Week 8, Lec 16

Database Systems -

Introduction to Databases and Data Warehouses

CHAPTER 2 - Database Requirements and ER Modeling

(Part 3)

MAIN TOPICS

- Multiple ER Diagrams

- ERD Example 2

- Database requirements and ER Model Usage

- Various ER Notations

- Enhanced ERD

- M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

- Associative Entity

- **Ternary Relationship**

- ERD Modeling Case Study

MULTIPLE ER DIAGRAMS

- An E-R diagram for a database is always a connected graph
  - There exist a path from one entity to any other entity
- An E-R diagram that is not a connected graph
  - No path from some entity to other entities
  - For multiple schemas (i.e. databases)
- When depicting multiple ER diagrams
  - Visualize each diagram separately
    - o Use multiple schemas
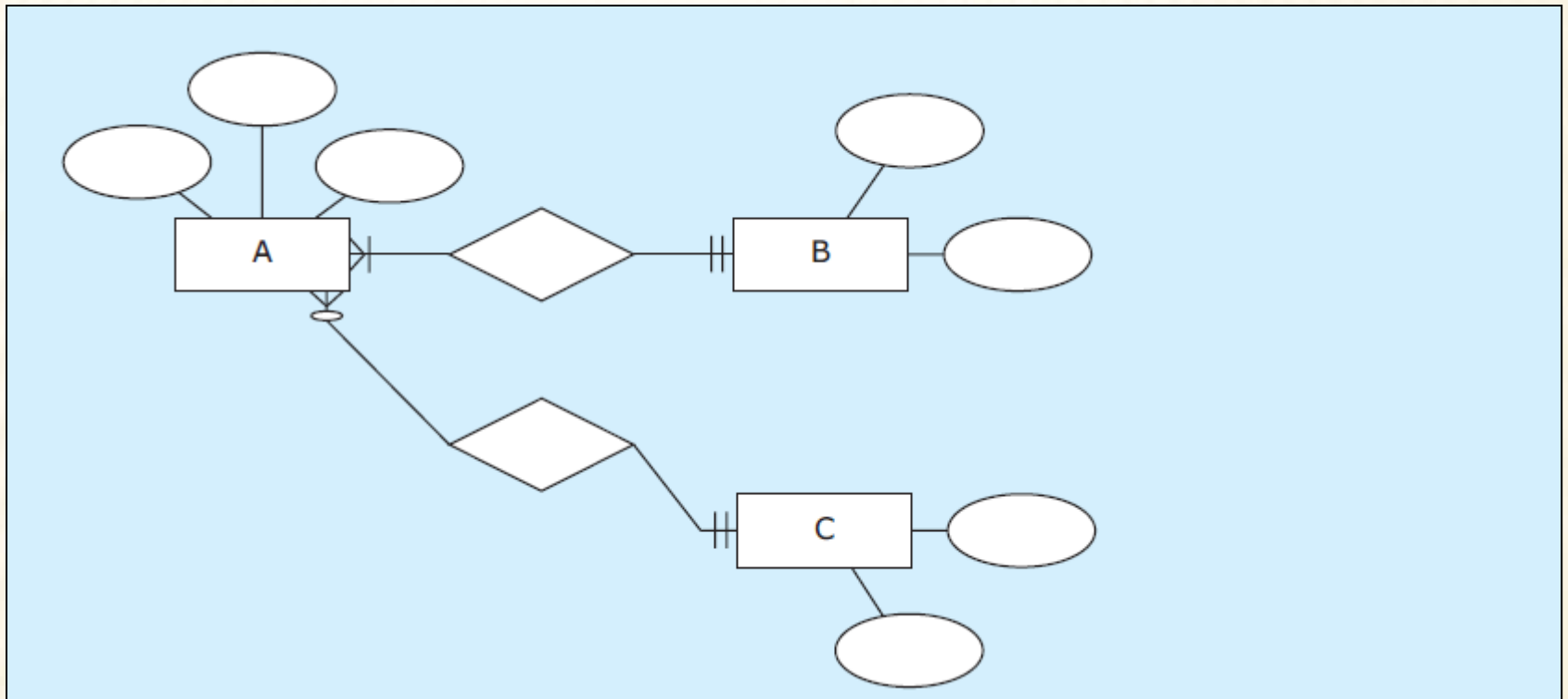   - o Present each ER diagram in a separate schema

MULTIPLE ER DIAGRAMS

A schema with two separate ER diagrams (potentially misleading)
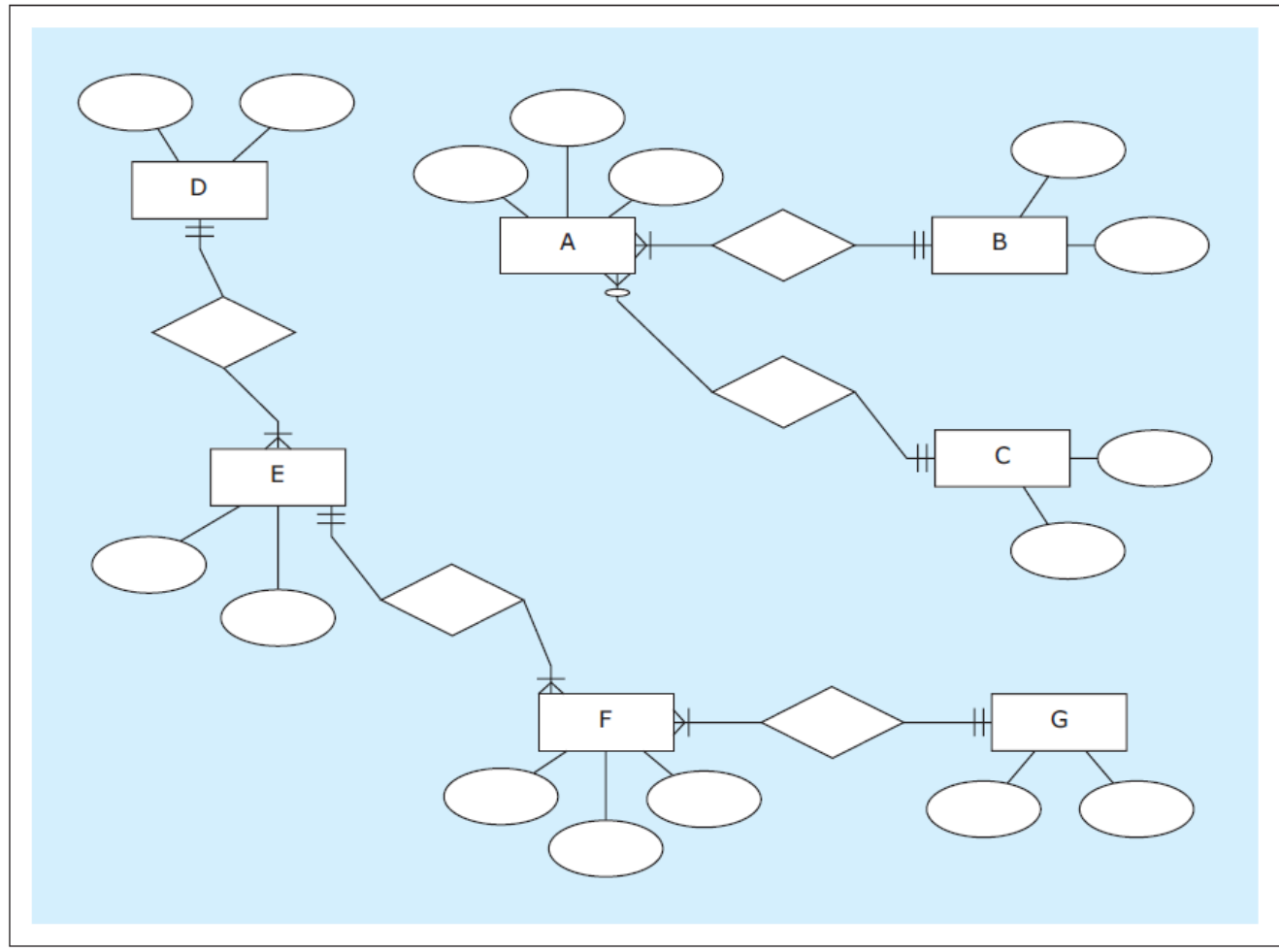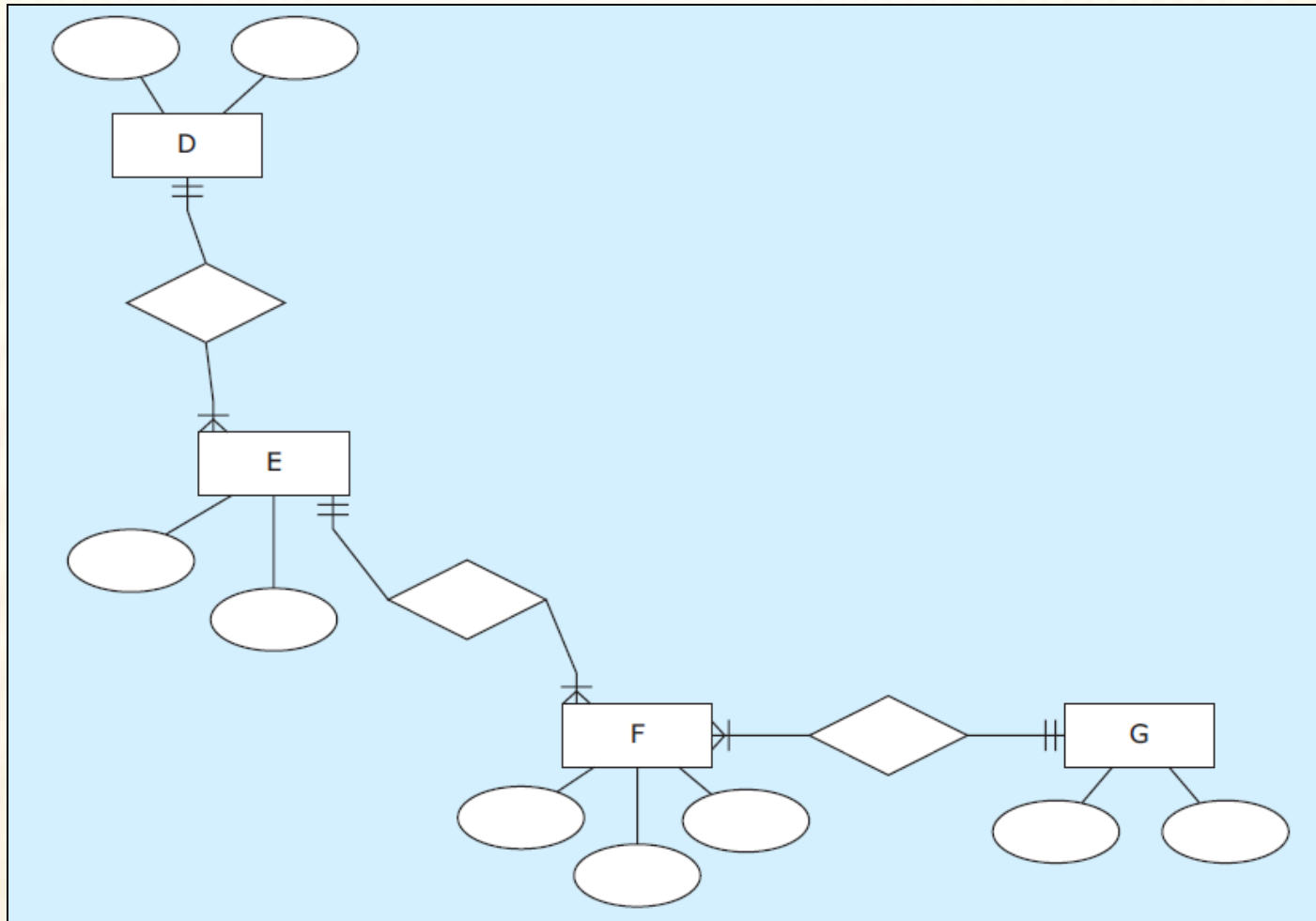
MULTIPLE ER DIAGRAMS

