

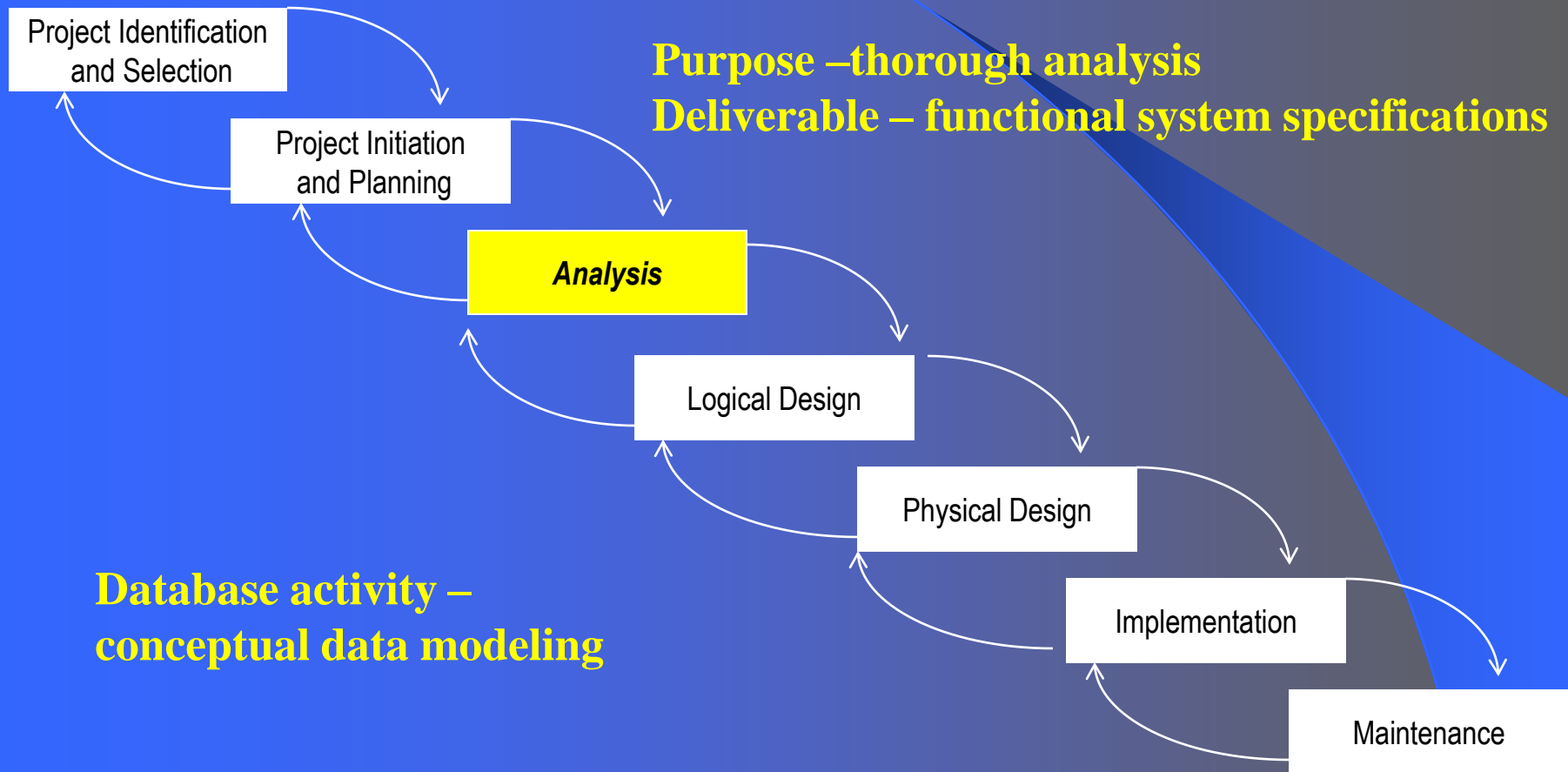
Chapter 3: Modeling Data in the Organization

Modern Database Management

6th Edition

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SDLC Revisited – Data Modeling is an Analysis Activity (figures 2.4, 2.5)



Business Rules

Statements that define or constrain some aspect of the business

Assert business structure

Control/influence business behavior

Expressed in terms familiar to end users

Automated through DBMS software

A Good Business Rule is:

Declarative – what, not how

Precise – clear, agreed-upon meaning

Atomic – one statement

Consistent – internally and externally

Expressible – structured, natural language

Distinct – non-redundant

Business-oriented – understood by business people

E-R Model Constructs

Entity instance - person, place, object, event, concept
(often corresponds to a row in a table)

- **Entity Type** – collection of entities (often corresponds to a table)

Attribute - property or characteristic of an entity type
(often corresponds to a field in a table)

Relationship instance – link between entities
(corresponds to primary key-foreign key equivalencies in related tables)

- **Relationship type** – category of relationship...link between entity types

Sample E-R Diagram (figure 3-1)

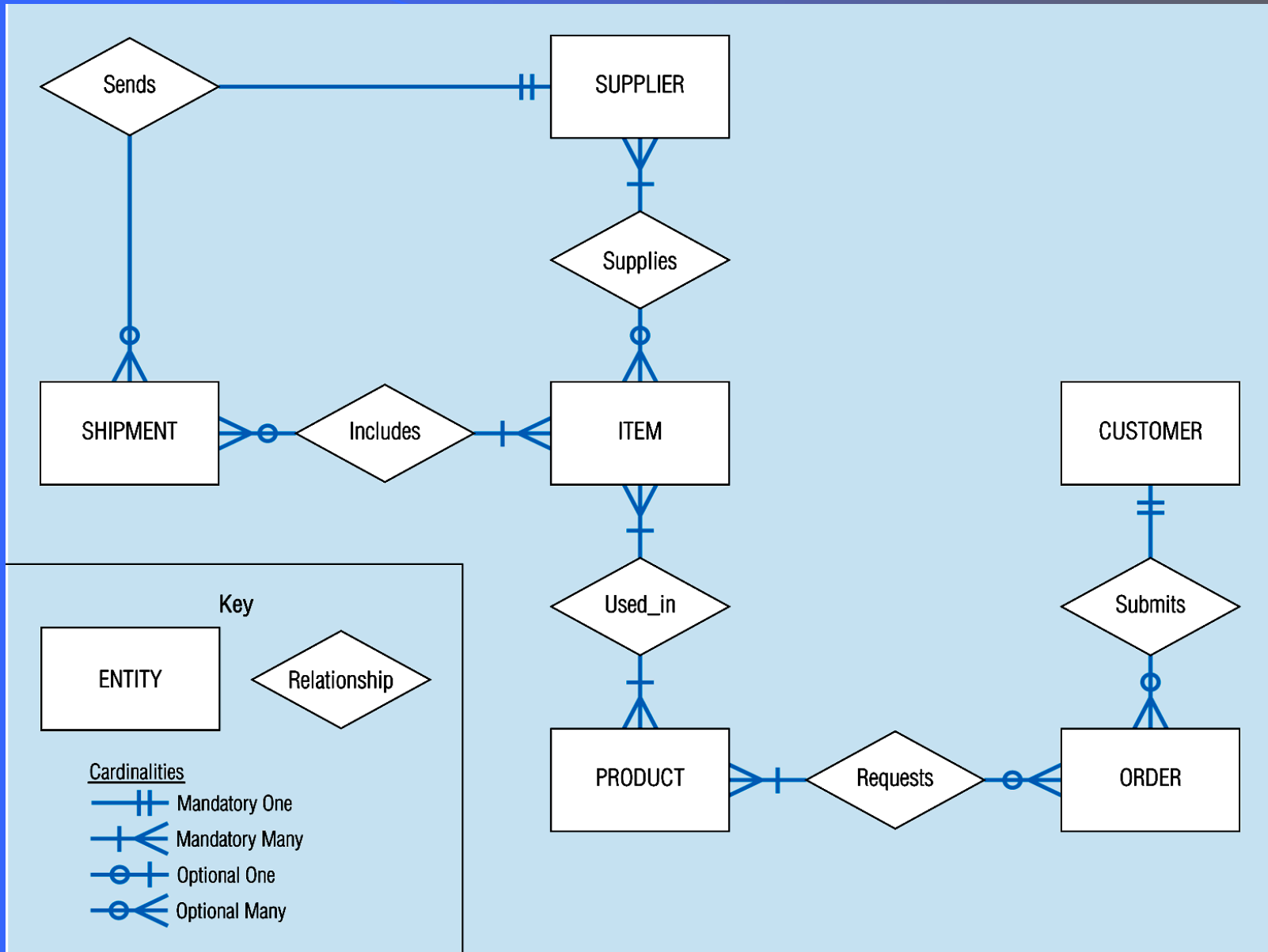


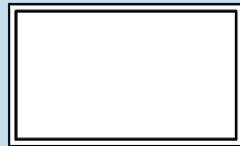
Figure 3-2 -- Basic E-R Notation

Entity
symbols

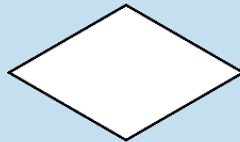
Basic symbols



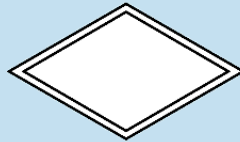
Strong entity



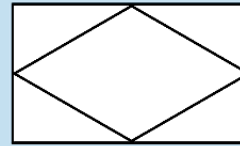
Weak entity



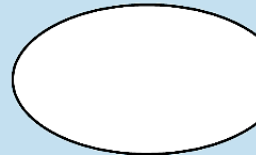
Relationship



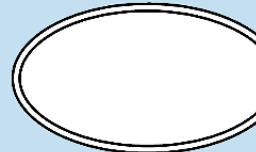
Identifying relationship



Associative entity



Attribute



Multivalued attribute



Derived attribute

A special
entity that is
also a
relationship

Attribute
symbols

Relationship
symbols

What Should an Entity Be?

SHOULD BE:

- An object that will have many instances in the database
- An object that will be composed of multiple attributes
- An object that we are trying to model

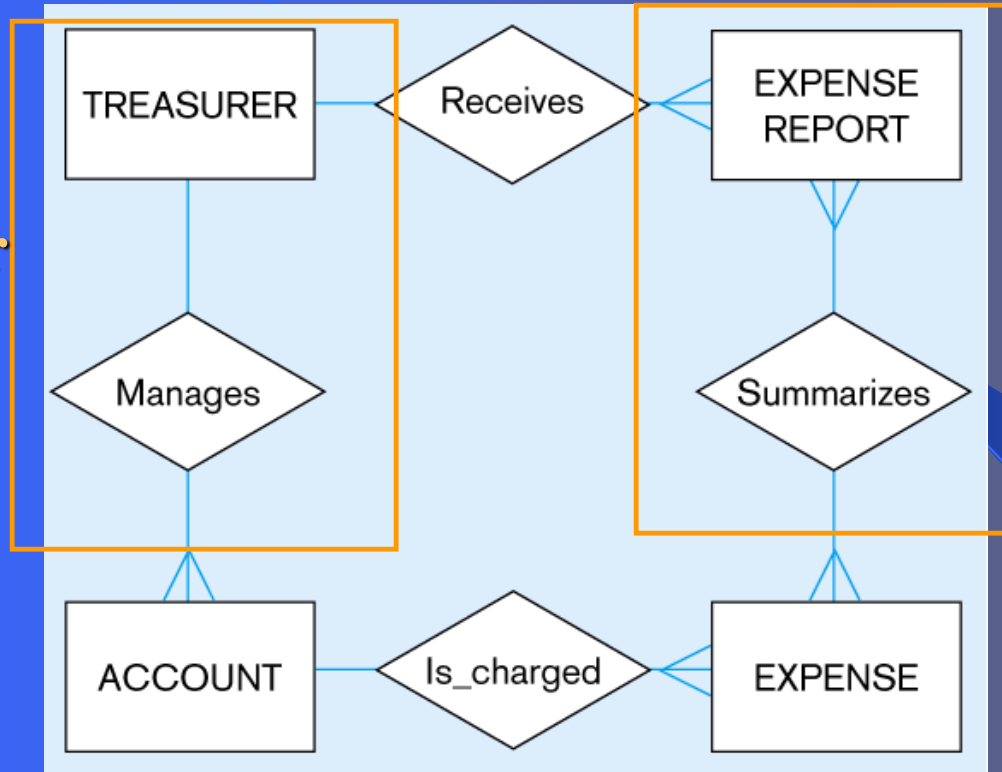
SHOULD NOT BE:

