SC2207/CZ2007 Introduction to Database Systems (Week 1)

Topic 1: Entity Relationship Diagram (1)

This Lecture

- Database and DBMS
- ER diagram
- Types of relationships
- Roles

Database and DBMS

- What is a database?
  - A collection of data specially organized for efficient retrieval by a computer
- What is a database system?
  - A piece of software that helps us efficiently manage/retrieve information from databases
- More formal name: Database Management System (DBMS)

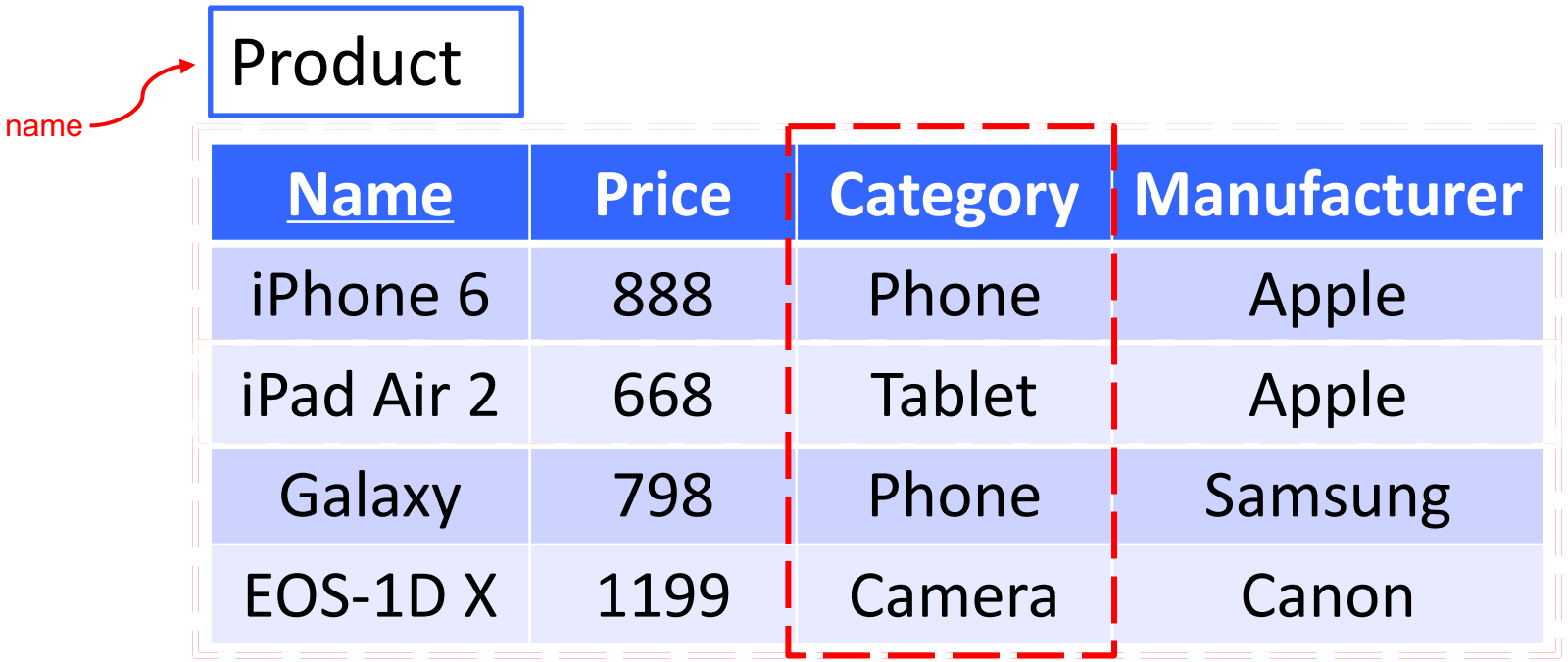
DBMS in Practice

- Large web sites rely heavily on DBMS
  - Facebook
  - Twitter
- Many non-web companies, too
  - Banks, hospitals, etc
- Even small pieces of software on your computer
  - Google Chrome

Relational Model

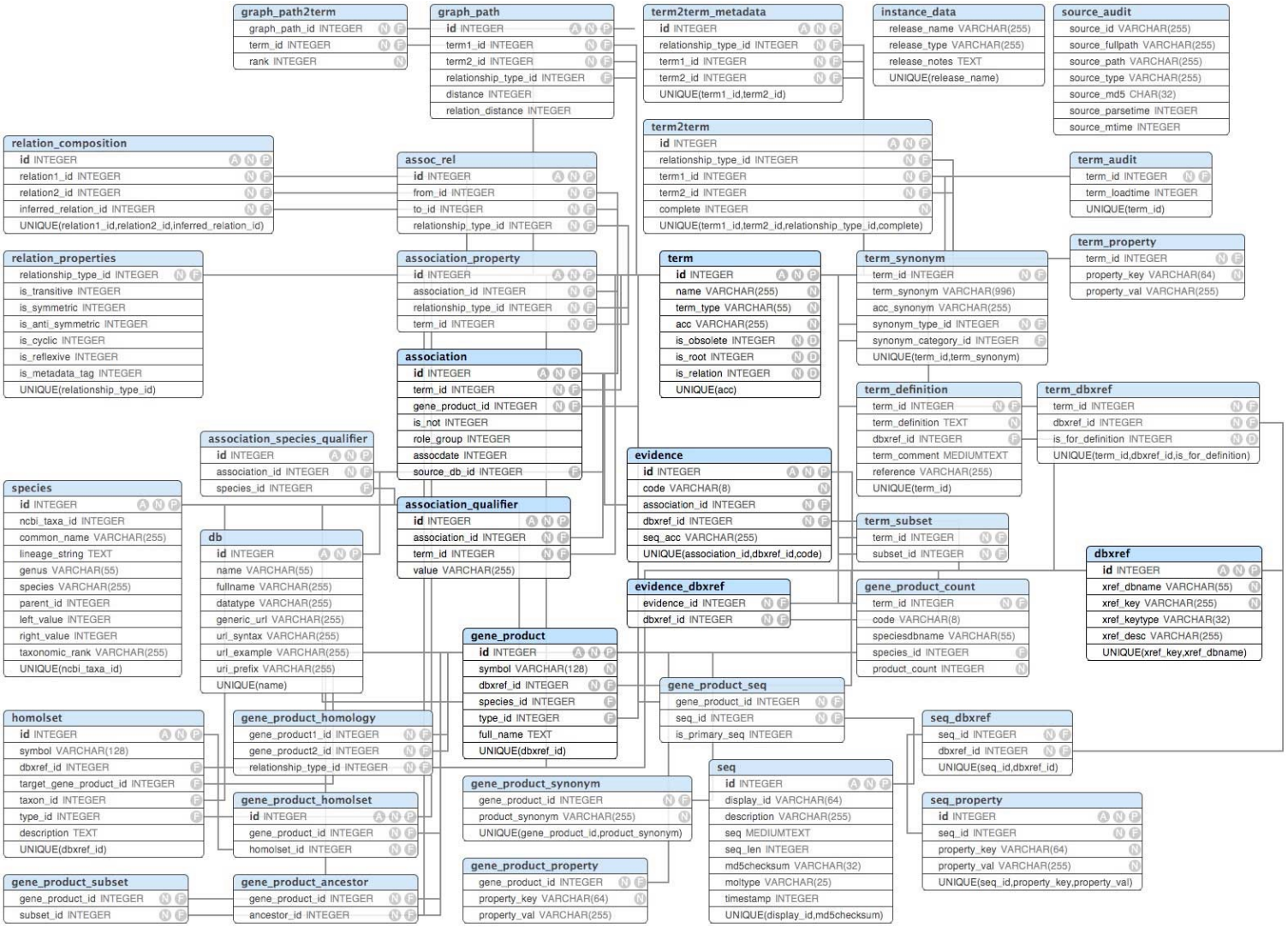
- Numerous DBMS exist on the market
  - Oracle, SQL Server, MongoDB, …
- Most of them follow the relational model
- What does it mean?
- Answer: They store all data in the form of relations.

Relation



- Some jargons:
  - A relation is often referred to as a table
  - A row in a table is also called a tuple or a record
  - A column in a table is also called an attribute of the table

