

Lecture 07 Data Modeling: E/R Diagrams

Monday, October 14, 2002

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Outline

- E/R diagrams (Chapter 2)
- From E/R diagrams to relations (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

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Database Design Formalisms

1. Object Definition Language (ODL):
 - Closer in spirit to object-oriented models
 - Will not cover in class
 2. Entity/Relationship model (E/R):
 - More relational in nature.
 - Very widely used
- Both can be translated (semi-automatically) to relational schemas
 - ODL to OO-schema: direct transformation (C++ or Smalltalk based system).

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Entity / Relationship Diagrams

Objects → entities
Classes → entity sets

Product

Attributes are like in ODL.

address

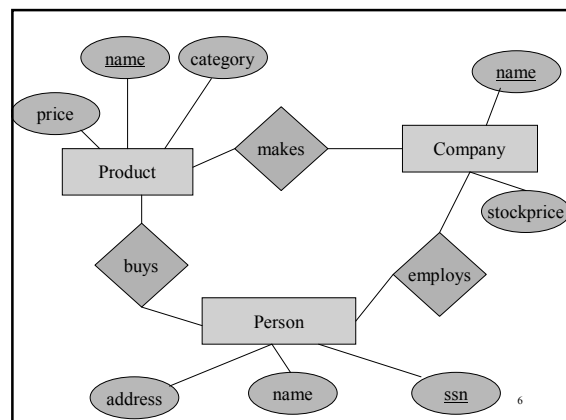
Relationships: like in ODL except

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 $A \times B$
- $A = \{1, 2, 3\}$, $B = \{a, b, c, d\}$, $A =$
 - $R = \{(1, a), (1, c), (3, b)\}$

- makes is a subset of **Product** x **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

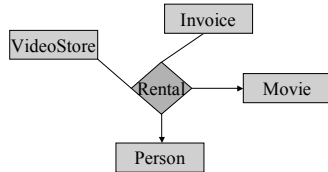
Q: what does the arrow mean ?

A: if I know the store, person, invoice, I know the movie too

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Arrows in Multiway Relationships

Q: what do these arrow mean ?



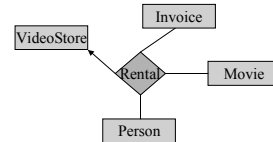
A: store, person, invoice determines movie and store, invoice, movie determines person

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Arrows in Multiway Relationships

Q: how do I say: "invoice determines store" ?

A: no good way; best approximation:

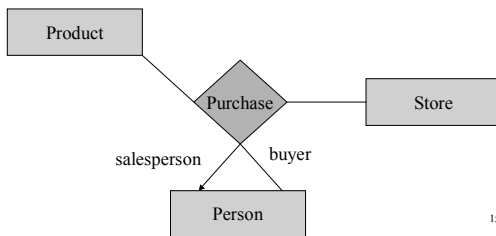


Q: Why is this incomplete ?

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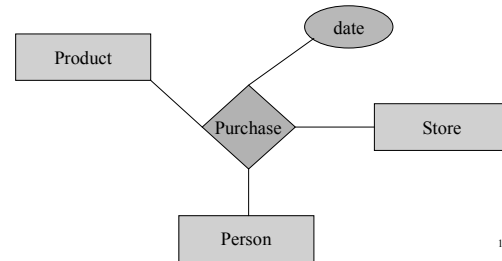
Roles in Relationships

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



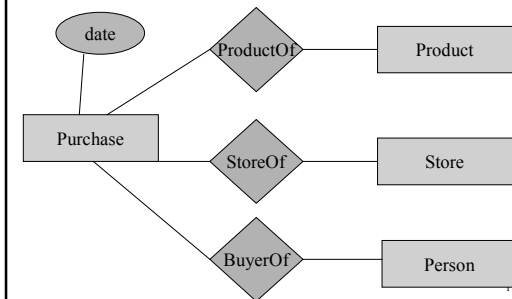
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Attributes on Relationships



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Converting Multi-way Relationships to Binary



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)

name	category	price
gizmo	gadgets	\$19.99

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Relationships to Relations

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

Product-name	Product-Category	Company-name	Starting-year
gizmo	gadgets	gizmoWorks	1963

(watch out for attribute name conflicts)

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Relationships to Relations

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

name	category	price	StartYear	companyName
gizmo	gadgets	19.99	1963	gizmoWorks

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Multi-way Relationships to Relations

Purchase(, , ,)

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3. Design Principles

What's wrong?

Moral: be faithful!

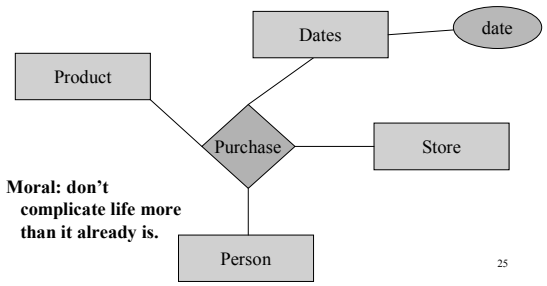
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Design Principles: What's Wrong?