- A user of the database system
- An output of the database system (e.g. a report)

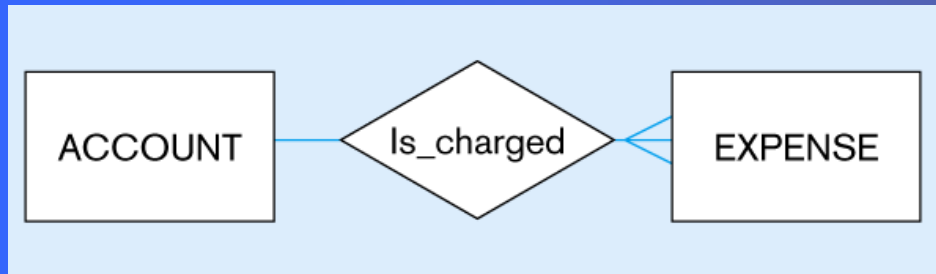
Figure 3-4

Inappropriate entities

System user



System output



Appropriate entities

Attributes

Attribute - property or characteristic of an entity type

Classifications of attributes:

- Simple versus Composite Attribute
- Single-Valued versus Multivalued Attribute
- Stored versus Derived Attributes
- Identifier Attributes

Identifiers (Keys)

Identifier (Key) - An attribute (or combination of attributes) that uniquely identifies individual instances of an entity type

Simple Key versus Composite Key

Candidate Key – an attribute that could be a key...satisfies the requirements for being a key

Characteristics of Identifiers

Will not change in value

Will not be null

No intelligent identifiers (e.g. containing locations or people that might change)

Substitute new, simple keys for long, composite keys

Figure 3-7 -- A **composite** attribute

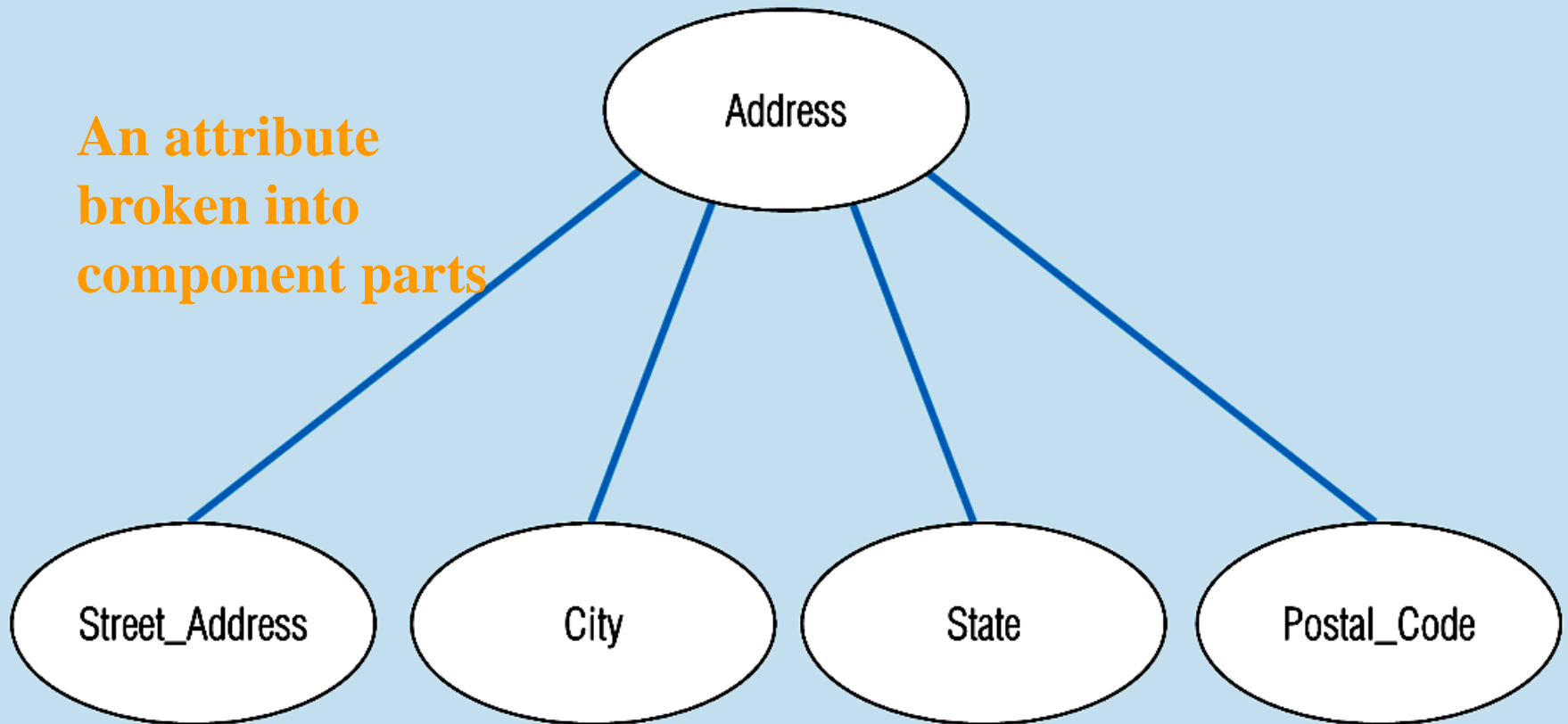


Figure 3-9a – Simple key attribute

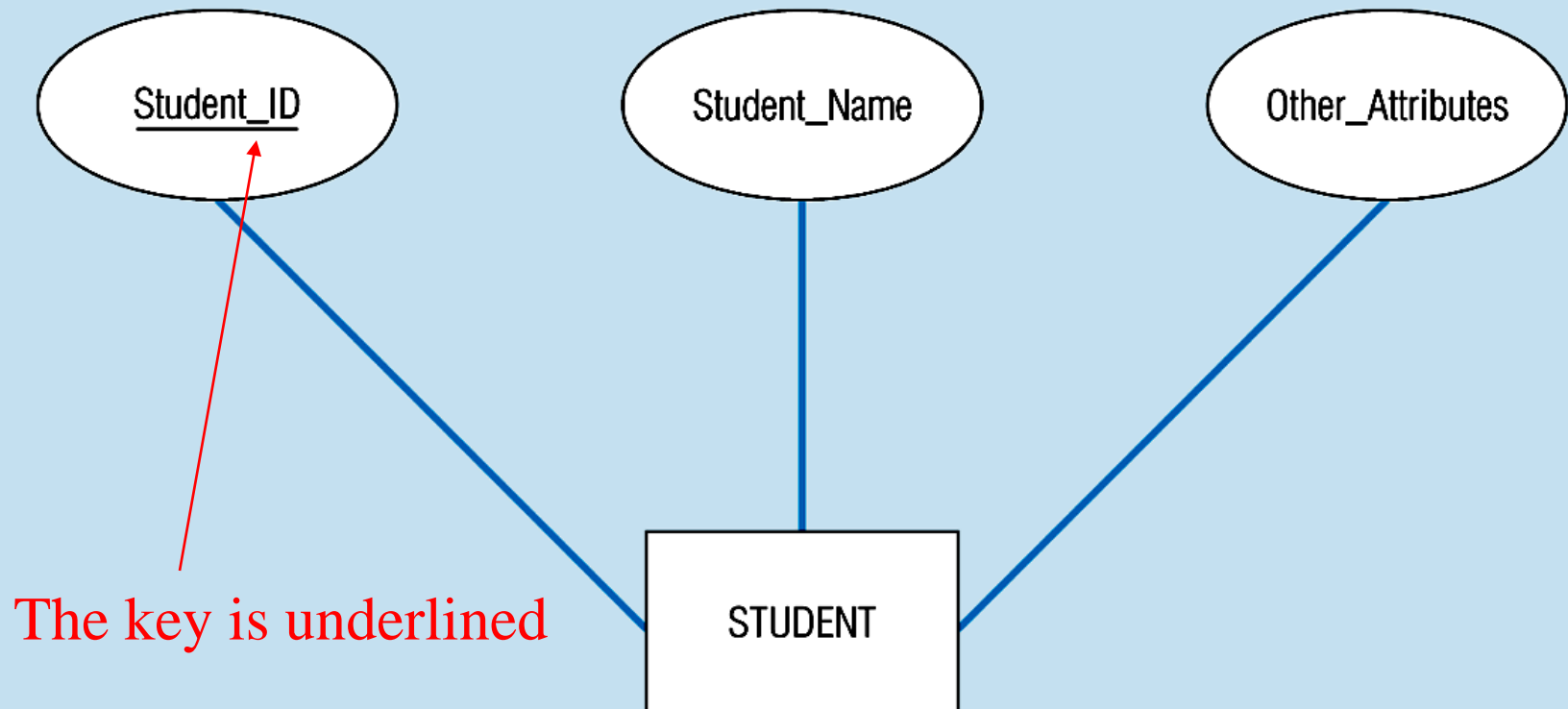


Figure 3-9b -- Composite key attribute

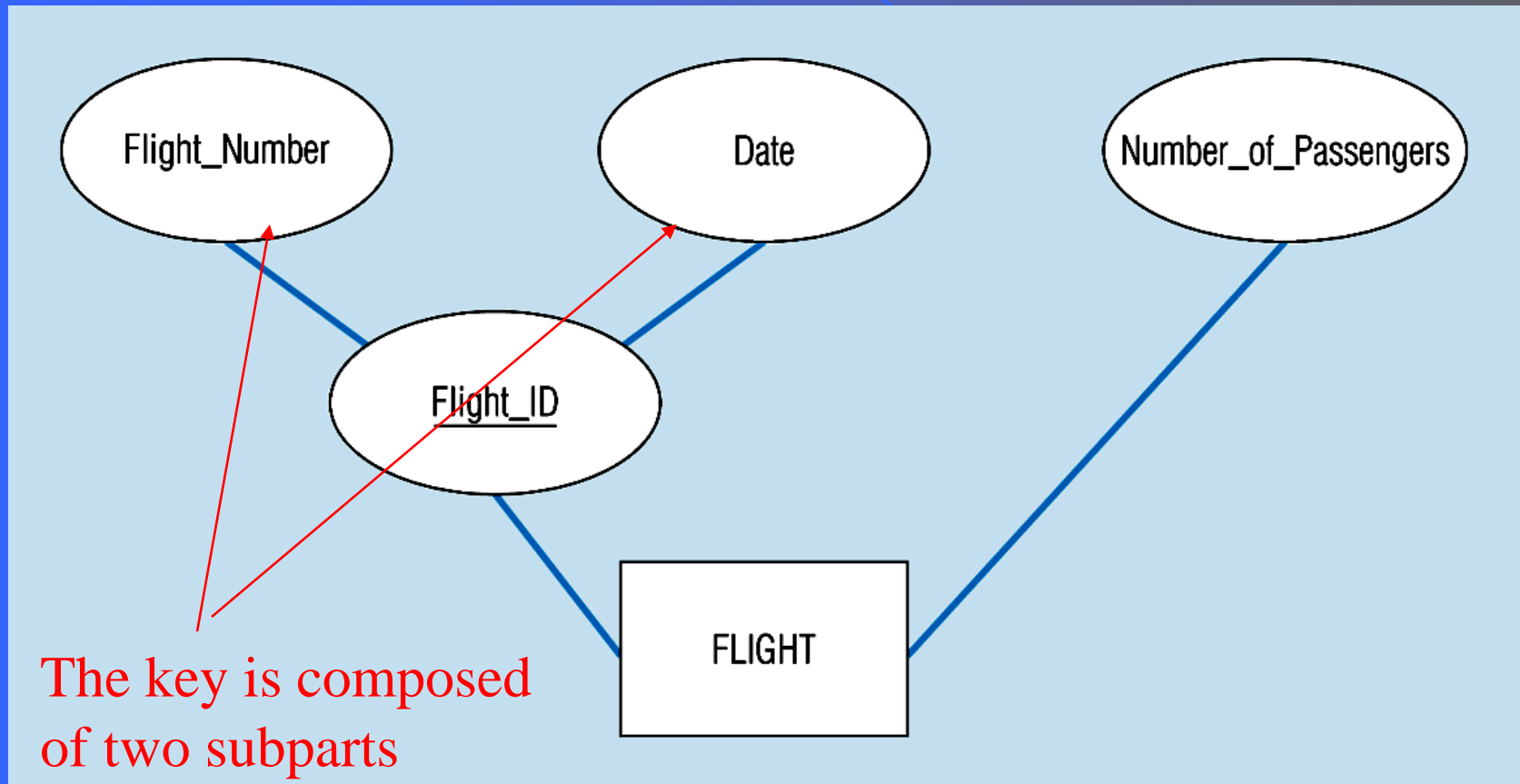


Figure 3-8 -- Entity with a multivalued attribute (Skill) and derived attribute (Years_Employed)

