

Introduction to Database Systems CSE 444

Lecture 07 E/R Diagrams

October 10, 2007

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Outline

- E/R diagrams
 - Chapter 2
- From E/R diagrams to relations
 - Chapters 3.2, 3.3

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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

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Entity / Relationship Diagrams

Objects \longrightarrow entities
Classes \longrightarrow entity sets

Product

Attributes are like in ODL.

address

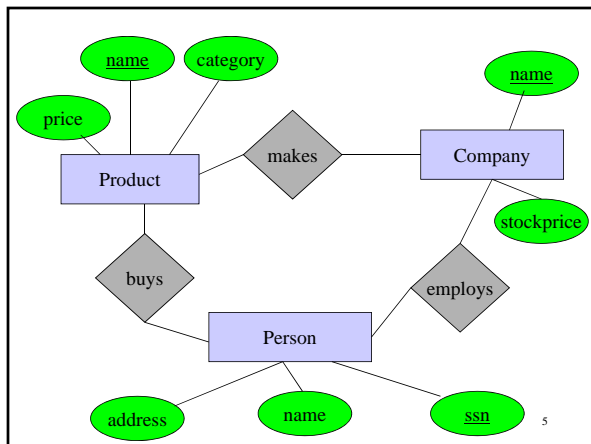
Relationships: like in ODL except

buys

- first class citizens (not associated with classes)

- not necessarily binary

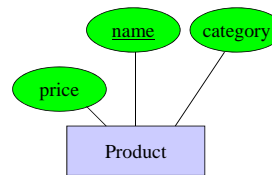
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Keys in E/R Diagrams

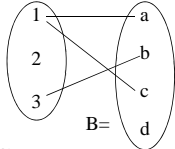
- Every entity set must have a key



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What is a Relation ?

- A mathematical definition:
 - if A, B are sets, then a relation R is a subset of $A \times B$
- $A = \{1, 2, 3\}$, $B = \{a, b, c, d\}$,
 $A \times B = \{(1,a), (1,b), \dots, (3,d)\}$
 $R = \{(1,a), (1,c), (3,b)\}$



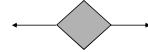
- **makes** is a subset of **Product** \times **Company**:



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Multiplicity of E/R Relations

- one-one:



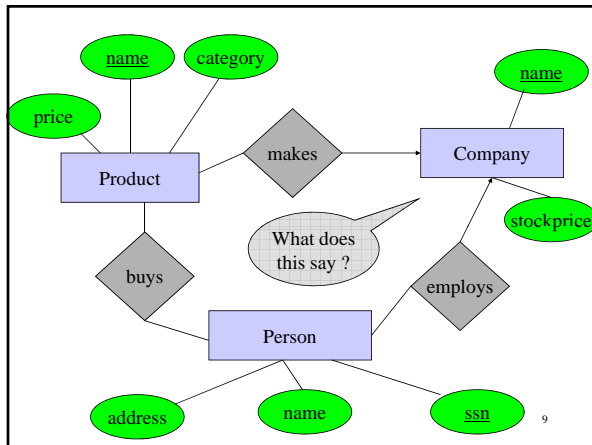
- many-one



- many-many



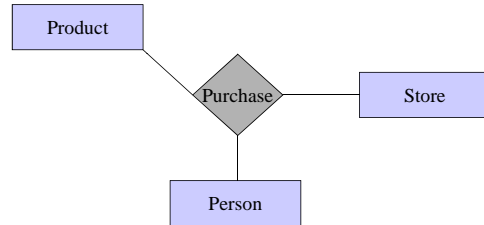
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Multi-way Relationships

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

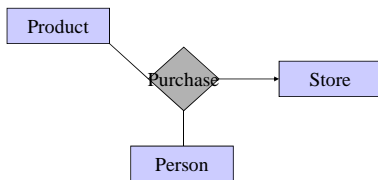


Can still model as a mathematical set (how?)