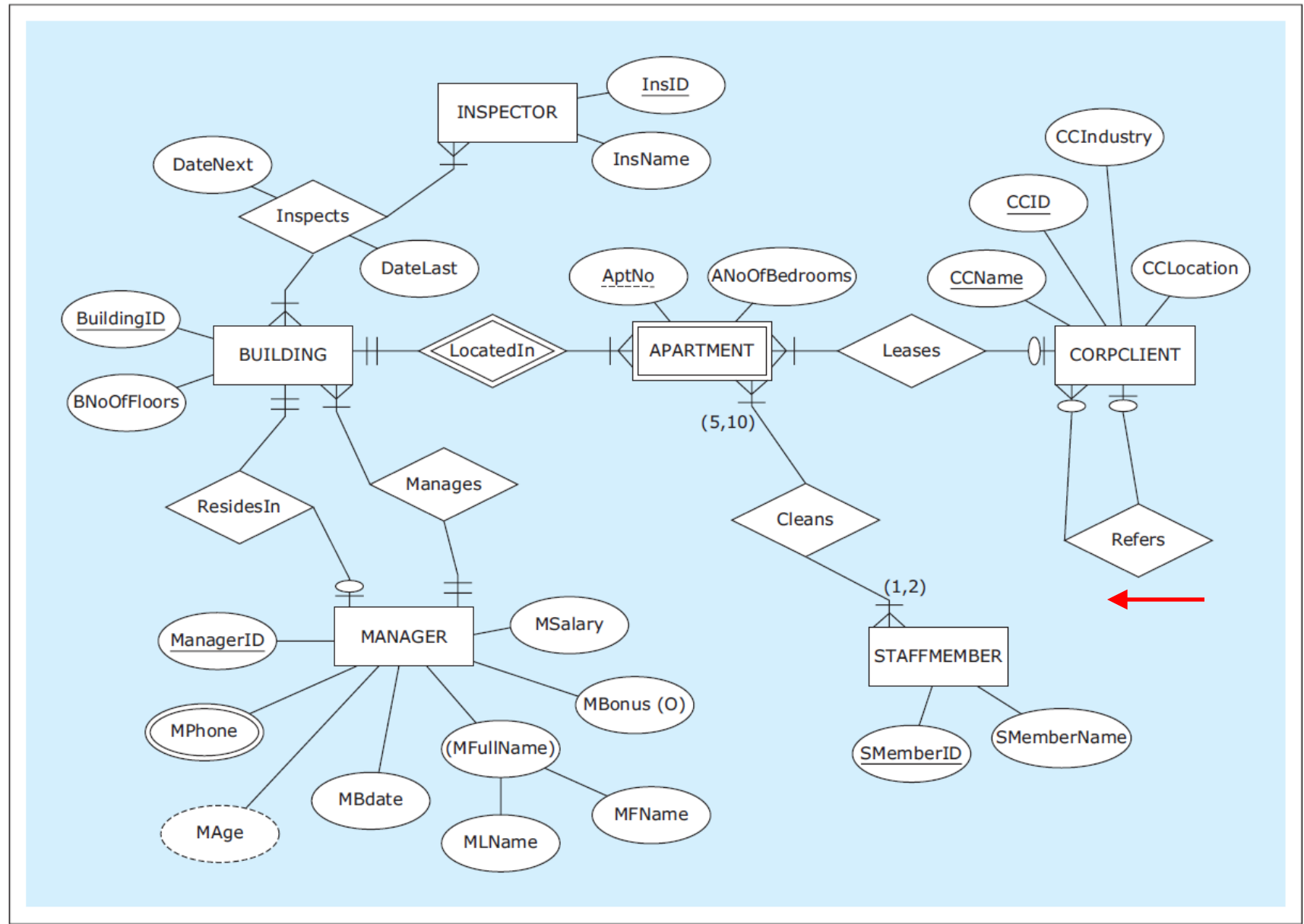Separate ER diagrams in separate schemas

MULTIPLE ER DIAGRAMS

Separate ER diagrams in separate schemas

Another ER diagram example: HAFH Realty Company Property Management Database

DATABASE REQUIREMENTS AND ER MODEL USAGE

- ER modeling
  - A straightforward technique for collecting, structuring, and visualizing requirements
    - Not just for creating ER models based on the requirements
    - Also for requirements collection
  - Help data modelers to focus on asking the right questions
    - To discover the relevant facts about entities, attributes, and relationships

DATABASE REQUIREMENTS AND ER MODEL USAGE

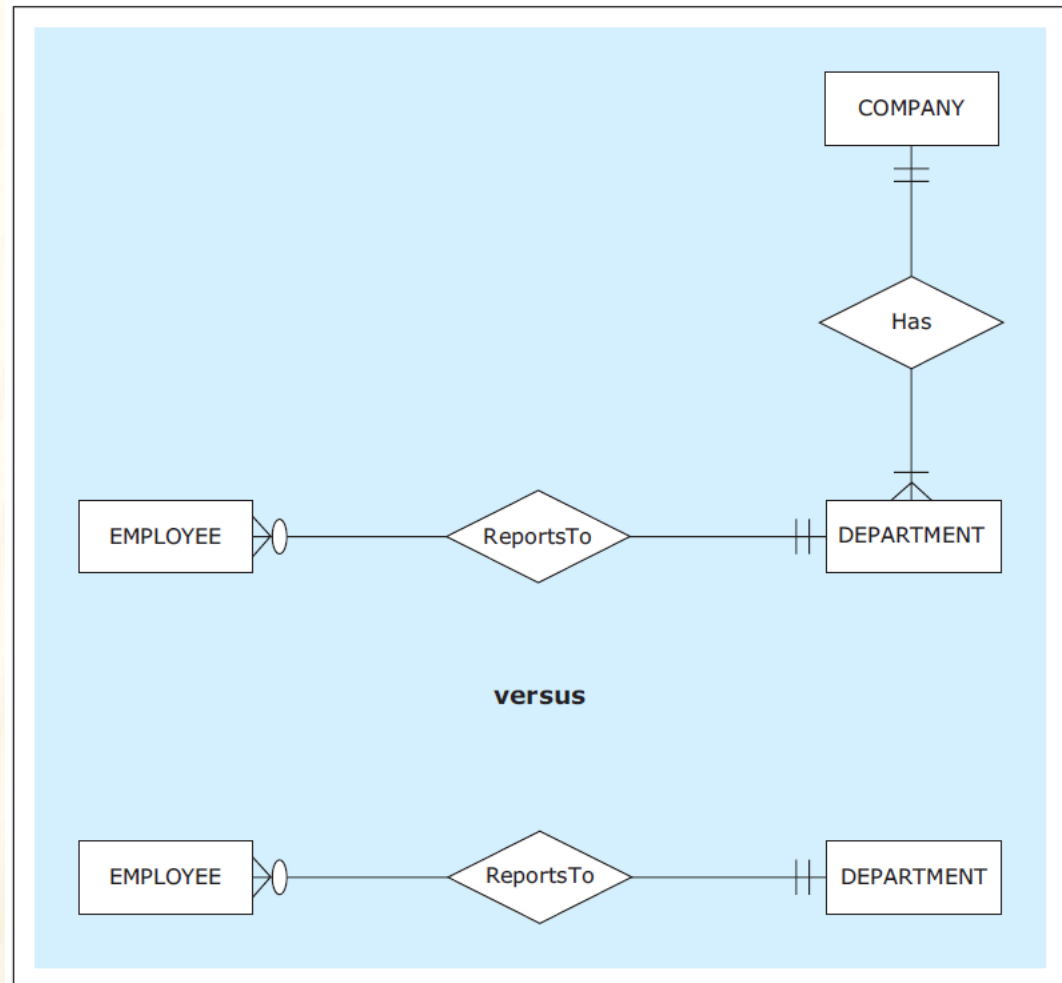- One common mistake in ER modelling
  - Not recognize the difference between an entity and the ER diagram itself
  - E.g. draw ER diagram for the requirements
    - Company X keeps information about its departments, employees who reports to those departments.
    - Each employee reports to exactly one department
    - Each department can have many employees reporting to it but does not have to have any.