Moral: pick the right kind of entities.

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Design Principles: What's Wrong?

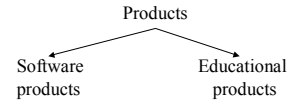


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Modeling Subclasses

Some objects in a class may be special

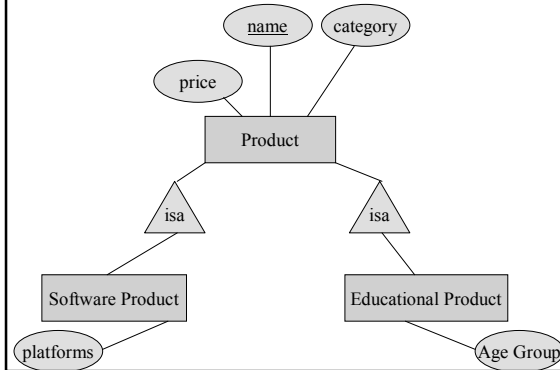
- define a new class
- better: define a *subclass*



So --- we define subclasses in E/R

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Subclasses



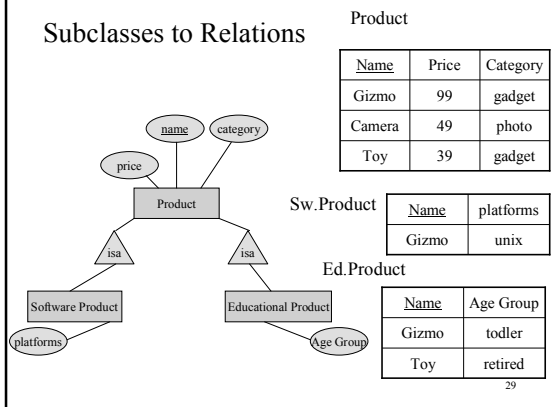
Understanding Subclasses

• Think in terms of records:

- Product	field1
	field2
- SoftwareProduct	field1
	field2
	field3
- EducationalProduct	field1
	field2
	field4
	field5

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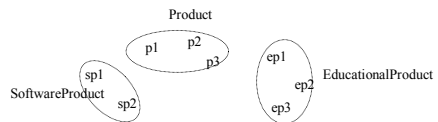
Subclasses to Relations



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Difference between ODL and E/R inheritance

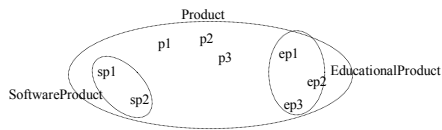
• ODL: classes are disjoint



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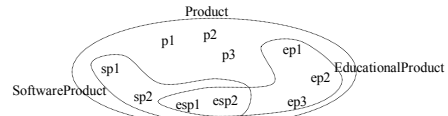
Difference between ODL and E/R inheritance

- E/R: entity sets overlap



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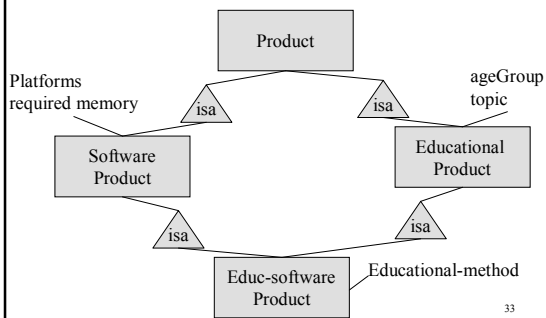
- No need for multiple inheritance in E/R



- we have three entity sets, but four different kinds of objects
- Still needed if we want extra attributes

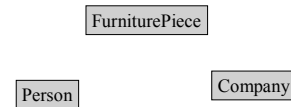
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Modeling Subclass Structure



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Modeling Union Types With Subclasses



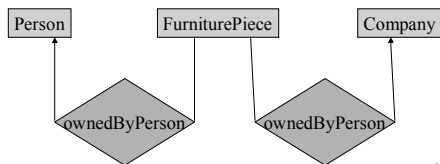
Say: each piece of furniture is owned either by a person, or by a company

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Modeling Union Types with Subclasses

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

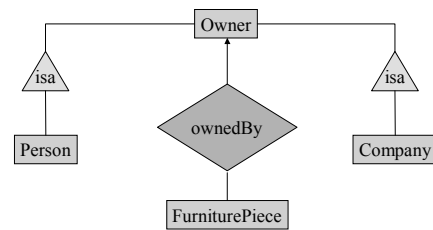
Solution 1. Acceptable, imperfect (What's wrong?)



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Modeling Union Types with Subclasses

Solution 2: better, more laborious



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