A real database may have a large number of tables …



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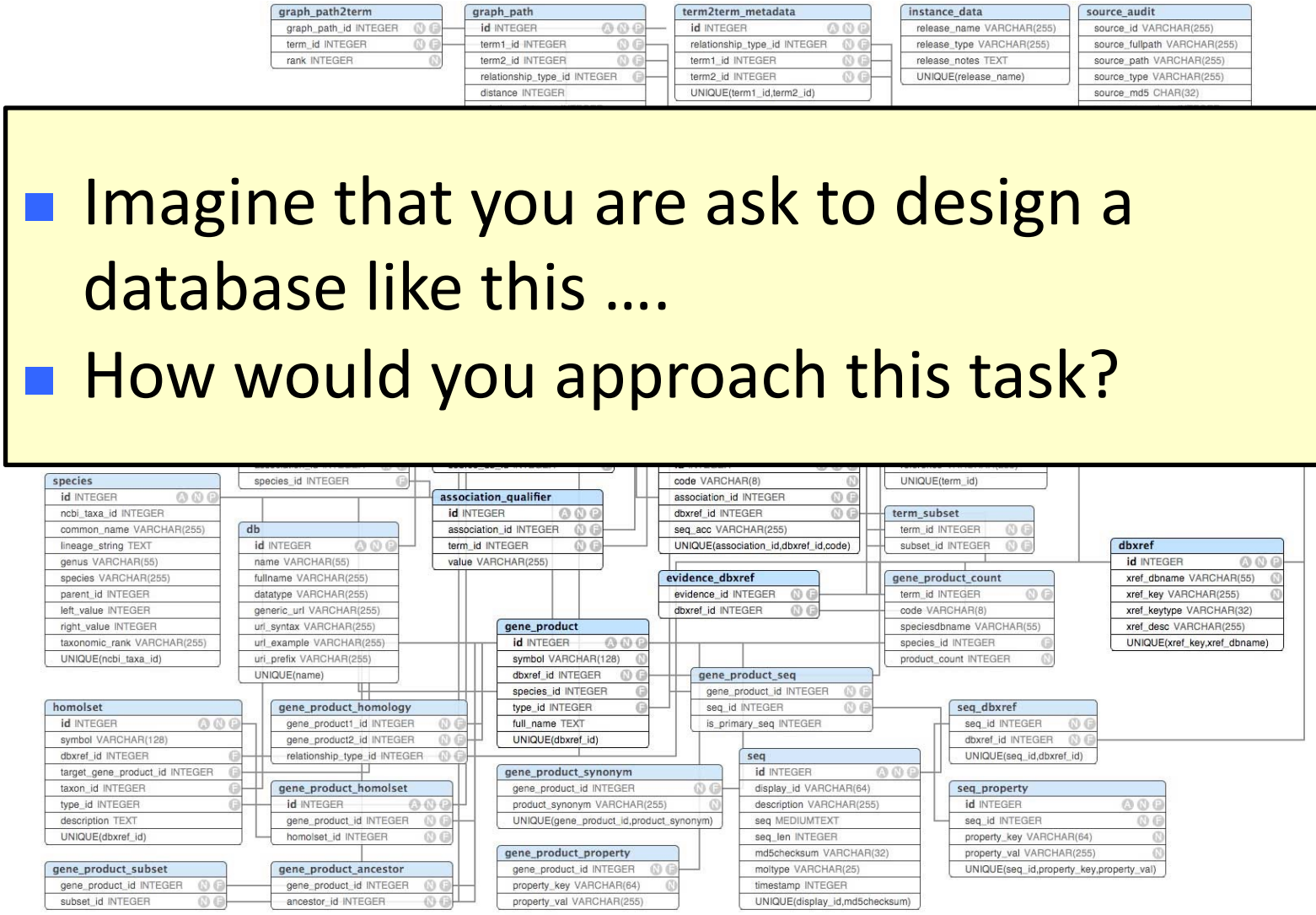

- Imagine that you are ask to design a database like this ….
- How would you approach this task?

Designing a Database for an Application

- Conceptually model the data requirements of the application
  - What are the things that need to be stored?
  - How do they interact with one another?
- Tool to use: Entity-Relationship (ER) Diagrams
  - A pictorial and intuitive way for modelling
- Translate the conceptual model into a set of tables
- Construct the tables with a DBMS

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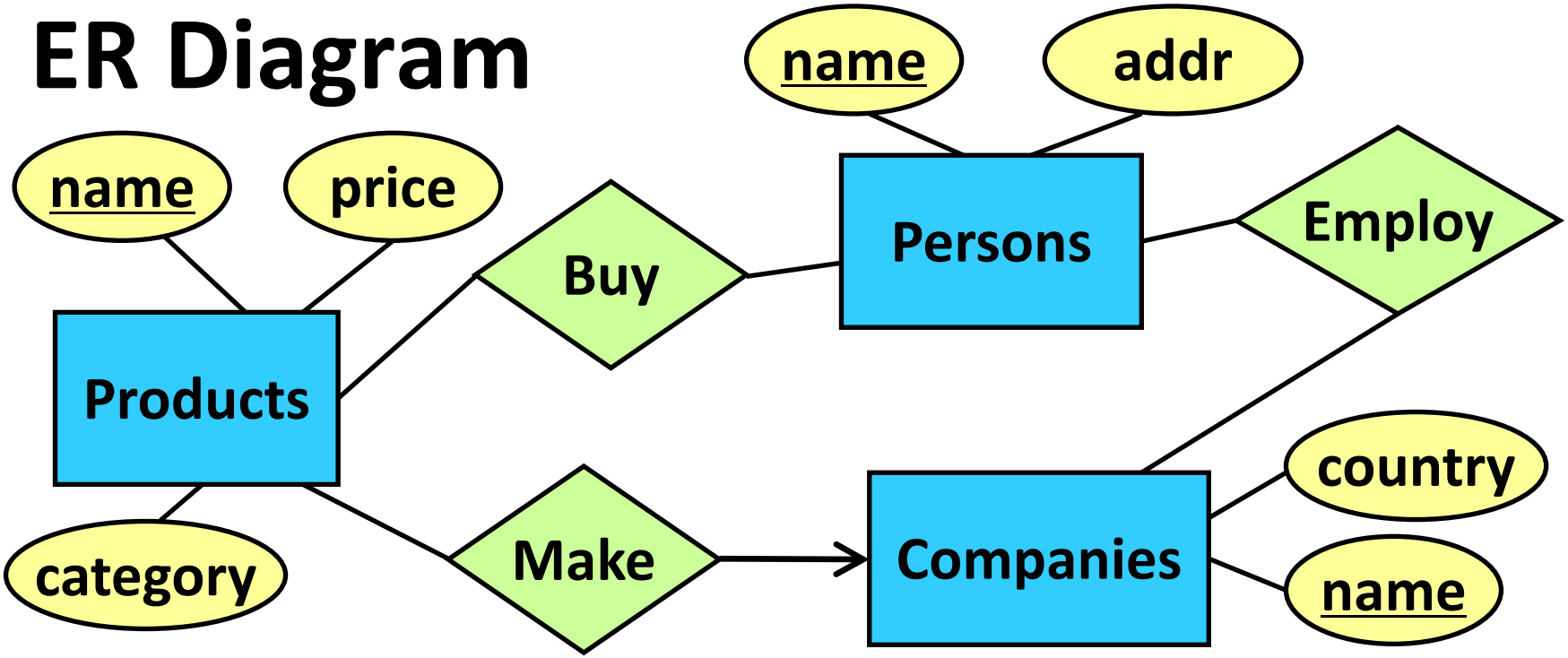
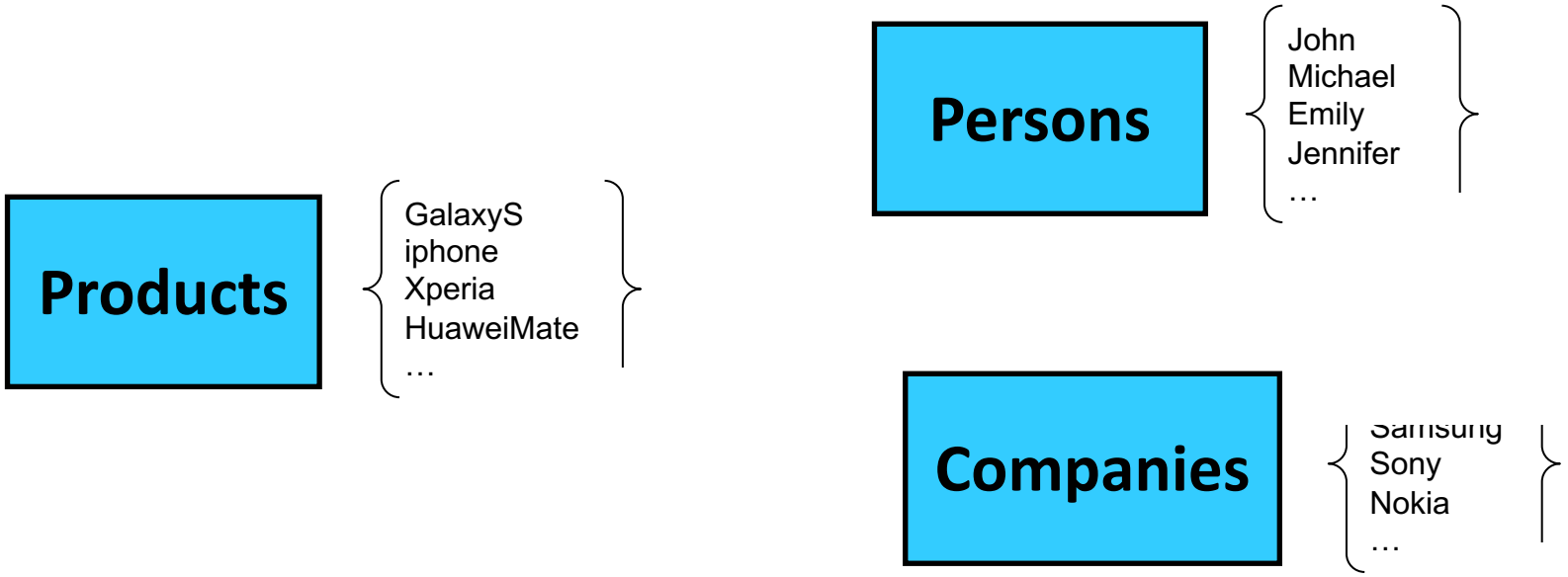
ER Diagram



