Introduction to Data Management CSE 344

Lecture 17: E/R Diagrams and Constraints

Guest Lecturer: Shumo Chu

Announcements

- HW5 due this Friday
- HW6, WQ6 will be out this Friday
  - Due on 11/21

Database Design

What it is:

- Starting from scratch, design the database schema: relation, attributes, keys, foreign keys, constraints etc

Why it's hard

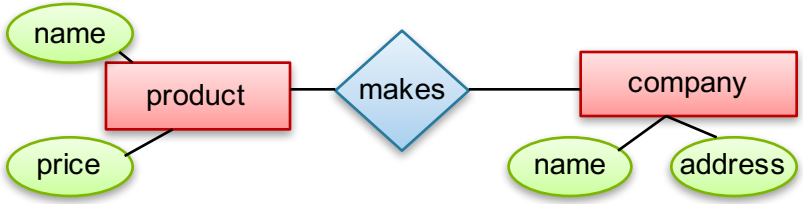
- The database will be in operation for a very long time (years). Updating the schema while in production is very expensive (why?)

Database Design

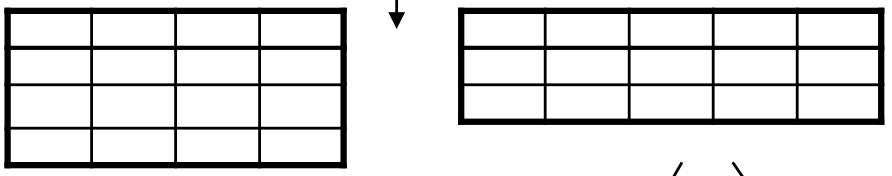
- Consider issues such as:
  - What entities to model
  - How entities are related
  - What constraints exist in the domain
- Several formalisms exists
  - We discuss E/R diagrams
- Reading: Sec. 4.1-4.6

Database Design Process

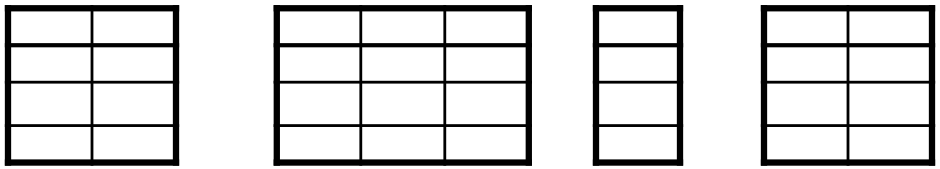
Conceptual Model:



Relational Model:
Tables + constraints
And also functional dep.

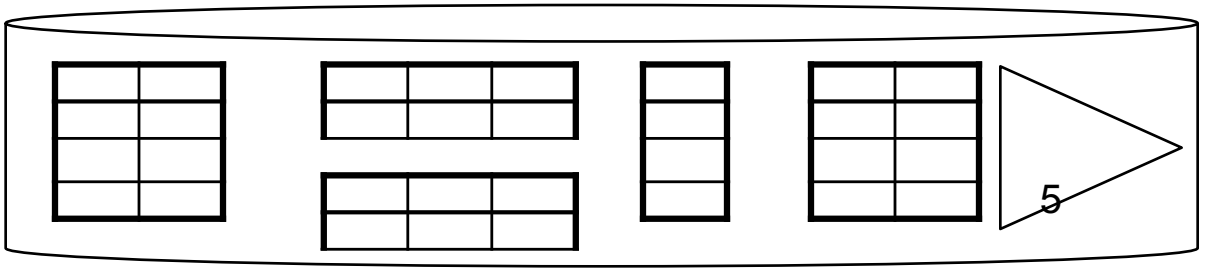


Normalization:
Eliminates anomalies



Conceptual Schema

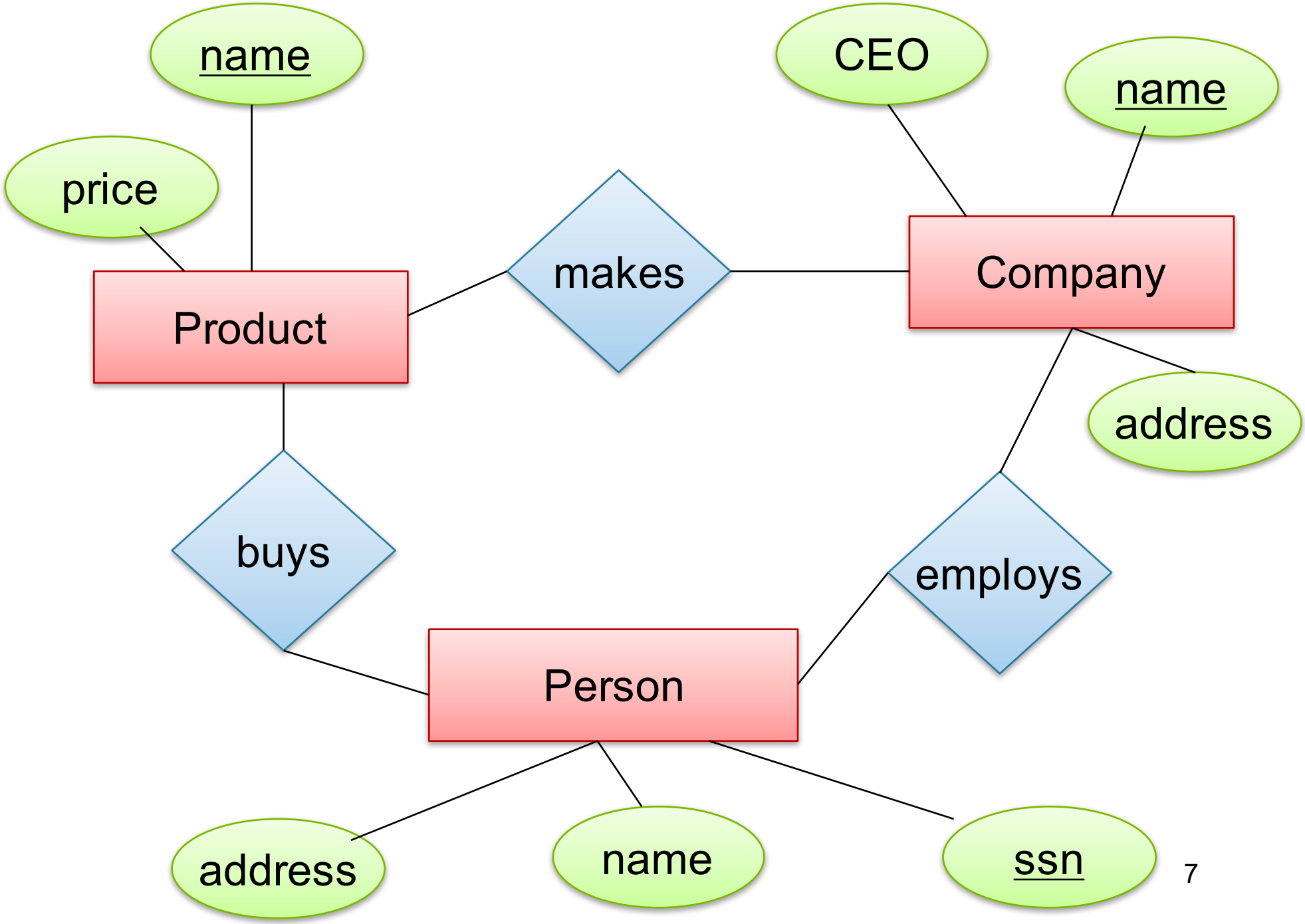
Physical storage details



Physical Schema

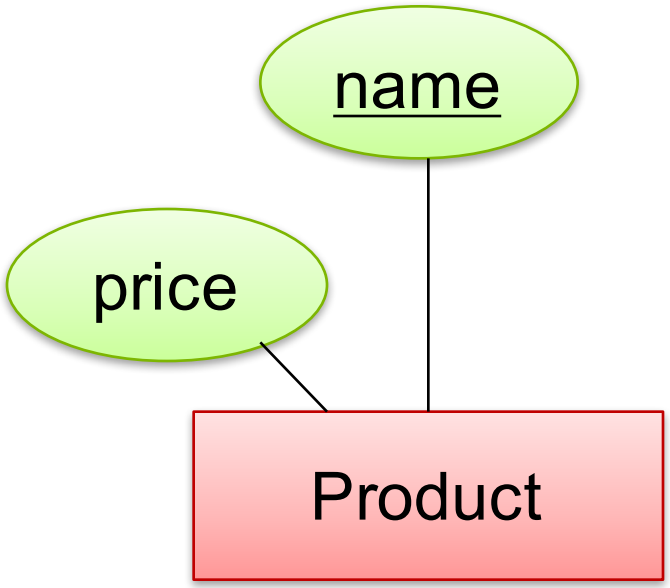
Entity / Relationship Diagrams

- Entity set = a class
  - An entity = an object
- Attribute
- Relationship


name
CEO
name
price
makes
Company
Product
address
buys
employs
Person
address
name
ssn

