CS411
Database Systems

02: ER Model

The New Contract on Lecture: Students

- Students:
  - Please attend class and participate.
  - Please sit in the front rows so we are together.
  - Please interact with instructor (signal, ask, answer).
  - Please do not fall asleep or …

The New Contract on Lecture: Instructor

- Instructor:
  - Will be do my best to prepare.
  - Will respect each question.
  - Will not rush to cover all the materials.
  - Will make sure online students hear well.
  - Will not fall asleep or …

Why Do We Learn This?

Data Modeling: E-R diag.

~ How do I express data?

~ How do I think about data?

Proj Overview = Next week.

APP Steps in Building a DB Application

- Suppose you are working on CS411 project
- Step 0: pick an application domain
  - we will talk about this later
- Step 1: conceptual design
  - discuss with your team mates what to model in the application domain
  - need a modeling language to express what you want — capture.
  - ER model is the most popular such language
  - output: an ER diagram of the app. domain

Steps in Building a DB Application

- Step 2: pick a type of DBMS
  - relational DBMS is most popular and is our focus
- Step 3: translate ER design to a relational schema
  - use a set of rules to translate from ER to rel. schema
  - use a set of schema refinement rules to transform the above rel. schema into a good rel. schema
- At this point
  - you have a good relational schema on paper

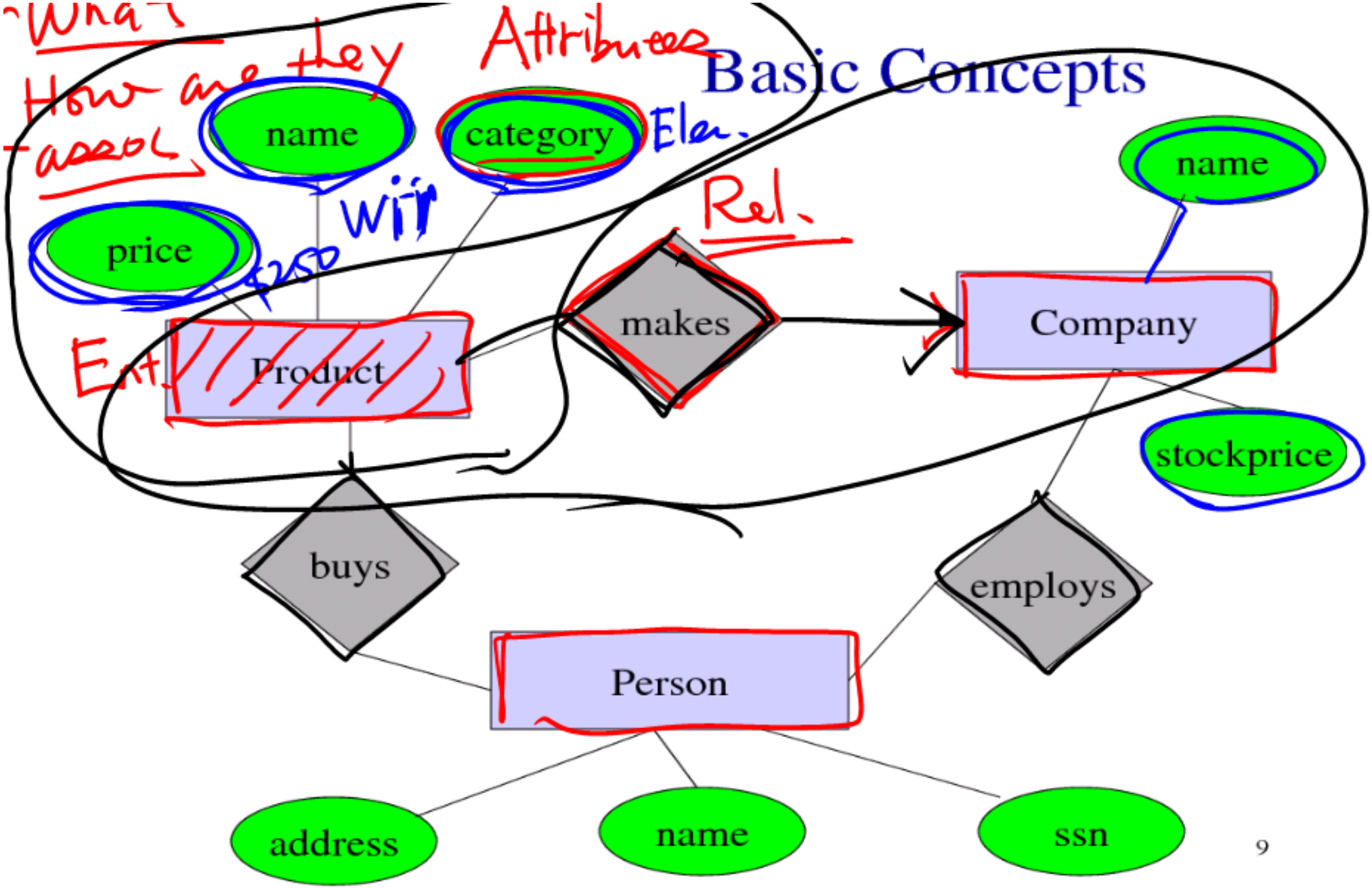
Steps in Building a DB Application

- Subsequent steps include
  - implement your relational DBMS using a "database programming language" called SQL
  - ordinary users cannot interact with the database directly
  - and the database also cannot do everything you want
  - hence write your application program in C++, Java, Perl, etc to handle the interaction and take care of things that the database cannot do
- So, the first thing we should start with is to learn ER model ...