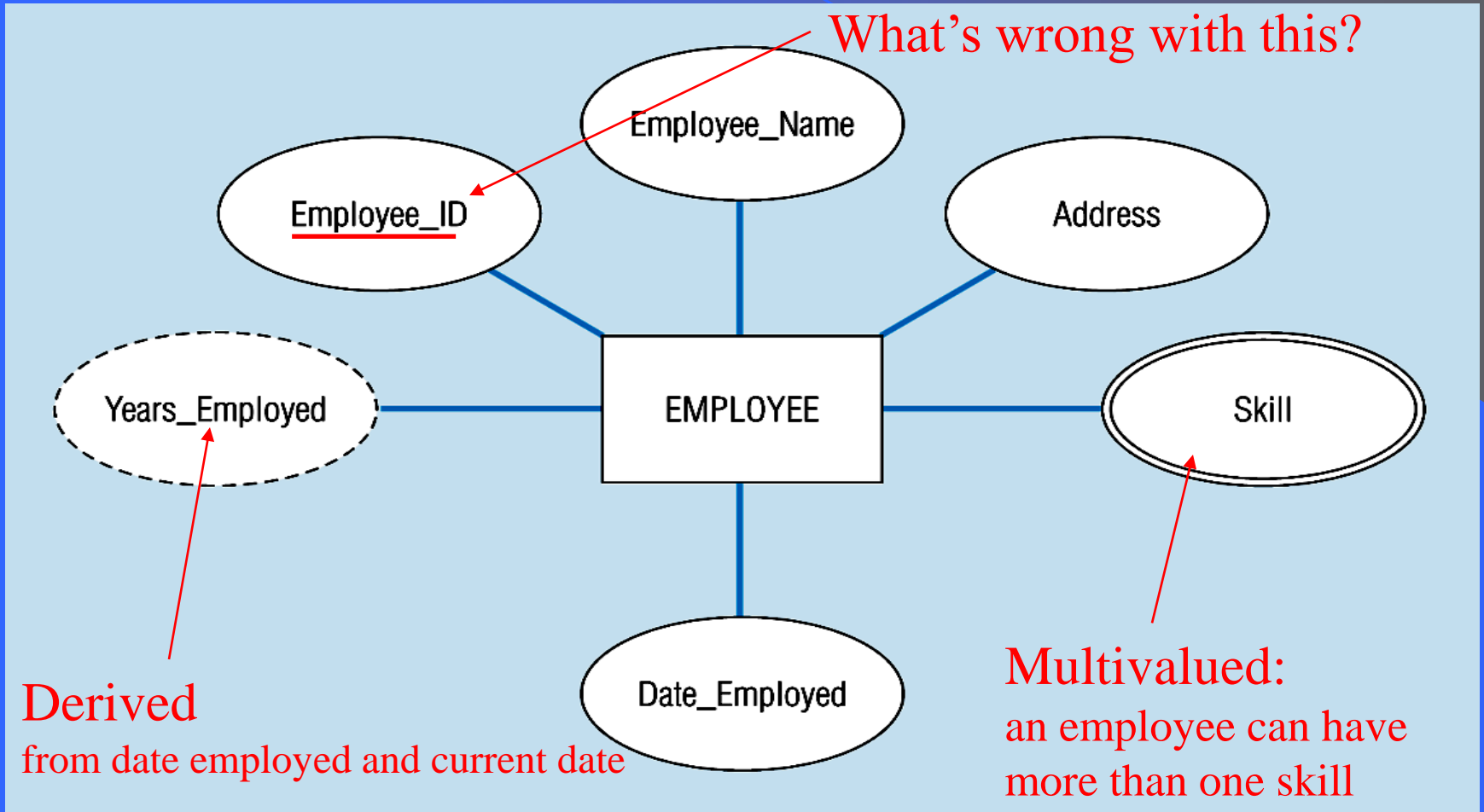
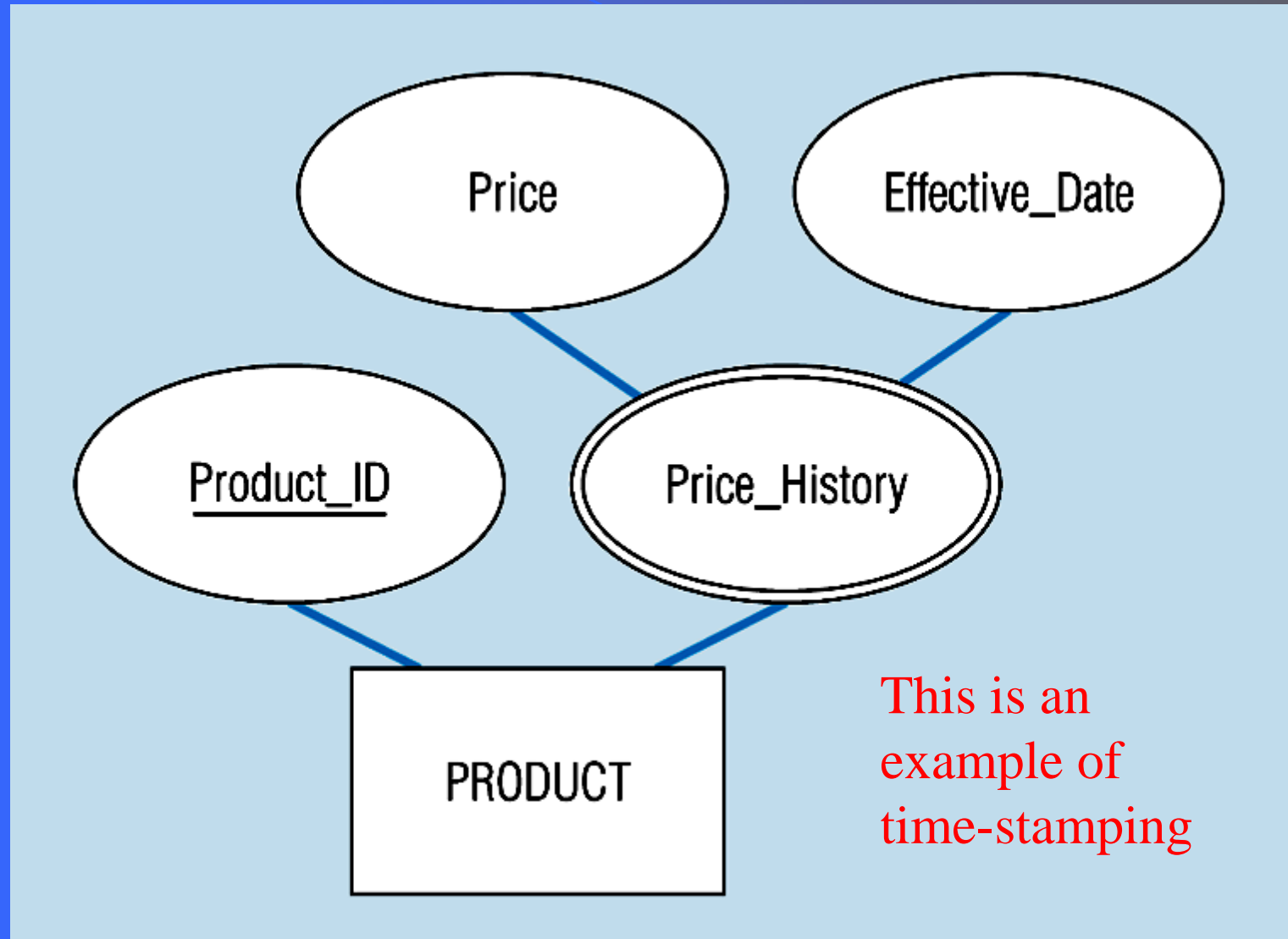


Figure 3-19 – an attribute that is both multivalued and composite



More on Relationships

Relationship Types vs. Relationship Instances

- The relationship type is modeled as the diamond and lines between entity types...the instance is between specific entity instances

Relationships can have attributes

- These describe features pertaining to the association between the entities in the relationship

Two entities can have more than one type of relationship between them (multiple relationships)

Associative Entity = combination of relationship and entity

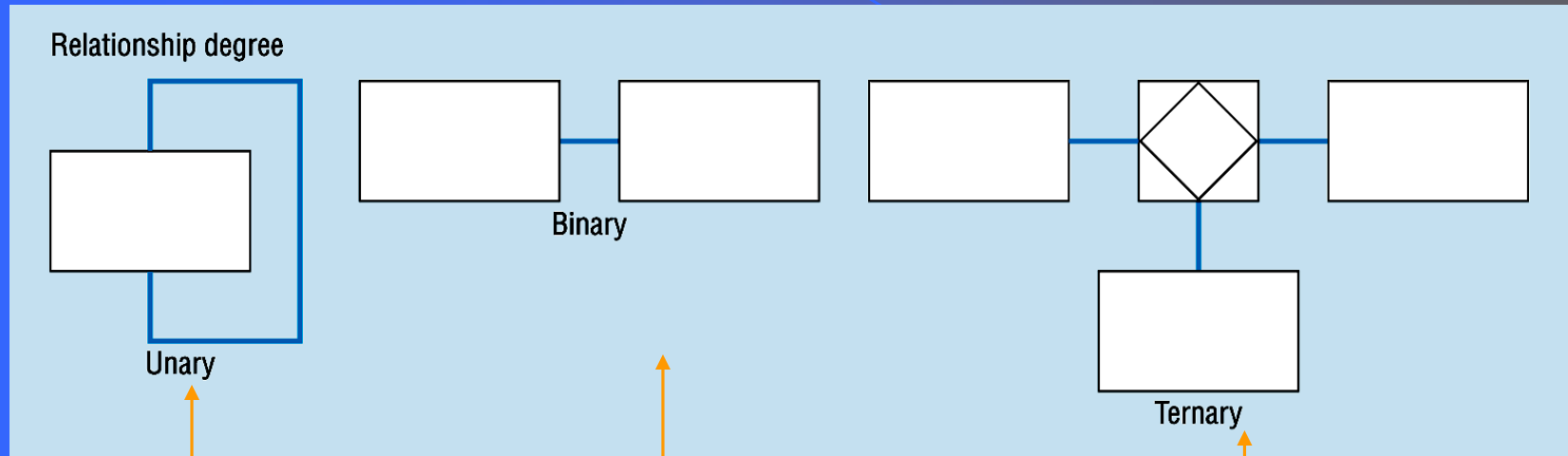
- More on this later

Degree of Relationships

Degree of a Relationship is the number of entity types that participate in it

- Unary Relationship
- Binary Relationship
- Ternary Relationship

Degree of relationships – from figure 3-2



One entity related to another of the same entity type

Entities of two different types related to each other

Entities of three different types related to each other

Cardinality of Relationships

One – to – One

- Each entity in the relationship will have exactly one related entity

One – to – Many

- An entity on one side of the relationship can have many related entities, but an entity on the other side will have a maximum of one related entity

Many – to – Many

- Entities on both sides of the relationship can have many related entities on the other side

Cardinality Constraints

Cardinality Constraints - the number of instances of one entity that can or must be associated with each instance of another entity.