Keys in E/R Diagrams

- Every entity set must have a key

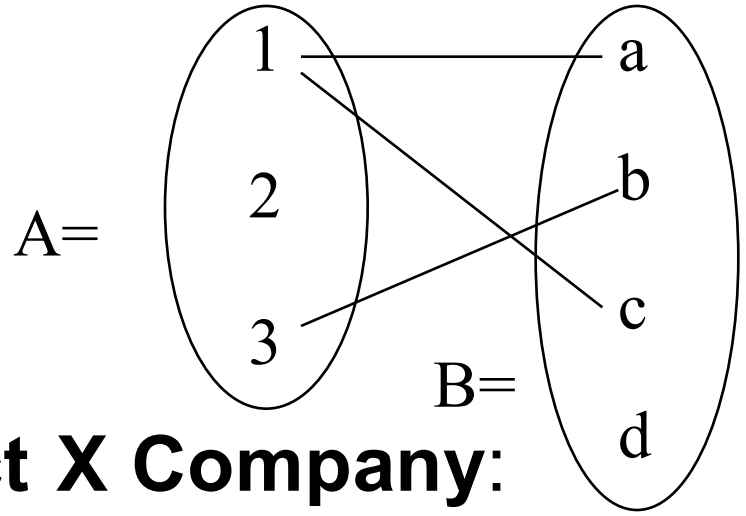


What is a Relation ?

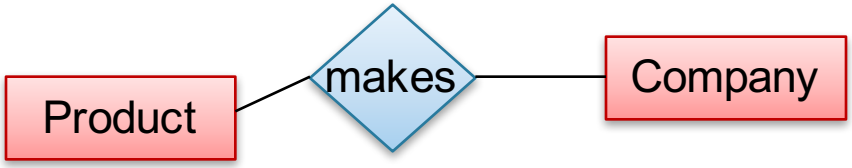
- A mathematical definition:
  - if A, B are sets, then a relation R is a subset of A X B
- A={1,2,3}, B={a,b,c,d},

  A X B = {(1,a),(1,b), . . ., (3,d)}

  R = {(1,a), (1,c), (3,b)}

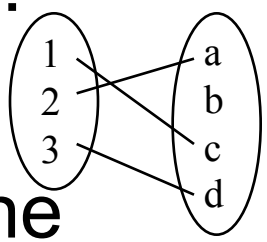


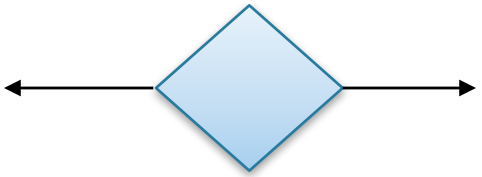
- **makes** is a subset of **Product X Company**:



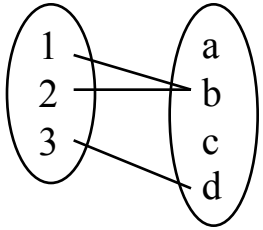
Multiplicity of E/R Relations

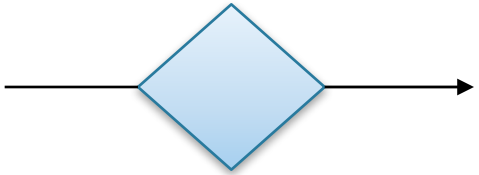
- one-one:



