

Lecture 05: E/R Diagrams

Wednesday, April 7, 2010

Announcements

- Homework 1 is posted: due April 21st
- You need to create tables, import data:
 - On SQL Server, in your own database, OR
 - On postgres (we will use it for Project 2)
- Follow Web instructions for importing data
- Read book about CREATE TABLE, INSERT, DELETE, UPDATE

Outline

- E/R diagrams
 - Chapter 4.1-4.4
- From E/R diagrams to relations
 - Chapters 4.5

Database Design

- Why do we need it?
 - Agree on structure of the database before deciding on a particular implementation.
- Consider issues such as:
 - What entities to model
 - How entities are related
 - What constraints exist in the domain
 - How to achieve *good* designs
- Several formalisms exist
 - We discuss E/R diagrams

Entity / Relationship Diagrams

Objects → entities
Classes → entity sets

Attributes:

Relationships



Product

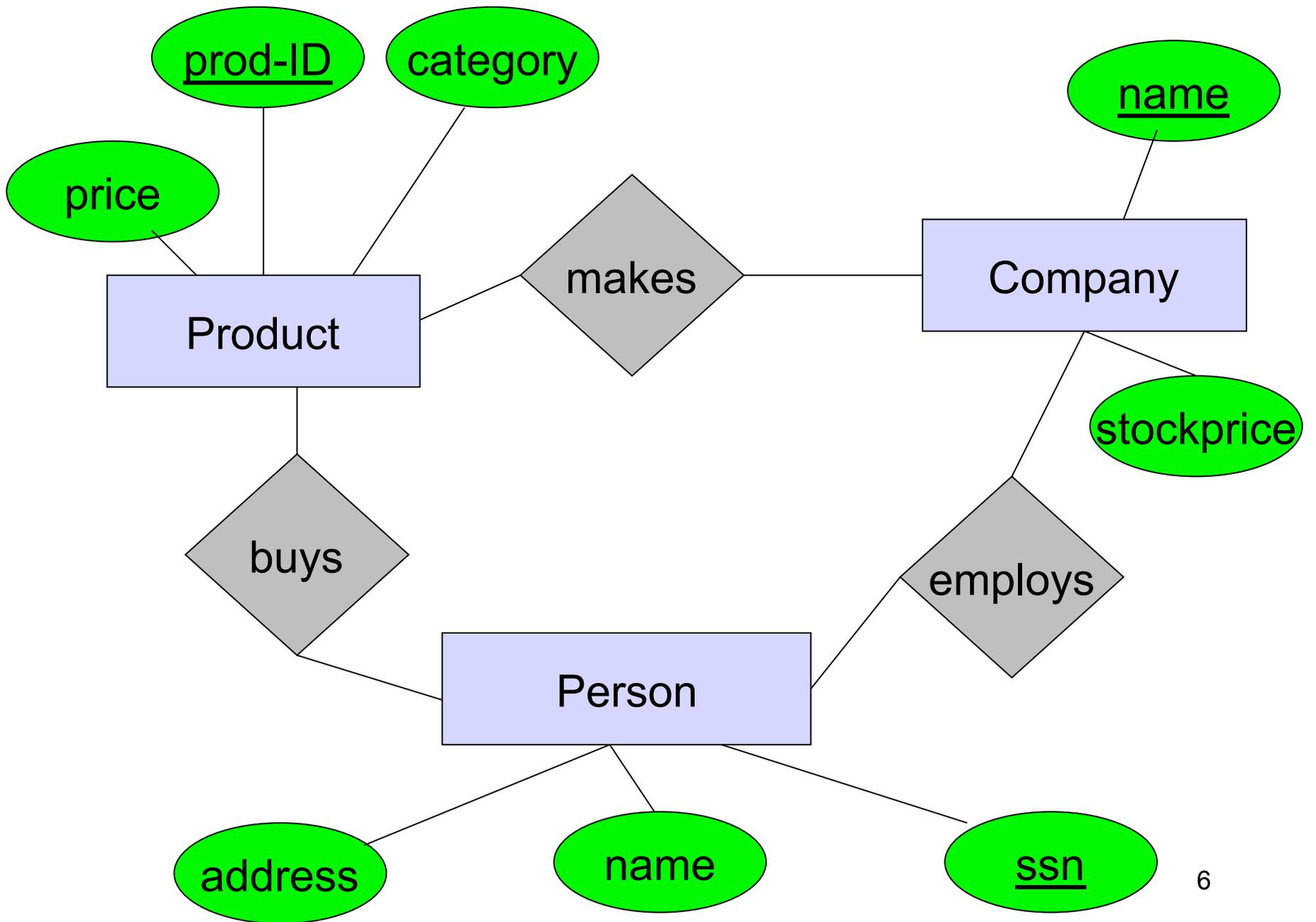


address



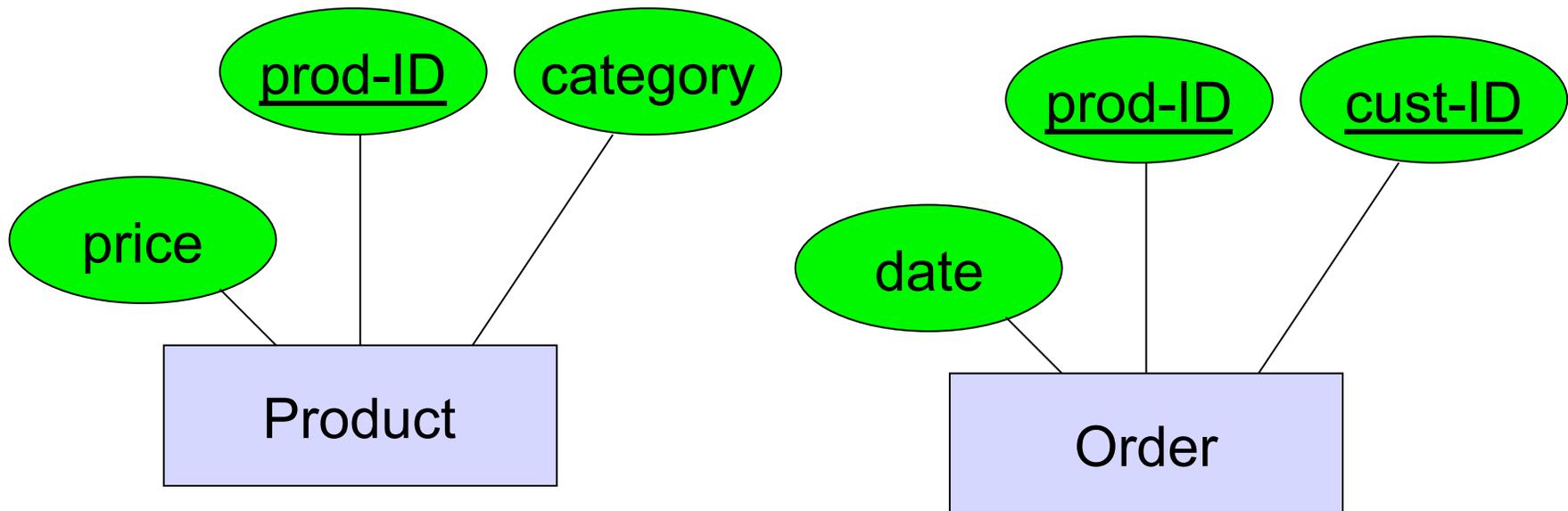
buys

- first class citizens (not associated with classes)
- not necessarily binary



Keys in E/R Diagrams

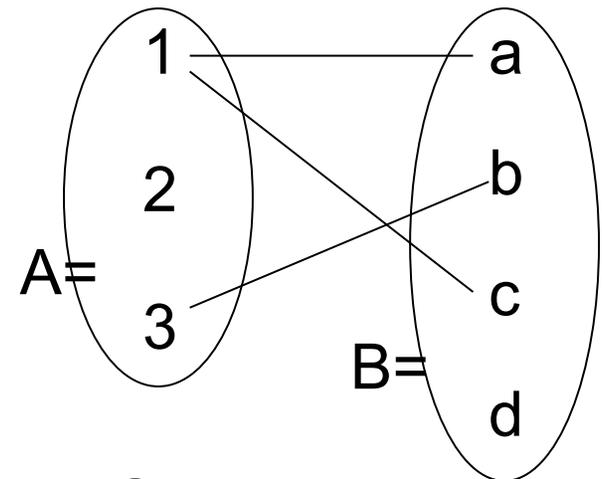
- Every entity set must have a key
- May be a *multi-attribute key*:



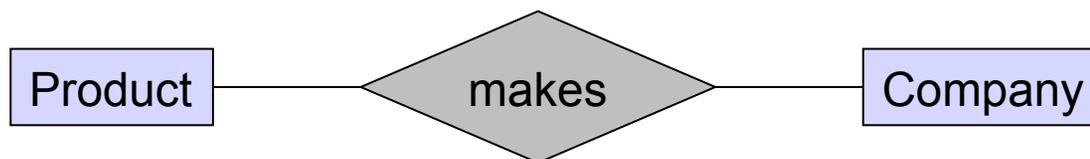
What is a Relation ?