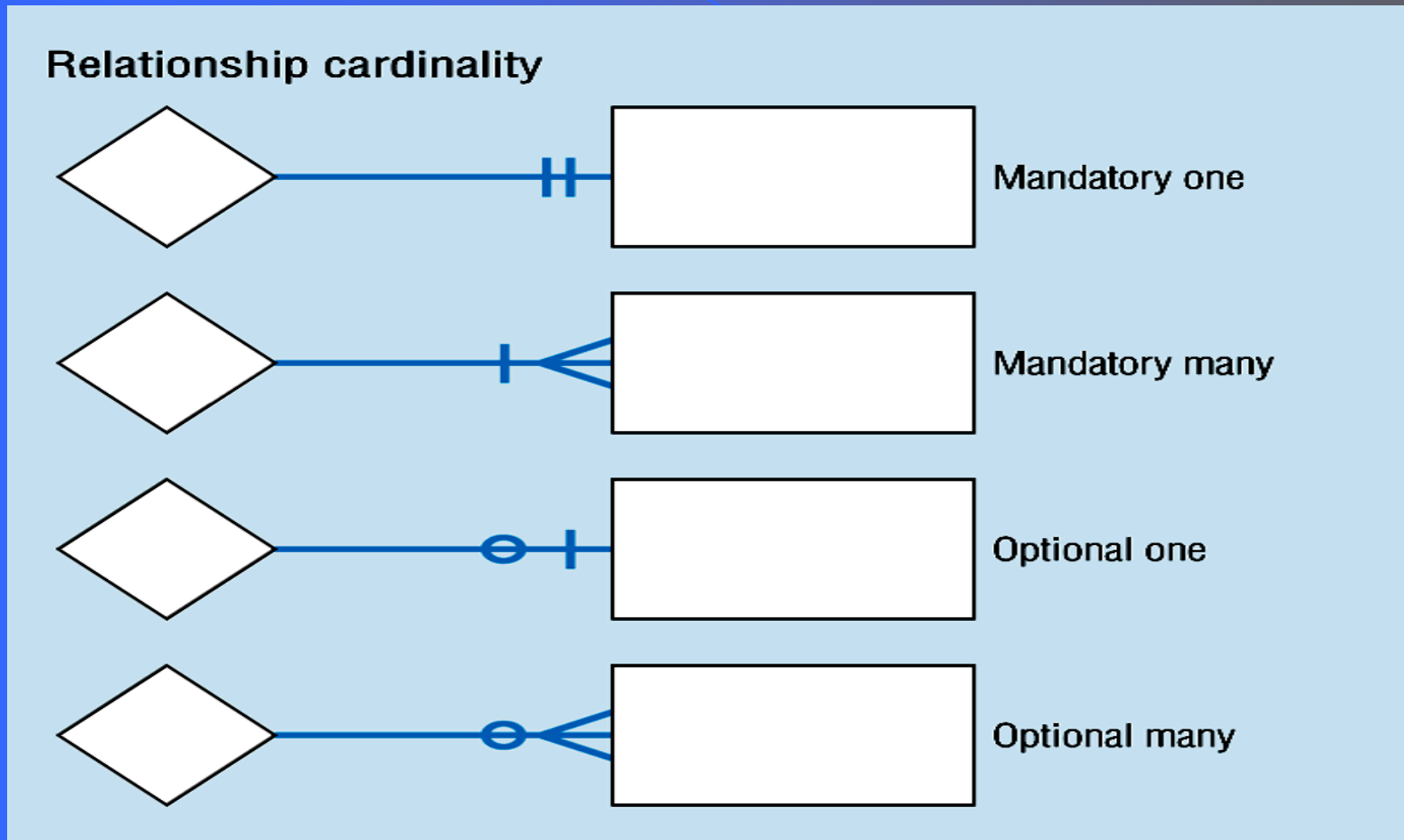
Minimum Cardinality

- If zero, then optional
- If one or more, then mandatory

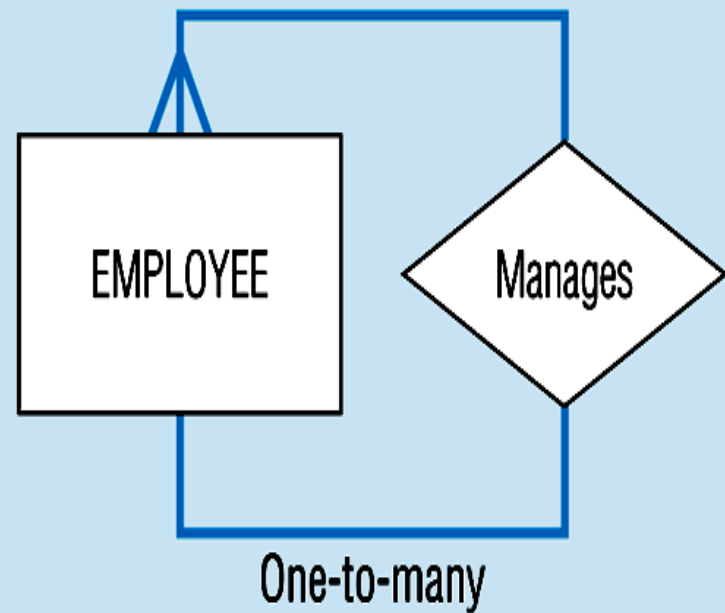
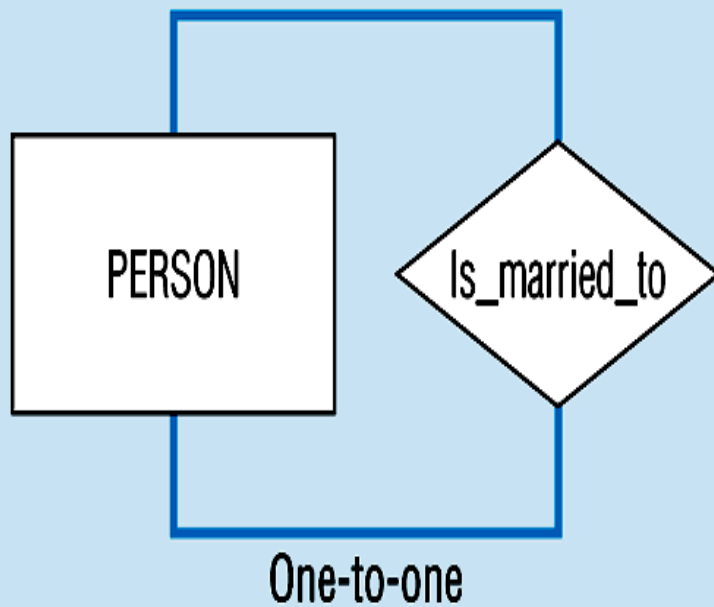
Maximum Cardinality

