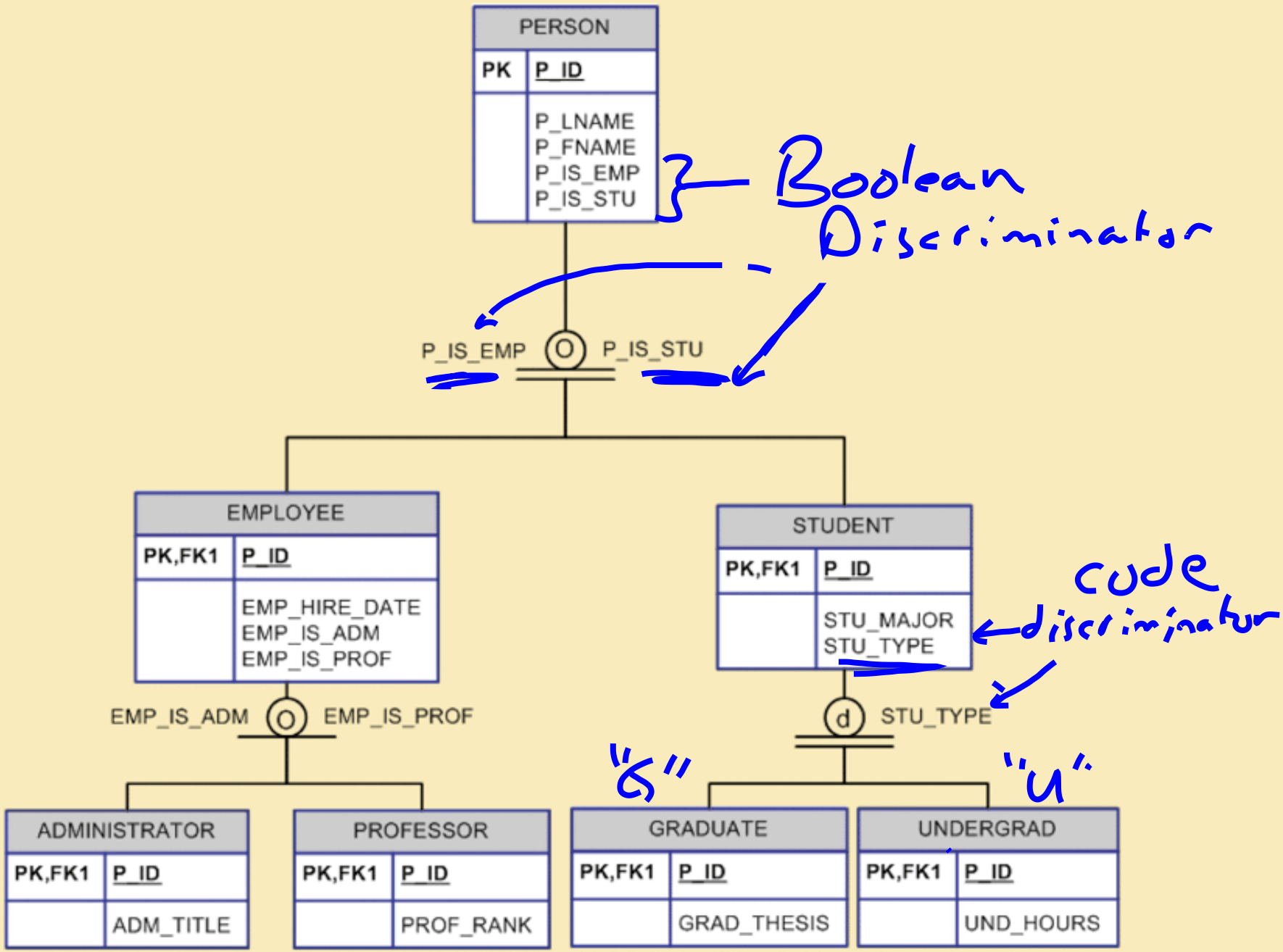
Attribute in the supertype entity that determines to which entity subtype the supertype occurrence is related

Disjoint subtypes: Each entity instance of the supertype can appear in only one of the subtypes. Known as nonoverlapping subtype

Overlapping subtypes: Each entity instance of the supertype may appear in more than one subtype.