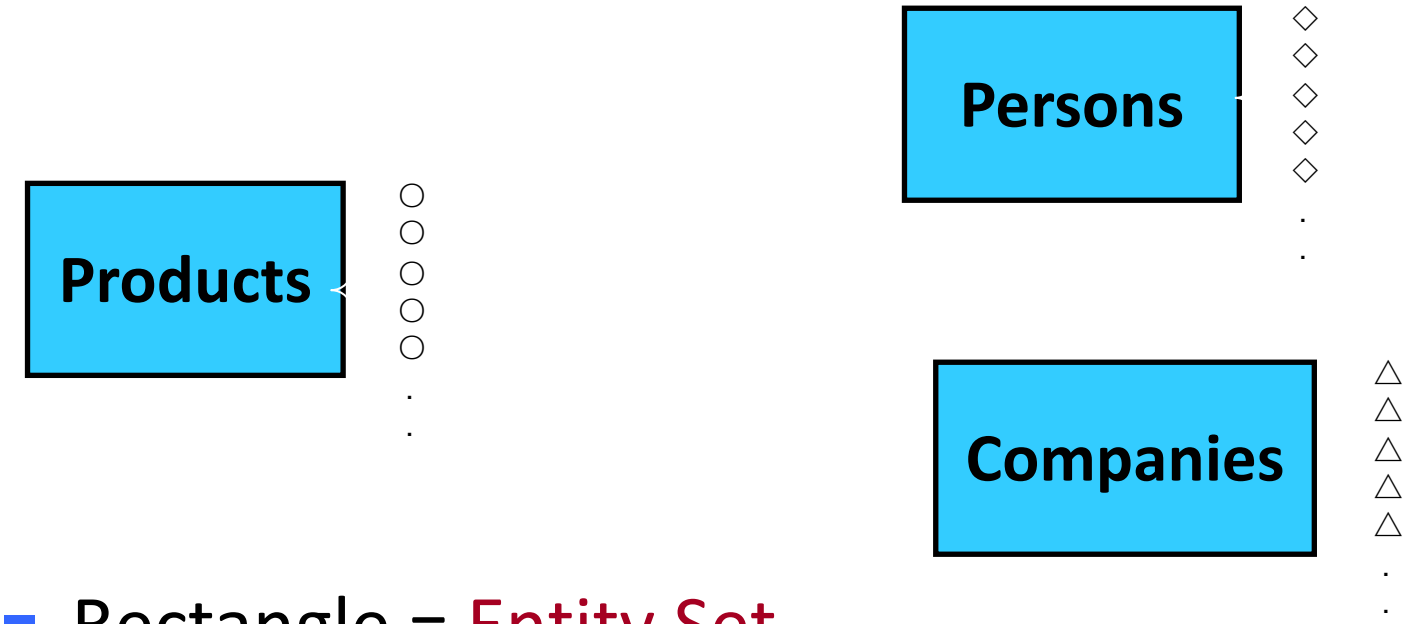
- ER diagram is a collection of visual artifacts
- Each artifact captures some data requirement or relationship

ER Diagram



- Rectangle = Entity Set
- Entity = Real-world object (entity)
- Entity Set = Collection of similar objects (entities)
- Analogue: An object class in object-oriented programming language

ER Diagram



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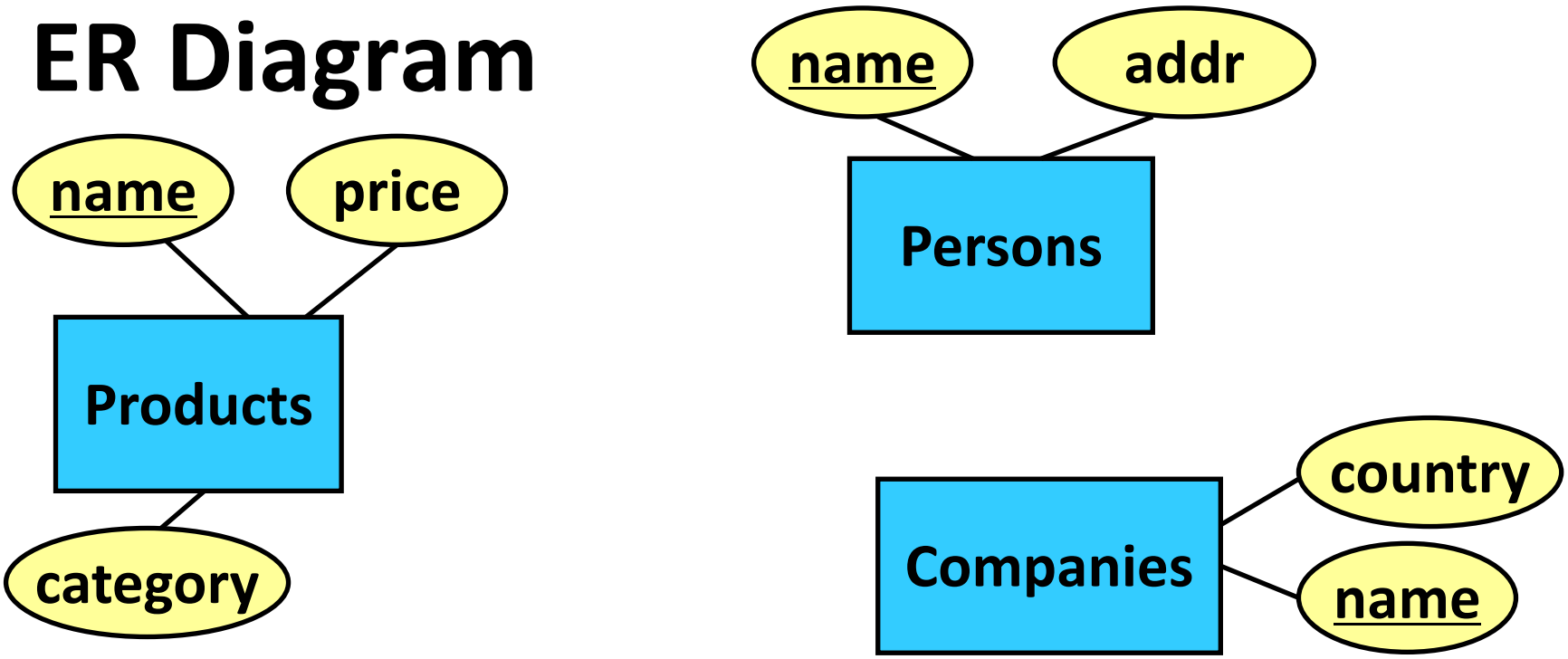
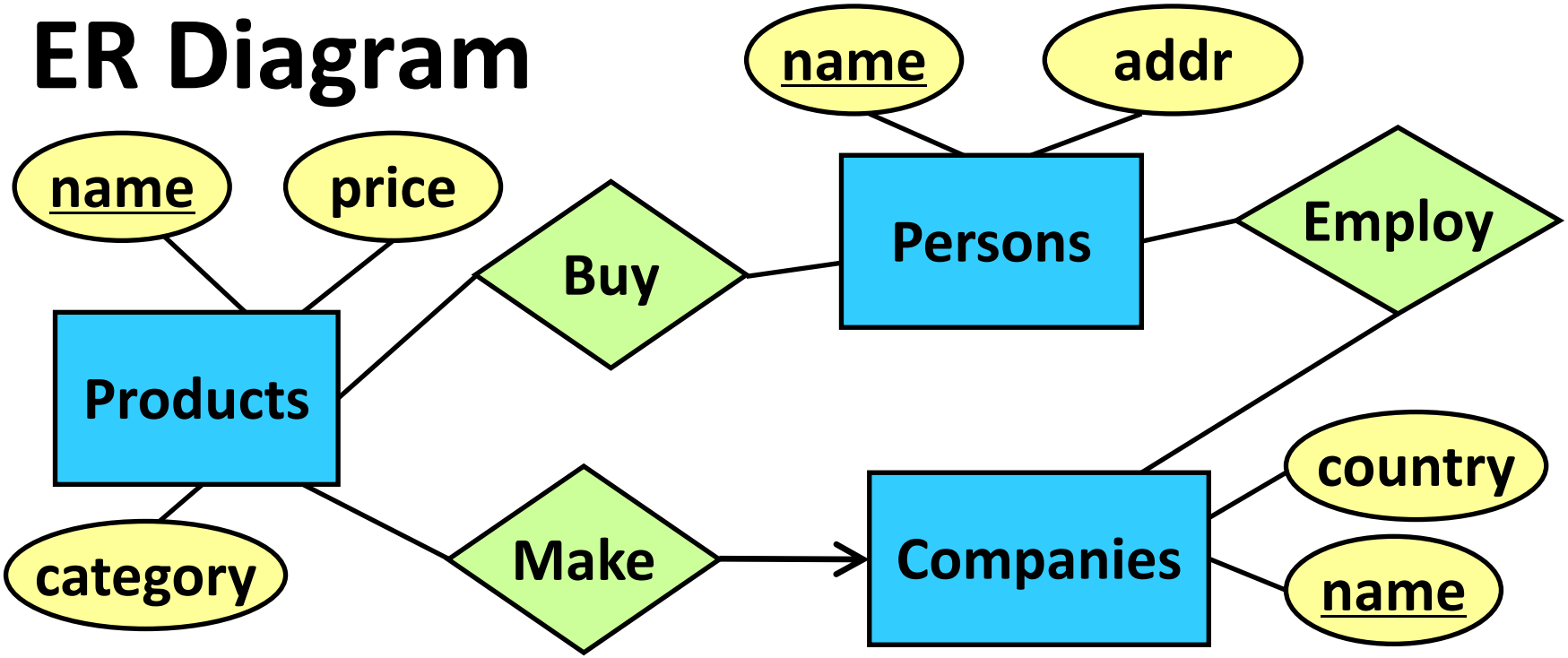


