Block 2
BASIC E/R DESIGN
(PART 3)

Debora Gil, Oriol Ramos, Alejandro Párraga

Basic Design ER Contents

ER Model 1. Introduction

2. Basic Structures

        2.1 Entities

        2.2 Attributes

        2.3 Relationships

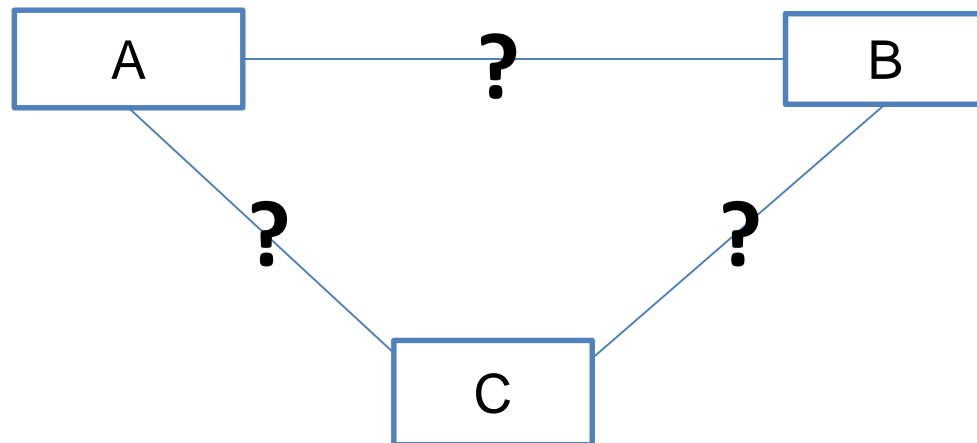3. Relationships Features

        3.1 Cardinality
        3.2 Degree
        3.3 Participation

Basic Design ER Contents

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2.1 Entities

2.2 Attributes

2.3 Relationships

3. Relationships Features

3.1 Cardinality

3.2 Degree

3.3 Participation

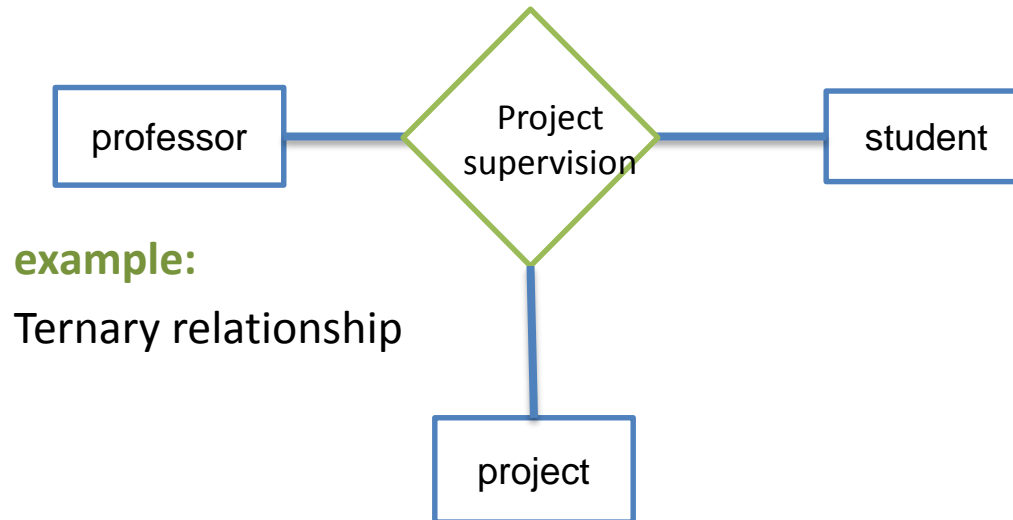# Conceptual Model: Entity-Relation Design

Multiple relationships:

While most relationships are binary, there are times when it is more convenient to associate **elements from more than one entity**

Conceptual Model: Entity-Relation Design

Multiple relationships:

While most relationships are binary, there are times when it is more convenient to associate **elements from more than one entity**

example:

Ternary relationship

Conceptual Model: Entity-Relation Design

Type of relationship:

As the number of entities involved, a relationship can be classified as:

- **unary (1-degree):** relation to the same entity (hierarchical structure or equivalent structure).
- **Binary (2-degree):** relationship between two entities. It is the most common.
- **Ternary (3-degree):** relationship between the three entities.
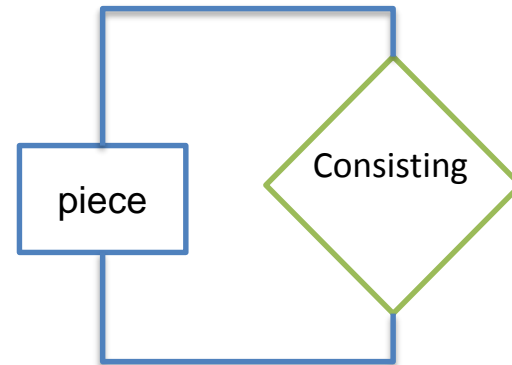- **n-ary (n-degree):** relationship between n (known) entities.

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d'enginyeria

Conceptual Model: Entity-Relation Design

Type of relationship:

- **unary (1-degree):** Relation of an entity with itself (Hierarchical)

A piece can be composed of other pieces.

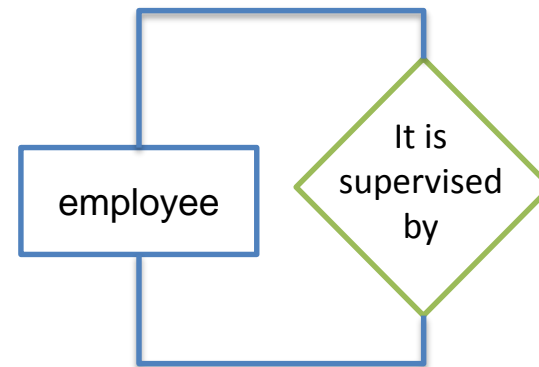**example:** Hinge comprising a bis and a lid.

Conceptual Model: Entity-Relation Design

Type of relationship:

- **unary (1-degree):** Relation of an entity with itself (Hierarchical)

A worker can work under the supervision of other employees.

example: an employee of a bank can be supervised by a manager (another employee of the same bank).
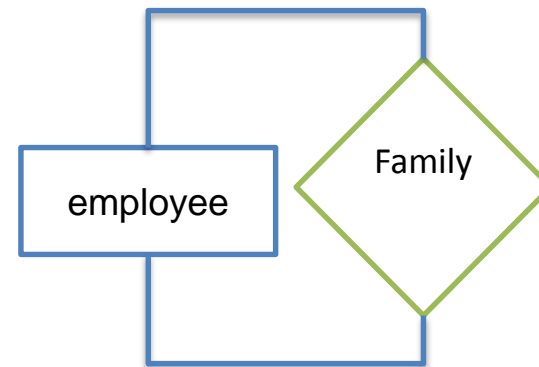
Conceptual Model: Entity-Relation Design

Type of relationship:

- **unary (1-degree):** Relation of an entity with itself (Equivalent structure)

Unary equivalent relationships no establish hierarchy

example: A worker can be family of another worker (and this for the first).
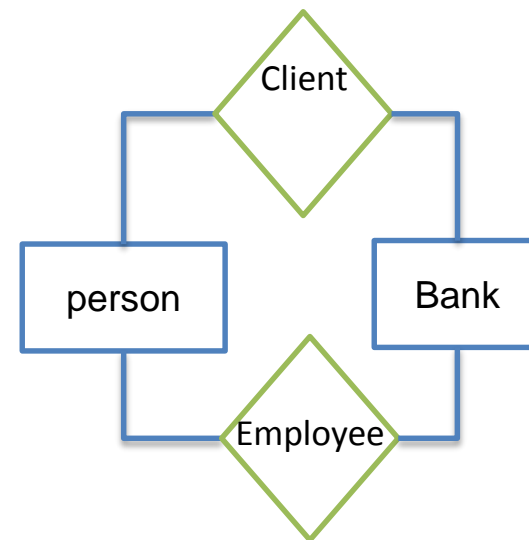
Conceptual Model: Entity-Relation Design

Type of relationship:

- **Binary Relationship (2-degree):**relationship between two entities. The most common.

Multiple binary relations:

It may be the case of more than one binary relation between two entities.

example: An employee can be,also, a bank client

Conceptual Model: Entity-Relation Design

Type of relationship:

- **Ternary relationship (3-degree):** relationship among three entities.

It is usually possible replace a relations of degree> 2 by a number of different binary relations.