- A mathematical definition:
 - if A, B are sets, then a relation R is a subset of $A \times B$

- $A = \{1, 2, 3\}$, $B = \{a, b, c, d\}$,
 $A \times B = \{(1, a), (1, b), \dots, (3, d)\}$
 $R = \{(1, a), (1, c), (3, b)\}$

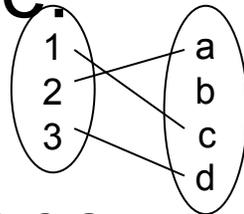


- **makes** is a subset of **Product** \times **Company**:

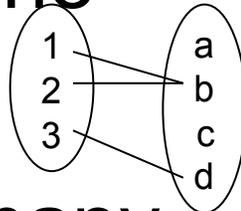


Multiplicity of E/R Relations

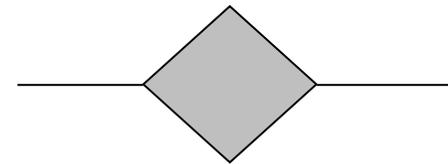
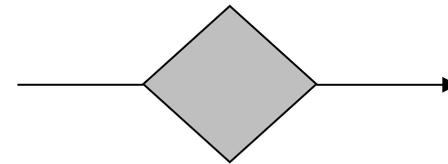
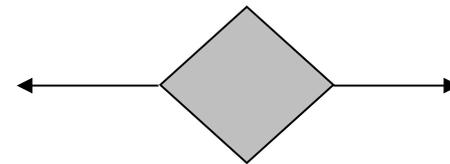
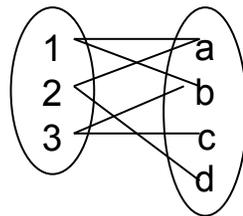
- one-one:

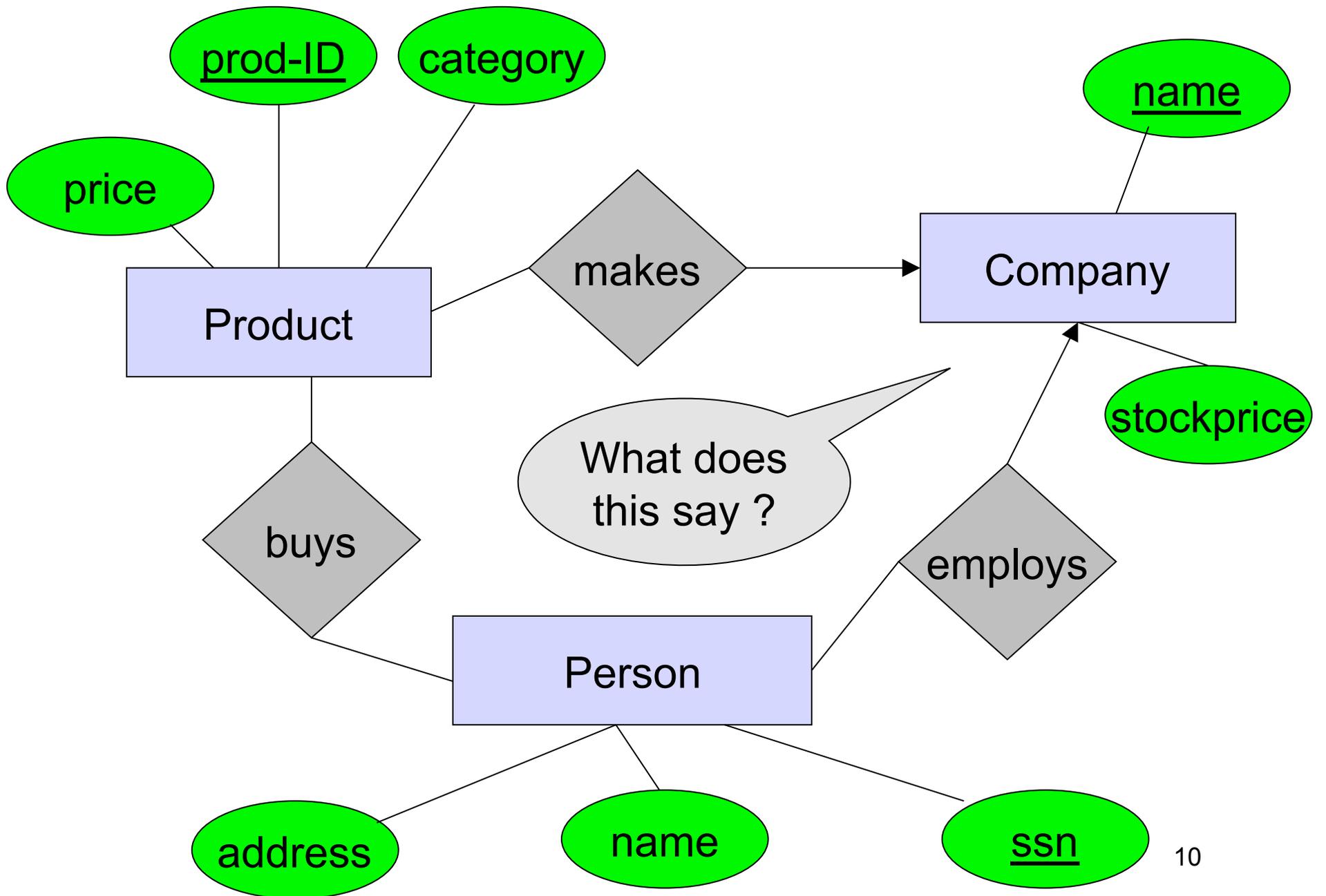


- many-one

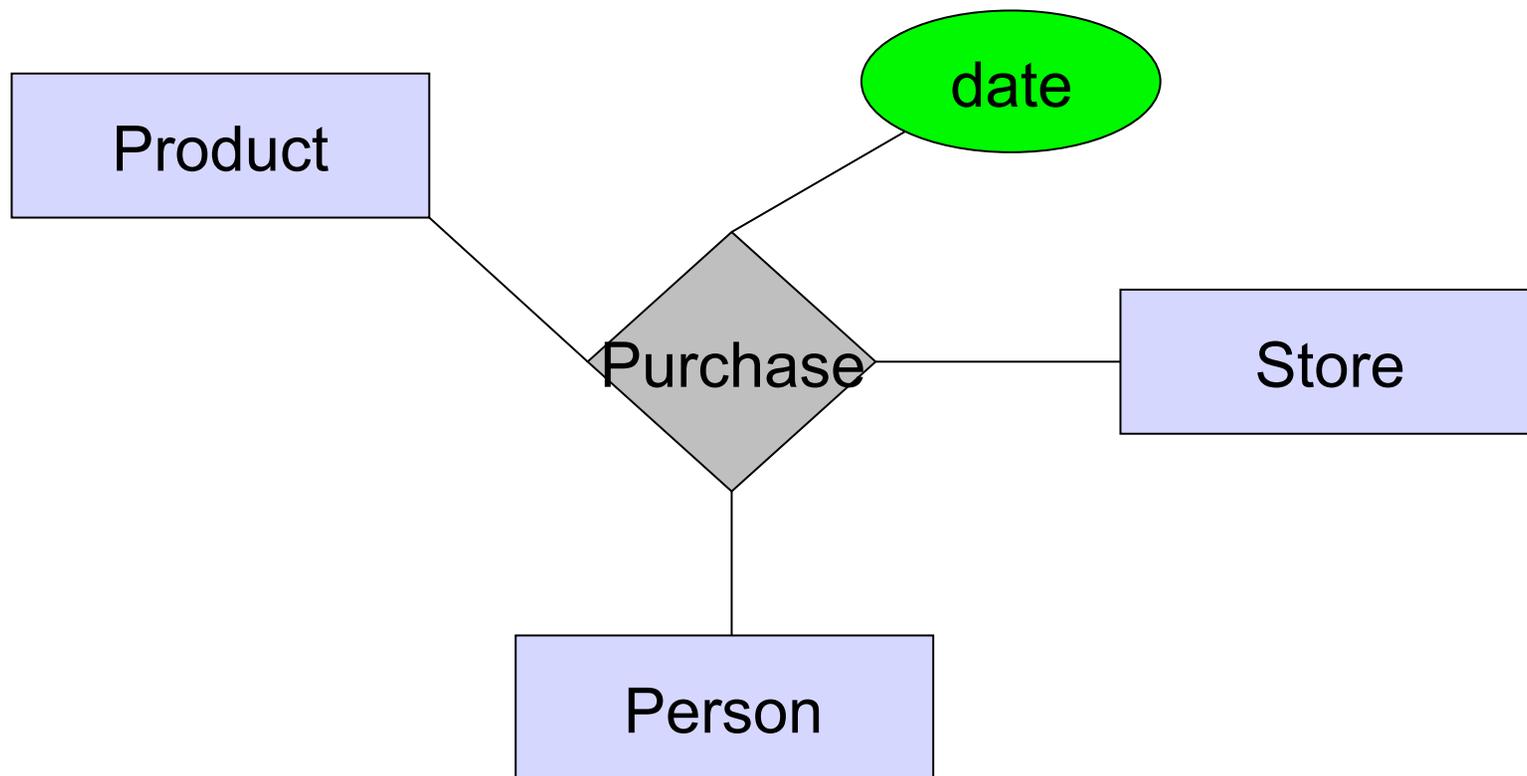


- many-many

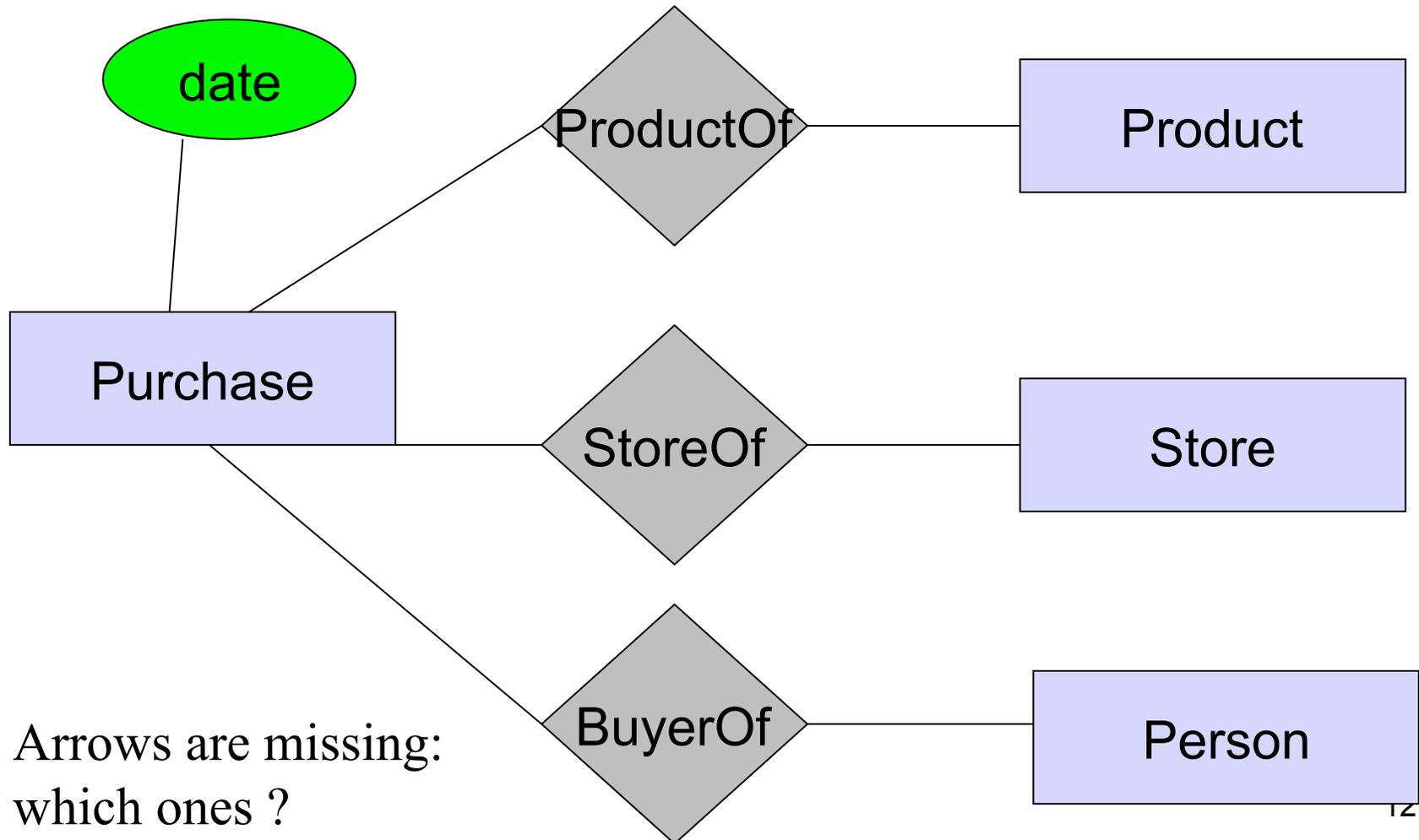




Multi-way Relationships

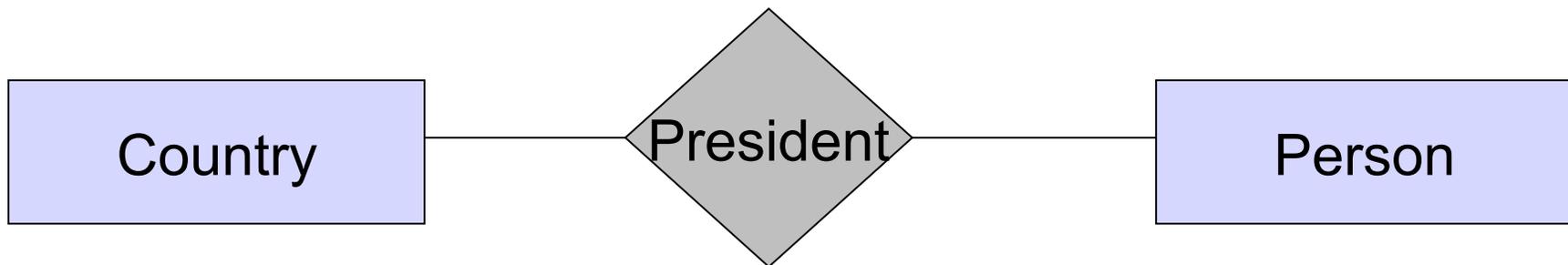
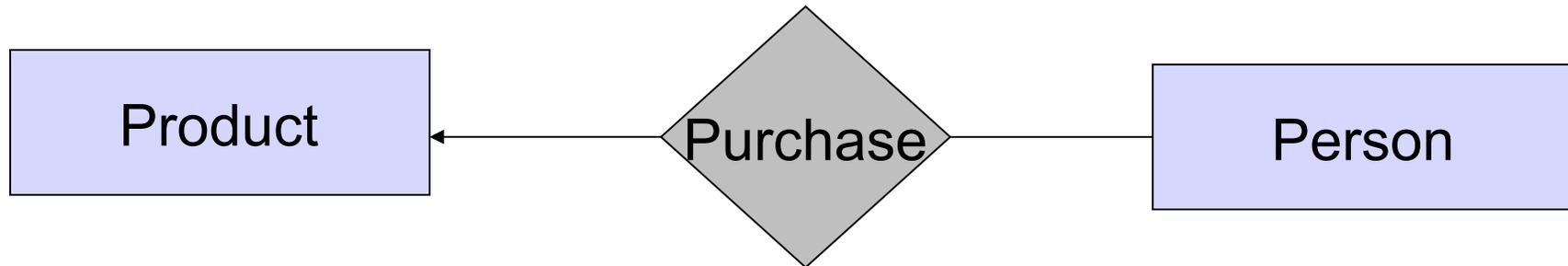