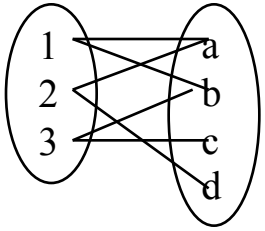


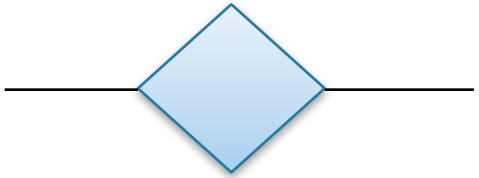
- many-one

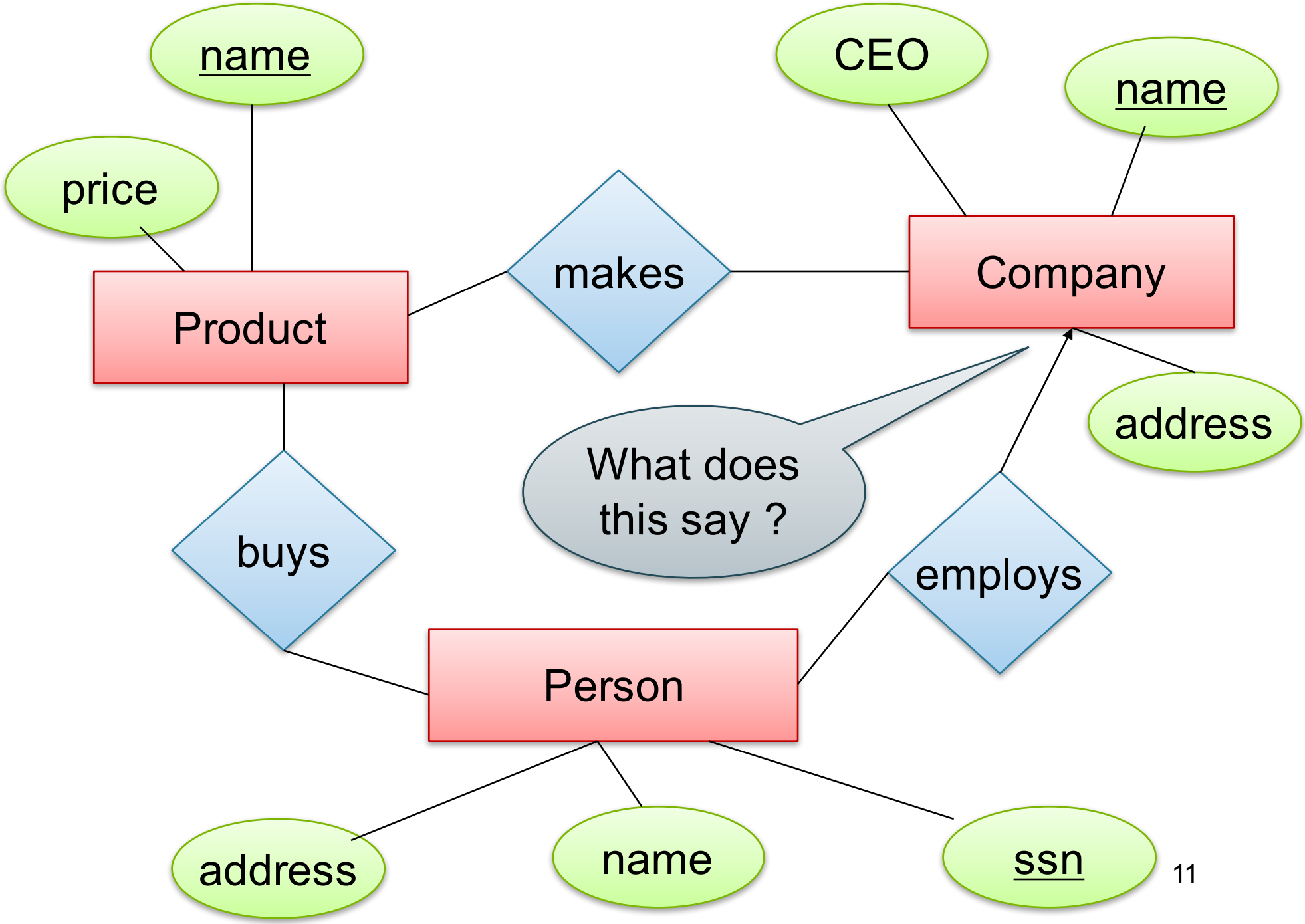




- many-many

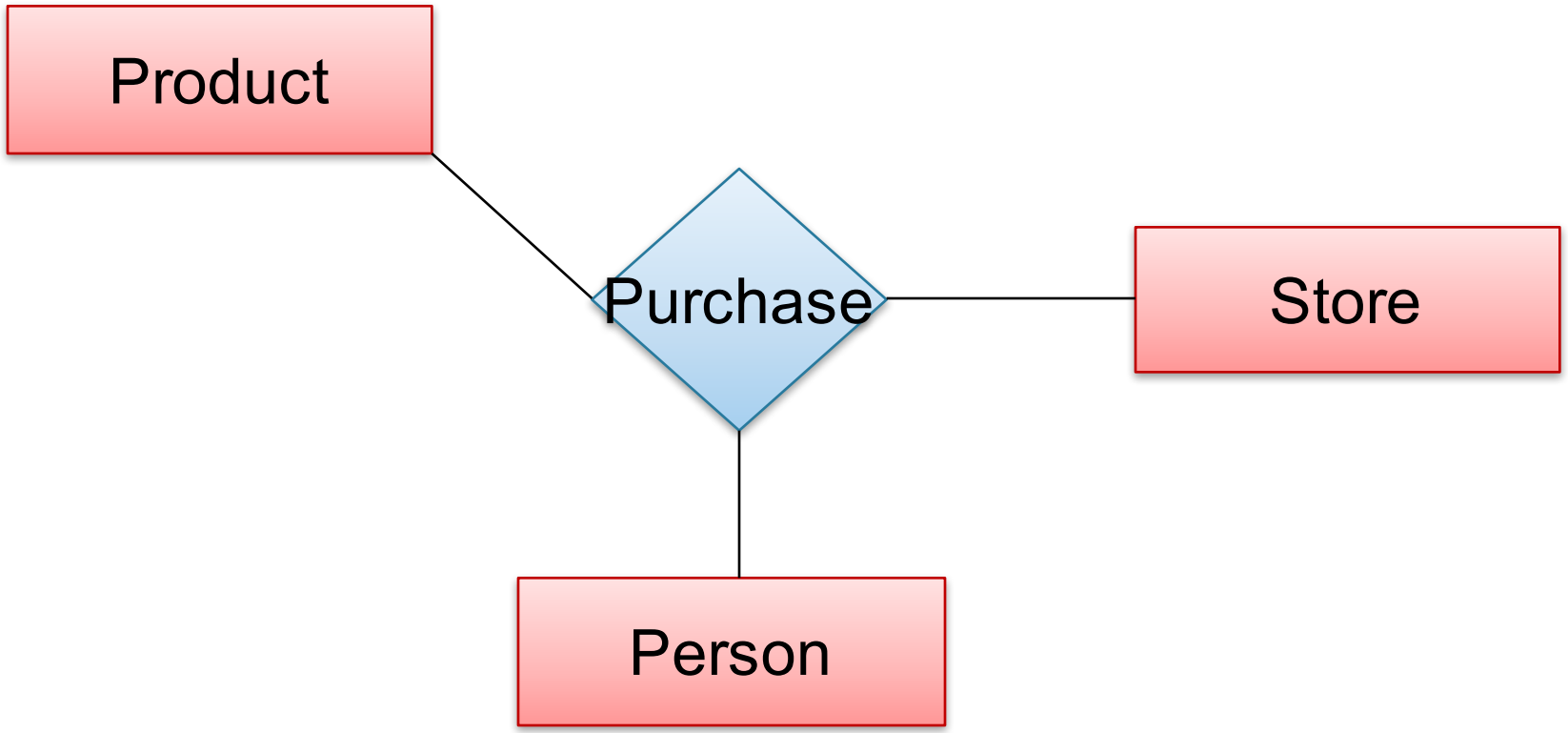





name
CEO
name
price
makes
Company
Product
address
What does this say ?
buys
employs
Person
address
name
ssn

Multi-way Relationships

How do we model a purchase relationship between buyers, products and stores?

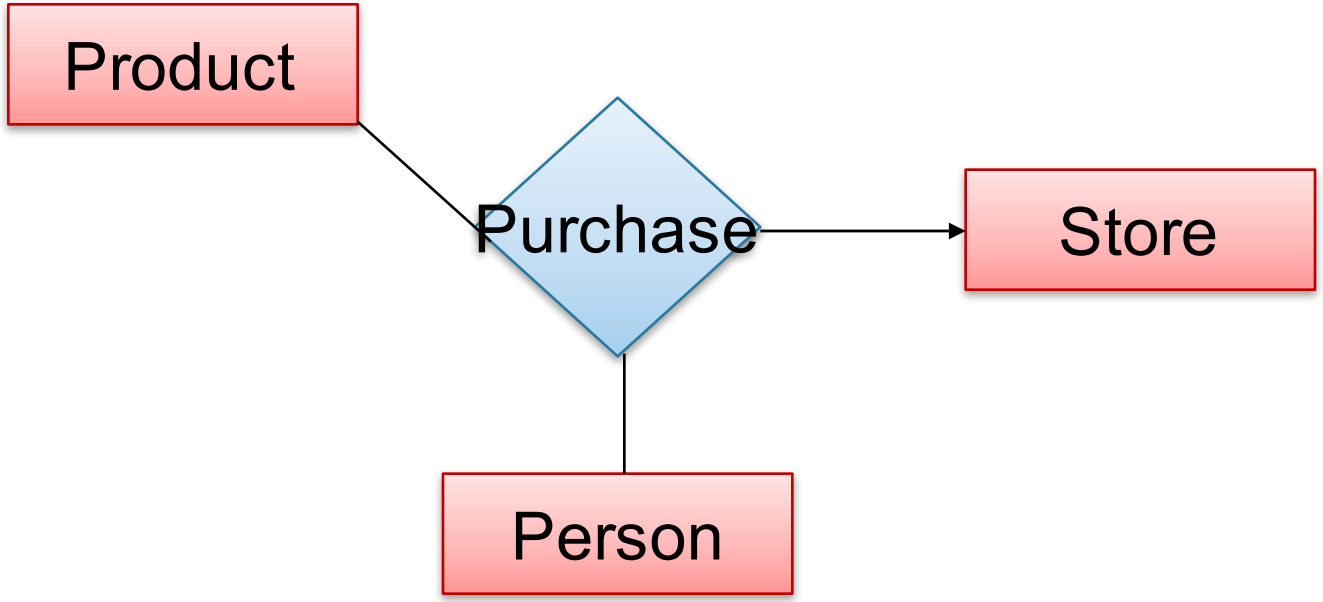


Can still model as a mathematical set (Q. how ?)

A. As a set of triples $\subseteq$ Person X Product X Store

Arrows in Multiway Relationships

Q: What does the arrow mean ?

