CS422 Principles of Database Systems
Entity-Relationship Model

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Adapted from Jeffrey Ullman’s lecture notes at http://www-db.stanford.edu/~ullman/dscb.html

Schema Design

Problem in Real World

![ER Diagram]

Tables in RDBM

Entity-Relationship (ER) Model

Problem —> ER Model —> Tables

- *Sort of* an object-oriented approach
  - minus the operation/method part
- A graphical representation of the design
  - ER Diagram
- Easily converted to relational model

ER Diagram

![ER Diagram]

Entity Set and Attributes

- Entity Set is similar to *class* in an OO language
- Attributes are the properties of an entity set
  - Similar to the *class variables* in an OO language
  - Must have simple values like numbers or strings – *cannot be collection or composite type*

Instances of An Entity Set

- Entity – *object* in an OO language
  - (Bud, Anheuser-Busch)
  - (Miller, Miller Brewing)
  - (Bud Lite, Anheuser-Busch)

- (Joe’s Bar, 113 Main St, Full)
- (Sue’s Bar, 20 East St, Beer)
**Relationship**

- ![Diagram](image1.png)

- **Instances of a relationship??**

**Many-to-Many Relationship**

- ![Diagram](image2.png)

- An entity of either set can be connected to many entities of the other set

**Many-to-One Relationship**

- ![Diagram](image3.png)

- The relationship `Favorite` between `Drinkers` and `Beers`

**Many-to-One in ER Diagram**

- ![Diagram](image4.png)

- An arrow is used to indicate the "one" side
- There could be multiple relationships between two entity sets

**One-to-One Relationship**

- ![Diagram](image5.png)

- The relationship `Best-seller` between `Manufactures` and `Beers`

**One-to-One in ER Diagram**

- ![Diagram](image6.png)

- Arrows on both ends
Multiway Relationship

 иногда требуется отношение, которое соединяет более двух множеств.
 иногда потребуется отношение, что бы пить определенные
 пиво в определенных барах.

 A 3-Way Relationship

 Instances of the Preferences Relationship

<table>
<thead>
<tr>
<th>Bar</th>
<th>Drinker</th>
<th>Beer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joe’s Bar</td>
<td>Ann</td>
<td>Miller</td>
</tr>
<tr>
<td>Sue’s Bar</td>
<td>Ann</td>
<td>Bud</td>
</tr>
<tr>
<td>Sue’s Bar</td>
<td>Ann</td>
<td>Pete’s Ale</td>
</tr>
<tr>
<td>Joe’s Bar</td>
<td>Bob</td>
<td>Bud</td>
</tr>
<tr>
<td>Joe’s Bar</td>
<td>Bob</td>
<td>Miller</td>
</tr>
<tr>
<td>Joe’s Bar</td>
<td>Cal</td>
<td>Miller</td>
</tr>
<tr>
<td>Sue’s Bar</td>
<td>Cal</td>
<td>Bud Lite</td>
</tr>
</tbody>
</table>

 “Arrows” in Multi-way Relationships

 Attributes of Relationships

 иногда полезно прикрепить атрибут к отношению.

 Roles

 иногда один и тот же набор отношений может появляться
 более одного раза.
 иногда мы можем добавить стрелки в предпочтения.
 иногда мы можем добавить стрелки в предпочтения.
A Different Perspective

Subclasses
- Subclass
  - Special case
  - More properties
  - No multiple inheritance
- Represented by the isa triangle

Keys
- A key is an attribute or a set of attributes that uniquely identify an entity in an entity set.

Rules about Keys
- Each entity set must have a key
- If there are multiple keys, choose one of them as the primary key
- Super class must have all the key attributes

Weak Entity Set
- Entity set $E$ is said to be weak if in order to identify entities of $E$ uniquely, we need to follow one or more many-one relationships from $E$ and include the key of the related entities from the connected entity sets.
Weak Entity Set Example

What’s the key for *Players*??

Representing Weak Entity Sets

The key of a weak entity set consists of its own key attributes and the key attributes of the supporting set.

Referential Integrity

A stronger many-to-one or one-to-one relationship

- *At most one*
- *Exact one*

Representing Referential Integrity

Manufactures

- Best-seller

- Beers

Design Principles

- Faithfulness
- Avoid redundancy
- Don’t use an entity set when an attribute would do
- Limit the use of weak entity set

Avoid Redundancy

Redundancy wastes space, and more importantly, encourages inconsistency.
Entity Set vs. Attributes

An entity set should satisfy at least one of the following conditions:

- It is more than the name of something; it has at least one non-key attribute, or
- It is the "many" in a many-one or many-many relationship.
Example: Bad

Don’t Overuse Weak Entity Set

We can usually create unique IDs for entity sets.

Exercise

- Student, Grades, Courses
  - w/o relationship attributes