DATABASE REQUIREMENTS AND ER MODEL USAGE

An ER diagram incorrectly and correctly interpreting requirements

An ER diagram for
 Company X:
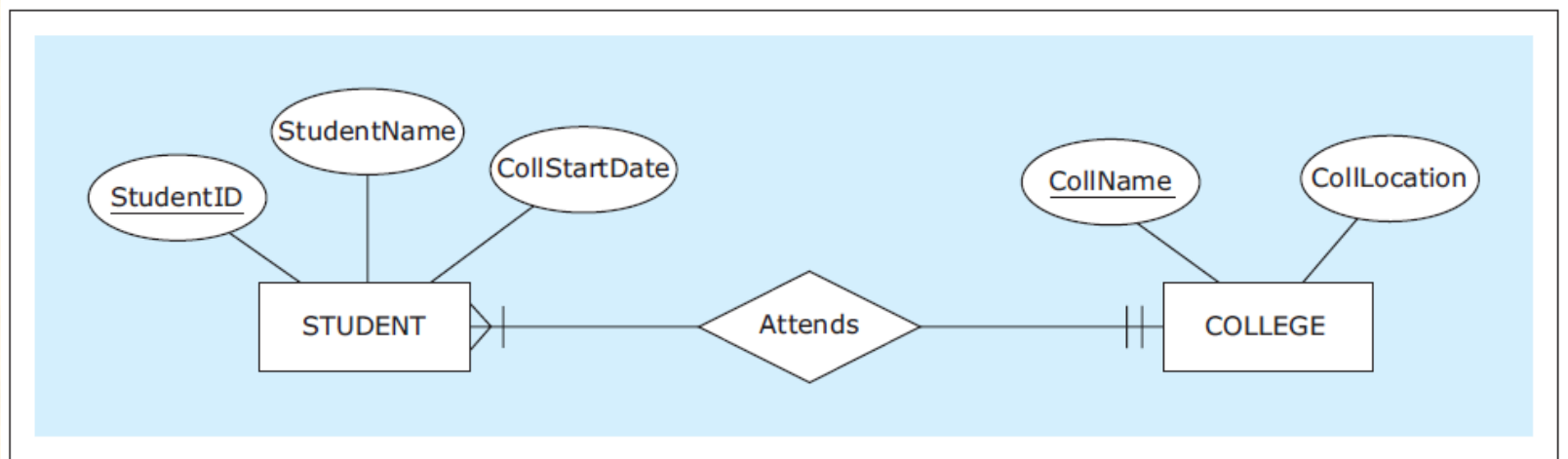
DATABASE REQUIREMENTS AND ER MODEL USAGE

- One common mistake in ER modelling (cont'd)
  - Not recognize the difference between an entity and the ER diagram itself
  - E.g. draw ER diagram for the requirements
    - An industry association keeps information about its member companies, its departments, and its employees.
    - Each employee reports to exactly one department
    - Each department can have many employees reporting to it but does not have to have any.

DATABASE REQUIREMENTS AND ER MODEL USAGE

An ER diagram correctly interpreting requirements

an ER diagram for Temple University?

DATABASE REQUIREMENTS AND ER MODEL USAGE

- One common mistake in ER modelling (cont'd)
  - Not recognize the difference between an entity and the ER diagram itself
  - E.g. database requirements for a non-profit foundation
    - ○ A non-profit foundation keeps track of its scholarship recipients that it is funding.
    - ○ For each student (scholarship recipient), keep unique student id, student name, the start college date
    - ○ For each college attended by each scholarship recipient, keep unique college name, college location
    - ○ Each scholarship recipient attends exactly one college.
    - ○ Each college has at least one scholarship recipient attending.

DATABASE REQUIREMENTS AND ER MODEL USAGE

- **Another common mistake** in database requirements collection and ER modeling
  - **Not distinguishing between**:

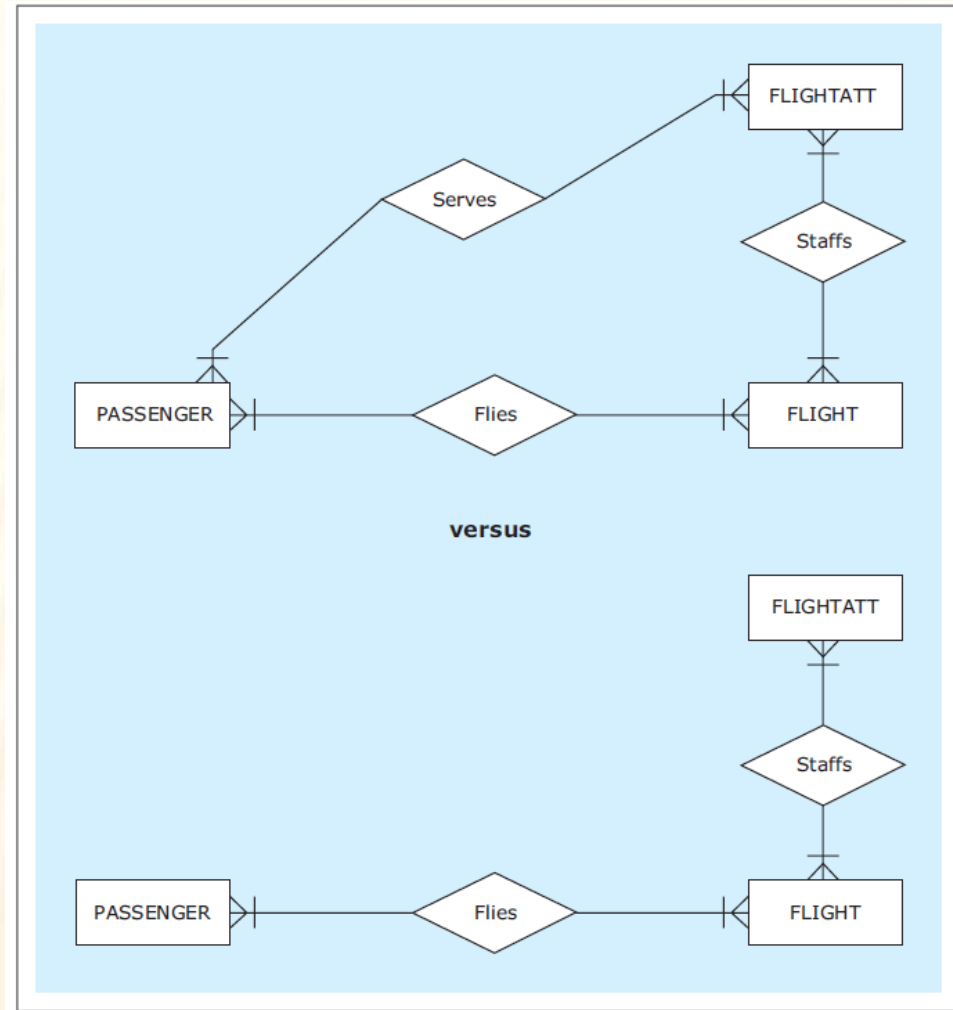*Modeling of the **data that is wanted and can be kept track** of*

versus

*Modeling of **everything that takes place** in an organization*

DATABASE REQUIREMENTS AND ER MODEL USAGE

An ER diagram based on unfeasible and proper requirements

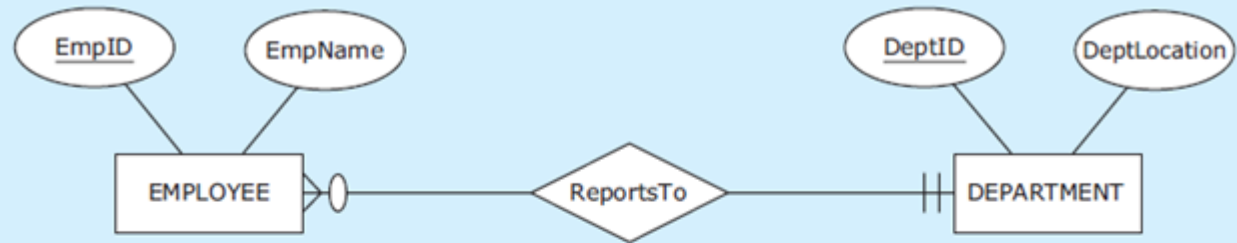ER diagram
for an airline
Company:

VARIOUS ER NOTATIONS

- No universally adopted ER notation to which all database projects conform

- A variety of available ER notations in use

- Familiarity with one ER notation help understanding other alternative ER notations
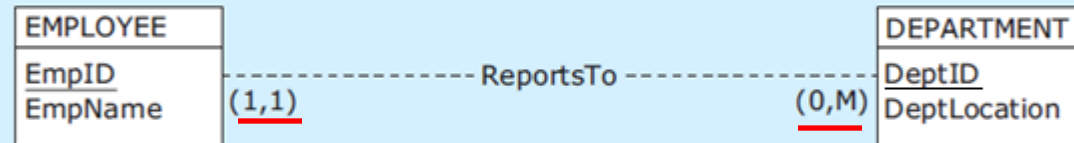
VARIOUS ER NOTATIONS

Examples of various ER notations

This book:

Cardinality reversed:

UML notation:

Enhanced ER (EER)

- Expanded ER notation
  - Use additional concepts beyond standard ER modeling
  - Overview in Appendix A
  - Not commonly used by business-related databases