ER Model

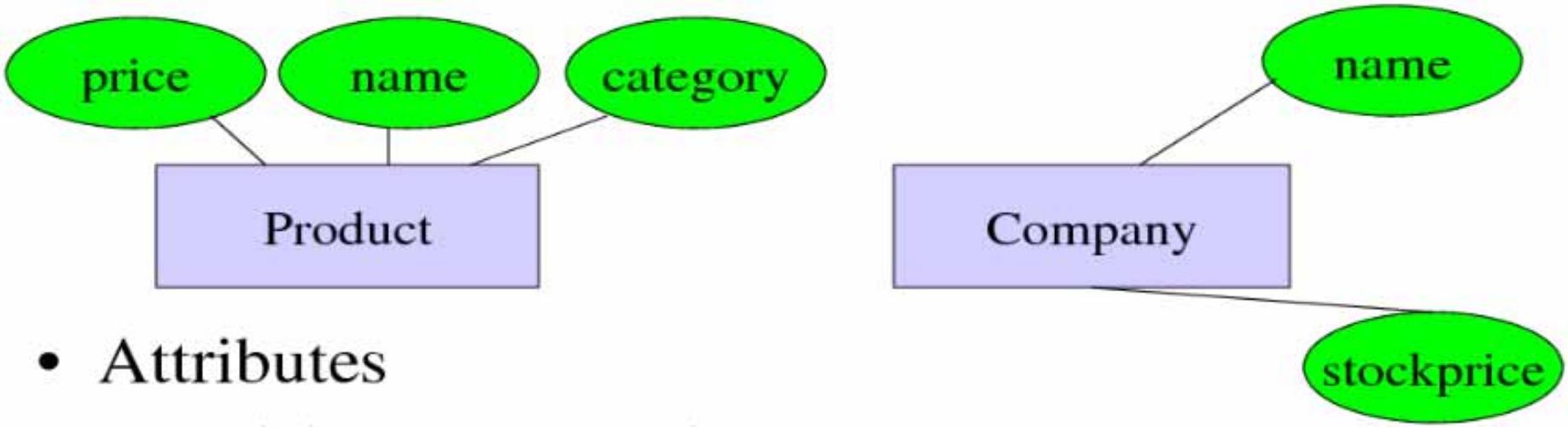
- Gives us a language to specify
  - what information the db must hold
  - what are the relationships among components of that information
- Proposed by Peter Chen in 1976
- What we will cover
  - basic stuff
  - constraints
  - weak entity sets
  - design principles

Basic Concepts



Entities and Attributes

- Entities
  - real-world objects distinguishable from other objects
  - described using a set of attributes



- Attributes
  - each has an atomic domain: string, integers, reals, etc.
- Entity set: a collection of similar entities

Relations

Asso. of Val.

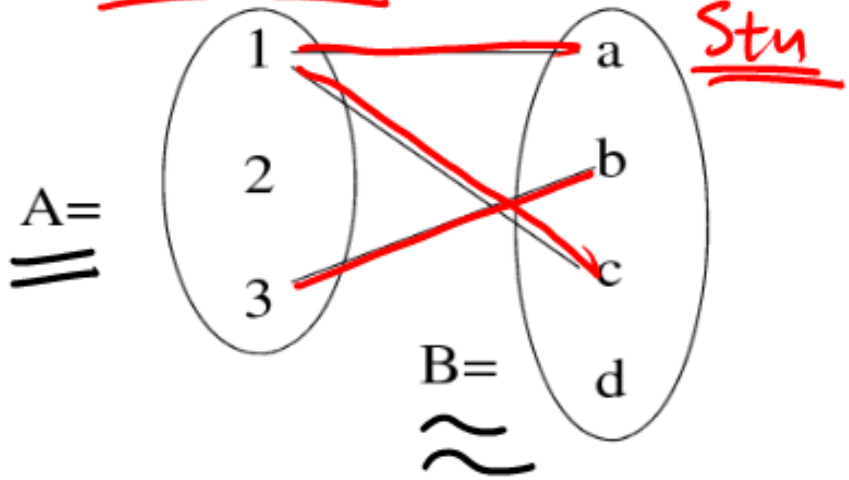
- A mathematical definition:
  - if A, B are sets, then a relation R is a subset of A x B
- A={1,2,3}, B={a,b,c,d},

