E-R Diagram:
Roles in relationships, Binary vs. Multi-way relationship, Weak entity

CS 4750
Database Systems

[A. Silberschatz, H. F. Korth, S. Sudarshan, Database System Concepts, Ch.6]
[C.M. Ricardo and S.D. Urban, Database Illuminated, Ch.3]

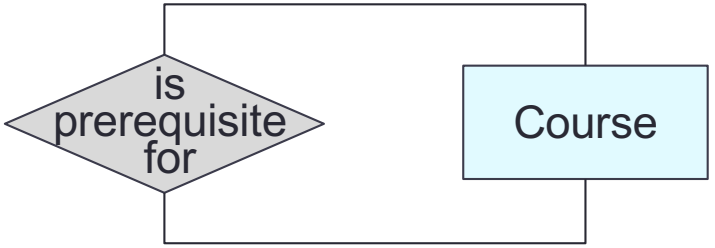
Degree of a Relationship

Binary relationship

Two entities participate in the relationship

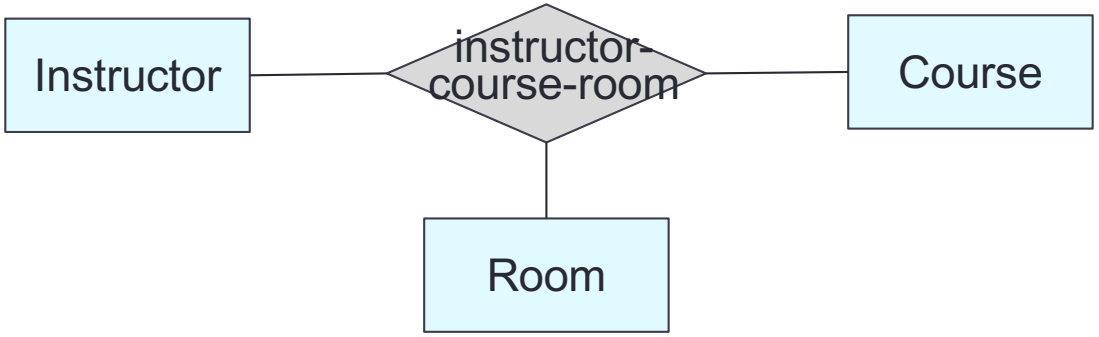
Unary relationship

Both participants in the relationship are the same entity



Ternary relationship

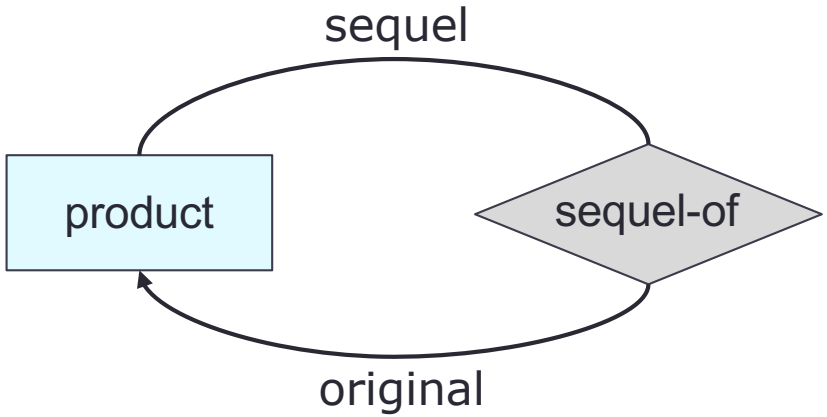
Three entities participate in the relationship



Roles in Relationships

- An entity set can appear two or more times in a single relationship
- Each edge to the entity set represents a different role that the entity set plays in the relationship

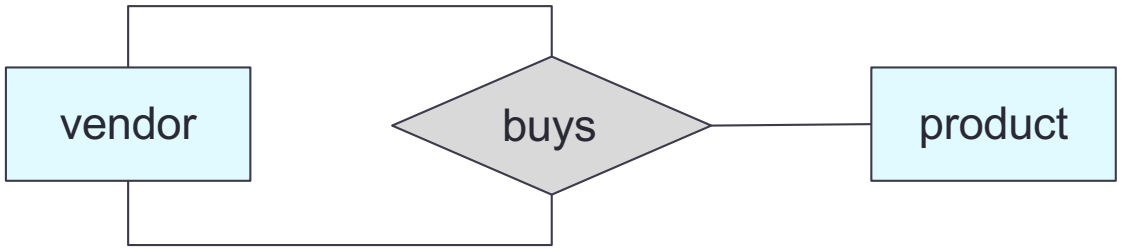
"self-referential relationship"



A product can have many sequels.
For each sequel, there is only one original product

Let's try: Self-Referential

Given the following E-R diagram. Come up with an example that can be represented by the diagram.