Converting Multi-way Relationships to Binary



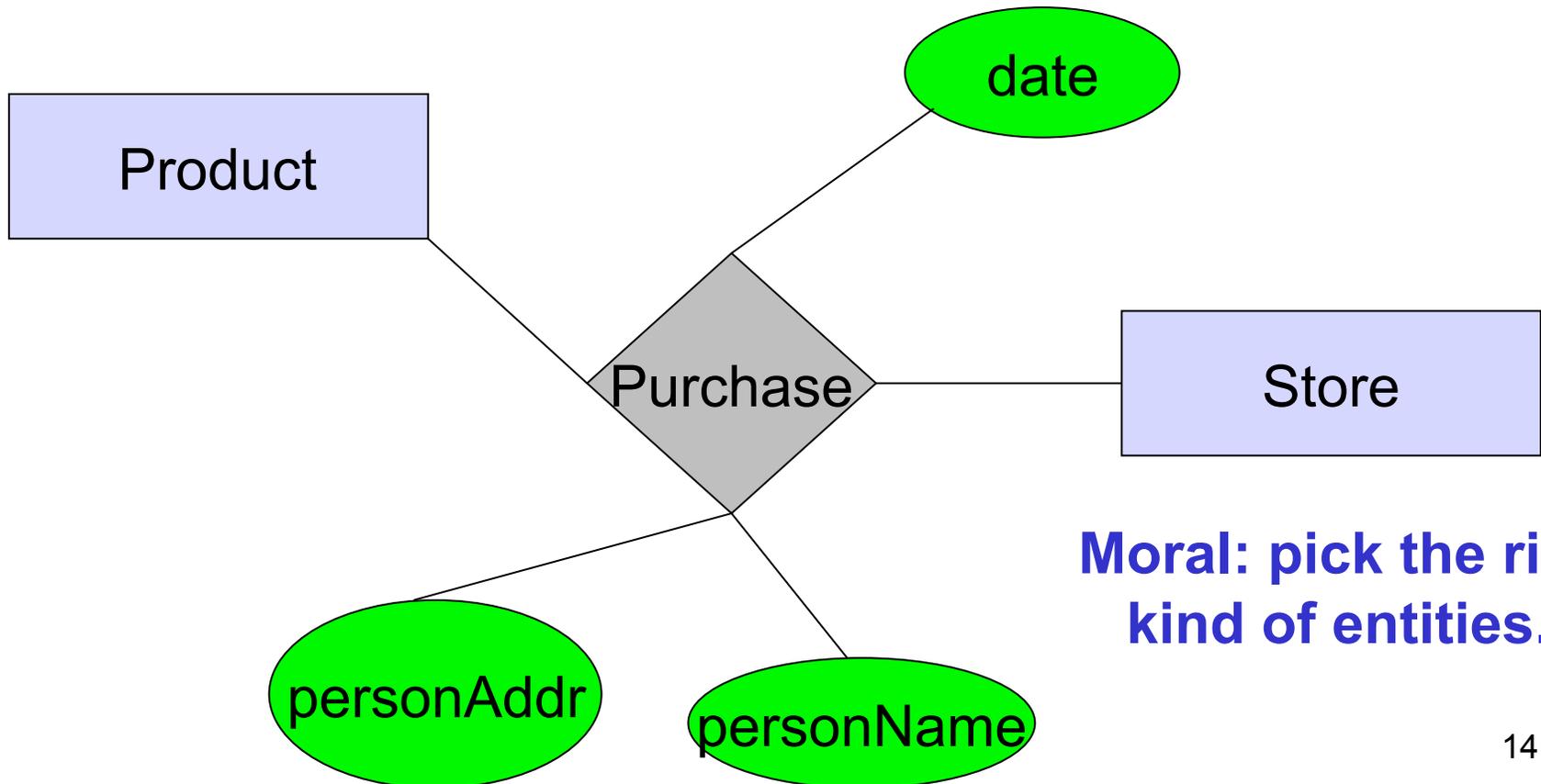
3. Design Principles

What's wrong?



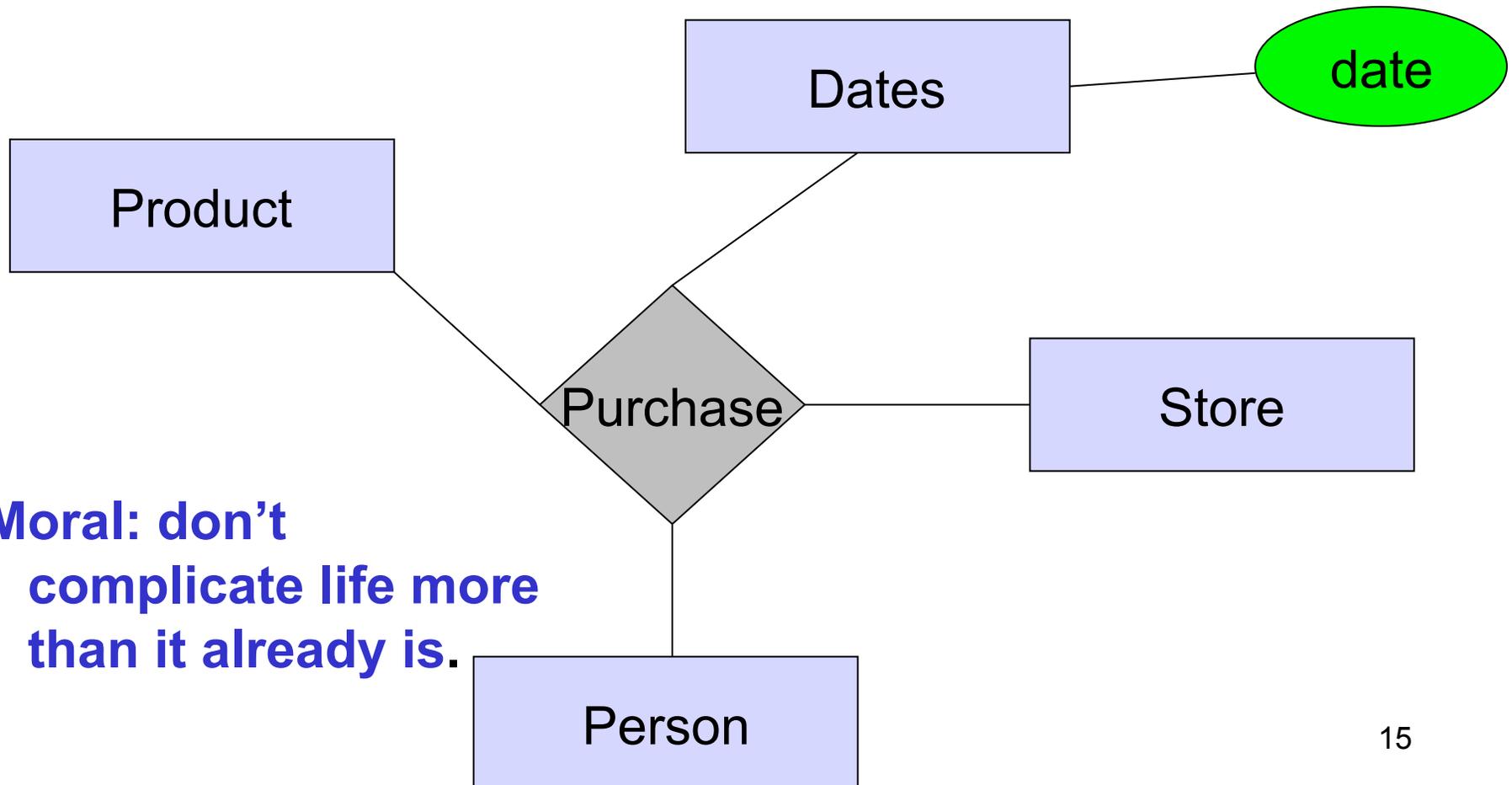
Moral: be faithful!

Design Principles: What's Wrong?



**Moral: pick the right
kind of entities.**

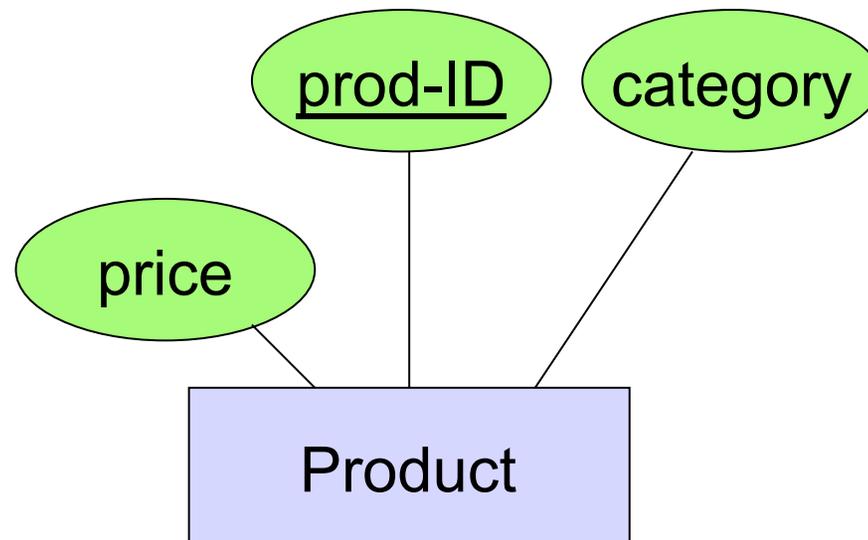
Design Principles: What's Wrong?