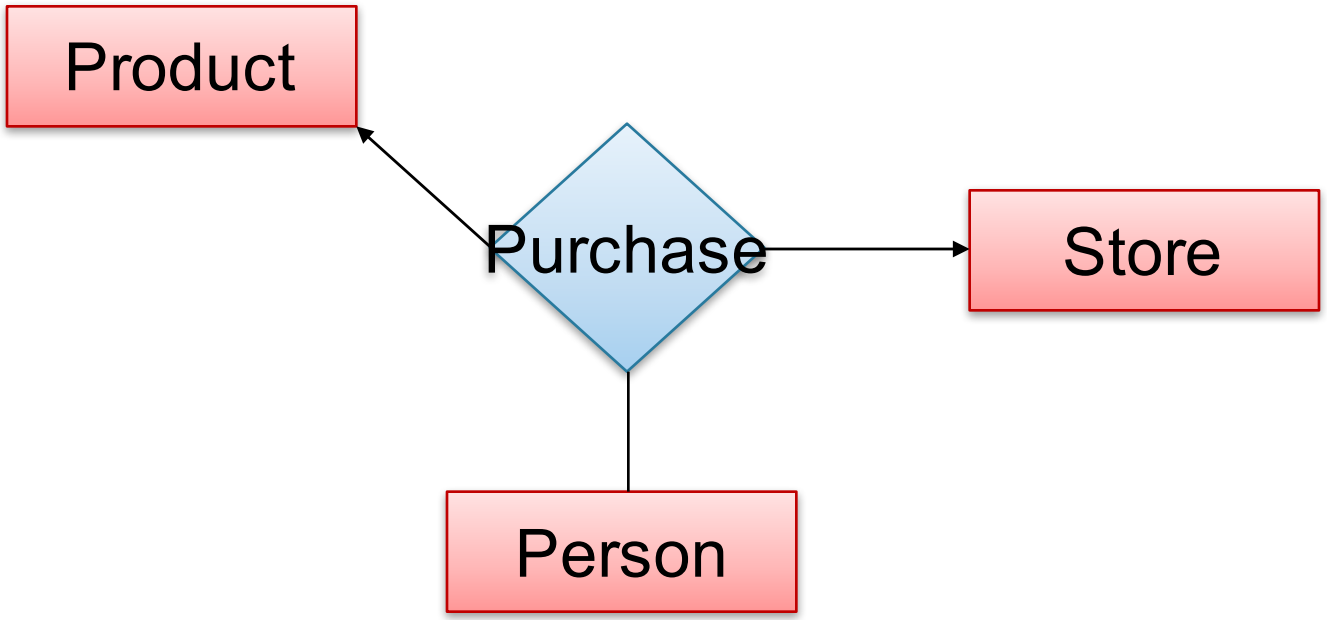


A: A given person buys a given product from at most one store

[Arrow pointing to E means that if we select one entity from each of the other entity sets in the relationship, those entities are related to at most one entity in E]

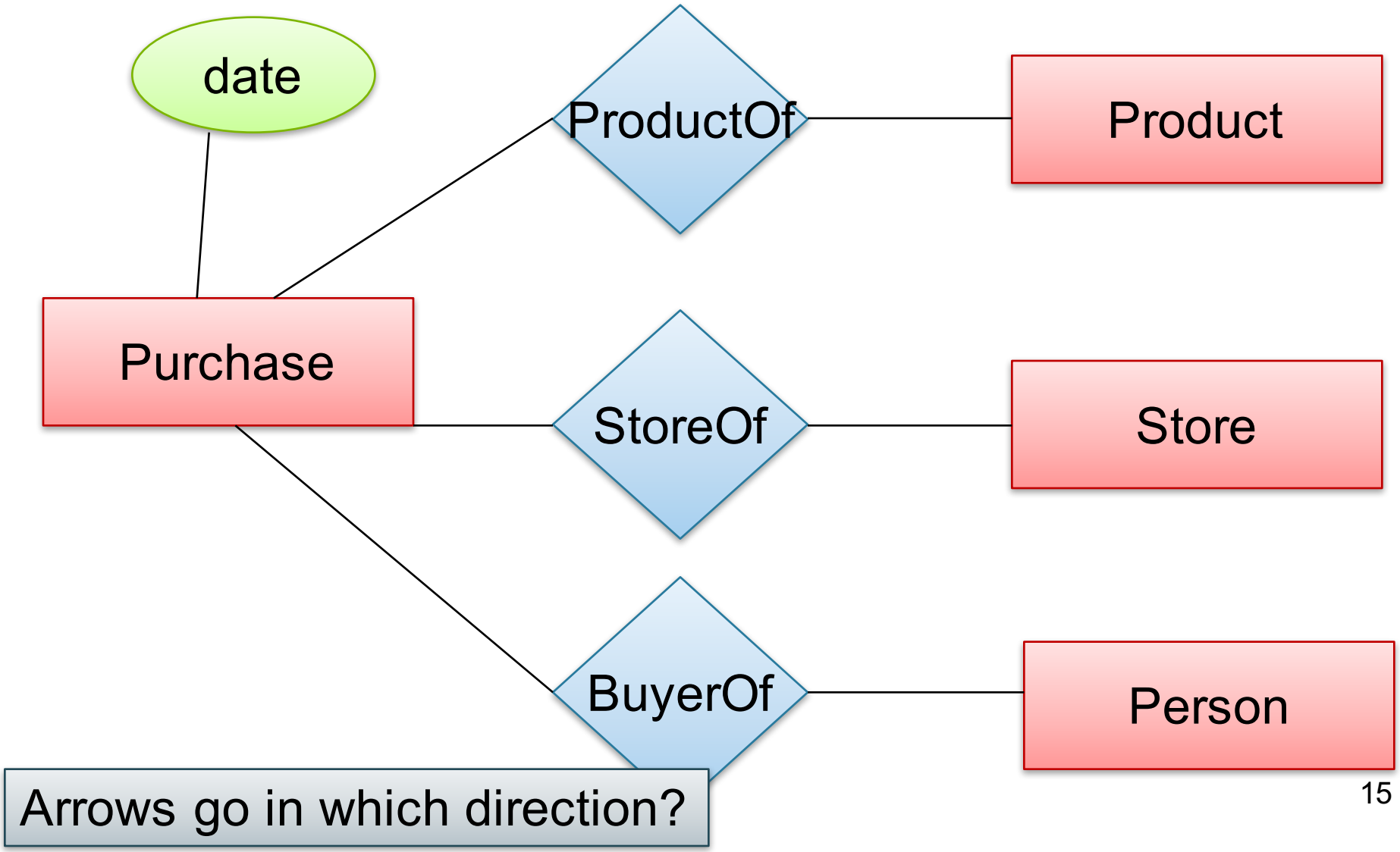
Arrows in Multiway Relationships

Q: What does the arrow mean ?