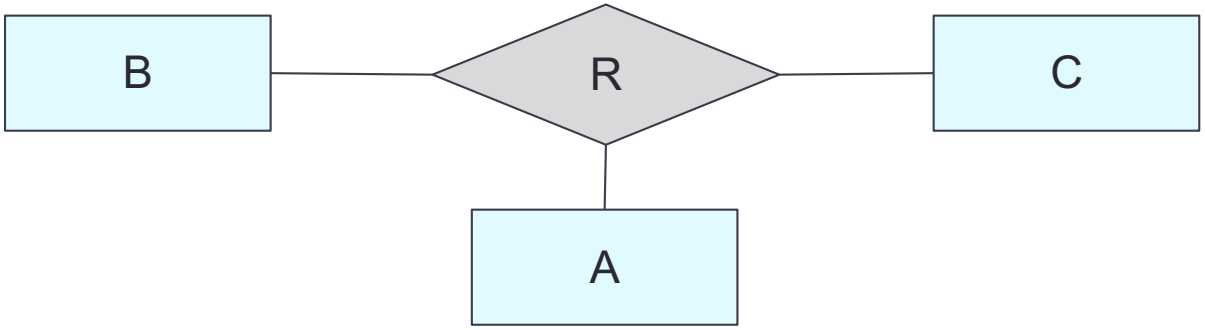
"Microsoft buys a printer from HP"

Binary vs. Multi-Way Relationships

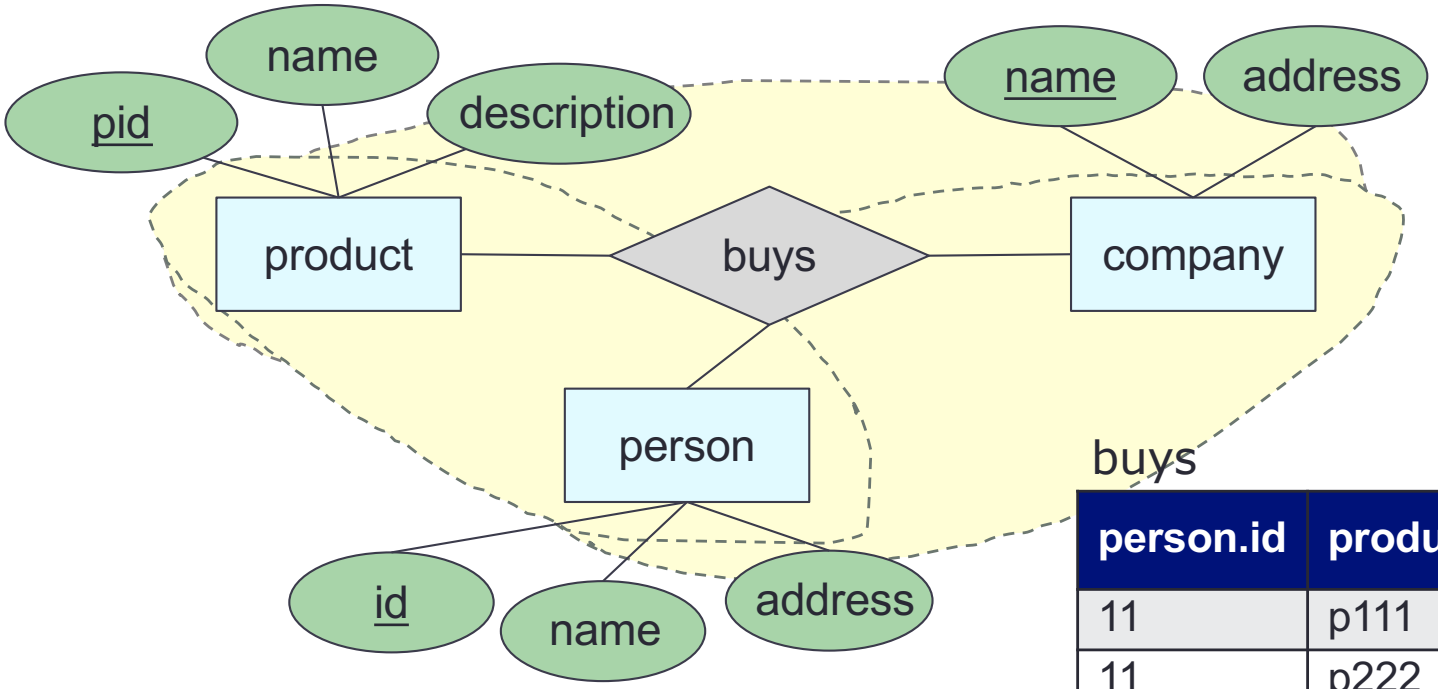
E-R model makes it convenient to define relationships involving more than two entity sets.

