**Entity-Relationship (ER) Model**

- Problem → ER Model → Tables
- Sort of an object-oriented approach
- A graphical representation of the design – ER Diagram
- Easily converted to relational model

**Sample Problem**

- Design a database to keep track information about bars, beers, and drinkers
- Beers – name, manufacturer
  - Name, manufacturer
- Bars – name, address
  - Bars sell beers
- Drinkers – name, address
  - Drinkers go to bars and like beers

**Entity Set and Attributes**

- Entity Set is a collection of entities
  - E.g. Bars, Beers, Drinkers, Products, ...
- Attributes are the properties of an entity set
  - For example
    - Attributes of Bars: name, address
    - Attributes of Products: id, description, category, price
  - Must have simple values like numbers or strings
Instances of An Entity Set

Entity Set
- Beers
  - (Bud, Anheuser-Busch)
  - (Miller, Miller Brewing)
  - (Bud Lite, Anheuser-Busch)

Instances of the Entity Set
- Bars
  - Joe's Bar, 113 Main St
  - Sue's Bar, 20 East St

Relationship

- Bars
- Sells
- Beers

Types of Relationships

- Many-to-Many
- Many-to-One (One-to-Many)
- One-to-One

Many-to-Many Relationship

- Sells is a many-to-many relationship
  - One bar can sell many beers
  - One beer can be sold in many bars

Many-to-One Relationship

- Favorite
- Beers

- Favorite is a many-to-one relationship
  - One drinker only has one favorite beer
  - One beer can be the favorites of many drinkers
  - An arrow is used to indicates the "one" side

One-to-One Relationship

- Bestseller
- Beers

- Bestseller is a one-to-one relationship
  - One manufacturer only has one bestselling beer
  - One beer can only be the bestselling beer of one manufacturer
  - Arrows on both sides
Relationship Examples

- students
- teachers
- customers
- orders
- classes

Attributes of Relationships

- Sometimes it’s useful to attach an attribute to a relationship.

Roles

- An entity set may appear in the same relationship more than once.
- Label the edges with names called Roles

Another Way to Look at Roles

Keys

- A key is an attribute or a set of attributes that uniquely identify an entity in an entity set.
- Each entity set must have a key
- If there are multiple keys, choose one of them as the primary key

Keys in ER Diagram
Design the **Store Database**

- Keep track information about
  - Products
  - Customers
  - Orders

Design #1: Order as an Entity Set

- Products
- Customers
- Orders

Design #2: Order as a Relationship

- Customers
- Order
- Products

Quick Summary about ER Diagram

- **Entity Sets**
  - Attributes
    - Must have simple values
  - Keys
- **Relationships**
  - Many-to-many, many-to-one, one-to-one
  - Attributes

Alternative Notations and Things We Won’t Cover

- Different ways to represent relationships
  - Weak entity set
  - Subclass
  - Multi-way relationship

Convert ER Diagram to Relations

- Entity sets
- Relationships
Converting Entity Sets

Drinkers

Beers

Drinkers( name, addr )

Beers( name, manf )

Converting Relationships

Bars

Sells

Beers

Sells( bar_name, beer_name, price )

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

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.

Example of Combining Tables

Drinkers (name, addr )

Beers (name, manf )

Favorite (drinker_name, beer_name )

Drinkers (name, addr, favorite_beer_name )

Beers (name, manf )

The Store Database

◆ Convert the ER diagram from Design #1
◆ Convert the ER diagram from Design #2
◆ Which one is better??
Normal Forms

- Formal ways to evaluate the “goodness” of a database design
- Covered in CS422