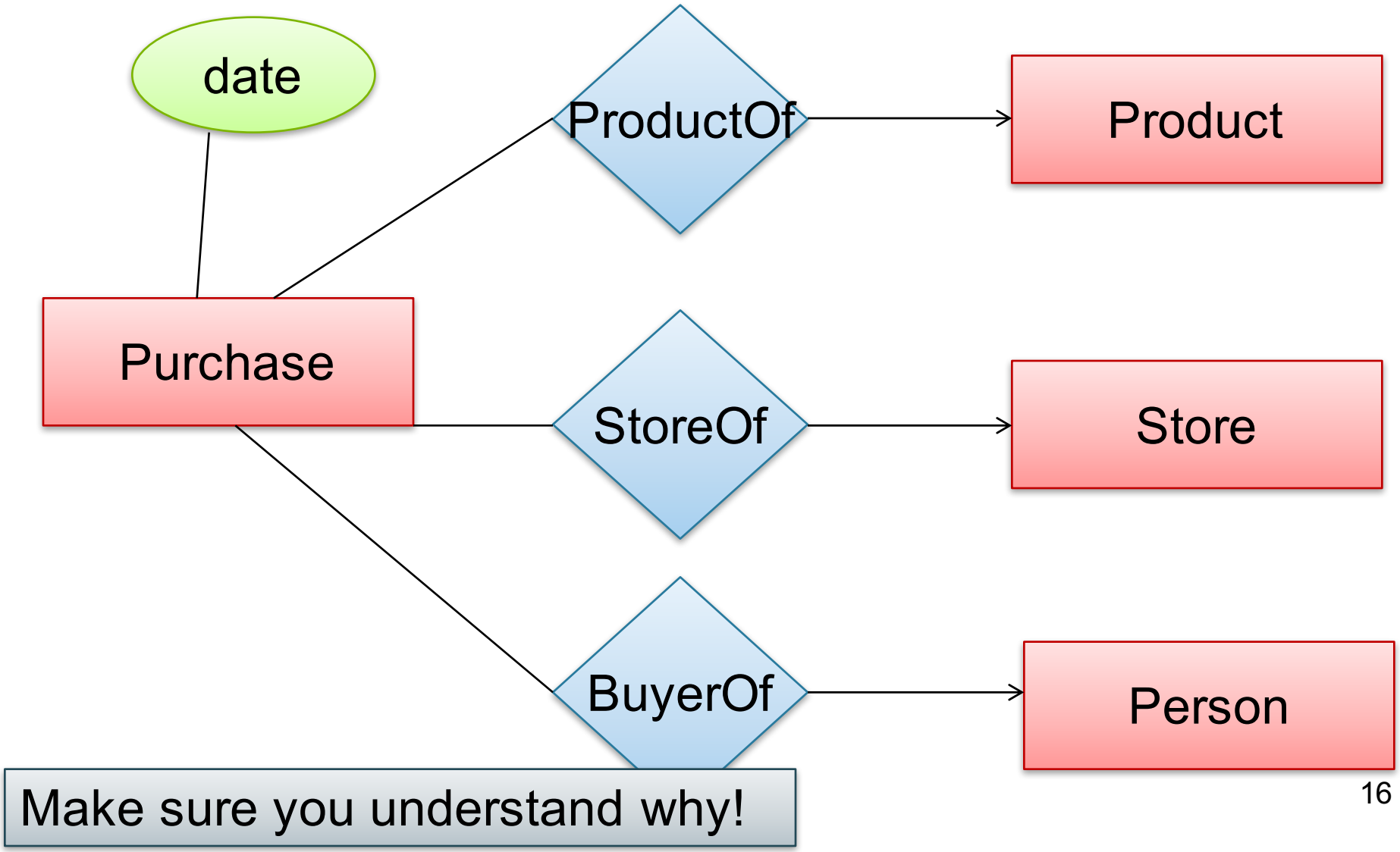


A: A given person buys a given product from at most one store AND every store sells to every person at most one product

Converting Multi-way Relationships to Binary

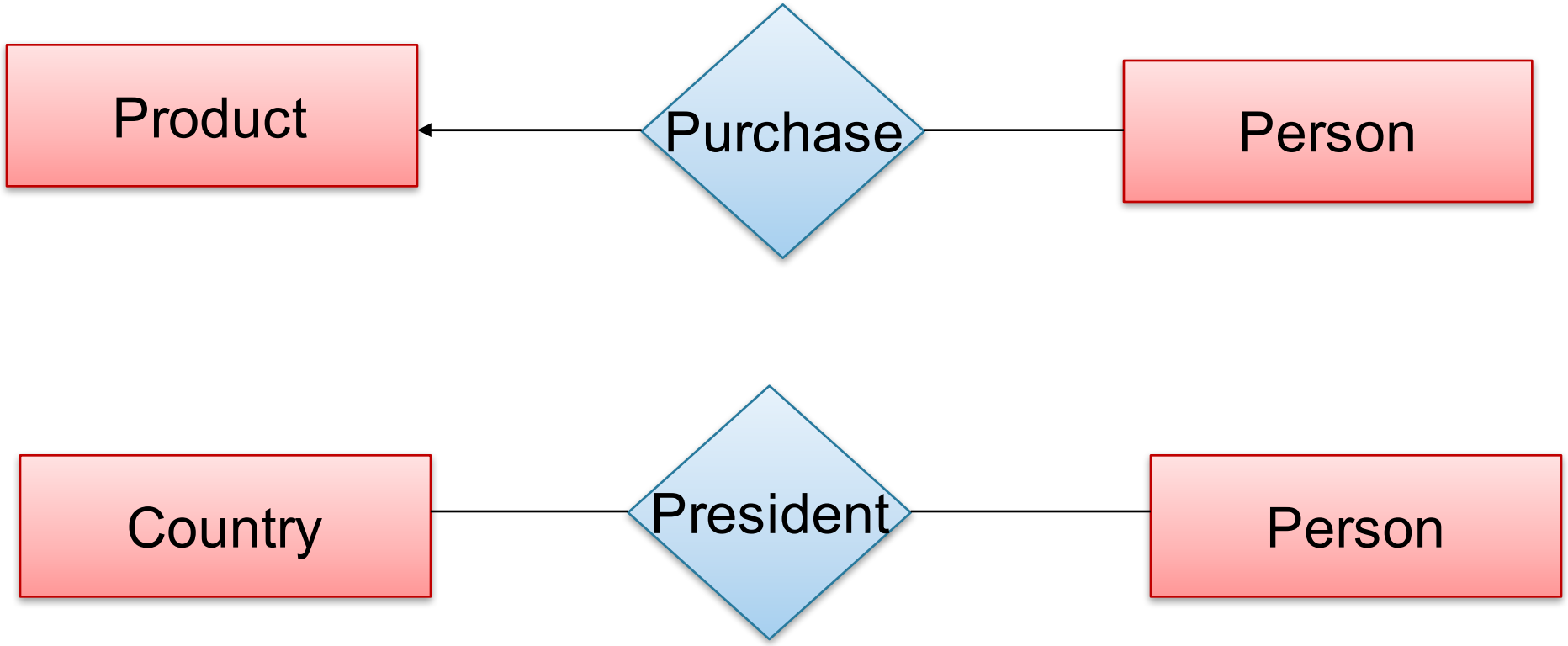


Converting Multi-way Relationships to Binary



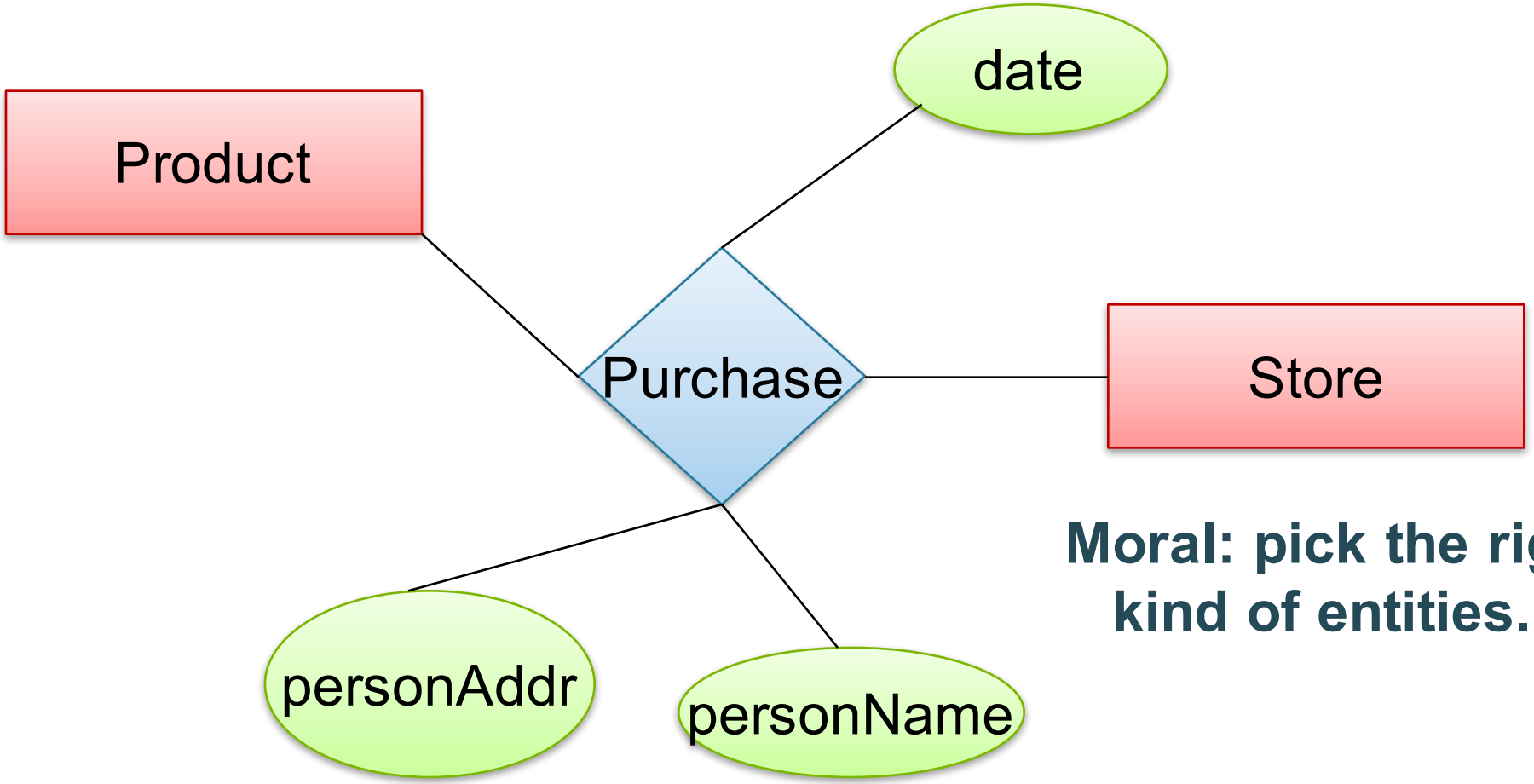
3. Design Principles

What's wrong?