FIGURE 5.4 Specialization hierarchy with overlapping subtypes

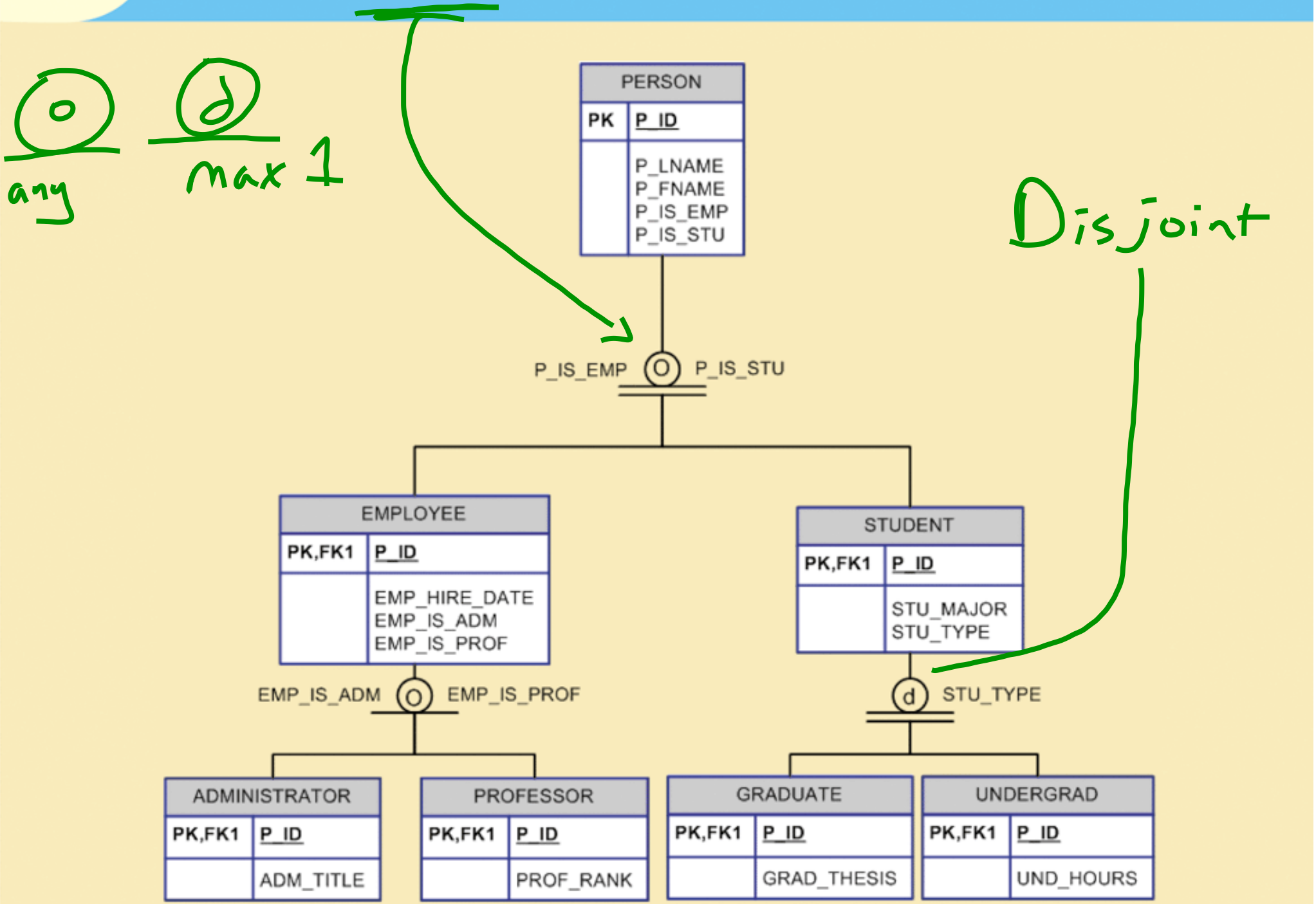
Subtype Discriminator



SOURCE: Course Technology/Cengage Learning

FIGURE 5.4 **Specialization hierarchy with overlapping subtypes**

Disjoint and Overlapping Constraints



SOURCE: Course Technology/Cengage Learning

Completeness Constraint

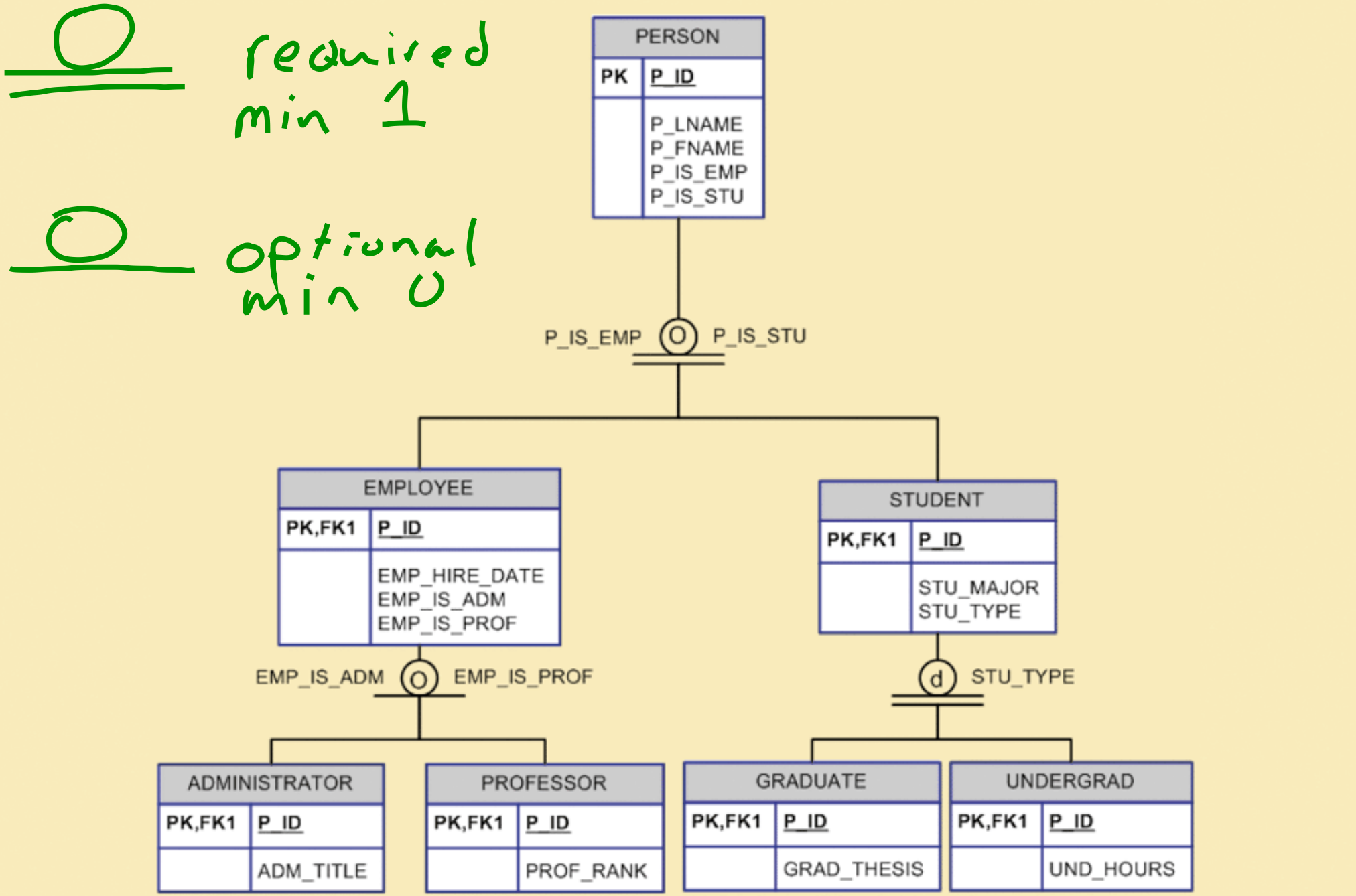
Specifies whether each supertype occurrence must also be a member of at least one subtype

Partial completeness: not every supertype occurrence is a member of a subtype

Total completeness: every supertype occurrence must be a member of at least one subtypes