In practice, ternary (3-way) or higher-degree relationships are rare and usually add complexity to the design.

If *A*, *B,* and *C* are sets, a relationship *R* is a subset of *A X B X C*



Multi-Way Relationships



buys

person.id	product.pid	company.name
11	p111	Humpty Inc.
11	p222	Humpty Inc.
22	p111	Humpty Inc.
22	p111	Dumpty Shop

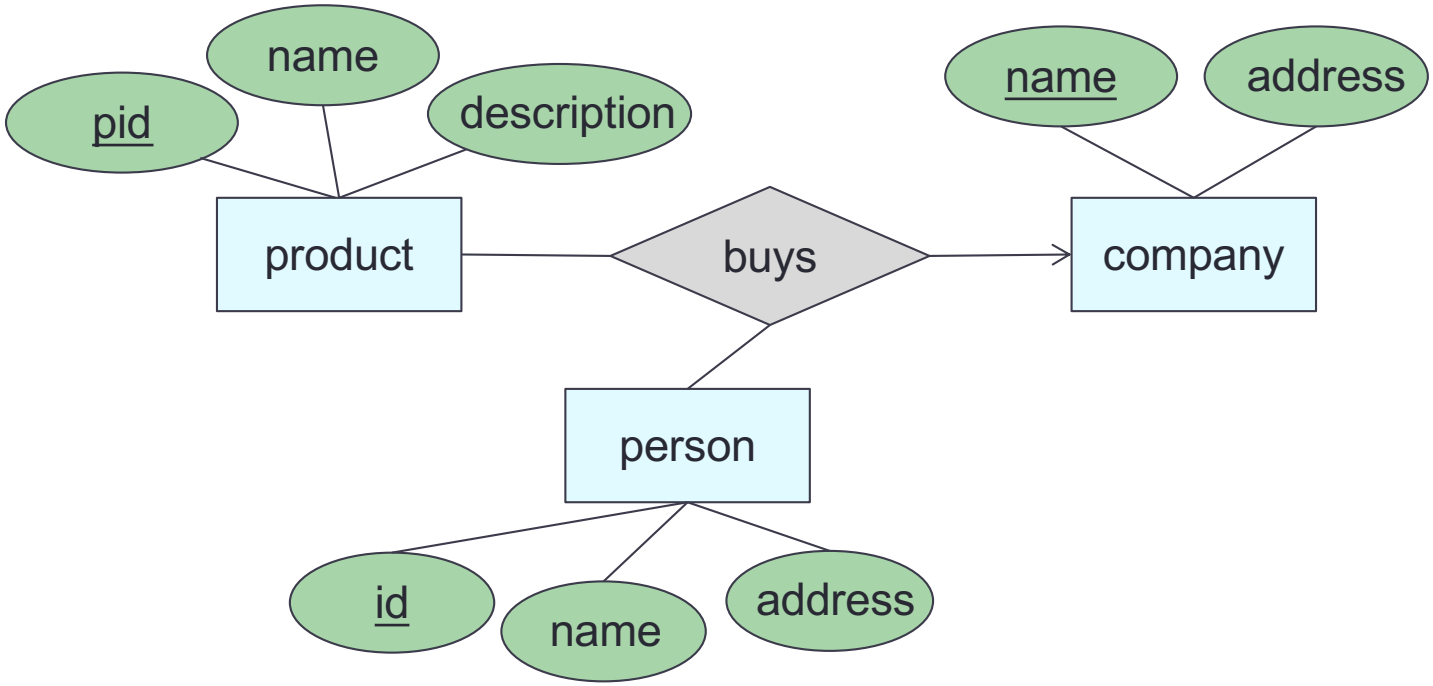
Each (person, product) pair can connect to many companies.
Each (person, company) pair can connect to many products.
Each (company, product) pair can connect to many persons.

Note: instances do not exist in E-R. These tables are only to help visualize the database being designed.