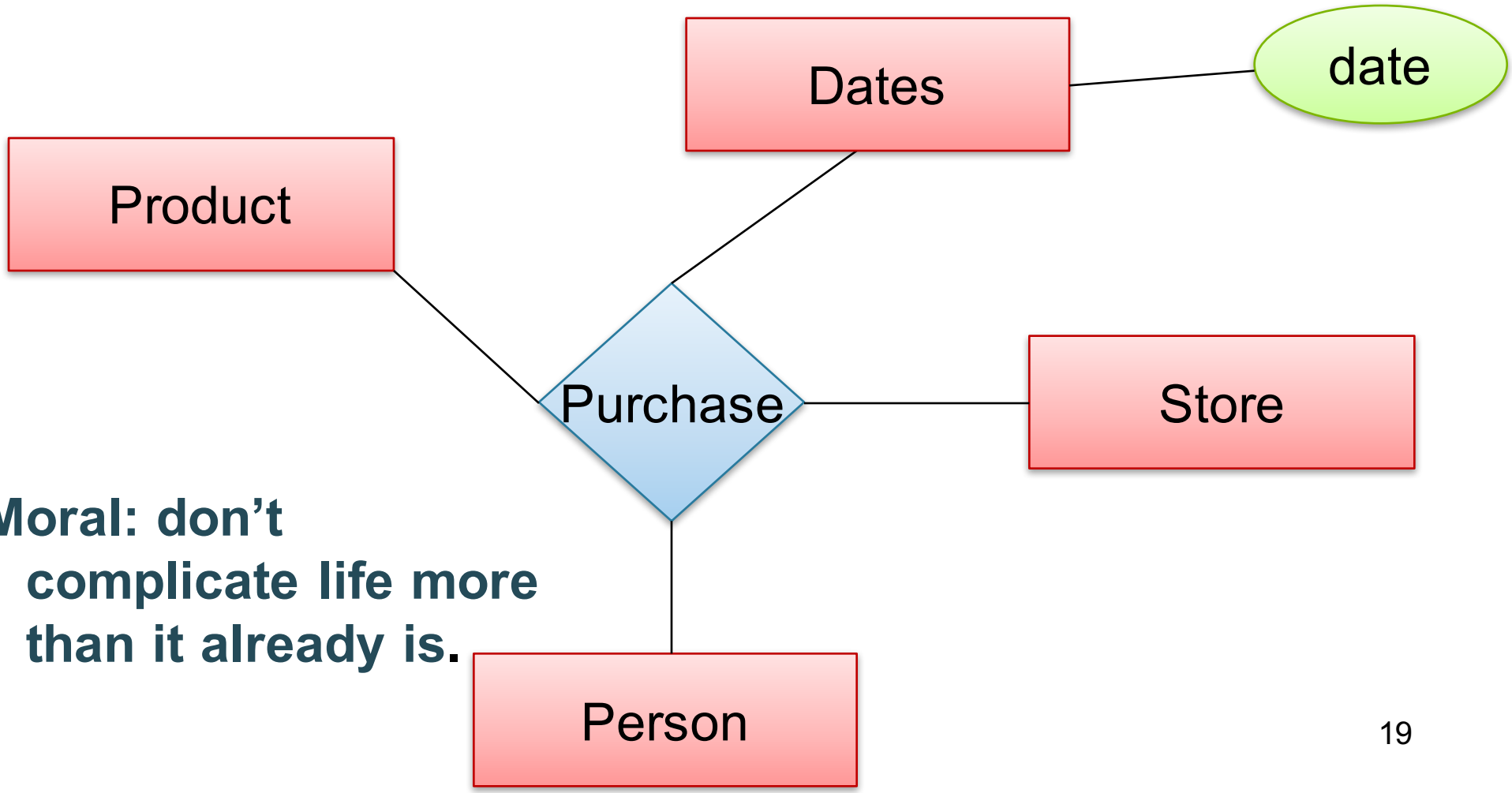
Moral: Be faithful to the specifications of the application!

Design Principles: What's Wrong?



Moral: pick the right kind of entities.

Design Principles: What's Wrong?

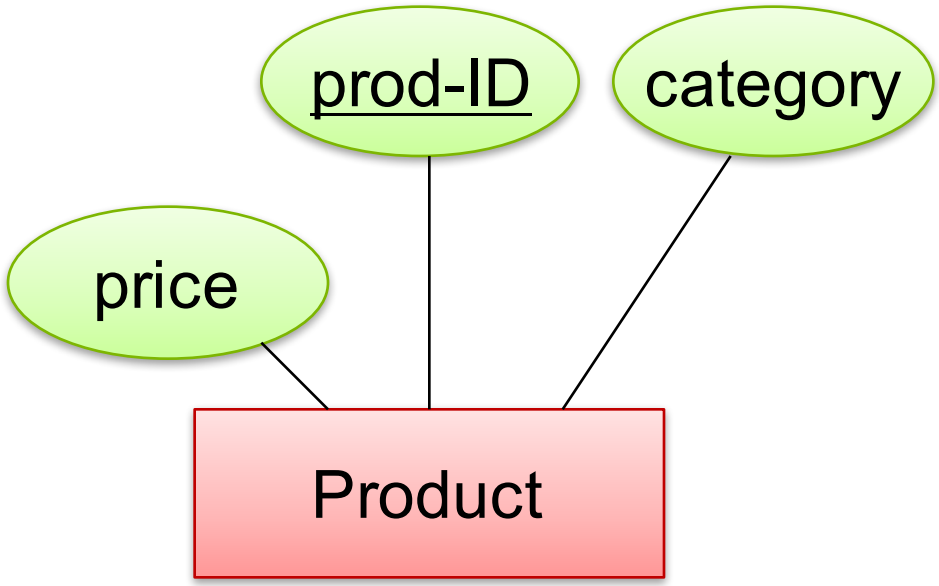


Moral: don't complicate life more than it already is.