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

taking

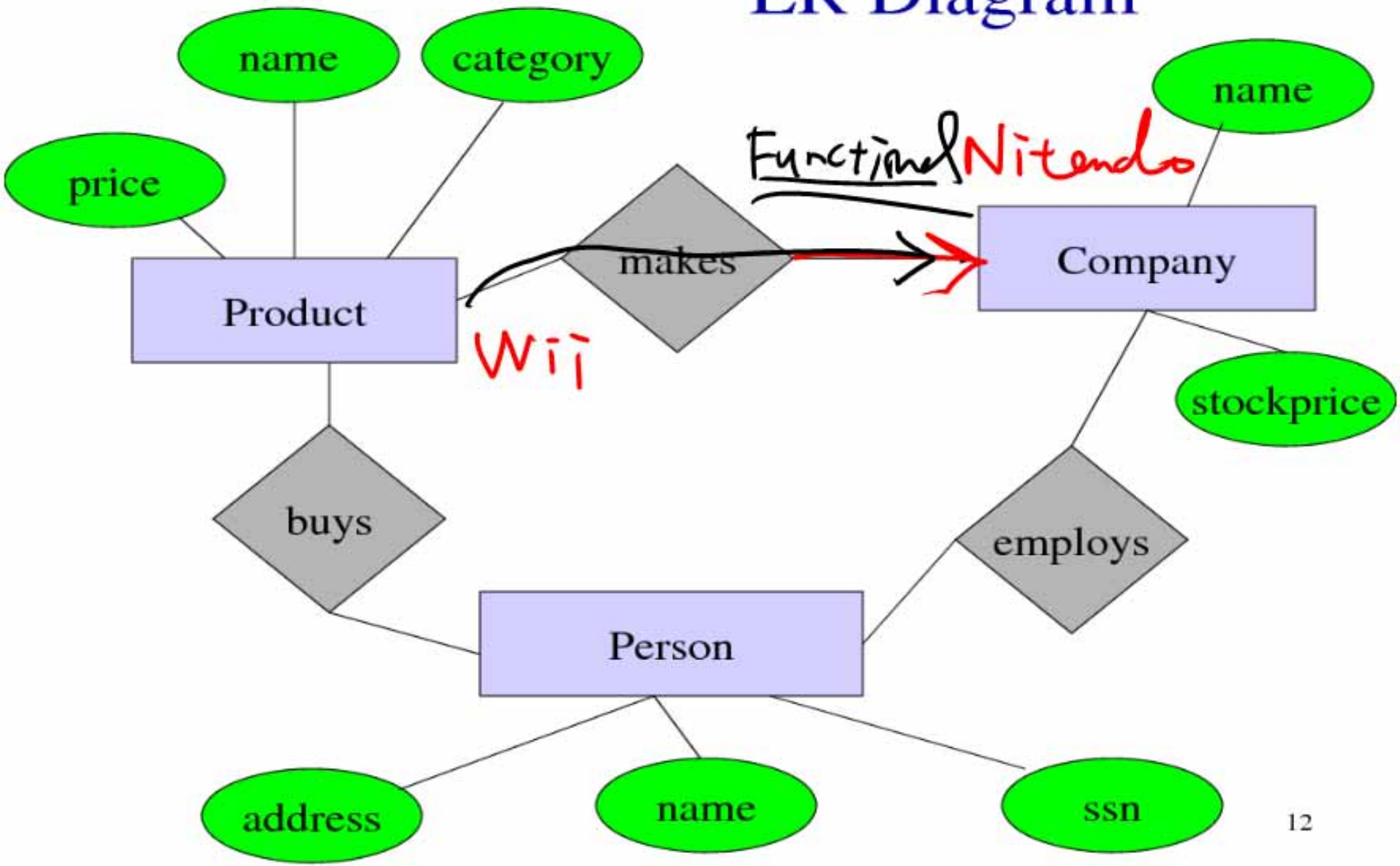
classes

Stu



makes is a subset of Product x Company:

ER Diagram


name
category
price
Product
makes
Company
name
Functional Nitendo
Wii
stockprice
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Person
address
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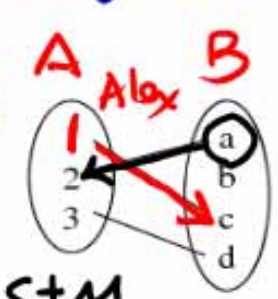
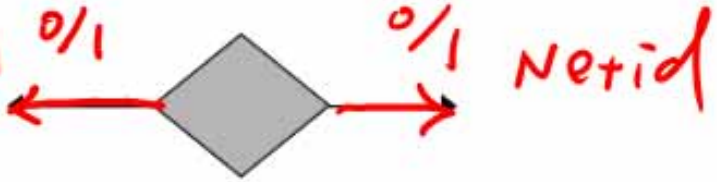
More about relationships ...

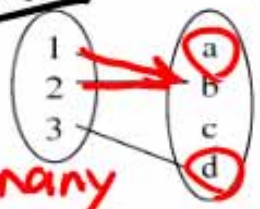
Multiplicity of E/R Relationships

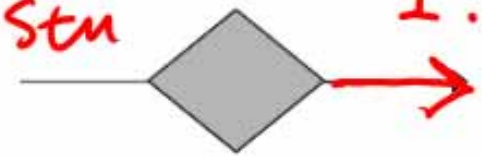
- one-one:



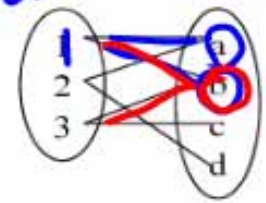


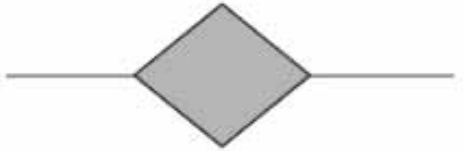
- many-one





- many-many



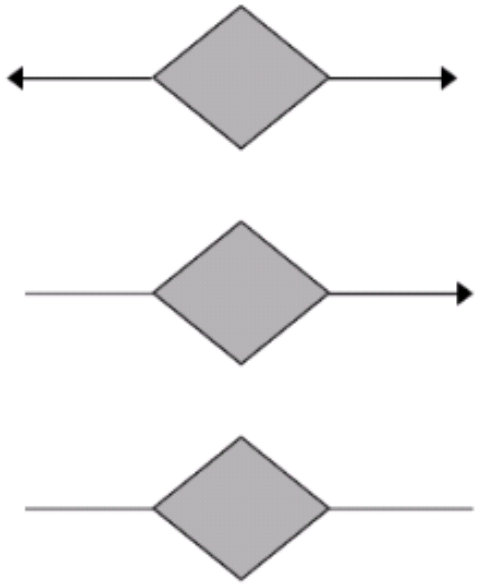


1 = a, b,

b = 1, 3,

Q: Example scenarios for each case?