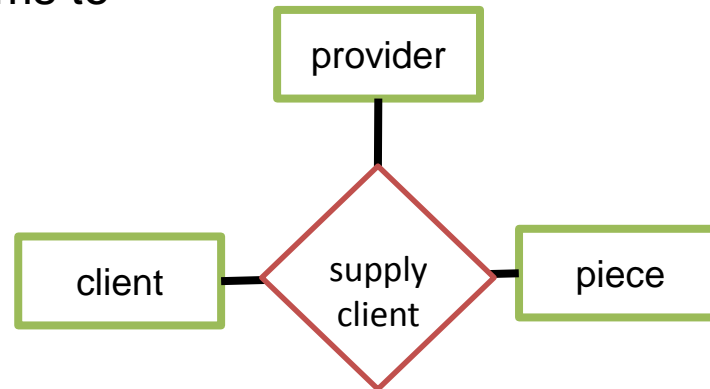In some cases these two designs are not equivalent

They are very rigid structures

Conceptual Model: Entity-Relation Design

Type of relationship:

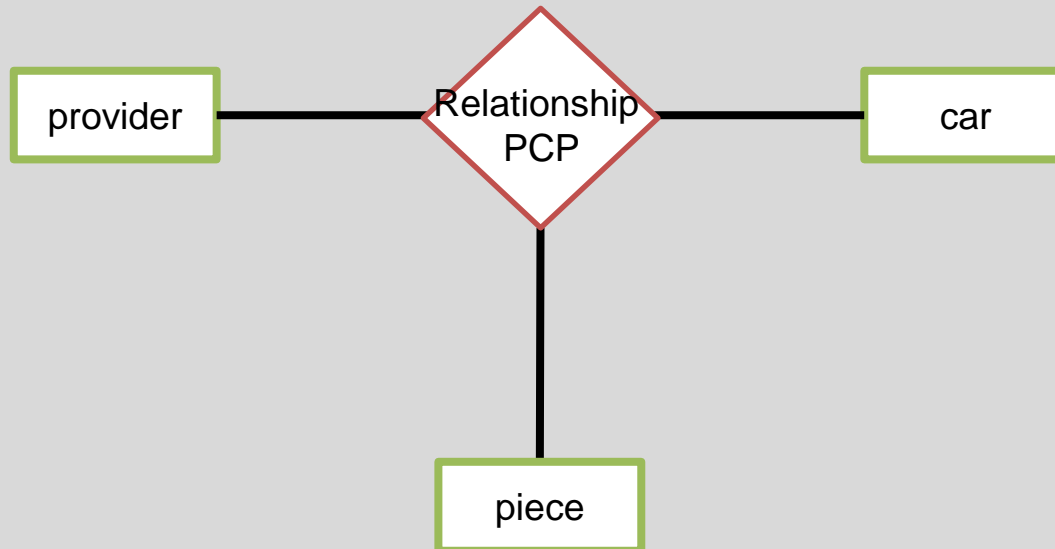- **Ternary relationship (3-degree):** relationship among three entities.

example: Some vendors provide certain items to certain customers

Ternary Relationships cardinality (degree 3)

Discussion 2: **Ternary relationships cardinality**
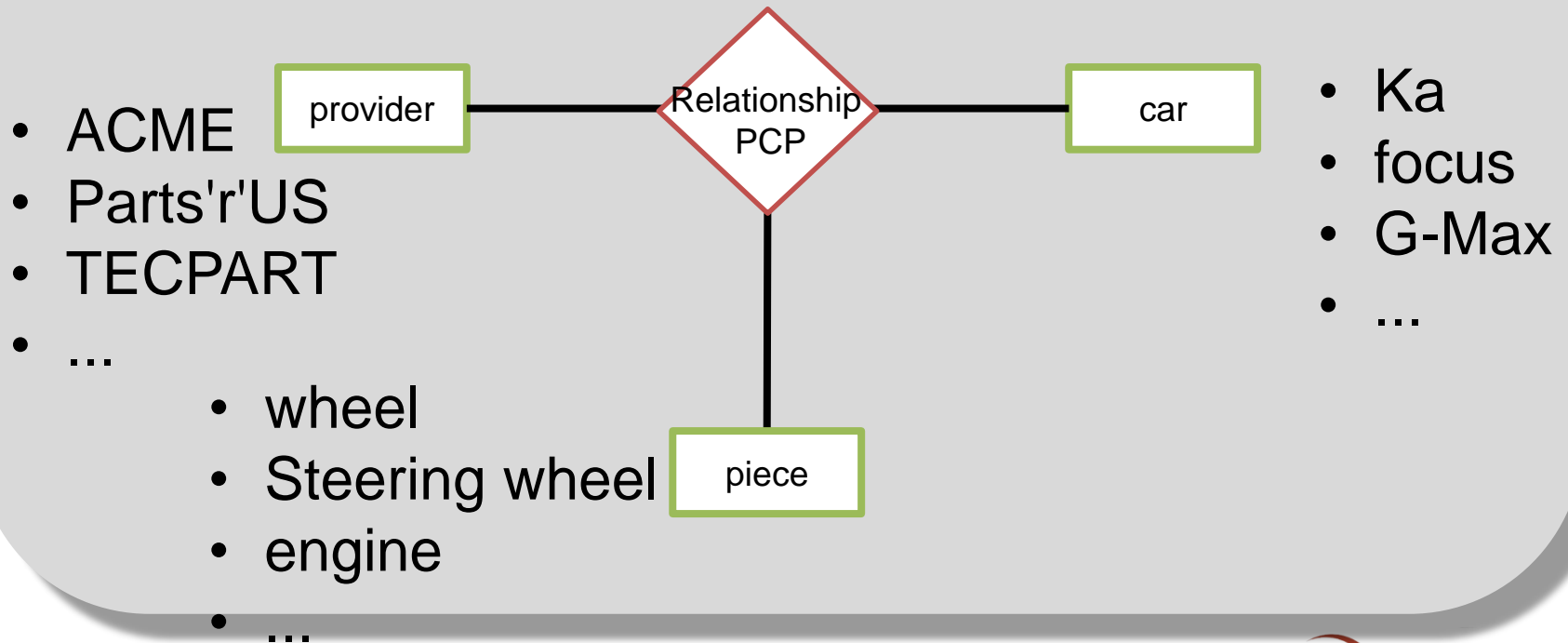
Consider the following ER design.
Expressing cardinalities.

Reviewing Cardinality

Discussion 2:
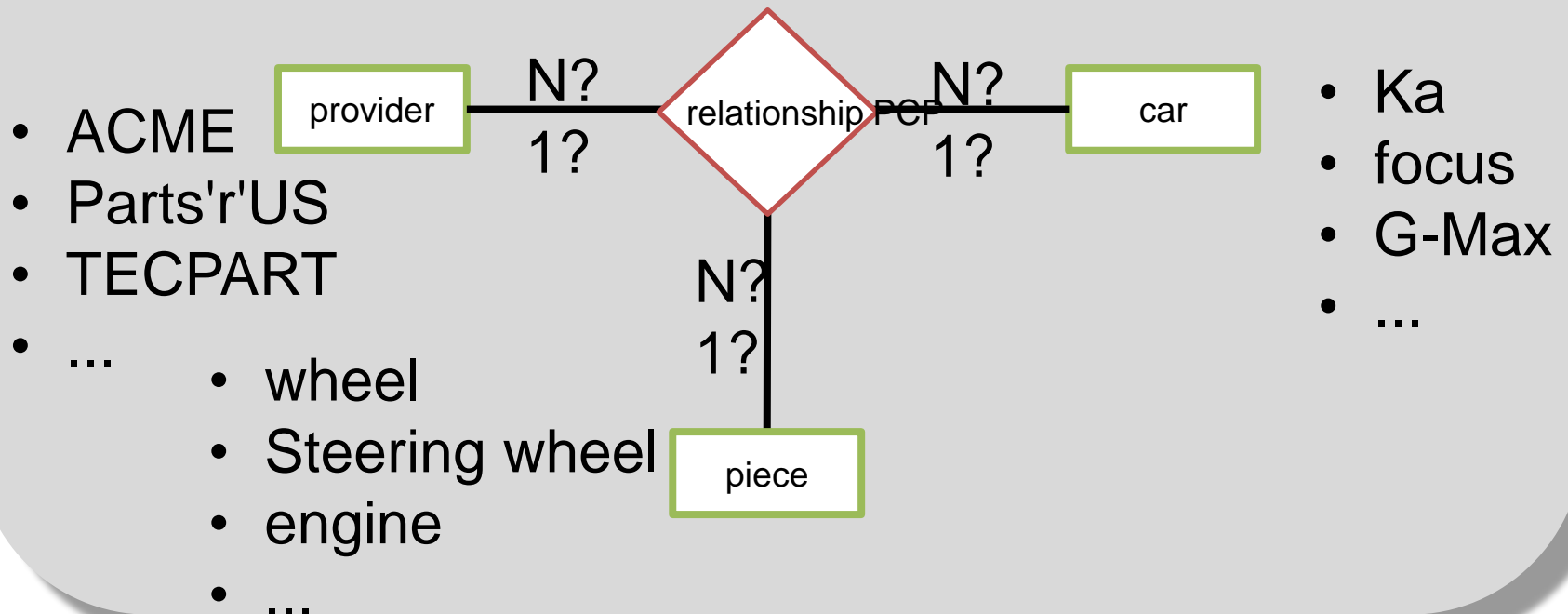**Ternary relationship cardinality**

Consider the following instances

- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

provider — Relationship PCP — car

piece

- Ka
- focus
- G-Max
- ...