From E/R Diagrams to Relational Schema

- Entity set \rightarrow relation
- Relationship \rightarrow relation

Entity Set to Relation



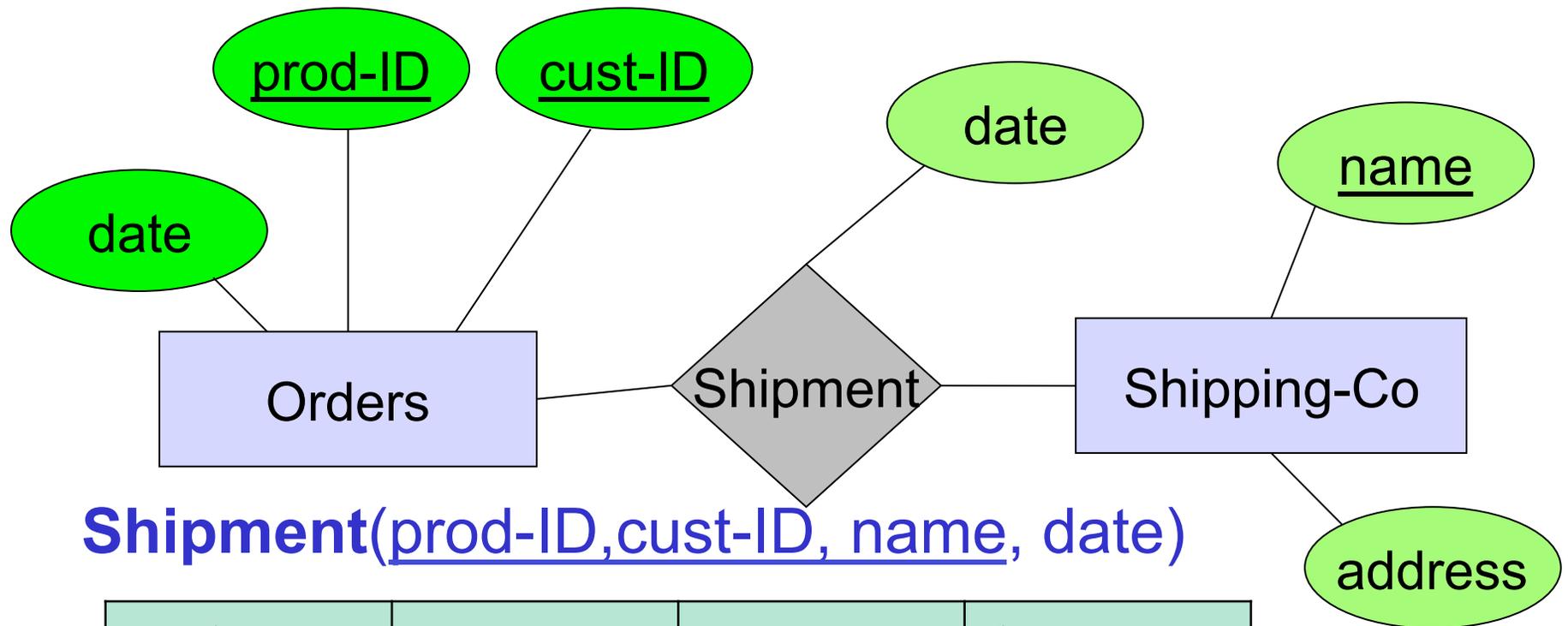
Product(prod-ID, category, price)

<u>prod-ID</u>	category	price
Gizmo55	Camera	99.99
Pokemn19	Toy	29.99

Create Table (SQL)

```
CREATE TABLE Product (  
  prod-ID CHAR(30) PRIMARY KEY,  
  category VARCHAR(20),  
  price double)
```

Relationships to Relations



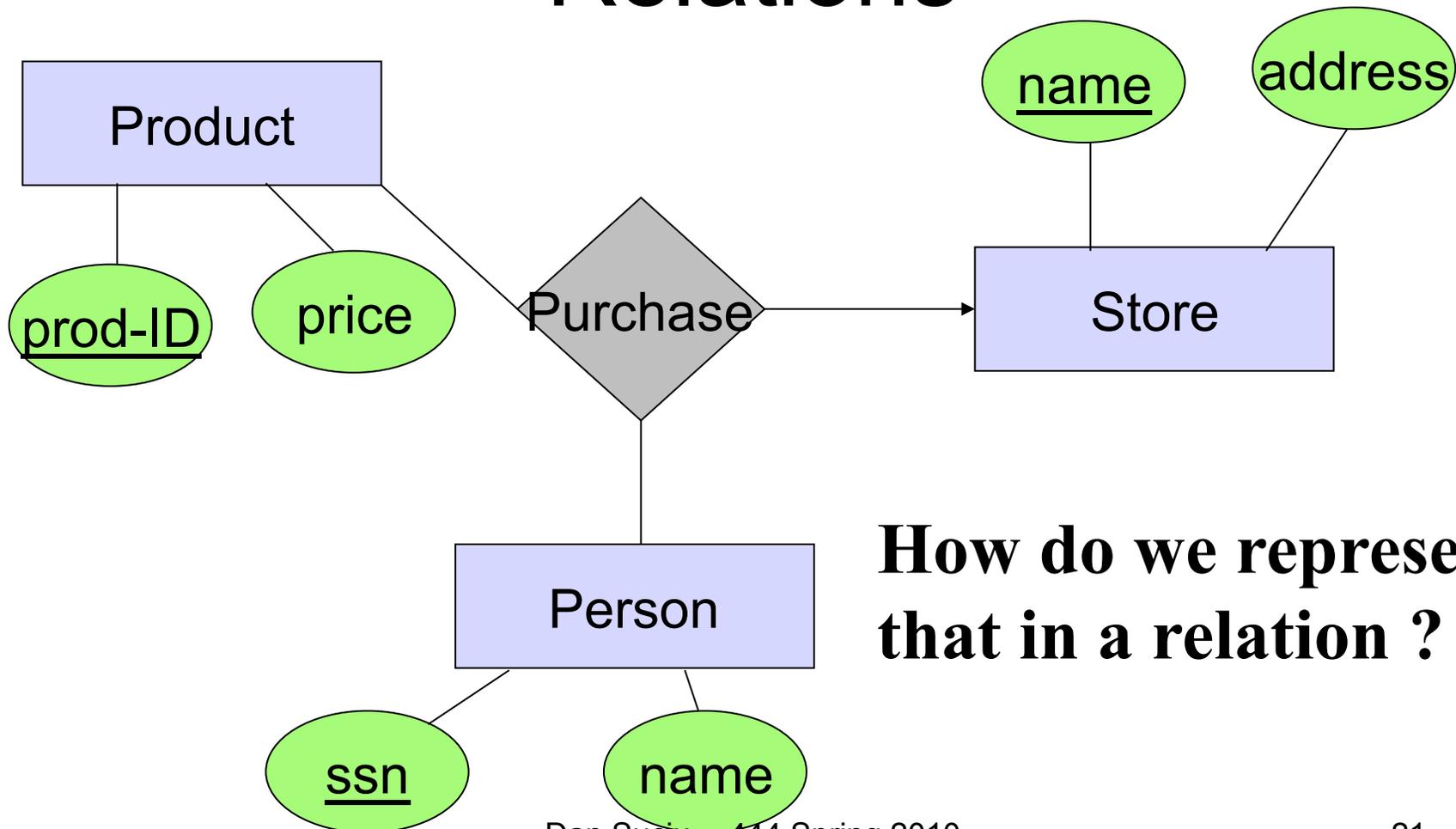
Shipment(prod-ID, cust-ID, name, date)

<u>prod-ID</u>	<u>cust-ID</u>	<u>name</u>	date
Gizmo55	Joe12	UPS	4/10/2010
Gizmo55	Joe12	FEDEX	4/9/2010

Create Table (SQL)

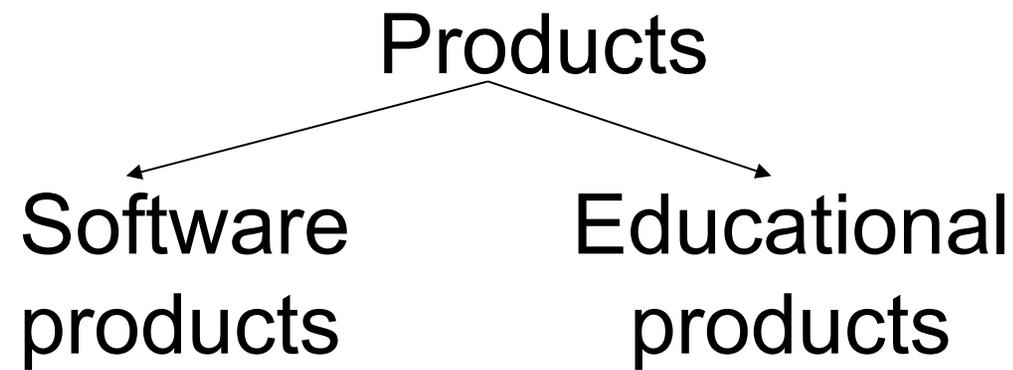
```
CREATE TABLE Shipment(  
    name CHAR(30)  
        REFERENCES Shipping-Co,  
    prod-ID CHAR(30),  
    cust-ID VARCHAR(20),  
    date DATETIME,  
    PRIMARY KEY (name, prod-ID, cust-ID),  
    FOREIGN KEY (prod-ID, cust-ID)  
        REFERENCES Orders  
)
```