Let's try: Multi-Way Relationships

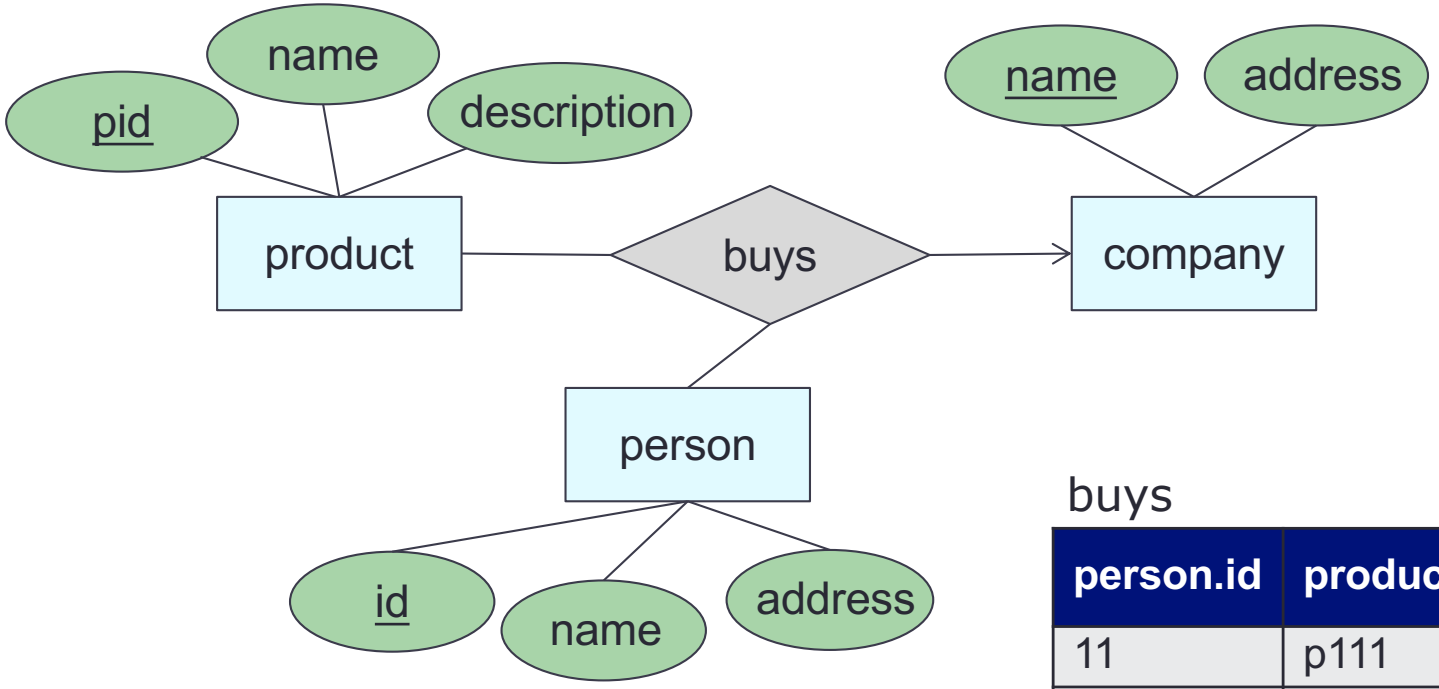
What if we want to ensure that each (person, product) pair comes from (or connects to) a single company?

Complete the diagram. (hint: don't forget the cardinality)



Let's try: Multi-Way Relationships

Based on the E-R diagram, **identify if any row in the given table is not allowed**