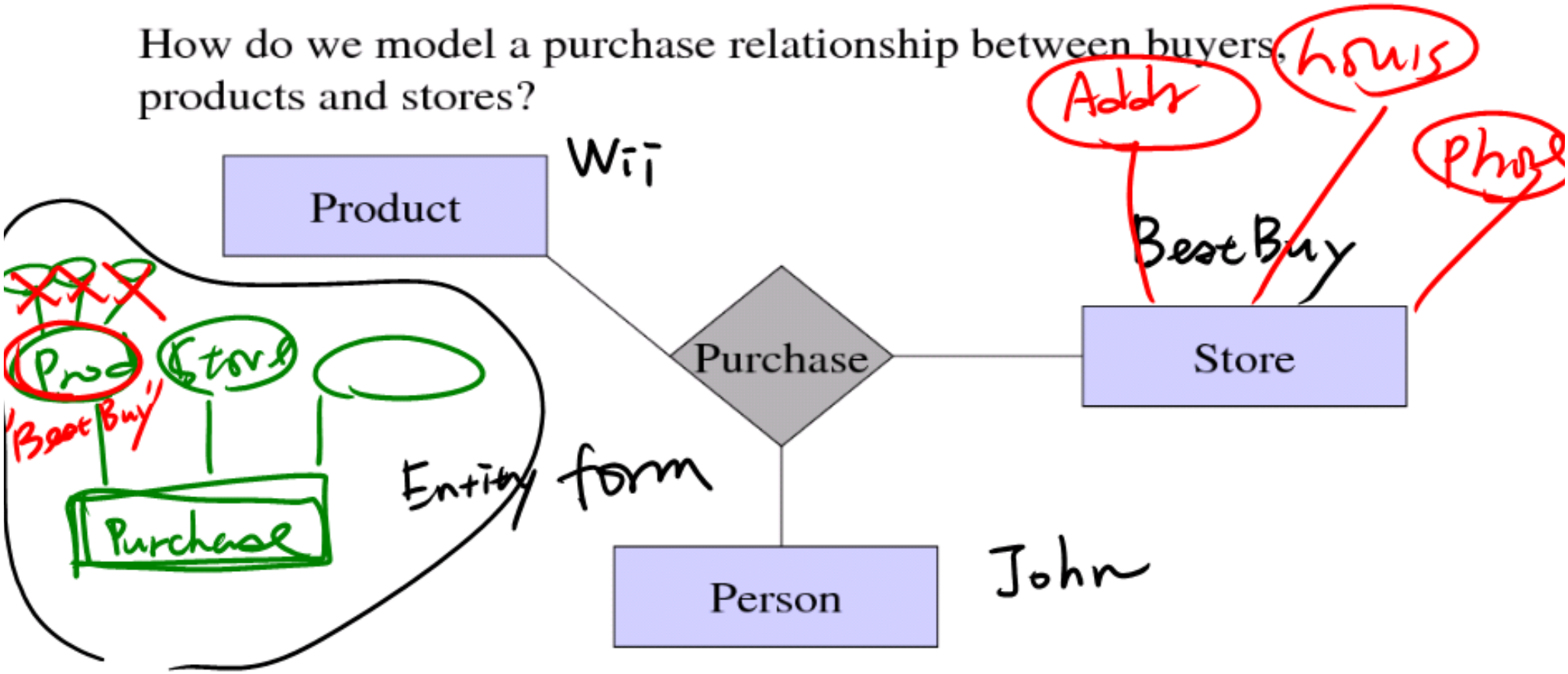
- one-one:
- many-one
- many-many



3-way

Multiway Relationships

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



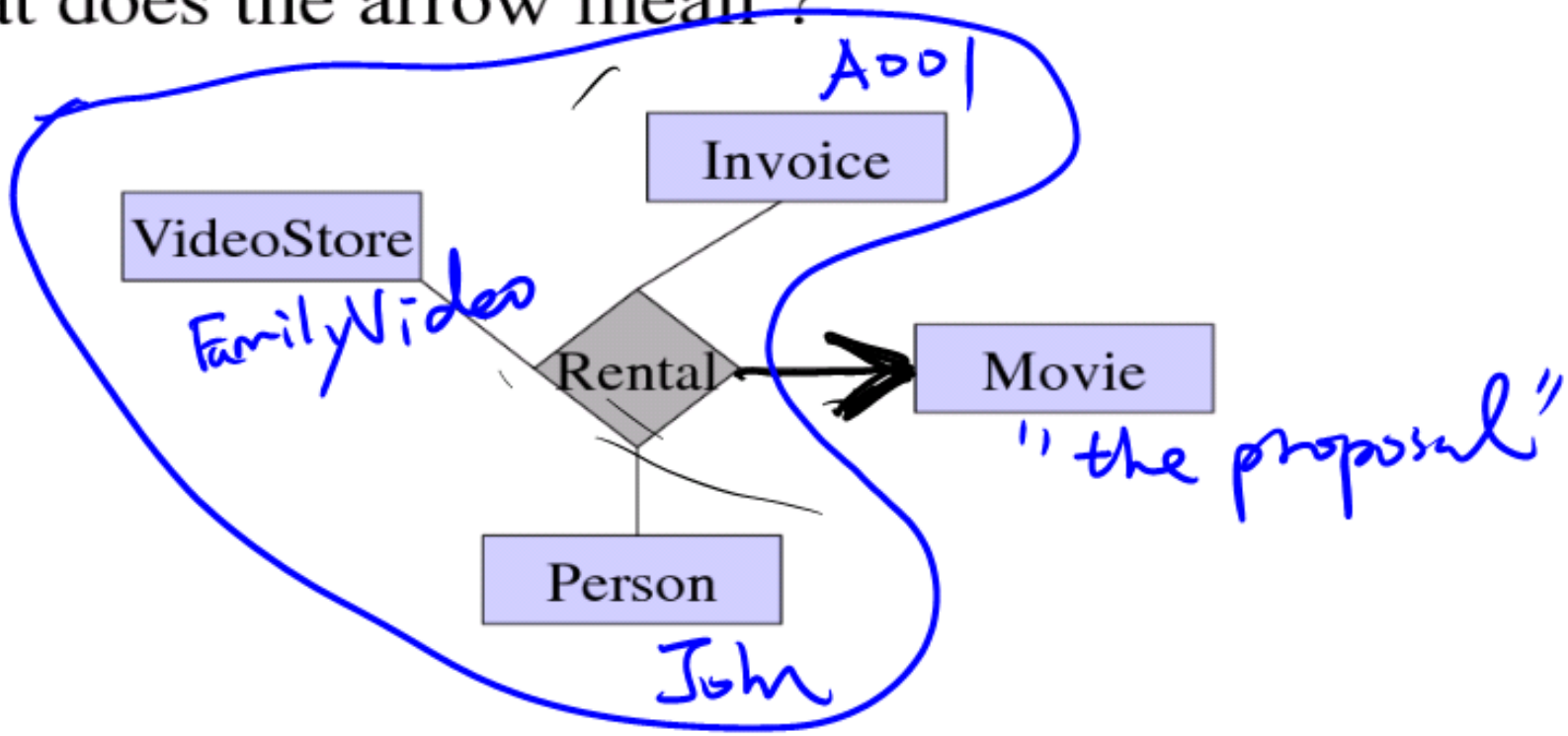
Can still model as a mathematical set (how ?)

$$Purchase \subseteq Person \times Prod \times Store$$

Always state your assumptions

Arrows in Multiway Relationships

Q: what does the arrow mean ?