Multi-way Relationships to Relations

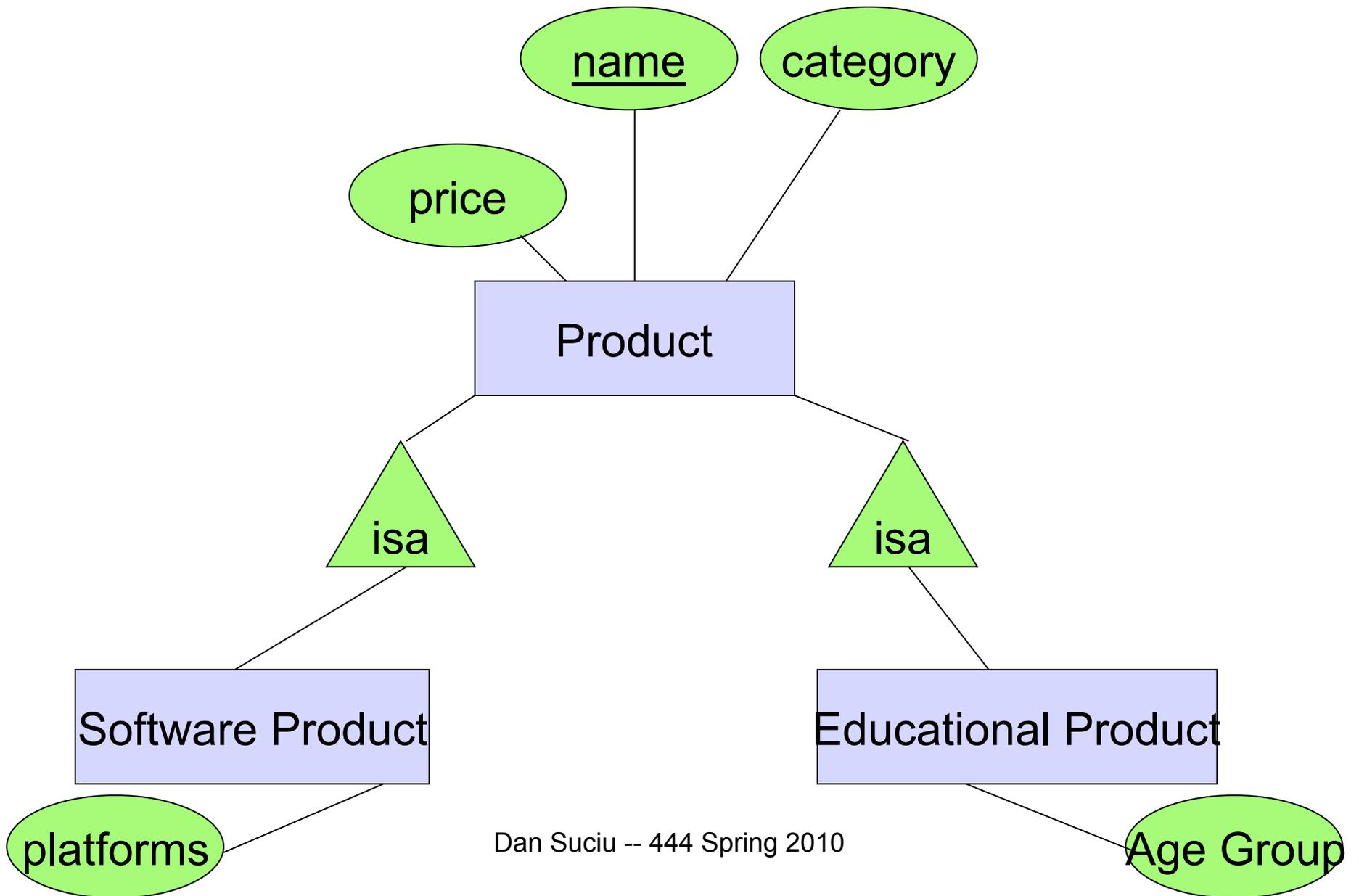


How do we represent that in a relation ?

Modeling Subclasses



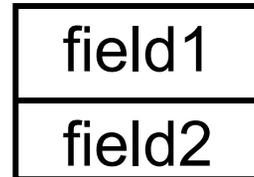
Subclasses



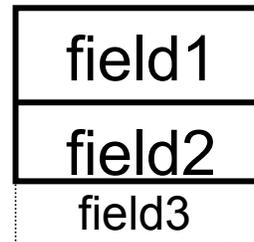
Understanding Subclasses

- Think in terms of records:

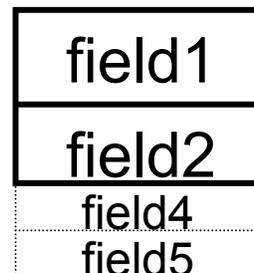
- Product



- SoftwareProduct



- EducationalProduct



Subclasses to Relations

Product

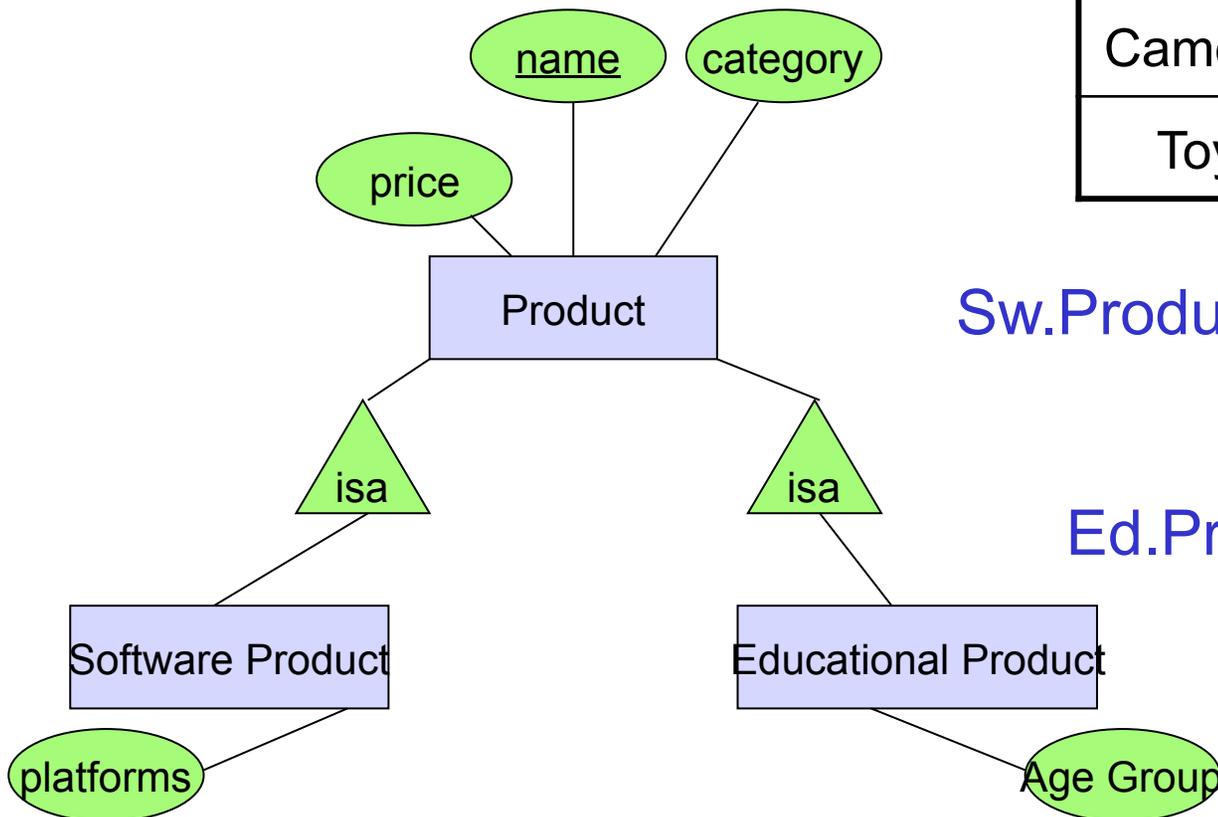
<u>Name</u>	Price	Category
Gizmo	99	gadget
Camera	49	photo
Toy	39	gadget