Reviewing Cardinality

Discussion 2:
Ternary relationships cardinality

Expressing cardinalities.

Consider the following ...

- ACME
- Parts'r'US
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provider —— N? 1? —— relationship PER —— N? 1? —— car

N? 1? — piece

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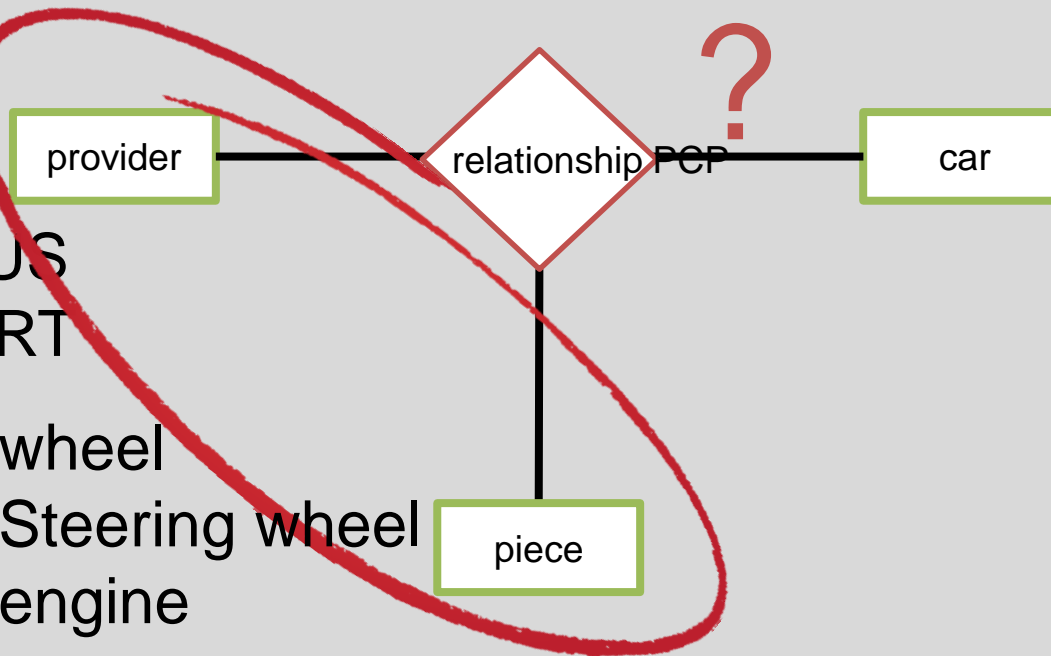- ...

Reviewing Cardinality

Discussion 2: For a given instance of a given supplier of a given piece .... Can this particular combination (Provider / piece) satisfies several cars or at most just a car?

?

- ACME
- Parts'r'US
- TECPART
- ...

  - wheel
  - Steering wheel
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?

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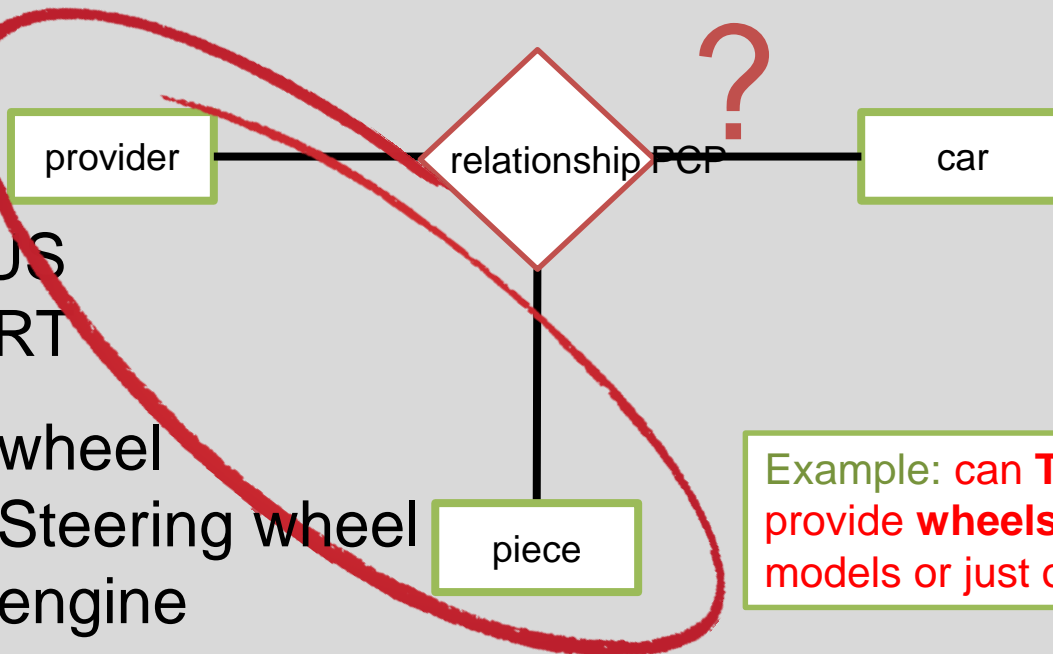- ...

Reviewing Cardinality

Discussion 2:

For a given instance of a given supplier of a given piece .... Can this particular combination (Provider / piece) satisfies several cars or at most just a car?

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- ACME
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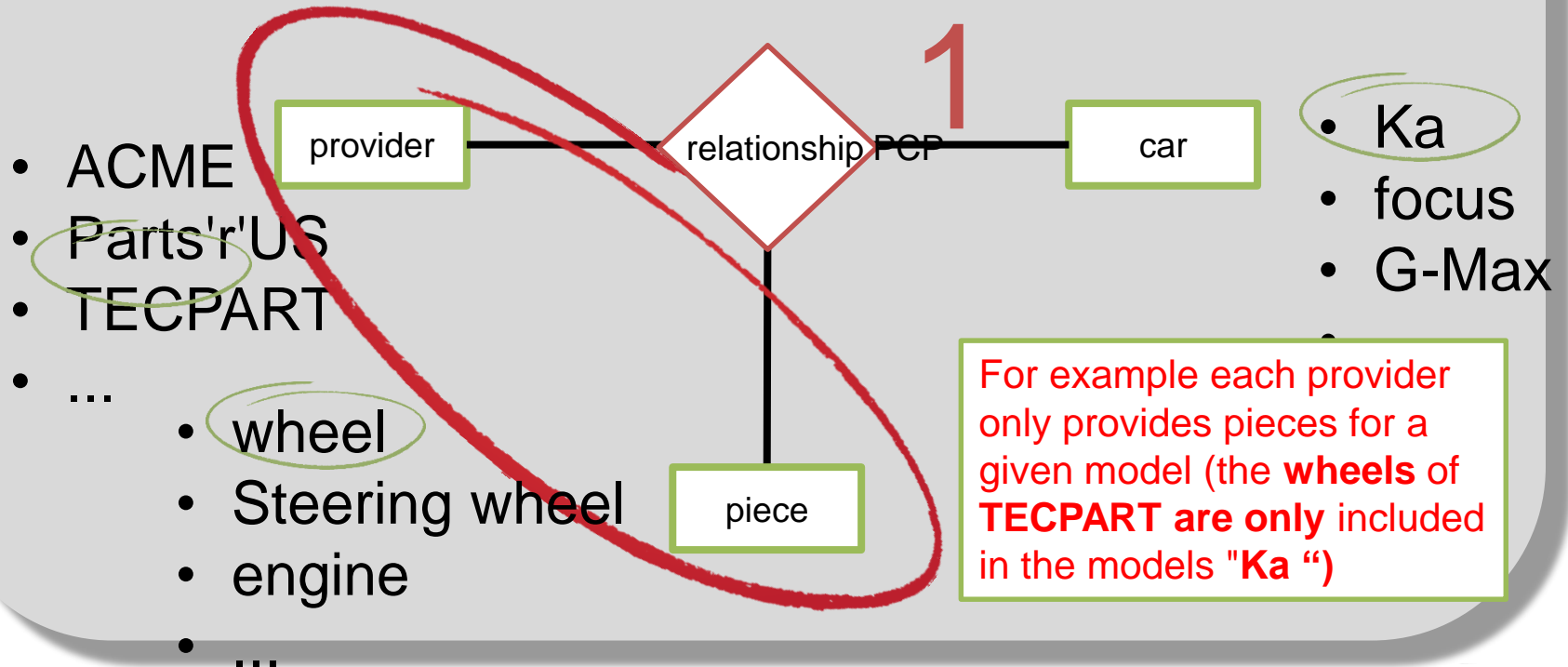- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

provider — relationship PCP — car

piece

?