A:

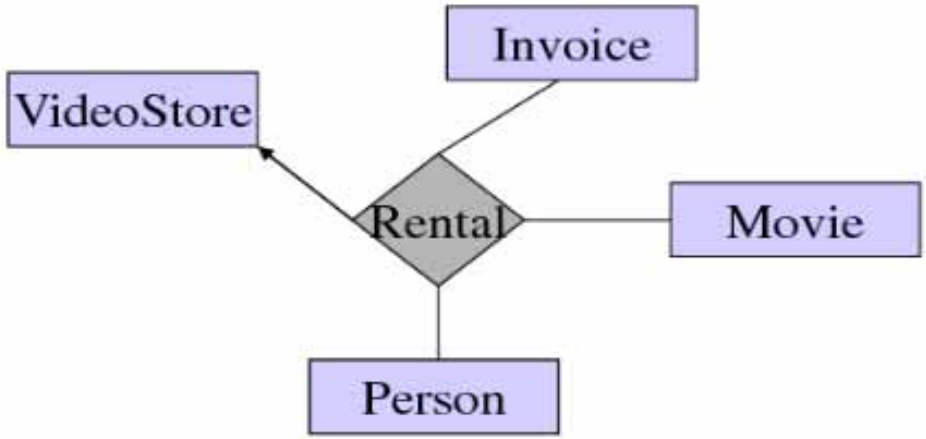
✓ Invoice, Person, VideoStore → Movie

✓ ~~Invoice~~ → Movie

Arrows in Multiway Relationships

Q: how do I say: “invoice determines store” ?

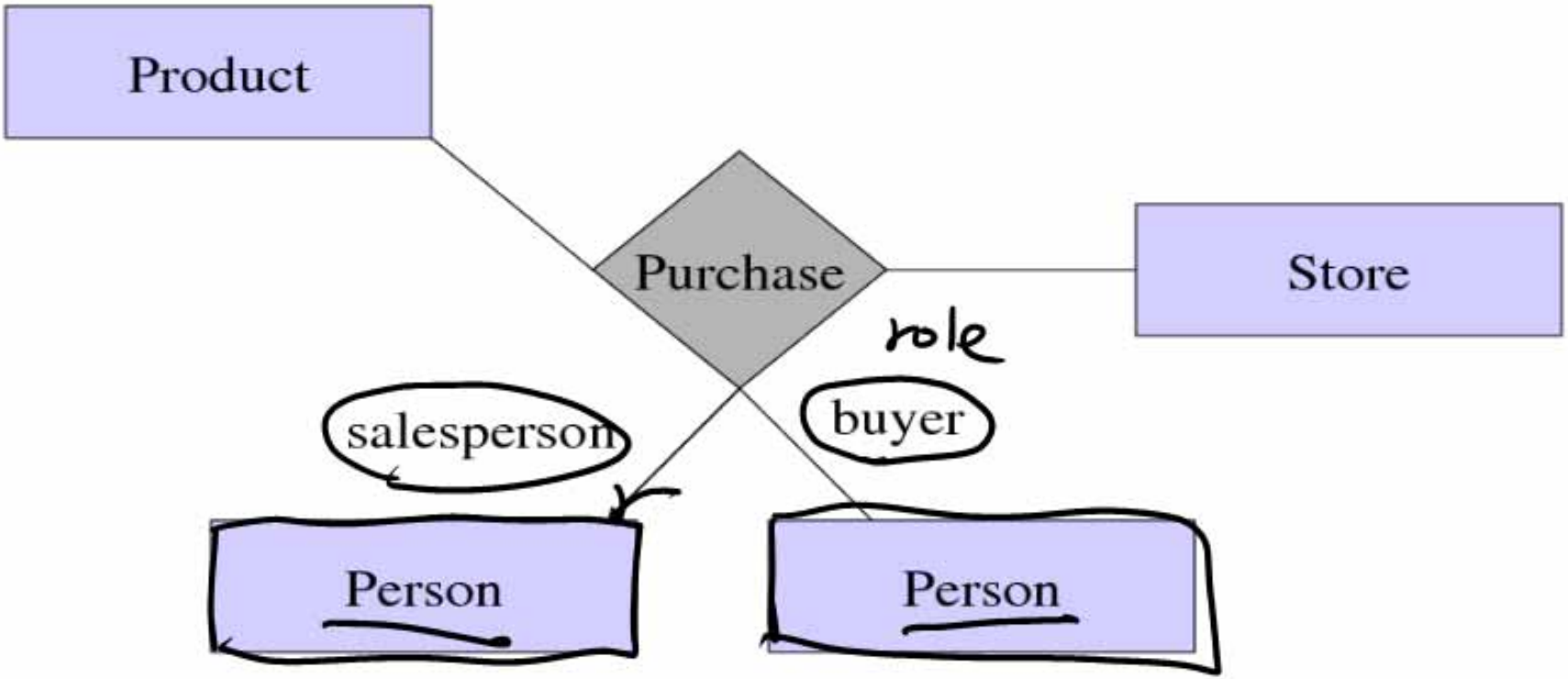
A: no good way; best approximation:



Q: Why is this incomplete ?

Roles in Relationships

What if we need an entity set twice in one relationship?