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Arrows in Multiway Relationships

Q: what does the arrow mean ?

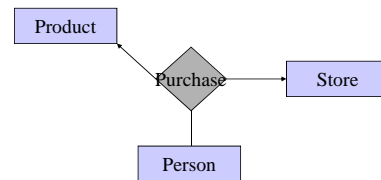


A: a given person buys a given product from at most one store

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Arrows in Multiway Relationships

Q: what does the arrow mean ?

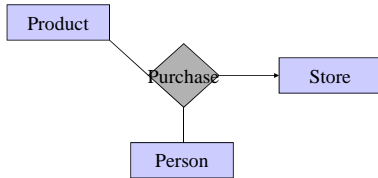


A: a given person buys a given product from at most one store AND every store sells to every person at most one product

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Arrows in Multiway Relationships

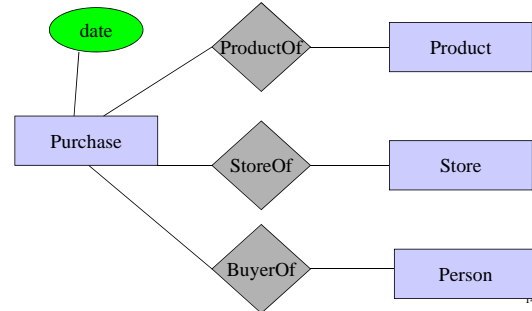
Q: How do we say that every person shops at at most one store ?



A: cannot. This is the best approximation.
(Why only approximation ?)

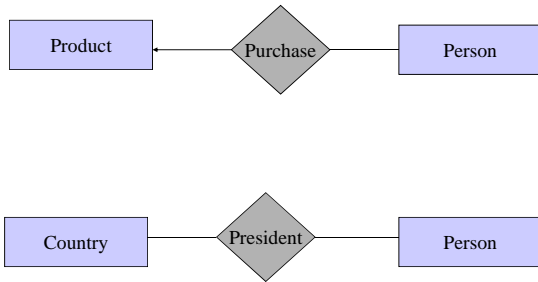
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Converting Multi-way Relationships to Binary



3. Design Principles

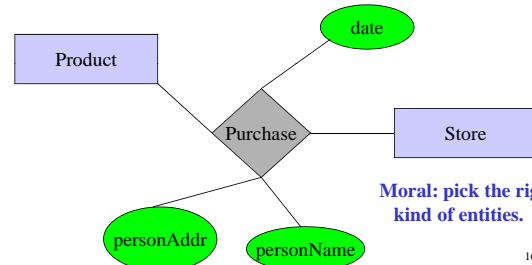
What's wrong?



Moral: be faithful!

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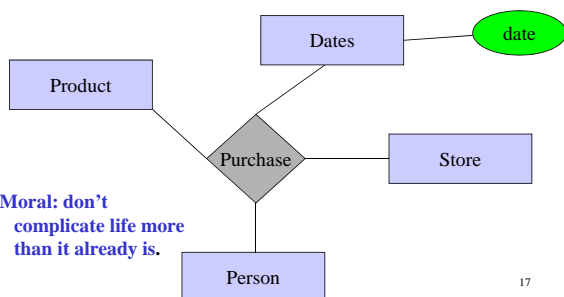
Design Principles: What's Wrong?



Moral: pick the right kind of entities.

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Design Principles: What's Wrong?