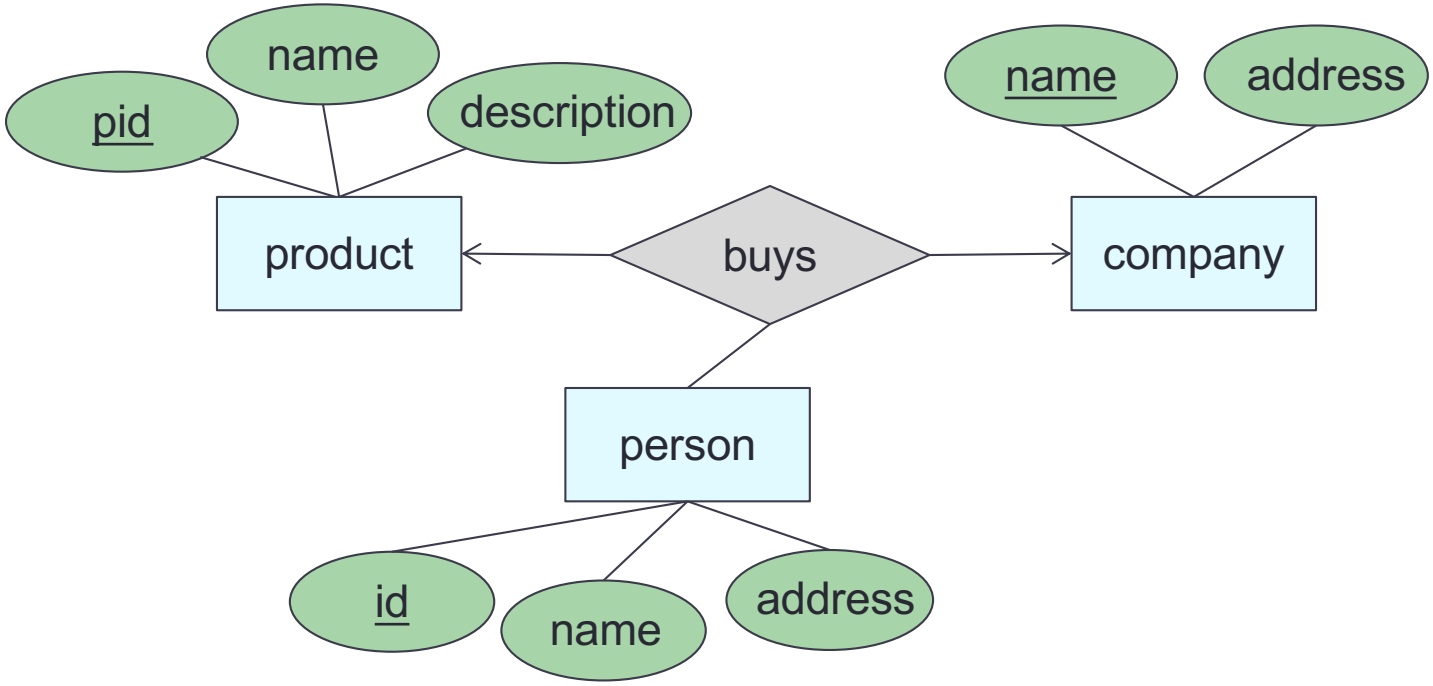
buys

person.id	product.pid	company.name
11	p111	Humpty Inc.
11	p222	Humpty Inc.
22	p111	Humpty Inc.
~~22~~	~~p111~~	~~Dumpty Shop~~

Note: instances do not exist in E-R. These tables are only to help visualize the database being designed.

Let's try: Multi-Way Relationships

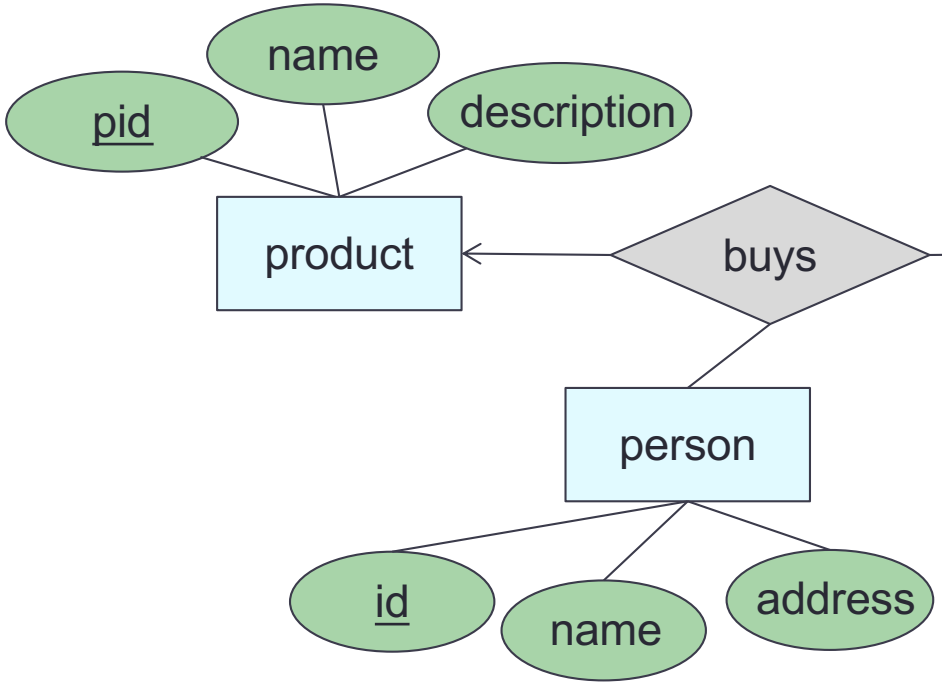
What can we interpret from the E-R diagram?



Each (person, product) pair connects to at most one company.
Each (person, company) pair connects to at most one product.
Each (company, product) pair connects to many persons.