FIGURE 5.4 **Specialization hierarchy with overlapping subtypes**

Completeness Constraint

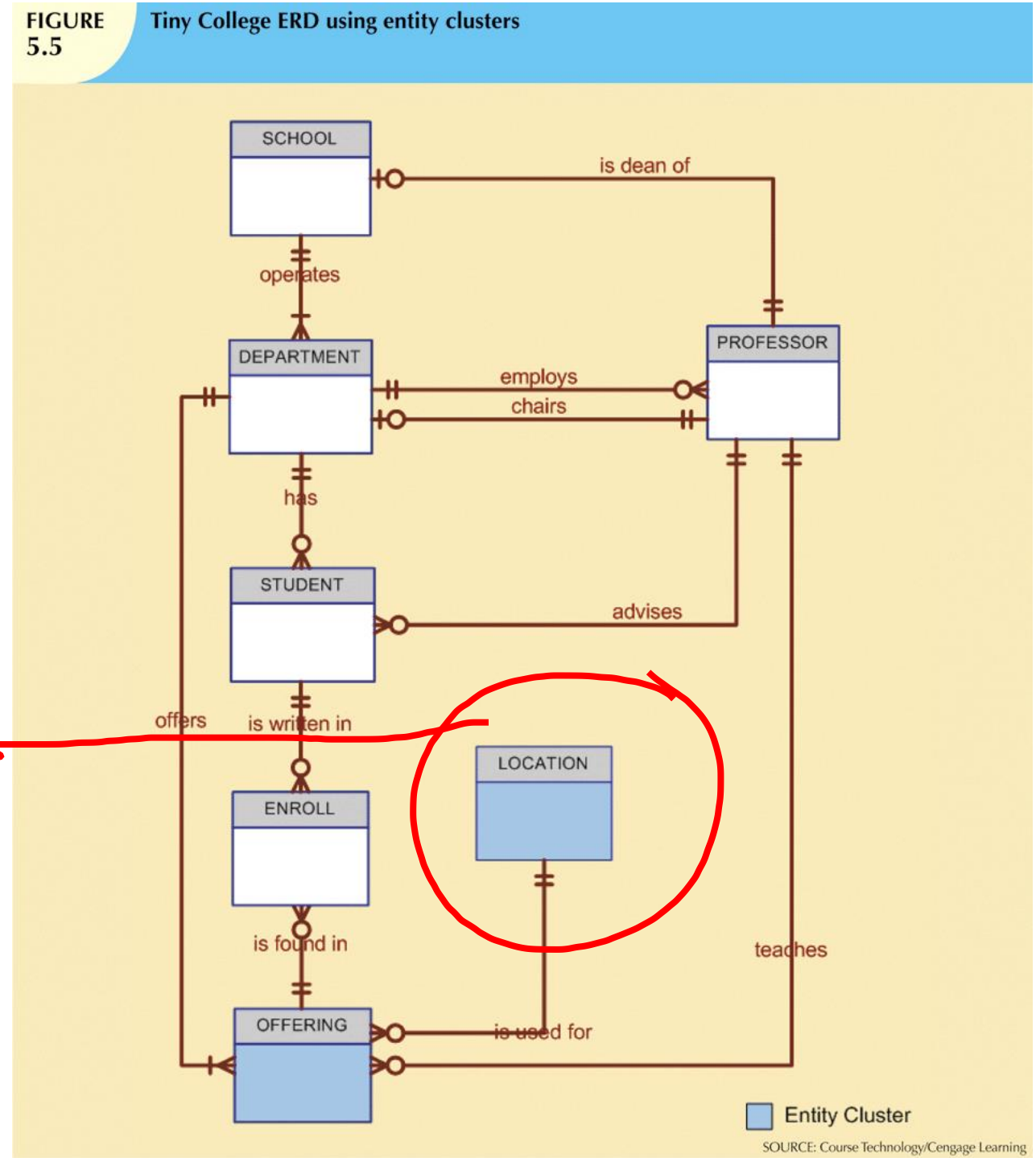


SOURCE: Course Technology/Cengage Learning

Questions?

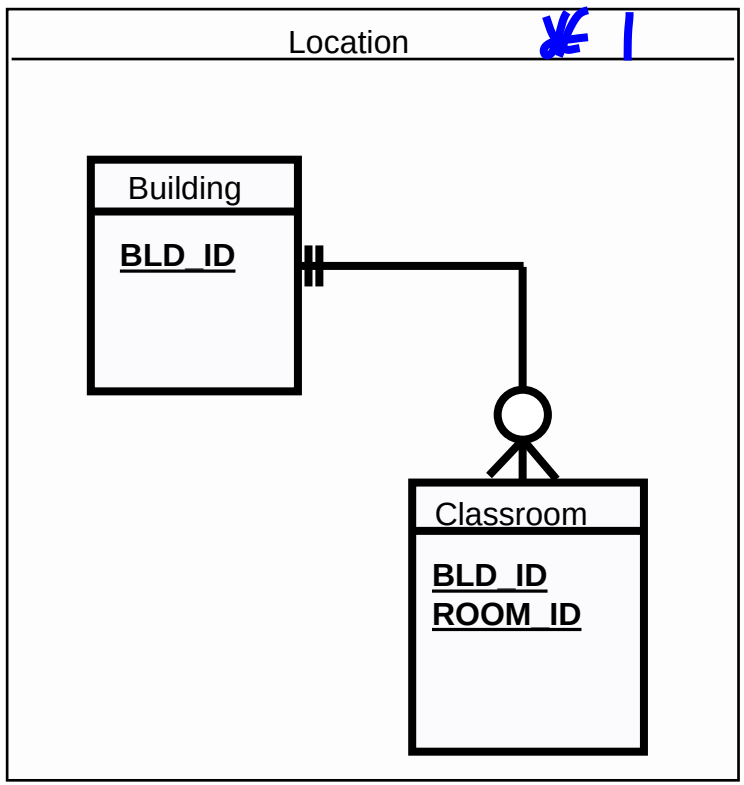
Entity Clustering

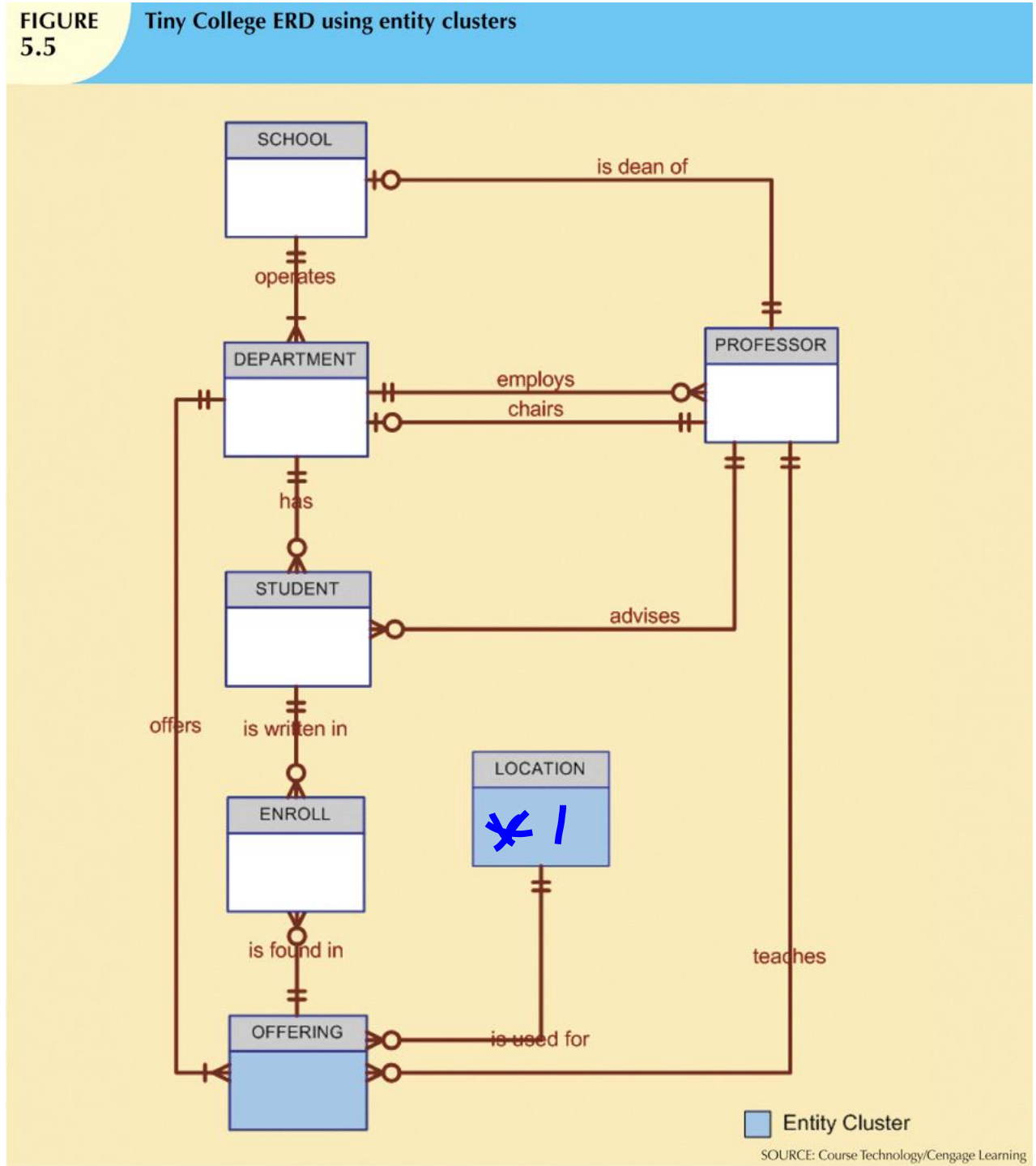
Virtual entity that represents multiple entities and relationships



Entity Clustering

Virtual entity that represents multiple entities and relationships





Selecting Primary Keys

Natural Key or Natural Identifier

- real-world, generally accepted identifier (Empl_id, SID, VIN)
- e-mail, SIN, while natural & unique, not recommended