- The maximum number

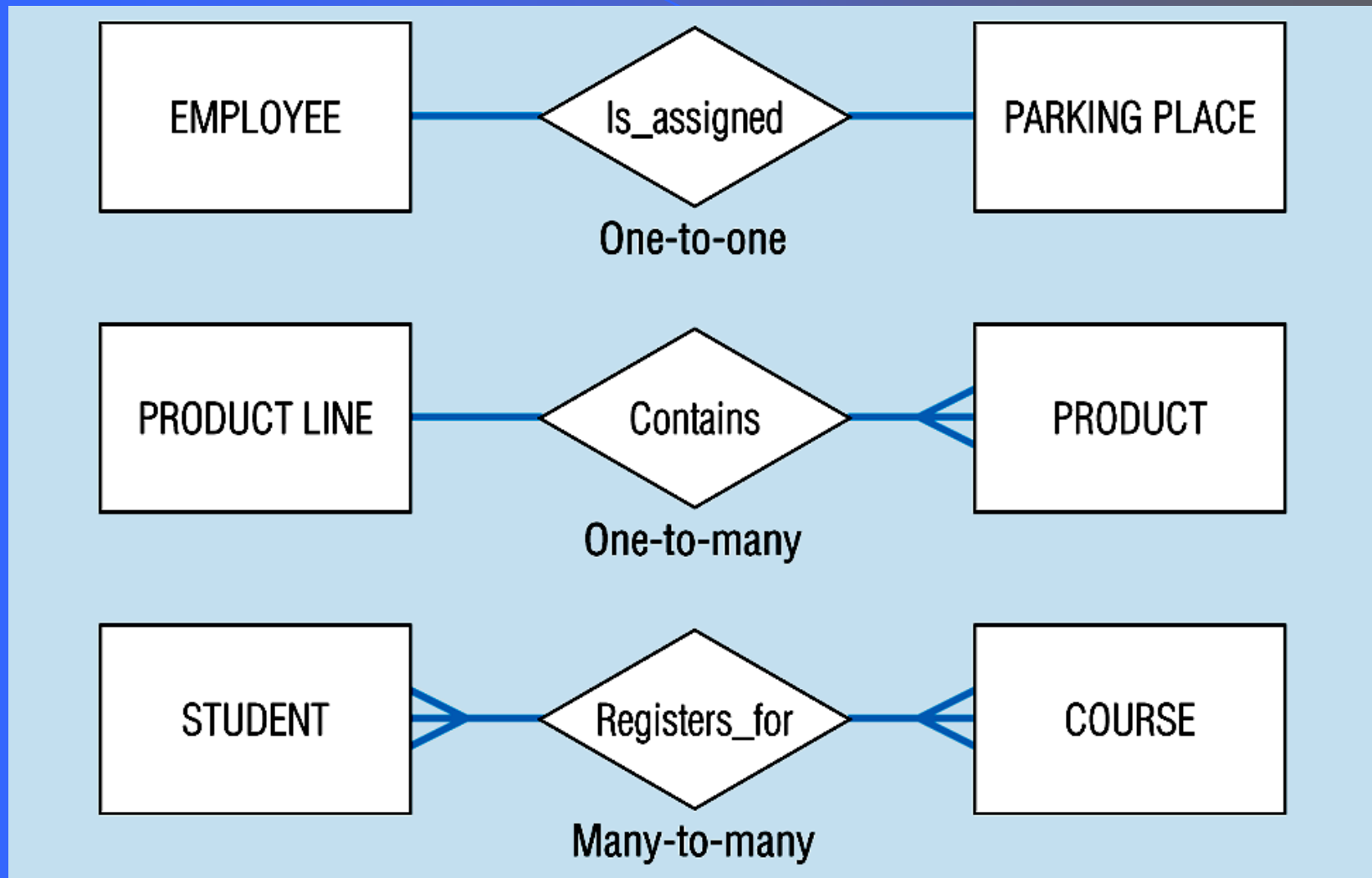
Cardinality – figure 3-2



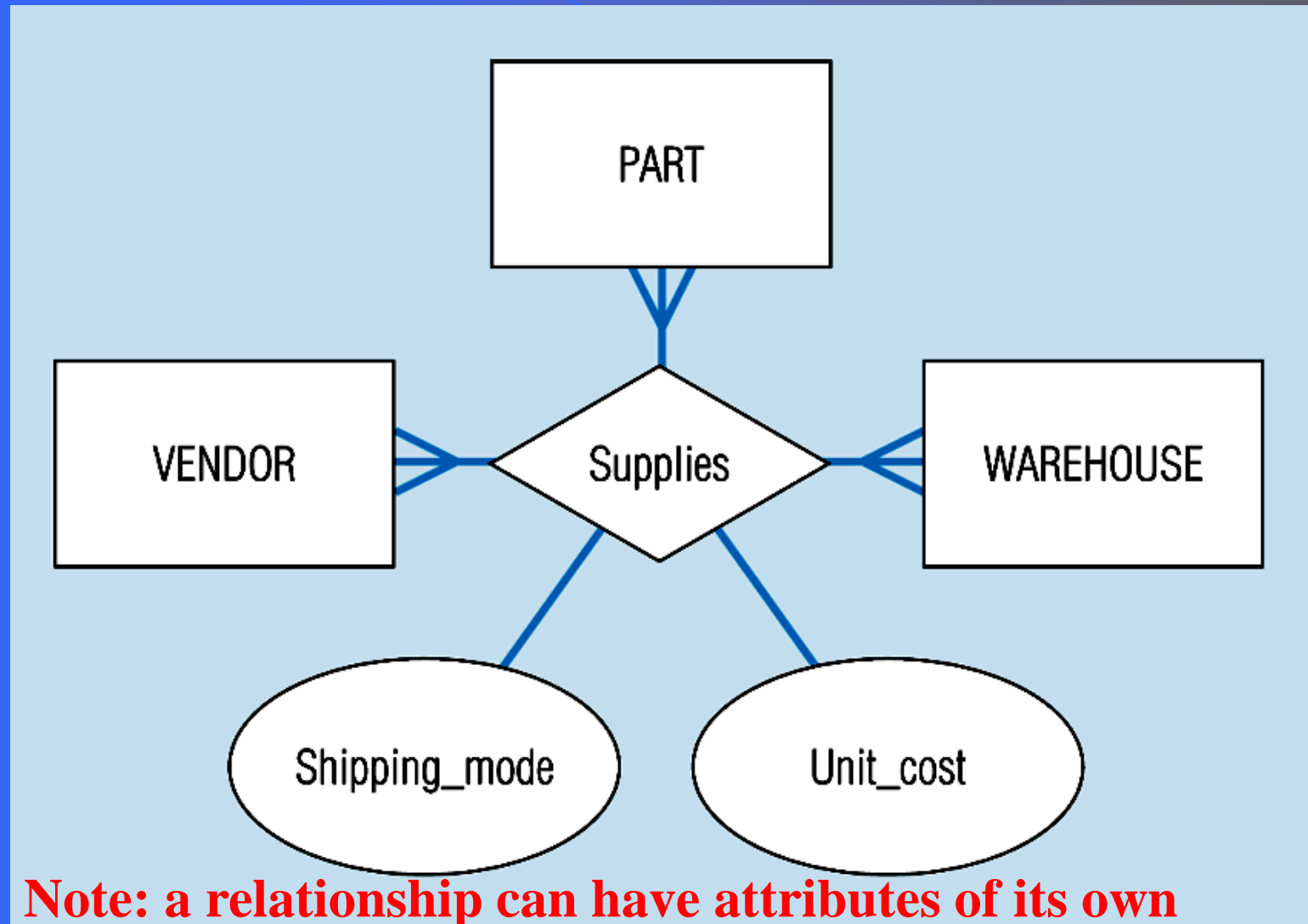
Unary relationships -- figure 3-12a



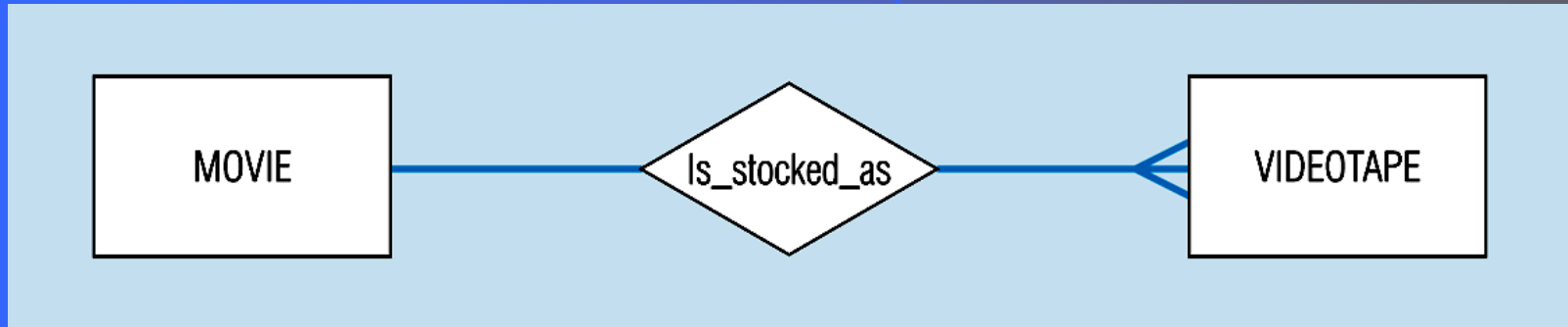
Binary relationships – figure 3-12b



Ternary relationships –figure 3-12c



Basic relationship with only maximum cardinalities showing – figure 3-16a



Mandatory minimum cardinalities – figure 3-17a

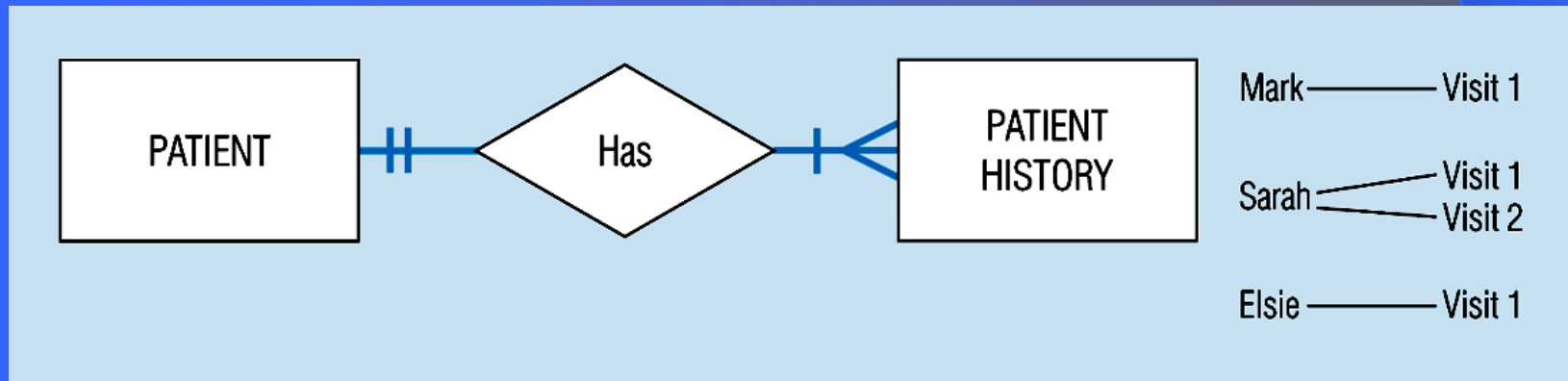


Figure 3-17c

Optional cardinalities with unary degree, one-to-one relationship

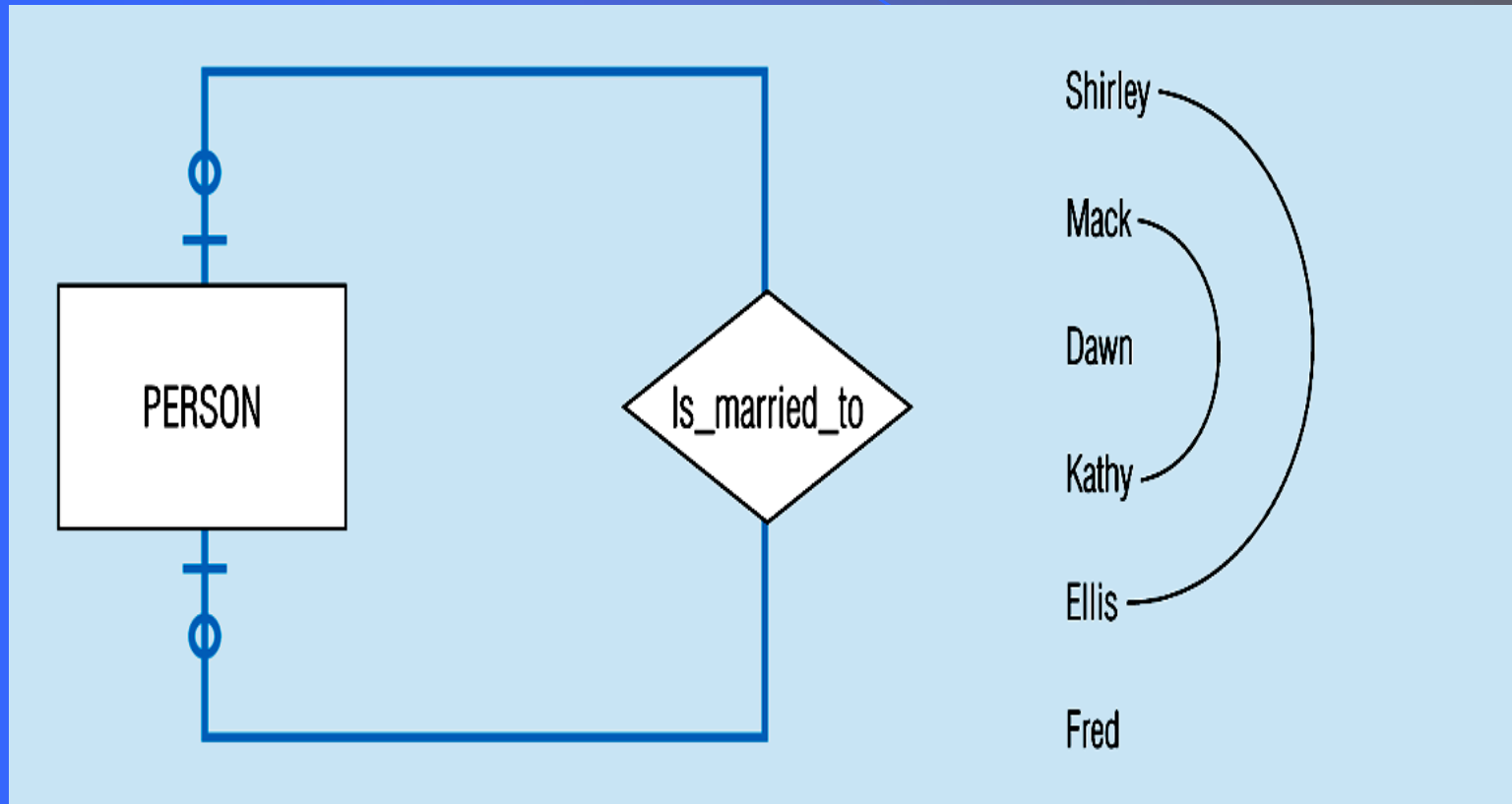
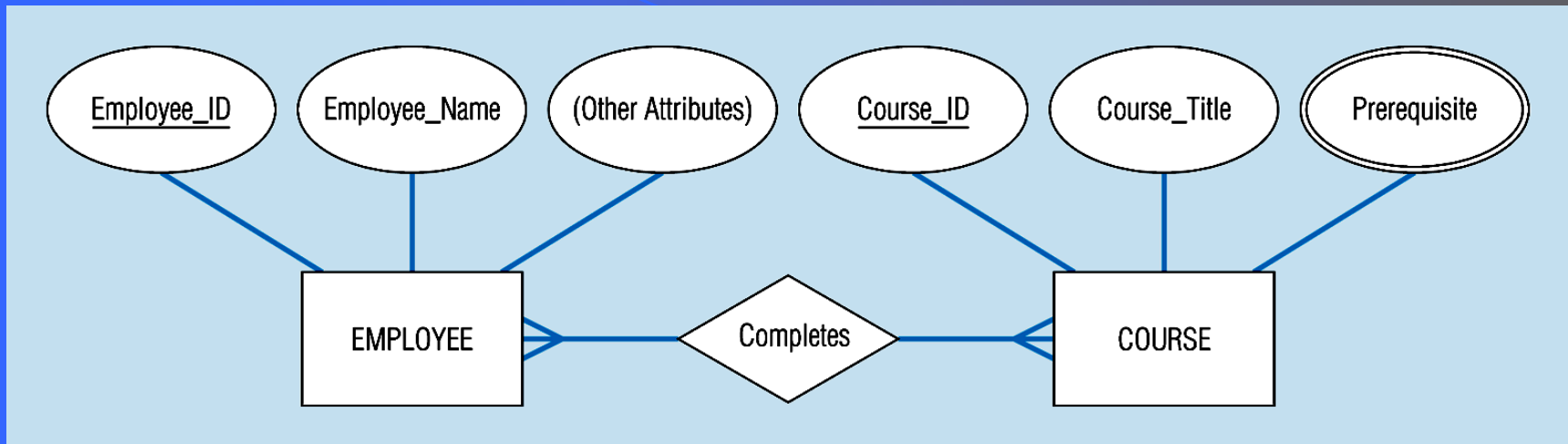