Let's try: Multi-Way Relationships

Based on the E-R diagram, **identify if any row in the given table is not allowed**



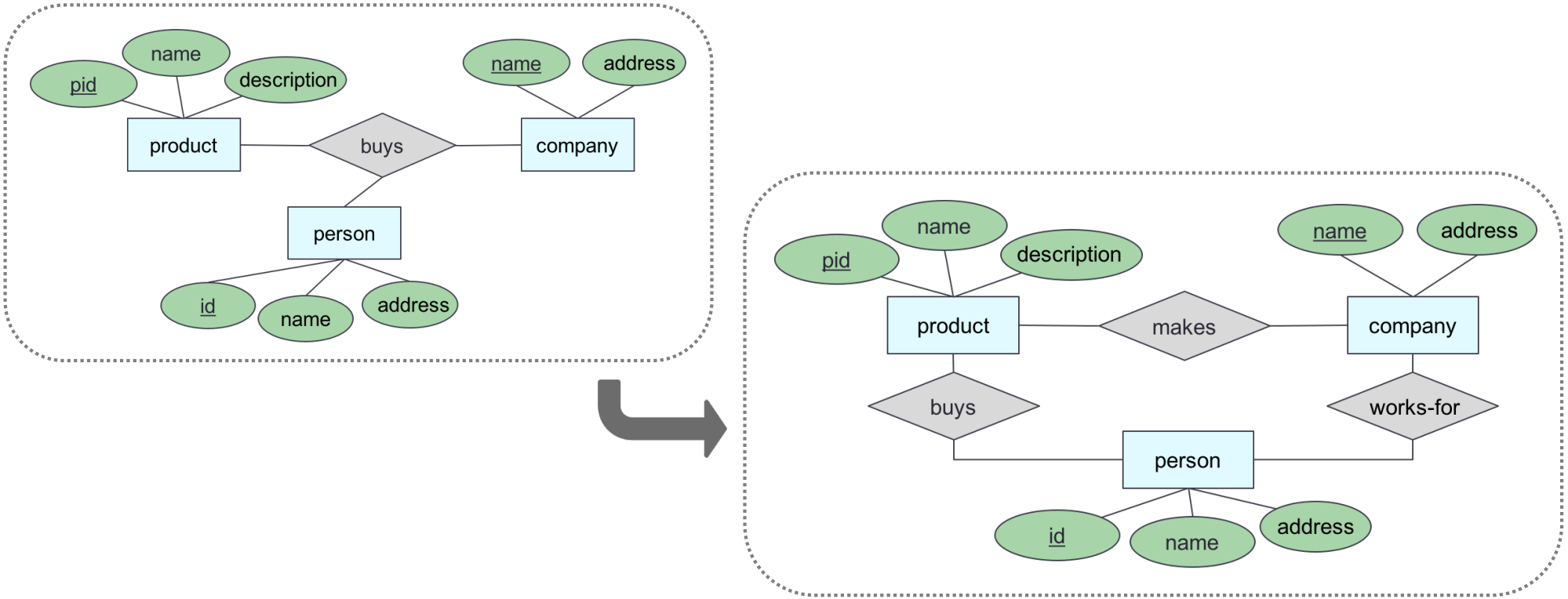
buys

person.id	product.pid	company.name
11	p111	Humpty Inc.
~~11~~	~~p222~~	~~Humpty Inc.~~
22	p111	Humpty Inc.
~~22~~	~~p111~~	~~Dumpty Shop~~
11	p333	Awesome Shop
33	p333	Awesome Shop

Note: instances do not exist in E-R. These tables are only to help visualize the database being designed.

Converting Multi-Way to Binary

- E-R model does not require binary relationships
- It is useful to convert a multi-way relationship to a collection of binary relationships
- To convert, replace a multi-way relationship with an entity set and binary relationships

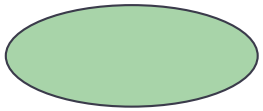


revisit

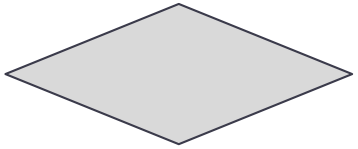
E-R Diagram: Building Blocks

(strong) Entity set

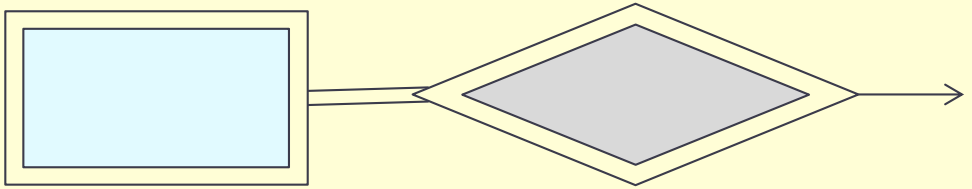
Attribute



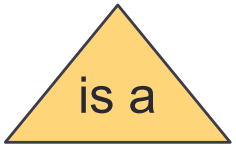
Relationship



Weak entity



Subclass



Note: colors are not part of E-R Diagram. They simply are used to increase readability.