Guidelines

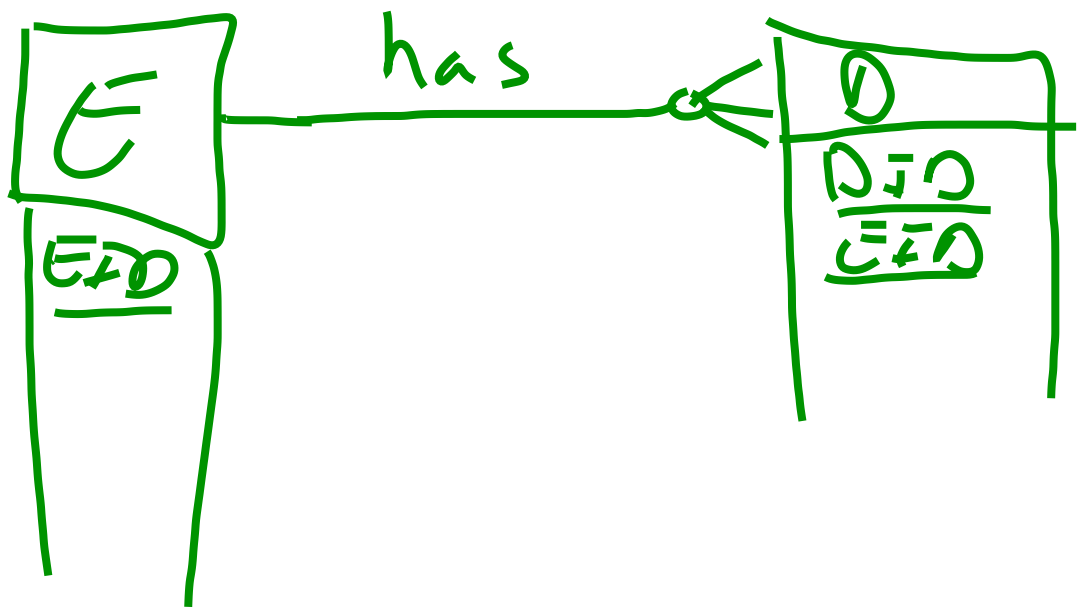
Uniquely identify an entity instance or row

Used to implement relationships...

When to use composite keys

Identifiers of composite entities (when handling M:N) for Student, Course

Identifiers of weak entities with a strong identifying relationship for Employee, Dependent



Desirable Primary Key Characteristics (pg. 178)

Unique ← Not Null

N**on-intelligent** - no semantic meaning

N**o change over time** - e.g. names can change

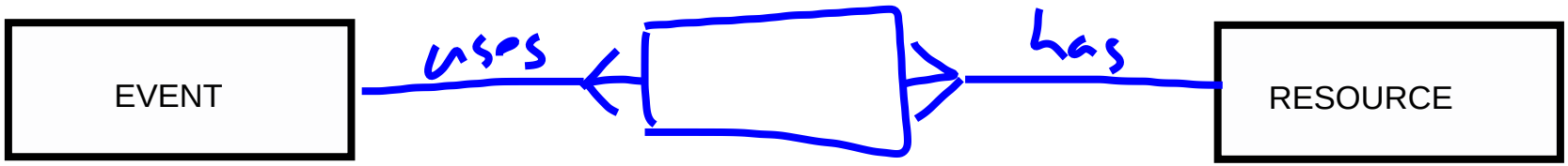
S**ingle attribute** - fewer attributes make life easier

N**umeric** - simpler to manage (auto-number!)

S**ecurity compliant** - don't leak information

Surrogate Key

When there is no natural key



EID

EVENT [e_date, e_time_start, e_time_end, e_room, event_name, e_party_of]

RID

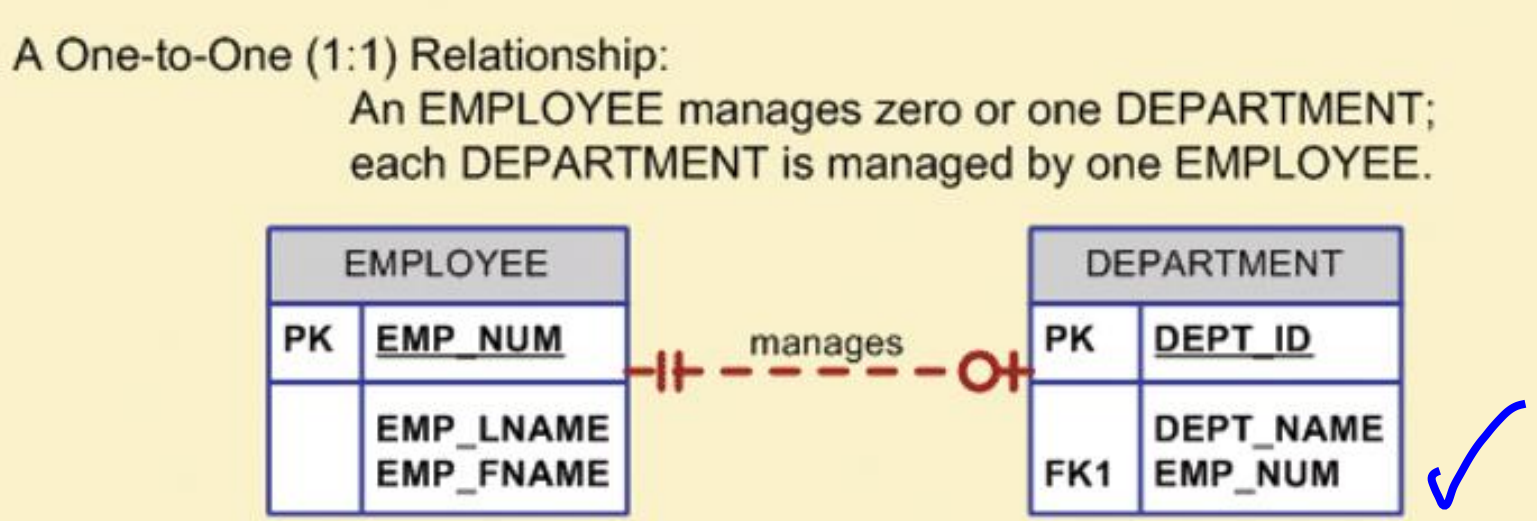
RESOURCE [rsc_type, rsc_description, rsc_qty, rsc_price]

EVENTRESOURCE [Rid, eid, evtrsc_qty used]