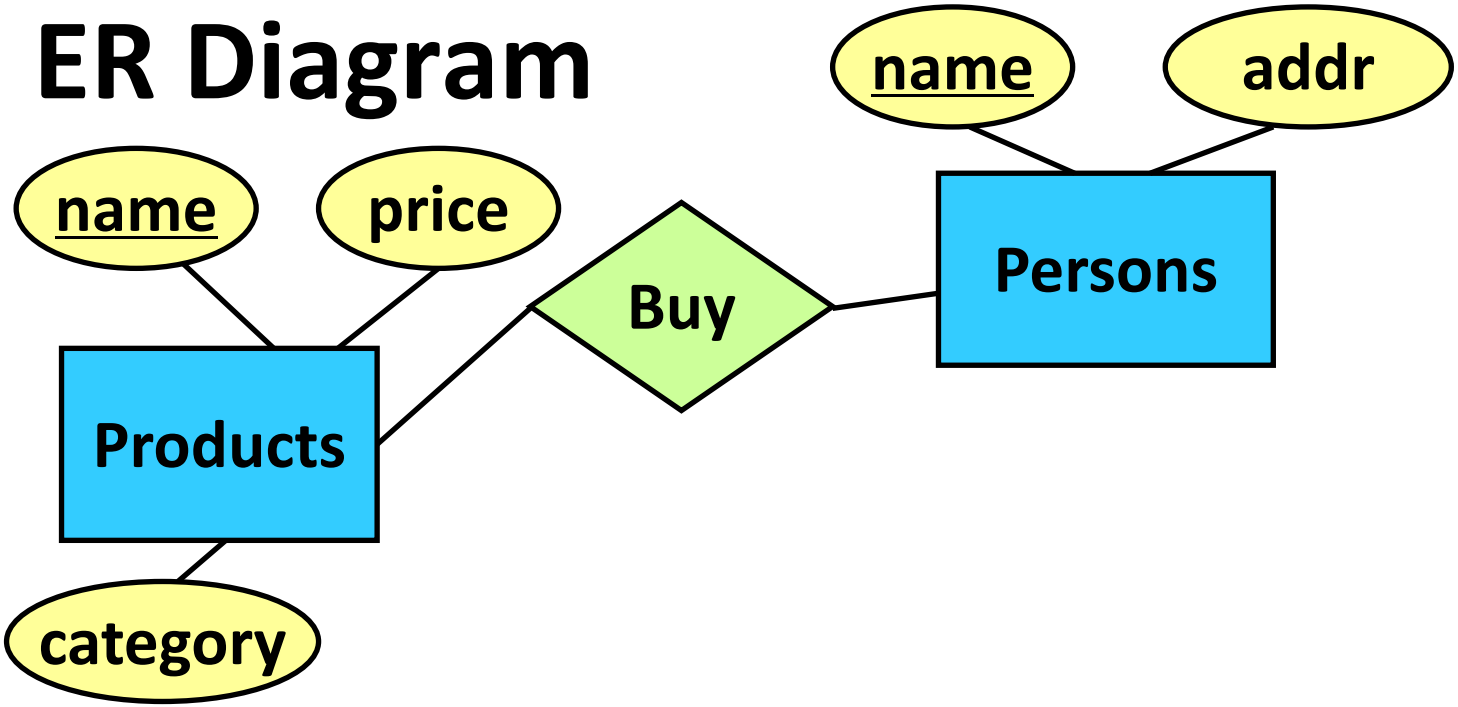
- Oval = Attribute = Property of an entity set

ER Diagram



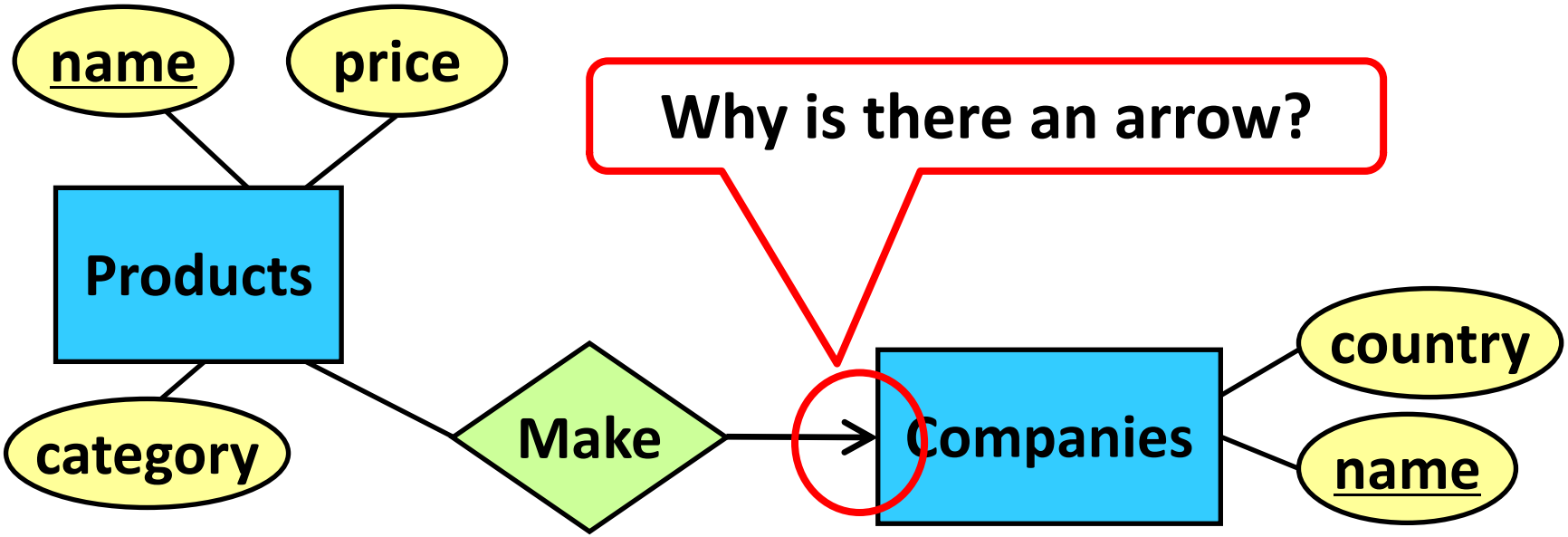
- Diamond = Relationship = Connection between two entity sets

ER Diagram



- Diamond = Relationship = Connection between two entity sets
- Persons buy products

ER Diagram



- Diamond = Relationship = Connection between two entity sets
- Companies make products

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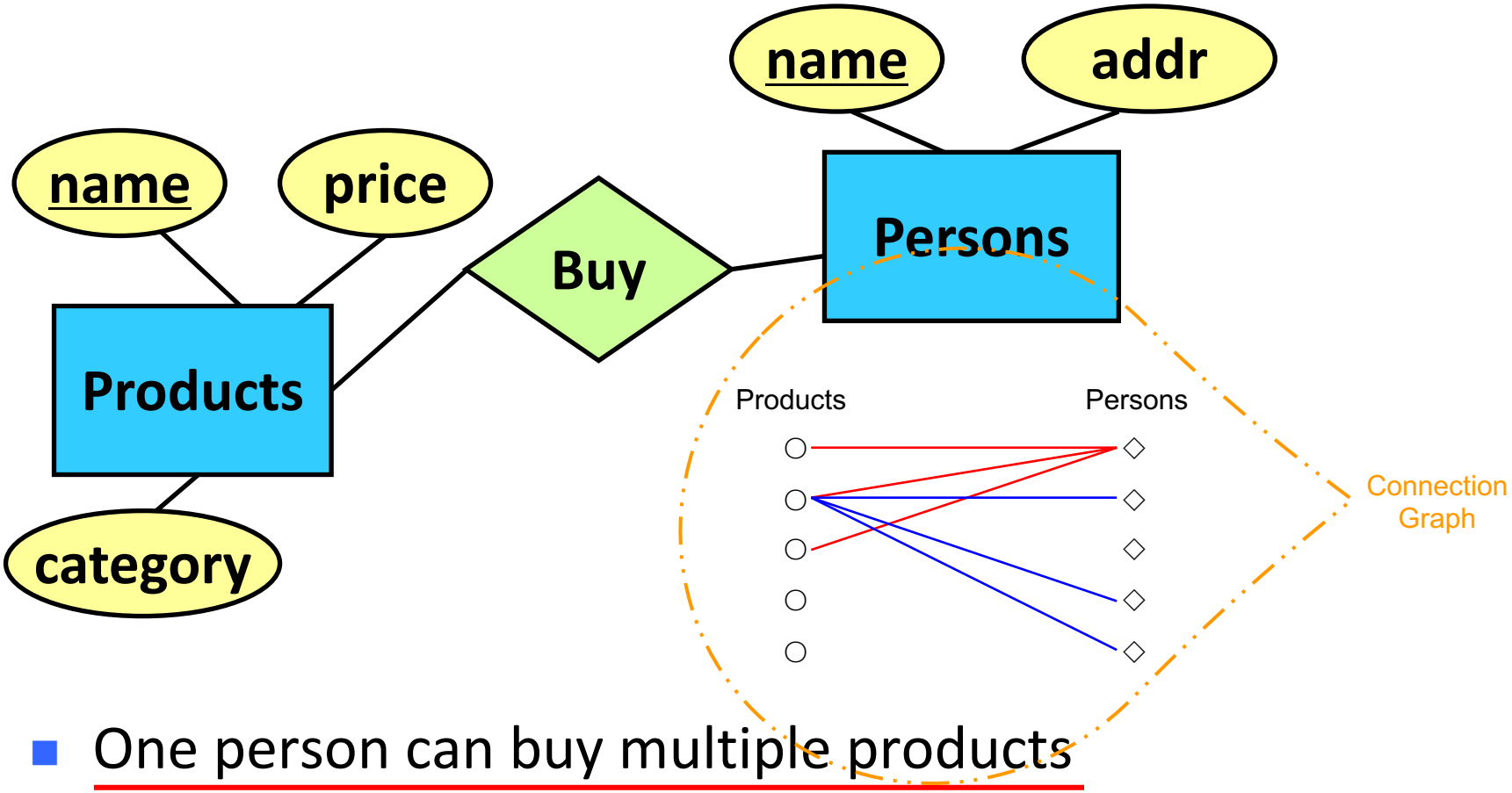
Types of Relationships