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

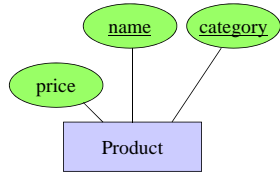
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From E/R Diagrams to Relational Schema

- Entity set \rightarrow relation
- Relationship \rightarrow relation

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Entity Set to Relation

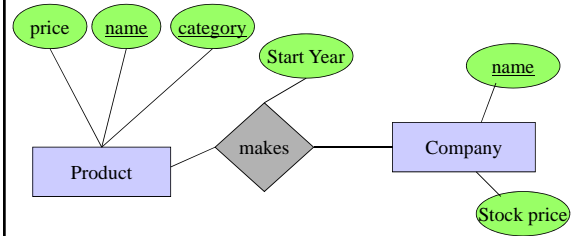


Product(name, category, price)

<u>name</u>	<u>category</u>	<u>price</u>
gizmo	gadgets	\$19.99

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Relationships to Relations



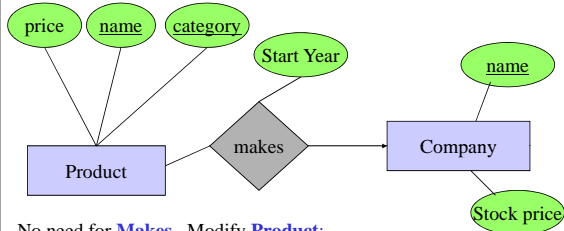
Makes(product-name, product-category, company-name, year)

<u>Product-name</u>	<u>Product-Category</u>	<u>Company-name</u>	<u>Starting-year</u>
gizmo	gadgets	gizmoWorks	1963

(watch out for attribute name conflicts)

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Relationships to Relations

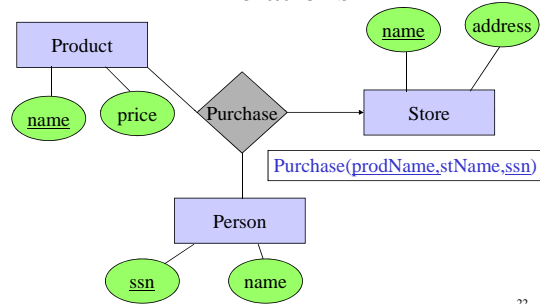


No need for **Makes**. Modify **Product**:

<u>name</u>	<u>category</u>	<u>price</u>	<u>StartYear</u>	<u>companyName</u>
gizmo	gadgets	19.99	1963	gizmoWorks

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Multi-way Relationships to Relations



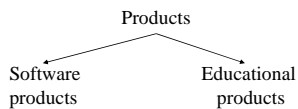
Purchase(prodName, stName, ssn)

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Modeling Subclasses

Some objects in a class may be special

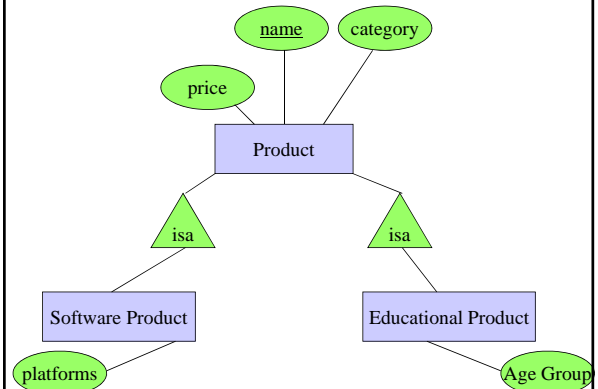
- define a new class
- better: define a *subclass*



So --- we define subclasses in E/R

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Subclasses



Understanding Subclasses

- Think in terms of records:

– Product

field1
field2

– SoftwareProduct

field1
field2
field3

– EducationalProduct

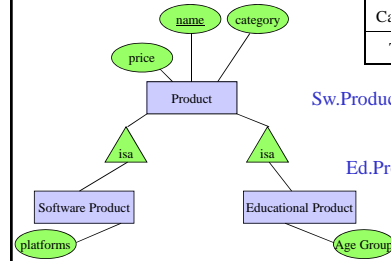
field1
field2
field4
field5

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Subclasses to Relations

Product

Name	Price	Category
Gizmo	99	gadget
Camera	49	photo
Toy	39	gadget



Sw.Product

Name	platforms
Gizmo	unix

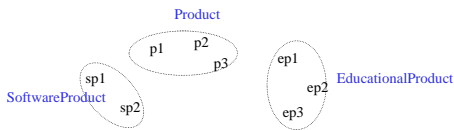
Ed.Product

Name	Age Group
Gizmo	todler
Toy	retired

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Difference between OO and E/R inheritance