Some design things to consider

Employee manages 0 or one department
Department managed by exactly one employee

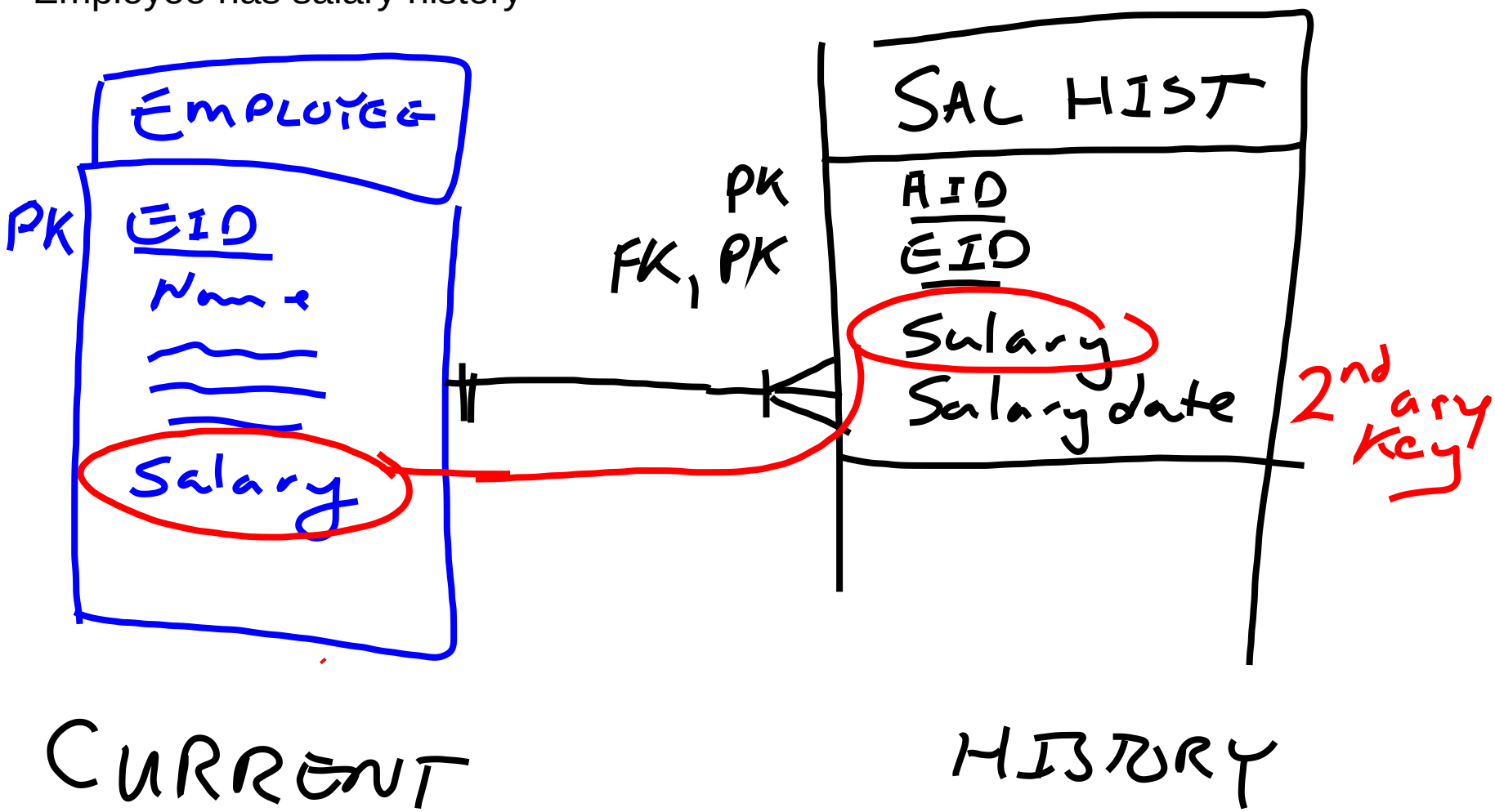
FIGURE 5.7 The 1:1 relationship between DEPARTMENT and EMPLOYEE