Figure 3-10a Relationship type



3-10b Entity and Relationship instances

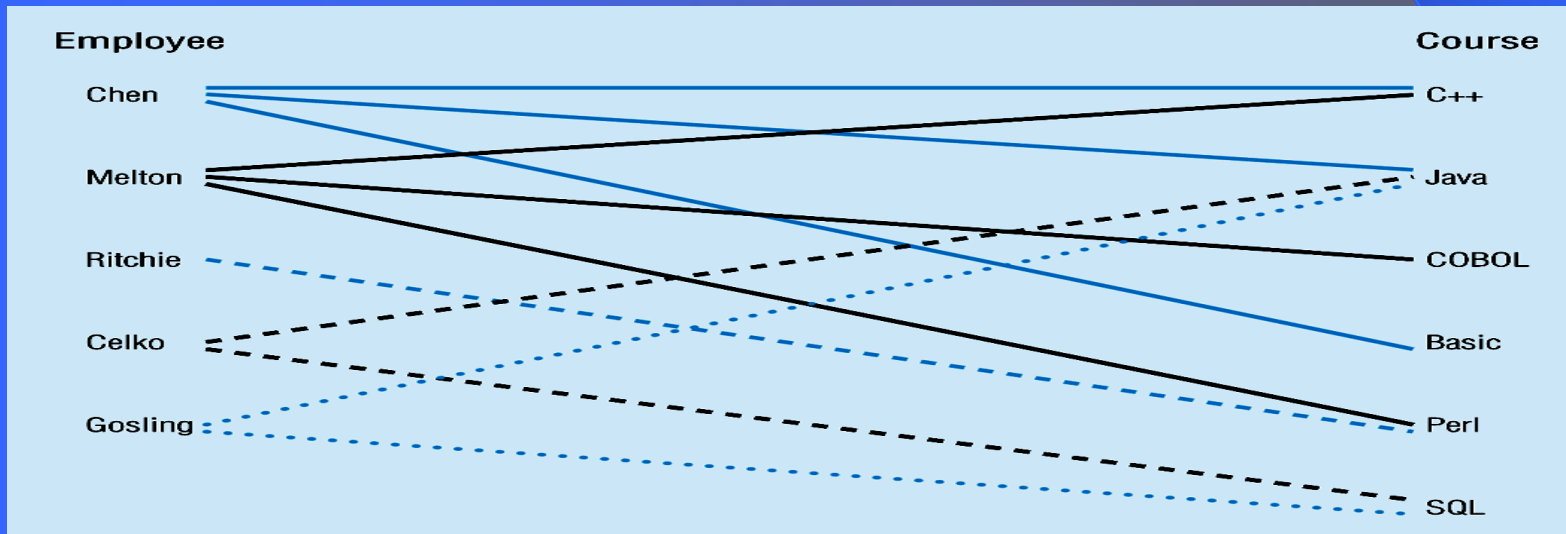
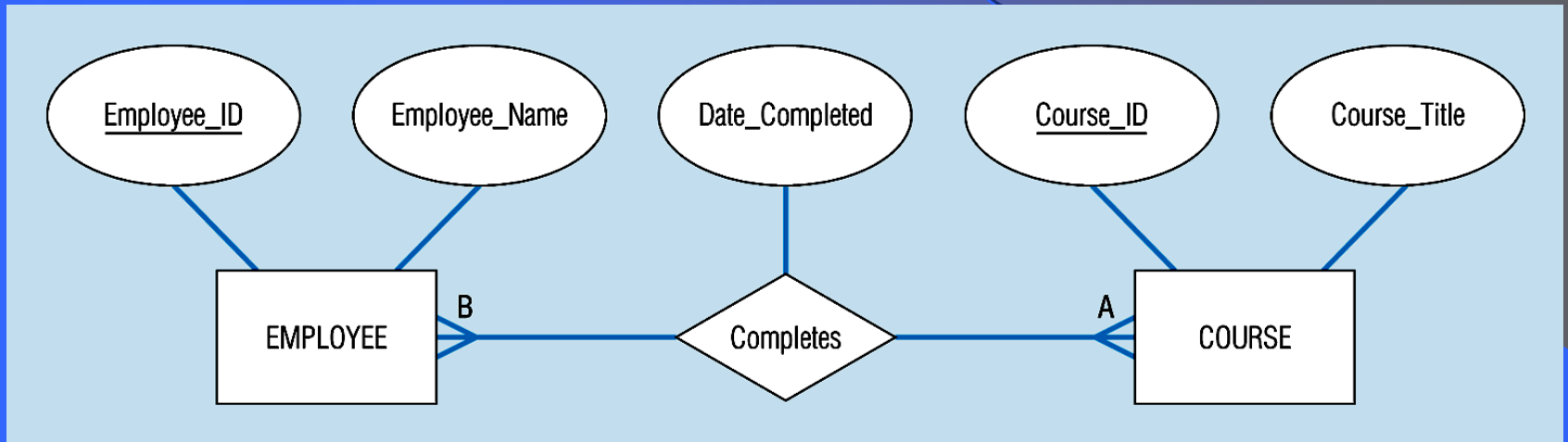


Figure 3-11a A binary relationship with an attribute



Here, the date completed attribute pertains specifically to the employee's completion of a course...it is an attribute of the *relationship*

Figure 3-12c -- A ternary relationship with attributes

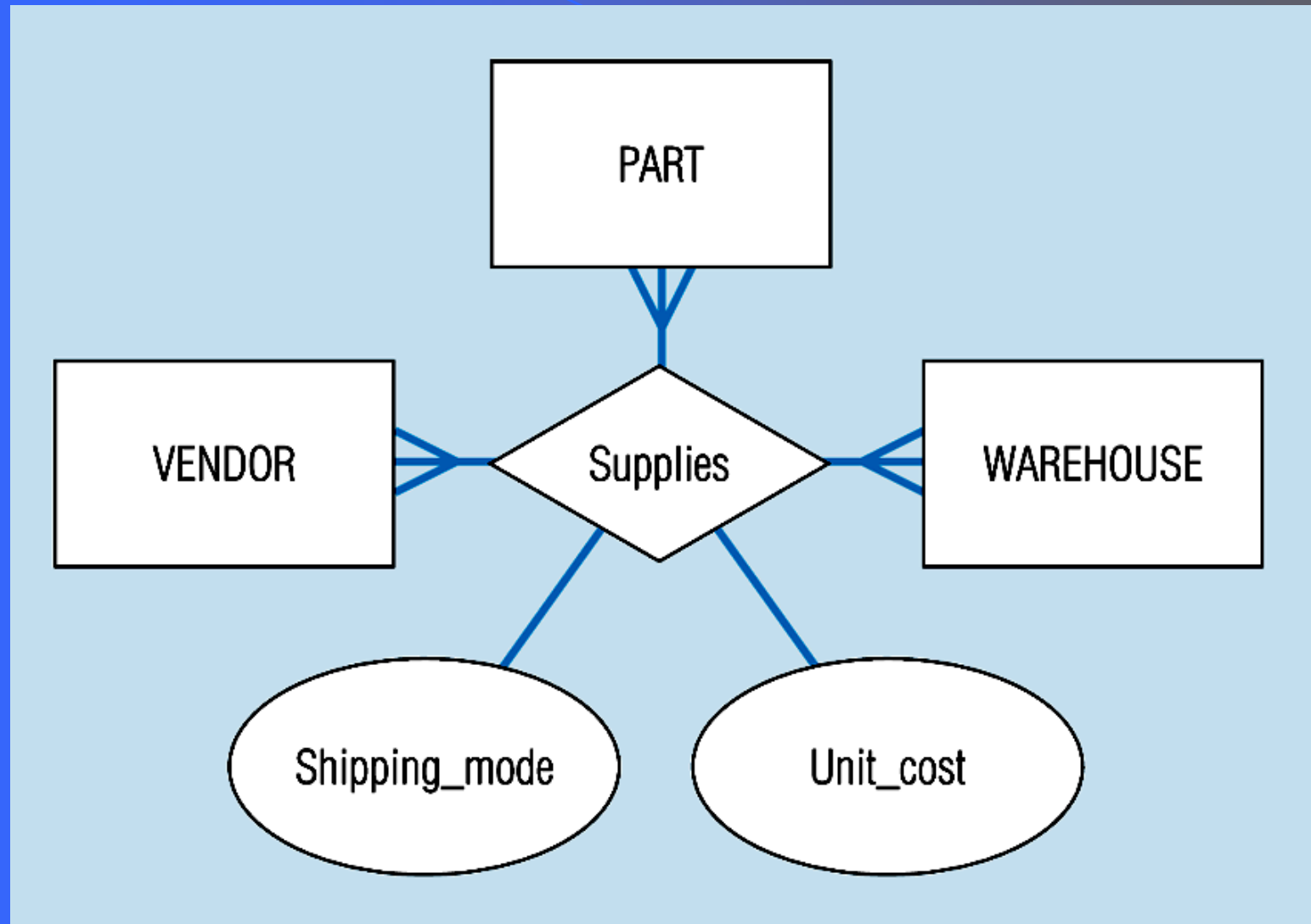
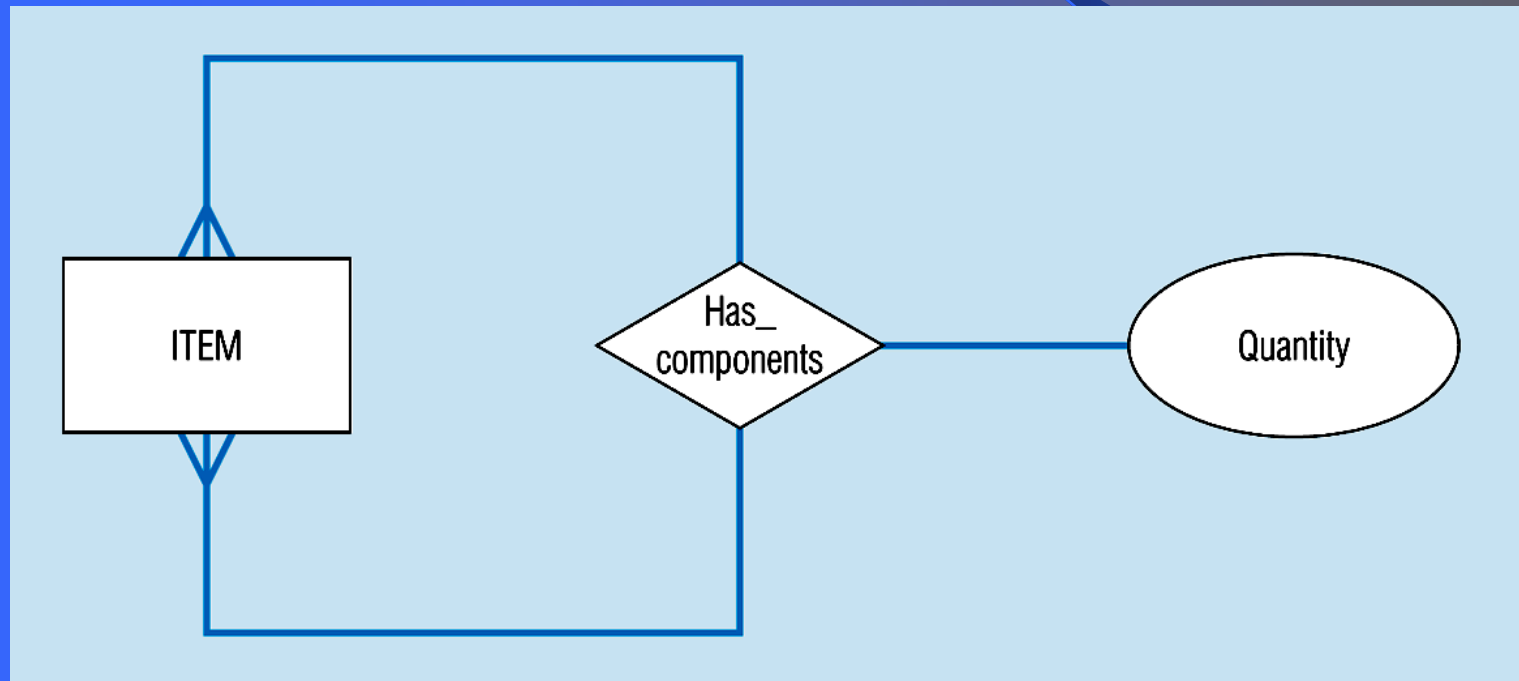


