Introduction to Data Management
CSE 344

Lecture 14: E/R Diagrams

Midterm

- Next Monday in class
- Content:
  - Lectures 1 through 13
  - Homework 1 through 4
- Open books and open notes
  - But no portable devices (no laptops, no phones, etc.)
- Three questions:
  - Question 1: SQL and Physical tuning
  - Question 2: Relational algebra, calculus, datalog
  - Question 3: XML/XPath/XQuery

How To Study

- Go over the lecture notes
- Read the book
- Go over the homeworks
- Practice
  - Practice webquiz will be posted Tuesday or Wednesday
  - Look at the midterm from 344 Spring 2011
  - Look at both midterm and final from 444 past years
  - Look for questions about SQL, relational algebra, and XML/Path
- Ask Kristi and me questions
- The goal of the midterm is to help you learn!

Today: E/R Diagrams

Motivating scenario

- Customer asks you to help them setup a DBMS
- They want to store information about
  - Companies and various branches inside companies
  - Each company has a name, an address, and a CEO
  - Each company also has a list of key employees
  - Each branch has a name and a market share in $$$
  - Products manufactured by these companies
  - Each product has a name and a description
  - Products are manufactured by different branches

Database Design

- Why do we need it?
  - Need a way to model real world entities in terms of relations
  - Not easy to go from real-world entities to a database schema
- 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 exists
  - We discuss E/R diagrams

Database Design Process

Conceptual Model:

Relational Model:
- Tables + constraints
- And also functional dep.

Normalization:
- Eliminates anomalies

Conceptual Schema

Physical storage details

Physical Schema
Entity / Relationship Diagrams

- Objects entities
- Classes entity sets
- Attributes are like in ODL (ODL = Object Definition Language)
- Relationships: like in ODL except
  - first class citizens (not associated with classes)
  - not necessarily binary

Keys in E/R Diagrams

- Every entity set must have a key

What is a Relation?

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

- makes is a subset of Product × Company:

Multiplicity of E/R Relations

- one-one:
- many-one
- many-many
Multi-way Relationships

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

Can still model as a mathematical set (how?)

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

(Why only approximation?)

Converting Multi-way Relationships to Binary

3. Design Principles

What’s wrong?

Moral: be faithful to the specifications of the app!
Design Principles: What’s Wrong?

Moral: pick the right kind of entities.

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

From E/R Diagrams to Relational Schema

- Entity set → relation
- Relationship → relation

Entity Set to Relation

Product(name, category, price)

<table>
<thead>
<tr>
<th>name</th>
<th>category</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>gizmo</td>
<td>gadgets</td>
<td>$19.99</td>
</tr>
</tbody>
</table>

Relationships to Relations

No need for Makes. Modify Product:

<table>
<thead>
<tr>
<th>name</th>
<th>category</th>
<th>price</th>
<th>StartYear</th>
<th>companyName</th>
</tr>
</thead>
<tbody>
<tr>
<td>gizmo</td>
<td>gadgets</td>
<td>19.99</td>
<td>1963</td>
<td>gizmoWorks</td>
</tr>
</tbody>
</table>

(watch out for attribute name conflicts)
Multi-way Relationships to Relations

Person

name

ssn

store

name

address

Purchase(prodName, ssn, price)

Multi-Way Relationships to Relations

购

Product

name

price

store

name

address

Purchase(prodName, ssn, price)

Modeling Subclasses

Some objects in a class may be special
- define a new class
- better: define a subclass

Products

Software products

Educational products

So --- we define subclasses in E/R

Subclasses

Product

name

category

price

isa

isa

Software Product

Educational Product

platforms

Age Group

Modeling Subclasses

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So --- we define subclasses in E/R

Understanding Subclasses

- Think in terms of records:
  - Product
    - field1
    - field2
  - SoftwareProduct
    - field1
    - field2
  - EducationalProduct
    - field1
    - field2

Modeling UnionTypes With Subclasses

FurniturePiece

Person

Company

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

Subclasses to Relations

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Other ways to convert are possible
See book sec 4.6

Modeling UnionTypes With Subclasses

FurniturePiece

Person

Company

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

Magda Balazinska - CSE 344, Fall 2011
Modeling Union Types with Subclasses

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

Solution 1. Acceptable but imperfect (What’s wrong?)

Solution 2: better, more laborious