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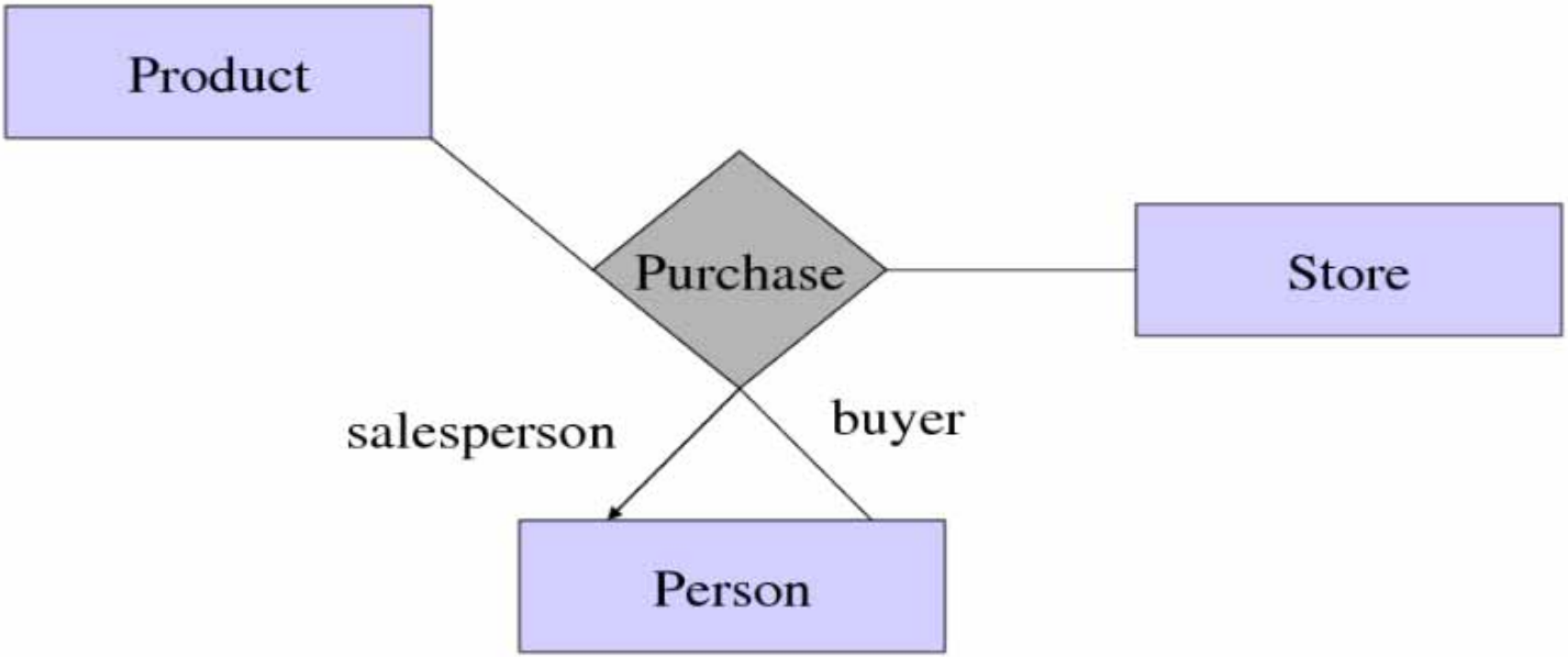