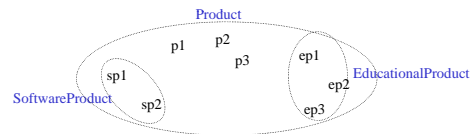
- OO: classes are disjoint (same for Java, C++)



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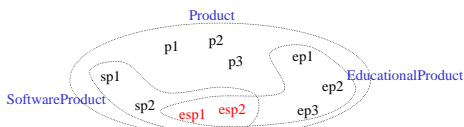
Difference between OO and E/R inheritance

- E/R: entity sets overlap



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No need for multiple inheritance in E/R



We have three entity sets, but four different kinds of objects.

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Modeling UnionTypes With Subclasses

FurniturePiece

Person

Company

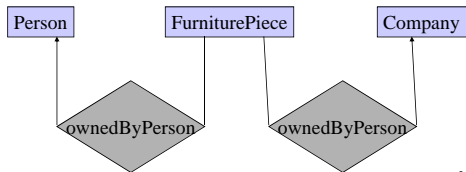
Say: each piece of furniture is owned either by a person, or by a company

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Modeling Union Types with Subclasses

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

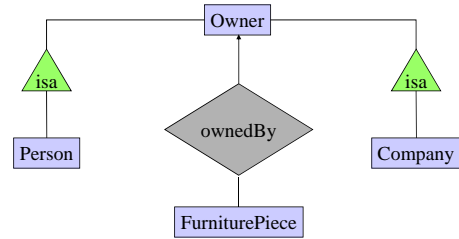
Solution 1. Acceptable, imperfect (What's wrong ?)



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Modeling Union Types with Subclasses

Solution 2: better, more laborious



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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.

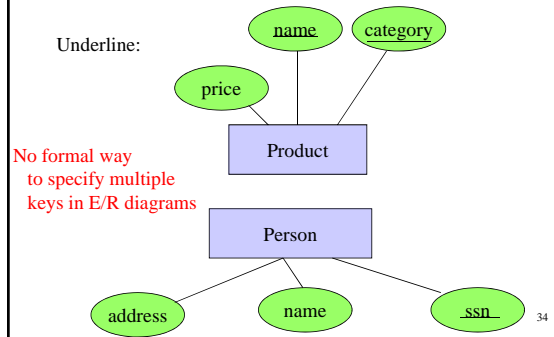
Referential integrity constraints: if you work for a company, it must exist in the database.

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

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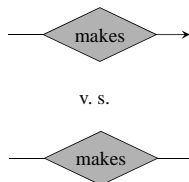
Keys in E/R Diagrams

Underline:



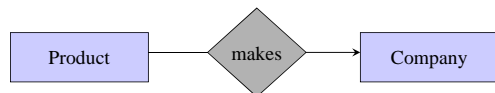
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Single Value Constraints

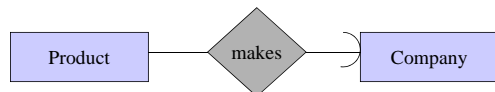


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Referential Integrity Constraints



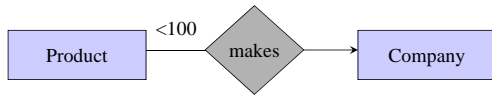
Each product made by at most one company.
Some products made by no company



Each product made by *exactly* one company.

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Other Constraints

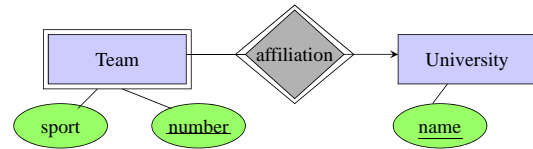


What does this mean ?

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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

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