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES
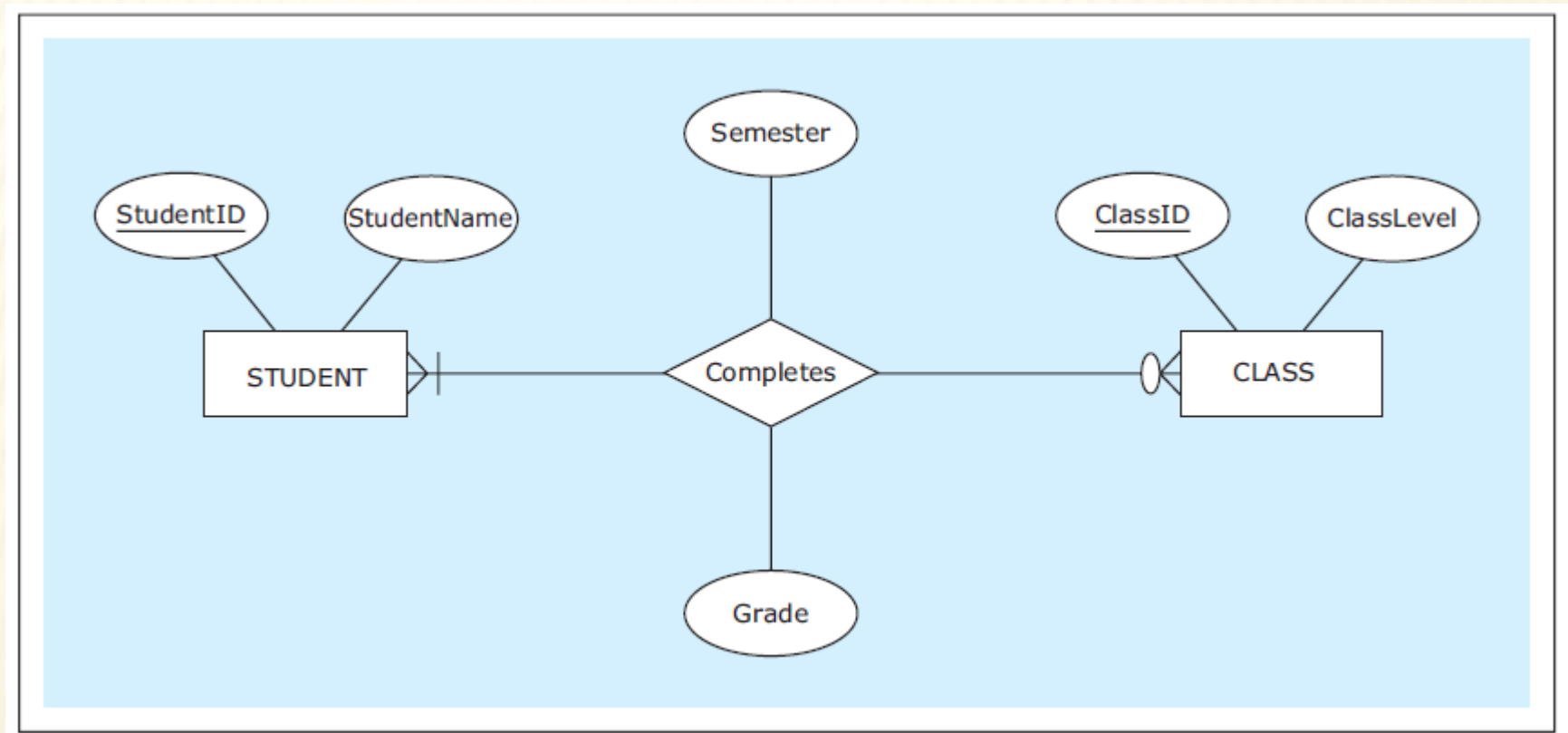
- M:N relationships may have multiple occurrences between the same instances of involved entities
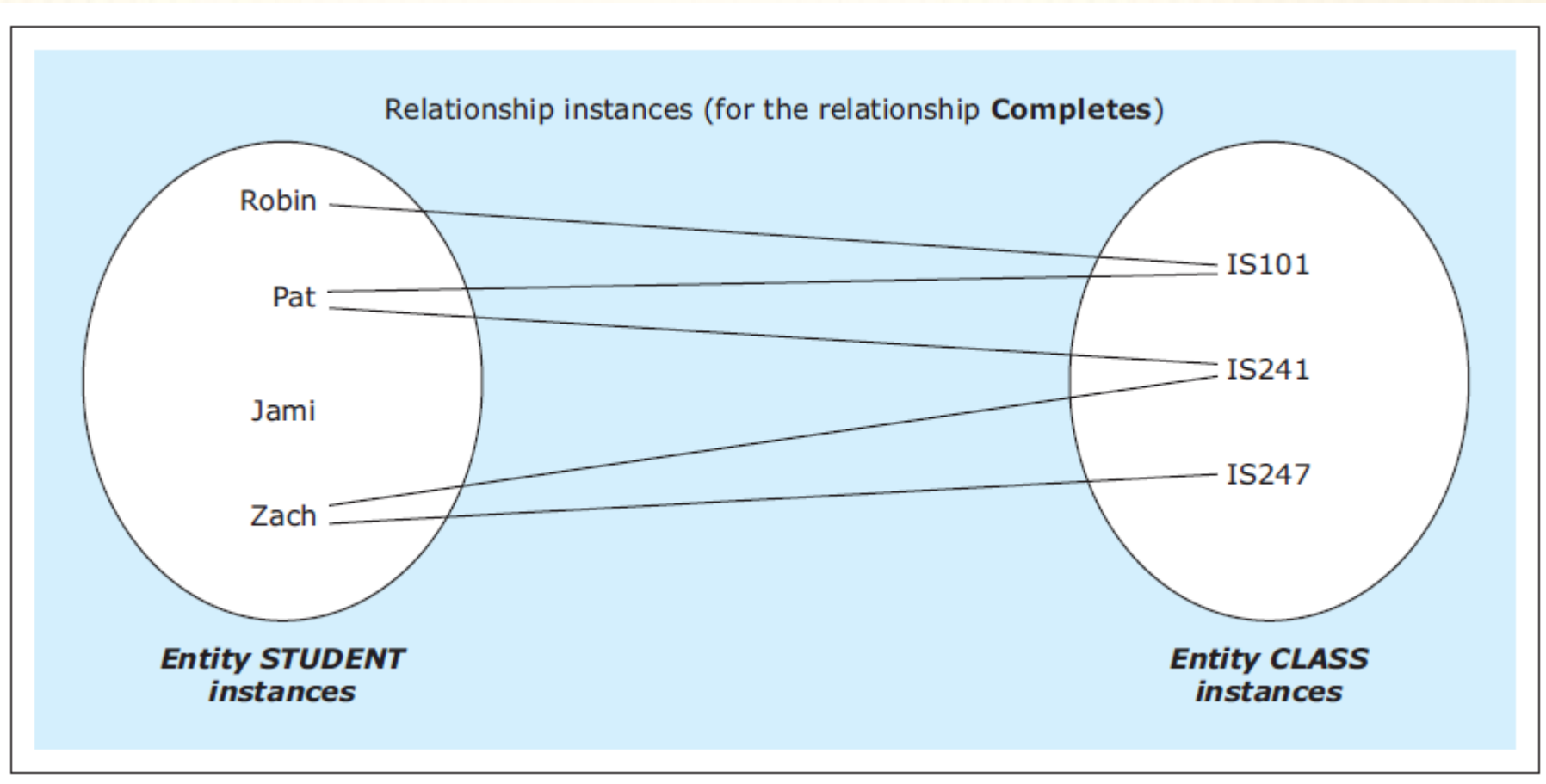 - Example in next slide

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

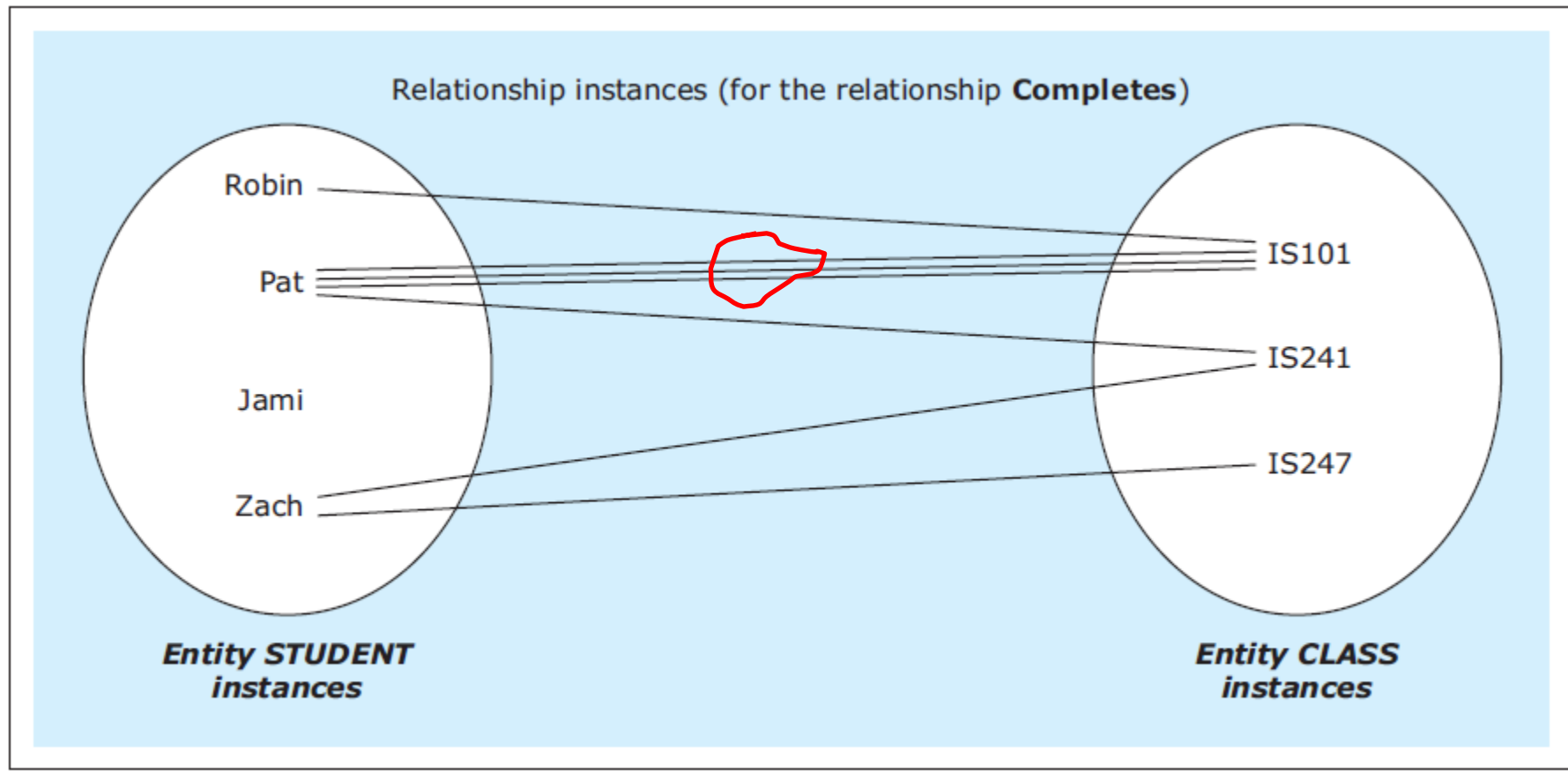An ER diagram for an M:N relationship depicting students completing classes