SOURCE: Course Technology/Cengage Learning

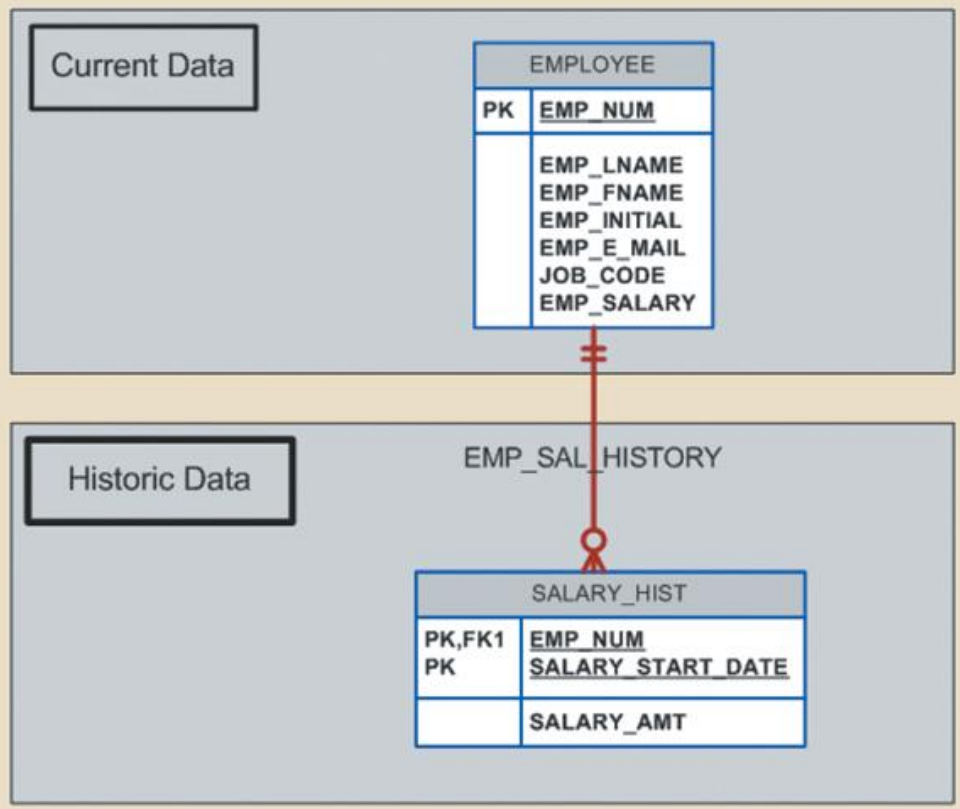
Time Variant Data

Employee has salary history



Design Case 2: Maintaining History of Time-Variant Data

FIGURE 5.9 MAINTAINING SALARY HISTORY

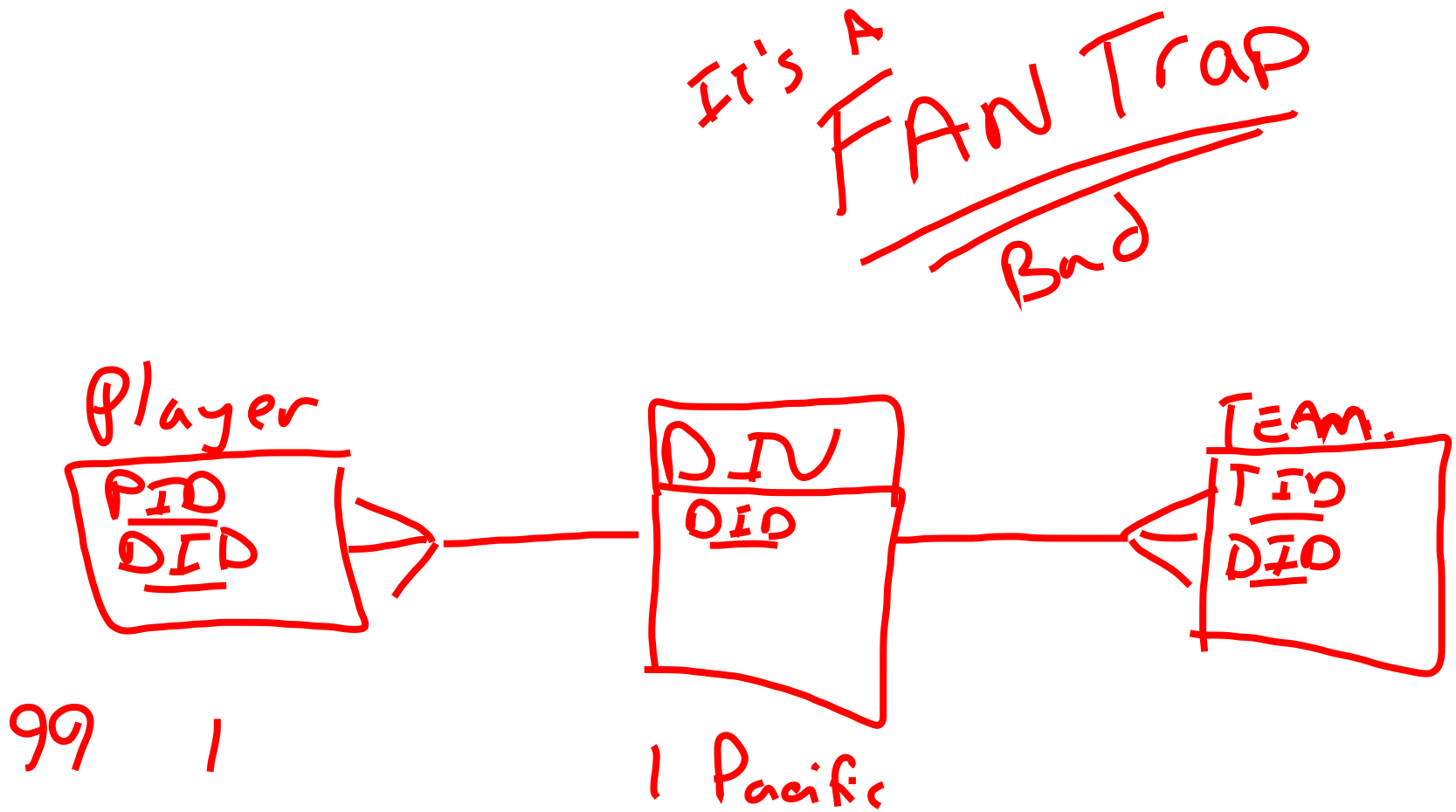


Design Case 3: Fan Traps

- Design trap: occurs when a relationship is improperly or incompletely identified
  - Represented in a way not consistent with the real world
- Fan trap: occurs when one entity is in two 1:M relationships to other entities
  - Produces an association among other entities not expressed in the model

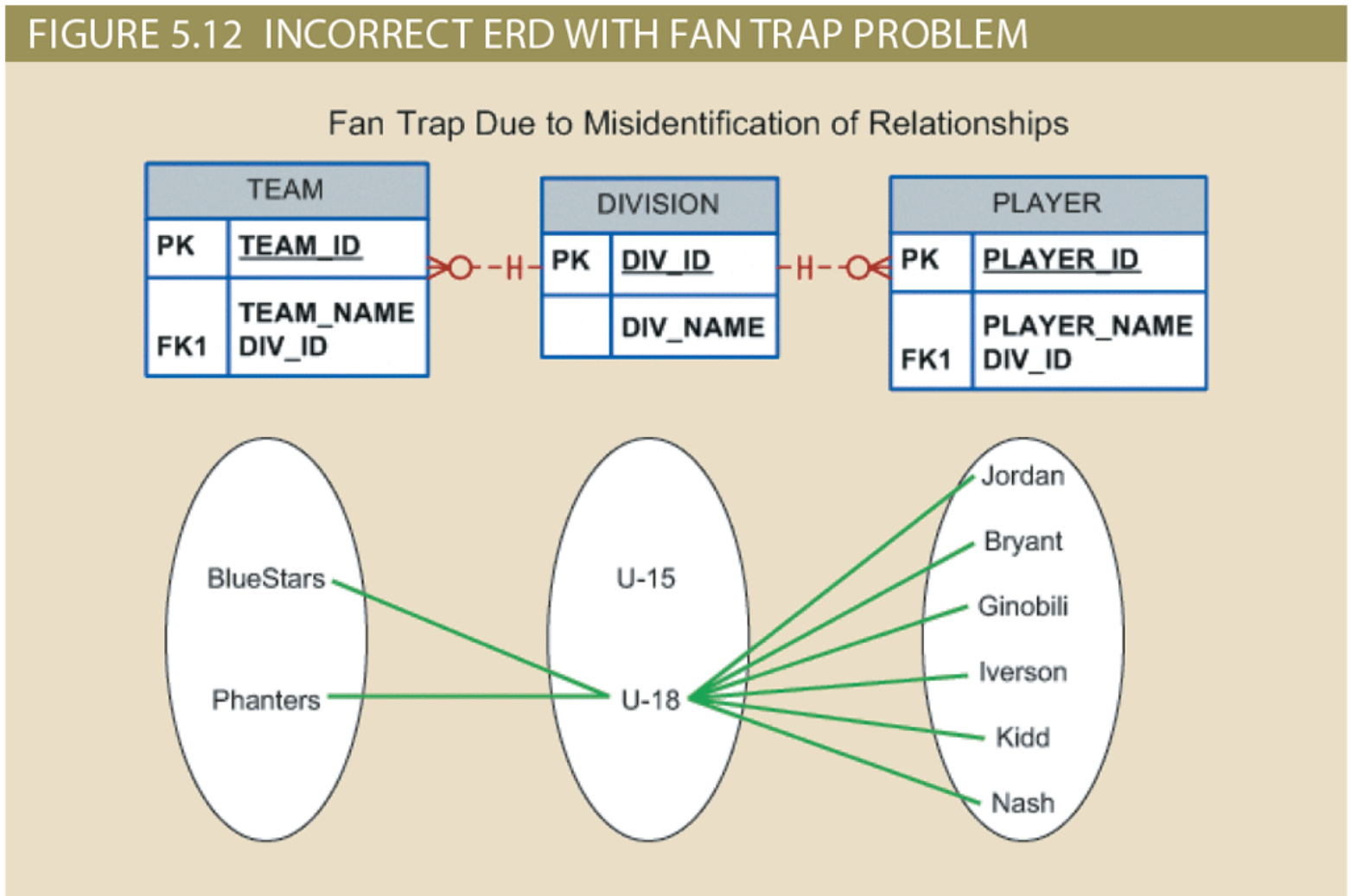
How can we draw this?

Division has many teams
Division has many players



Design Case 3: Fan Traps

FIGURE 5.12 INCORRECT ERD WITH FAN TRAP PROBLEM



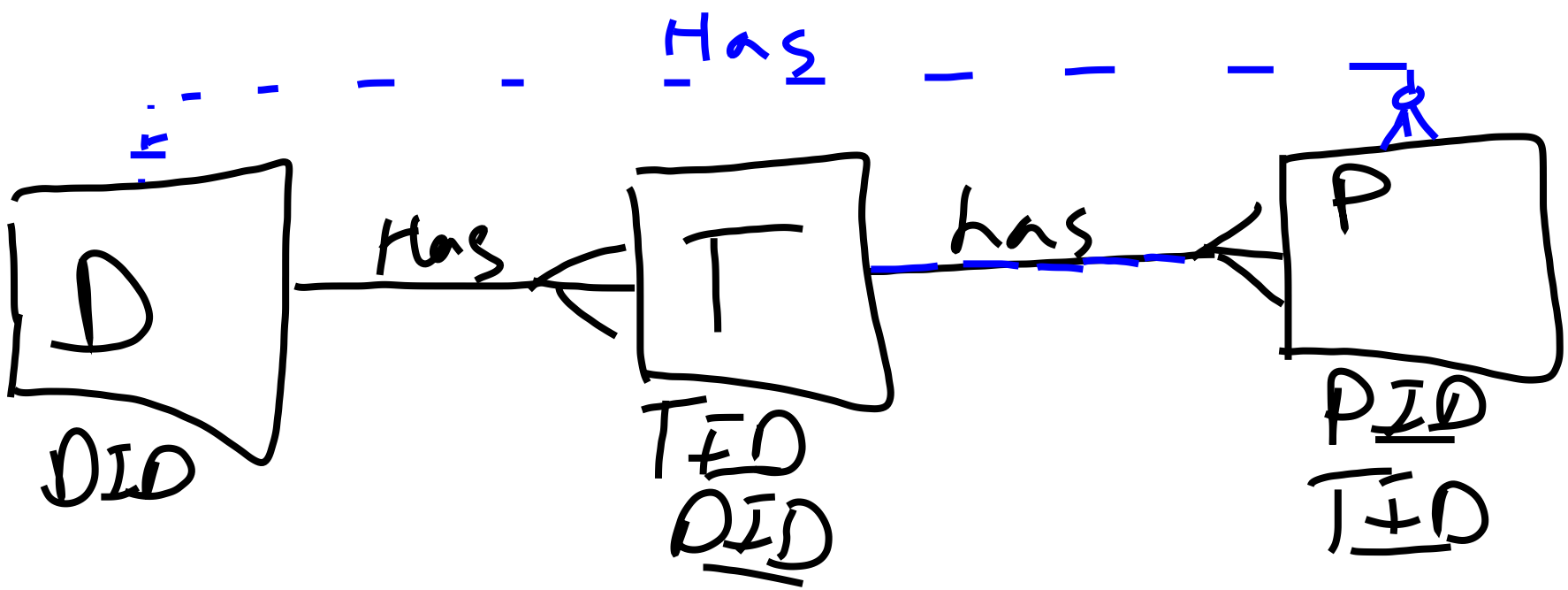
Beware of fan traps

One entity in two 1:M relationships to other entities, producing an association that is not expressed in the model.

