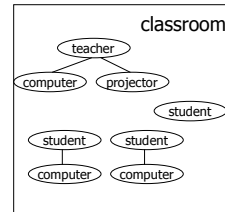## CS422 Principles of Database Systems
Entity-Relationship Model

Chengyu Sun
California State University, Los Angeles
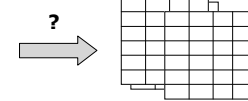
Adapted from Jeffrey Ullman's lecture notes at
http://www-db.stanford.edu/~ullman/dscb.html

Schema Design

Problem in Real World

classroom
teacher
computer   projector
student
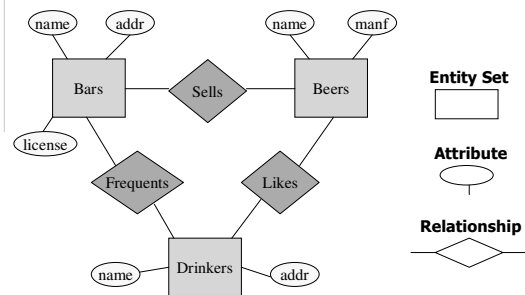student   student
computer   computer

?

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

name   addr   name   manf

Bars — Sells — Beers

license

Frequents   Likes

name   Drinkers   addr
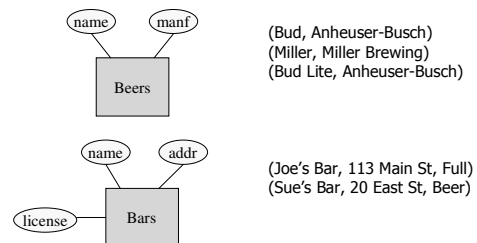
Entity Set

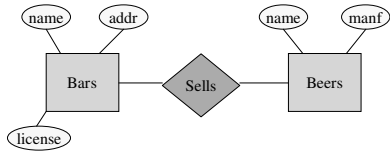**Attribute**

Relationship

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

name   manf

Beers

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

name   addr

license   Bars

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

Relationship
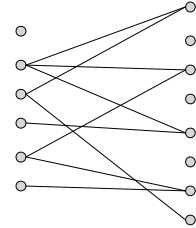
name addr   name manf

Bars — Sells — Beers
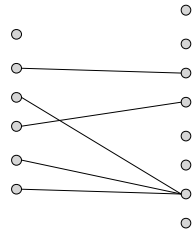
license

◆ *Instances* of a relationship??

Many-to-Many Relationship

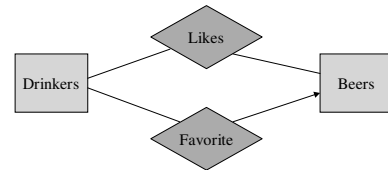◆ An entity of *either* set can be connected to many entities of the other set

Many-to-One Relationship

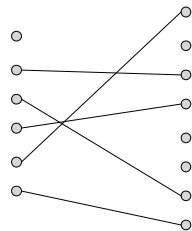◆ The relationship *Favorite* between *Drinkers* and *Beers*

Many-to-One in ER Diagram

Likes
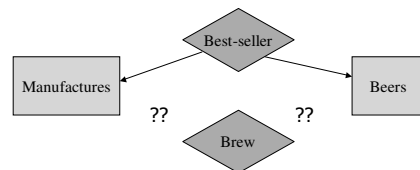
Drinkers — Beers

Favorite

◆ 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

Best-seller

Manufactures   Beers
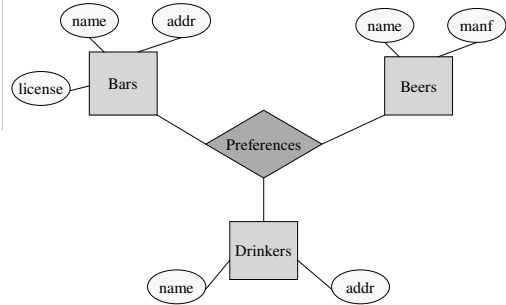
??   ??