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

Instances of the M:N relationship Completes

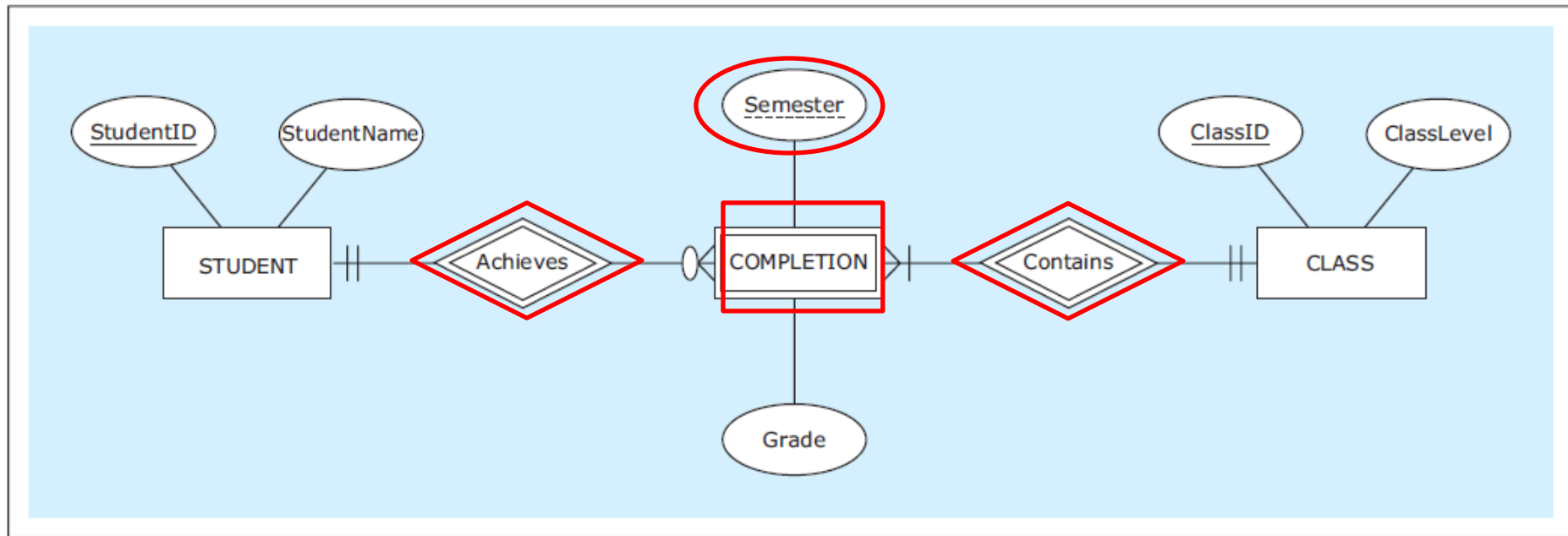# M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

Instances of the M:N relationship Completes with an additional requirement: one student takes same class multiple times

Relationship instances (for the relationship **Completes**)

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

CanNOT be represented in a M:N relationship

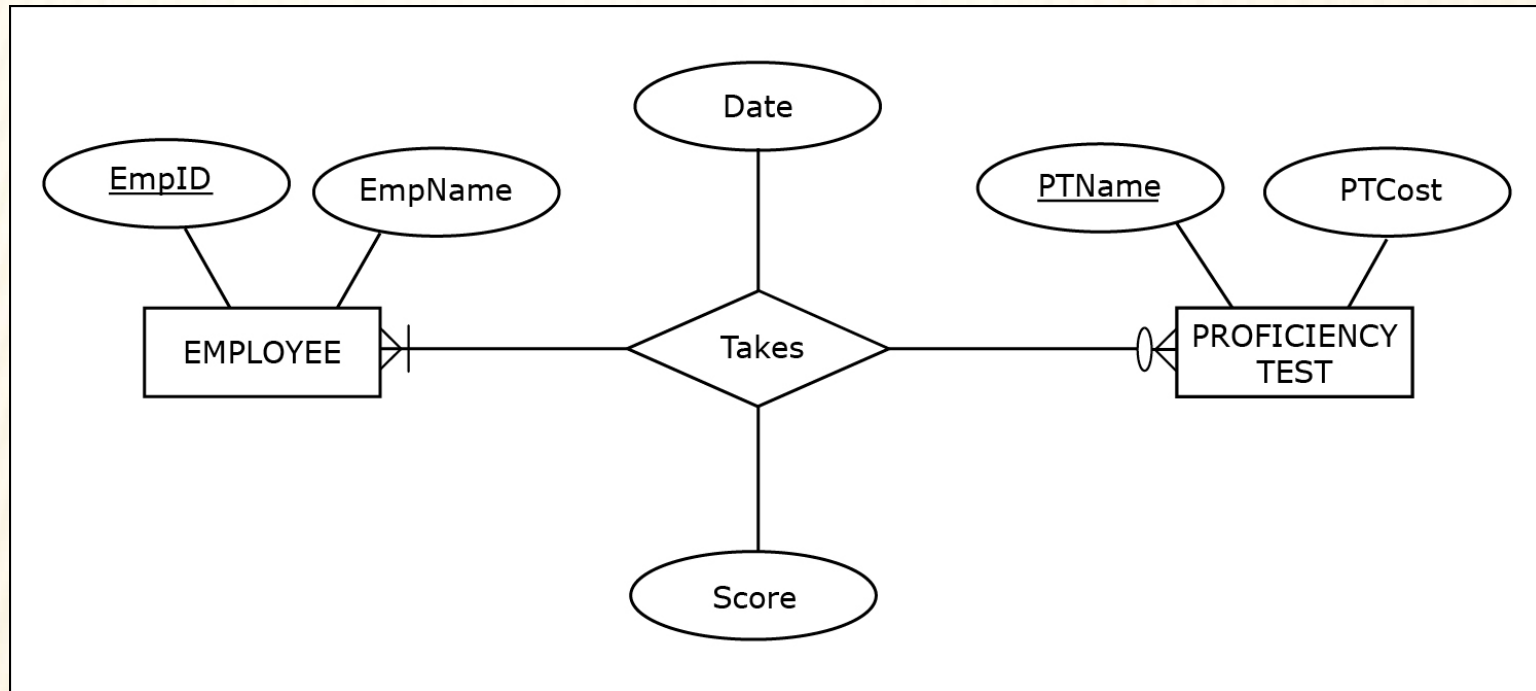Can be represented as a weak entity with partial key and multiple owner entities. Example:

Note the cardinality constraints

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

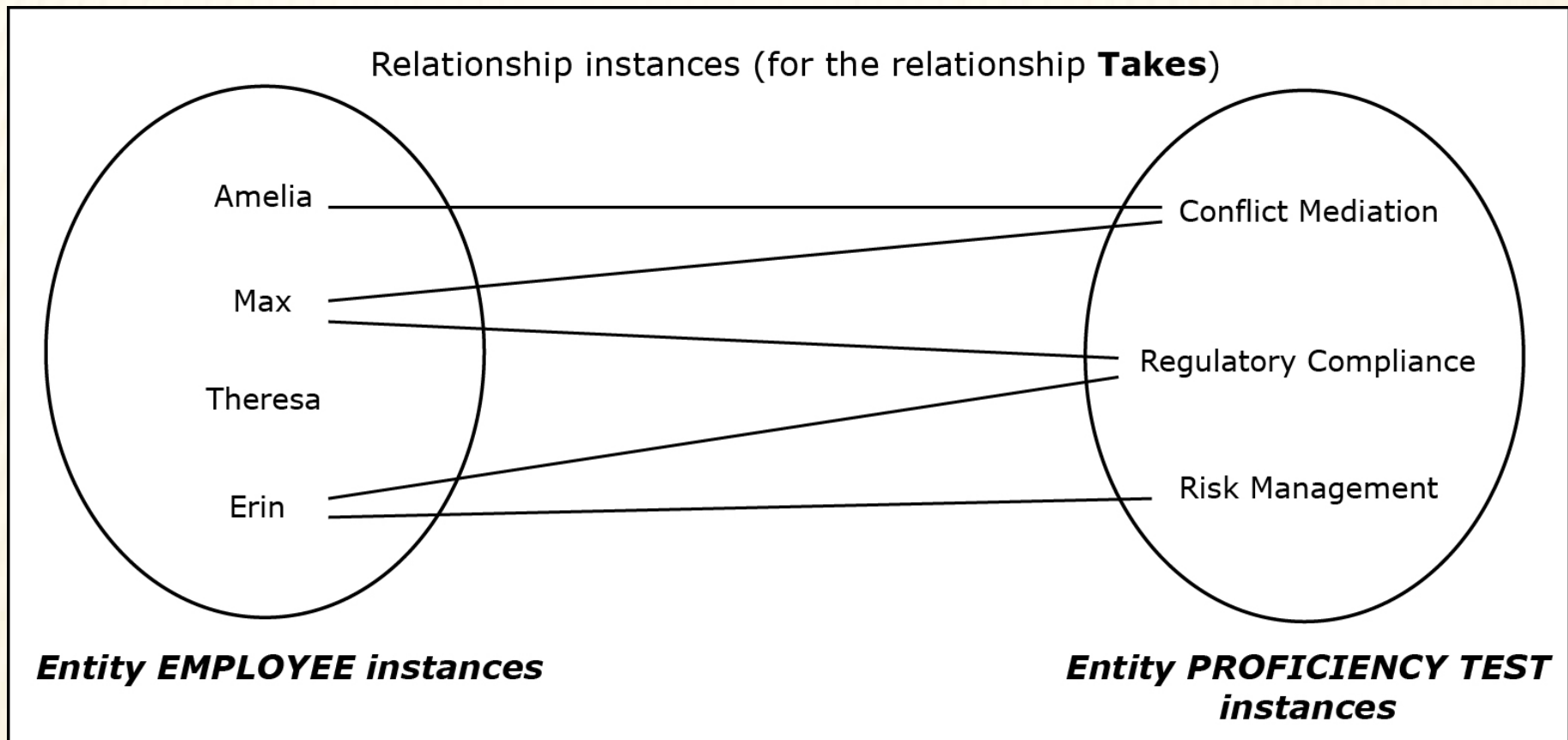An ER diagram for an M:N relationship depicting students completing classes