Division has many teams

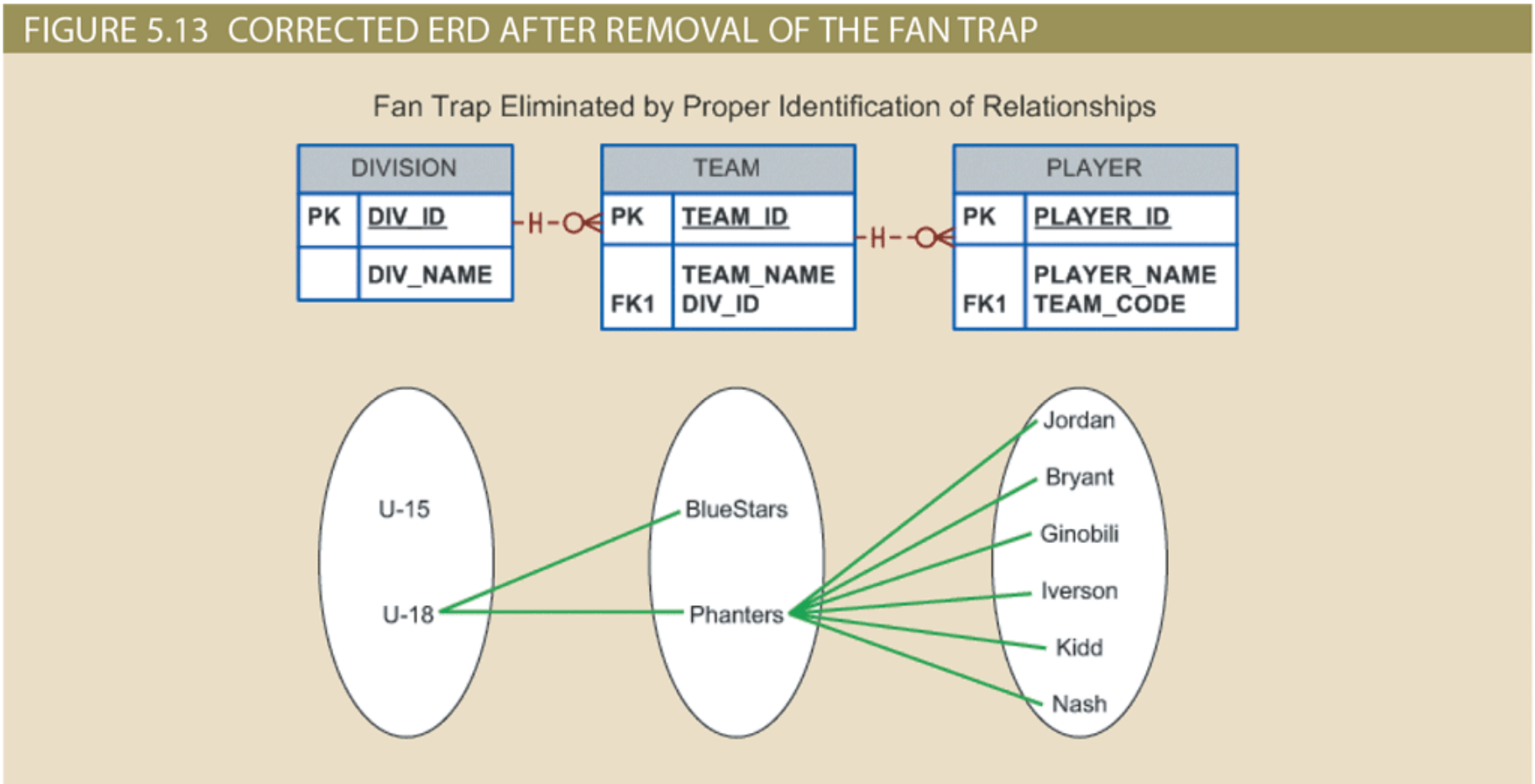
Division has many players

TEAM



Design Case 3: Fan Traps (3 of 3)

FIGURE 5.13 CORRECTED ERD AFTER REMOVAL OF THE FAN TRAP

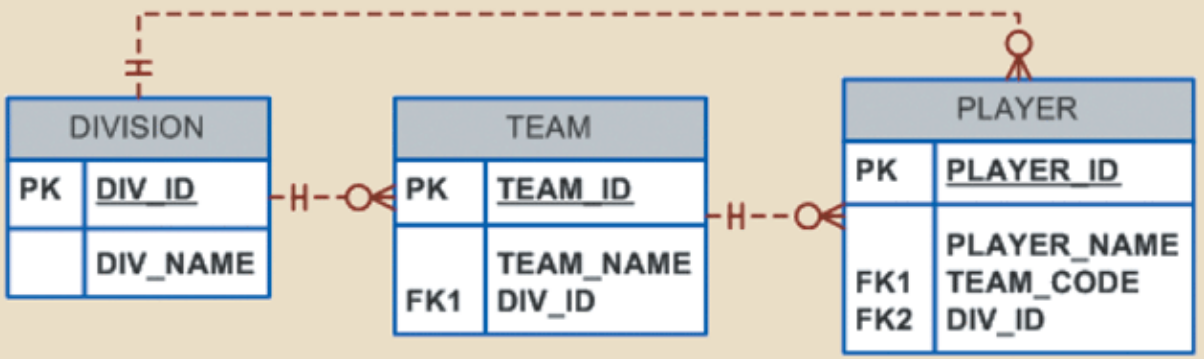


Design Case 4: Redundant Relationships

- Occur when there are multiple relationship paths between related entities
  - Must remain consistent across the model
  - Help simplify the design