Figure 3-13a A unary relationship with an attribute. This has a many-to-many relationship



Representing a bill-of -materials structure

Examples of multiple relationships – entities can be related to one another in more than one way

Figure 3-21a Employees and departments

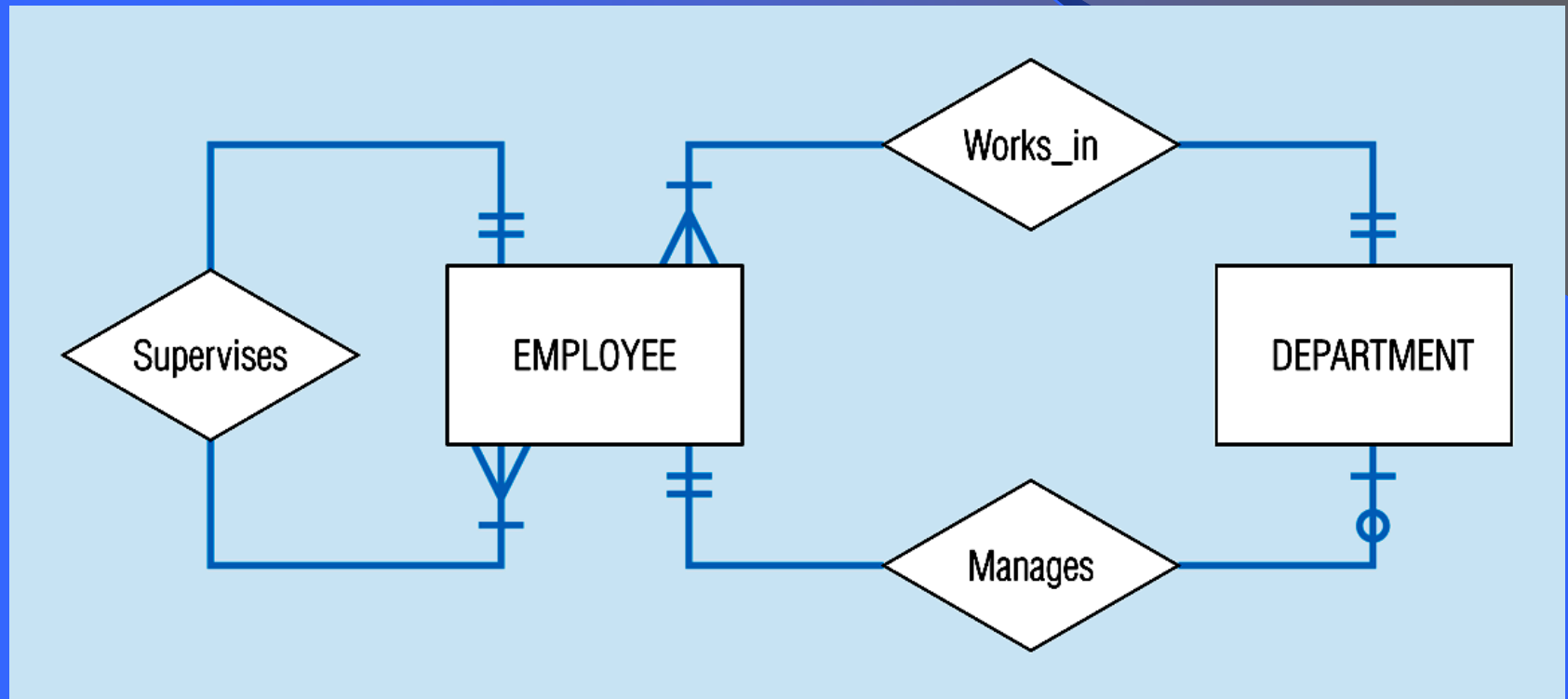


Figure 3-21b -- Professors and courses (fixed upon constraint)

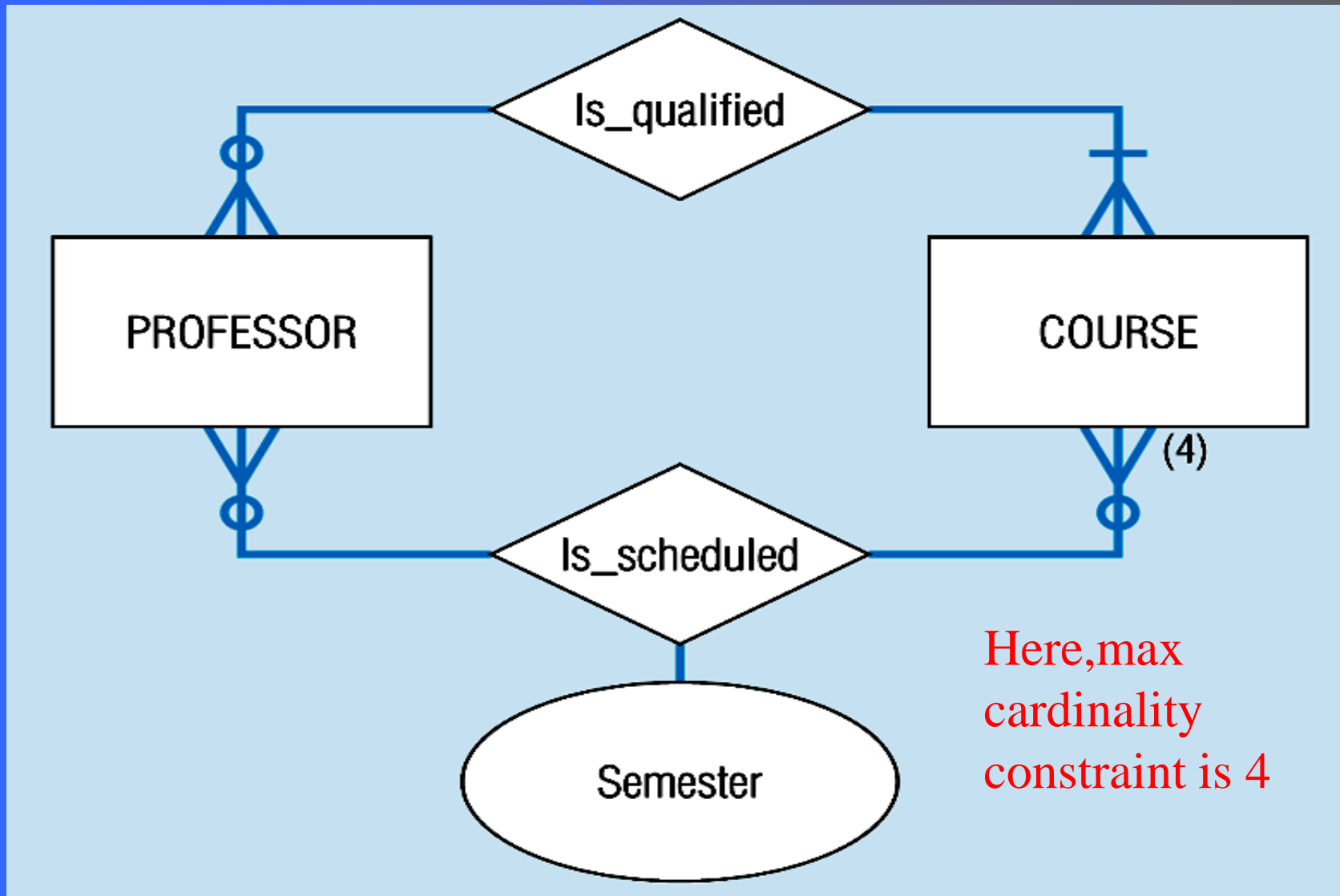
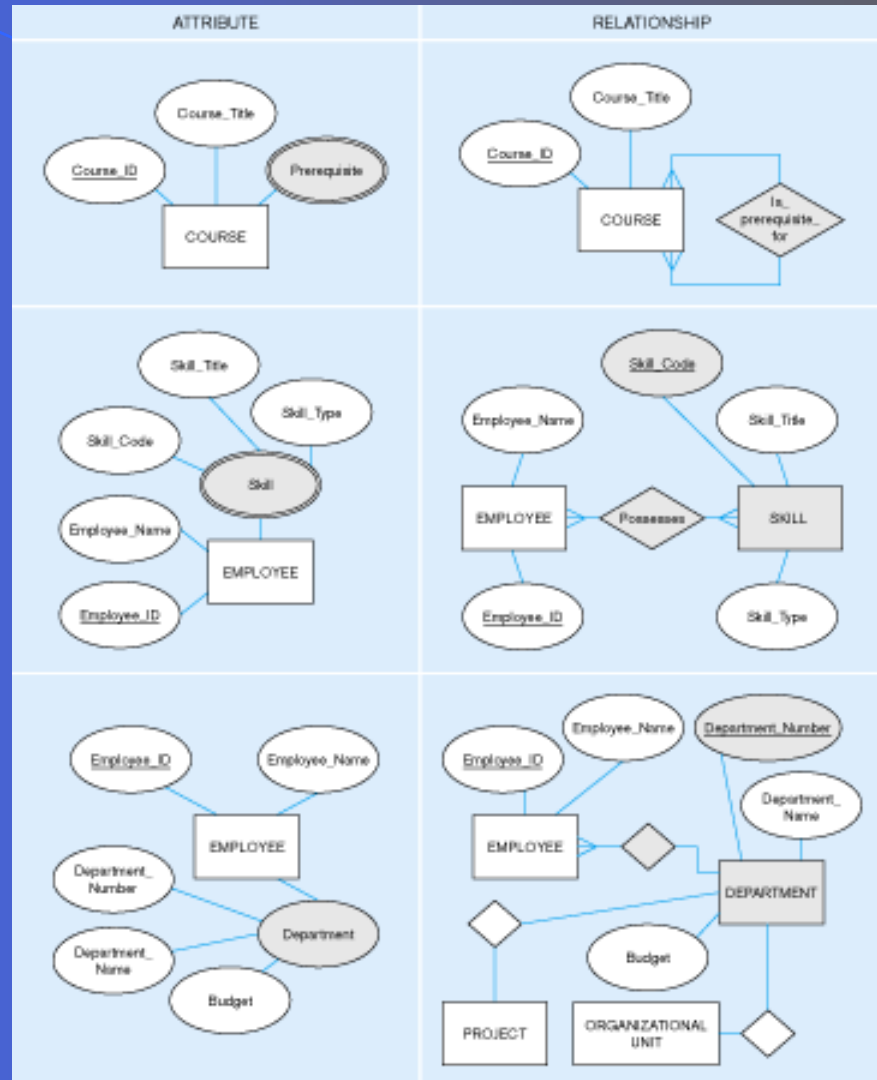


Figure 3-15:
Multivalued attribute
vs. relationship.
Alternative approaches



Strong vs. Weak Entities, and Identifying Relationships

Strong entities

- exist independently of other types of entities
- has its own unique identifier
- represented with single-line rectangle

