CS422 Principles of Database Systems
Entity-Relationship Model

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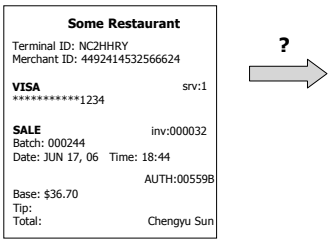
Adapted from Jeffrey Ullman's lecture notes at http://www-db.stanford.edu/~ullman/dscb.html

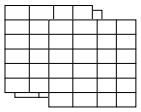
Data Modeling

Problem in Real World



?

Tables in RDBM

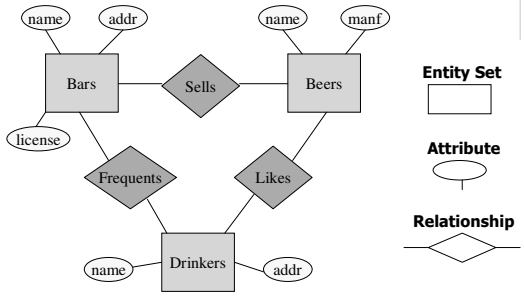


Entity-Relationship (ER) Model

Problem ⟶ ER Model ⟶ Tables

- *Sort of* an object-oriented approach
  - Support subclasses
- A graphical representation of the design – ER Diagram
- Easily converted to relational model

ER Diagram

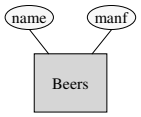


Entity Set and Attributes

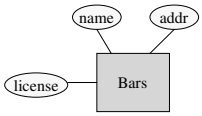
- Entity Set is similar to *class* in an OO language
- Attributes are the properties of an entity set
  - Similar to the *class variables* in an OO language
  - Must have simple values like numbers or strings – *cannot be collection or composite type*

Instances of An Entity Set

- Entity – *object* in an OO language

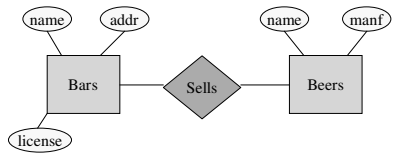


(Bud, Anheuser-Busch)
(Miller, Miller Brewing)
(Bud Lite, Anheuser-Busch)



(Joe's Bar, 113 Main St, Full)
(Sue's Bar, 20 East St, Beer)

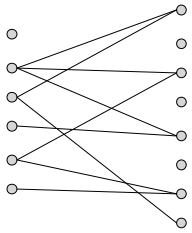
Relationship



- *Instances* of a relationship??

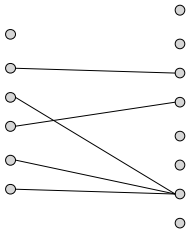
Many-to-Many Relationship

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

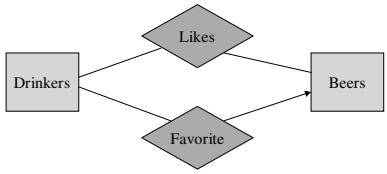


Many-to-One Relationship

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



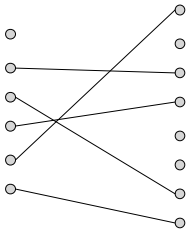
Many-to-One in ER Diagram



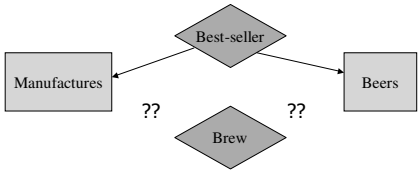
- An arrow is used to indicate the "one" side
- There could be multiple relationships between two entity sets

One-to-One Relationship

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



One-to-One in ER Diagram

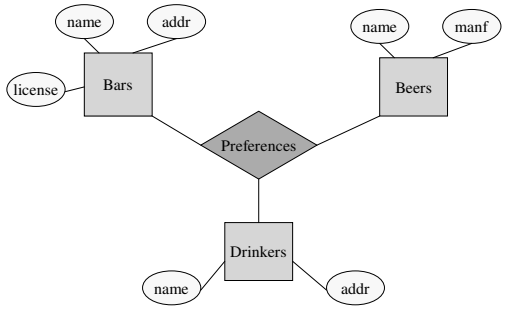


- Arrows on both ends

Multiway Relationship

- Sometimes we need a relationship that connects more than two entity sets.
- Suppose drinkers will only drink certain beers at certain bars.

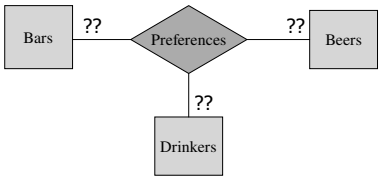
A 3-Way Relationship



Instances of the *Preferences* Relationship

Bar	Drinker	Beer
Joe's Bar	Ann	Miller
Sue's Bar	Ann	Bud
Sue's Bar	Ann	Pete's Ale
Joe's Bar	Bob	Bud
Joe's Bar	Bob	Miller
Joe's Bar	Cal	Miller
Sue's Bar	Cal	Bud Lite

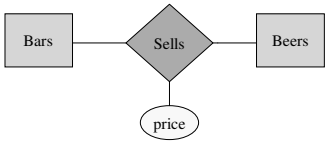
"Arrows" in Multi-way Relationships



- What does an arrow mean in a multi-way relationship??
- Can we add any arrows in the *Preferences* relationship??