Sw.Product

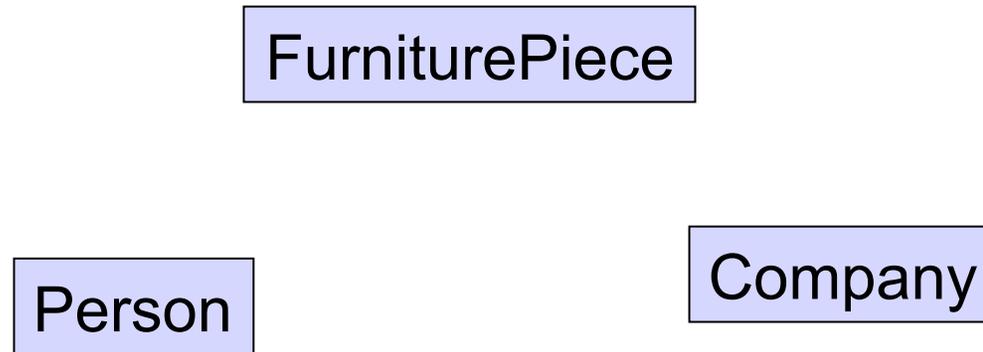
<u>Name</u>	platforms
Gizmo	unix

Ed.Product

<u>Name</u>	Age Group
Gizmo	todler
Toy	retired



Modeling UnionTypes With Subclasses

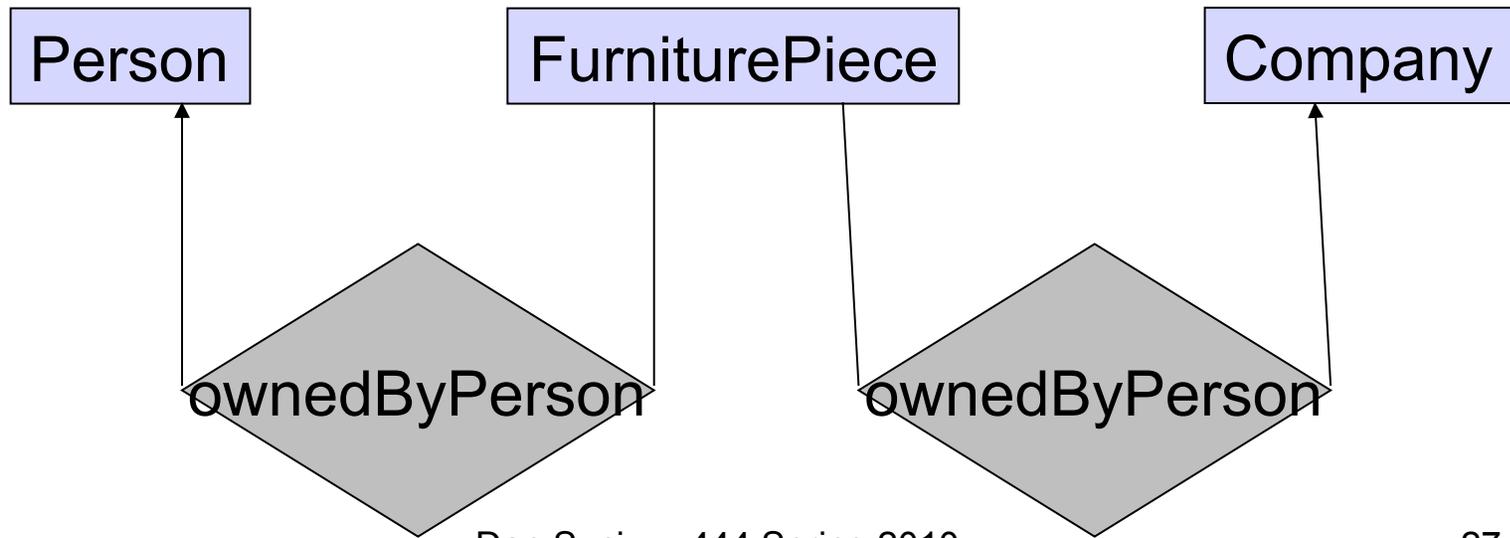


Say: each piece of furniture is owned either by a person, or by a company

Modeling Union Types with Subclasses

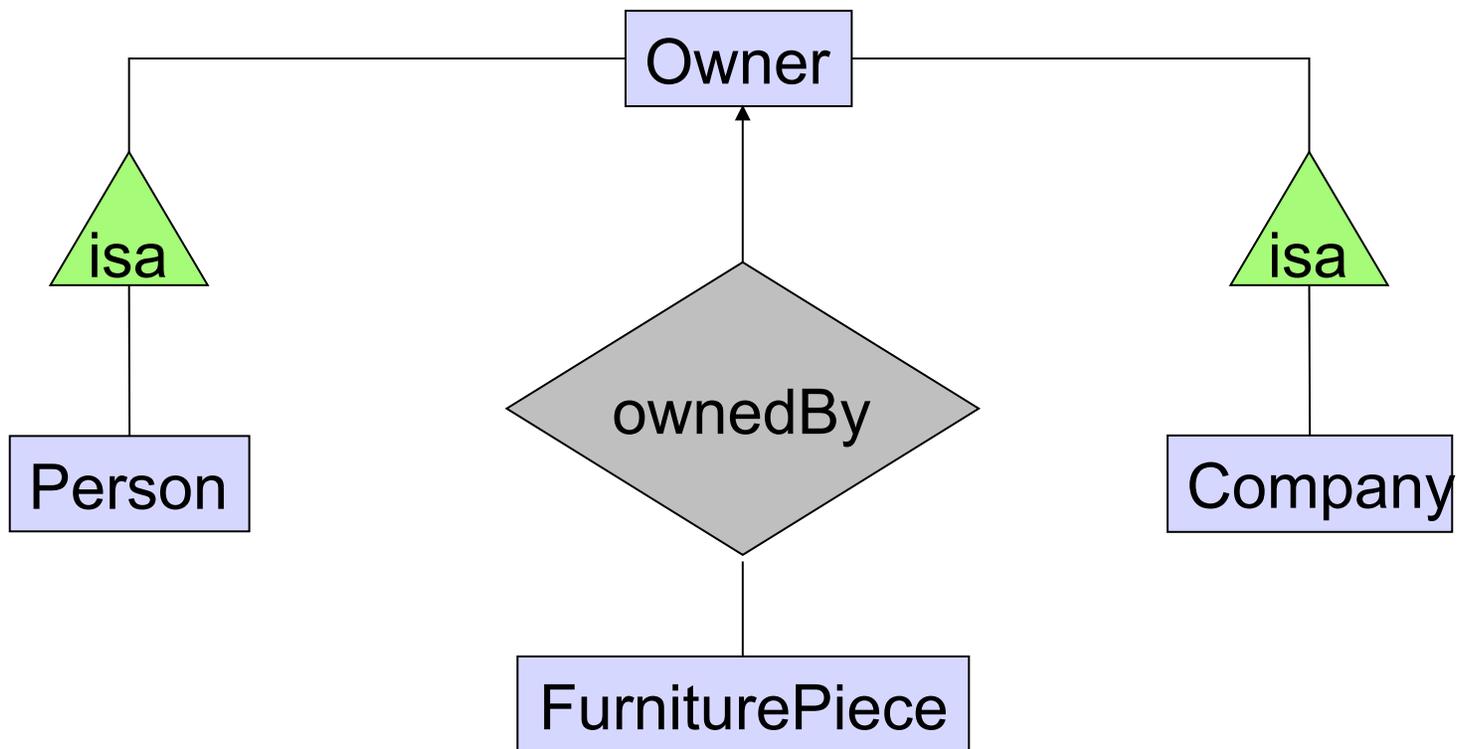
Say: each piece of furniture is owned either by a person, or by a company

Solution 1. Acceptable (What's wrong ?)



Modeling Union Types with Subclasses

Solution 2: More faithful



Constraints in E/R Diagrams

Finding constraints is part of the modeling process.
Commonly used constraints:

Keys: social security number uniquely identifies a person.

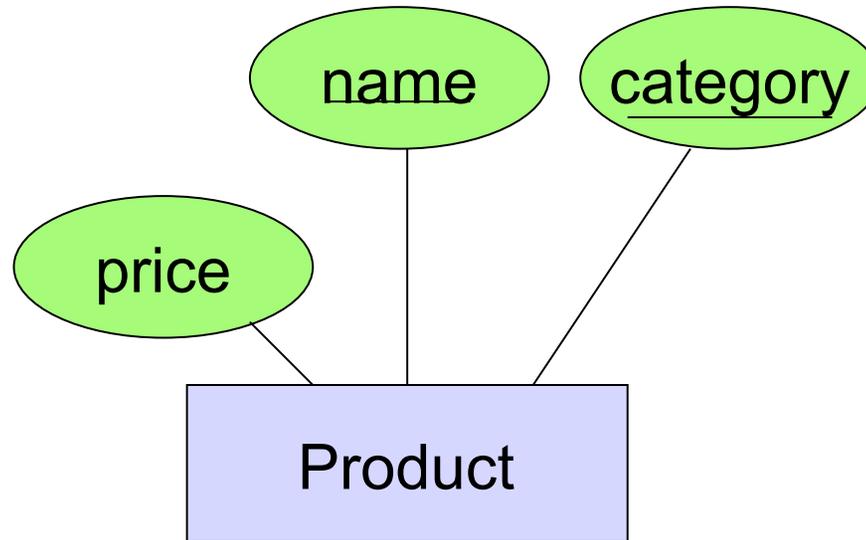
Single-value constraints: a person can have only one father.

Referential integrity constraints: if you work for a company, it must exist in the database.

Other constraints: peoples' ages are between 0 and 150.

Keys in E/R Diagrams

Underline:



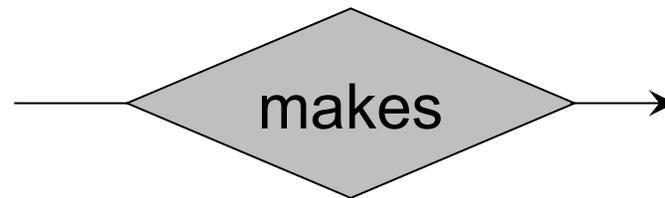
Multi-attribute key

v.s.