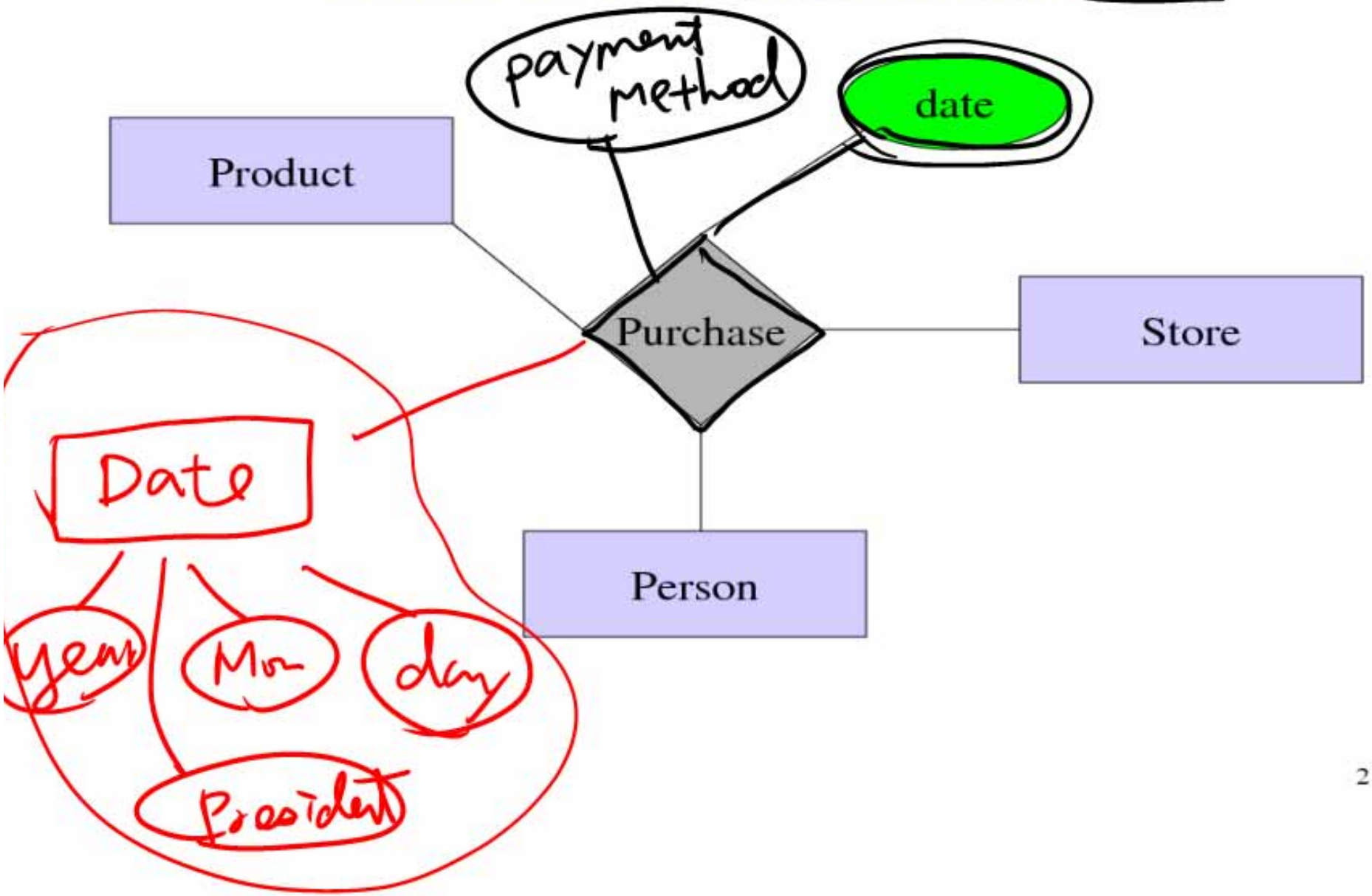
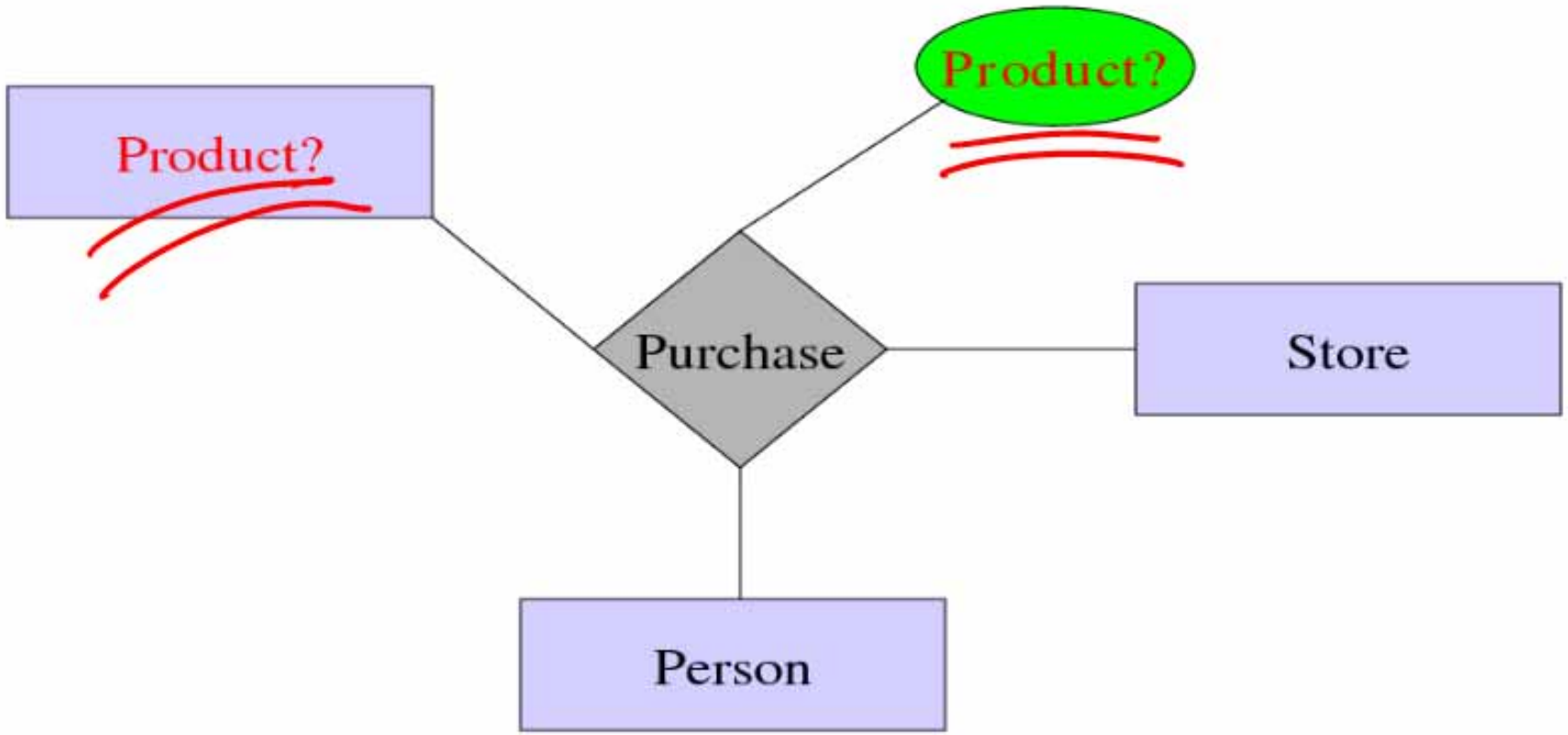