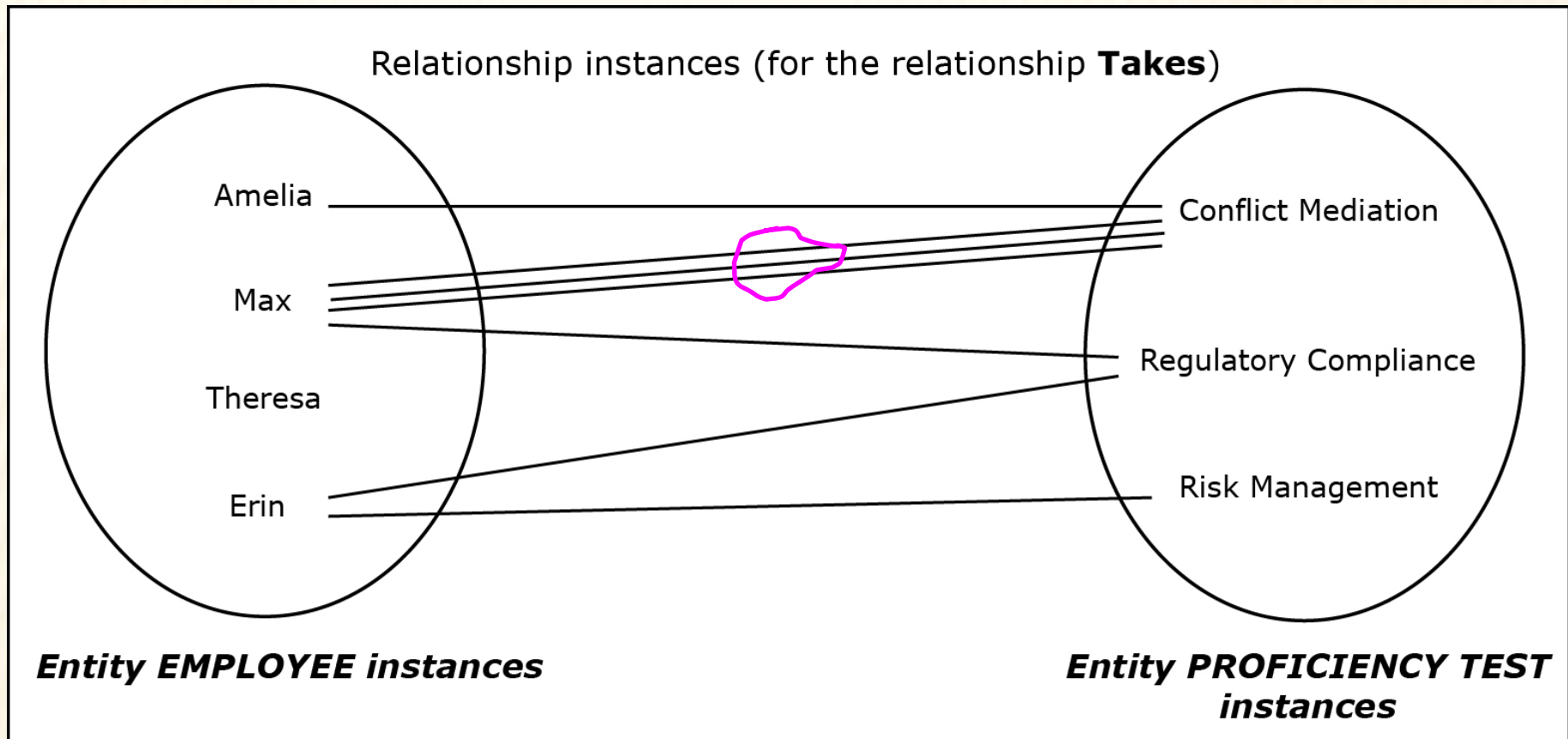# M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

Instances of the M:N relationship Completes

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

Instances of the M:N relationship Completes with an additional requirement: Max can complete the same test 3 times.
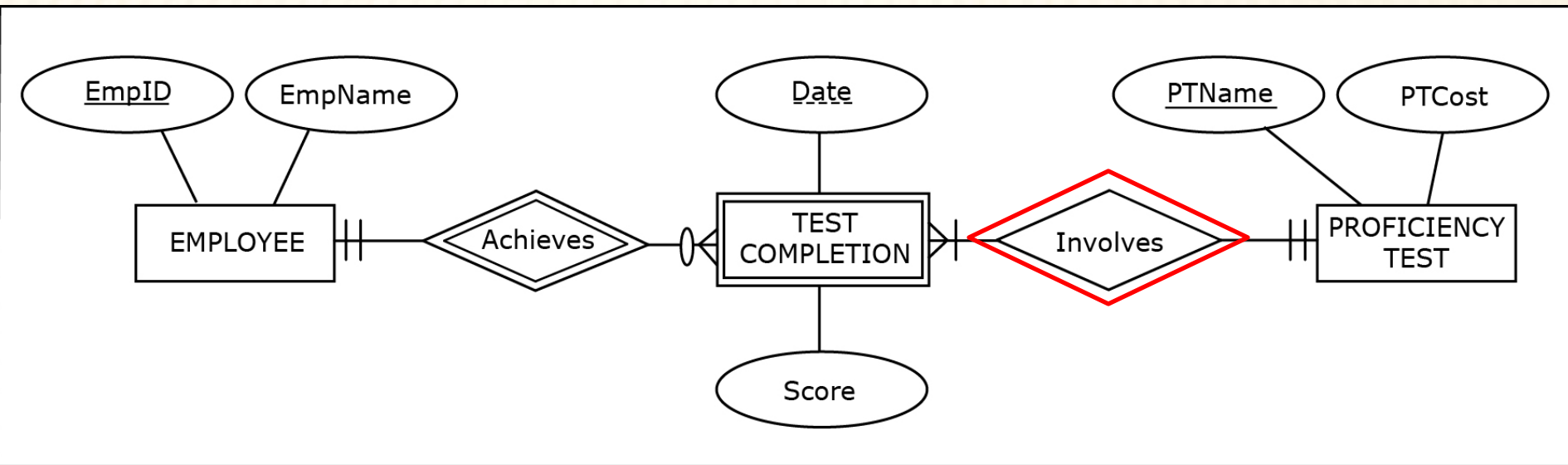
M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

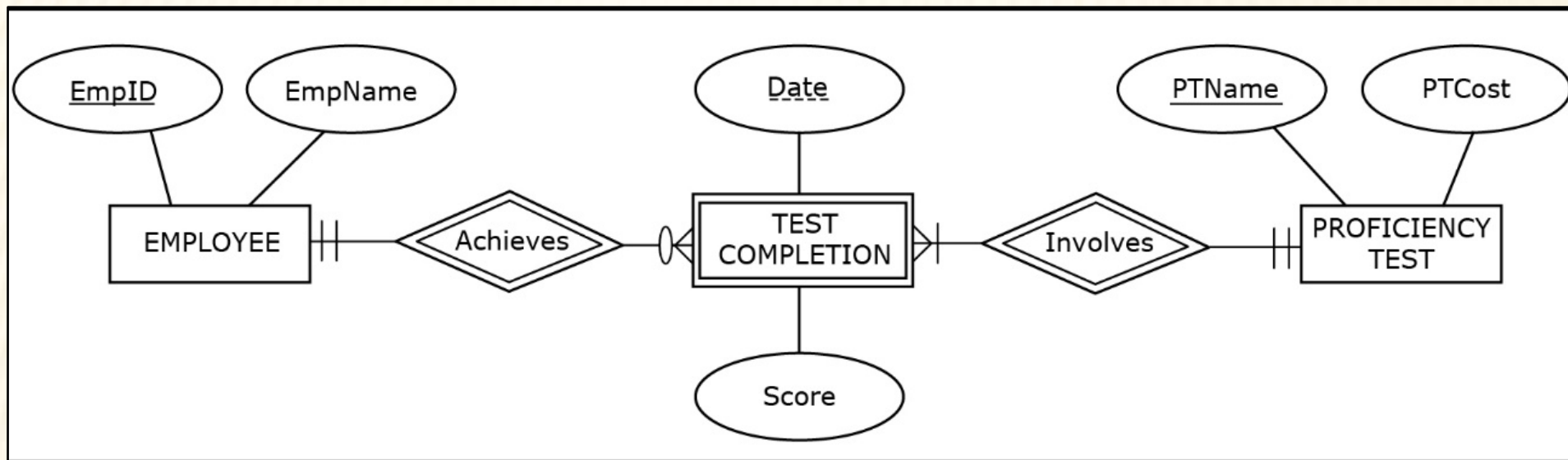An ER diagram for an M:N relationship represented as a weak entity

Each employee can complete only one test on a given date.
Each employee can complete the same test multiple times.

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

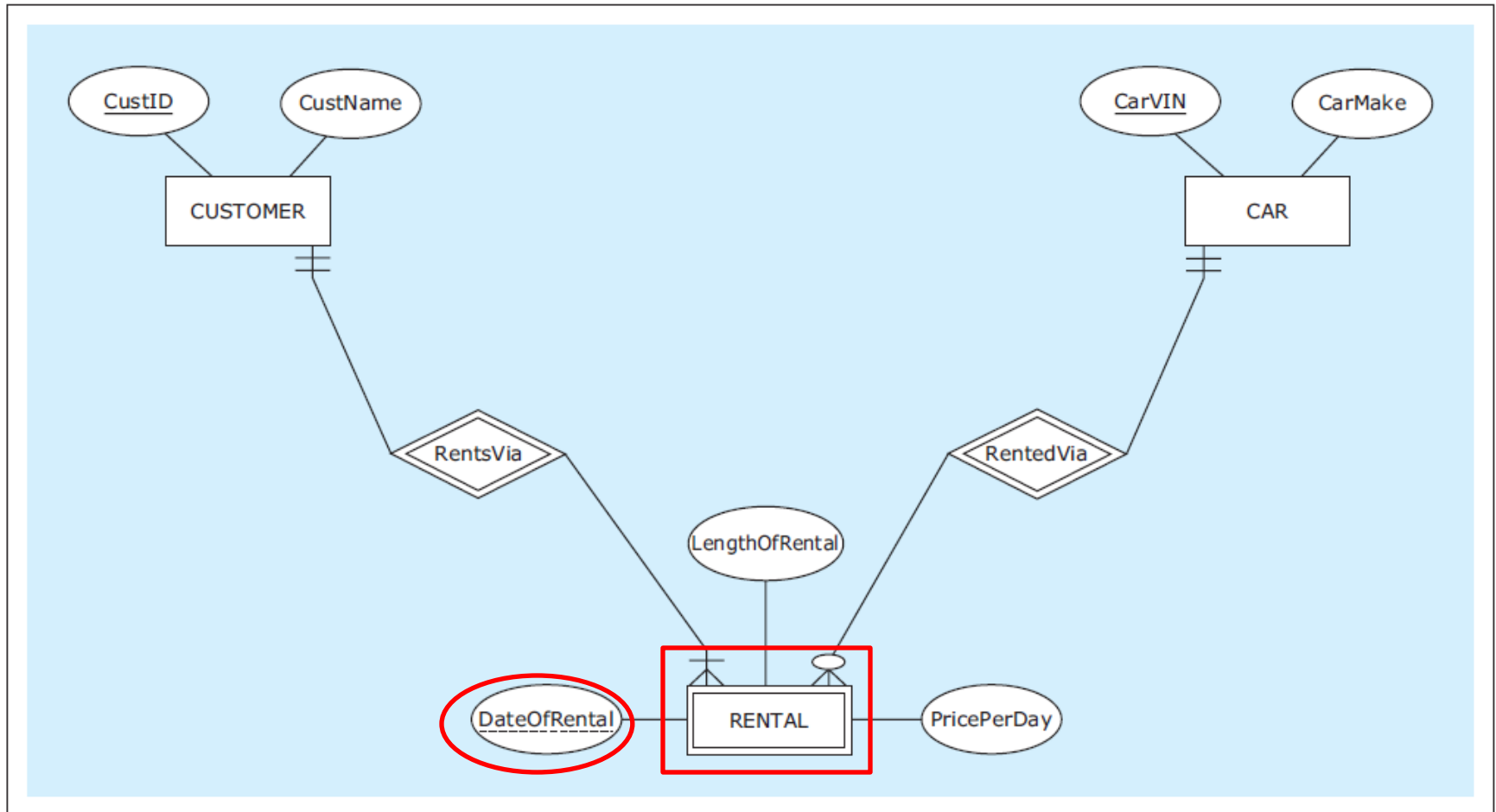An ER diagram for an M:N relationship represented as a weak entity

Each employee can complete multiple Different proficiency tests on a given date.