- Ka
- focus
- G-Max
- ...

Example: can **TECPART** provide **wheels to different** models or just one?
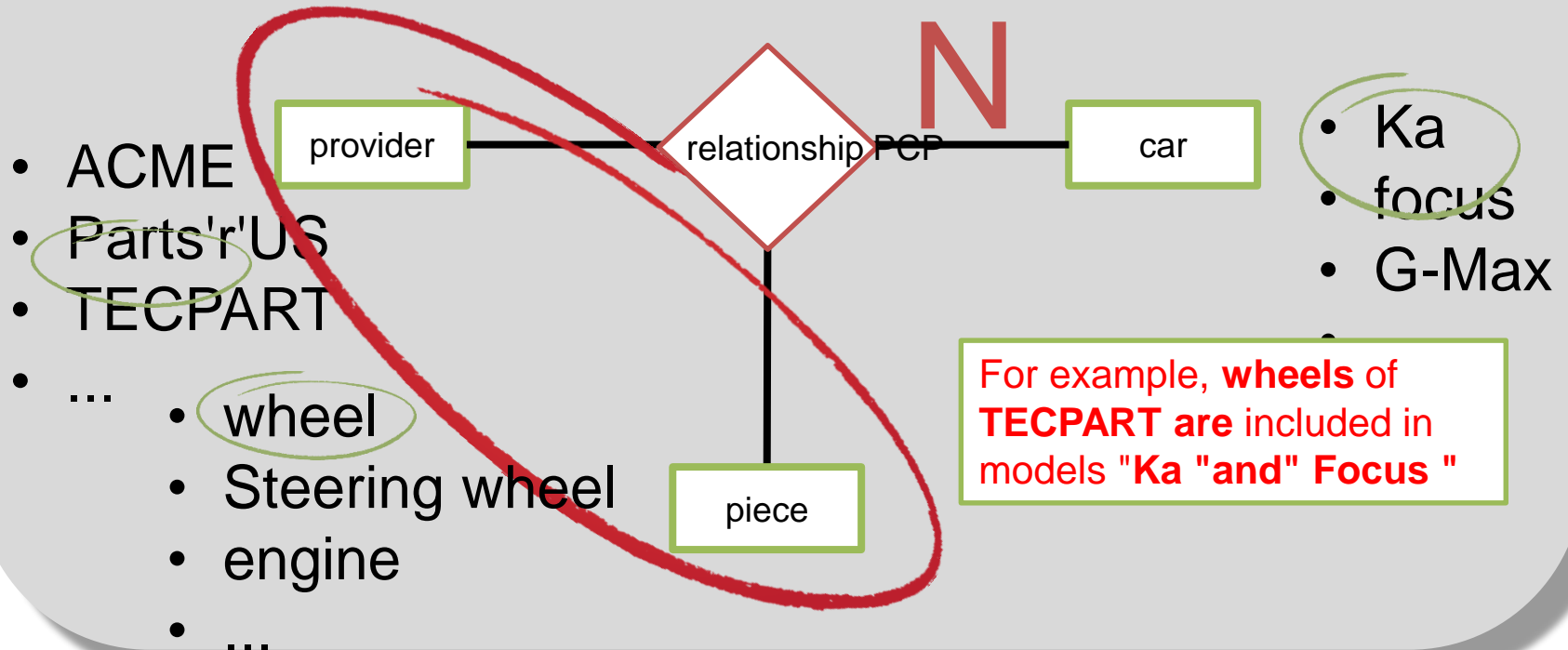
Reviewing Cardinality

Discussion 2: If combinations of provider and piece can only meet one model car, then the car cardinality is 1

- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

provider — relationship PCP — car

1

piece

- Ka
- focus
- G-Max

For example each provider only provides pieces for a given model (the **wheels** of **TECPART are only** included in the models "**Ka** ")

Reviewing Cardinality

Discussion 2:

If a combination of provider and piece can satisfy several cars, then the "car" cardinality is N (many)

- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

provider — relationship PCP — car

N

piece

- Ka
- focus
- G-Max

For example, **wheels** of **TECPART are** included in models "**Ka** "and" **Focus** "
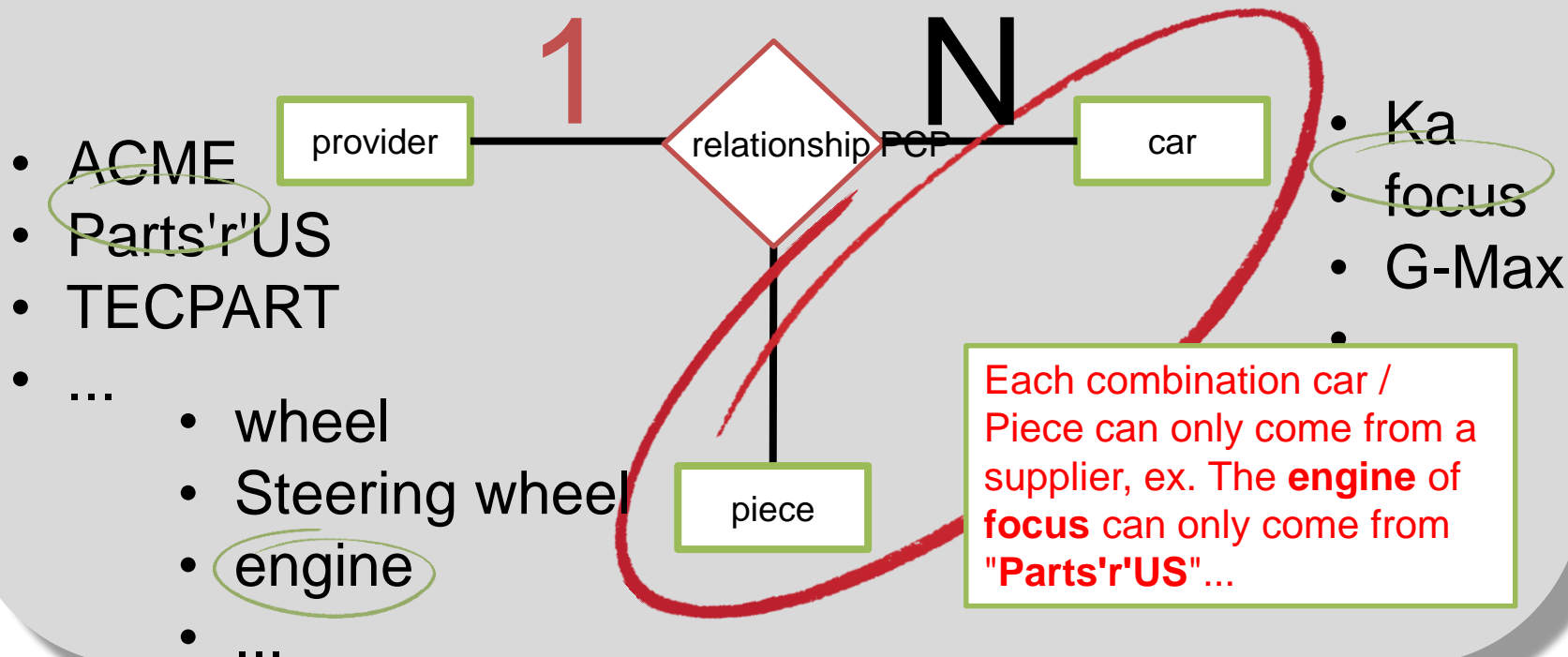
Reviewing Cardinality

Discussion 2:

Same for the other combinations: for a given instance of a car and a given piece .... Can this particular combination (car / piece) relate to several suppliers or simply with a single supplier at most?
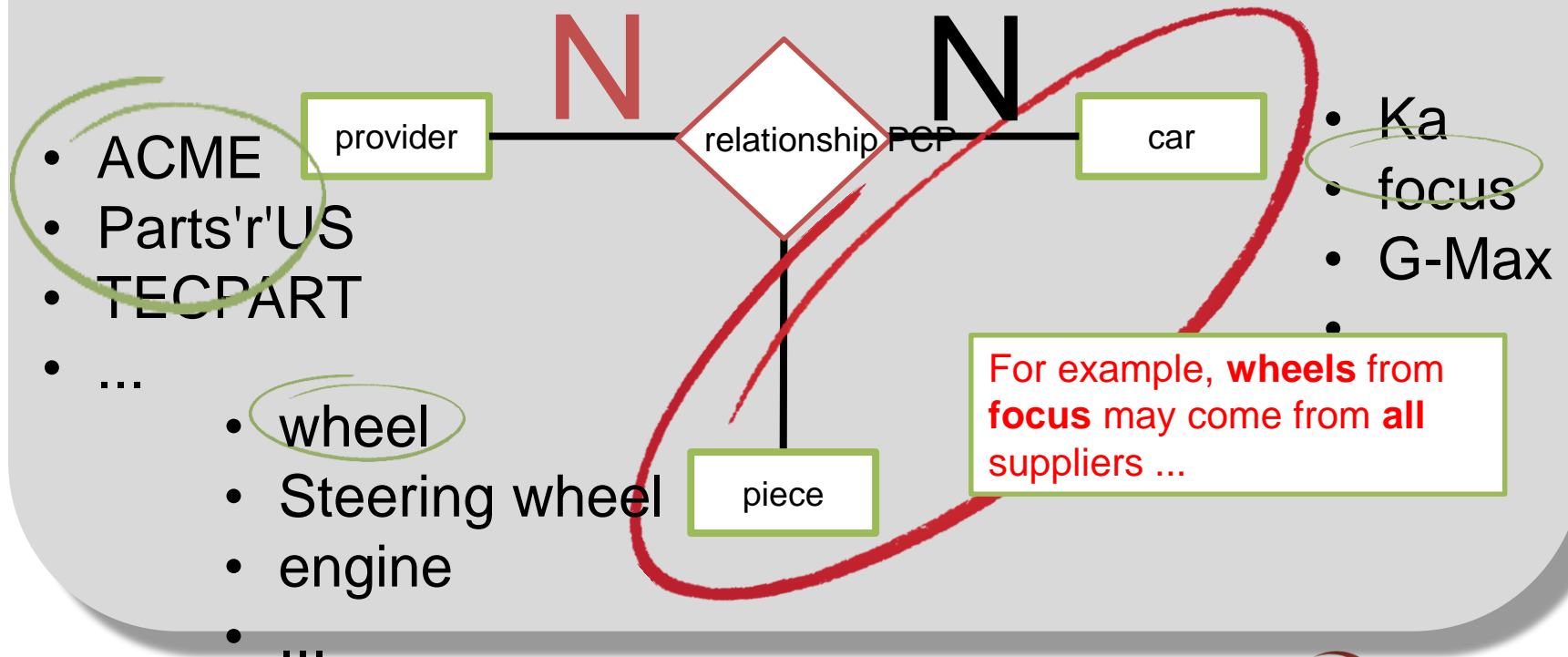
- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

? relationship PCP N

provider

car

piece

- Ka
- focus
- G-Max
- ...
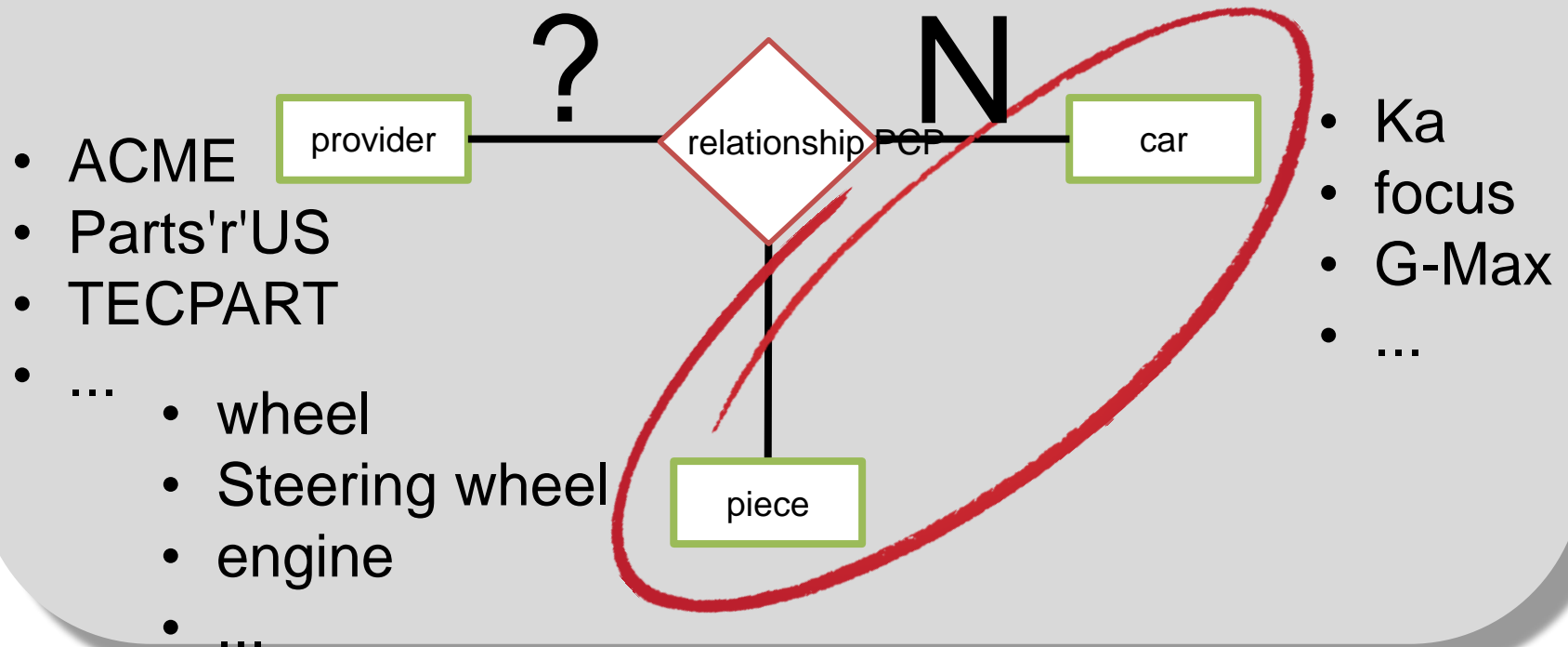
Reviewing Cardinality

Discussion 2: If a combination car-piece can only come from a single provider, then the cardinality of "Provider" is 1.

- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

provider —1— relationship PCP —N— car

piece

- Ka
- focus
- G-Max
-

Each combination car / Piece can only come from a supplier, ex. The **engine** of **focus** can only come from "**Parts'r'US**"...
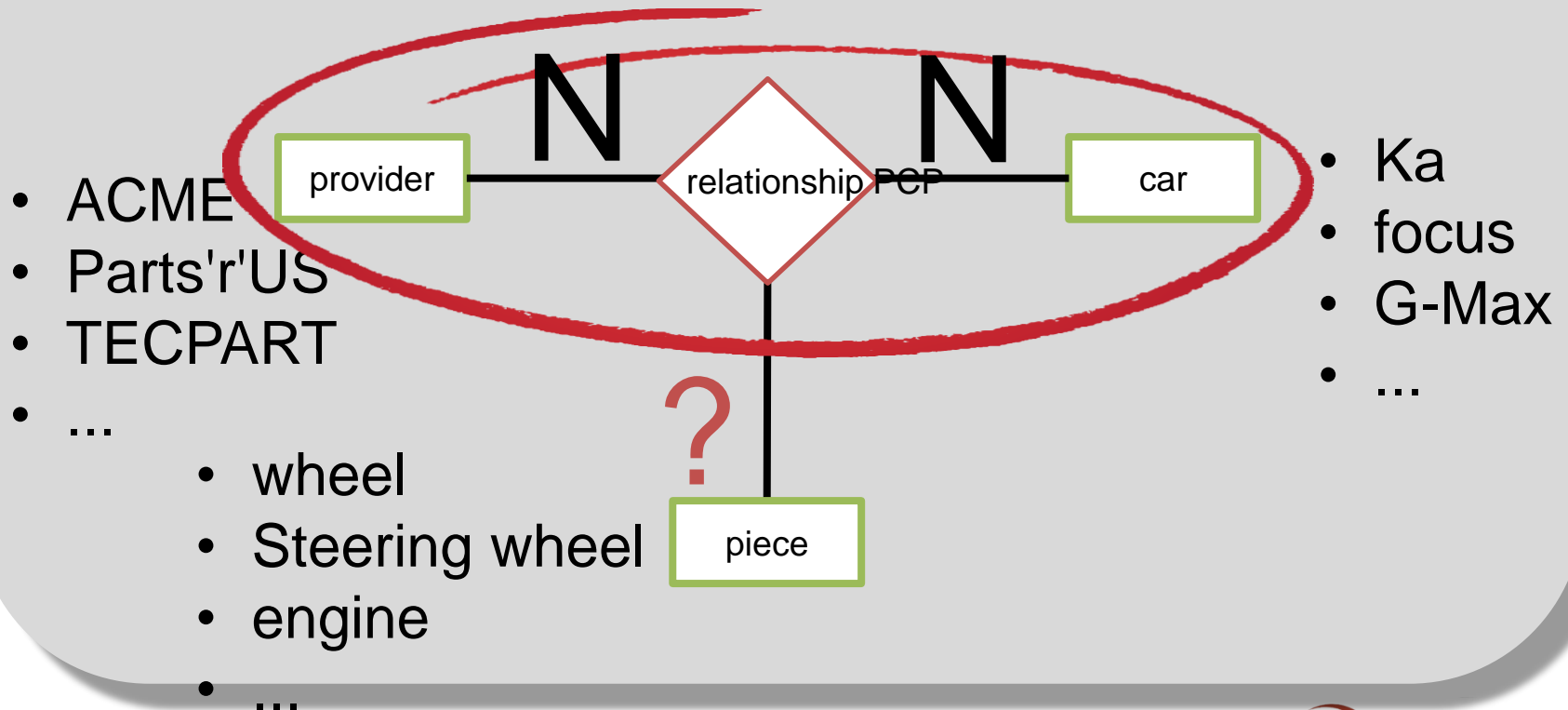
Reviewing Cardinality