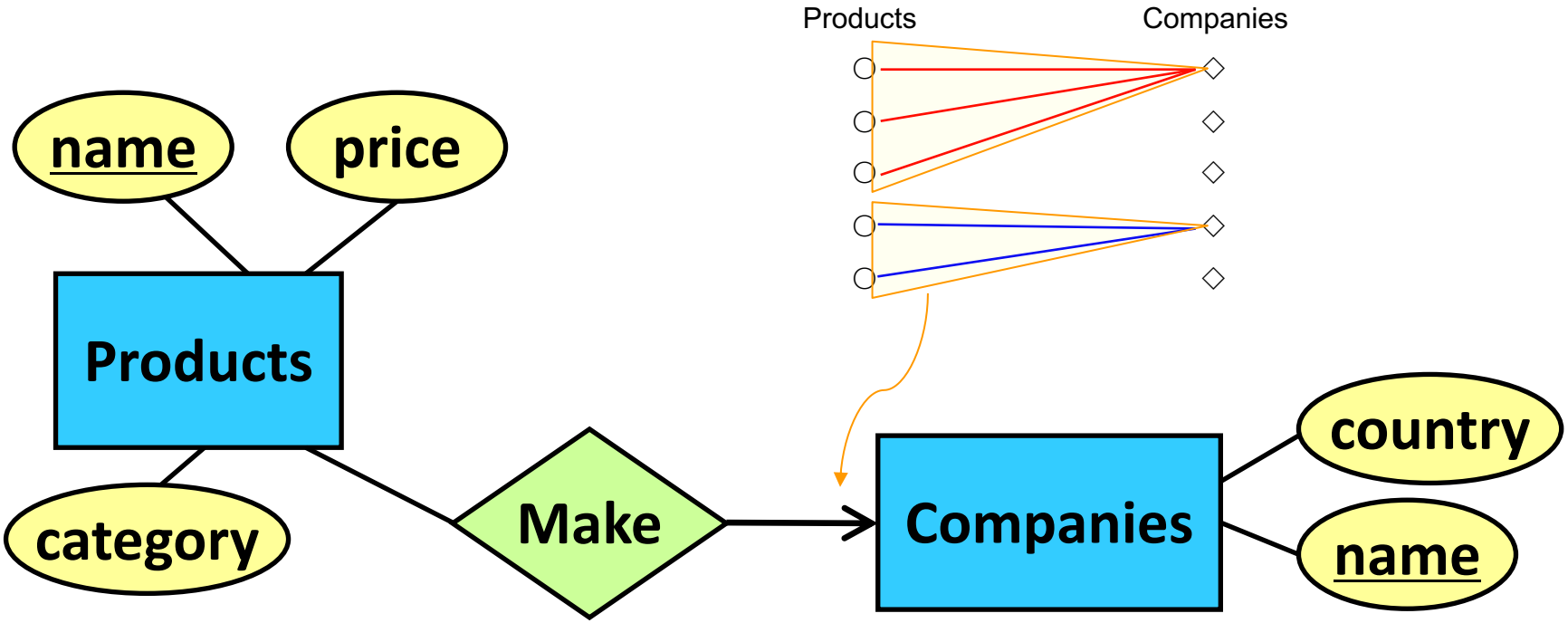
- Many-to-Many Relationships
- Many-to-One Relationships
- One-to-One Relationships

Many-to-Many Relationship



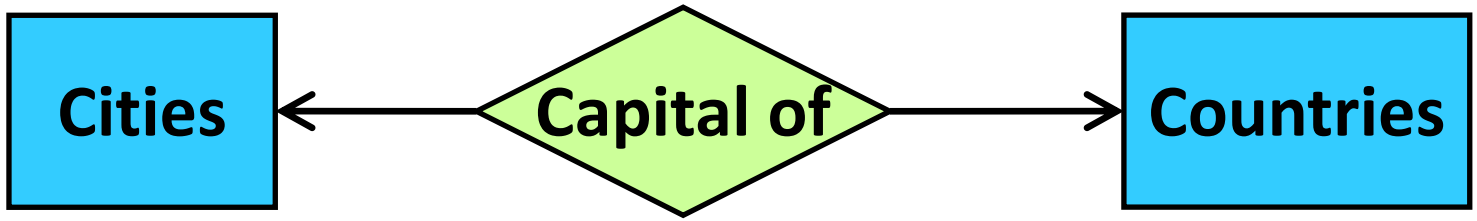
- One person can buy multiple products
- One product can be bought by multiple persons
- Note: Some Person entity is not related to Product entities, vice versa

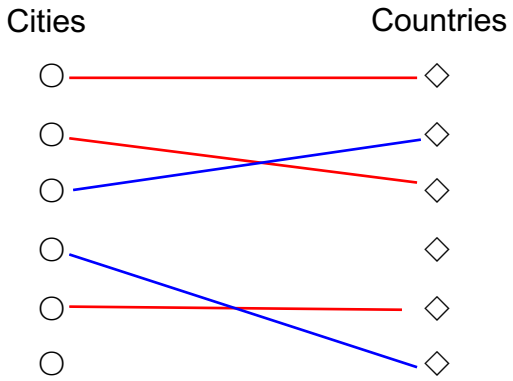
Many-to-One Relationship



- One company can make multiple products
- But one product can only be made by one company
- Note: Some Company entity does not make any Product entity

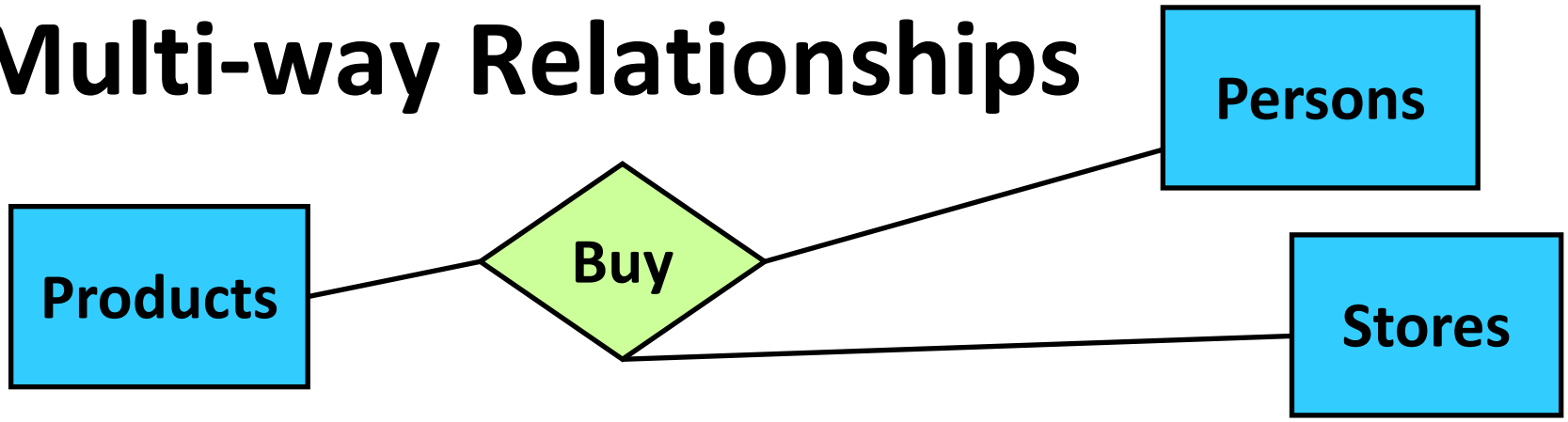
One-to-One Relationship





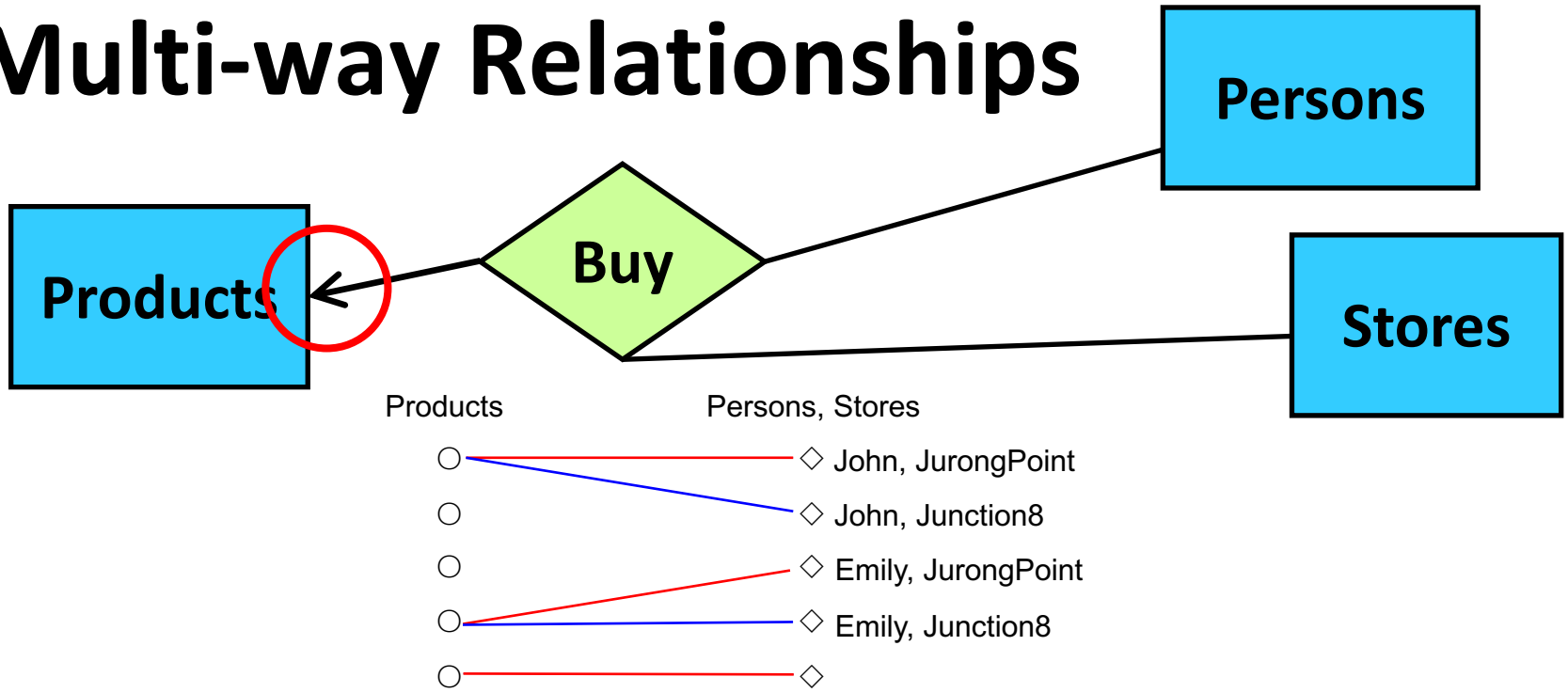
- A city can be the capital of only one country
- A country can have only one capital city
- Note: Some Country entity has no capital city, vice versa