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

Another M:N relationship represented as a weak entity
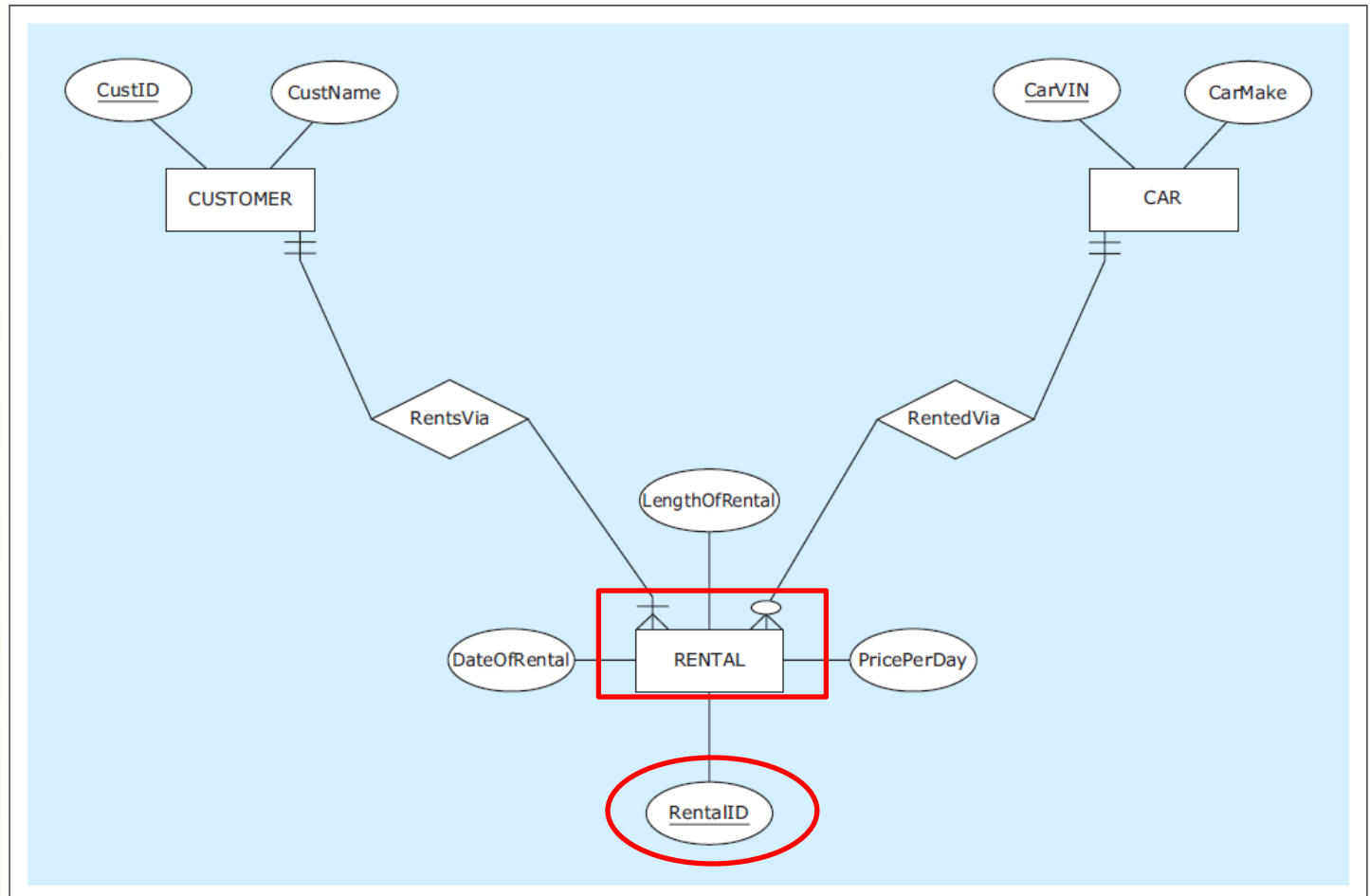
ER diagram for a rental company:

M:N RELATIONSHIPS WITH MULTIPLE INSTANCES BETWEEN THE SAME ENTITIES

Use a regular entity with a unique attribute for a M:N relationship with multiple instances between same entities

Common Technique:

- Add a unique attribute

ASSOCIATIVE ENTITY

- Associative entity
  - An alternative way of depicting M:N relationships
  - Do not have unique or partially unique attributes
  - Often do not have any attributes at all
  - Example in next slide
    - Relationship AssignedTo = entity ASSIGNMENT entity
      - Equivalent attributes
      - Equivalent cardinality
  - Always have mandatory one cardinality in a relationship
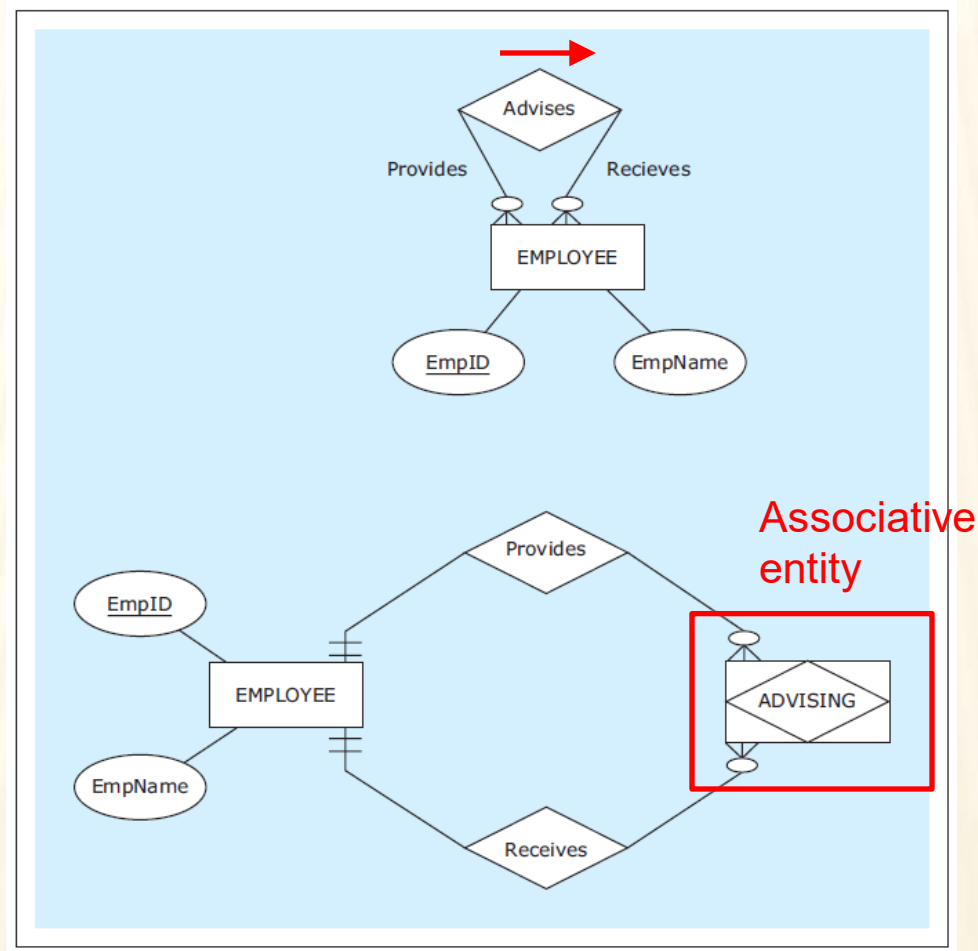
ASSOCIATIVE ENTITY