From E/R Diagrams to Relational Schema

- Entity set → relation
- Relationship → relation

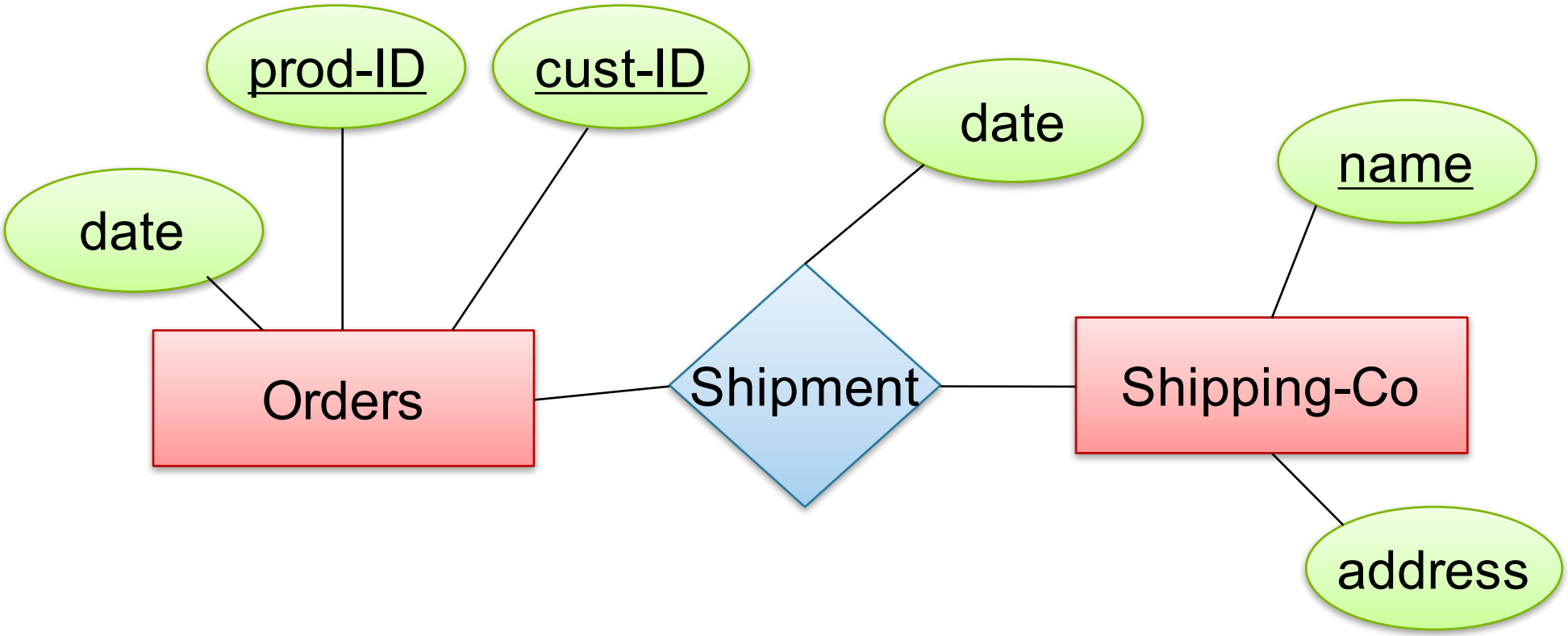
Entity Set to Relation



Product(prod-ID, category, price)

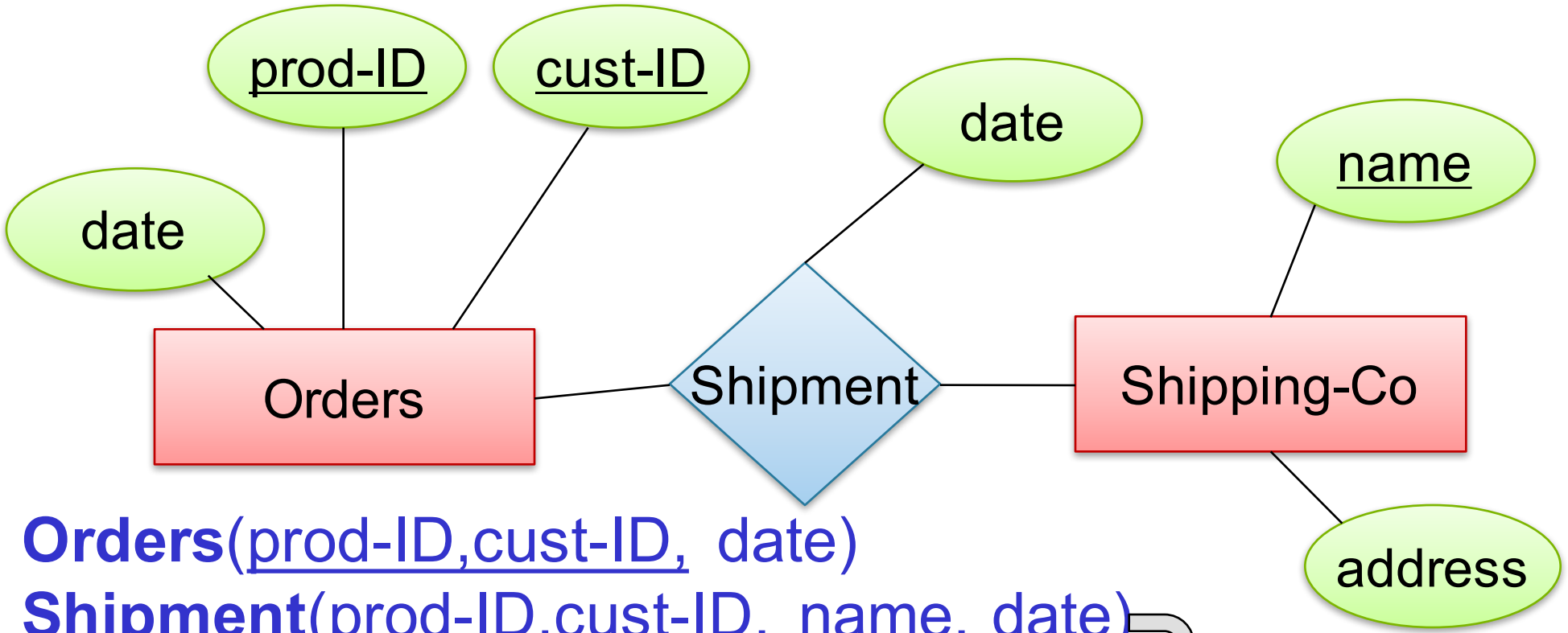
prod-ID	category	price
Gizmo55	Camera	99.99
Pokemn19	Toy	29.99

N-N Relationships to Relations



Represent this in relations

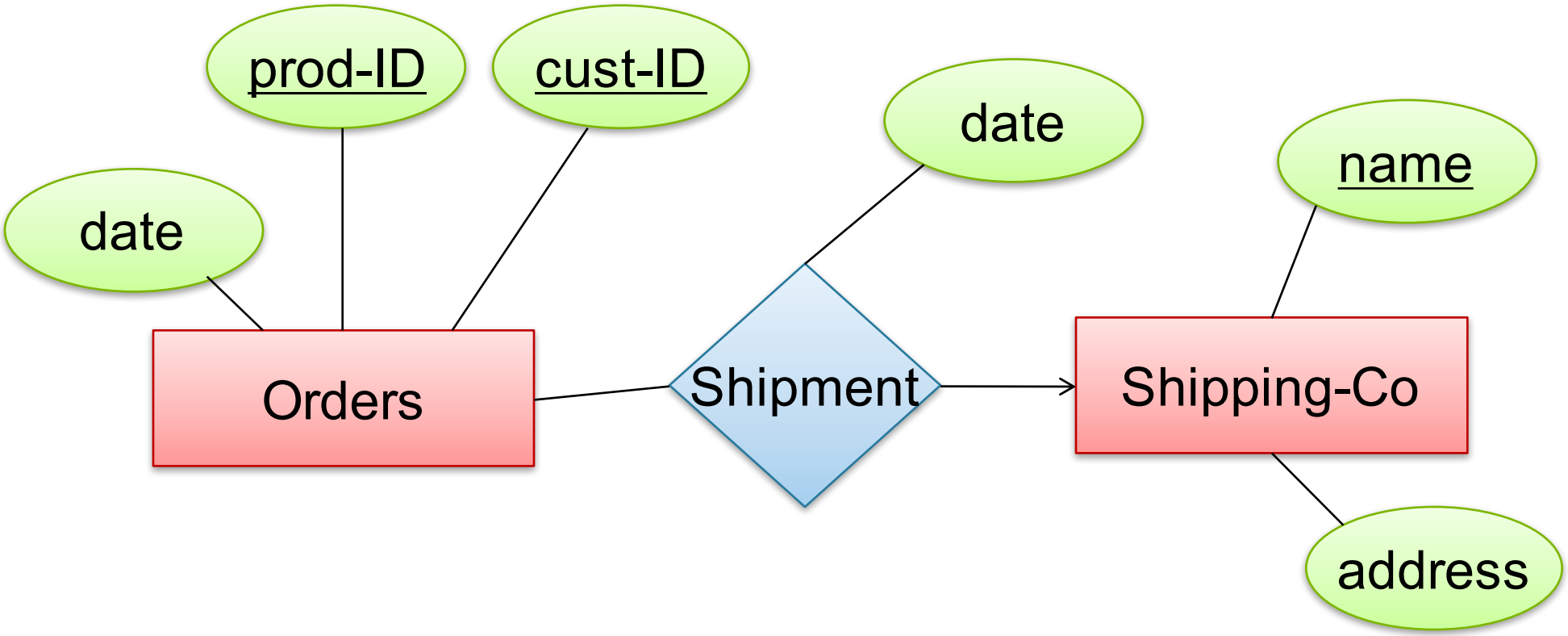
N-N Relationships to Relations



Orders(prod-ID,cust-ID, date)
Shipment(prod-ID,cust-ID, name, date)
Shipping-Co(name, address)

