Relation

<table>
<thead>
<tr>
<th>Attributes (fields)</th>
<th>Tuples (Records)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>Winter Brew</td>
<td>Pete’s</td>
</tr>
<tr>
<td>Bud Lite</td>
<td>Anheuser-Busch</td>
</tr>
</tbody>
</table>

Relation schema:
- Beers( name, manufacturer )
- or Beers( name:string, manufacturer:string)

About Relational Model

- Attributes values must be atomic
- No order among attributes
- No order among tuples

Convert ER Diagram to Relations

- Entity sets
- Relationships
- Weak entity sets
- Subclasses

Entity Sets

- Drinkers( name, addr )
- Beers( name, manf )

Relationships

- Drinkers
- Likes
- Beers
- Buddies
- Favorite
- Married

husband
wife

??
Converting Relationships – General Rules

- The resulting relation includes
  - All key attributes from the entity sets involved in the relationship
  - All the attributes of the relationship itself

Combining Relations

Drinkers and Likes ??
Drinkers and Favorite ??
Beers and Likes ??
Beers and Favorite ??

Converting Relationships – Combining Relations

- The relations converted from many-to-one and one-to-one relationships can be absorbed into the relation of the “many” side.

Weak Entity Set Example

Teams( ? )
Players( ? )
Plays-on ??

Weak Entity Sets

- Relation for a weak entity set includes its complete key as well as its own non-key attributes
- A supporting relationship is redundant and yields no relation

Subclass Example
Subclasses
- Object-oriented approach
  - One relation per class
  - Each entity belongs to exact one relation
- ER approach
  - One relation per class
  - Each entity may appear in multiple relations
- NULL approach
  - One relation per class hierarchy

Object-Oriented Approach

<table>
<thead>
<tr>
<th>name</th>
<th>manf</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bud</td>
<td>Anheuser-Busch</td>
<td></td>
</tr>
</tbody>
</table>

Beers

<table>
<thead>
<tr>
<th>name</th>
<th>manf</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summerbrew</td>
<td>Pete’s</td>
<td></td>
</tr>
</tbody>
</table>

Ales

ER Approach

<table>
<thead>
<tr>
<th>name</th>
<th>manf</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bud</td>
<td>Anheuser-Busch</td>
<td></td>
</tr>
<tr>
<td>Summerbrew</td>
<td>Pete’s</td>
<td></td>
</tr>
</tbody>
</table>

Beers

<table>
<thead>
<tr>
<th>name</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summerbrew</td>
<td>dark</td>
</tr>
</tbody>
</table>

NULL Approach

<table>
<thead>
<tr>
<th>name</th>
<th>manf</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bud</td>
<td>Anheuser-Busch</td>
<td>NULL</td>
</tr>
<tr>
<td>Summerbrew</td>
<td>Pete’s</td>
<td>dark</td>
</tr>
</tbody>
</table>

Beers

Discriminator

<table>
<thead>
<tr>
<th>name</th>
<th>type</th>
<th>manf</th>
<th>color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bud</td>
<td>General</td>
<td>Anheuser-Busch</td>
<td>NULL</td>
</tr>
<tr>
<td>Summerbrew</td>
<td>Ale</td>
<td>Pete’s</td>
<td>dark</td>
</tr>
</tbody>
</table>

Beers

Another Subclass Example

Movies

- title
- year
- length

Cartoons

Murder-Mysteries

- type
- weapon

- 1a
- 1a
Comparison of Subclass Conversion Approaches

- Constraints and data integrity
- Query performance
  
  Q1: find all beers made by Pete's
  Q2: find colors of the ales made by Pete's

Examples

- Receipt again
  - Items, Customers, Waiters, and Orders
- Hierarchical categories
- Price that changes

Example: Survey Questions

- Four types of survey questions
  - Single-choice
  - Multiple-choice
  - Single-answer
  - Multiple-answer

- Database stores information about users, surveys, questions, and answers