An identical relationship represented as a M:N relationship and as an associative entity
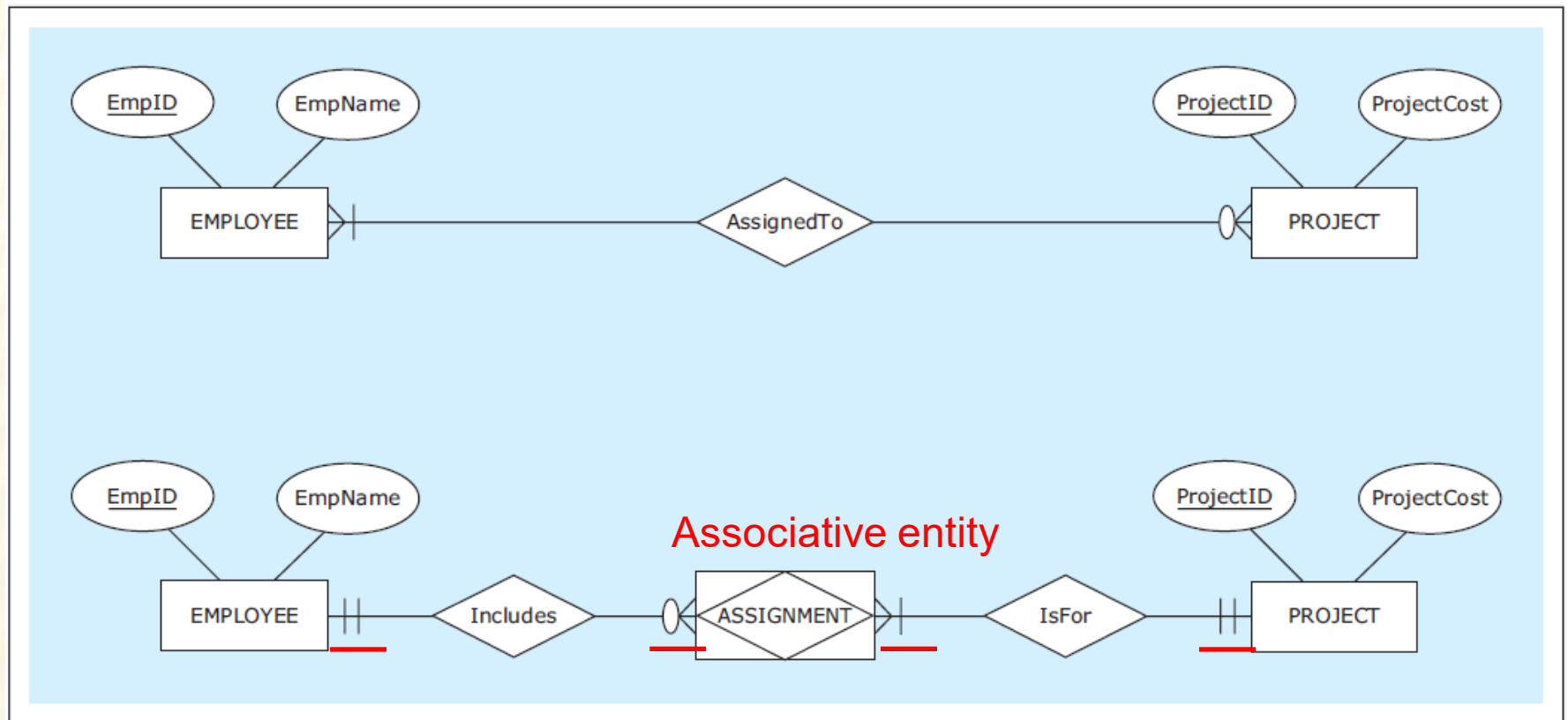
ASSOCIATIVE ENTITY

An identical relationship represented as a unary M:N relationship and as an associative entity

Associative entity

ASSOCIATIVE ENTITY

An identical relationship represented as an M:N relationship with an attribute and as an associative entity with an attribute


Associative entity
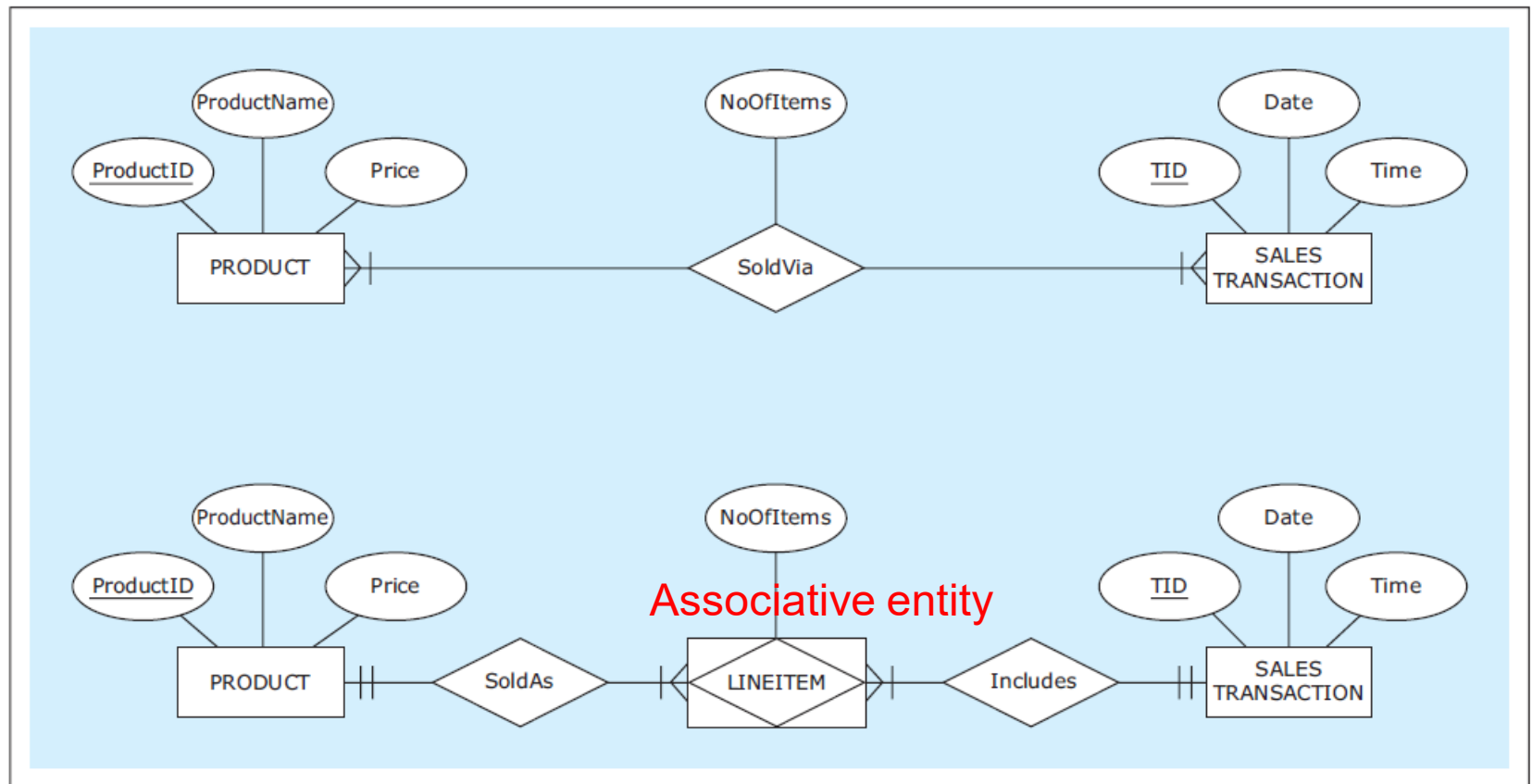
ASSOCIATIVE ENTITY

- Simply another way of depicting a binary or unary relationship
- But eliminate potential ambiguities in the ER diagrams
  - For relationships with a degree higher than 2 such as ternary relationships

TERNARY RELATIONSHIP

A ternary relationship

- Involving 3 entities
- Degree: 3
- This example depicts

  A specific supplier S1 provides a specific component C1 for a specific product P1.
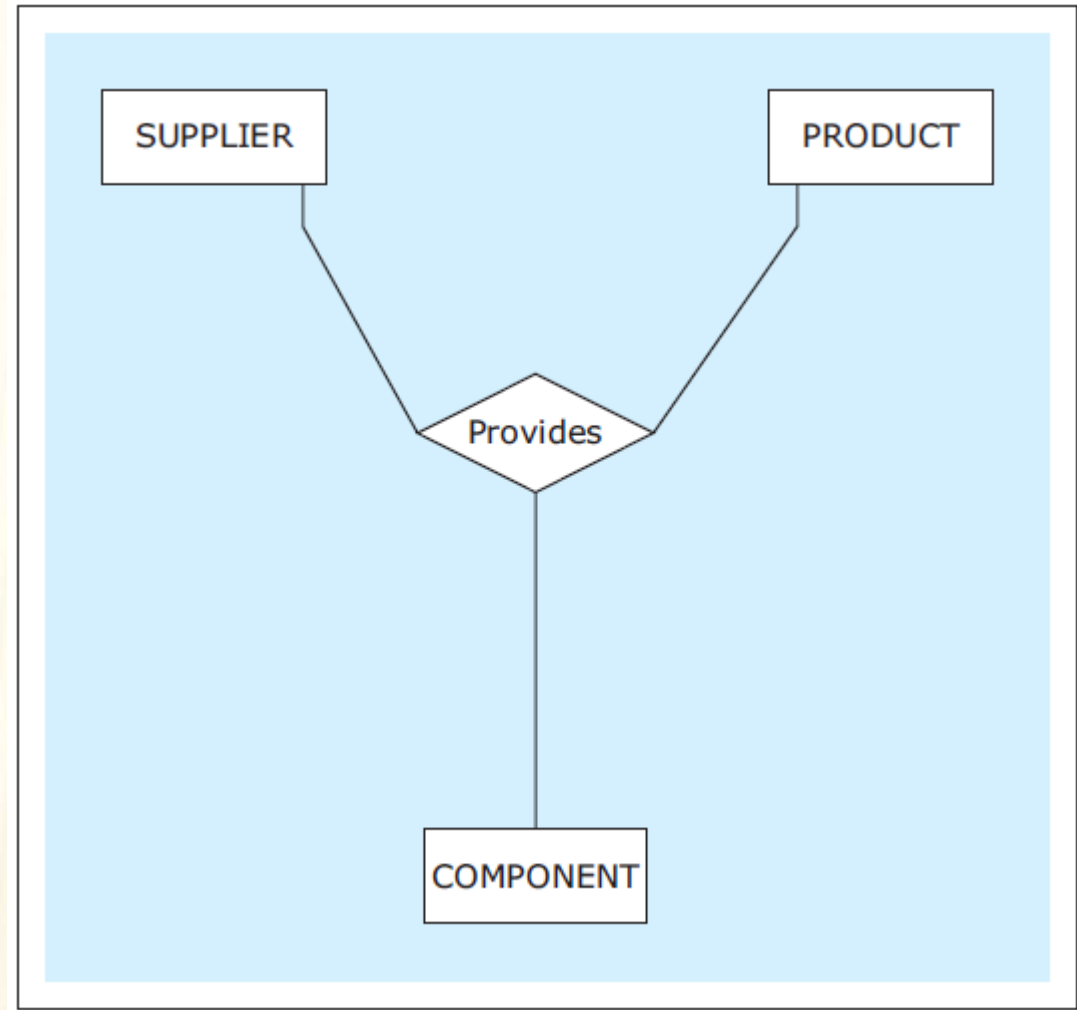
TERNARY RELATIONSHIP

Three binary relationships that are insufficient for depicting a
ternary relationship

Can not depict
clearly which
supplier provide
which component
for which product.