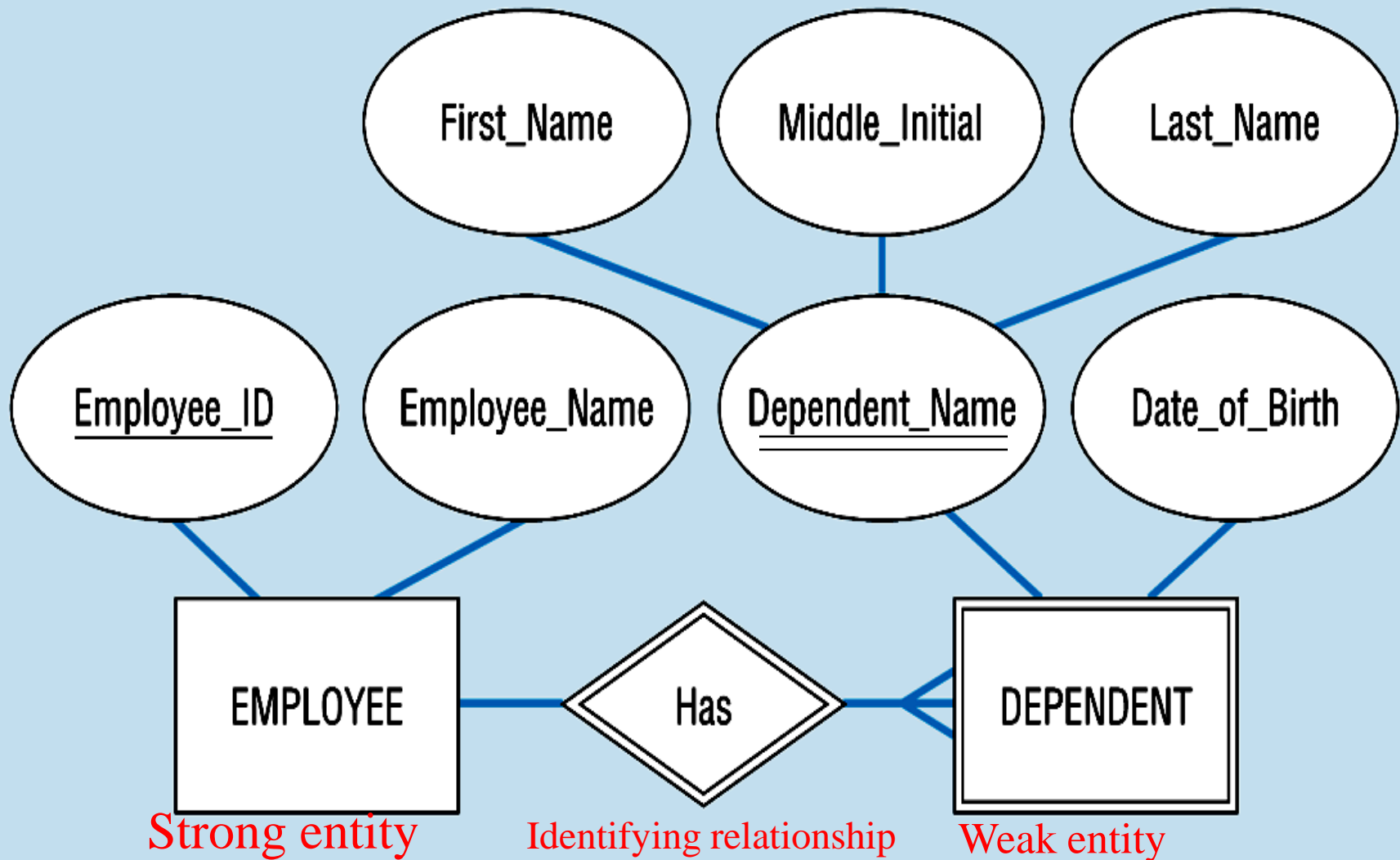
Weak entity

- dependent on a strong entity...cannot exist on its own
- Does not have a unique identifier
- represented with double-line rectangle

Identifying relationship

- links strong entities to weak entities
- represented with double line diamond

Figure 3-5: Strong and weak entities



Associative Entities

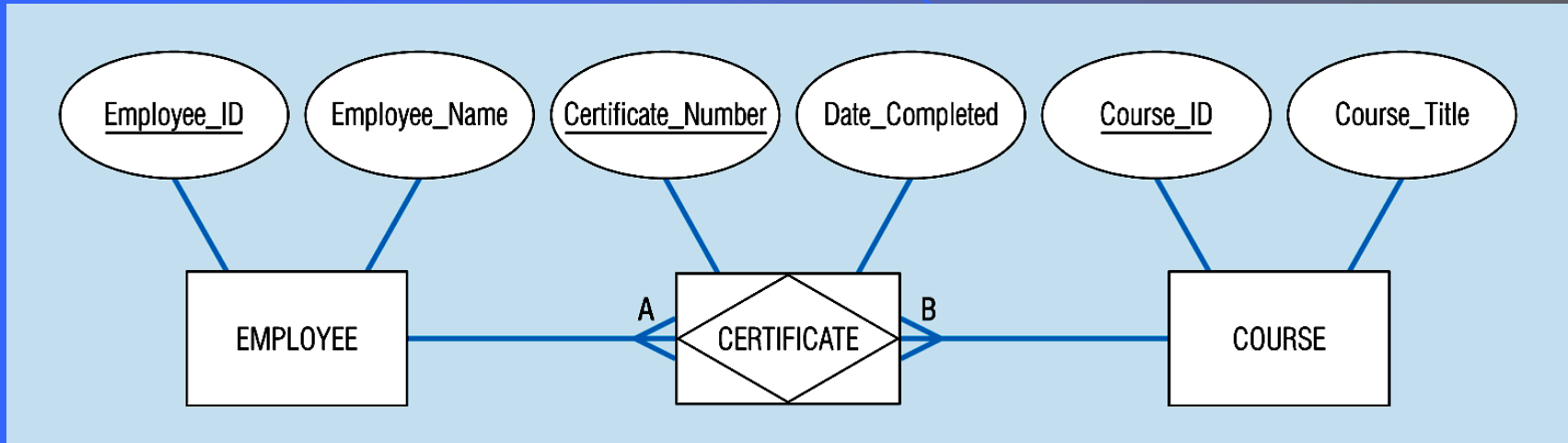
It's an **entity** – it has attributes

AND it's a **relationship** – it links entities together

When should a *relationship with attributes* instead be an *associative entity*?

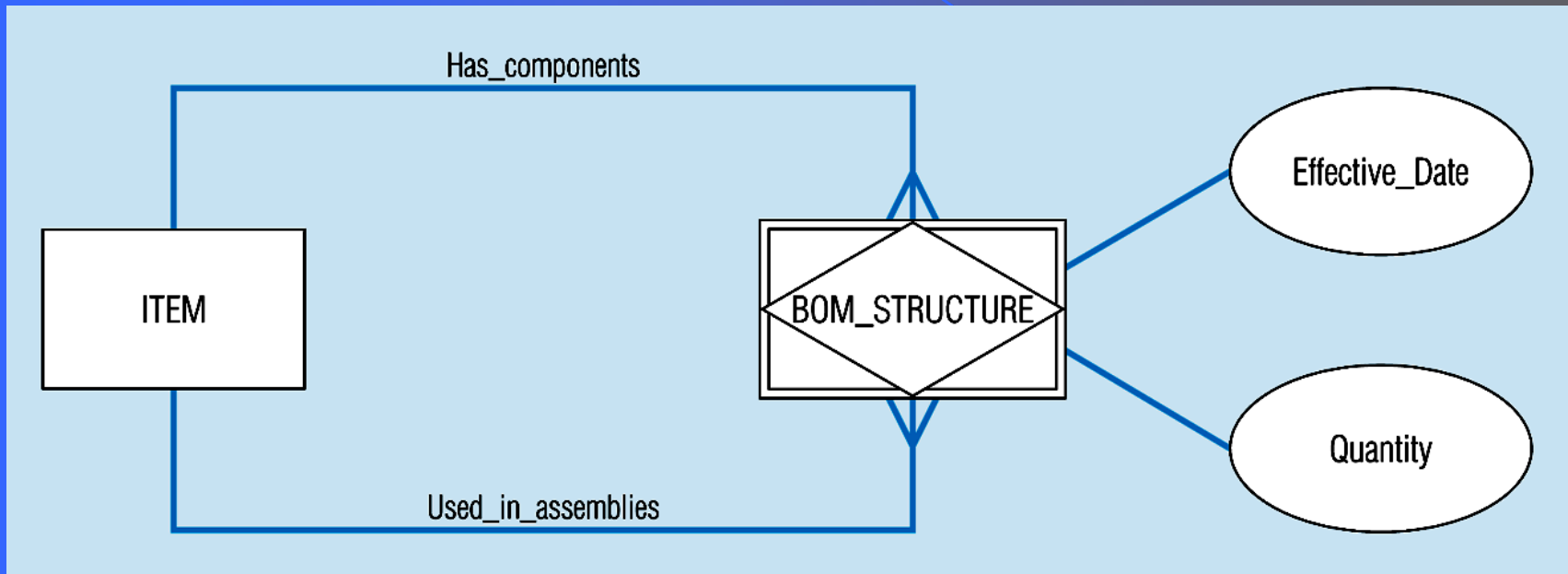
- All relationships for the associative entity should be many
- The associative entity could have meaning independent of the other entities
- The associative entity preferably has a unique identifier, and should also have other attributes
- The associative may be participating in other relationships other than the entities of the associated relationship
- Ternary relationships should be converted to associative entities (p102)

Figure 3-11b: An associative entity (CERTIFICATE)



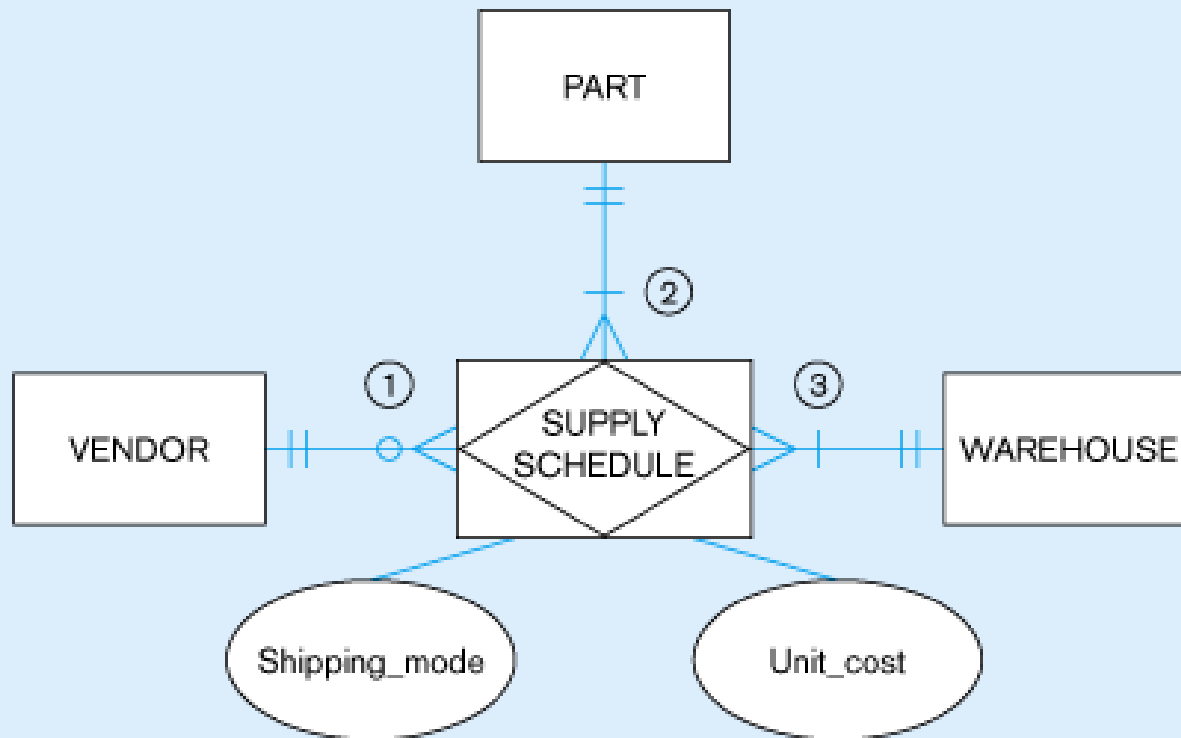
Associative entity involves a rectangle with a diamond inside. Note that the many-to-many cardinality symbols face toward the associative entity and not toward the other entities

Figure 3-13c -- an associative entity – bill of materials structure



This could just be a relationship with attributes...it's a judgment call

Figure 3.18 -- Ternary relationship as an associative entity



Business Rules

- ① Each vendor can supply many parts to any number of warehouses, but need not supply any parts.
- ② Each part can be supplied by any number of vendors to more than one warehouse, but each part must be supplied by at least one vendor to a warehouse.
- ③ Each warehouse can be supplied with any number of parts from more than one vendor, but each warehouse must be supplied with at least one part.

Figure 3-22
E-R diagram for Pine
Valley Furniture