Multi-way Relationships



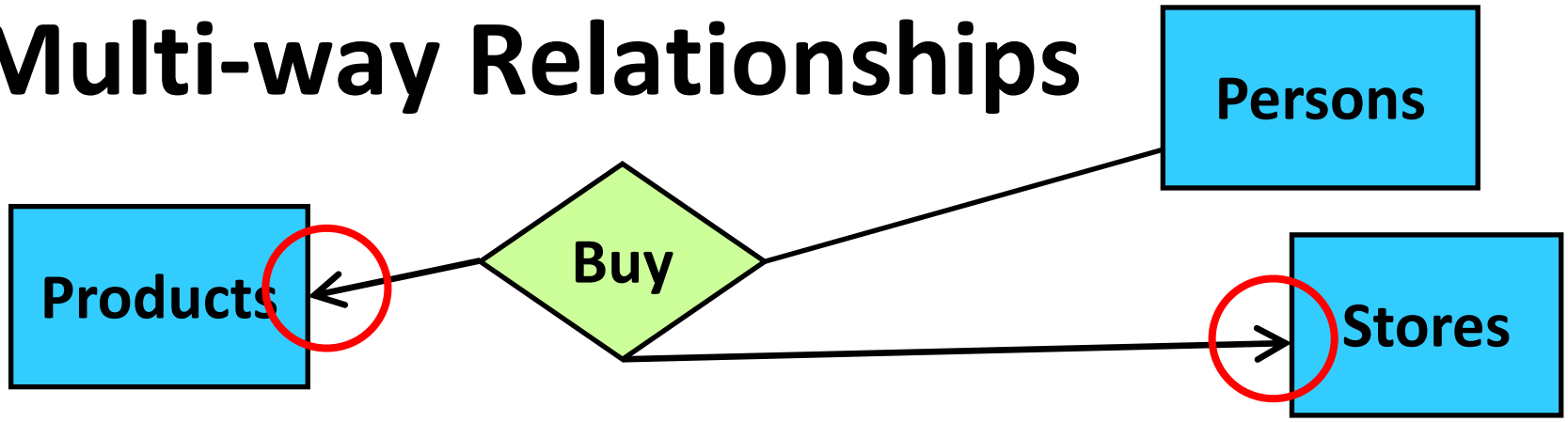
- What if we want to record the store from which the person bought the product?
- We can use a 3-way relationship
- Drawback: The arrows would be complicated

Multi-way Relationships



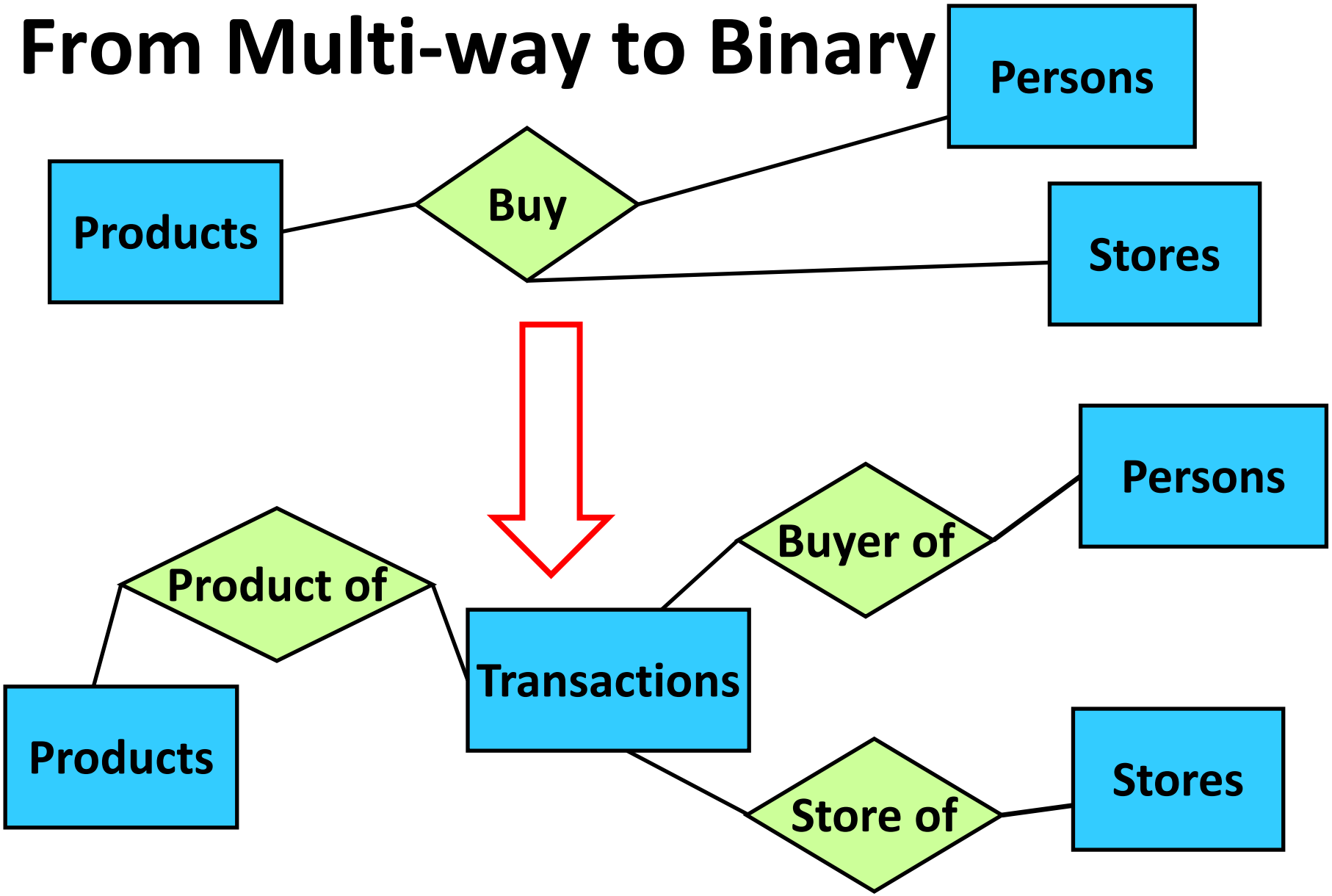
- Should we use this? What does it mean?
- One <person, store> pair to one product
- One product to many <person, store> pairs
- Meaning: A person only buys one product from one shop

Multi-way Relationships

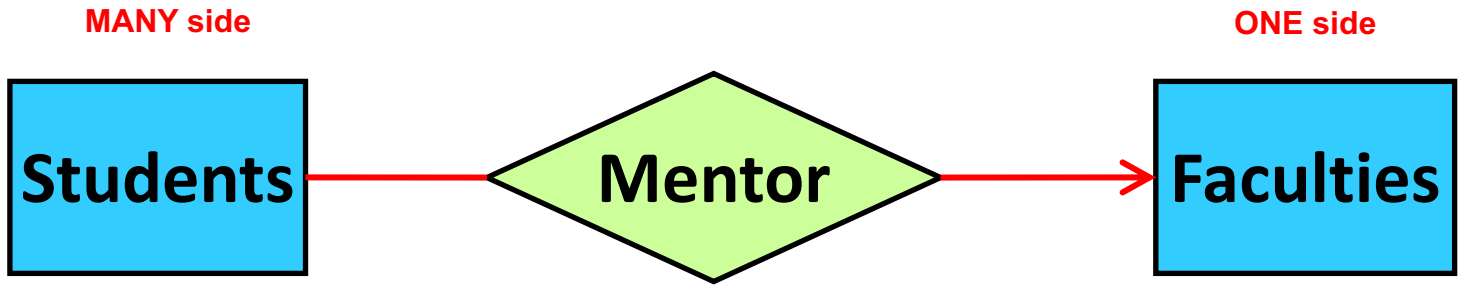


- What about this?
- <person, store> to product? many to one?
- <person, product> to store? many to one?
- Getting more complicated - avoid this

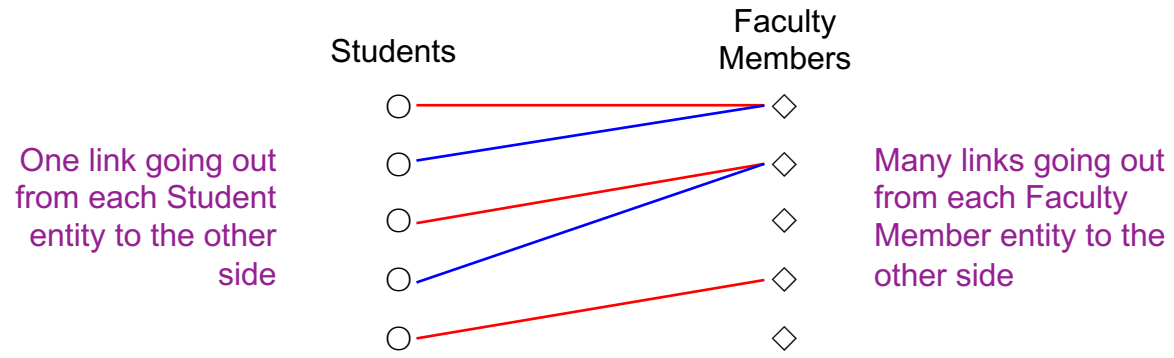
From Multi-way to Binary



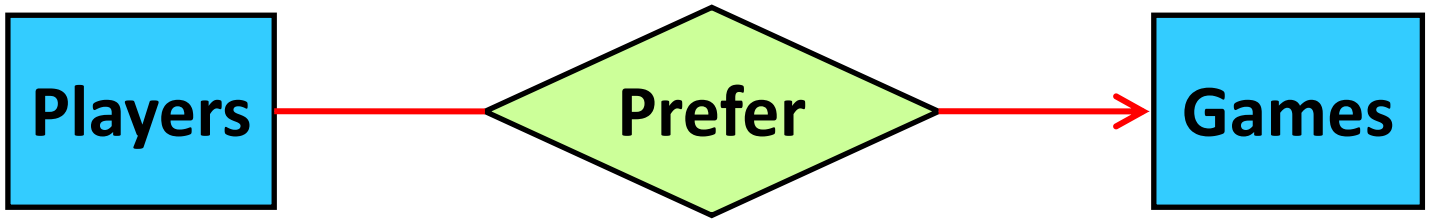
Example



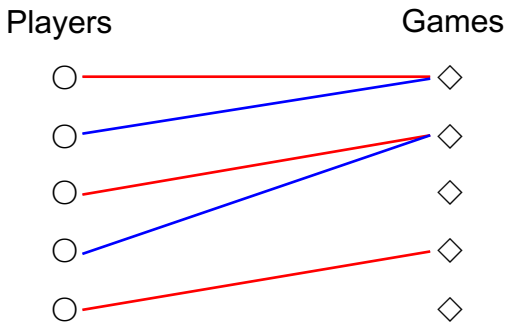
- Each student is mentored by one faculty member
- Each faculty member can mentor multiple students