Discussion 2: If a combination of car and piece may come from different vendors, then the cardinality of "Provider" is N (many)
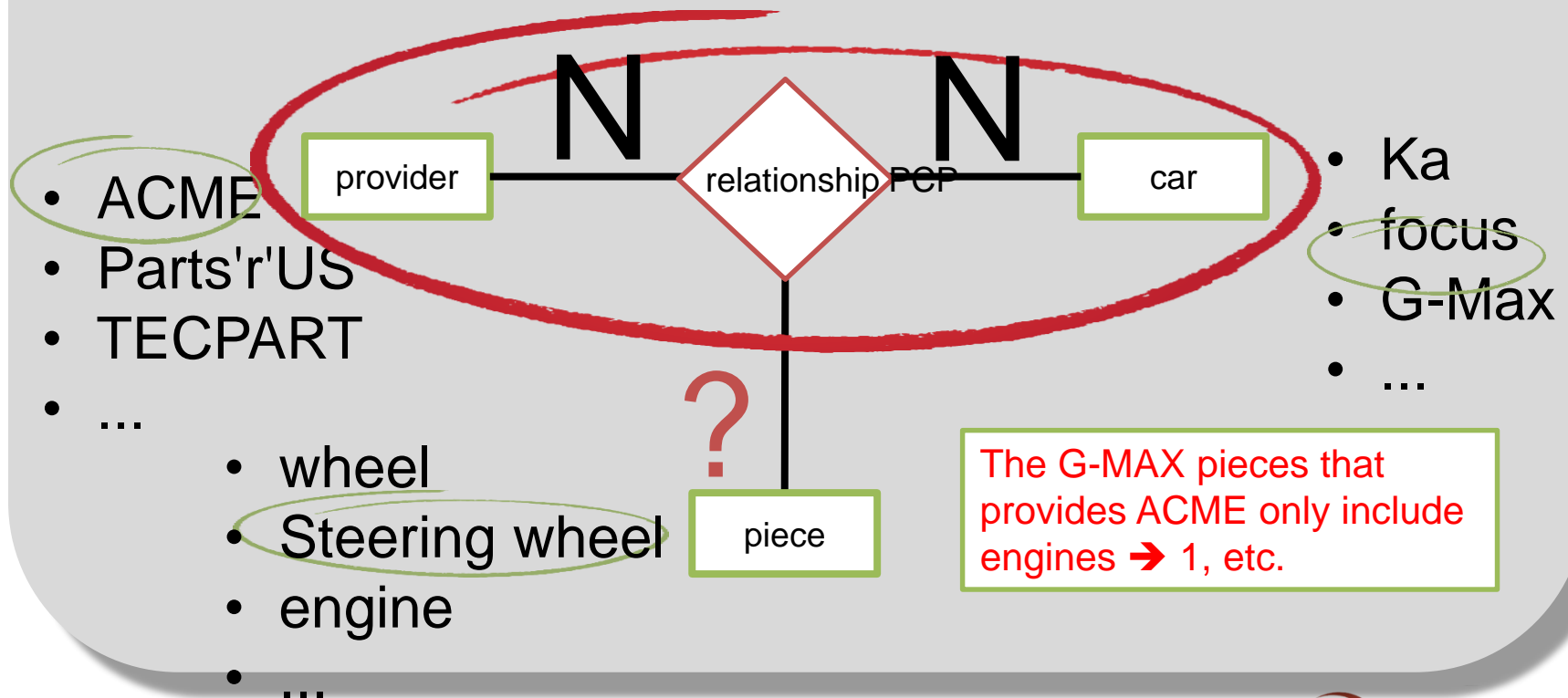
N   N

- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

provider — relationship PCP — car

piece

- Ka
- focus
- G-Max
-

For example, **wheels** from **focus** may come from **all** suppliers ...

Reviewing Cardinality

Discussion 2: Also for a given instance of a given Supplier and a given Car ... Can this particular combination (Provider / car) relate to various pieces or at most to just one piece?

- ACME
- Parts'r'US
- TECPART
- ...
  - wheel
  - Steering wheel
  - engine
  - ...

N provider — relationship PCP — N car

?

piece

- Ka
- focus
- G-Max
- ...

Reviewing Cardinality

Discussion 2: Also for a given instance of a given Supplier and a given Car ... Can this particular combination (Provider / car) relate to various pieces or at most to just one piece?

- ACME
- Parts'r'US
- TECPART
- ...

  - wheel
  - Steering wheel
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  - ...

N [provider] — N [relationship PCP] — [car]

?

[piece]

- Ka
- focus
- G-Max
- ...

The G-MAX pieces that provides ACME only include engines ➔ 1, etc.

Conceptual Model: Entity-Relation Design

In this case it is not the same a ternary relation that a three binary relations:
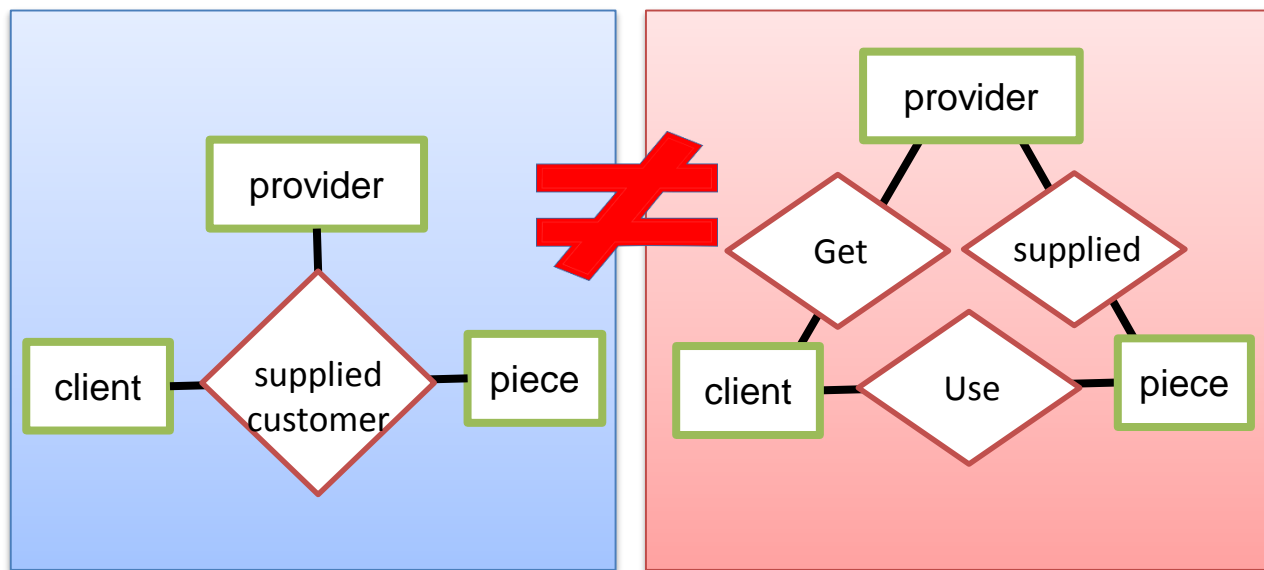
Conceptual Model: Entity-Relation Design
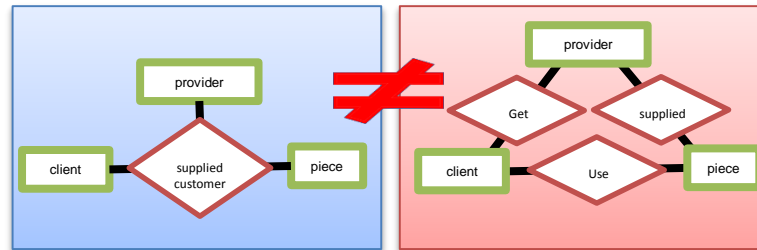
Example 1:

The ternary relationship between entities "supplier", "piece" and "client":
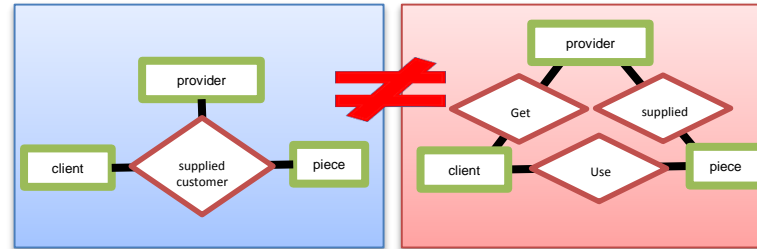
Some vendors provide certain items to certain customers.