Brew

◆ Arrows on both ends

2

Multiway Relationship

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

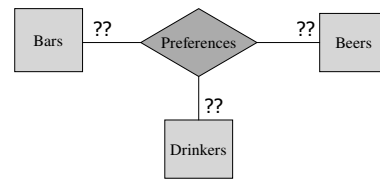## A 3-Way Relationship

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??
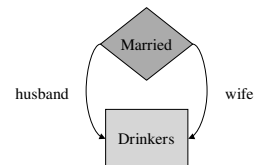◆ Can we add any arrows in the *Preferences* relationship??

Attributes of Relationships

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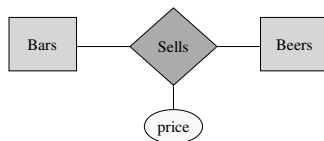
Roles

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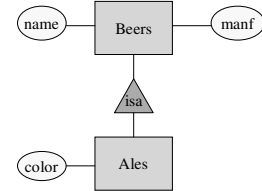◆ Label the edges with names called Roles

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A Different Perspective

Husband (Drinkers) — Married — Wife (Drinkers)

Husband	Wife
Bob	Ann
Joe	Sue
...	...

Subclasses

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

name — Beers — manf

isa

color — Ales

Keys

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

Keys in ER Diagram

First_Name   Last_Name   CIN

Student

??

??   Courses

Quarter   Name   Section
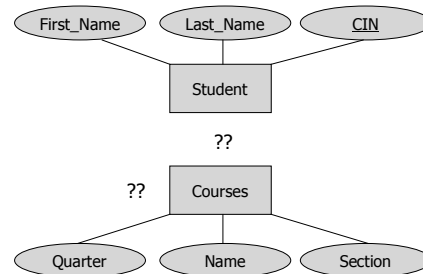
Rules about Keys

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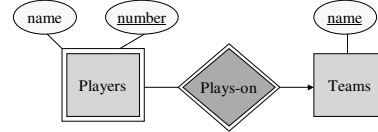◈ Super class must have all the key attributes

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
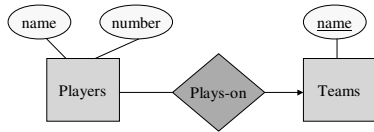
◆ What's the key for *Players*??
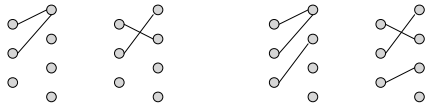
Representing Weak Entity Sets

◆ 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

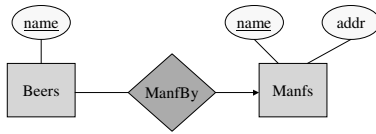## Design Principles

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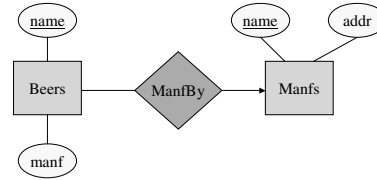◆ Limit the use of weak entity set

Avoid Redundancy

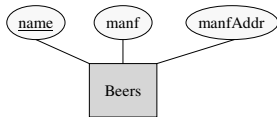◆ Redundancy wastes space, and more importantly, encourages inconsistency.

Example: Good

name — Beers — ManfBy → Manfs — name, addr

Example: Bad

name, manf — Beers — ManfBy → Manfs — name, addr

Example: Bad

name, manf, manfAddr — Beers
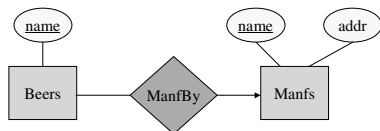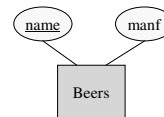
Entity Set vs. Attributes

◆ 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
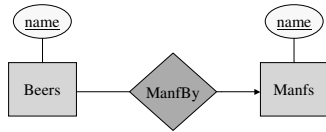 - It is the "many" in a many-one or many-many relationship.

Example: Good

name — Beers — ManfBy → Manfs — name, addr

Example: Good

name, manf — Beers

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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