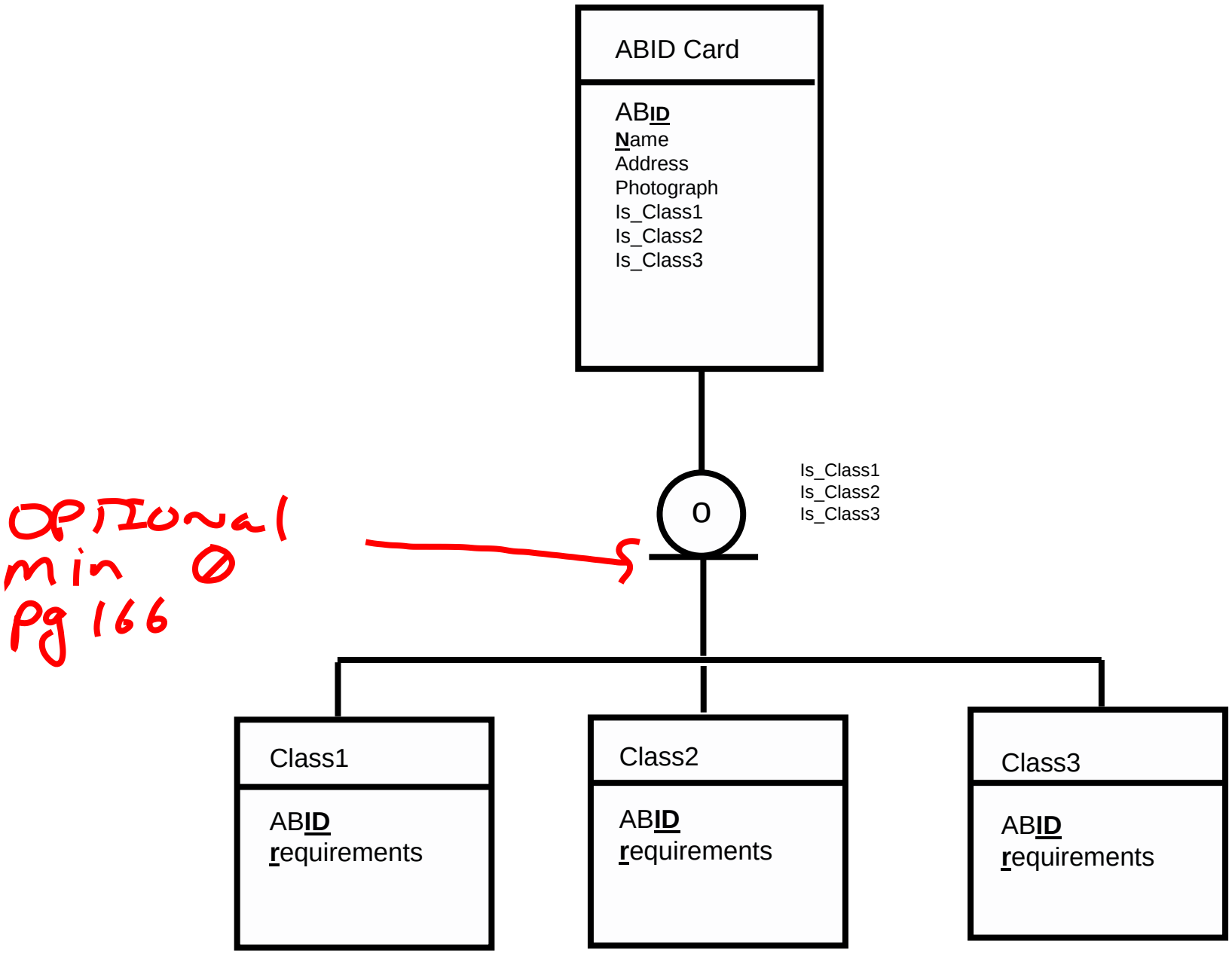
Design Case 4: Redundant Relationships

FIGURE 5.14 A REDUNDANT RELATIONSHIP



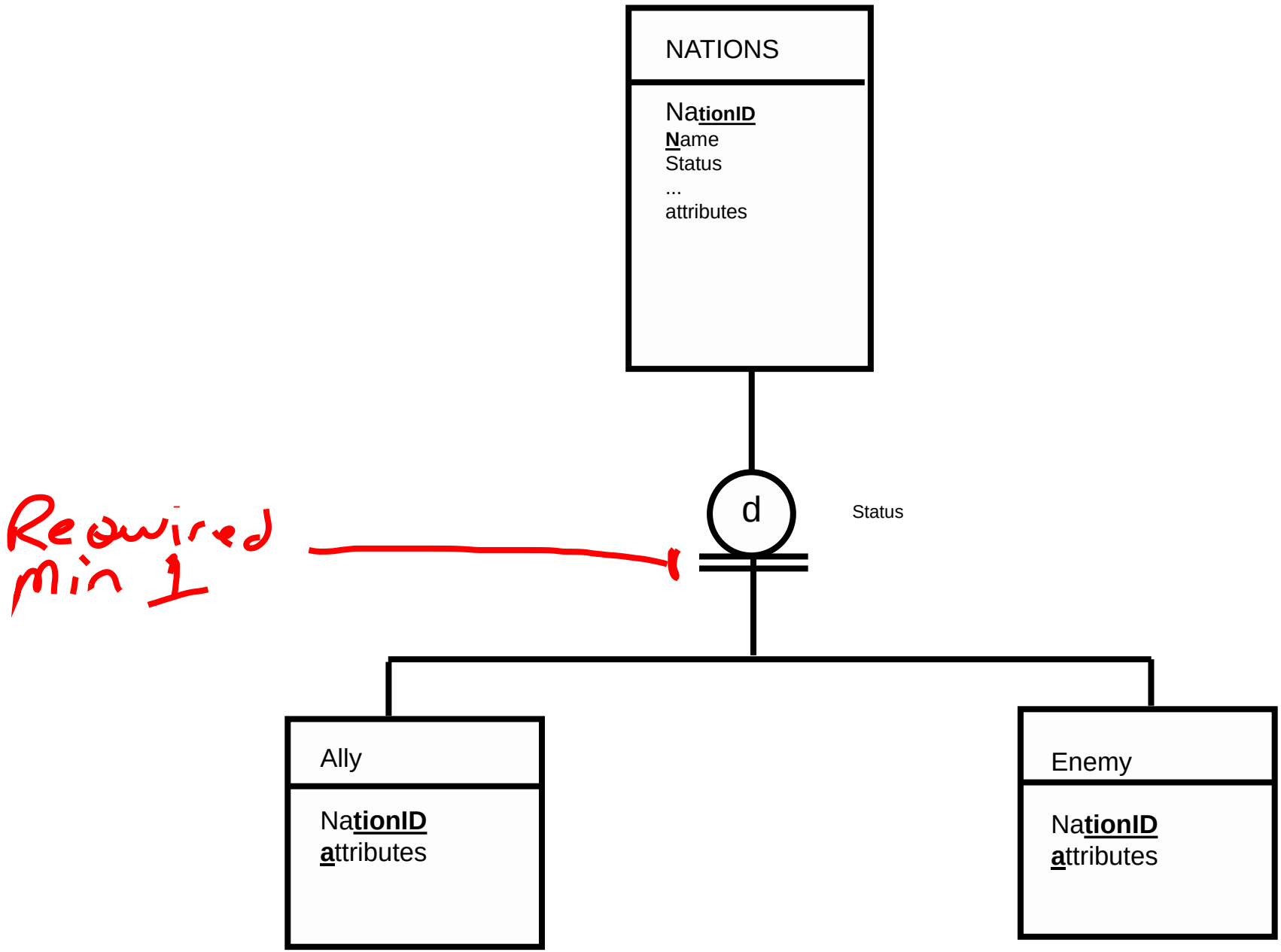
In Alberta, residents may receive an Identity Card. This card has name, address, photograph and other personal information. If a resident has passed one or more driver's tests, this card is also works as a Driver's License by indicating the classes of driver's license held by the resident. Assume that each class of license has different information and requirements.

For simplicity, you may assume Alberta only has 3 classes of license.


ABID Card
ABID
Name
Address
Photograph
Is_Class1
Is_Class2
Is_Class3
O
Is_Class1
Is_Class2
Is_Class3
Optional
min 0
Pg 166
Class1
ABID
requirements
Class2
ABID
requirements
Class3
ABID
requirements

In my little world of international relations, Canada keeps a record of all the nations of the world. Each nation is either an ally or an enemy. How can we model this relationship?

(Not Both)
(not Neither)


NATIONS
NationID
Name
Status
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min 1
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attributes
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