Attributes of Relationships

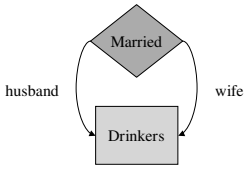
- Sometimes it's useful to attach an attribute to a relationship.



Can we do without relationship attributes??

Roles

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

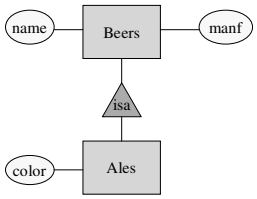


A Different Perspective

Husband	Wife
Bob	Ann
Joe	Sue
…	…

Subclasses

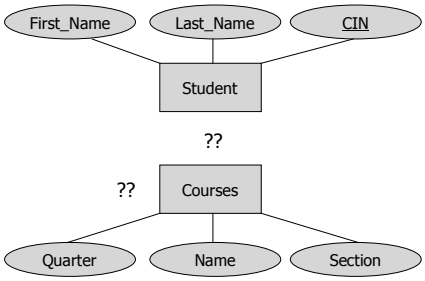
- Subclass
  - Special case
  - *More properties*
  - No multiple inheritance
- Represented by the isa triangle



Keys

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

Keys in ER Diagram



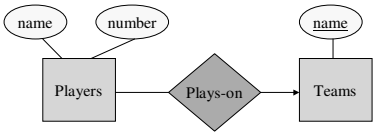
Rules about Keys

- 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

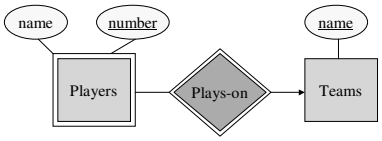
- Entity set *E* is said to be weak if in order to identify entities of *E* uniquely, we need to follow one or more many-one relationships from *E* and include the key of the related entities from the connected entity sets.

Weak Entity Set Example



- What's the key for *Players*??

Representing Weak Entity Sets

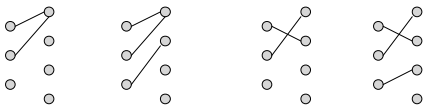


- The key of a weak entity set consists of its own key attributes *and* the key attributes of the supporting set

Referential Integrity

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

many-to-one *one-to-one*



Representing Referential Integrity

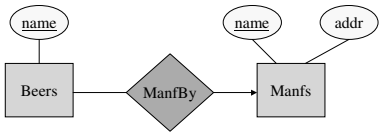
Design Principles

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

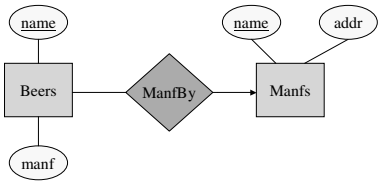
Avoid Redundancy

- Redundancy wastes space, and more importantly, encourages inconsistency.

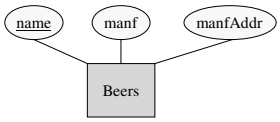
Example: Good



Example: Bad



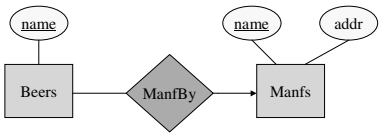
Example: Bad



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: Good



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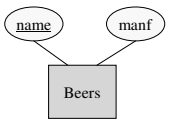
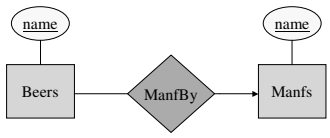


Example: Bad



Don't Overuse Weak Entity Set

- We can usually create unique IDs for entity sets.

Some Common Problems

- *Missing arrows*
- Not identifying keys
- Two entity sets are connected without a relationship
- Attributes are not of simple type
- Misuse of multiway relationships

Example 1: Receipt Revisited

Some Restaurant

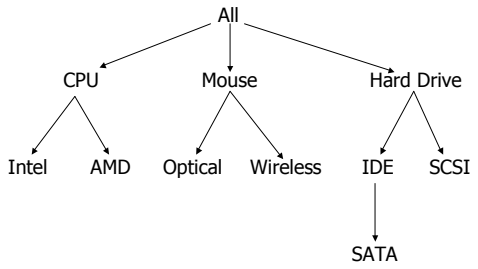
Terminal ID: NC2HHRY
Merchant ID: 4492414532566624

VISA srv:1
**********1234

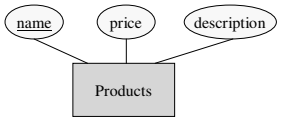
SALE inv:000032
Batch: 000244
Date: JUN 17, 06 Time: 18:44

AUTH:00559B
Base: $36.70
Tip:
Total: Chengyu Sun

Example 2: Product Hierarchy



Example 3: Price That Changes



What if we want to model price that changes??