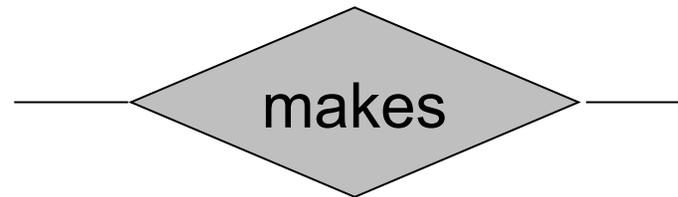
Multiple keys

Not possible in E/R

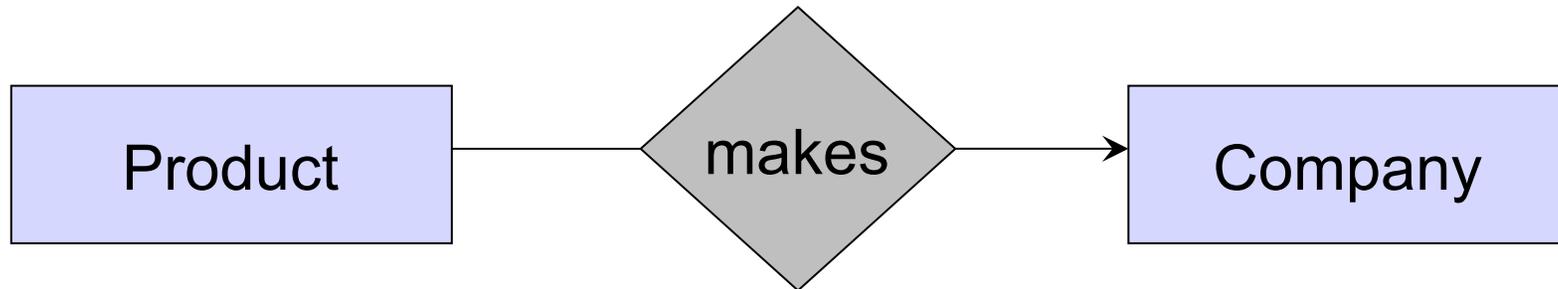
Single Value Constraints



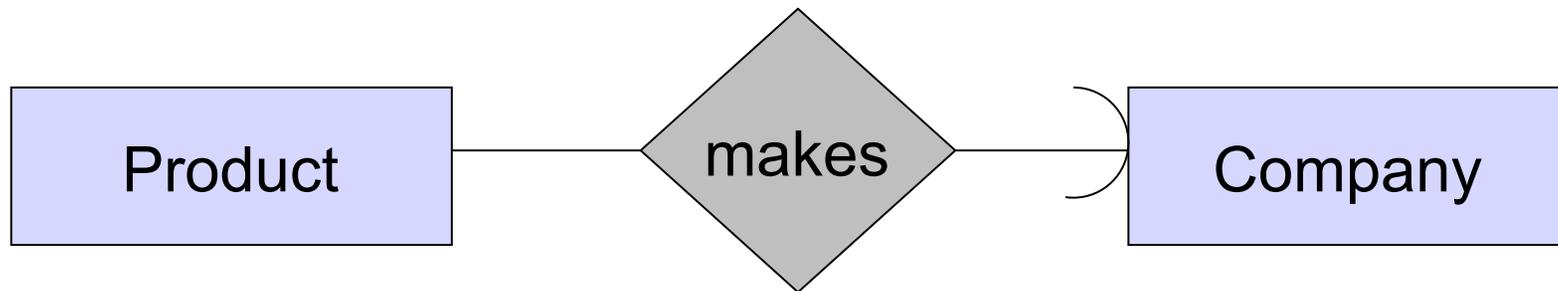
v. s.



Referential Integrity Constraints

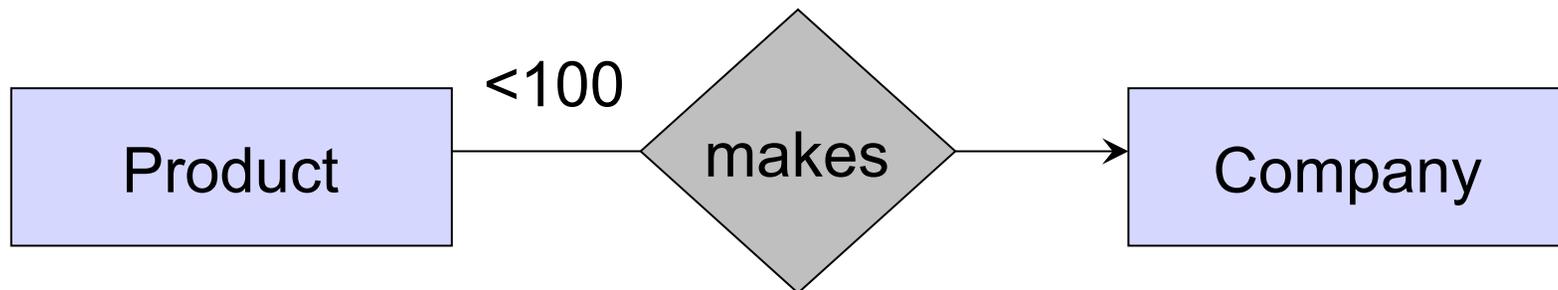


Each product made by at most one company.
Some products made by no company



Each product made by exactly one company.

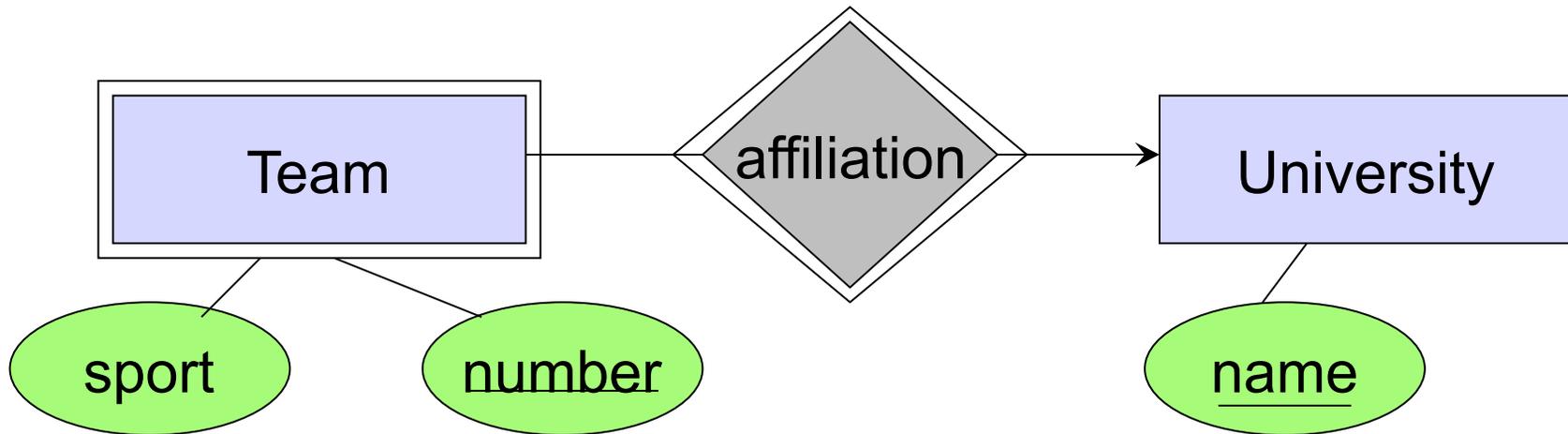
Other Constraints



What does this mean ?

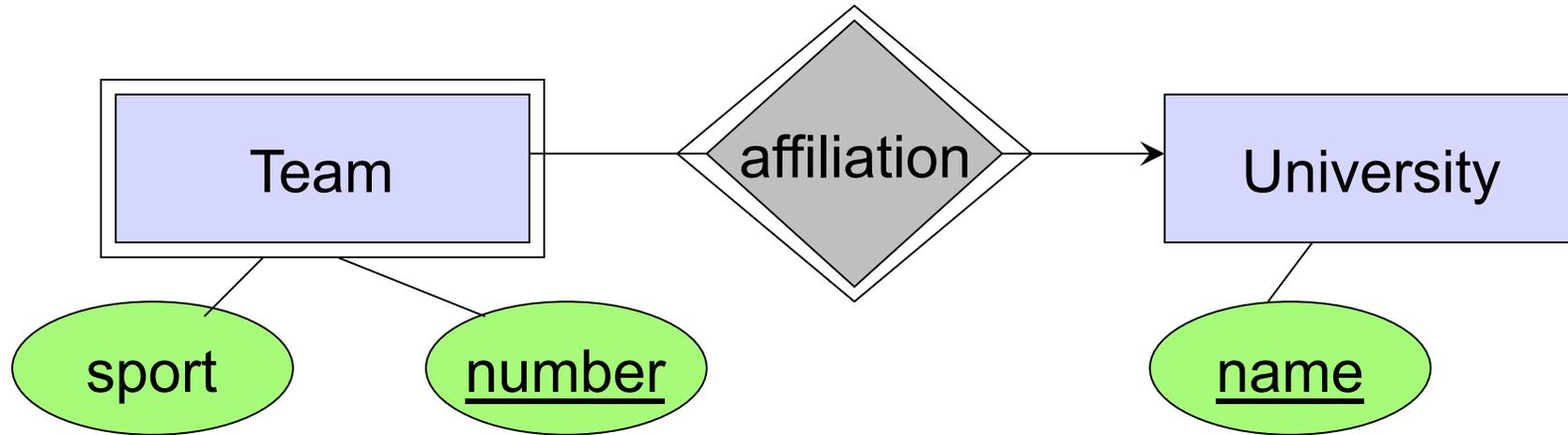
Weak Entity Sets

Entity sets are weak when their key comes from other classes to which they are related.



Notice: we encountered this when converting multiway relationships to binary relationships

Handling Weak Entity Sets



How do we represent this with relations ?