Exercise



- Each player prefers only one game, but not vice versa
- Many-to-many? ✗
- Many-to-one? ✓
- One-to-one? ✗



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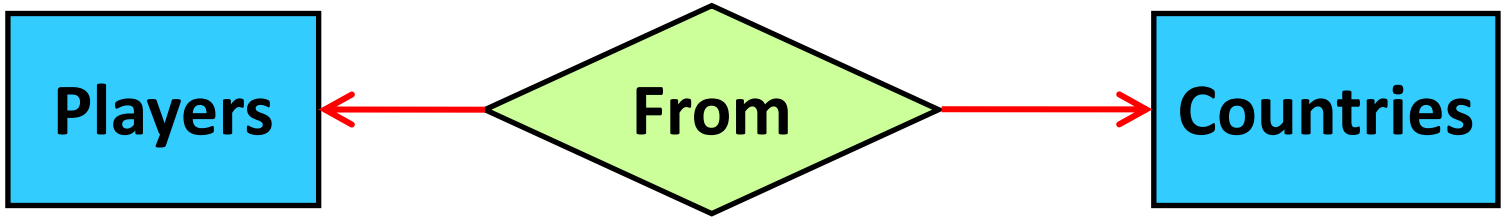
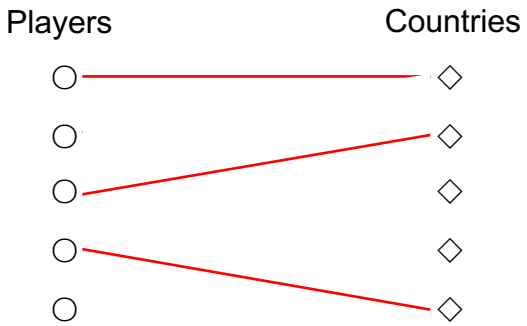
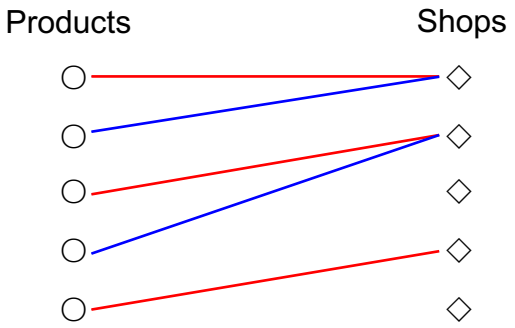


- Any two players are from exactly two different countries
- Many-to-many? ✗
- Many-to-one? ✗
- One-to-one? ✓



Exercise

- No two shops sell the same product
- Many-to-many? ✗
- Many-to-one? ✓
- One-to-one? ✗



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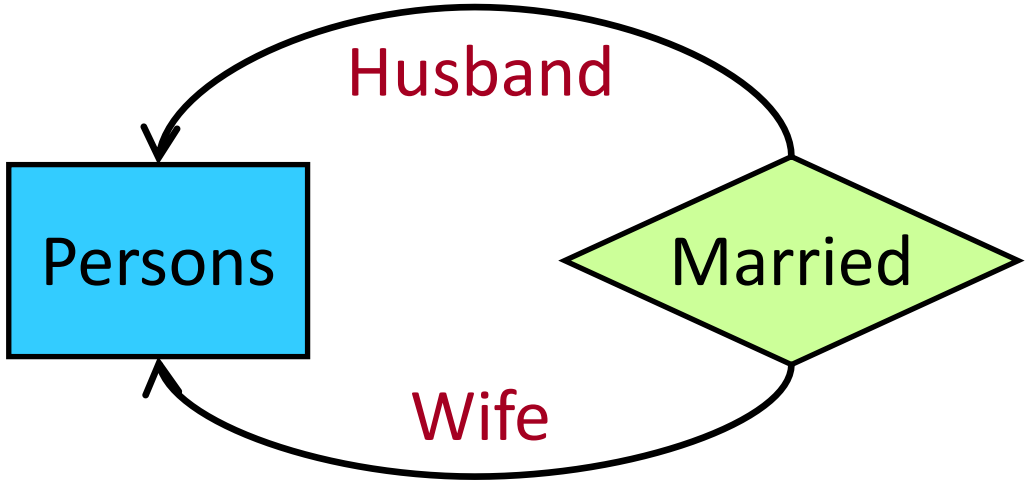
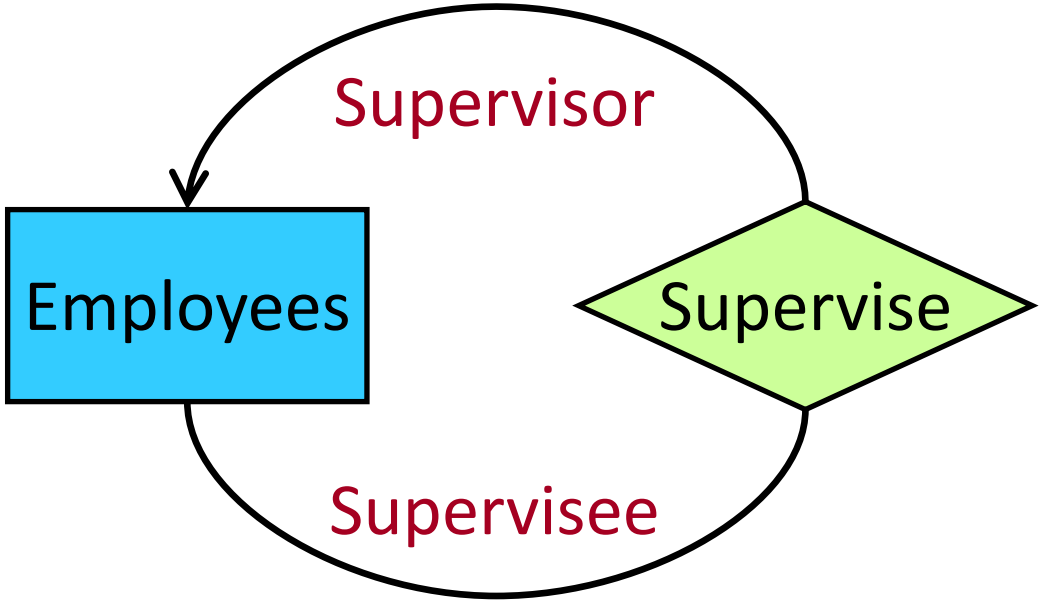
Roles



- Sometimes an entity set may appear more than once in a relationship
- Example: some persons are married to each other
- The role of the person is specified on the edge connecting the entity set to the relationship

Husband	Wife
Bob	Alice
David	Cathy
…	…

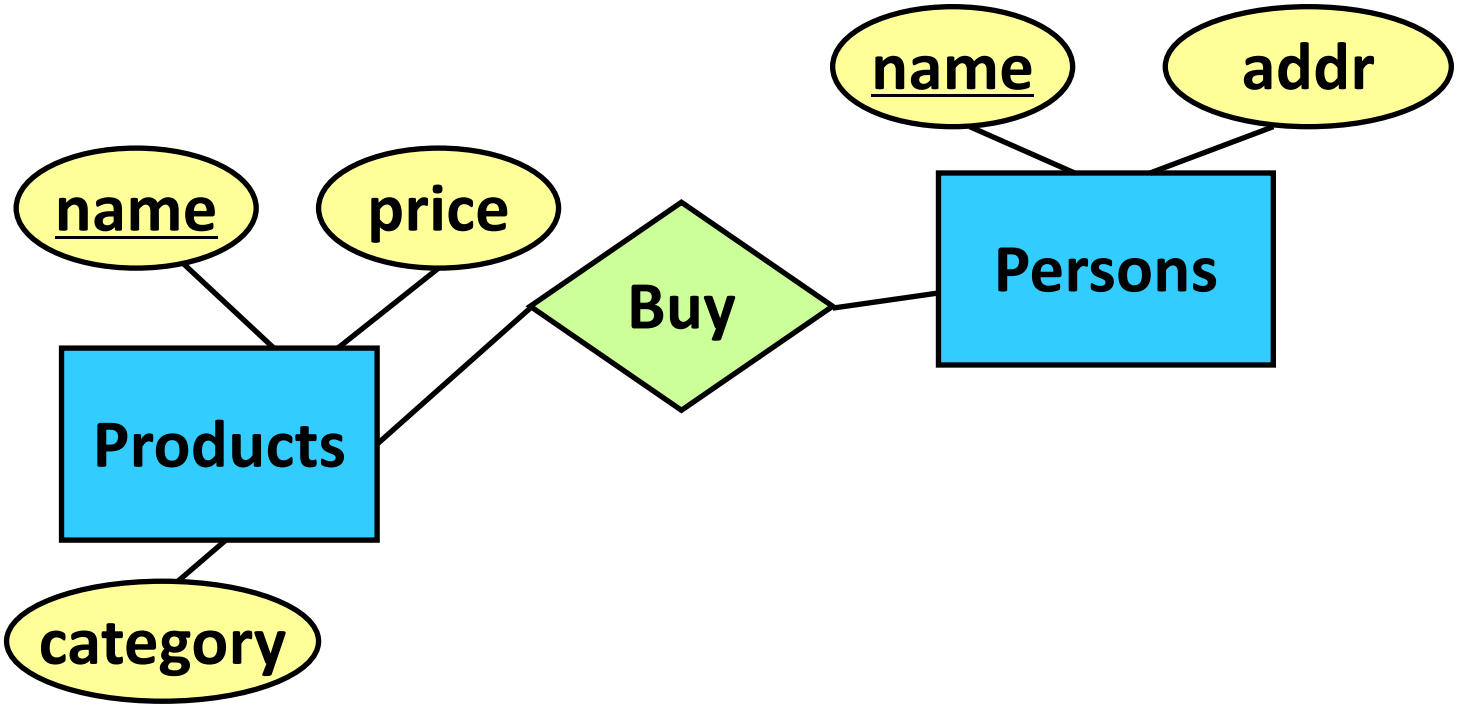
Roles



- Example: some employee supervises other employees
- Without the roles, it is unclear whether it is many-to-one from supervisees to supervisors, or the other way around