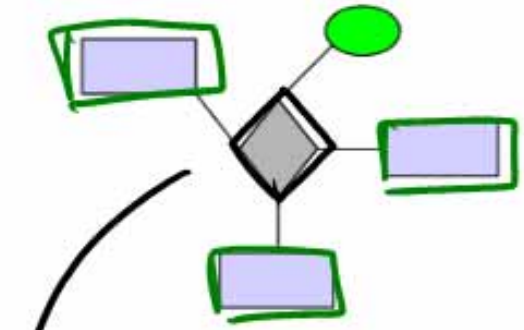
Attributes on Relationships

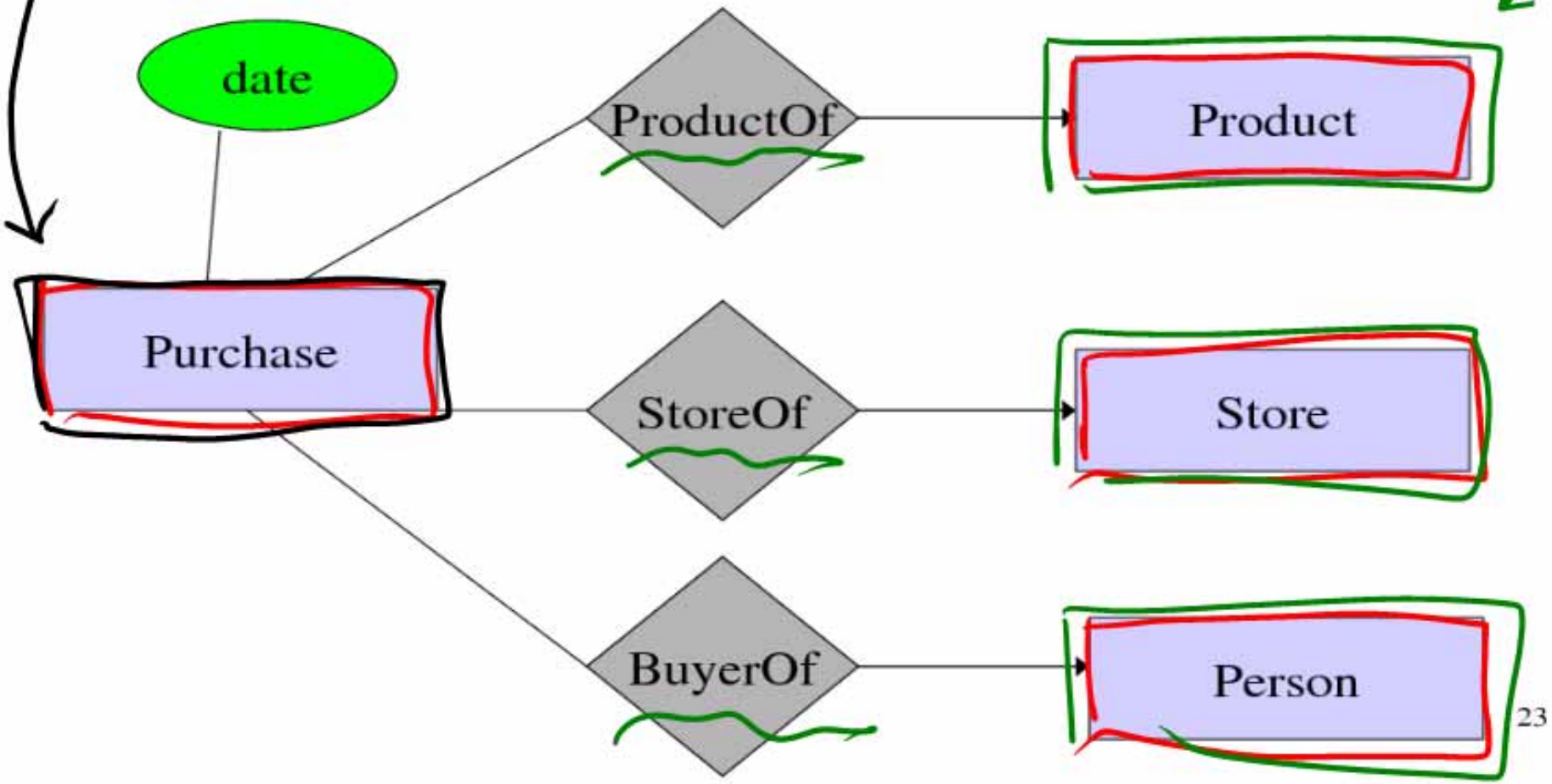


Q: Attributes vs. Entities on Relationships?



Converting Multiway Relationships to Binary



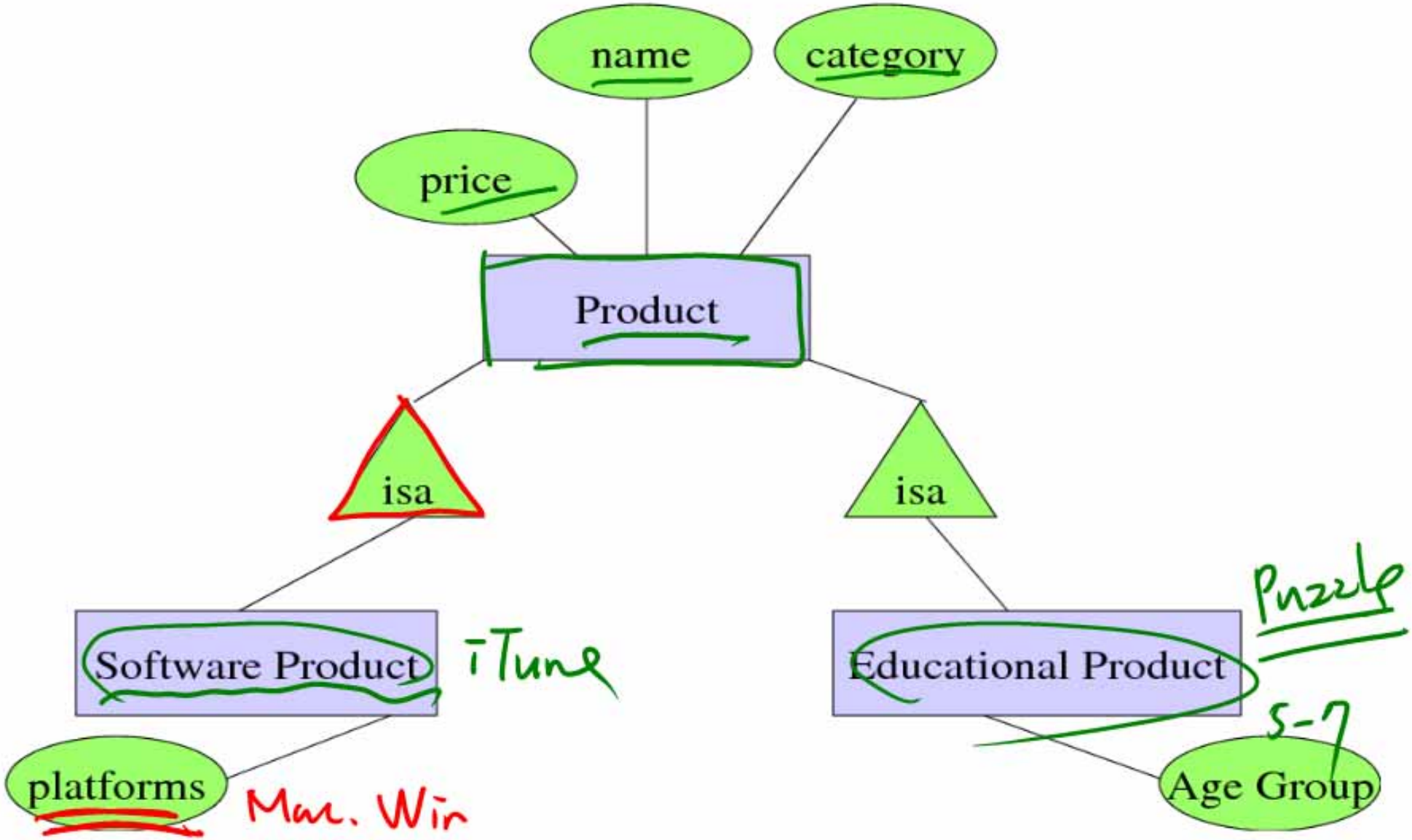


Entity

Relationships: Summary

- Modeled as a mathematical set
- Binary and multiway relationships
- Converting a multiway one into many binary ones
- Constraints on the degree of the relationship
  - many-one, one-one, many-many
  - limitations of arrows
- Attributes of relationships
  - not necessary, but useful

Subclasses in ER Diagrams



Warning: Viewers' Discretion Please