NOT semantically equivalent to:

- Providers SUPPLY Pieces
- Customers use Pieces   } binary relations
- CLIENT receives supplies from provider

Conceptual Model: Entity-Relation Design

Consider the following individual instances:

- Provider= IKEA,
- Pieces= hinges,
- Client= UAB

IKEA suplies hinges to UAB

It is semantically Equivalent to: **?**

binary relations

- **IKEA supplies hinges**
- **Hinges are used for UAB**
- **UAB receives IKEA products**

Conceptual Model: Entity-Relation Design
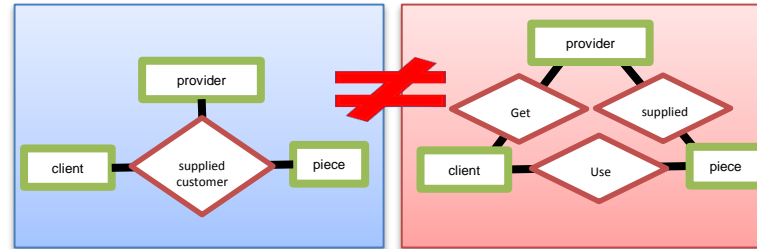
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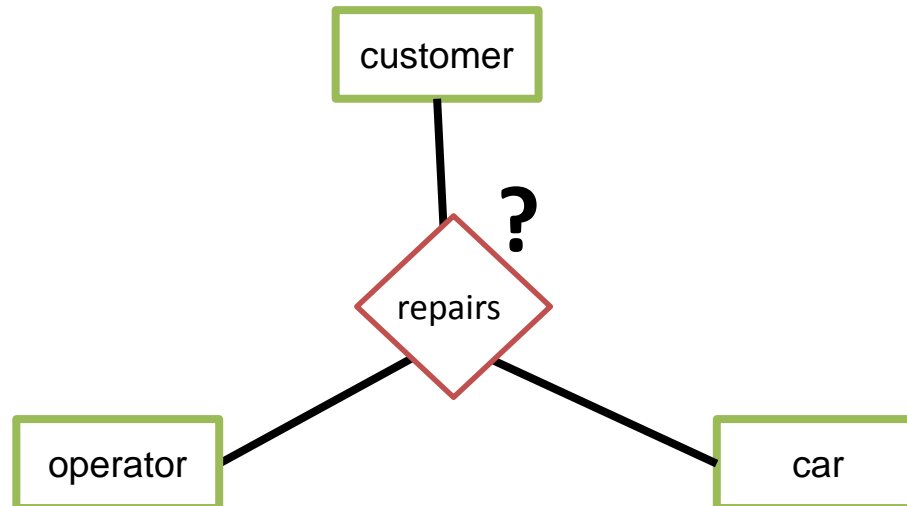**?** can not be deduced

binary relations
- **IKEA supplies hinges**
- **Hinges are used for UAB**
- **UAB receives IKEA products**

False inference: TRAP CONNECTION

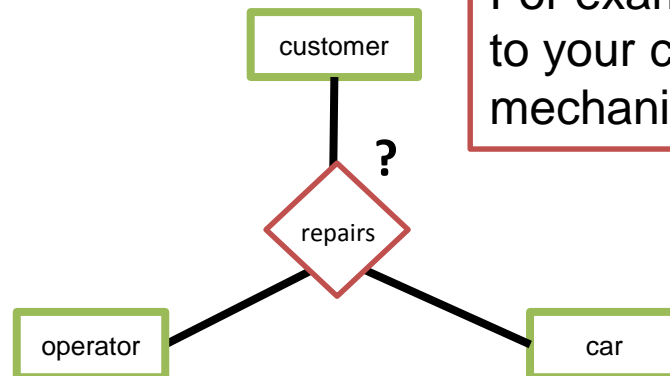# Conceptual Model: Entity-Relation Design

Example 2

Car repair: A car repair shop wants to keep customer information, the operator that serves them and the car being repaired

Conceptual Model: Entity-Relation Design

Example 2

Car repair: A car repair shop wants to keep customer information, the operator that serves them and the car being repaired

The interrelationships with degree **> 2** are more specific, but more rigid: we have to know all instances when they are created.

For example, when a new client comes to your car you have to assign a mechanic (operator)
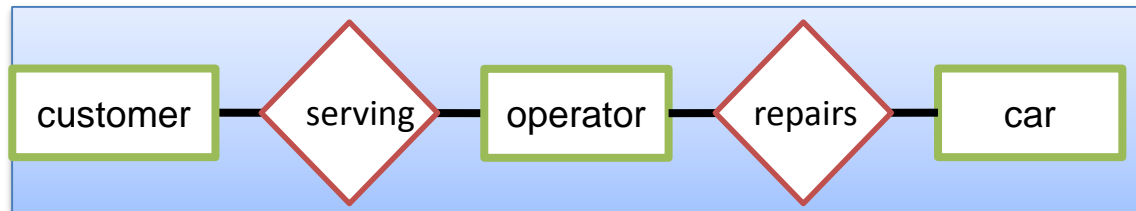
Not practical

customer

?

repairs

operator

car

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Conceptual Model: Entity-Relation Design

Discussion:

Car repair: A car repair shop wants to keep customer information, the operator that serves them and the car being repaired

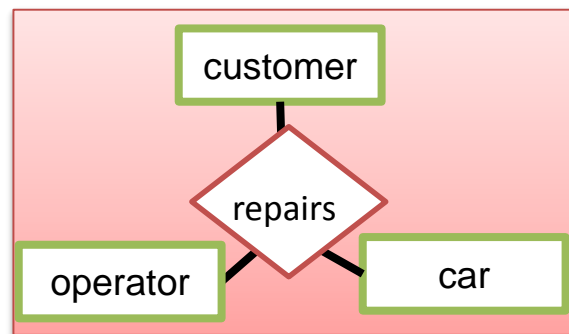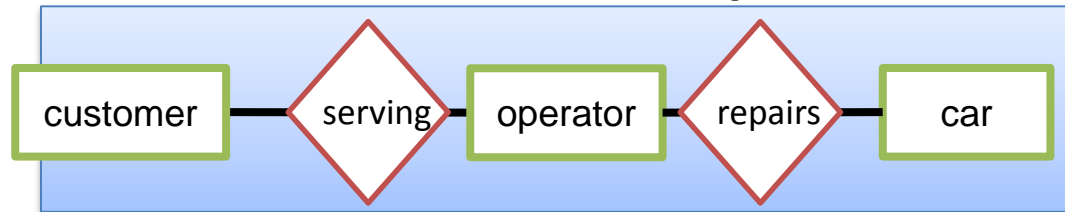Another possible design is as follows:

Conceptual Model: Entity-Relation Design

Discussion

Car repair: A car repair shop wants to keep customer information, the operator that serves them and the car being repaired
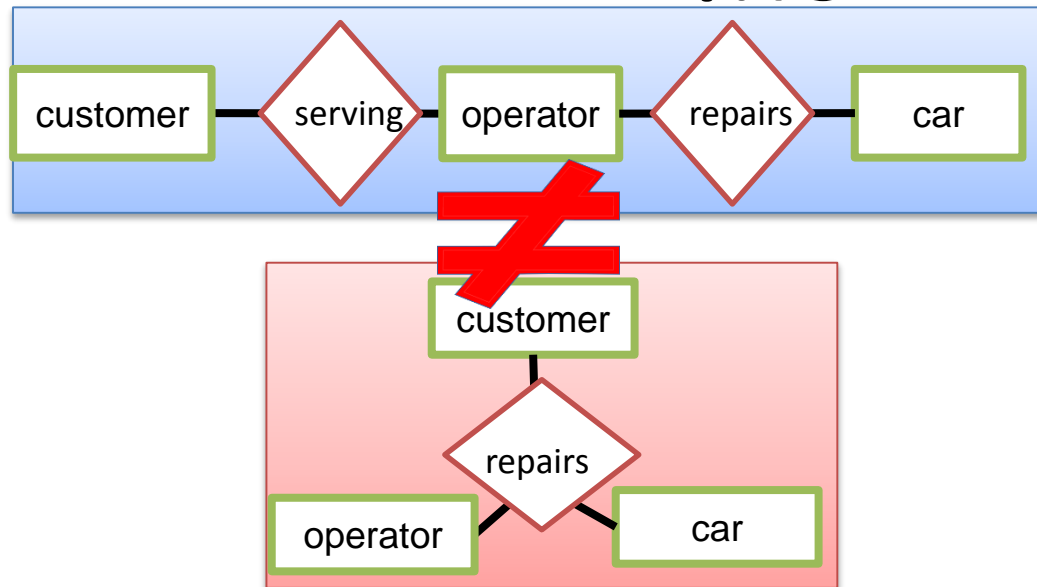

These two designs are equivalent ?