Strong and Weak Entity Sets

Strong entity set

What we have been discussing so far

- Entities can be identified by the values of their attributes (a primary key)

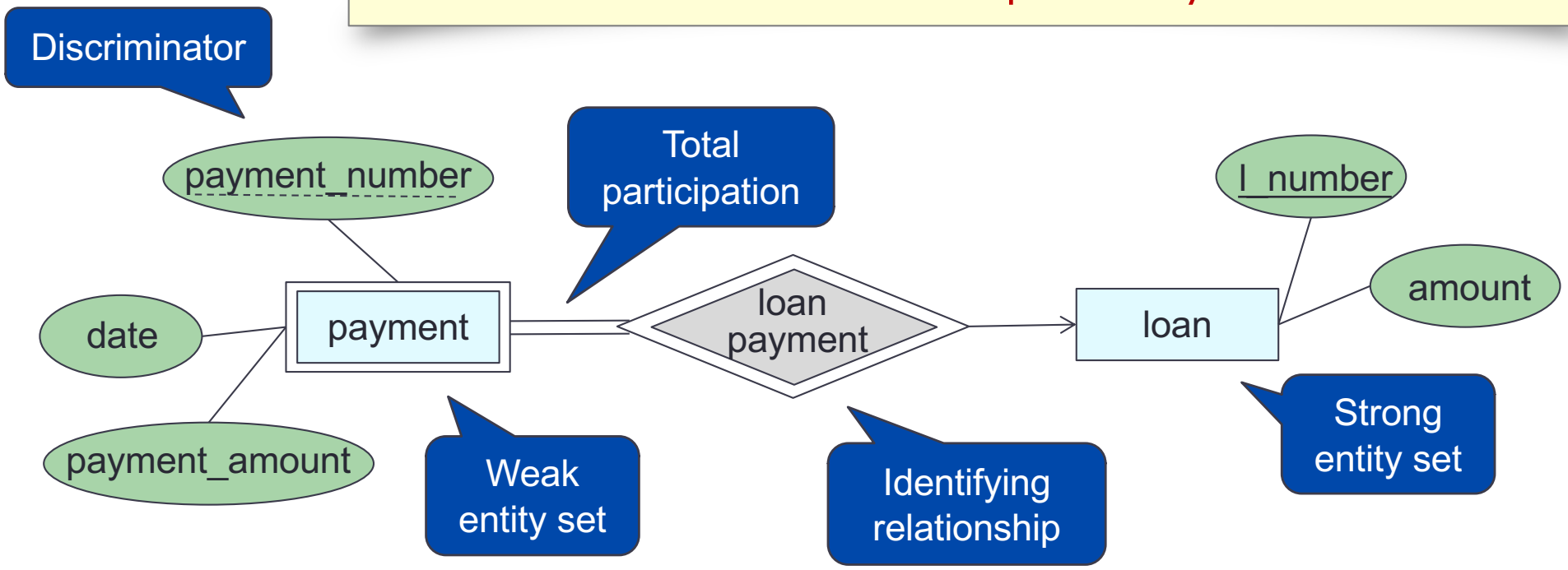
Weak entity set

A weak entity's existence depends on its strong entity

- No primary key → cannot be identified by their attributes
- To identify, need a combination of their attributes ("discriminator") and the relationship they have with another entity set ("identifying relationship")
- If X and Y are entities and each instance of Y must have a corresponding instance of X, Y is "existence dependent" on X
  - → Y is a weak entity, and X is its strong entity
  - → Y must have total participation in its relationship set with X