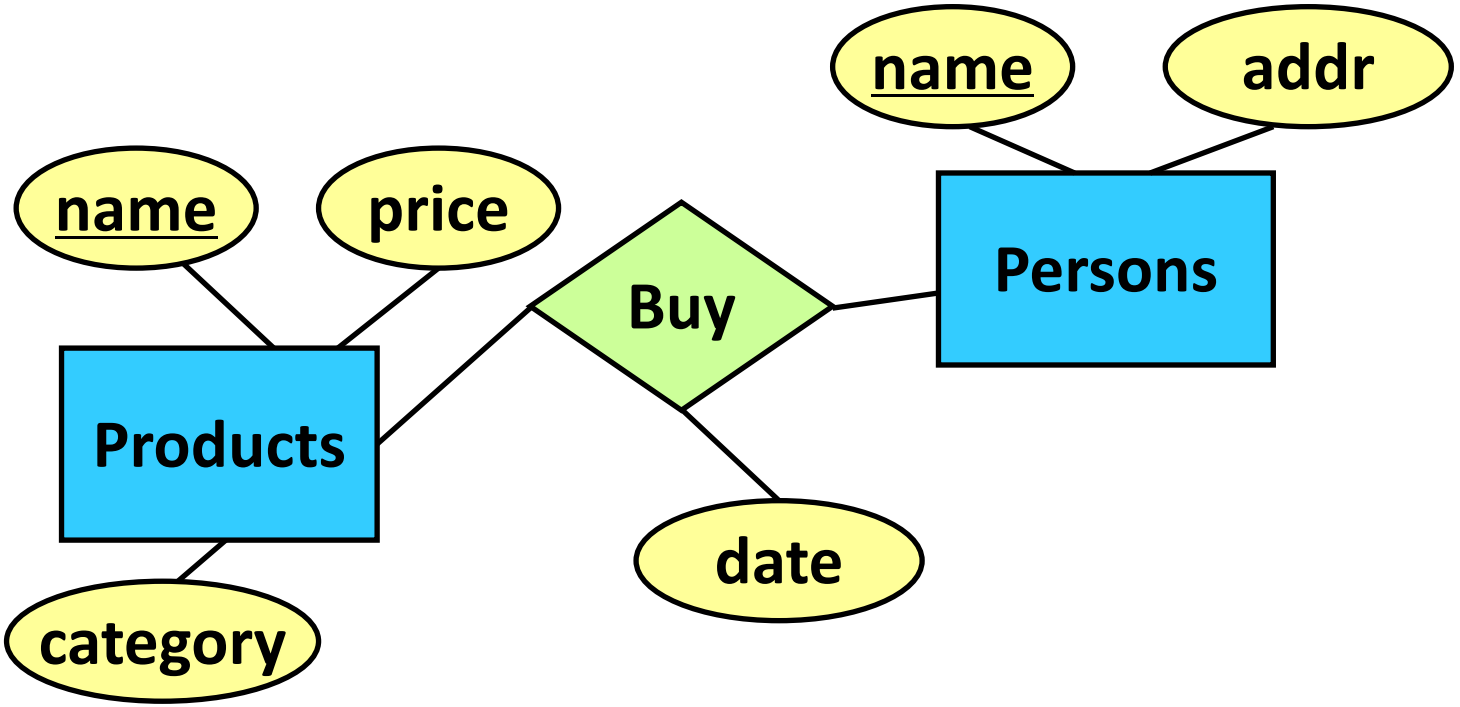
One More Thing about Relationships

- A relationship can have its own attribute



One More Thing about Relationships

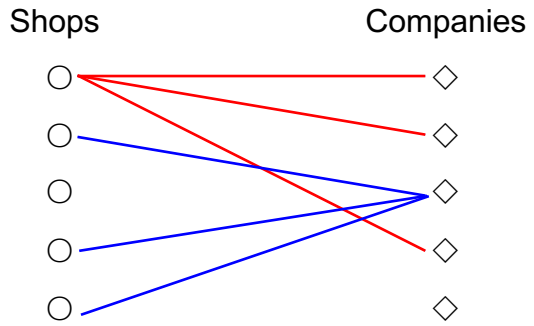
- A relationship can have its own attribute
- If we want to record the date of the purchase



Exercise

- Consider two entity sets, Shops and Companies
- Each shop sells products from at least one company
- Each company has its product sold in at least one shop
- A shop may be the flagship shop of at most one company
- Each company has at least one flagship shops
- Draw some relationships between Shops and Companies to capture the above statements

Exercise



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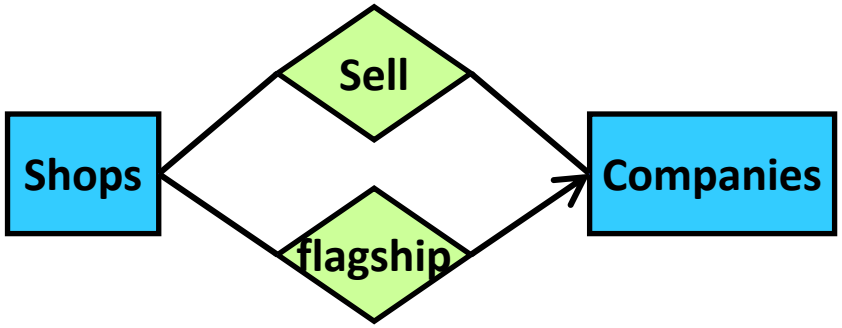

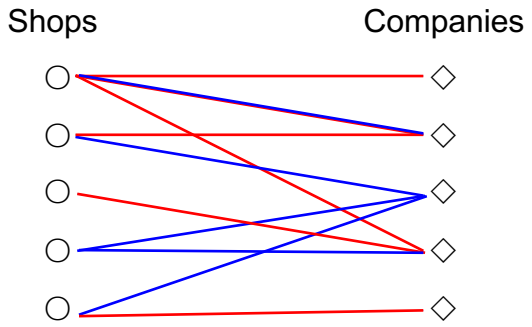

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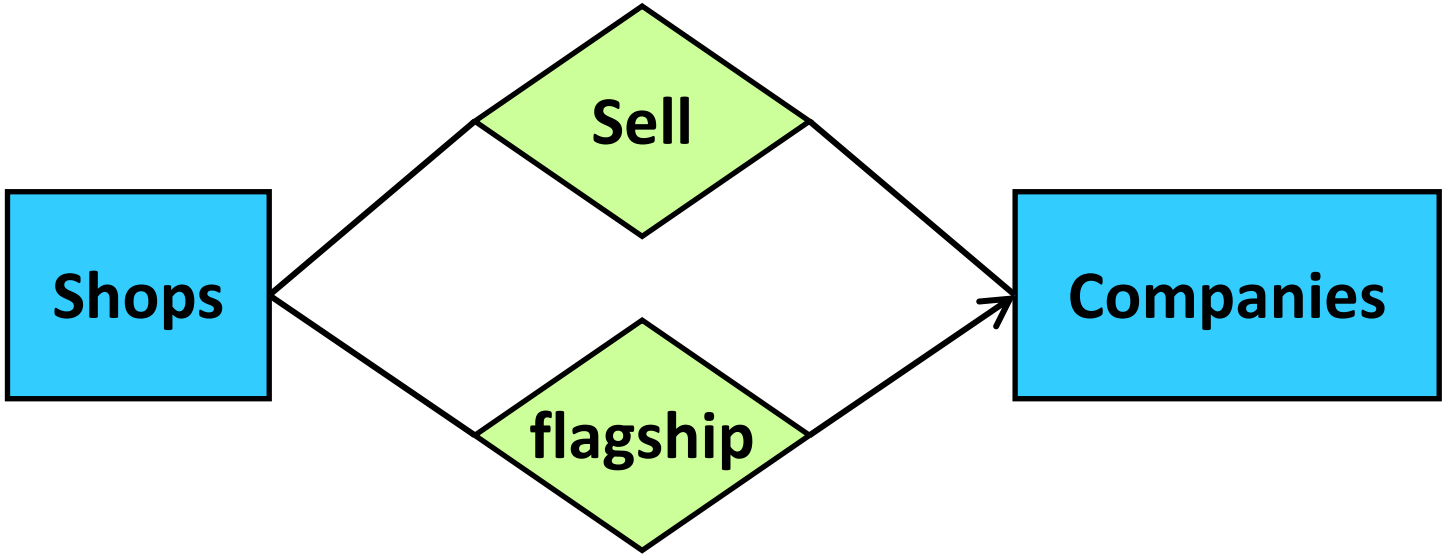

- There can be multiple relationships between two entity sets

To continue in

Topic 1: Entity Relationship Diagram (2)