Conceptual Model: Entity-Relation Design

Discussion

Car repair: A car repair shop wants to keep customer information, and the operator that serves the car being repaired

These two designs are equivalent ?NO

Conceptual Model: Entity-Relation Design

Discussion:

Car repair: A car repair shop wants to keep customer information, the operator that serves them and the car being repaired
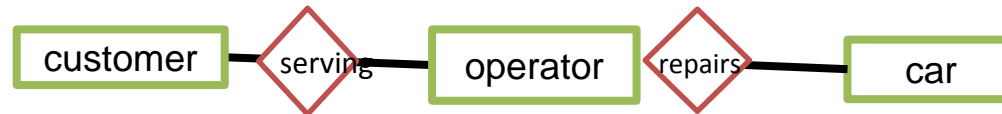

This scheme allows new customers who do not come for reparation ('partners') **but** I can not relate each car with its owner

I have **ambiguity: Trap connection**

Conceptual Model: Entity-Relation Design

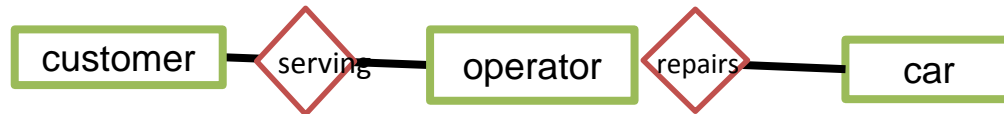## Discussion:

Trap connection

example:

- *Operator 7 serves Mr. Puig*
- *The operator 7 repairs a car with licenes plate 567 HYT*

Is repairing the Mr. Puig car?*We don't know. I can not connect cars with their owners (Trap connection)*
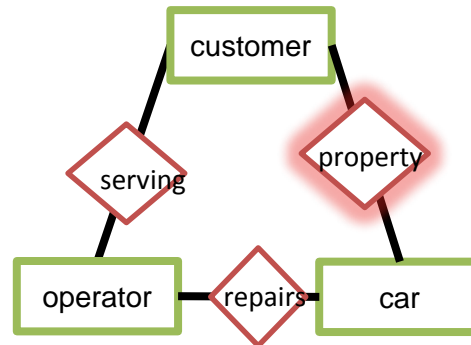
escola d'enginyeria

Conceptual Model: Entity-Relation Design

Discussion:

Trap connection

Solution:

- *Mr. Puig is the owner of license plate HYT 567 car*
- *Operator 7 serves Mr. Puig*
- *The operator 7 repairs a car with license plate HYT 567*

Basic ER Design Contents

Conceptual Model: Entity-Relation Design

Participation Restrictions

Specify whether the existence of an entity **A** depends on its relation to another **entity B**.

There are two types:

- **Total participation:** All elements of **A** must be related to some element of B.
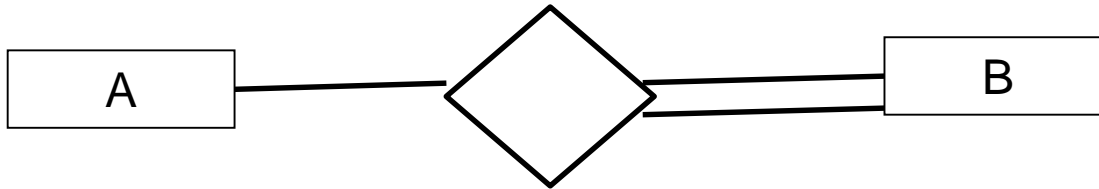
Indicated by the double line

- **Partial participation:** Not all elements of **A** must be related to some element of **B**

Suitable for plain line

<u>Completetness Definition:</u> All B items have be related with some A item. It is represented by a double line from B to the relationship
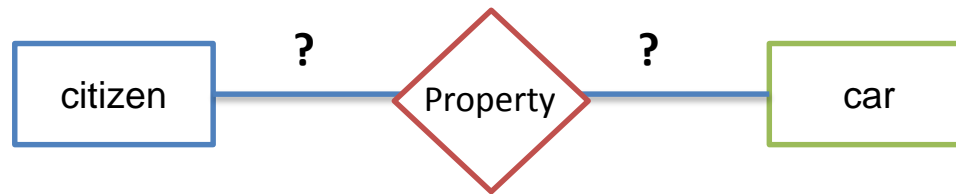

To insert an instance B, I must have inserted an A instance to relate with

Conceptual Model: Entity-Relation Design

Participation Restrictions

Example 1: **Relation** Car - Citizen

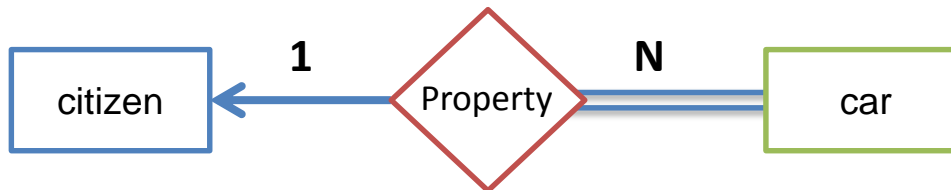**All cars must have an owner**

If all cars must have at least one owner (citizen), "car" participation in the relation is total

Conceptual Model: Entity-Relation Design

Participation Restrictions

Example 1: **Relation** Car - Citizen

All cars must have an owner

Not all citizen have to be car owner. The "citizen" participation in the relation is partial

Conceptual Model: Entity-Relation Design

Participation Restrictions

The combination cardinality / participation appropriate for a particular relation obviously depends on the situation of the real world of this relationship

Example 2: Relation Person - Book

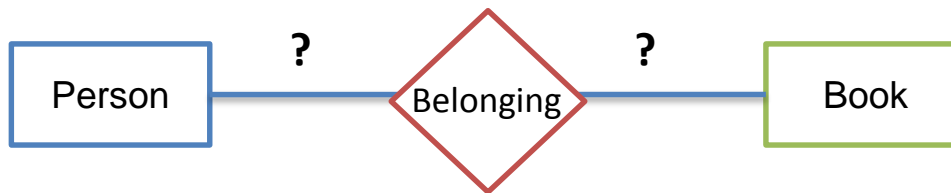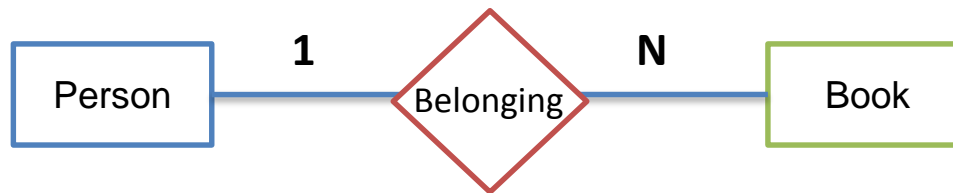**Each book should belong to anyone?**

Conceptual Model: Entity-Relation Design

Participation Restrictions

The combination cardinality / participation appropriate for a particular relation obviously depends on the situation of the real world of this relationship

Example 2: **R**elation Person - Book

Each book should belong to anyone?: NO

```
┌─────────┐   1        ◇        N   ┌─────────┐
│ Person  │────────Belonging───────│  Book   │
└─────────┘                        └─────────┘
```

Depends on the context, but in most cases it is not necessary that every book has an owner ...

Conceptual Model: Entity-Relation Design

Participation Restrictions

Example 2: Relation Person - Book

Each book should belong to anyone? :YES

```
                              ◇
┌──────────┐    1        ╱ Belonging ╲    N    ┌──────────┐
│  person  │◄────────────◇            ◇────────│   Book   │
└──────────┘              ╲          ╱          └──────────┘
                              ◇
```

In the case that any book must necessarily have an owner, then participation is "total"