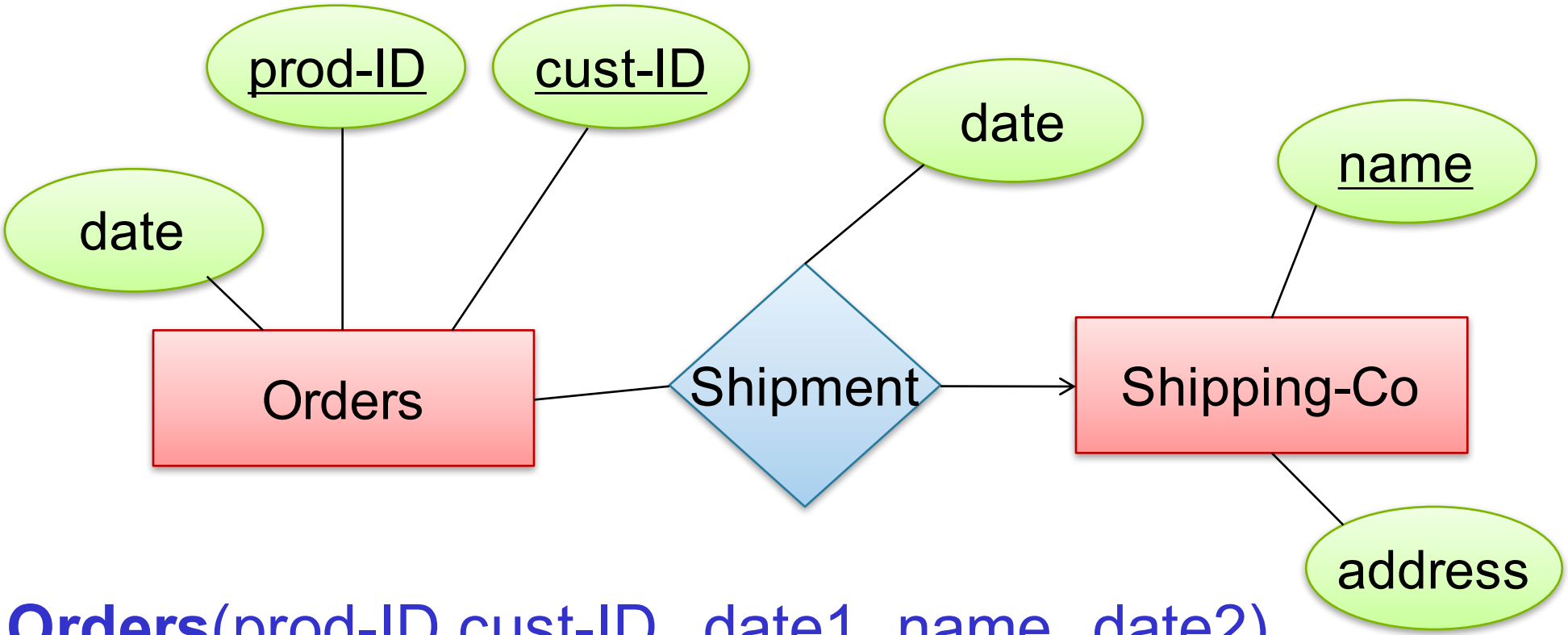
prod-ID	cust-ID	name	date
Gizmo55	Joe12	UPS	4/10/2011
Gizmo55	Joe12	FEDEX	4/9/2011

N-1 Relationships to Relations



Represent this in relations

N-1 Relationships to Relations

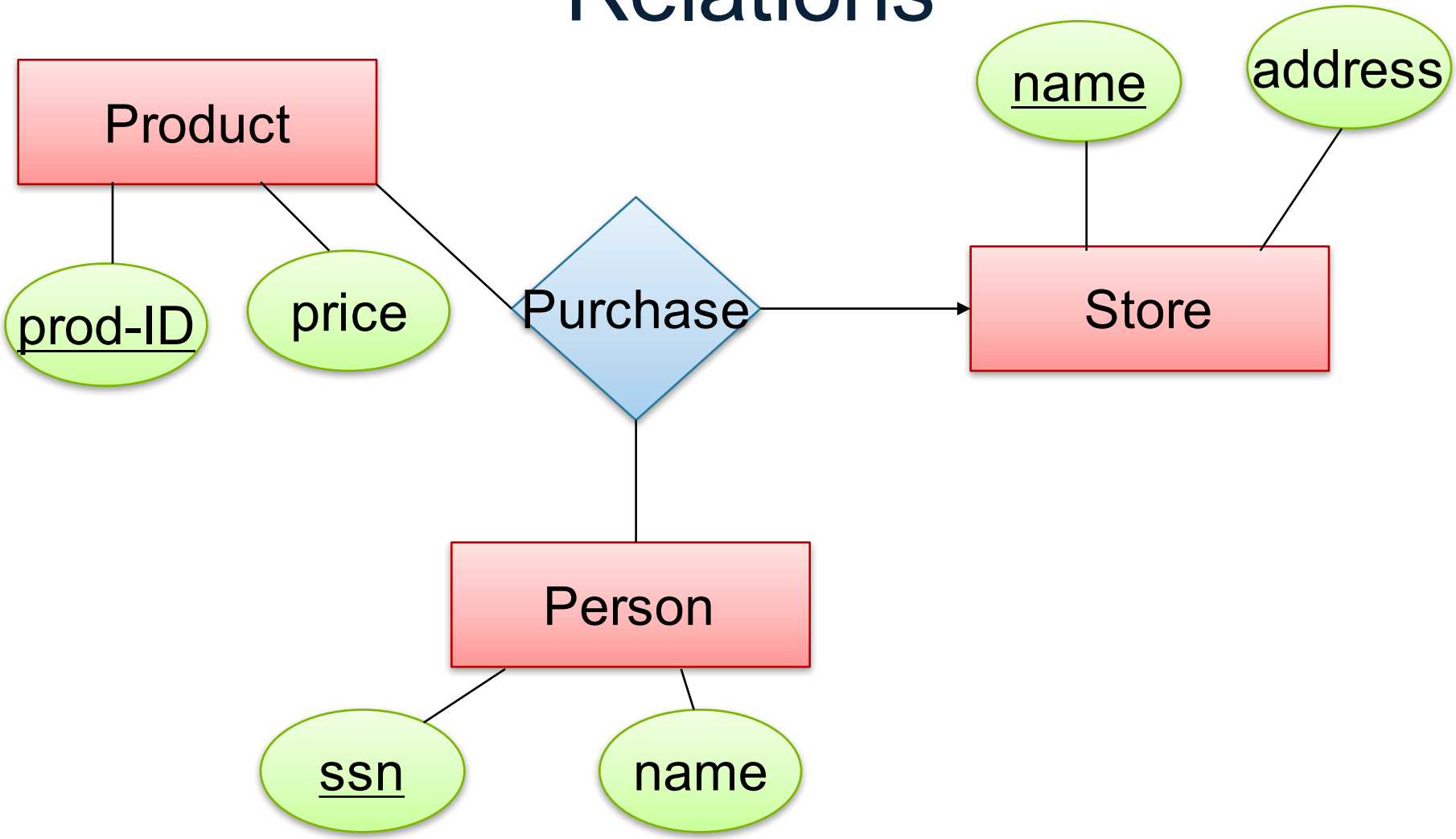


Orders(prod-ID,cust-ID, date1, name, date2)

Shipping-Co(name, address)

Remember: no separate relations for many-one relationship

Multi-way Relationships to Relations



Purchase(prod-ID, ssn, name)