Introduction to Data Management
CSE 344

Lecture 17: E/R Diagrams and Constraints

Guest Lecturer: Shumo Chu
Announcements

• HW5 due this Friday

• HW6, WQ6 will be out this Friday
  – Due on 11/21
Database Design

What it is:

• Starting from scratch, design the database schema: relation, attributes, keys, foreign keys, constraints etc

Why it’s hard

• The database will be in operation for a very long time (years). Updating the schema while in production is very expensive (why?)
Database Design

• Consider issues such as:
  – What entities to model
  – How entities are related
  – What constraints exist in the domain

• Several formalisms exist
  – We discuss E/R diagrams

• Reading: Sec. 4.1-4.6
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

• Entity set = a class
  – An entity = an object

• Attribute

• Relationship

Product

city

makes
Keys in E/R Diagrams

• Every entity set must have a key

Product

name

price
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 × B = {(1,a),(1,b), . . . , (3,d)}
  R = {(1,a), (1,c), (3,b)}

• makes is a subset of Product X Company:
Multiplicity of E/R Relations

- one-one:
  - a
  - b
  - c
  - d

- many-one

- many-many
What does this say?
Multi-way Relationships

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

Can still model as a mathematical set (Q. how ?)

A. As a set of triples $\subseteq \text{Person} \times \text{Product} \times \text{Store}$
Q: What does the arrow mean?

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

[Arrow pointing to E means that if we select one entity from each of the other entity sets in the relationship, those entities are related to at most one entity in E]
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.
Converting Multi-way Relationships to Binary

Arrows go in which direction?
Converting Multi-way Relationships to Binary

Make sure you understand why!
3. Design Principles

What’s wrong?

Product \rightarrow Purchase \leftarrow Person

Country \rightarrow President \rightarrow Person

Moral: Be faithful to the specifications of the application!
Design Principles: What’s Wrong?

Moral: pick the right kind of entities.
Design Principles: What’s Wrong?

Moral: don’t complicate life more than it already is.
From E/R Diagrams to Relational Schema

- Entity set $\rightarrow$ relation
- Relationship $\rightarrow$ relation
**Product** *(prod-ID, category, price)*

<table>
<thead>
<tr>
<th>prod-ID</th>
<th>category</th>
<th>price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gizmo55</td>
<td>Camera</td>
<td>99.99</td>
</tr>
<tr>
<td>Pokemon19</td>
<td>Toy</td>
<td>29.99</td>
</tr>
</tbody>
</table>
N-N Relationships to Relations

Represent this in relations

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N-N Relationships to Relations

Orders(prod-ID,cust-ID, date)
Shipment(prod-ID,cust-ID, name, date)
Shipping-Co(name, address)

<table>
<thead>
<tr>
<th>prod-ID</th>
<th>cust-ID</th>
<th>name</th>
<th>date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gizmo55</td>
<td>Joe12</td>
<td>UPS</td>
<td>4/10/2011</td>
</tr>
<tr>
<td>Gizmo55</td>
<td>Joe12</td>
<td>FEDEX</td>
<td>4/9/2011</td>
</tr>
</tbody>
</table>
N-1 Relationships to Relations

Represent this in relations
Orders\((\text{prod-ID}, \text{cust-ID}, \text{date1}, \text{name}, \text{date2})\)

Shipping-Co\((\text{name}, \text{address})\)

Remember: no separate relations for many-one relationship
Multi-way Relationships to Relations

Product
- prod-ID
- price

Purchase

Person
- ssn
- name

Store
- name
- address

Purchase \((\text{prod-ID, ssn, name})\)