Weak Entity Set

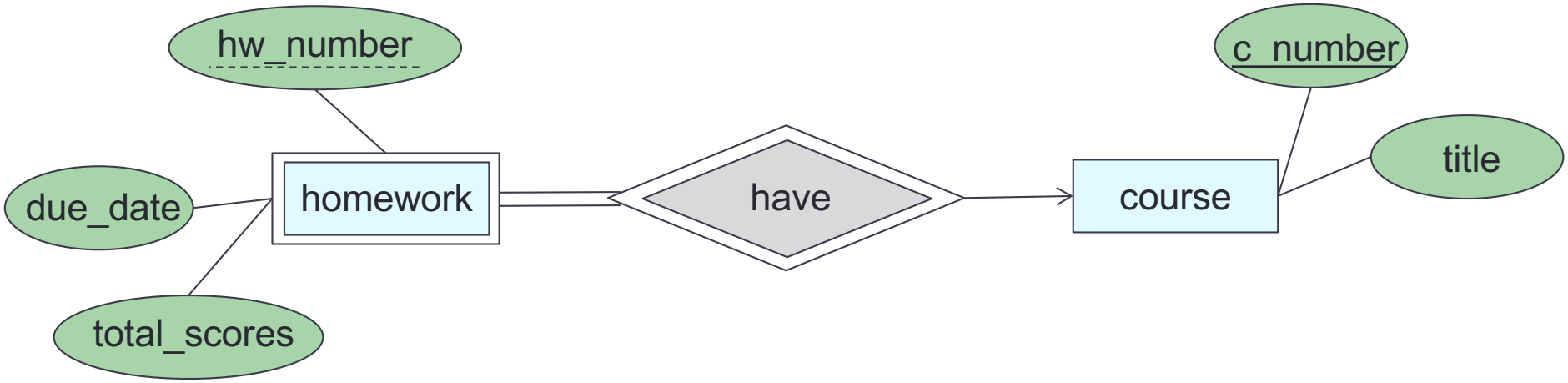
By definition, there must be total participation between the weak entity set and its identifying relationship "existence dependency"



- Does not have sufficient attributes to form a primary key.
- Depends on the strong entity set it is associated with.
- Needs a discriminator and a primary key of the strong entity set.

Let's try (1): Weak Entity Set

What can be concluded from the following E-R diagram?



Homework cannot exist without a course.
Every homework must belong to a single class.
A course can have many homework.
Different courses may have the same homework number.
To identify a homework, we need `c_number` and `hw_number`.

Let's try (2): Weak Entity Set

Draw an E-R diagram for the following scenario

Assume that the teaching evaluations of faculty members are conducted by the Dean's office, and the ratings are stored in the database.

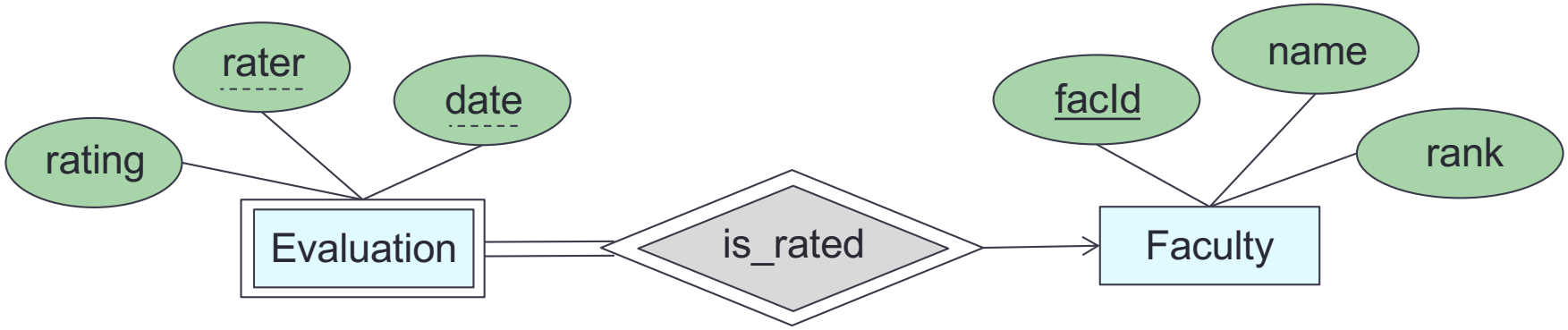
A faculty can be identified by his/her `facId`. There is additional information maintained for a faculty – *(you come up with a few attributes to describe a faculty; e.g., name, …)*.

For simplicity, assume a single rating is given for each evaluation so that an evaluation entity has attributes `date`, `rater`, and `rating`.

Since there might be several instances with identical values of all three attributes, an `Evaluation` entity must be associated with the correct `Faculty` instance to have meaning.

Let's try (2): Weak Entity Set

Draw an E-R diagram for the following scenario



(from previous page)

Assume that the teaching evaluations of faculty members are conducted by the Dean's office, and the ratings are stored in the database.

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Wrap-Up

- Roles in Relationships
- Relationships: binary, n-ary
- Weak entity

What's next?

- Subclassing
- Converting from E-R diagrams to relational designs